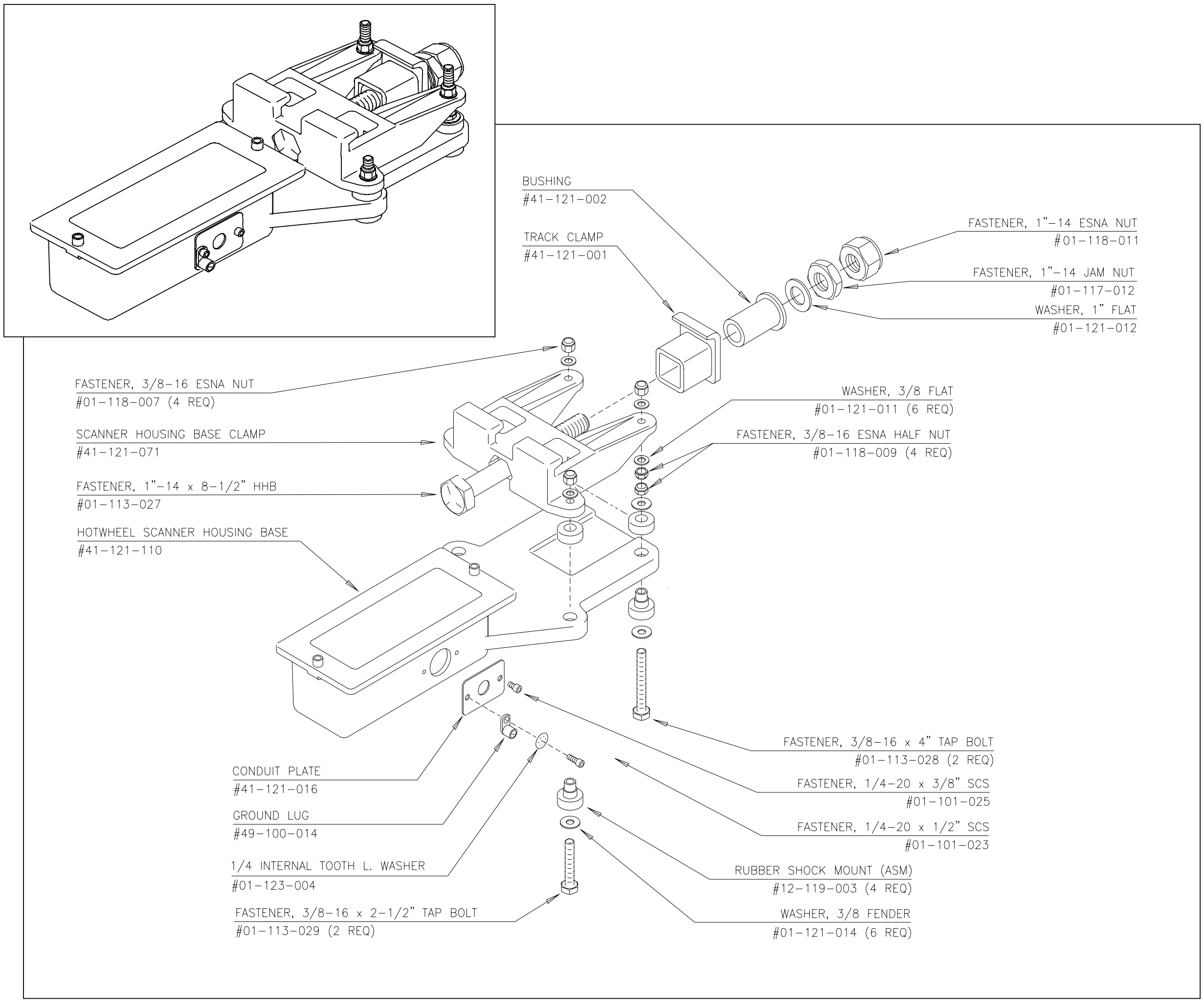
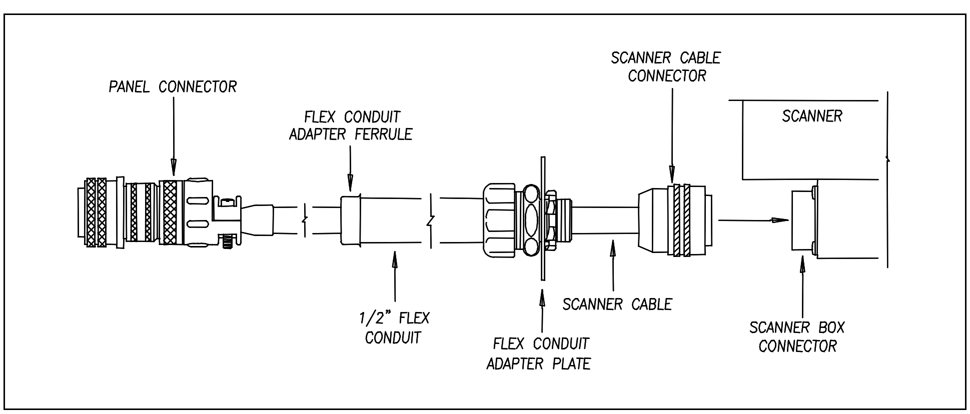
The figures below show a wheel scanner mount (2100-701).



The figure below shows the wheel scanner cable. The only difference between the bearing scanner cable and the wheel scanner cable is a different flex-conduit-adapter plate. The one for the wheel scanner is smaller. (The part number for the 65-foot (19.8-meter) wheel scanner cable is 2058-260HW. For the 85-footer, it's 2058-268HW. For the 100-footer (30.5-meter), it's 2058-265HW.)



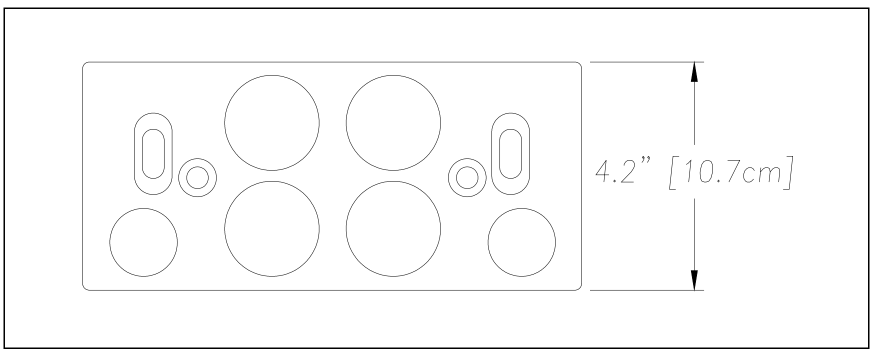
2.2 Transducers

Transducers are rail-mounted devices that provide the timing signals that allow the system to:

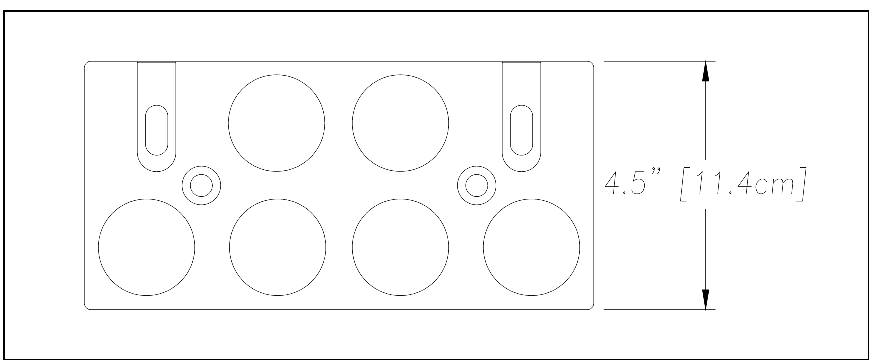
- Detect a train's presence
- Coordinate gating
- Determine a train's direction
- Calculate a train's arrival and exit speeds
- Calculate a train's length
- Identify individual railcars and locomotives based on axle spacing patterns

One of two mounting plates is packaged with each transducer. The smaller one, which is labeled **112LB-130LB**, is used with lighter rails. The larger one, which is labeled **131LB-141LB**, is used with heavier rails.

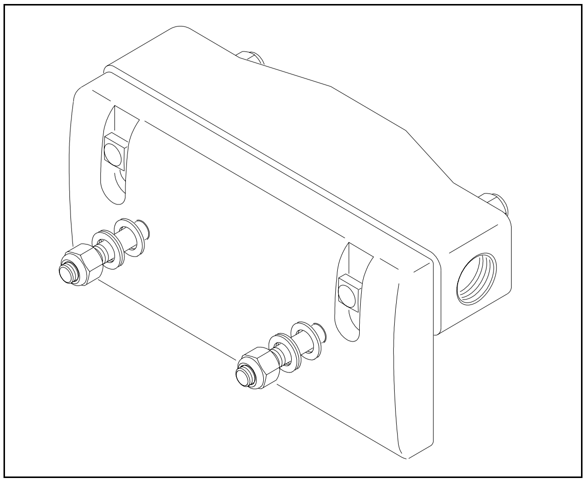
If your rail size were 112 to 130 pounds per yard (55.6 to 64.5 kilograms per meter), you would use the smaller mounting plate (2100-554) that looks like this.



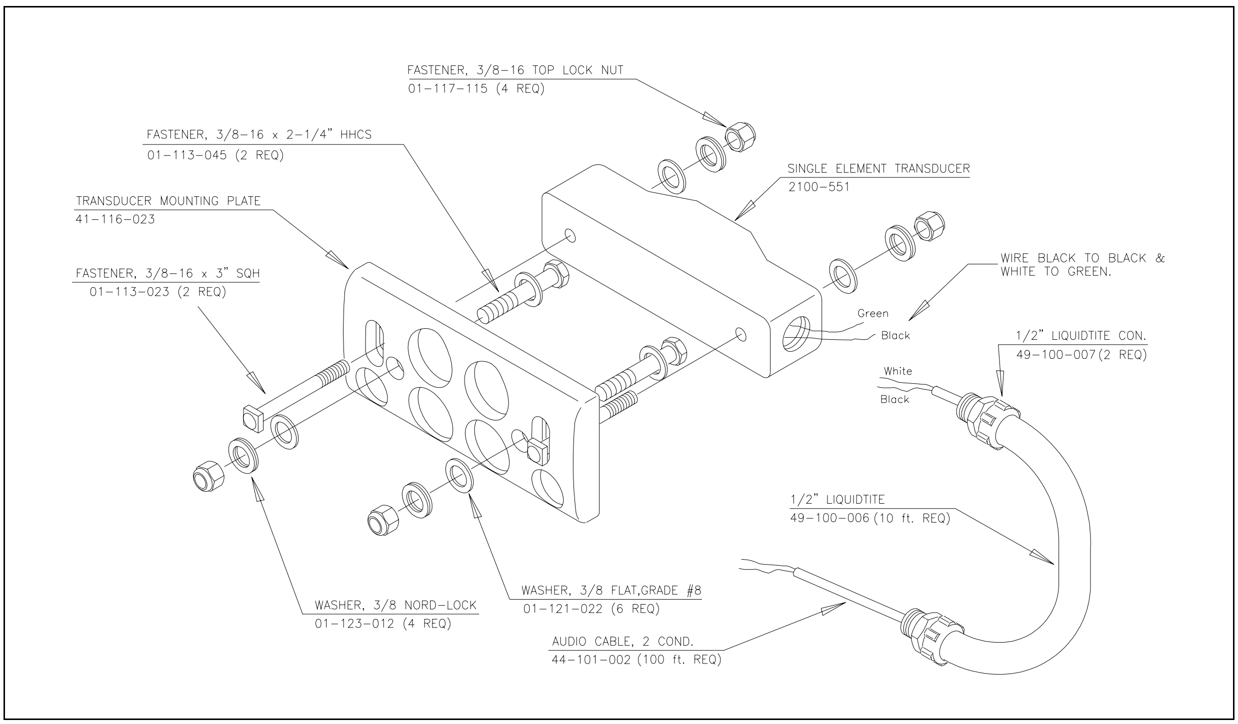
If your rail size were 131 to 141 pounds per yard (65.0 to 69.9 kilograms per meter), you would use the larger mounting plate (2100-552) that looks like this.



The figure below shows an assembled transducer with the larger mounting plate.



The figure below shows the parts of a transducer with the smaller mounting plate.

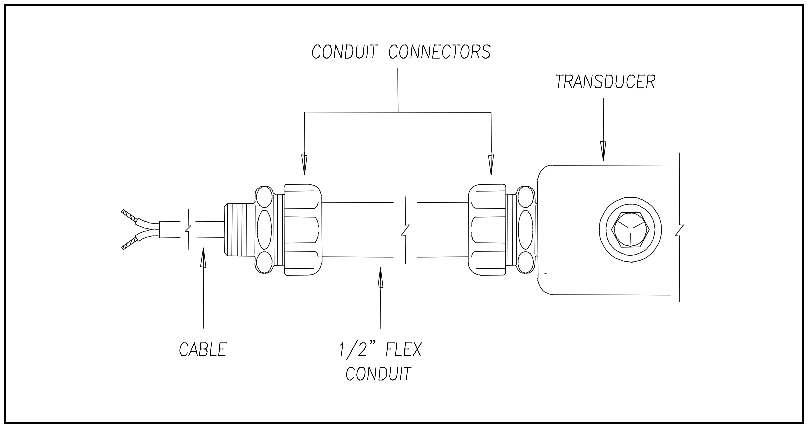


STC transducers consist of a horseshoe magnet with a tightly wound coil, encapsulated in a rigid epoxy potting compound. Each transducer is mounted 1-9/16 inches (3.97 centimeters) below the top of the rail. As the wheels of a railcar pass over the transducer, the wheel flange disturbs the flux field of the magnet, causing the output of a sinusoidal waveform of varying amplitude. The depth of the flange and the speed at which the wheel is moving determines amplitude.

The SmartScanIS can use two types of STC magnetic transducers. Both are identical, but are named differently, depending on their location and their function. One type is called gating transducer. The other is called advance transducer. Instead of two advance transducers, most sites use a track circuit.

All tracks use two rail-mounted gating transducers. On the rail nearest the bungalow, these transducers (labeled **TO1** and **TO2**) are mounted near and to the north or east of the bearing scanner. They control scan timing and car recognition. Additionally, some tracks use rail-mounted advance transducers. On the rail nearest the bungalow, the two advance transducers are mounted about 32 feet (9.75 meters) on either side of the bearing scanner. The first one encountered provides a signal that changes the state of an inactive system from idle to scan mode. Once mounted to the rail, the bodies of advance transducers and gating transducers can be moved up and down.

The figure below shows a transducer cable.



One end of the transducer cable comes attached to the transducer. The other end has two wires protruding from the conduit. These wires are black and white, and attach to a surge protector located on the surge-protection panel. There is one surge protector assigned to transducer TO1 and another to transducer TO2. These surge protectors protect the SmartScanIS from transients and surges, which can be induced onto external wiring by lightning.

2.3 Auxiliary-Alarm Detectors

The standard SmartScanIS can support input from as many as four external alarm devices. Any device that provides an open set of relay contacts upon alarm detection can be supported by the system. The system responds to an open contact by announcing the defect and the axle number nearest the defect. Alarm detection and announcement are in real-time. The SmartScanIS supports dragging-equipment, high-load, and wide-load alarms. Other alarm devices require custom speech programming.

STC doesn't manufacture any auxiliary-alarm input devices. However, they do supply some sites with dragging-equipment detectors.

2.4 AEI Antennas

Two antennas are required for each AEI-configured SmartScanIS site. In reference to the track, **antenna1** is the northmost or eastmost antenna. **Antenna2** is the southmost or westmost antenna. The antennas are used in conjunction with the 2200-504 Readers or 2200-750 Reader, which are described in ***Chapter 4 - Bungalow Components***.

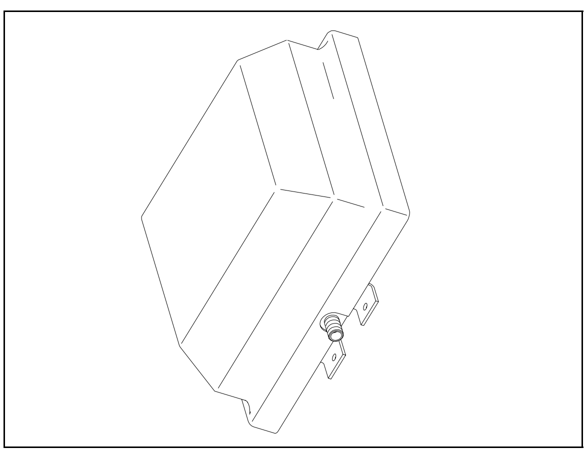
The SmartScanIS supports two types of antennas.

- Sinclair SRL470 antennas
- Scala HP9-915 Parapanel antennas

These antennas are described below.

2.4.1 Sinclair SRL470 Antennas

Two 100-watt Sinclair SRL470 antennas are installed per track. The SRL470 is a directionally-pointed horizontally-polarized panel antenna. It is housed in a compact white enclosure that is made from materials that don't interfere with the transmission and reception of radio waves. It is suitable for pipe, tower, or wall mounting.

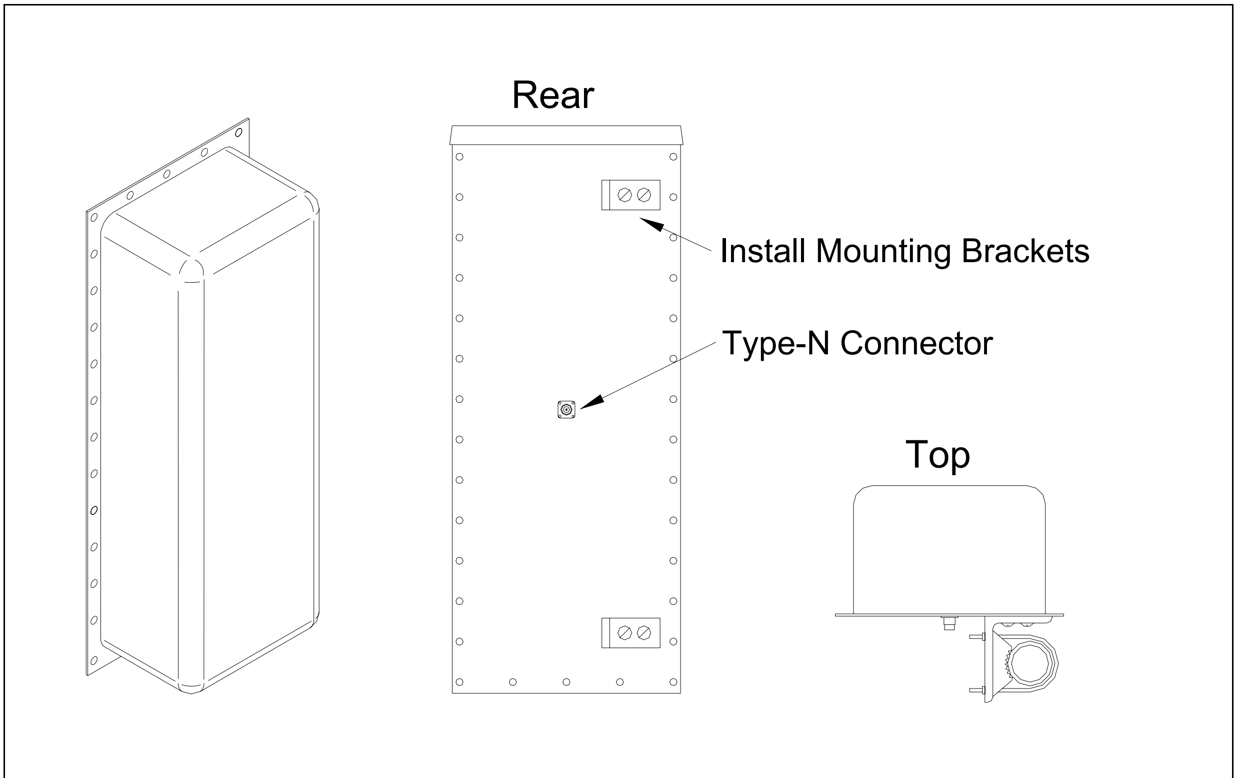


Each SRL470 antenna is installed:

- With its face parallel to the rails
- With its N-type socket pointing down
- 10 feet (3 meters) from the center of the track
- 3.5 feet (1.1 meters) above the top of the rails
- Centered between the gating transducers
- Opposite each other

2.4.2 Scala HP9-915 Parapanel Antennas

Two 100-watt Scala HP9-915 Parapanel antennas are installed per track. The HP9-915 is a directionally-pointed horizontally-polarized panel antenna. It has a gain of 9.5 dBd. It is housed in a compact white enclosure that is made from materials that don't interfere with the transmission and reception of radio waves. It is suitable for either pipe or tower mounting.



Each HP9-915 antenna is installed:

- Vertically with its face parallel to the rails
- 10 feet (3 meters) from the center of the track
- 3.5 feet (1.1 meters) above the top of the rails
- Centered between the transducers
- Opposite each other

2.5 Track Circuit

Most SmartScanIS sites use a track circuit, which is nothing more than two wires attached to the rails. One wire is attached to each rail. They are attached directly opposite each other, centered between the gating transducers. Connection to the rail can be made in one of two ways.

- **Bonding** – Cadweld manufactures a complete line of bond welding systems that are commonly used in the rail industry. Recommended practice is to weld a short length of bond strand to the web of each rail. Cadweld can provide these items as prepackaged kits, which include the bond strand (a 3/16-inch (4.8-millimeter) diameter strand is recommended), and the one-shot welding system. A reusable mold of the correct size is required.
- **Drilling** – The alternative to Cad-welding is to drill a 3/8-inch (9.5-millimeter) hole in the web of each rail at the neutral axis, and apply a bonding kit. The kit includes ready-made lengths of bond strand with "chicken heads" attached. The "chicken heads" are tapered solid metal inserts that can be driven into the 3/8-inch (9.5-millimeter) holes to establish a permanent connection to the rail.

Once the rail attachment is made, extend the connection to the Surge Protection Subassembly in the SmartScanIS enclosure. You do this by splicing a length of wire to each bond strand. Okonite Cable makes a twisted-pair cable (Okonite 113-12-3933) that is suitable for direct burial. The cable has two 6 AWG solid conductors and a very rugged insulation jacket. The cable should be attached to the bond strand using compression sleeves.

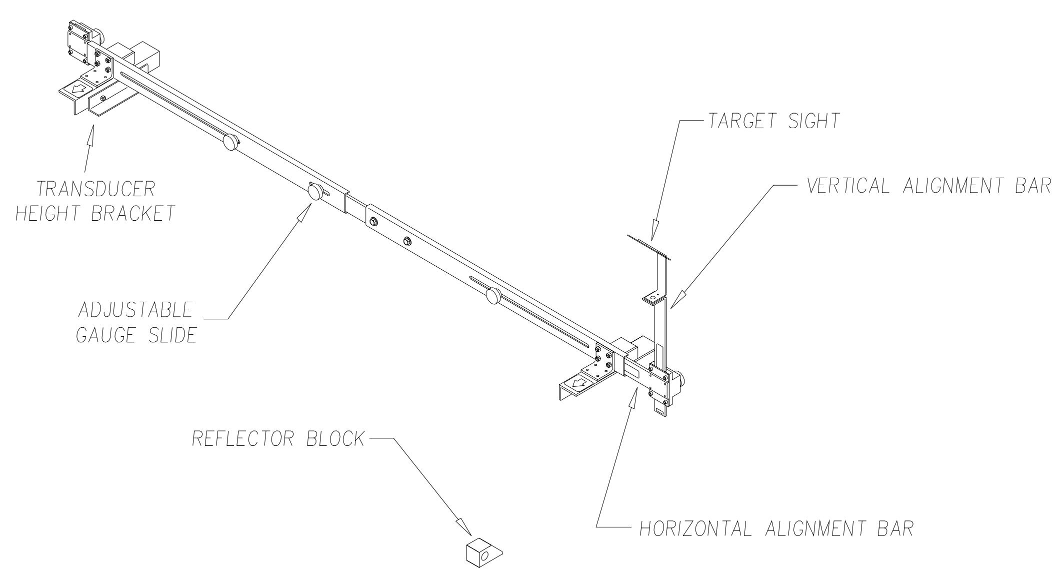
The track circuit is used in conjunction with the 2200-500 Presence Detector, which is described in ***Chapter 4 - Bungalow Components***. This module continuously sends a signal down one of the wires of the track circuit. When the wheels-axle of a train (or any metal object) shunts the track, this completes the circuit, causing the signal to return to the 2200-500 Presence Detector via the other wire. At a certain distance from the track circuit, the amplitude of the signal is strong enough to trigger an active high, which indicates to the SmartScanIS that a train is present. This shunting zone is adjustable up to 150 feet (45.7 meters) on each side of the attached track-circuit wires.

Chapter 3
Adjustment Components

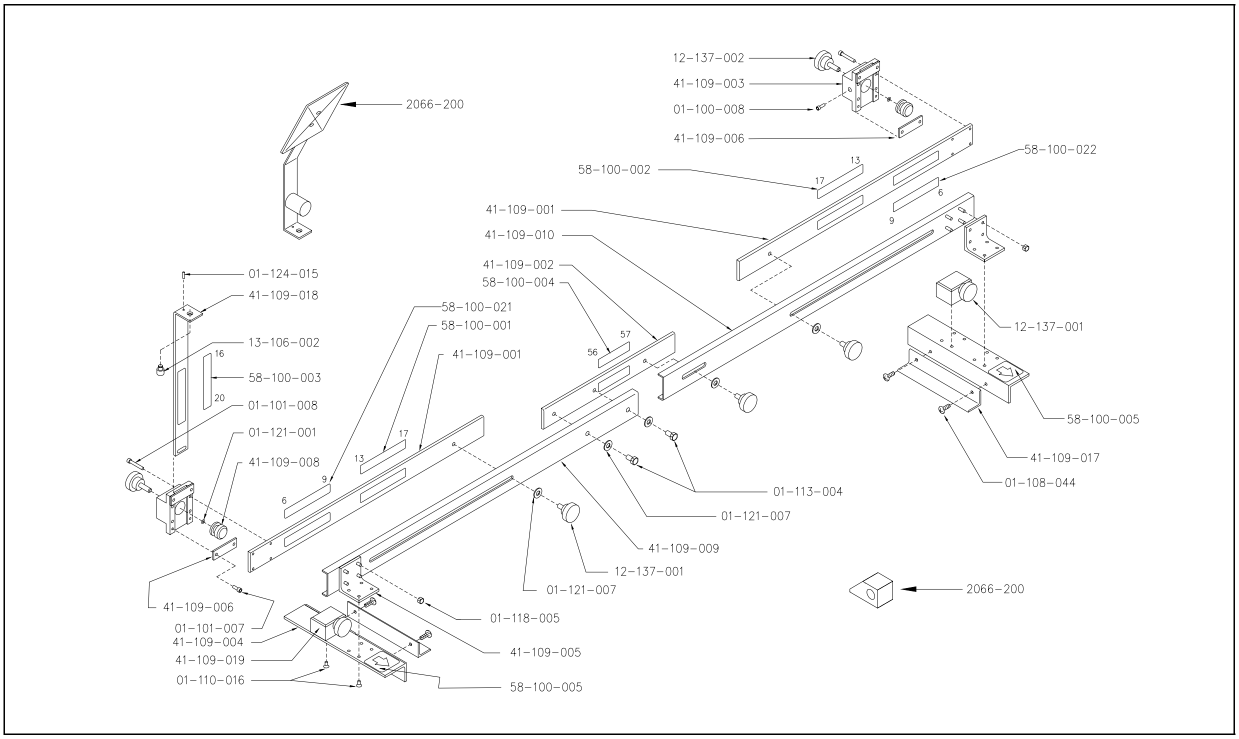
This chapter describes the components that are used during the adjustment process. Covered are the alignment fixture and the calibrated heat source. STC supplies one of each for each SmartScanIS site.

3.1 2066-000 Alignment Fixture

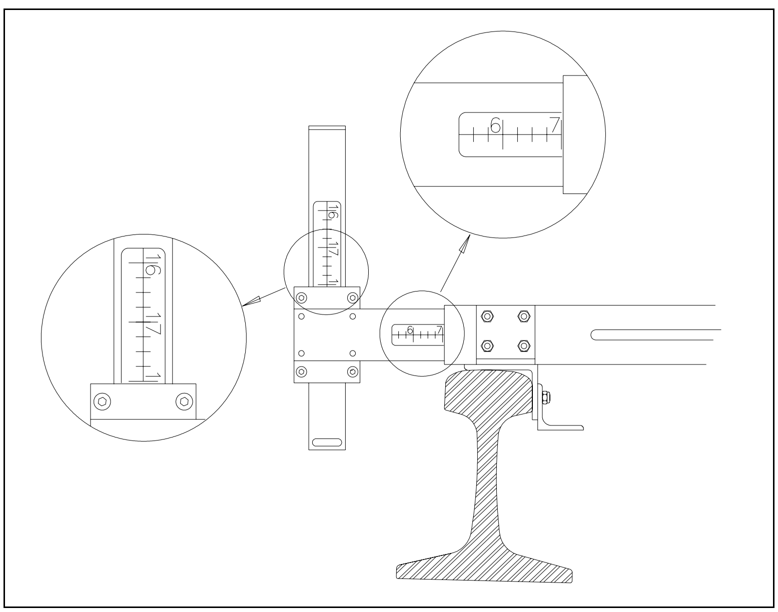
The figure below shows an assembled alignment fixture (2066-000).



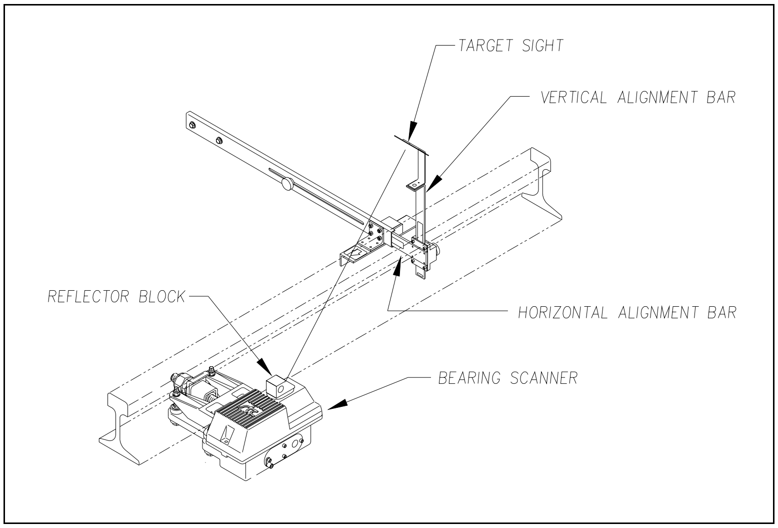
The figure below shows the parts of an alignment fixture (2066-000).



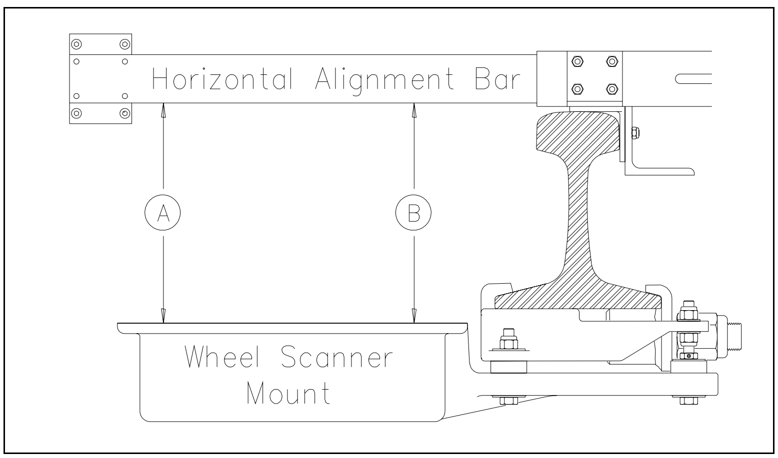
The alignment fixture is used to ensure that all scanners are aimed at the proper point above the rail. Each axis of the fixture is equipped with graduated scales that give indications relative to the top of the rail and the gauge.



The fixture is used differently for bearing scanners and for wheel scanners. To align bearing scanners, you use the optical system of the fixture. The key parts of this optical system are the target sight and the reflector block.

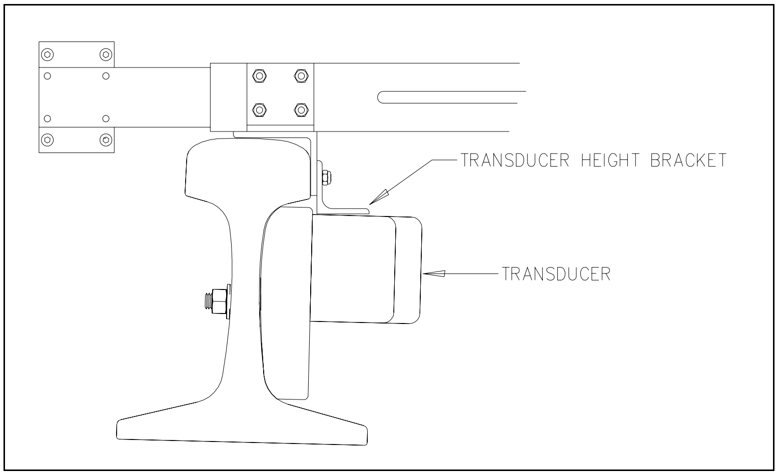


To align wheel scanners, you use the horizontal alignment bar of the fixture. Alignment is done by measuring from the bottom of the extended bar to the top of both ends of the scanner mount. When both measurements are the same, alignment is correct. That is, as shown below, when distance **A** is equal to distance **B**, alignment is correct.



When a new scanner is installed, alignment is done. Thereafter, unless the scanner is damaged, it is unlikely that alignment will change once it has been set.

The transducer height bracket on the bottom of the alignment fixture can be used to ensure proper installation of the transducers. When the transducer body touches the bracket, the transducer body is 1-9/16 inches (3.97 centimeters) below the top of the rail <u>and</u> parallel to it.



3.2 2100-810NG Calibrated Heat Source

When a new scanner is installed, calibration is done. Thereafter, calibration usually is done only when needed or on a regular basis during scheduled maintenance.

The supplied calibrated heat source (2100-810NG) operates from a 120-volt 60 Hz power source. Minimum operating voltage is 105 volts. A frequency of 50 Hz won't work. The supplied 16-gauge orange power cable provides the necessary safety ground. This cable is 50 feet (15 meters) long. If you need to add an extension cord to this cable, make sure it is 16 gauge or larger thickness of wire.

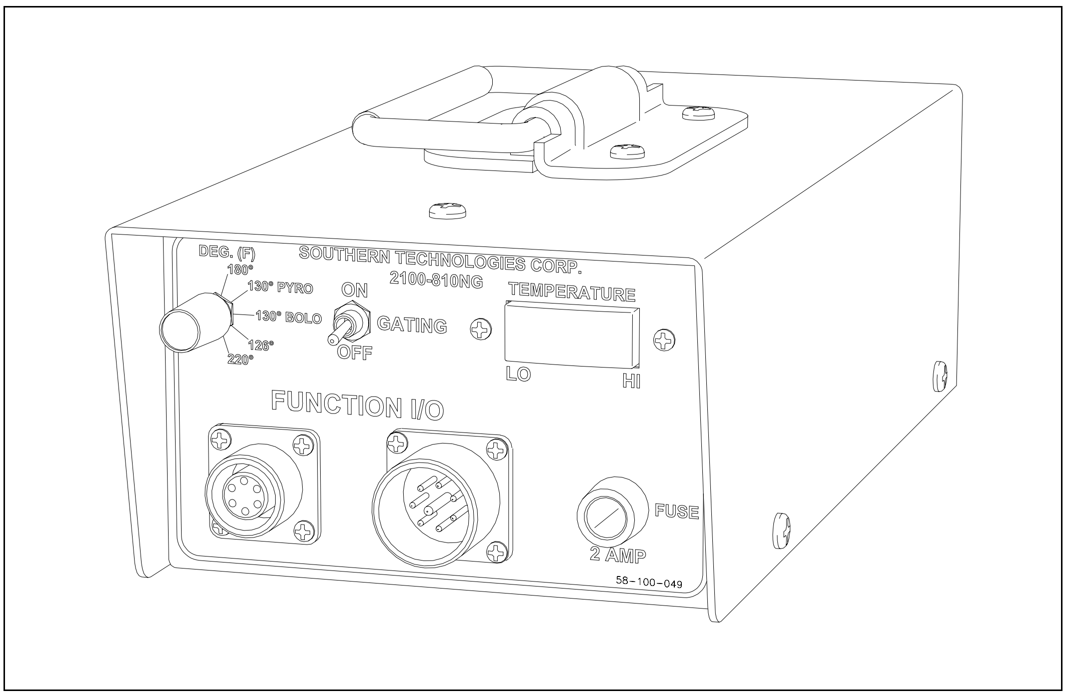
On the front of the calibrated heat source is a knob that lets you select one of five delta temperatures, ranging from 126°F to 220°F. The heat source contains a heat block that can reach a combined temperature of your delta temperature and the ambient temperature. It can maintain this temperature for extended periods. The heat block is controlled by a circuit that references both ambient temperature and the temperature of the heat block, and maintains the selected differential. For example, if the ambient temperature were 85°F (29.4°C) and the knob were set to180°F (100°C), the heat block would be maintained at 265°F (129.4°C).

Infrared scanners respond to rapid changes in infrared radiation. The calibrated heat source accomplishes the rapid changes by employing a rotating wheel with an aperture in one side. As the wheel turns, the infrared radiation from the heat block is shielded from the scanner until the aperture lines up with the opening in the bottom of the heat source case. The wheel rotates at 300 rpm.

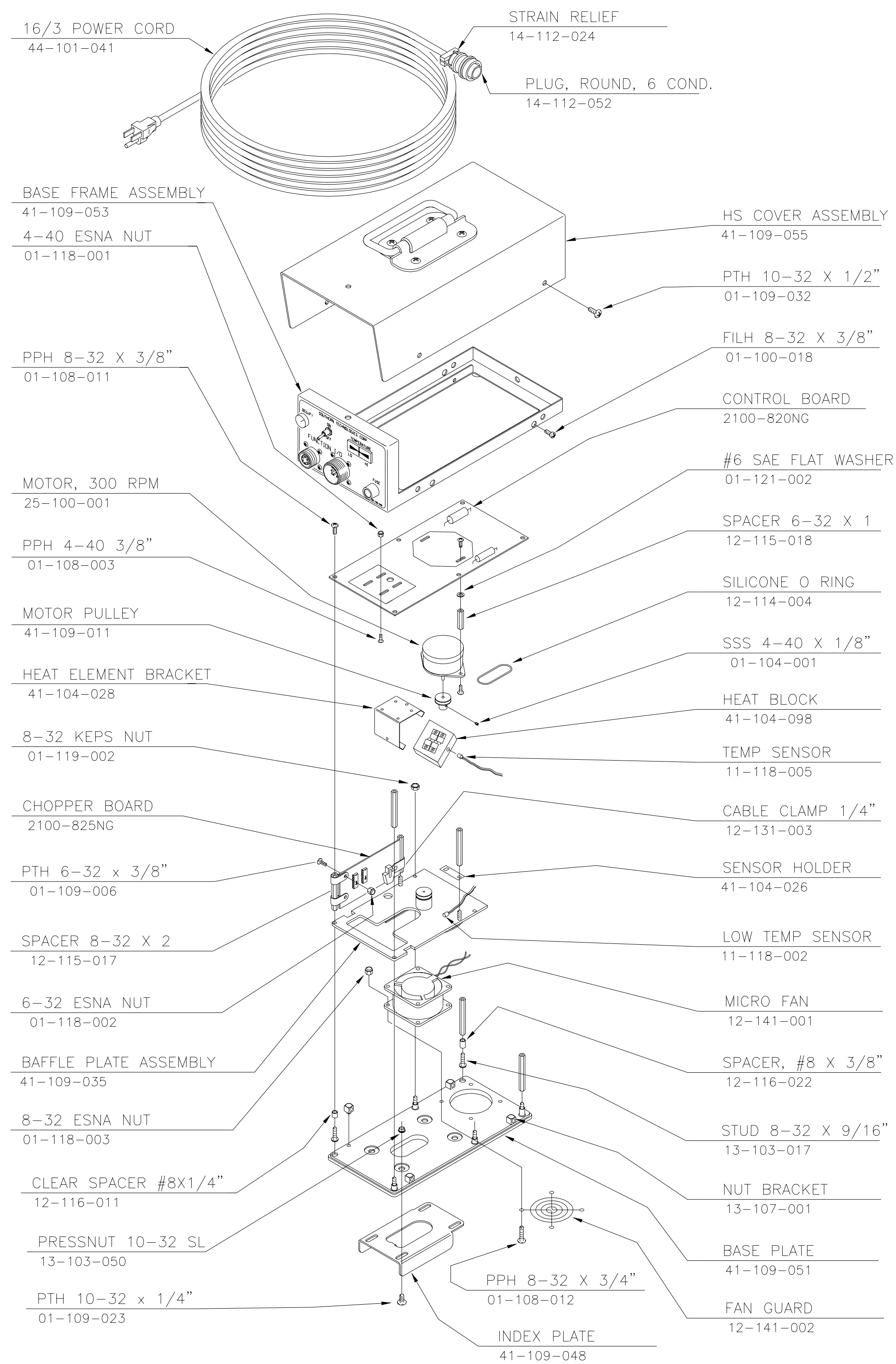
The calibrated heat source is placed over the opening of the scanner cover. With the heat source in place, it is then possible to calibrate the system at a precise value above ambient temperature.

STC recommends that you use the calibrated heat source (2100-810NG) only when the outside (ambient) temperature is above 0°F (-18°C) and below 90°F (32°C). If you must use it at other times, do so only when the needle is centered on the front of the temperature meter. If the needle isn't stabilized within ± 2 degrees of set point, the heat source isn't operating properly.

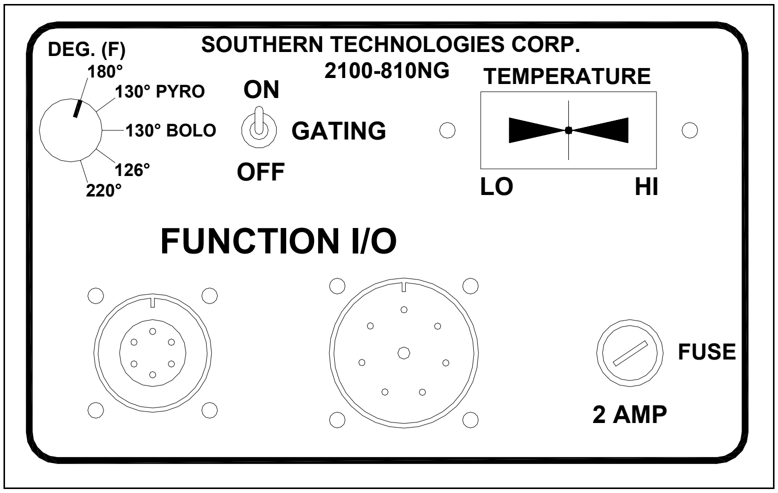
The figure below shows an assembled calibrated heat source (2100-810NG).



The figure below shows the parts of a calibrated heat source (2100-810NG).



The figure below shows the control panel that's on the front of a calibrated heat source (2100-810NG).



3.2.1 Temperature Knob

The temperature knob allows you to select one of five delta temperatures. The temperature label on each knob setting represents degrees Fahrenheit above ambient. The **180** setting is normally used with all STC scanners.

3.2.2 Gating Switch

On the front of the heat source is the **Gating** switch. Toggling it on causes gating signals to be sent to the Function I/O connectors. The first signal sent is a simulated TO1 (aka transducer-A) signal. The second signal sent is a simulated TO2 (aka transducer-B) signal. As long as this switch is toggled on, this sequence continues at a rate of 10 signals per second (five of them being TO1s and five of them being TO2s).

The gating signals aren't needed for calibration of the SmartScanIS. The **Gating** switch may be left in the off position.

3.2.3 Temperature Meter

The temperature meter shows when heat block has reached the selected temperature setting and has stabilized within ± 2 degrees of set point. From a cold start, this could take 5 to 8 minutes. The heat block is stabilized when the needle is centered.

3.2.4 Function Connectors

The function connectors provide the I/O lines to the heat source including AC power in and gating signals out.

The six-contact circular connector (on the left side) is compatible with the power cord included with system. One end of the supplied 2100-832 power cord is connected to the heat source. The other end is plugged into a stable grounded three-wire AC outlet capable of at least 105 VAC at 15 amperes.

The table below shows the pin assignment for the six-contact connector.

Pin	Assignment
A	AC Neutral
B	**AC Hot**
C	AC Ground
D	TO1 (positive output pulse)
E	TO2 (positive output pulse)
F	Ground

The eight-contact circular connector (on the right side) isn't used when calibrating STC scanners.

3.2.5 Fuse

On the front of the heat source is a 2-amp 250-volt fast-acting fuse. It protects the heat source from excessive current.

Chapter 4
Bungalow Components

In this guide, the structure along side the track is called a "bungalow." This structure, which comes in many shapes and sizes, can be any appropriate waterproof enclosure. It goes by many other names, such as wayside enclosure, location case, apparatus housing, and equipment enclosure.

Attached to the inside of the bungalow is:

- One SmartScanIS enclosure per track
- One power subsystem per SmartScanIS enclosure

Attached to the outside of the bungalow is:

- One antenna per radio
- One shielded temperature probe per SmartScanIS enclosure

This chapter describes most of these components.

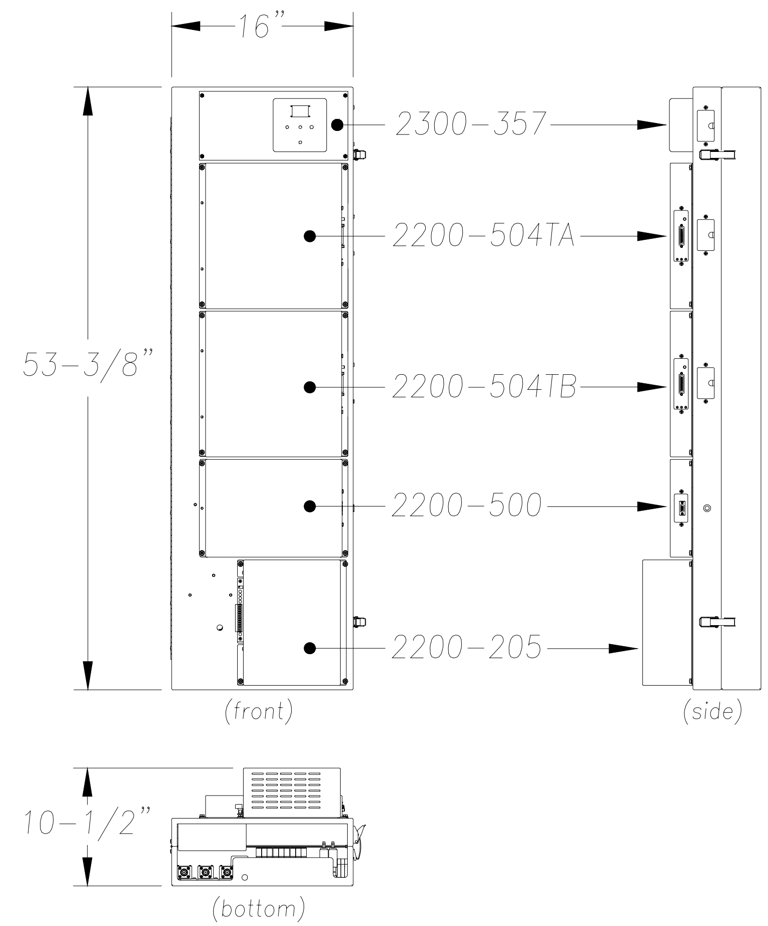
4.1 SmartScanIS Enclosure

There is one SmartScanIS enclosure per track. At double-track sites, the one on the left supports track1 and the one on the right supports track2.

The SmartScanIS enclosure is a wall-mounted system that provides mounting points and interconnections for the various modules that comprise a typical mainline AEI and non-AEI subsystem. The enclosure is designed for applications where trackside space isn't limited, and the user would prefer the SmartScanIS enclosure located in a bungalow.

The SmartScanIS enclosure is designed for easy installation inside the controlled environment of an equipment room or bungalow. The system provides a compact hinged assembly that bolts easily to a wall or other secure structure. The enclosure requires wall space measuring 16 inches (40.6 centimeters) wide by 53.4 inches (135.6 centimeters) high. Forward projection from the wall is 10.5 inches (26.7 centimeters) with the door closed and 18 inches (45.7 centimeters) with the door open.

The figure below shows the outside of the SmartScanIS enclosure with two 2200-504 Readers attached.

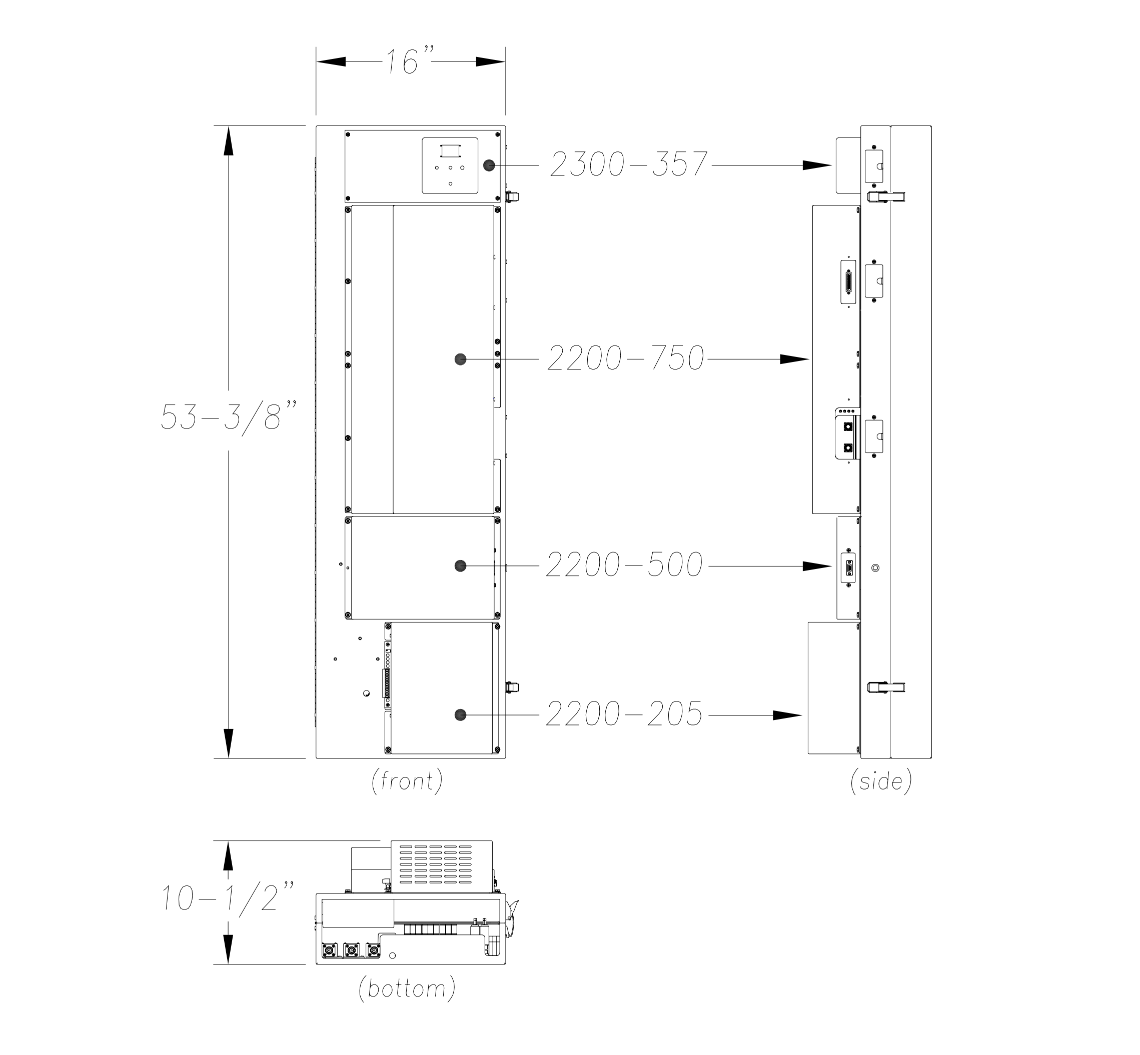


On the outside of the front panel shown above, mounting points are provided for up to five system modules. Beginning from the top of the panel, the modules are:

- optional 2300-357 Efficiency Test panel
- optional 2200-504TA Reader module, which is used with **antenna1**
- optional 2200-504TB Reader module, which is used with **antenna2**
- optional 2200-500 Presence Detector module
- required 2200-205 Power Supply module

Each module is secured to the panel with four Keps-nuts. Serial cables provide interconnections to the System Interface board. The remaining connections are provided through a wire harness with appropriate connectors at the attachment points to the modules.

The figure below shows the <u>outside</u> of the SmartScanIS enclosure with one 2200-750 Reader attached.

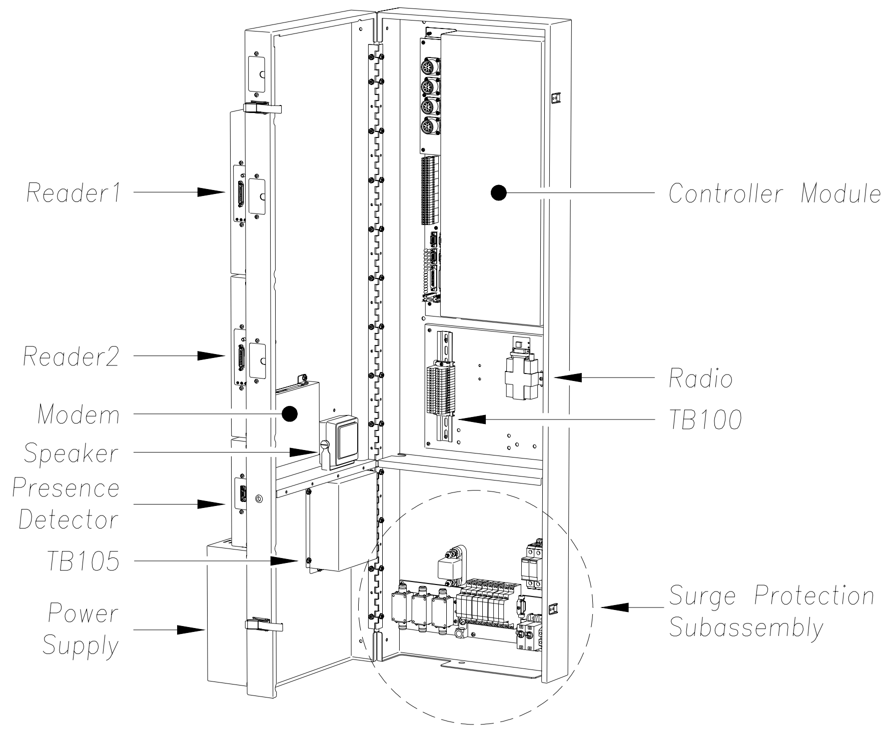


On the outside of the front panel shown above, mounting points are provided for up to four system modules. Beginning from the top of the panel, the modules are:

- optional 2300-357 Efficiency Test panel
- optional 2200-750 Reader module, which is used with both **antenna1** and **antenna2**
- optional 2200-500 Presence Detector module
- required 2200-205 Power Supply module

Each module is secured to the panel with four Keps-nuts. Serial cables provide interconnections to the System Interface board. The remaining connections are provided through a wire harness with appropriate connectors at the attachment points to the modules.

The figure below shows the inside of the SmartScanIS enclosure.



The SmartScanIS enclosure consists of two formed sheet-metal box panels that are joined by a continuous hinge and coated with a white polyester powder coat to provide a long-lasting finish. An enclosure can easily fit in a 4-foot x 4-foot signal bungalow. It is secured to a plywood backboard with six 1/4 x 1-inch lag screws. System modules are mounted inside and outside of the enclosure to reduce the size of the complete system.

On the inside of the front panel are these components.

- Speaker
- 2200-600 Modem module
- Terminal Block TB105

On the inside of the back panel are these components.

- Controller module
- Terminal Block TB100
- Radio
- Surge Protection Subassembly

4.2 2200-504 Reader Module

Not all SmartScanIS sites use the AEI subsystem. If your site does, the AEI subsystem will consist of two AEI antennas, which were described in a prior chapter, and either two 2200-504 Reader modules, which are described below, or one 2200-750 Reader module.

The 2200-504 Reader reads and reports RFID tags in the original programmed format. It can also decode owner's initials, equipment number, and side indicator of tags that are in AAR, ISO, or ATA data format.

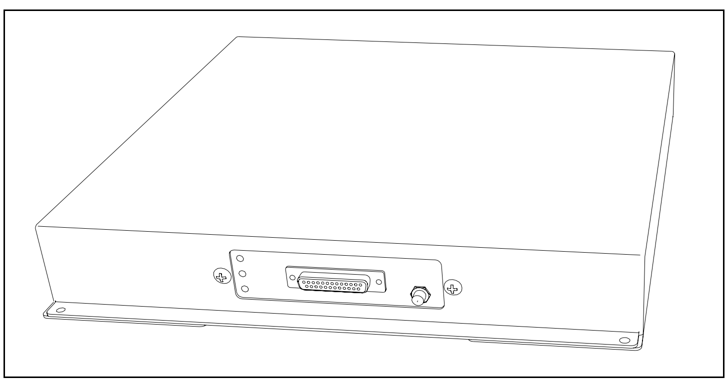
The 2200-504 Reader is available in a factory set, narrow-band frequency between 902 and 928 megahertz at about 1.5 watts. In the standard configuration, the SmartScanIS uses a 2200-504TA (911.5 megahertz high power) for **reader1** and a 2200-504TB (918.5 megahertz high power) for reader2. Different frequencies prevent interference between readers. Always install the 2200-504TA Reader as reader1 (with signals to and from **antenna1**) and the 2200-504TB Reader as **reader2** (with signals to and from **antenna2**).

Data communication with the SmartScanIS is in RS232 format.

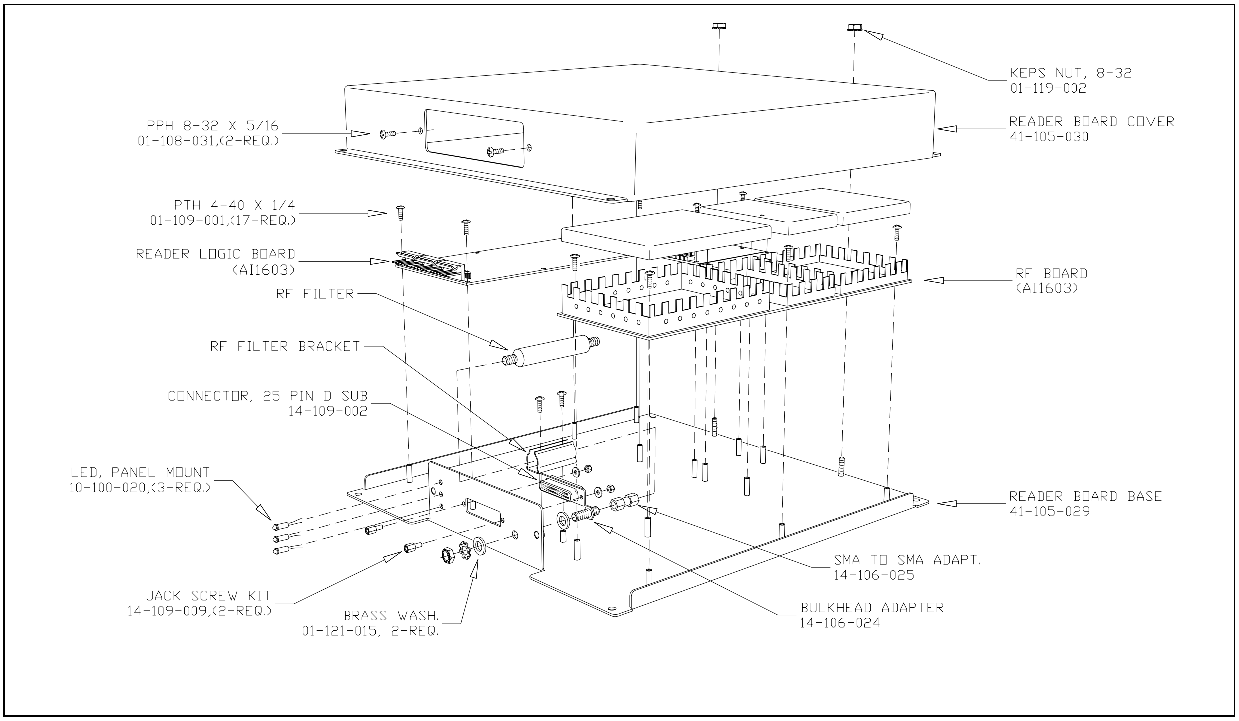
On the outside of the SmartScanIS enclosure, mounting studs are provided for the 2200-504 Readers. About 6.5 inches (16.5 centimeters) below the top edge of the enclosure, the 2200-504TA Reader is secured with four Keps-nuts. A serial cable connects the reader to the System Interface board. A coaxial cable connects the reader to a lighting arrester that connects to an AEI antenna. The 2200-504TB Reader is installed directly under the 2200-504TA Reader. If your SmartScanIS enclosure was shipped in a bungalow, you'll need to install the readers. If it was shipped in a crate instead, the readers were already installed.

4.2.1 Module Views

The figure below shows an assembled 2200-504 Reader.

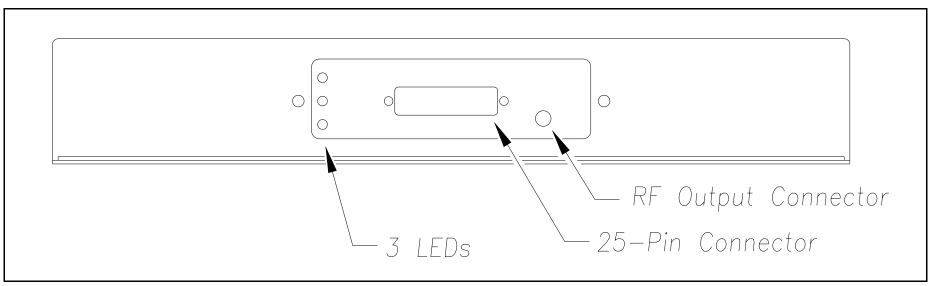


The figure below shows the parts of a 2200-504 Reader, containing RF and Reader Logic boards (AI1603).



4.2.2 Front Panel

The next figure shows the front panel of a 2200-504 Reader. As shown below, the reader uses two connectors.



As shown above, the 2200-504 has three LEDs. The table below describes what each lit green LED means.

LED Name	LED Location	Meaning When Lit
Power	Top	Proper voltage is present. Stays lit as long as the reader is powered up.
Lock	Middle	A valid tag is in the read field. Stays lit as long as the reader senses a tag.
RF On	Bottom	RF power is on. Stays lit as long as RF power is on.

4.2.3 Pinout

The next chart shows the pinout of the DB25 socket.

Pin #	Signal Name	Pin #	Signal Name
1	Ground (Power)	14	Ground (Power)
2	Rxd	15	*Unused*
3	Txd	16	Input0 (TTL)
4	CTS (clear to send)	17	Input1 (TTL)
5	RTS (request to send)	18	Lock Signal (TTL)
6	Ground (Check Tag)	19	*Unused*
7	Signal Ground	20	*Unused*
8	Check Tag	21	*Unused*
9	+5 VDC	22	*Unused*
10	*Unused*	23	*Unused*
11	Output0 (TTL)	24	*Unused*
12	Output1 (TTL)	25	+12 VDC
13	+12 VDC		

4.2.4 Operation

Commands are used to control the operation of the readers. Setup commands are sent from the Controller module at power startup to configure the readers.

In data mode, the reader reads RFID tags and transmits data messages, such as tag IDs and reports, to the Controller module. Reports provide information on input status changes (input0 and input1), a presence without tag report, and buffer overflow information. In data mode, the Controller module will only send Command 01, which changes the reader from data mode to command mode.

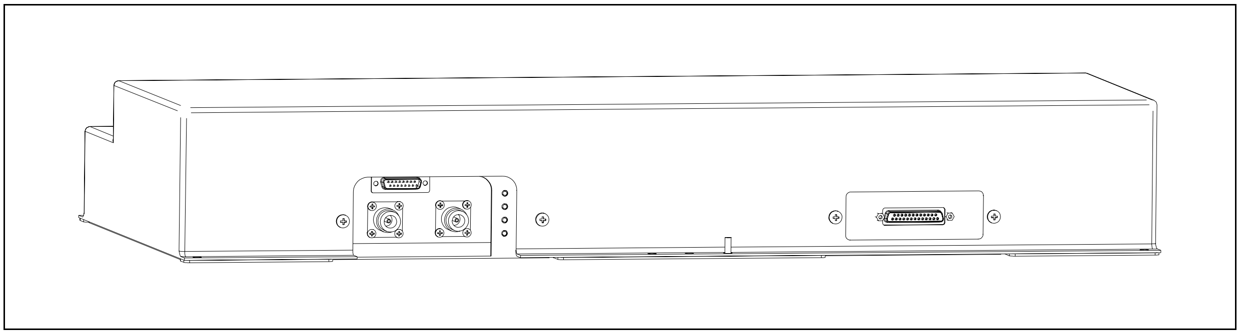
In command mode, the Controller module sends commands to the reader. These commands control the operation and configuration of the reader. After the reader receives a command, it sends an acknowledgment message. Typically, the acknowledgment message contains the word Error, the word Done, or data relating specifically to the command request. These messages may be of variable length since some commands require information as part of the message.

4.3 2200-750 Reader Module

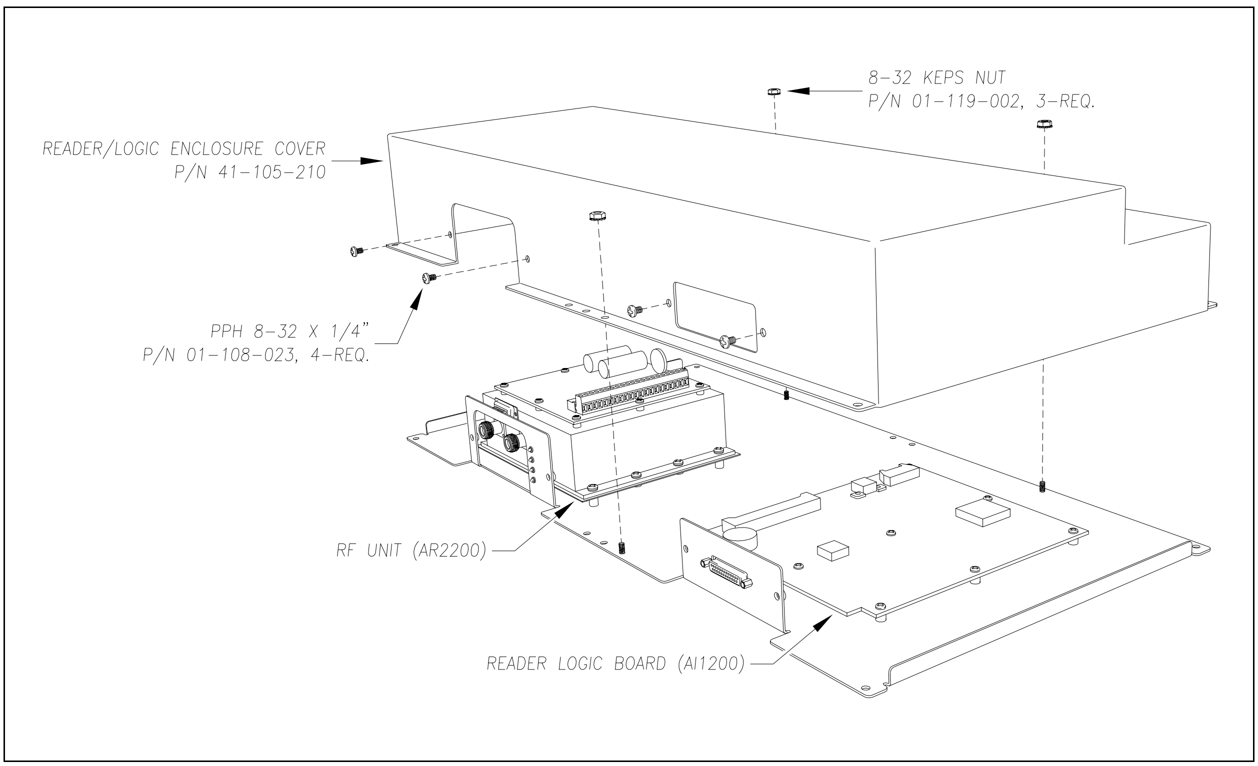
When installed, one 2200-750 Reader functionally replaces two 2200-504 Readers. The 2200-750 Reader does this by multiplexing its RF output between two antennas. Normally, the 2200-750 Reader is connected to the **reader1** port, which is the DB25F socket **P5** on the System Interface board.

4.3.1 Module Views

The figure below shows an assembled 2200-750 Reader.

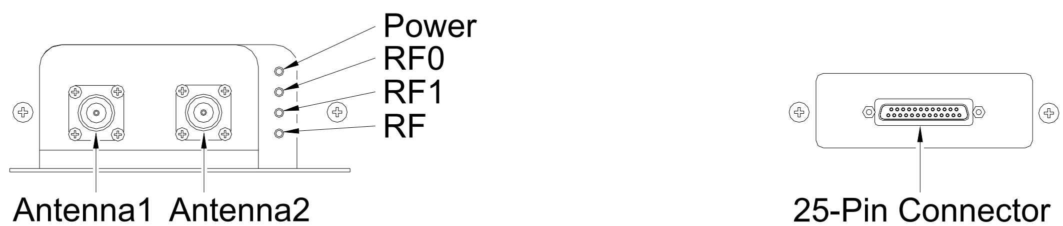


The figure below shows the parts of a 2200-750 Reader, containing a RF unit (AR2200) and a Reader Logic board (AI1200).



4.3.2 Front Panel

The next figure shows the front panel of a 2200-750 Reader.



4.3.3 Pinout on AI1200

The next chart shows the pinout of the DB25 socket.

Pin #	Signal Name	Pin #	Signal Name
1	Ground (Power)	14	Ground (Power)
2	Rxd	15	*Unused*
3	Txd	16	*Unused*
4	CTS (clear to send)	17	*Unused*
5	RTS (request to send)	18	*Unused*
6	*Unused*	19	*Unused*
7	Signal Ground	20	*Unused*
8	*Unused*	21	*Unused*
9	*Unused*	22	*Unused*
10	*Unused*	23	*Unused*
11	*Unused*	24	*Unused*
12	*Unused*	25	+12 VDC
13	+12 VDC		

4.3.4 LEDs on AR2200

The table below describes what each lit LED means.

LED Name	LED Color	Meaning When Lit
PWR	Green	Proper voltage is present. Stays lit as long as the AR2200 is powered up.
RF	Green	RF power is on.
RF0	Green	RF power to **antenna1** is on. In reference to the track, **antenna1** is the northmost or eastmost antenna.
RF1	Green	RF power to **antenna2** is on. In reference to the track, **antenna2** is the southmost or westmost antenna.

4.3.5 Operation

Commands are used to control the operation of the readers. Setup commands are sent from the Controller module at power startup to configure the readers.

In data mode, the reader reads RFID tags and transmits data messages, such as tag IDs and reports, to the Controller module. Reports provide information on input status changes (input0 and input1), a presence without tag report, and buffer overflow information. In data mode, the Controller module will only send Command 01, which changes the reader from data mode to command mode.

In command mode, the Controller module sends commands to the reader. These commands control the operation and configuration of the reader. After the reader receives a command, it sends an acknowledgment message. Typically, the acknowledgment message contains the word Error, the word Done, or data relating specifically to the command request. These messages may be of variable length since some commands require information as part of the message.

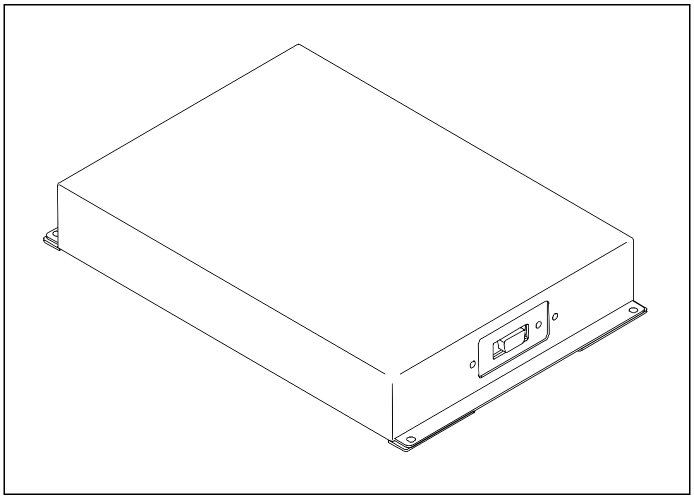
4.4 2200-500 Presence Detector Module

Most SmartScanIS sites use a track circuit. If your site does, it also needs a 2200-500 Presence Detector module, which activates the SmartScanIS when a train is present at the site. If your site is using two advance transducers instead of a track circuit, there is no 2200-500 Presence Detector.

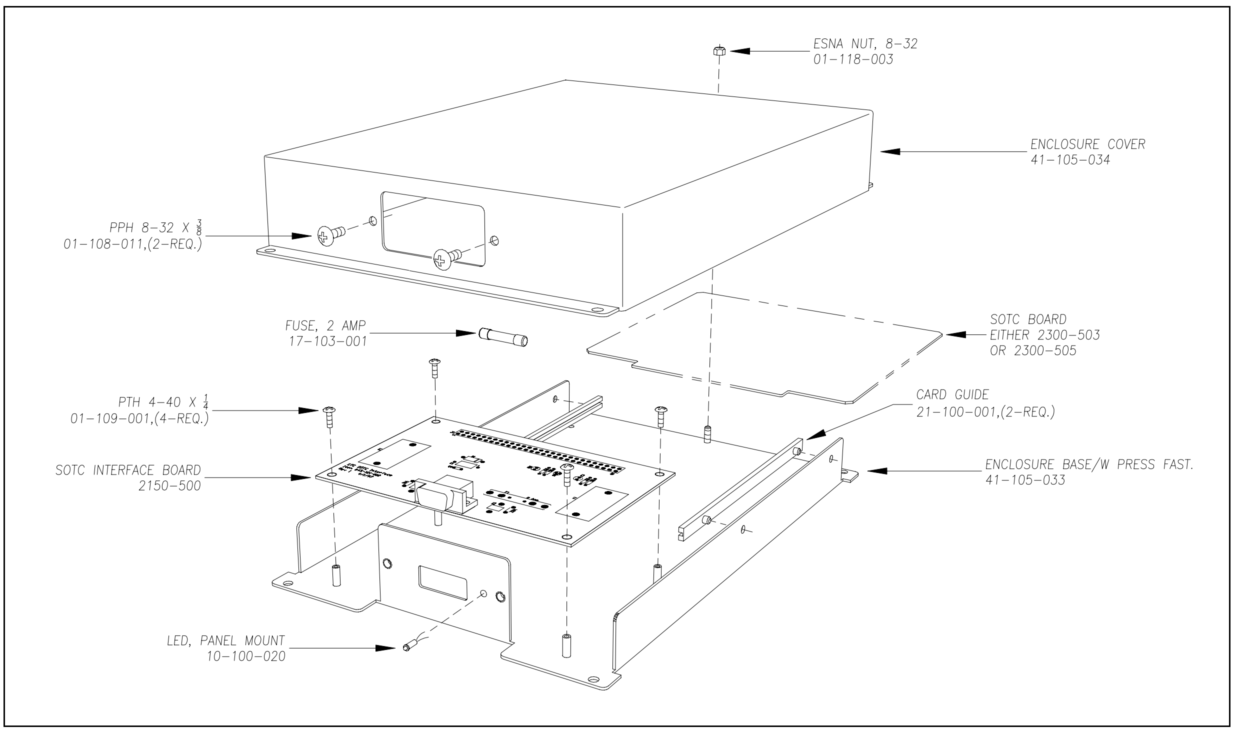
On the outside of the SmartScanIS enclosure, mounting studs are provided for the 2200-500 Presence Detector. Directly below the 2200-504TB Reader, the Presence Detector is secured to the panel with four Keps-nuts. A cable connects the Presence Detector to terminal block TB105 located inside the SmartScanIS enclosure. If your SmartScanIS was shipped in a bungalow, you'll need to install the Presence Detector. If it was shipped in a crate instead, the Presence Detector was already installed.

4.4.1 Module Views

The figure below shows an assembled 2200-500 Presence Detector.

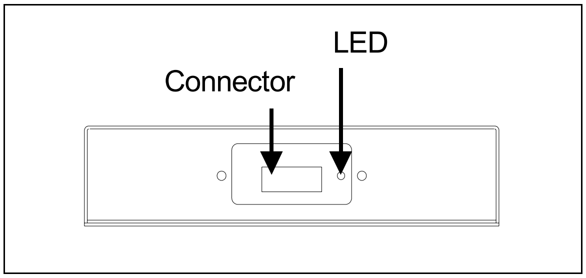


The figure below shows the parts of a 2200-500 Presence Detector.



4.4.2 Front Panel

The next figure shows the front panel of a 2200-500 Presence Detector. As shown below, the Presence Detector uses one connector. This 9-pin connector connects the Presence Detector to the rest of the SmartScanIS and to the track.



As shown above, the 2200-500 has one LED. When lit, this LED indicates a received signal from the track circuit. If everything is functioning properly, a lit LED indicates that a train is present. When unlit, the LED indicates no signal from the track circuit. If everything is functioning properly, an unlit LED indicates that no train is present.

4.4.3 Pinout

The next chart shows the pinout of the DB9 socket.

Pin #	Function
1 and 6	+12 VDC to SOTC
2	Output from SOTC (0 volts = no presence, 5 volts = presence)
3 and 7	Connection to one rail
4 and 8	Connection to other rail
5 and 9	Ground to SOTC

4.4.4 2300-503/505 SOTC Board

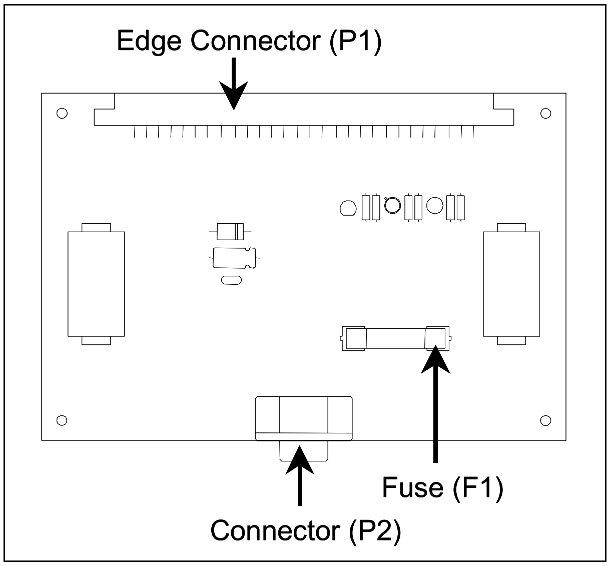
The 2200-500 Presence Detector uses either the 2300-503 (10.0 kHz) SOTC board or the 2300-505 (5.9 kHz) SOTC board to alert the system when a train is present at the site. The choice of operating frequencies offers flexibility in applications in which the site is located within close proximity of crossings or other equipment using a track circuit. On the board is potentiometer **R24**, which is used to adjust the gain control of the track circuit.

4.4.5 2150-500 SOTC Interface Board

Among other things, the 2150-500 SOTC Interface board provides:

- Connection points to the SOTC board and the rest of the system.
- Fusing for itself and the SOTC board.

The figure below shows a 2150-500 SOTC Interface board.



4.4.5.1 Fuse (F1)

Fuse F1 is a 2-amp 250-volt fast-acting fuse in the 12-volt supply to the SOTC. It protects both the 2300-503/505 SOTC board and the 2150-500 SOTC Interface board. If this fuse is blown, the 2200-500 Presence Detector won't operate.

4.4.5.2 Edge Connector (P1)

The 28-pin edge connector connects the 2150-500 SOTC Interface board to the 2300-503/505 SOTC board.

4.4.5.3 Connector (P2)

The 9-pin connector P2 connects the 2200-500 Presence Detector to the rest of the SmartScanIS and to the track. This is the DB9 socket on the front panel of a 2200-500 Presence Detector.

4.5 2200-205 Power Supply Module

The 2200-205 Power Supply module is a combination power supply and battery charger for the SmartScanIS. Two DC outputs are provided.

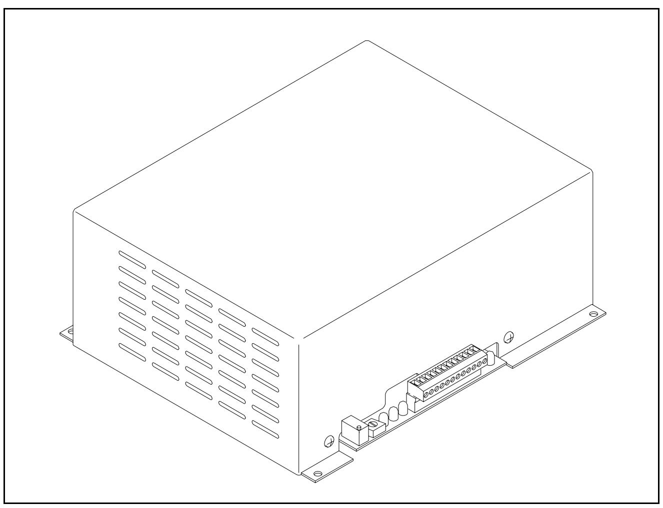
- A 24-volt output capable of charging batteries.
- A 12-volt (adjustable) 100-watt output capable of 8-amps maximum current.

The SmartScanIS is powered by AC, with battery backup. Input power is 104-127 VAC. The 2200-205 Power Supply converts the externally supplied AC to regulated DC power. When AC power fails, the 12 VDC output is supplied from the batteries through the 2200-205's DC-DC converter. LED indicators are provided for the two DC outputs, the AC input, and an AC power fail condition. A relay contact closure is also provided for the AC power fail condition. All connections to the 2200-205 Power Supply are made through a pluggable terminal block (TB1).

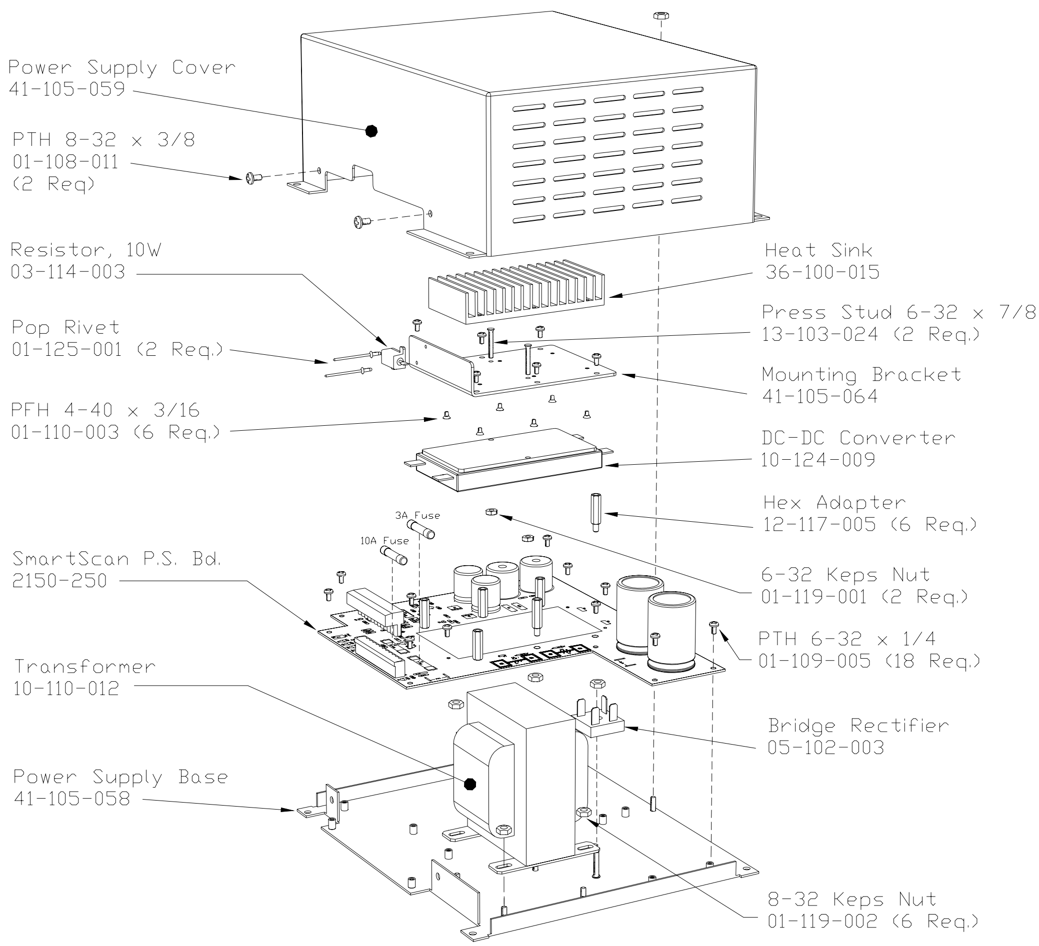
The 2200-205 Power Supply contains:

- Module cover
- Fuses
- Potentiometers
- Status LEDs
- Power converter and battery charger
- Power Supply board
- Module base

The figure below shows an assembled 2200-205 Power Supply.



The figure below shows the parts of a 2200-205 Power Supply.



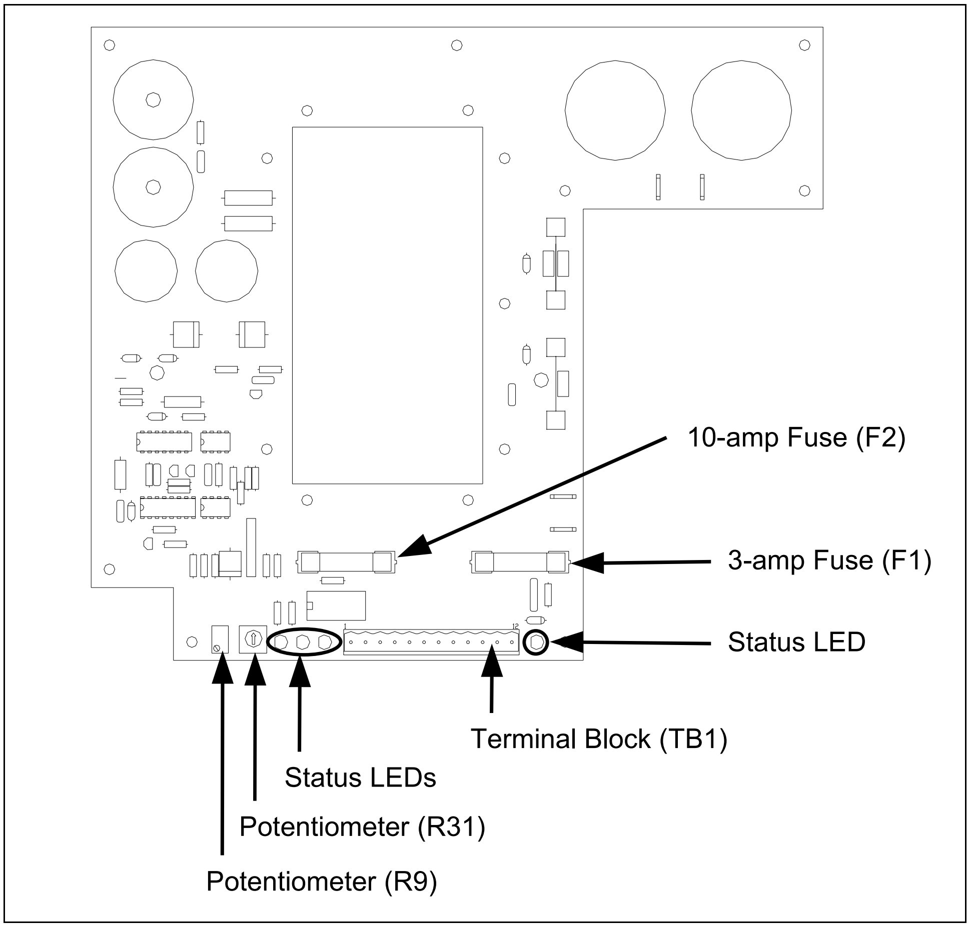
DANGER

When AC is present, there is a risk of shock inside and outside of the 2200-205 Power Supply. Some possible high-voltage danger areas are the transformer, bridge rectifier, AC fuse holder, and terminal block. Other dangerous areas also exist. So, when power is on, touching these areas could electrocute you.

4.5.1 Power Supply Board

The Power Supply board provides filtering and regulation of the DC voltages used by the SmartScanIS. It also provides LED indicators for the input and output voltages and a terminal block for connections to the barrier strip and the Fuse panel. Fuses are provided on the board for the AC input and 24-volt DC output.

The figure below shows a Power Supply board.



4.5.1.1 Potentiometer (R9)

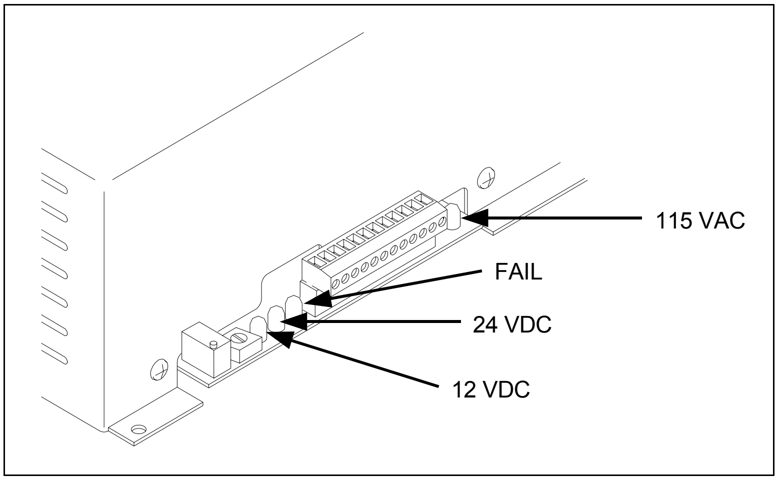
Potentiometer **R9** is used to adjust the battery float voltage. It was factory adjusted to 28 VDC. At the site, when the voltage is not between 27.8 and 28.2, adjust R9 until a multimeter shows 28 VDC at terminal 4 on TB1. You can do this by turning R9 clockwise to increase the voltage or counterclockwise to decrease the voltage. The batteries must be disconnected while setting the float voltage.

4.5.1.2 Potentiometers (R31)

Potentiometer **R31** is used to adjust the DC voltage that is present at terminal 8 on TB1. At the factory, it is adjusted for a value of 12.5 VDC. Turn R31 clockwise to increase the voltage. Turn it counterclockwise to decrease the voltage.

4.5.1.3 Status LEDs

On the edge of the Power Supply board are four status LEDs. The figure below shows the location of the LEDs.



The table below describes what each lit LED means.

LED Name	LED Color	Meaning When Lit
12 VDC	Green	Proper DC voltage is present at terminal 8 on TB1. Stays lit as long as the system is powered up and 12 VDC is present.
24 VDC	Green	Proper DC voltage is present at terminal 4 on TB1. Stays lit as long as the system is powered up and 24 VDC is present.
FAIL	Red	Proper AC voltage isn't present at terminal 10 on TB1. Stays lit as long as the system is powered up, AC isn't present, and the system is running on battery backup.
115 VAC	Green	Proper AC voltage is present at terminal 10 on TB1. Stays lit as long as the system is powered up and AC is present.

4.5.1.4 Fuses (F1, F2)

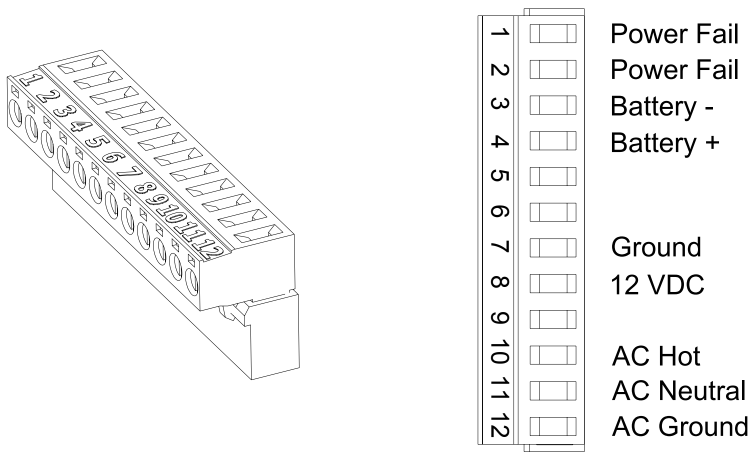
There are two fuses on the Power Supply board. Both are 3AG glass-body fast-acting fuses. The 3-amp fuse (F1) protects the 2200-205 Power Supply from excessive AC. The 10-amp fuse (F2) protects the rest of the SmartScanIS from excessive DC.

4.5.1.5 Terminal Block (TB1)

The 12-position terminal block connects the Power Supply board to TB105, the Controller module, and the Surge Protection Subassembly.

DANGER
Do not touch the terminal block (TB1) without the power shut off. If the power is on, the AC voltage present on part of this block could electrocute you.

The figure below shows what is wired to each terminal.



4.5.2 Power Converter and Battery Charger

Inside the module is the power converter and battery charger, consisting of these major parts.

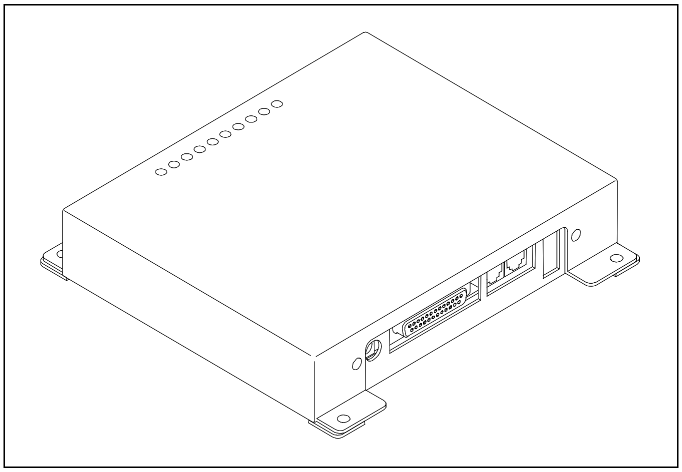
- Transformer
- Bridge rectifier
- Filter capacitors
- Regulators
- DC-DC converter

For the needs of the AC powered system, the 2200-205 Power Supply converts the externally supplied 120 VAC to a regulated 12 VDC and 24 VDC. The regulated 24 VDC is also used to float charge the standby battery system. This allows continued system operation for about 100 hours when there is an interruption in the externally supplied 120 VAC.

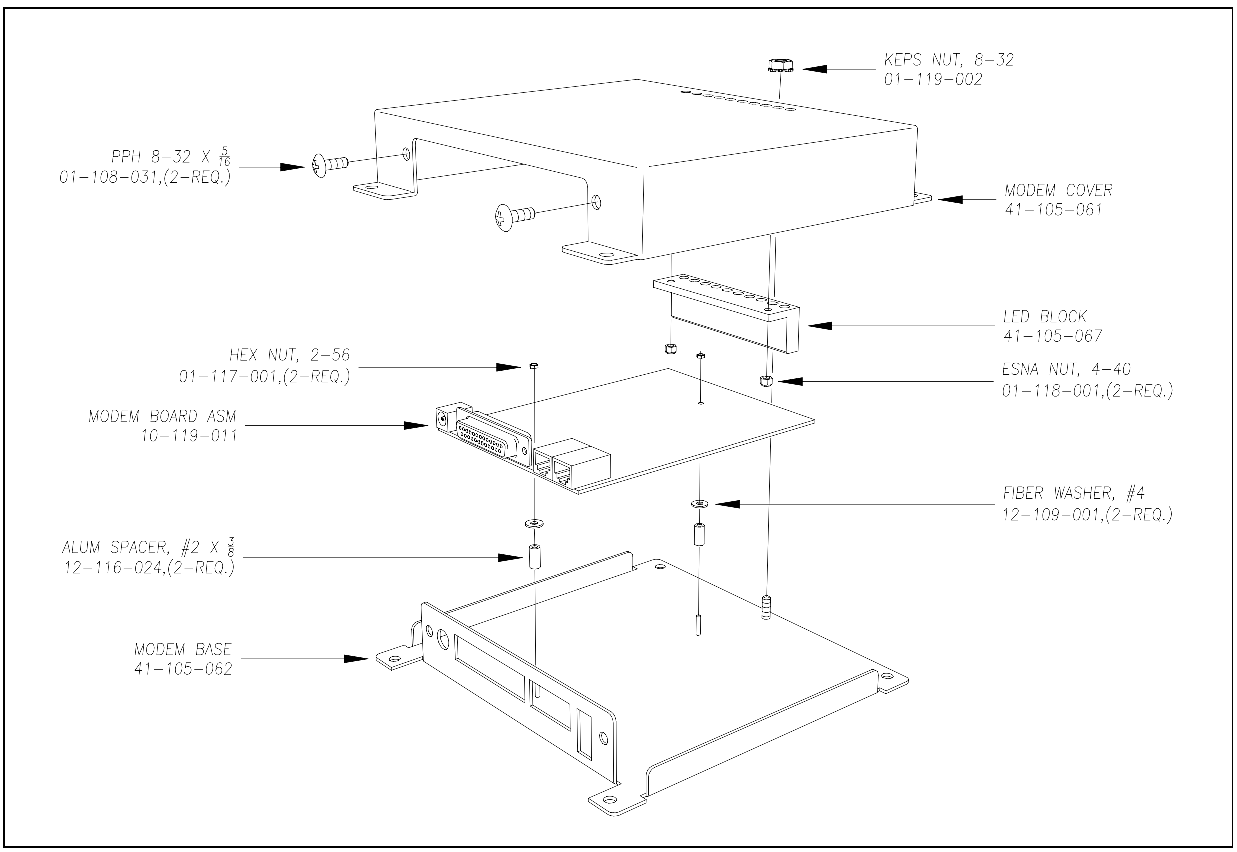
4.6 2200-600 Modem Module

The 2200-600 Modem module is a device that lets the system (at the site) communicate with a computer (away from the site) over the telephone system. Inside the 2200-600 Modem is a MultiTech Systems modem, either model MT1932ZDX or MT2834ZDXb.

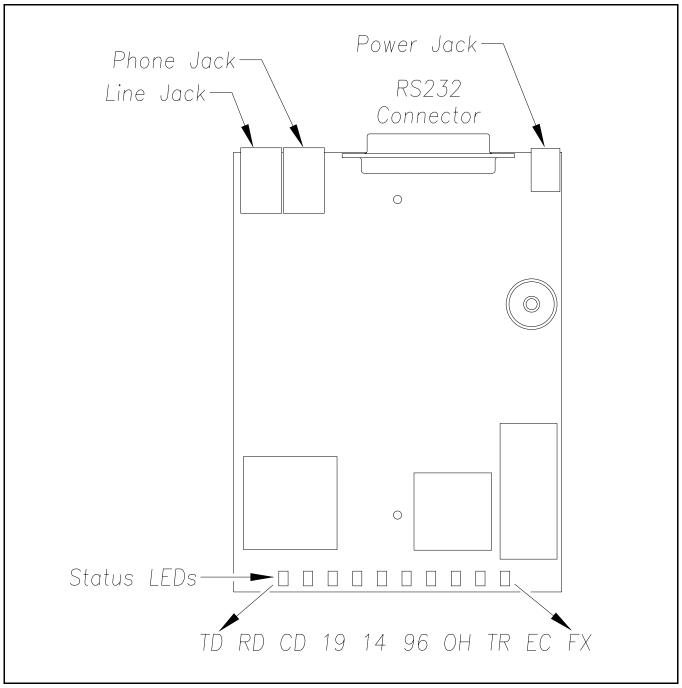
The figure below shows an assembled 2200-600 Modem.



The figure below shows the parts of a 2200-600 Modem.

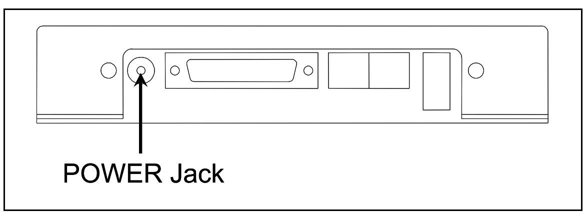


The figure below shows a Modem board.



4.6.1 Power Connection (Power Jack)

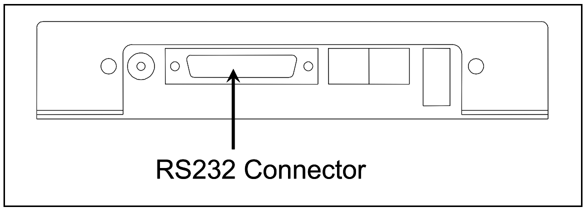
The POWER jack is used to supply low-voltage DC power to the modem.



At the factory, one end of a power cord was plugged into the power jack. The other end of the power cord was wired to terminal block TB105.

4.6.2 System Connection (RS232 Connector)

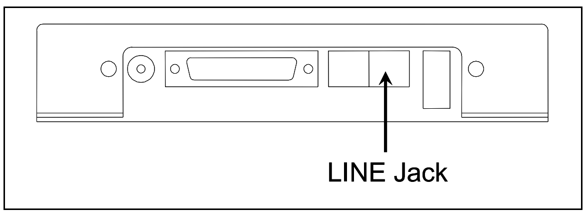
The RS232 connector is used to connect the modem to the rest of the system.



At the factory, the 25-pin end of a standard modem cable was plugged into the RS232 connector on the Modem board. The other end is a 26-pin connector that is plugged into P8 on the System Interface board.

4.6.3 Line Cable Connection (Line Jack)

The LINE jack is used to connect the modem to the telephone system.



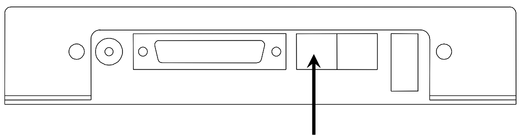
At the factory, one end of a telephone cord was plugged into the LINE jack (on the Modem module). The other end was wired to a universal transient barrier of the Surge Protection Subassembly. At the site, the customer finishes this wiring by supplying the site with normal telephone service, bringing the telephone line to a four-wire modular plug (type RJ11/14) in the bungalow, and wiring from the universal transient barrier to this modular plug.

CAUTION

The LINE jack and the PHONE jack aren't interchangeable.
Therefore, don't plug the line cable into the PHONE jack. Doing so causes your modem not to work properly.

4.6.4 Telephone Connection (Phone Jack)

The PHONE jack is used to plug a telephone into the modem for voice communications. When you do so, the telephone shares the same telephone line as the modem. This jack is provided as a convenience. It is rarely used.



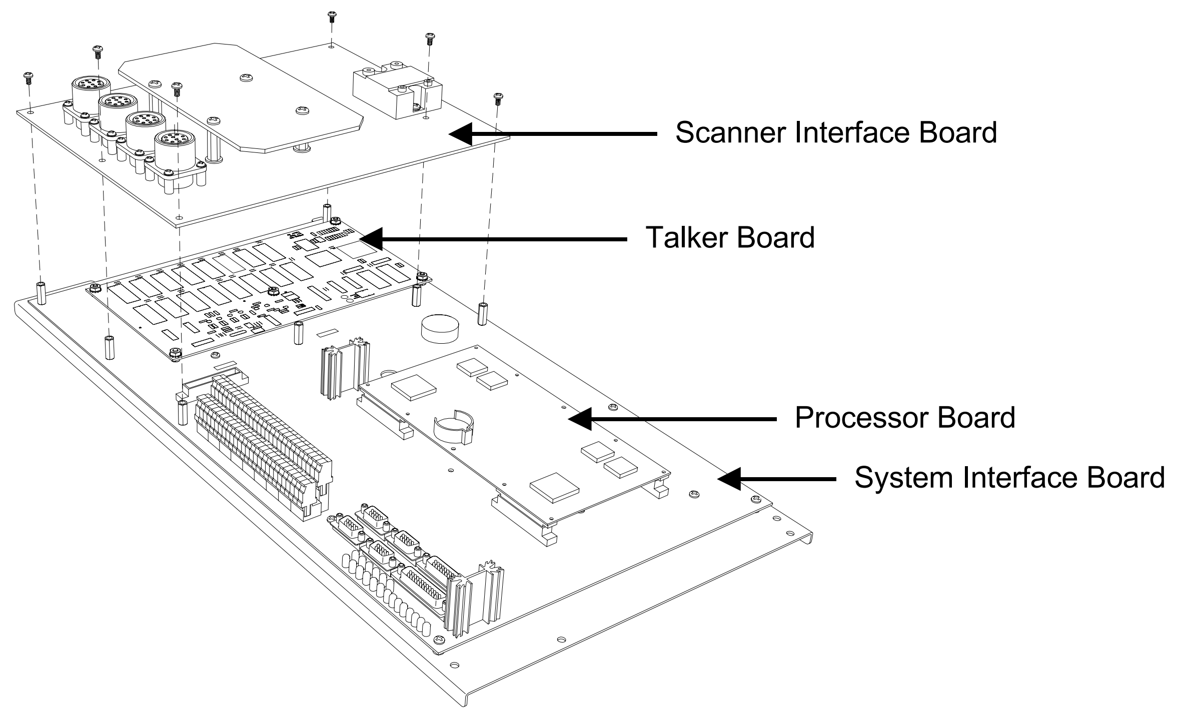
4.6.5 Status LEDs

On the module cover are 10 status LEDs. The table below describes what each lit LED means.

LED	Meaning When Lit
14	By itself, lights when the modem is operating at 14,400 bps. When lit with LED 19, the modem is operating at 16,800 bps. When lit with LED 96, the modem is operating at 12,000 bps.
19	By itself, lights when the modem is operating at 19,200 bps. When lit with LED 14, the modem is operating at 16,800 bps.
96	By itself, lights when the modem is operating at 9600 bps. When lit with LED 14, the modem is operating at 12,000 bps. If no speed LED lights, the modem is operating at less than 9600 bps.
CD	Lights when valid carrier signal from another modem is detected.
EC	Lights when the modem is in error-correction mode. Flashes when compression is activated.
FX	Lights when the modem is in fax mode.
OH	Lights when the phone line is off-hook, which occurs when the modem is dialing, online, or answering a call. Flashes when the modem is pulse dialing.
RD	Blinks when data is being received.
TD	Blinks when data is being transmitted.
TR	STC's firmware configures the modem to ignore this light. So, it is never lit.

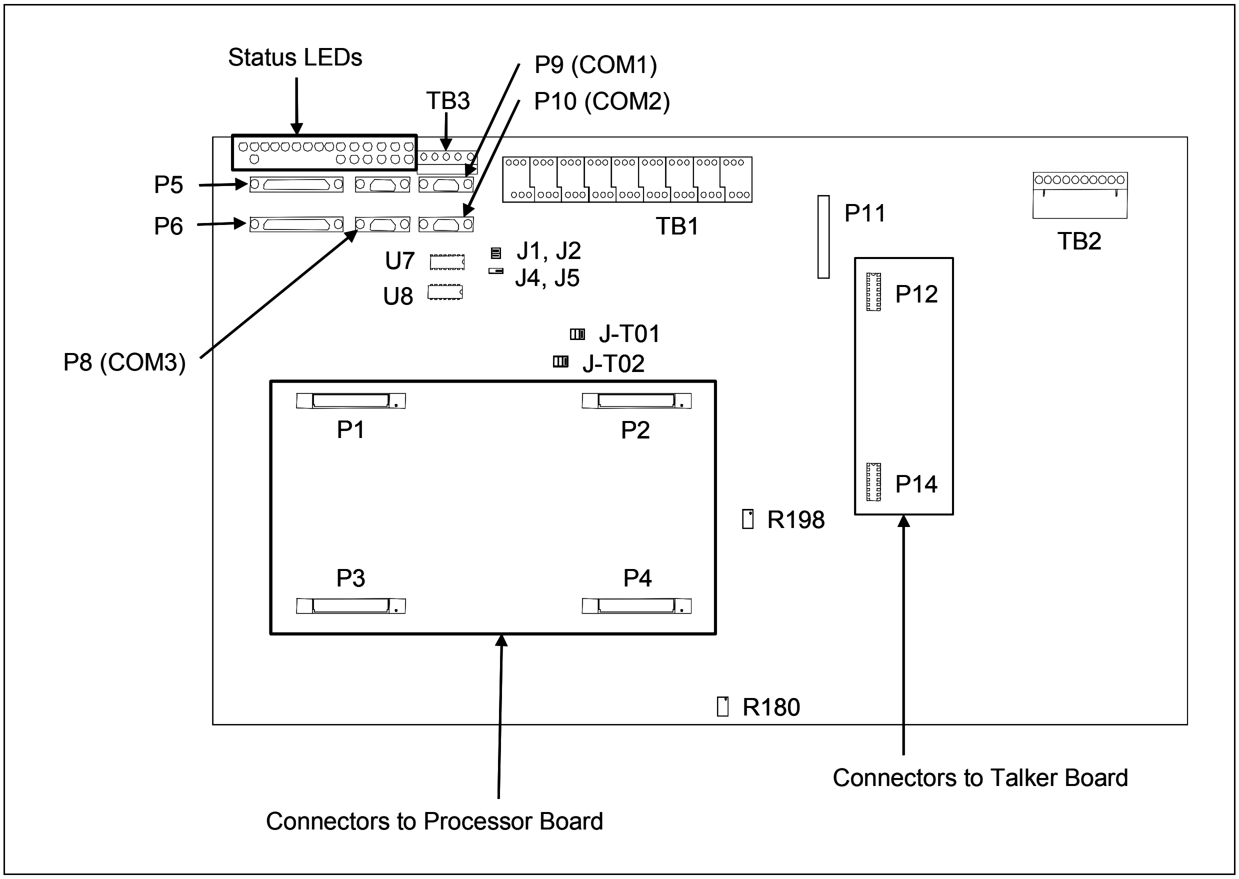
4.7 2300-350 Controller Module

The figure below shows the major parts of the 2300-350 Controller module.



4.7.1 2300-200 System Interface Board

As its name implies, all the interface and signal conditioning circuitry is located on the 2300-200 System Interface board. The figure below shows a System Interface board, with some important components highlighted.



4.7.1.1 Terminal Block TB1

The 54-position terminal block TB1 is the largest set of terminals on the System Interface board. Each screw terminal is numbered and has an associated label located on the circuit board. The labels indicate how a given terminal is used.

The table below describes the function of each terminal.

Function	Num
Ground – Power supply ground.	28
Ground – Power supply ground.	29
Output1 is the open collector sinking output of transistor Q3. Designed to supply a ground to drive a relay. *Not used*.	30
Output2 is the open collector sinking output of transistor Q4. Designed to supply a ground to drive a relay. *Not used*.	31
Input1 ground return. Associated with terminal 5.	32
Input2 ground return. Associated with terminal 6.	33
Input3 ground return. Associated with terminal 7.	34
High-load or high-wide ground return. Associated with terminal 8.	35
Dragging-equipment ground return. Associated with terminal 9.	36
Wide-load-1 ground return. Associated with terminal 10.	37
Wide-load-2 ground return. Associated with terminal 11.	38
SOTC ground. Associated with terminal 12.	39
Number 1 zero-speed transducer ground return. Associated with terminal 13.	40
Number 2 zero-speed transducer ground return. Associated with terminal 14.	41
Number 3 zero-speed transducer ground return. Associated with terminal 15.	42
Number 4 zero-speed transducer ground return. Associated with terminal 16.	43

Num	Function
1	+12 VDC input.
2	+24 VDC input.
3	Normally closed relay contact. *Not used*.
4	Normally closed relay contact. *Not used*.
5	Input1 signal. Contact closure to ground or to terminal 32 indicates presence of the AC power.
6	Input2 signal. Contact closure to ground or to terminal 33 indicates the AC surge arrestor is in working condition.
7	Input3 signal. *Not used*.
8	High-load or high-wide signal. Contact closure to ground or to terminal 35 indicates no high-load or high-wide. Open contacts signify high-load or high-wide.
9	Dragger signal. Contact closure to ground or to terminal 36 indicates no dragging equipment. Open contacts signify dragging equipment.
10	Wide-load-1 signal. Contact closure to ground or to terminal 37 indicates no wide-load on right-side of track. Open contacts signify wide-load on right-side of track.
11	Wide-load-2 signal. Contact closure to ground or to terminal 38 indicates no wide-load on left-side of track. Open contacts signify wide-load on left-side of track.
12	SOTC signal. +12 VDC applied here indicates train is present.
13	Number 1 zero-speed transducer signal. *Not used*.
14	Number 2 zero-speed transducer signal. *Not used*.
15	Number 3 zero-speed transducer signal. *Not used*.
16	Number 4 zero-speed transducer signal. *Not used*.

Function	Num	Num	Function
Number 5 zero-speed transducer ground return. Associated with terminal 17.	44	17	Number 5 zero-speed transducer signal. *Not used*.
Ground. Associated with terminal 18.	45	18	+12 VDC output. *Not used*.
TO1 magnetic transducer ground return. Associated with terminal 19.	46	19	TO1 magnetic transducer signal. Gating transducer connection.
TO2 magnetic transducer ground return. Associated with terminal 20.	47	20	TO2 magnetic transducer signal. Gating transducer connection.
Number 3 magnetic transducer ground return. Associated with terminal 21.	48	21	Number 3 magnetic transducer signal. Used to connect advance transducers.
Number 4 magnetic transducer ground return. Associated with terminal 22.	49	22	Number 4 magnetic transducer signal. *Not used*.
Number 5 magnetic transducer ground return. Associated with terminal 23.	50	23	Number 5 magnetic transducer signal. *Not used*.
Analog-to-digital converter channel7 ground return. Associated with terminal 24. *Not used*.	51	24	Signal from analog-to-digital converter channel7. *Not used*.
Analog-to-digital converter channel6 ground return. Associated with terminal 25. *Not used.*	52	25	Signal from analog-to-digital converter channel6. *Not used*.
Battery voltage ground return. Associated with terminal 26.	53	26	Battery Voltage Positive Input. Battery voltage is measured by the processor-A.
Ground return from shielded temperature probe. Associated with terminal 27.	54	27	Signal from shielded temperature probe. 0 to 5 VDC represents an outside air temperature of about -50° to +150°F (-45.6° to +65.6°C).

4.7.1.2 Terminal Block TB2

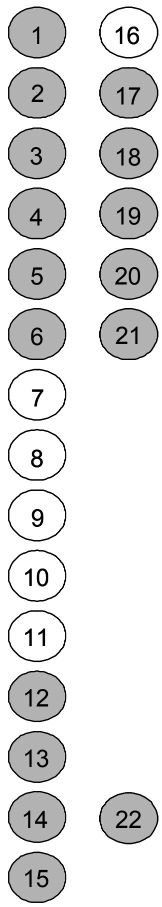
On the System Interface board, the 10-position terminal block TB2 is used to connect to the radio and the speaker.

The table below describes the function of each terminal.

Terminal Name	Function
Speaker + Speaker -	Connect these terminals to the positive and negative 8-ohm speaker terminals.
Ground $\overline{\text{PTT}}$ (push to talk)	Connect these terminals to the radio's $\overline{\text{PTT}}$ and ground. Active low.
Ground Transmit Audio	Connect these terminals to the transmit-audio input of the radio.
Ground $\overline{\text{Hold-Off Out}}$	This signal is not used. A low signal indicates the system is making an announcement.
Ground $\overline{\text{Hold-Off In}}$	Connect these terminals to the radio's carrier-detect output and ground. Active low when the radio's squelch breaks. Indicates to the Talker board that the channel is busy.

4.7.1.3 Status LEDs

On the System Interface board, there are 22 status LEDs. The table below describes what each lit LED means.



LED	Meaning When Lit
1	Lights when **wide-load-2** input is active.
2	Lights when **dragging-equipment** input is active.
3	Lights when **input3** is active. *Not used*.
4	Lights when AC power to the system is off and the system is running on **battery backup**. This LED is unlit when AC power is present.
5	Lights when **processor-A** is operating properly. Slowly fading off and on indicates normal operation.
6	Lights when **output1** is active. *Not used*.
7	Lights when **transducer TO1** is active. Will flicker as each wheel passes over transducer TO1 during train passage.
8	Lights when **transducer TO2** is active. Will flicker as each wheel passes over transducer TO2 during train passage.
9	Lights when either **advance transducer** is active. Will flicker as each wheel passes over either advance transducer during train passage.
10	Lights when **transducer4** input is active. *Not used*.
11	Lights when **transducer5** input is active. *Not used*.
12	Lights when voltage present at the **+24 VDC** input TB1 (terminal 2).
13	Lights when there is voltage from the +5-volt regulator U57. This regulator powers the 5-volt logic and processor circuitry.
14	Lights when there is voltage from the +5-volt regulator U59. This regulator powers reader1. (It powered both readers on System Interface boards made before 2004.)
15	Lights when voltage present at the **+12 VDC** input TB1 (terminal 1).
16	Lights continuously when the track circuit indicates a train is present at the site.
17	Lights when **wide-load-1** input is active.
18	Lights when the **high-load** input is active.
19	Lights when AC surge protector should be replaced. Dark when AC surge arrestor is in working condition.
20	Lights when **processor-B** is operating properly. Slowly fading off and on indicates normal operation.
21	Lights when **output2** is active. *Not used*.
22	Lights when there is voltage from the +5-volt regulator U59. This regulator powers reader2. (Added in 2004)

4.7.1.4 Sockets P12 and P14

On the System Interface board, the two 14-pin sockets P12 and P14 are used to connect to the Talker board. If your System Interface board was released before 2004, these sockets were labeled P1 and S1, respectively.

The table below shows the pinout of socket **P12**.

Pin 1	*Not Connected*	Pin 16	*Not Connected*
Pin 2	*Not Connected*	Pin 15	*Not Connected*
Pin 3	*Not Connected*	Pin 14	*Not Connected*
Pin 4	*Not Connected*	Pin 13	*Not Connected*
Pin 5	*Not Connected*	Pin 12	*Not Connected*
Pin 6	Active low reset signal from processor-A. Used to reset the Talker board.	Pin 11	Active low PTT signal to processor-A from Talker board.
Pin 7	Receive serial data to processor-A.	Pin 10	*Not Used*
Pin 8	Transmit serial data from processor-A.	Pin 9	Negative 12-volts to Talker board.

The table below shows the pinout of socket **P14**.

Pin 1	+12 VDC supply to Talker board.	Pin 16	TX audio to radio.
Pin 2	+12 VDC supply to Talker board.	Pin 15	Audio to System Interface board for amplification to drive speaker.
Pin 3	+12 VDC supply to Talker board.	Pin 14	Active low holdoff-out signal.
Pin 4	*Not Connected*	Pin 13	*Not Used*
Pin 5	*Not Connected*	Pin 12	Active low PTT signal from Talker to radio.
Pin 6	Ground	Pin 11	*Not Connected*
Pin 7	Ground	Pin 10	*Not Connected*
Pin 8	Ground	Pin 9	*Not Connected*

4.7.1.5 Connectors P1-P4

On the System Interface board, the four 32-pin connectors P1, P2, P3, and P4 are used to connect to the Processor board. These connectors are keyed so that the Processor board cannot be plugged in backwards. Totaling 128 pins that carry power supply voltages, address lines, data lines, digital signals, and analog signals to and from the Processor board.

Be sure the system is completely powered down before removing or installing the Processor board.

4.7.1.6 Connector P11

On the System Interface board, the 32-pin connector P11 contains power supply and control signals for the Scanner Interface board. If your System Interface board was released before 2004, this socket was labeled P5.

The table below shows the pinout of connector **P11**. If the track runs north and south, rail1 is the east rail. If the track runs east and west, rail1 is the north rail.

Pin 1	+5 VDC for heater relay.	Pin 2	Supplies a ground to activate the shutter relay.
Pin 3	Supplies a ground to activate the heater relay.	Pin 4	+5 VDC for shutter relay.
Pin 5	Ground.	Pin 6	Ground.
Pin 7	Ground return for the heat signal from bearing scanner on rail1.	Pin 8	Heat signal from bearing scanner on rail1.
Pin 9	Ground return for the heat signal from bearing scanner on rail2.	Pin 10	Heat signal from bearing scanner on rail2.
Pin 11	Ground return for the heat signal from wheel scanner on rail1.	Pin 12	Heat signal from wheel scanner on rail1.
Pin 13	Ground return for the heat signal from wheel scanner on rail2.	Pin 14	Heat signal from wheel scanner on rail2.
Pin 15	*Not Connected*	Pin 16	*Not Connected*
Pin 17	*Not Connected*	Pin 18	*Not Connected*
Pin 19	Ground.	Pin 20	Ground.
Pin 21	Ground.	Pin 22	Ground.
Pin 23	Ground.	Pin 24	Ground.
Pin 25	+12 VDC to the Scanner Interface board.	Pin 26	+12 VDC to the Scanner Interface board.
Pin 27	+12 VDC to the Scanner Interface board.	Pin 28	+12 VDC to the Scanner Interface board.
Pin 29	+12 VDC to the Scanner Interface board.	Pin 30	+12 VDC to the Scanner Interface board.
Pin 31	+12 VDC to the Scanner Interface board.	Pin 32	+12 VDC to the Scanner Interface board.

4.7.1.7 Socket P5

On the System Interface board, the DB25F socket P5 is used to connect to **reader1**. This 25-pin socket provides RS232 communications interface, +5 VDC, and +12 VDC to power reader1. On System Interface boards released before 2004, socket P5 included four digital inputs, which were not used. On boards released in 2004 or later, these inputs moved to connector P16 to allow access for future expansion.

The table below shows the pinout of socket **P5** on System Interface boards released in 2004 or later.

Pin 1	Ground	Pin 14	Ground
Pin 2	Transmit	Pin 15	Ground
Pin 3	Receive	Pin 16	*Not Connected*
Pin 4	RTS	Pin 17	*Not Connected*
Pin 5	CTS	Pin 18	*Not Connected*
Pin 6	*Not Connected*	Pin 19	*Not Connected*
Pin 7	Ground	Pin 20	+12 VDC
Pin 8	*Not Connected*	Pin 21	*Not Connected*
Pin 9	+5 VDC	Pin 22	*Not Connected*
Pin 10	+5 VDC	Pin 23	*Not Connected*
Pin 11	*Not Connected*	Pin 24	*Not Connected*
Pin 12	*Not Connected*	Pin 25	+12 VDC
Pin 13	+12 VDC		

The table below shows the pinout of socket **P5** on System Interface boards released before 2004.

Pin 1	Ground	Pin 14	Ground
Pin 2	Transmit	Pin 15	*Not Connected*
Pin 3	Receive	Pin 16	*Not Connected*
Pin 4	RTS	Pin 17	*Not Connected*
Pin 5	CTS	Pin 18	*Not Connected*
Pin 6	*Not Connected*	Pin 19	*Not Connected*
Pin 7	Ground	Pin 20	*Not Used*
Pin 8	*Not Connected*	Pin 21	*Not Used*
Pin 9	+5 VDC	Pin 22	*Not Used*
Pin 10	*Not Connected*	Pin 23	*Not Used*
Pin 11	*Not Connected*	Pin 24	*Not Connected*
Pin 12	*Not Connected*	Pin 25	+12 VDC
Pin 13	+12 VDC		

4.7.1.8 Socket P6

On the System Interface board, the DB25F socket P6 is used to connect to **reader2**. This 25-pin socket provides RS232 communications interface, +5 VDC, and +12 VDC to power reader2. On System Interface boards released before 2004, socket P5 included four digital inputs, which were not used. On boards released in 2004 or later, these inputs moved to connector P16 to allow access for future expansion.

The table below shows the pinout of socket **P6** on System Interface boards released in 2004 or later.

Pin 1	Ground	Pin 14	Ground
Pin 2	Transmit	Pin 15	Ground
Pin 3	Receive	Pin 16	*Not Connected*
Pin 4	RTS	Pin 17	*Not Connected*
Pin 5	CTS	Pin 18	*Not Connected*
Pin 6	*Not Connected*	Pin 19	*Not Connected*
Pin 7	Ground	Pin 20	+12 VDC
Pin 8	*Not Connected*	Pin 21	*Not Connected*
Pin 9	+5 VDC	Pin 22	*Not Connected*
Pin 10	+5 VDC	Pin 23	*Not Connected*
Pin 11	*Not Connected*	Pin 24	*Not Connected*
Pin 12	*Not Connected*	Pin 25	+12 VDC
Pin 13	+12 VDC		

The table below shows the pinout of socket **P6** on System Interface boards released before 2004.

Pin 1	Ground	Pin 14	Ground
Pin 2	Transmit	Pin 15	*Not Connected*
Pin 3	Receive	Pin 16	*Not Connected*
Pin 4	RTS	Pin 17	*Not Connected*
Pin 5	CTS	Pin 18	*Not Connected*
Pin 6	*Not Connected*	Pin 19	*Not Connected*
Pin 7	Ground	Pin 20	*Not Used*
Pin 8	*Not Connected*	Pin 21	*Not Used*
Pin 9	+5 VDC	Pin 22	*Not Used*
Pin 10	*Not Connected*	Pin 23	*Not Used*
Pin 11	*Not Connected*	Pin 24	*Not Connected*
Pin 12	*Not Connected*	Pin 25	+12 VDC
Pin 13	+12 VDC		

4.7.1.9 Plug P8 (COM3)

On the System Interface board, the DB9M plug P8 is an RS232 connector used to connect to the modem. This 9-pin plug is the only serial port that outputs information as the system boots up following a reset. Because COM1-P9 and COM2-P10 already have functions allocated to them, **STC recommends COM3-P8 as the only serial port for use with a laptop computer to access the serial interface**. It is necessary to use a null modem cable with the laptop. The default RS232 settings are 9600, N, 8, 1.

The table below shows the pinout of plug **P8**.

Pin 1	CD
Pin 2	RX
Pin 3	TX
Pin 4	DTR
Pin 5	Ground
Pin 6	DSR
Pin 7	RTS
Pin 8	CTS
Pin 9	RI

4.7.1.10 Plug P10 (COM2)

On the System Interface board, the DB9M plug P10 is dedicated to the Union Pacific's Polling System.

The table below shows the pinout of plug **P10**.

Pin 1	*Not Connected*
Pin 2	RX
Pin 3	TX
Pin 4	*Not Connected*
Pin 5	Ground
Pin 6	*Not Connected*
Pin 7	RTS
Pin 8	CTS
Pin 9	*Not Connected*

4.7.1.11 Plug P7 (COM4)

On the System Interface board, the DB9M plug P7 isn't for use by the customer. Rather, it is used at the factory to test the system. Since jumper J6 is associated with P7, do <u>not</u> short it.

4.7.1.12 Connector P16

The 10-pin connector P16 appears on System Interface boards released in 2004 or later. This connector allows access to eight optically isolated digital inputs that were connected to the reader1 and reader2 interface connectors on older boards. None of these inputs is currently used. This connector is intended for future expansion.

4.7.1.13 Connector P17

The 10-pin connector P17 only appears on System Interface boards released in 2004 or later. This connector connects to the 2300-357 Efficiency Test panel. ***Chapter 14 – Using the Efficiency Test Panel*** tells how to arm and disarm the panel.

4.7.1.14 Terminal Block TB3

On the System Interface board, the 6-position terminal block TB3 is used to connect to RS485 devices, such as wind speed and wind direction instrumentation. If your board was released before 2004, you have one less terminal. Terminal 12VDC isn't there.

Terminal Name	Function
12VDC	Protected with a 100mA, self-restoring fuse. Use for powering external instrumentation.
$\overline{\text{TX}}$	RS485 $\overline{\text{TX}}$ - (Connected to $\overline{\text{RX}}$ through J1)
TX	RS485 TX+ (Connected to RX through J2)
$\overline{\text{RX}}$	RS485 $\overline{\text{RX}}$ - (Connected to $\overline{\text{TX}}$ through J1)
RX	RS485 RX+ (Connected to TX through J2)
GND	Use for powering external instrumentation.

4.7.1.15 Plug P9 (COM1)

On the System Interface board, the DB9M plug P9 can be configured in one of three different modes of communications, RS232, RS422, and RS485. The configuration in which the board ships from the factory is RS485. All modes are described in this section for reference.

On System Interface boards released before 2004, for **RS232** communications

- Remove U8 (MAX489) chip
- Install U7 (MAX232) chip
- Ignore jumpers J1 and J2
- Remove any communications wiring from terminal block TB3
- Connect null modem communications cable to plug P9.

On System Interface boards released before 2004, for **RS422** four-wire communications:

- Install U8 (MAX489)
- Remove U7 (MAX232)
- Do not short jumpers J1 and J2
- Remove RS232 cable from plug P9
- Connect RS422 wiring to terminal block TB3

On System Interface boards released before 2004, for **RS485** two-wire communications:

- Install U8 (MAX489) chip
- Remove U7 (MAX232) chip
- Short jumpers J1 and J2
- Remove RS232 cable from plug P9
- Connect RS485 Wiring to terminal block TB3

On System Interface boards released in 2004 or later, for **RS232** communications:

- Install U8 (MAX489) chip
- Install U7 (MAX232) chip
- Ignore jumpers J1 and J2
- Short jumper J4
- Remove any communications wiring from terminal block TB3
- Connect null modem communications cable to plug P9

On System Interface boards released in 2004 or later, for **RS422** four-wire communications:

- Install U8 (MAX489) chip
- Install U7 (MAX232) chip
- Short jumper J5
- Do not short jumpers J1 and J2
- Remove RS232 cable from plug P9
- Connect RS422 wiring to terminal block TB3

On System Interface boards released in 2004 or later, for **RS485** two-wire communications:

- Install U8 (MAX489) chip
- Install U7 (MAX232) chip
- Short jumper J5
- Short jumpers J1 and J2
- Remove RS232 cable from plug P9
- Connect RS485 wiring to terminal block TB3

The table below shows the pinout of plug **P9**.

Pin 1	*Not Used*
Pin 2	RX
Pin 3	TX
Pin 4	*Not Used*
Pin 5	Ground
Pin 6	*Not Used*
Pin 7	RTS
Pin 8	CTS
Pin 9	RI

4.7.1.16 Jumpers J1 and J2

When COM1-P9 is configured for **RS485**, both jumpers J1 and J2 should be shorted, which is how they come from the factory. For **RS422**, they should not be shorted. For **RS232**, jumpers J1 and J2 have no effect.

4.7.1.17 Jumpers J4 and J5

On System Interface boards released in 2004 or later, for **RS232** communications, short jumper J4 and don't short J5. On System Interface boards released in 2004 or later, for **RS422** four-wire communication and for **RS485** two-wire communications, short jumper J5 and don't short J4. These jumpers aren't on boards released before 2004.

4.7.1.18 Jumper J6

On the System Interface board, jumper J6 isn't for use by the customer. Rather, it is used at the factory along with plug P7 to test the system. Therefore, do not short jumper J6. This jumper isn't on boards released before 2004.

4.7.1.19 Jumpers J-TO1 and J-TO2

On the System Interface board, the jumpers J-TO1 and J-TO2 set the sensitivity of the gating transducers. Jumper J-TO1 is used to select the sensitivity value for gating transducer TO1. TO1 is the first gating transducer going north or east from the bearing scanner. It is the gating transducer closest to the bearing scanner. Jumper J-TO2 is used to select the sensitivity value for gating transducer TO2. TO2 is the second gating transducer going north or east from the bearing scanner. It is the gating transducer farthest from the bearing scanner.

Each jumper setting selects a different loading. From top to bottom, the selections are high (470 ohms), medium (220 ohms), and low (100 ohms) sensitivity. High is the most sensitive. Low is the least sensitive. Medium is somewhat between these sensitivities.

Transducer loading is the application of a parallel resistance to the magnetic wheel transducer for controlling sensitivity. The SmartScanIS uses jumpers on the circuit board to select a loading resistor for each gating transducer. The transducer's sensitivity lowers as the loading resistance value lowers. It becomes more sensitive as the loading resistance value increases.

Too much sensitivity can make the transducer susceptible to interference from external sources, such as radio transmitters and locomotive traction motors. In this case, the detector can misinterpret this noise as extra wheel pulses. Not enough sensitivity will result in missed wheel pulses.

Once the transducers are optimally loaded, the SmartScanIS will operate over a relatively wide range of transducer signal strengths. This wide range is necessary because the signal level can vary greatly from one wheel to the next. This variation is largely due to wheel wear. For example, a newer wheel tends to generate a weaker transducer pulse than a worn wheel, which has a deeper flange that comes closer to the transducer. Track gauges that are out of tolerance also cause variations in signal strength allowing the wheel flange to wander out near the lateral operating limitations of the transducer.

Our research has led us to determine that a relatively high sensitivity setting, in the 470-ohm range, works well at most sites, but not necessarily for all. It is difficult to define a value that works with 100% accuracy for all installations due to external variables unique to a given site. Many sites produce very little if any external interference, which allows a higher sensitivity setting resulting in the ability to scan slightly slower trains than normal. Others have various issues that require a lesser resistance value than the now standard 470 ohms.

Generally, start with 470 ohms for maximum sensitivity. If you observe too many wheel pulses for a given train, reduce the loading to the center position of 220 ohms. If the SmartScanIS still counts too many pulses, reduce the loading to the bottom position.

4.7.1.20 Potentiometer R180

Potentiometer **R180** adjusts the audio level (loudness) into the on-board audio amplifier that drives the speaker. This factory adjustment is set for maximum loudness with minimal distortion. Once properly adjusted, the customer uses the volume control on the speaker set its volume.

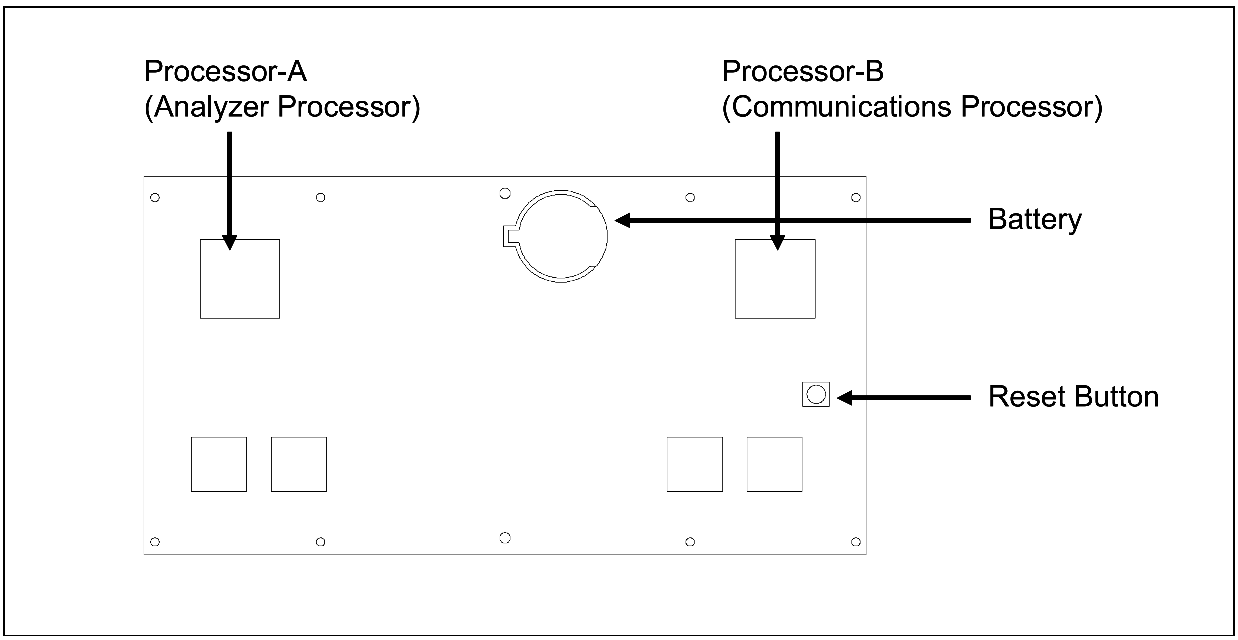
4.7.1.21 Potentiometer R198

Potentiometer **R198** adjusts the transmit audio level going to the radio. A misadjusted level will be distorted or very weak sounding. This adjustment is set at the factory to FCC specifications for 3 KHz FM deviation. Turn R198 clockwise to increase the audio level. Turn it counterclockwise to decrease the audio level.

4.7.2 2300-100 Processor Board

The 2300-100 Processor board controls the entire SmartScanIS. All signals to and from the external devices pass through the System Interface board on the way to their final destination, the Processor board. Running programs written by STC, the Processor board is the brains of the SmartScanIS.

The figure below shows a Processor board (2300-100).



The Processor board uses two, independently operating, central processing units (**CPUs**). The CPU on the left (aka processor-A aka Analyzer Processor) is responsible for data retrieval from most external sources, such as the shielded temperature probe, scanners, transducers, and dragging-equipment detectors. The CPU on the right (aka processor-B aka Communications Processor) is used to process and store the data retrieved by the other CPU. Also, the CPU on the right is responsible for data retrieval from the remaining external sources, such as the wind monitor. After the train data is stored, the system can send it to the user in the form of a report or through the polling system.

Processor-A initially stores train data in static random-access memory (SRAM) on the Processor board. After train passage, processor-B moves this data to a different SRAM for longterm storage. This SRAM contains:

- The Trains directory, which contains data on each new train that passes the site and each new generated gate-test train. The Train Summary report and Train Detail report get their data from this directory.
- The Exceptions directory, which contains data on each train that has one or more Exception Alarms or on a train where sliding wheels were detected. The Exception Summary report and Exception Detail report get their data from this directory.

Each directory is organized as a circular buffer. In this scheme, data is added to the directory until the directory is full. Once full, the oldest data in the directory is overwritten as new data is recorded. The buffer for the Trains directory holds data on about 88,000 axles. The buffer for the Exceptions directory holds data on about 14,000 axles. In the same SRAM as the directories is the Event Log, which also operates as a circular buffer.

Under the CPU on the right is a white **reset button**. Pressing it causes a "hard reset" of the Processor board. As long as no train is present at the site, pressing the reset button doesn't affect the setup information or train data. However, if a train is present, pressing the reset button only looses train data for that train.

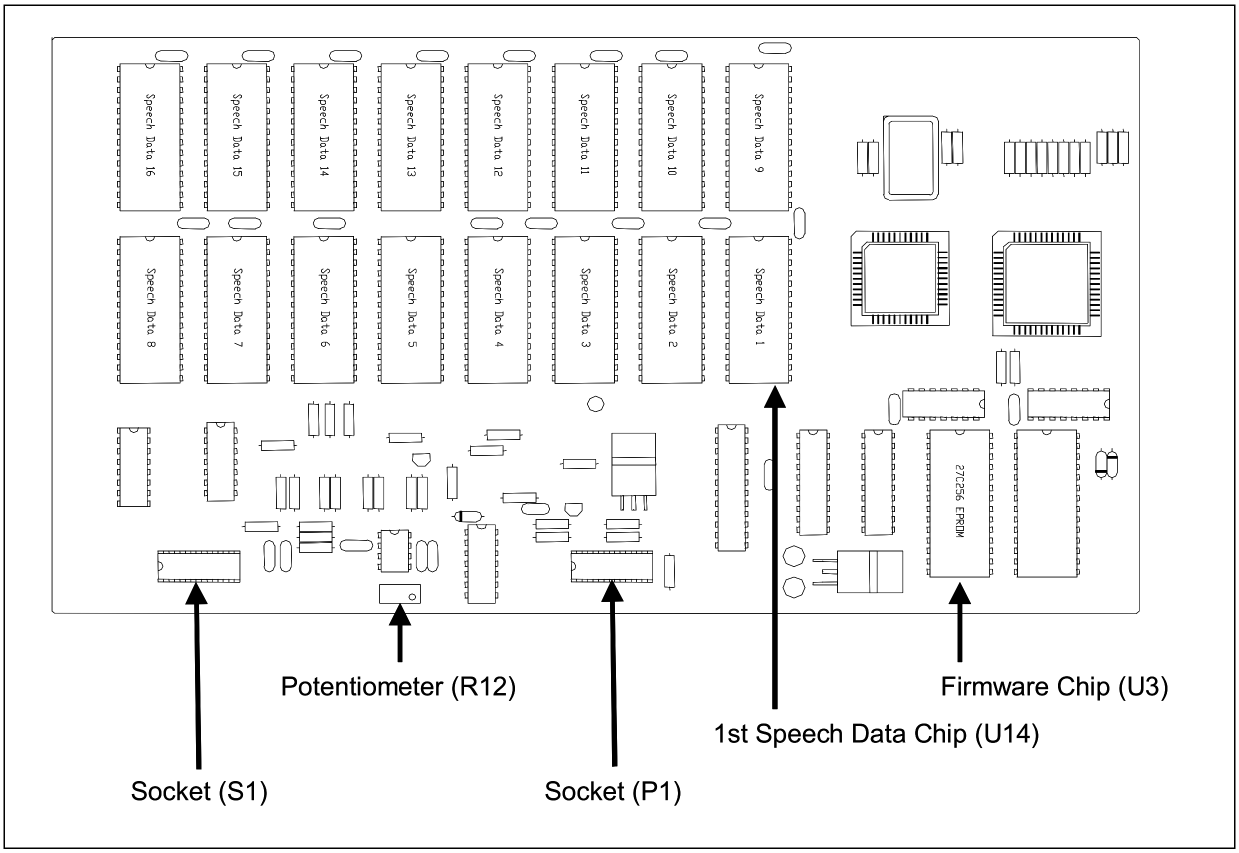
The Processor board requires regulated 5 VDC and regulated 12 VDC for operation. The input power is received from the Interface board.

Between the two CPUs is a **battery**. During a power interruption to the Processor board, this battery keeps the stored train data from being lost and the time/date accurate. If the battery is low or dead, there is no danger of losing train data unless the power to the system is lost. If you power down the system and remove the battery on the Processor board, the time, the date, and all train data will be lost.

4.7.3 2058-305 Talker Board

The 2058-305 Talker board transmits voice messages to the train crew. It receives various commands from processor-A (aka Analyzer Processor) on the Processor board during and after train passage. Processor-A decides what needs to be announced and sends high-level commands to the Talker board, which interprets these commands and constructs the appropriate messages. The Talker board also generates the audio and PTT signals necessary to control the radio.

The figure below shows a Talker board (2058-305).



4.7.3.1 Firmware Chip (U3)

On the Talker board, the firmware is in a single 27C256 or equivalent EPROM (erasable programmable read-only memory). If it becomes necessary to replace this chip, see ***Chapter 15 – Replacing Chips***.

4.7.3.2 Socket (P1)

The 16-pin socket (labeled P1) connects the Talker board to the System Interface board.

4.7.3.3 Socket (S1)

The 16-pin socket (labeled S1) connects the Talker board to the Processor board by way of the System Interface board.

4.7.3.4 Speech Data Chips (U14-U29)

On the Talker board, the 16 sockets, labeled U14 through U29, are for 27C256, 27C512, or equivalent EPROMs. These chips contain the digitized words and phrases required for voice announcements. If it becomes necessary to replace one or more of these chips, see ***Chapter 15 – Replacing Chips***.

4.7.3.5 Potentiometer (R12)

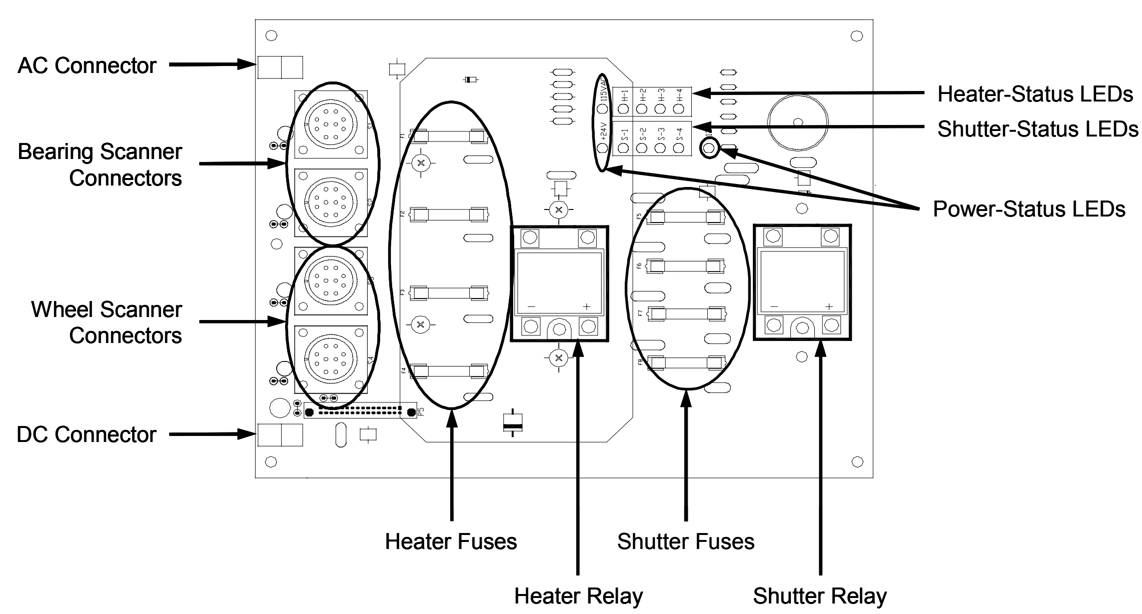
If your System Interface board was released before 2004, potentiometer **R12** on the Talker board is used to adjust the signal level for transmit audio. R12 adjusts the audio level of the radio. Turning it doesn't affect the volume of the system's speaker. Turn R12 clockwise to increase the audio level. Turn it counterclockwise to decrease the audio level.

If your System Interface board was released in 2004 or later, potentiometer **R12** should no longer be installed on Talker board. If it was, fully turn it clockwise to allow maximum audio level output. On System Interface boards released in 2004 or later, potentiometer **R198** is used to adjust the signal level for transmit audio.

4.7.4 2300-300 Scanner Interface Board

The 2300-300 Scanner Interface board provides interface connections between the scanners and the System Interface board. The cables from both bearing and wheel scanners are terminated into their respective connectors on the Scanner Interface board. On-board relays are used to control scanner heaters and shutters. Status LEDs are provided to indicate the current state of the heaters, shutters, and supply voltages.

The figure below shows a Scanner Interface board (2300-300), with some important components highlighted.



4.7.4.1 Power Connectors

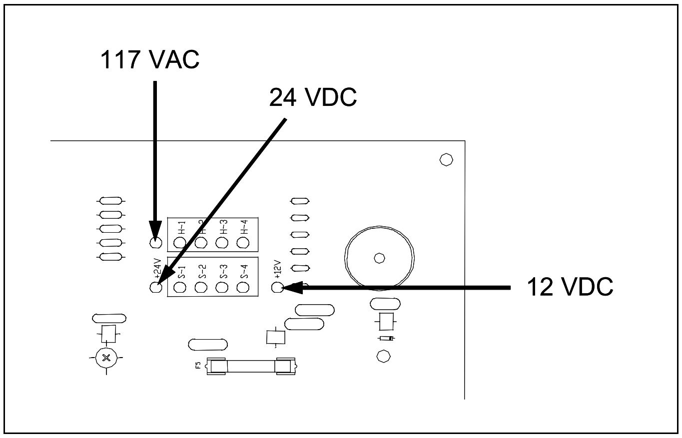
The two-position shrouded header located in the upper left-hand corner provides a termination point for the incoming 110 VAC wire harness. The two-position shrouded header located in the lower left-hand corner provides connection for the 24 VDC supply. These connections are prewired at the factory.

4.7.4.2 Board-to-Board Connector

A 32-pin connector located on underside of the Scanner Interface board provides board-to-board connections to the 2300-200 System Interface board.

4.7.4.3 Status LEDs

There are three power-status LEDs.



The table below describes what each lit LED means.

LED	Meaning When Lit
12VDC	12 VDC is present on Scanner Interface board.
24VDC	24 VDC is present on Scanner Interface board.
117VAC	110 VAC is present on Scanner Interface board.

There are four heater-status LEDs. The table below describes what each lit LED means.

LED	Meaning When Lit
H-1	Power is applied to activate heater on N/E bearing scanner.
H-2	Power is applied to activate heater on S/W bearing scanner.
H-3	Power is applied to activate heater on N/E wheel scanner.
H-4	Power is applied to activate heater on S/W wheel scanner.

There are four shutter-status LEDs. The table below describes what each lit LED means.

LED	Meaning When Lit
S-1	Power is applied to open shutter on N/E bearing scanner.
S-2	Power is applied to open shutter on S/W bearing scanner.
S-3	Power is applied to open shutter on n N/E wheel scanner.
S-4	Power is applied to open shutter on S/W wheel scanner.

4.7.4.4 Relays

The SmartScanIS uses optically isolated solid-state relays (SSRs) to eliminate electromagnetic radiation, which would otherwise be generated by arcing of mechanical relay contacts. There are two SSRs. One SSR is used to operate the scanner shutters. The other energizes the scanner heaters. The signals to activate the SSRs originate at the Processor board.

The power rating for each SSR is intentionally overrated to ensure long-lasting reliability. For example, the SSR associated with the scanner shutters is rated for 100 VDC at 12 amps, even though the shutters operate on 12 volts and require less than 3 amps each. Likewise, the heater SSR is rated for 240 VAC at 25 amps of current, even though the heaters require only 120 VAC at 1.6 amps each.

4.7.4.5 Fuses

There are four heater fuses. All are 3AG glass-body 3-amp 250-volt fast-acting fuses. The table below describes what each fuse protects.

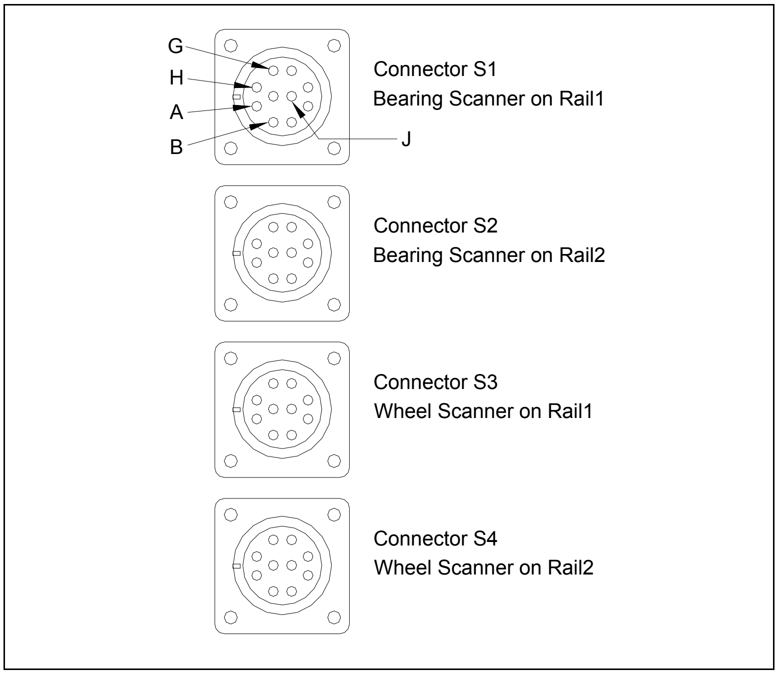
Fuse	Protects
F1	Heater for N/E bearing scanner.
F2	Heater for S/W bearing scanner.
F3	Heater for N/E wheel scanner.
F4	Heater for S/W wheel scanner.

There are four shutter fuses. All are 3AG glass-body 2-amp 250-volt fast-acting fuses. The table below describes what each fuse protects.

Fuse	Protects
F5	Shutter for N/E bearing scanner.
F6	Shutter for S/W bearing scanner.
F7	Shutter for N/E wheel scanner.
F8	Shutter for S/W wheel scanner.

4.7.4.6 Scanner Connectors

Mounted on the left side of the Scanner Interface board are four Amphenol connectors (97 series box receptacles). The top two, which are labeled S1 and S2, are for the bearing scanner cables. The bottom two, which are labeled S3 and S4, are for the wheel scanner cables.

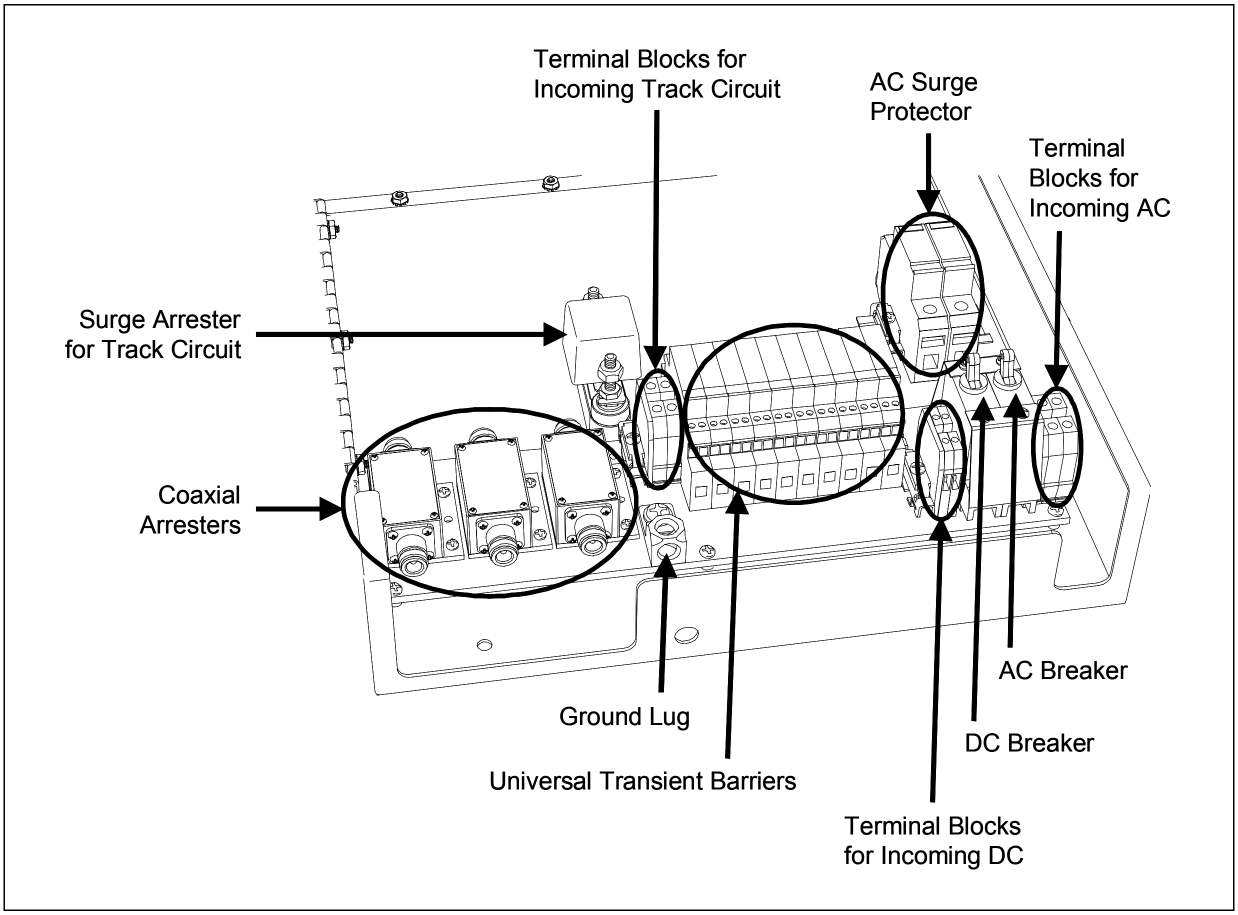


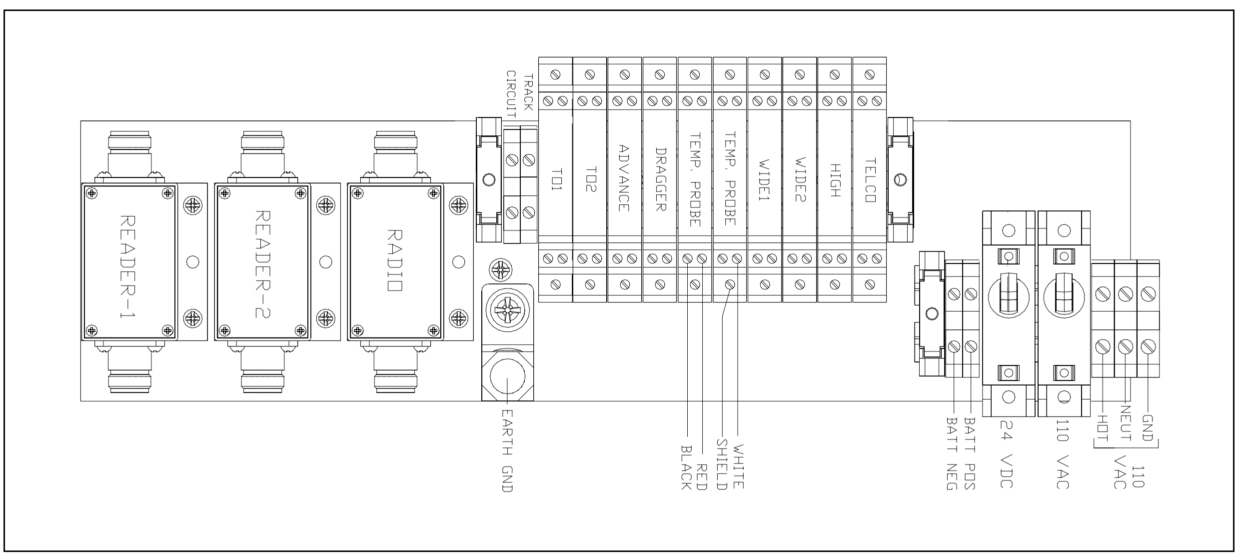
Connectors S1 through S4 on Scanner Interface board each have the same printout. The table below shows this pinout.

Pin A	Ground
Pin B	Shield
Pin C	120 VAC (line voltage) that activates the scanner heaters. Fused at 3 amps.
Pin D	Neutral for heaters.
Pin E	*Not Used*
Pin F	+24 VDC (battery voltage) that activates the scanner shutter.
Pin G	Ground return for shutter solenoid.
Pin H	Heat signal from the scanner.
Pin I	Ground return for heat signal from the scanner.
Pin J	Scanner pyrometer power. Regulated +12 VDC fused at 100-mA with a self-restoring fuse.

4.8 Surge Protection Subassembly

The figures below show the Surge Protection Subassembly, with some important components highlighted.





4.8.1 Ground Lug

In order for the Surge Protection Subassembly to function properly, the surge components must be properly grounded. To do this, a solderless copper lug has been provided as a termination point for an earth ground.

4.8.2 Coaxial Arresters

On the left side of the Surge Protection Subassembly are three Joslyn coaxial lightning arresters. At the factory, the top end of these arresters are wired to the radio and, if used, to the two 2200-504 Readers.

During installation, the customer attaches antenna cables to the bottom end of these arresters. For SmartScanIS to work properly, the northmost or eastmost AEI antenna, **antenna1**, must be connected to the arrester for reader1. The southmost or westmost AEI antenna, **antenna2**, must be connected to the arrester for reader2.

4.8.3 Surge Arrester for Track Circuit

Above the rightmost coaxial arrester is a three-terminal arrester, which is used to protect the system from voltage surges from the track circuit.

4.8.4 Terminal Blocks for Incoming Track Circuit

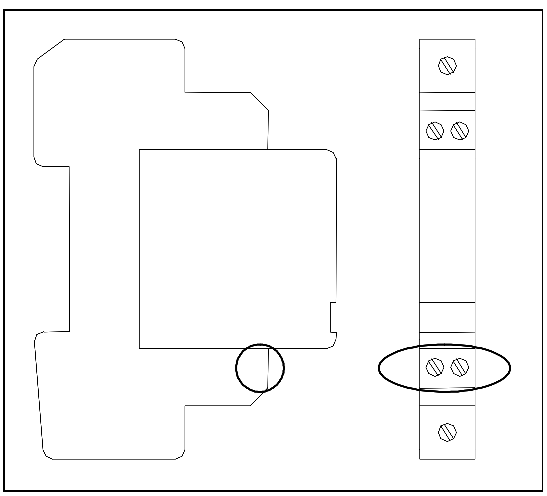
Two DIN mounted terminal blocks are provided for the termination of track circuit wiring. Polarity doesn't matter when connecting the wires from the track circuit.

4.8.5 Universal Transient Barriers

On the DIN rail are industrial grade surge suppressors (aka universal transient barriers or UTBs). They protect the system from voltage surges from the shielded temperature probe, telephone, transducers, and dragging-equipment detector. At sites with wide-load, high-load, or high-wide detectors, the system will also be protected from voltage surges from these devices.

The UTBs are capable of suppressing damaging electrical transients and surges, which can be induced onto signal lines by lightning. Here is a list of signals that pass through the UTBs on the DIN rail before entering the rest of the SmartScanIS enclosure.

- Gating transducer TO1
- Gating transducer TO2
- Advance transducer, if used
- Dragging-equipment detector
- Shielded temperature probe, which uses two UTBs
- High-load detector, if used
- Wide-load detector, if used
- High-Wide detector, if used
- Telephone line



Each UTB is mounted vertically on a DIN rail. Shown to the left are two views of the same UTB.

As you can see, there are two tiers of connectors (one above the other) on each side of the UTB. Starting from the top, the connectors on the first and fourth rows are lower than those on the second and third rows.

The equipment listed above is wired to the third row of connectors.

Also on the DIN rail, but not protected by UTBs, are connections for the track circuit. Before entering the rest of the SmartScanIS enclosure, the wiring from the track circuit is protected by a three-terminal arrester. Therefore, it doesn't need UTB protection.

4.8.6 AC Surge Protector

AC surge protection is provided by two DEHNguard Model P-150 Surge Suppressors. The Model P-150 consists of a base with a replaceable plug-in MOV module, contacts for remote monitoring, and a red fault indicating flag window.

Even in the event of suppressor failure, AC line voltage is still provided to the system. This reduces the possibility of a total system shutdown. However, after a suppressor failure, you no longer have surge protection. When running firmware version 5.01 or later, the integrity of the Model P-150 is monitored by the system. Should the protection become compromised, the end-user is alerted via the System Status report and the Union Pacific's Polling System.

4.8.7 AC and DC Breakers

The AC and DC breakers provide overload and short-circuit protection for the SmartScanIS. The AC breaker protects the AC power input to the electronics enclosure. The DC breaker protects the 24 VDC (battery) connection. These circuit breakers also provide a convenient means to turn off power to the system. Both the AC breaker and the DC breaker must be toggled off to power down the SmartScanIS.

4.8.8 Terminal Blocks for Incoming AC

To the right of the AC breaker, three DIN mounted terminal blocks are provided as a termination point for incoming AC service. At the factory, a power cord is attached to these terminal blocks.

4.8.9 Terminal Blocks for Incoming DC

To the left of the DC breaker, two DIN mounted terminal blocks are provided as a termination point for the 24 VDC battery backup.

4.9 2300-357 Efficiency Test Panel

Not all SmartScanIS sites use the 2300-357 Efficiency Test panel, which is used to monitor train crew performance during a hotbox or dragging-equipment stop.

The Efficiency Test panel contains:

- Panel cover
- LED
- Side-selection switch
- Detector-selection switch
- Car-selection thumbwheels
- Radio test switch

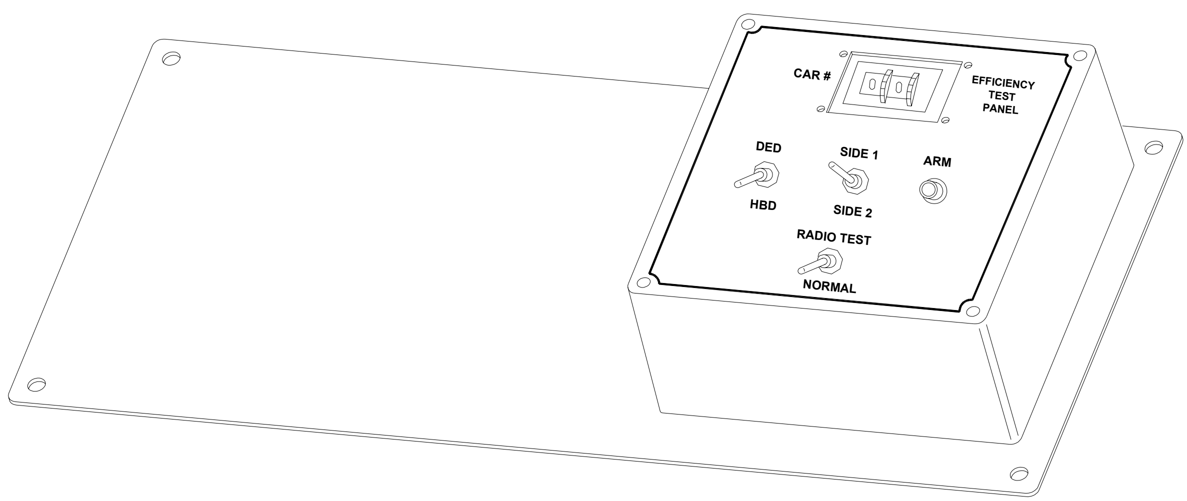
When armed, the panel causes the system to generate an alarm on the next train and at the car number specified by the panel.

CAUTION

Unless authorized to do so, do not arm this panel. Doing so will stop a train.

On the outside of the SmartScanIS enclosure, mounting studs are provided for the 2300-357 Efficiency Test panel. At the top edge of the enclosure, the 2300-357 Efficiency Test panel is secured with four Keps-nuts. A serial cable connects the test panel to the System Interface board. If your SmartScanIS enclosure was shipped in a bungalow, you'll need to install the test panel. If it was shipped in a crate instead, the test panel was already installed.

The figure below shows an assembled 2300-357 Efficiency Test panel.



4.9.1 Radio-Test Switch

On the front of the Efficiency Test panel is a two-position switch. With this switch, you can disable the PTT line to the radio. The up position is "Test," which prevents the radio from transmitting. The down position is "Normal" for normal operation.

4.9.2 LED

On the front of the Efficiency Test panel is a red LED labeled **ARM**. This LED is lit when the panel is armed.

4.9.3 Detector-Selection Switch

On the front of the Efficiency Test panel is a two-position switch. With this switch, you select either a Dragging-Equipment alarm or an absolute Hotbox alarm.

4.9.4 Side-Selection Switch

On the front of the Efficiency Test panel is a three-position switch. With this switch, you arm the panel and, in the case of a hotbox, you select the side on which the alarm occurs.

4.9.5 Car-Selection Thumbwheels

On the front of the Efficiency Test panel are two thumbwheels. With these wheels, you select the number of the car on which an alarm is to be generated.

For disarming the panel, select 00. For arming the panel, select a number from 01 through 99. ***Chapter 14 – Using the Efficiency Test Panel*** tells how to arm and disarm the panel.

Chapter 5
Preparation

The preparation phase starts with selecting the site. It ends with identifying the installation tools. Care taken during this phase can result in reduced maintenance and improved performance of the SmartScanIS.

This chapter covers what needs to be done before trackside hardware is installed. Contained herein is time-tested advice that is well worth following. Also covered is how to install the antenna masts, bungalow, and PVC pipes.

5.1 Selecting a Site

Locate the site:

- On level, well-drained ground (avoid low areas where flooding may occur)
- In an area that doesn't normally require heavy braking by passing trains
- At least 300 feet (91.4 meters) from the nearest road crossing
- Away from a track joint, a track switch, and a side track
- By a track that is on gauge (avoid placing track hardware in curves)
- By a roadbed that is tamped, stable, and well maintained
- Where trains usually travel more than 10 mph (16 kph)

5.2 Preparing the Site

To ready the scanner location:

1 Select a location to install the bearing scanners.

2 Inspect the ties and tie plates in the area where the scanners are to be installed.

3 If the ties or tie plates aren't in good condition, fix this problem before proceeding.

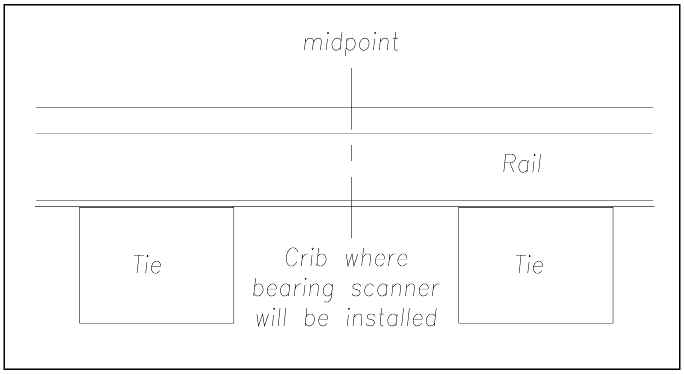
4 If the ties aren't well tamped, fix this problem before proceeding.

5 Measure the distance between the ties.

The scanners should be centered in the crib of two ties spaced at least 14 inches (35.6 centimeters) apart.

6 If the ties aren't spaced at least 14 inches (35.6 centimeters) apart, fix this problem before proceeding.

7 Mark the rail at the midpoint between the ties.



This midpoint mark is used later to locate where the holes for the mast bases are dug.

8 If your installation has wheel scanners:

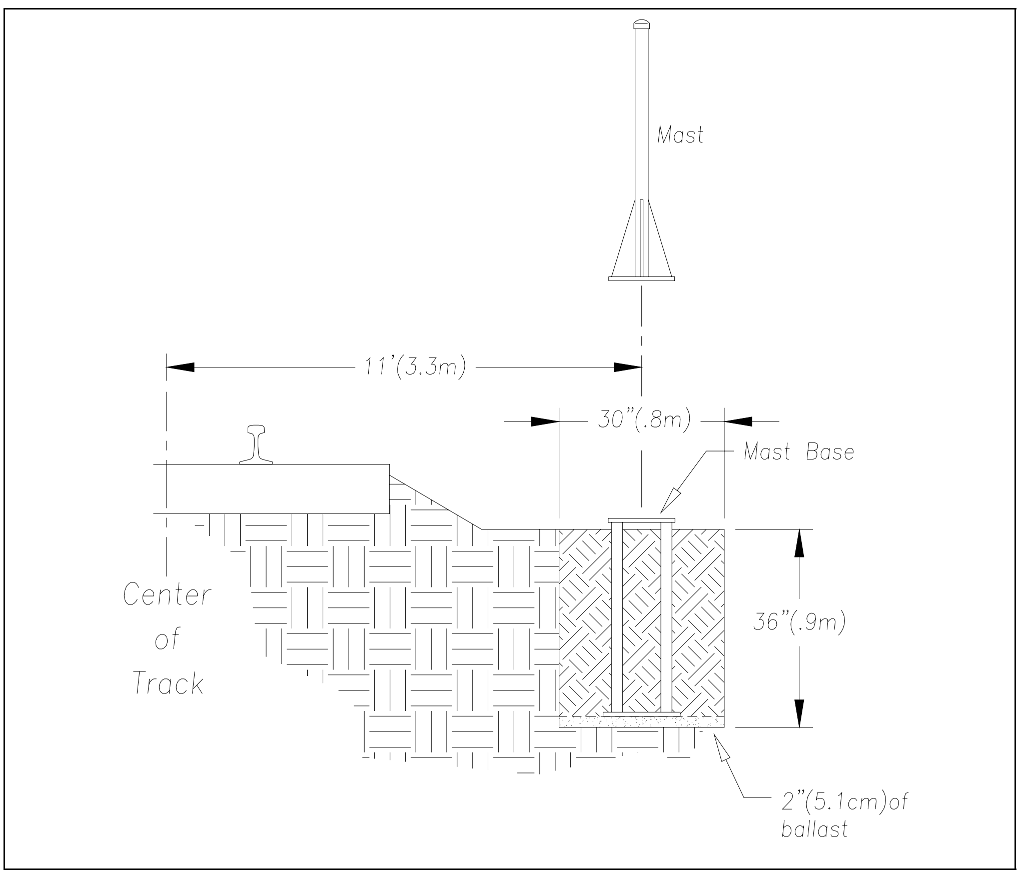
   a Select a location to install them.

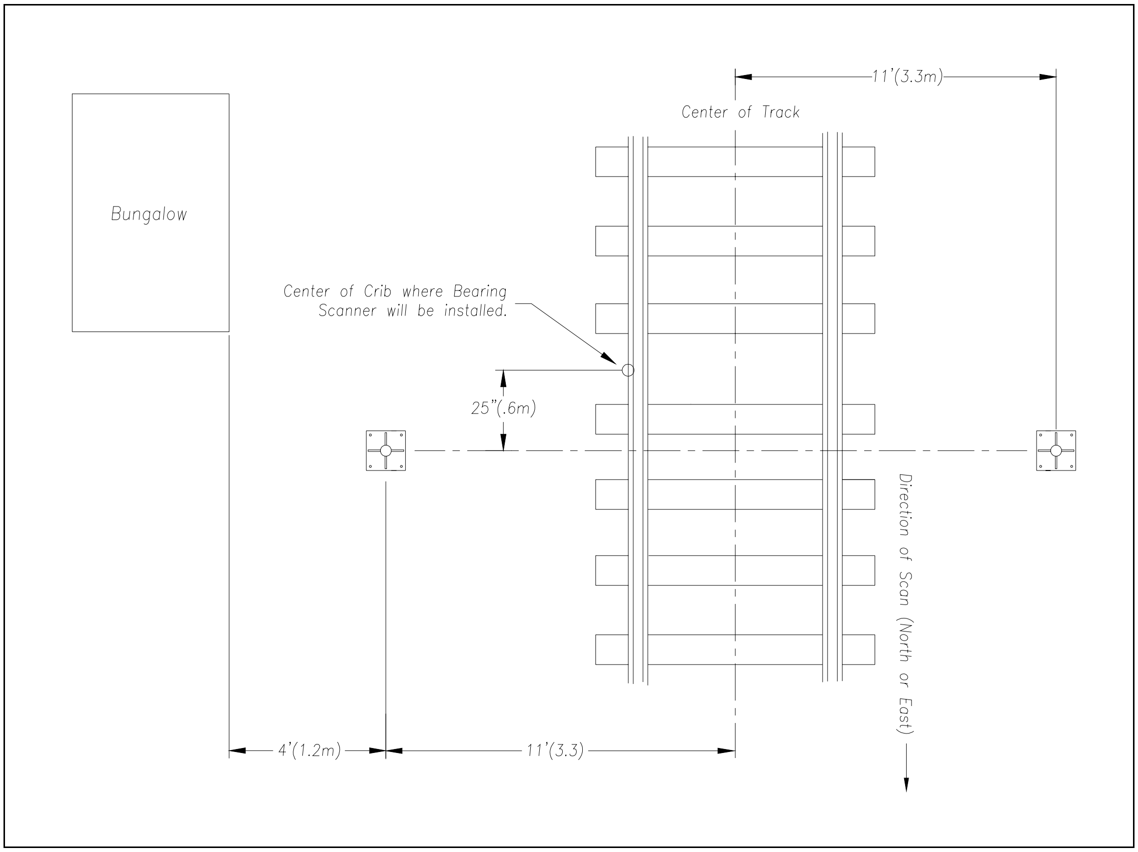
   The wheel scanners should be centered in the crib of the two ties immediately ahead (and to the north or east) of the bearing scanners.

   b Repeat steps **2** through **6**.

To ready the two antenna masts:

1 Using the dimensions below, dig two holes and add ballast.





2 Lower one metal mast base into each hole, rotating it until one edge of the base is parallel to the track.

Install each base so that it's plumb and so that its center is 11 feet (3.3 meters) from the center of the track and 25 inches (0.6 meters) from the center of the crib in which the bearing scanner will be installed. Both bases will be north or east of the crib.

3 With the supplied hardware, attach one mast to each base.

4 Plumb each mast.

5 Ground each mast.

When done, each mast should be level, grounded, attached to a base, and placed directly opposite the other mast.

To ready the bungalow:

1 Place the bungalow on level, well-drained ground.

Face the door side of the bungalow toward the tracks. This side of the bungalow should be parallel to the track and 15 feet (4.6 meters) from the center of the track.

2 Level the bungalow.

3 On the side of the bungalow, drive at least one 8-foot (2.4-meter) or longer ground rod into the ground.

Ground connectors, with attached copper wire, are welded to the underside of most bungalows.

4 Attach one end of the copper wire that is attached to the bungalow to the rod.

Telephone service is needed for the user to access the system remotely. Telephone service is not needed to send information through the polling system

5 If your site is not going to have telephone service, go to step **8**.

6 Supply the site with normal telephone service.

7 Complying with all applicable codes and inspections, bring the telephone line into the bungalow and leave it coiled on the floor.

8 Supply the site with a stable AC power source of at least 110 volts at 20 amperes.

The incoming AC voltage is internally converted to the 24 VDC and 12 VDC supplies required by the SmartScanIS. Two 115 AH batteries provide backup power for system.

9 Complying with all applicable codes and inspections, bring the outside power line to the circuit-breaker box inside the bungalow.

10 Toggle off all breakers in the circuit-breaker box.

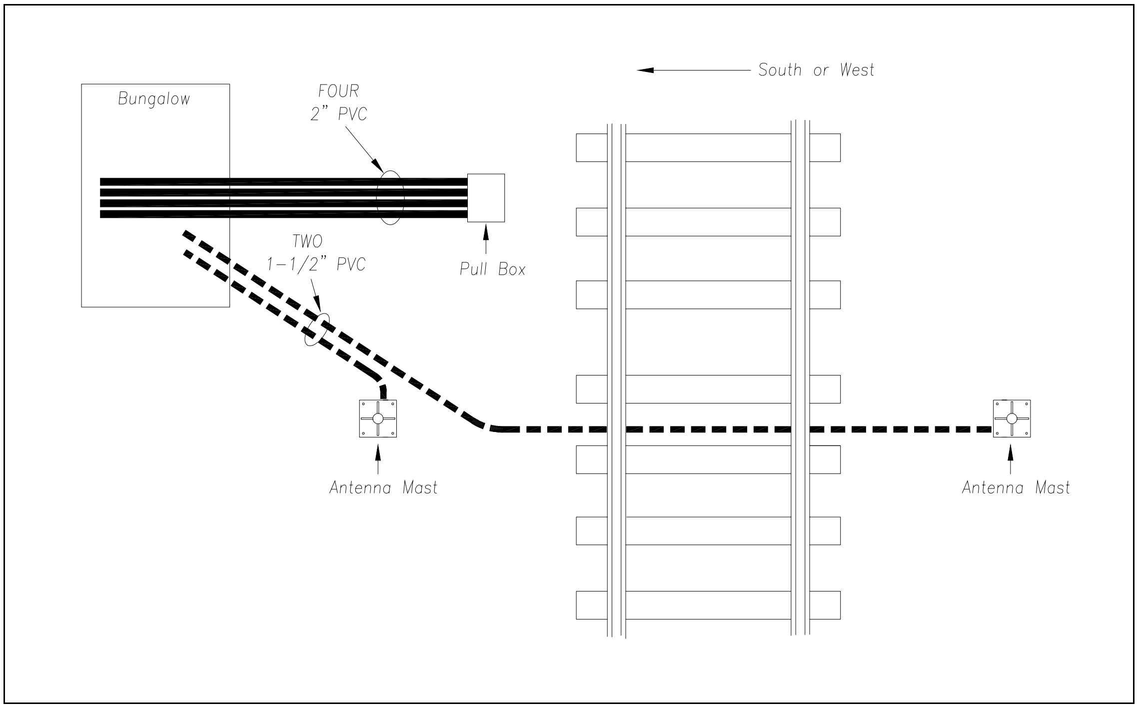
11 Complying with all applicable codes and inspections, wire the power line to the circuit-breaker box.

Some railroads wire the power line to a surge protector and then to the circuit-breaker box.

12 If not done already, wire from the circuit-breaker box to a grounded outlet.

To ready the pull box and PVC pipes:

1 Using the figure below and following your company's standards, dig trenches for the pull box and the PVC pipes.



2 Install the pull box.

3 Lay four 2-inch PVC pipes from the pull box to the bungalow.

Later, these four pipes will contain cables from the scanners and transducers to the bungalow.

4 Lay two 1-1/2-inch PVC pipes from the mast bases to the bungalow.

Later, these two pipes will contain cables from the AEI antennas to the bungalow.

5.3 Receiving Your System

All the dragging-equipment detectors that a site needs are shipped on one pallet. All the components that make up one or more systems are shipped either in a crate or in a bungalow, if one was ordered. The contents of this crate or bungalow are specific to the site and are detailed on the packing list.

When the packages arrive at the site, check them immediately for exterior damage. If there is any, notify STC.

5.4 Returning Damaged or Defective Hardware

Return any damaged or defective hardware to STC for repair or replacement. You don't need a return authorization number. You don't need to call first. Just ship it directly to:

Southern Technologies Corporation
Returns Department
6145 Preservation Drive
Chattanooga, Tennessee 37416-3638
USA

With the returned hardware, include:

- Complete address of where the hardware is to be returned.
- Name and telephone number of the person who should be contacted to answer questions about the hardware.
- Written explanation of the hardware damage or defect.

5.5 Getting Help with the Installation

If a part is missing or if you have any problems installing a part, call STC's engineering staff. You can reach them at 423-892-3029, Monday through Friday, from 8:00 a.m. until 5:00 p.m. Eastern time. After business hours, calls are answered by machine. These calls are returned promptly the next business day.

When calling, state that you are calling about a SmartScanIS. Your call will then be directed to the right person.

Though slower and more cumbersome, solving your problems by email is also possible.

5.6 Identifying the Installation Tools

Besides the tools needed to install signal cases, underground cables, and power services, you need these to install your SmartScanIS.

- Laptop computer
- Track drill with 3/8-inch bit
- 1/2-inch drive ratchet with 9/16-inch deep well socket
- 3/4-inch drive ratchet with 1-7/16-inch socket
- 9/16-inch torque wrench
- 1/2-inch nutdriver
- Medium size adjustable box wrench (aka crescent wrench)
- Carpenters level
- #2 Phillips head screwdriver
- Small slotted screwdriver (aka flathead screwdriver)
- 3/8-inch transfer punch or center punch
- 50-foot (15-meter) or longer tape measure
- Multimeter, reading at least 110-120 VAC, 0-50 VDC, and 0-1 megohm

In the box containing the bearing scanners are these tools.

- Short-handle 1-1/2-inch open-end wrench, which is used to install the scanner mounts
- T-handle 3/16-inch hex-wrench, which is used to install the flex-conduit-adapter plates on the scanner mounts
- T-handle 1/4-inch hex-wrench, which is used to install the scanners on the scanner mounts
- Two combination 9/16-inch open-end box wrenches, which are used to install the transducers and align the scanners

When you finish using the supplied tools, store them in the bungalow, if possible. They are also used to maintain the system.

Chapter 6
Installing the Track Components

For purposes of this guide, track components are scanners, transducers, track circuits, auxiliary-alarm detectors, and AEI antennas. This chapter tells how to install scanners, transducers, track circuits, and AEI antennas. The installation of dragging-equipment detectors and other auxiliary-alarm detectors isn't covered in this guide.

All SmartScanIS sites have two bearing scanners per track. Most tracks also have two wheel scanners. All tracks have two gating transducers. Gating transducers are used to control scan timing and car recognition. All tracks have either two advance transducers or one track circuit. Advance transducers and track circuits are used to indicate train presence.

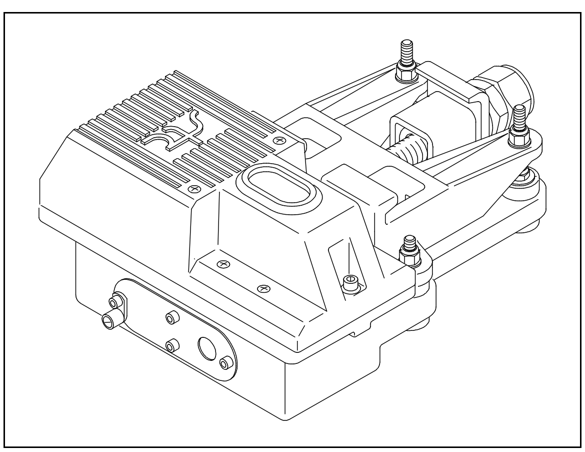
Track components are installed in this order.

- Bearing scanners and their cables
- Transducers and their cables
- When used, wheel scanners and their cables
- When used, the track circuit and its wires
- When used, AEI antennas and their cables
- When used, auxiliary-alarm detectors and their cables

The instructions that follow **only work in the northern hemisphere**. If your site is south of the equator, skip the instructions in this chapter and call STC for help.

6.1 Bearing Scanners

An assembled bearing scanner looks like:



To install the bearing scanners:

1 Be sure that you have on hand two bearing scanner covers, modules, and mounts.

2 Be sure that you have on hand a short-handle 1-1/2-inch open-end wrench, a T-handle 3/16-inch hex-wrench, a T-handle 1/4-inch hex-wrench, a #2 Phillips head screwdriver, and a 50-foot (15-meter) or longer tape measure.

3 Select a location to install the bearing scanners.

The bearing scanners should be centered in the crib of two ties spaced at least 14 inches (35.6 centimeters) apart.

4 Under <u>both</u> rails between the ties, remove the ballast to a depth of 4 inches (10.1 centimeters).

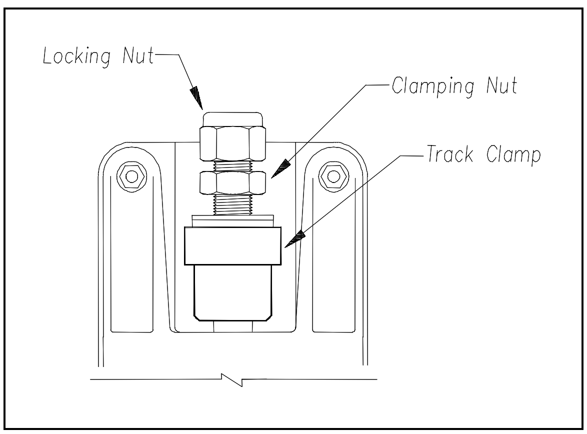
You'll next install the first bearing scanner.

5 Using a T-handle 1/4-inch hex-wrench, loosen the two socket-head-cap screws on the cover of a not-yet-installed bearing scanner.

6 Separate the scanner cover, which contains an attached scanner module, from its mount.

7 Store the cover-and-module combination in a safe place until you replace it.

In the steps that follow, the terms track clamp, clamping nut, and locking nut are used. Notice where they are on the mount.



8 Centered between the ties and on the rail <u>closest</u> to the bungalow, place the mount so that the moveable track clamp extends under the rail and toward the center of the track.

9 Tighten the inner nut (that is, the clamping nut) by hand.

This should hold the mount in place.

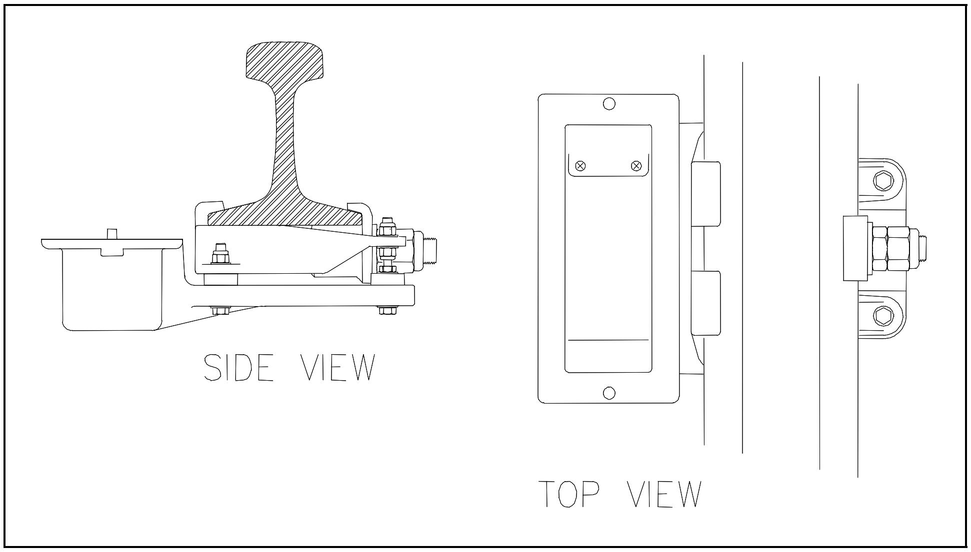
10 Using a short-handle 1-1/2-inch wrench, tighten the clamping nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters)**.

Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.

11 Using a short-handle 1-1/2-inch wrench, tighten the locking nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters)**.

Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.

At this point, your work should look like this.

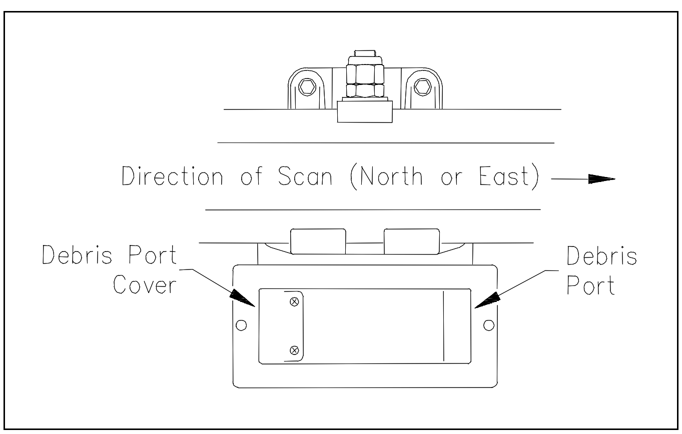


The next step is necessary to finish installing the bearing scanner mounts, to install the bearing scanners themselves, and to install the transducers.

12 Determine the direction of scan.

If the track runs north and south, both the oval hole in the top of the scanner and the rectangular hole in the bottom of the mount should be pointed north. If the track runs east and west, both holes should be pointed east. The goal of proper scanner orientation is to reduce the possibility of the scanners looking directly into the sun during scanning operations.

13 Examine the top of the mount.



In the bottom of the mount are two rectangular holes called debris ports. One port is covered. One isn't. Do the next step only if the <u>uncovered</u> debris port is at the southmost or westmost end of the mount.

14 If the debris port cover isn't as shown above, follow these steps.

a Using a #2 Phillips head screwdriver, remove the two screws holding the debris port cover.

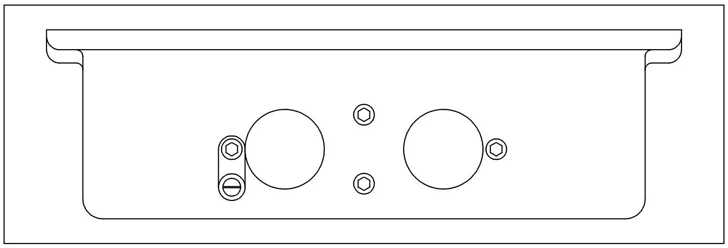
b Store the screws in a safe place until you replace them.

c With gentle pushing from underneath, remove the debris port cover.

d Place the debris port cover over the debris port on the other end of the mount.

e Using a #2 Phillips head screwdriver, replace the two screws through the debris port cover.

15 Examine the side of the mount farthest from the track.

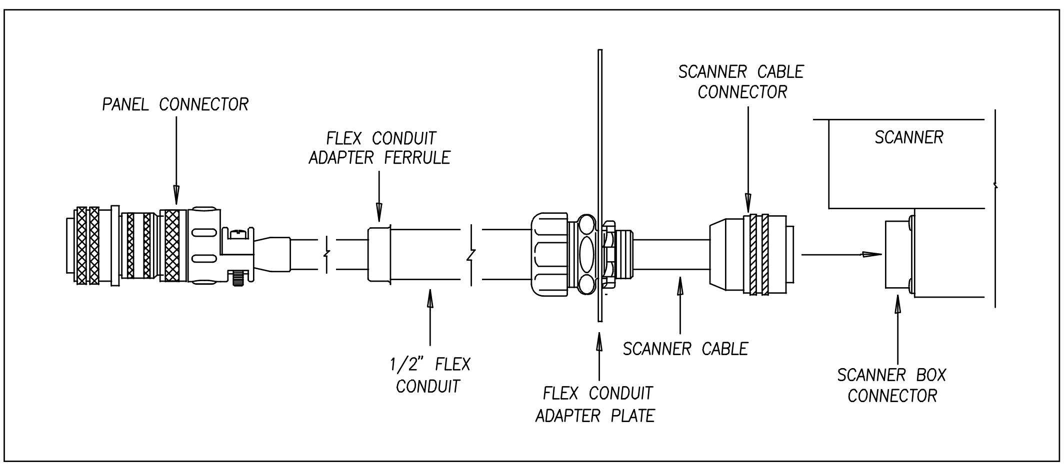


On the side of the mount are two large holes and four socket-head-cap screws. The longest screw is holding a ground lug and an internal-tooth washer.

16 Using a T-handle 3/16-inch hex-wrench, remove the four screws.

17 Store the screws, washer, and lug in a safe place until you replace them.

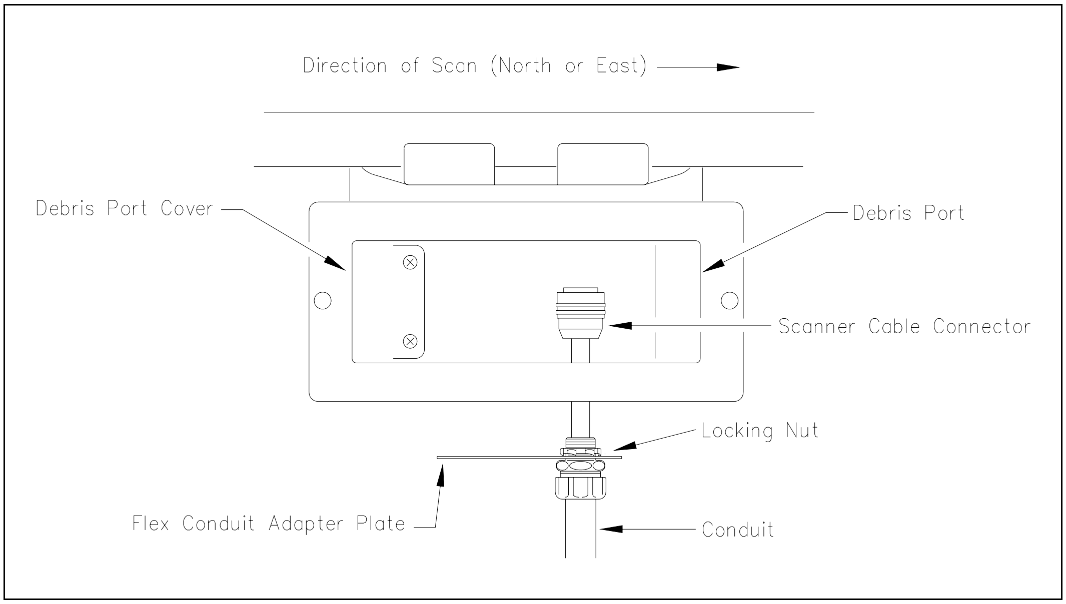
In the steps that follow, the terms scanner cable connector, panel connector, and flex-conduit-adapter plate are used. Notice where they are on a bearing scanner cable.



Single-track sites have two 65-foot (19.8-meter) bearing scanner cables. Double-track sites have two 65-foot bearing scanner cables for the track closest to the bungalow. For the track farthest from the bungalow, they have either two 85-foot (25.9-meter) or two 100-foot (30.5-meter) bearing scanner cables.

18 If this is a double-track site, select the correct length of cable.

19 Tighten the locking nut (on the conduit connector) until it is tight against the flex-conduit-adapter plate.



20 Put the scanner cable connector through the northmost or eastmost round hole in the side of the mount.

21 Align the screw holes in the flex-conduit-adapter plate with the screw holes in the mount.

22 Replace the two center screws and tighten by hand.

This should hold the flex-conduit-adapter plate in place.

23 Leave 6 inches (15.2 centimeters) of the bearing scanner cable in the mount.

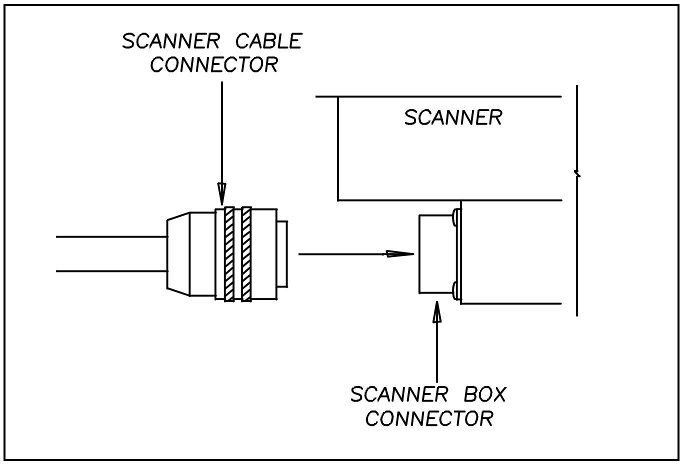
24 In the screw hole closest to the cable, replace the screw and tighten by hand.

25 In the screw hole farthest from the cable, replace the ground lug, internal-tooth washer, and screw.

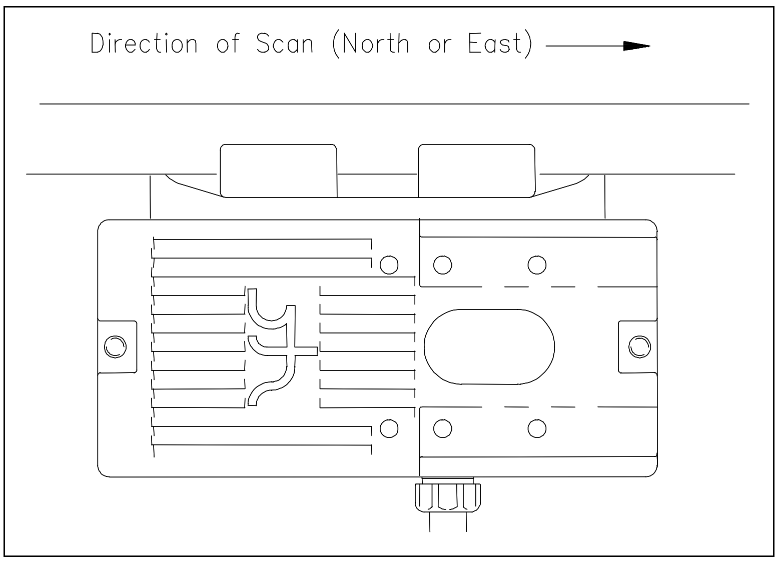
26 Tighten by hand.

27 Using a T-handle 3/16-inch hex-wrench, tighten the four screws until they are completely tight.

28 Attach the scanner cable connector to the scanner box connector.



29 With the hole (on top of the scanner cover) facing north or east, replace the cover-and-module combination.



30 Using a T-handle 1/4-inch hex-wrench, tighten the two screws (on the scanner cover) until they are completely tight.

31 If this is a single-track site, label the end of the cable that isn't attached to the bearing scanner **RAIL1** or **RAIL2**, whichever is appropriate.

If the track runs north and south, RAIL1 is the east rail. If the track runs east and west, RAIL1 is the north rail.

32 If this is a double-track site, label the end of the cable that isn't attached to the bearing scanner **RAIL1-TRACK1**, **RAIL2-TRACK1**, **RAIL1-TRACK2**, or **RAIL2-TRACK2**, whichever is appropriate.

33 Extend the cable into the bungalow and leave it coiled on the floor.

34 Attach one end of an 8 AWG stranded copper wire to the ground lug on the flex-conduit-adapter plate and the other end to the ground connector on the ground rod.

The ground rod was driven into the ground beside the bungalow.

You'll next install the second bearing scanner on the opposite rail.

35 Using a T-handle 1/4-inch hex-wrench, loosen the two screws on the cover of the remaining not-yet-installed bearing scanner.

36 Separate the scanner cover, which contains an attached scanner module, from its mount.

37 Store the cover-and-module combination in a safe place until you replace it.

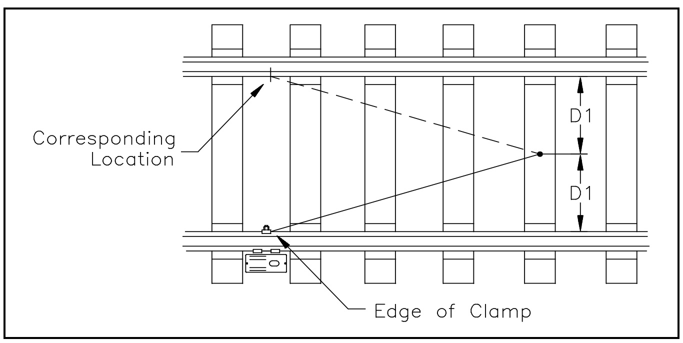
When installing the second bearing mount on the opposite rail, make sure that the two bearing mounts are squared with each other and directly opposite each other. The next step tells how to do this.

38 To locate the second mount on the opposite rail:

a Mark the center of the fourth tie ahead of the just installed mount.

b From this mark, measure to the edge of the track clamp on the just installed mount.

c From the mark, measure the same distance on the opposite rail.



d Mark this location on the rail.

This mark will correspond to the edge of the track clamp on the opposite mount.

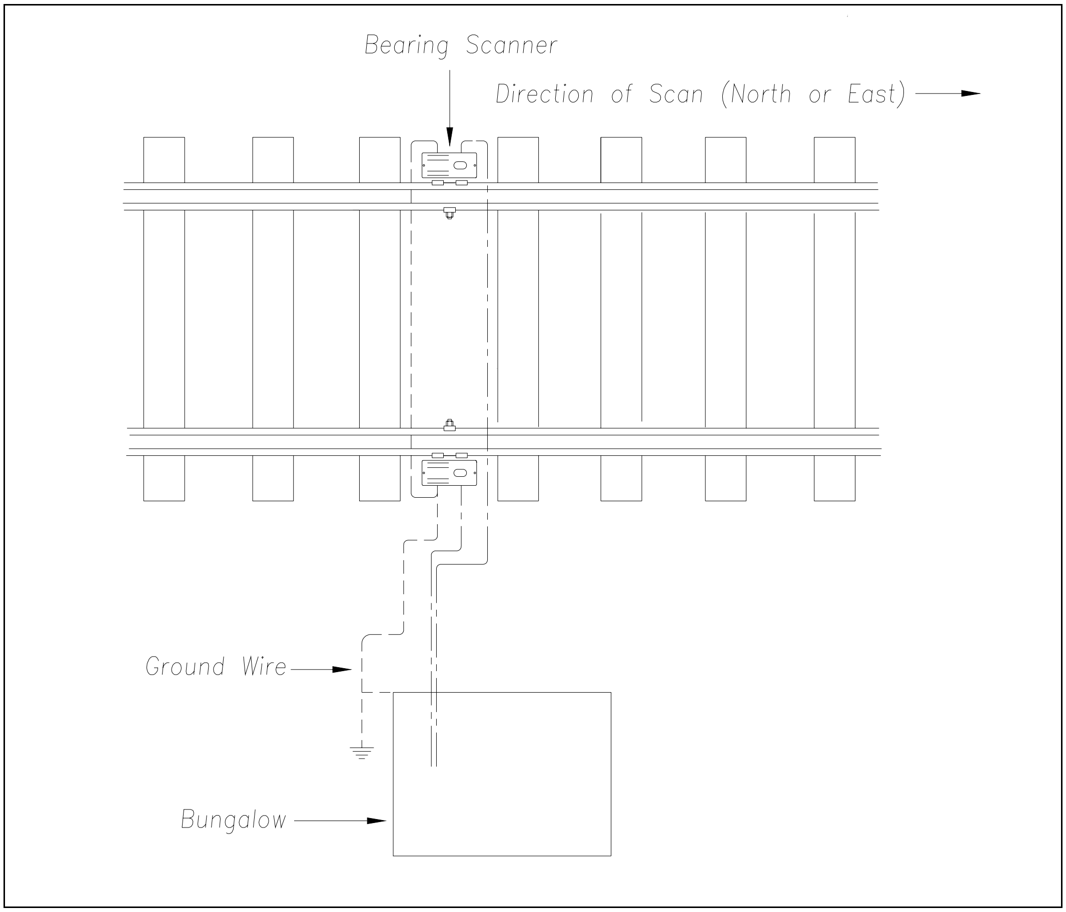
Use a permanent marker, magic marker, lumber crayon, or paint pen to mark the rail. Don't use a file or punch to mark the rail.

39 With the mark as a guide, place the second mount so that the moveable track clamp extends under the rail and toward the center of the track.

40 Repeat steps **9** through **33**.

41 Attach one end of a 6 AWG stranded copper wire to the ground lug on the flex-conduit-adapter plate and the other end to the ground lug on the other scanner mount.

Seen from above, your site would look something like this.



42 If this is a single-track site, go to ***6.2 Transducers***.

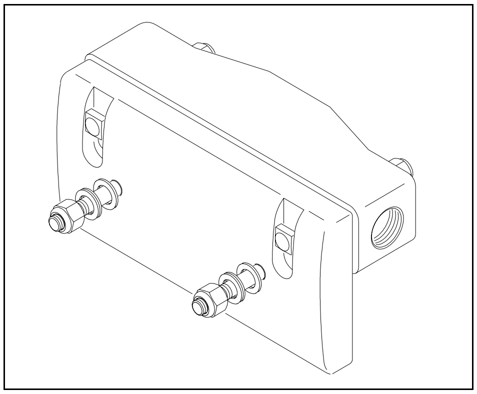
43 If this is a double-track site:

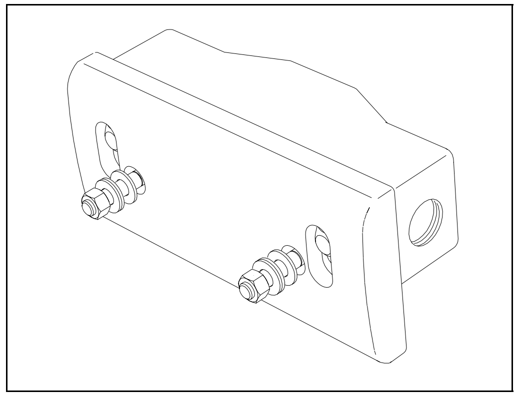
a Repeat steps **1** through **41** on the second track.

b Go to ***6.2 Transducers***.

6.2 Transducers

An assembled STC magnetic transducer looks like one of these.

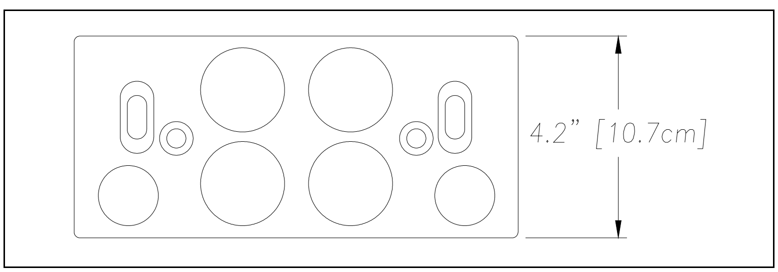




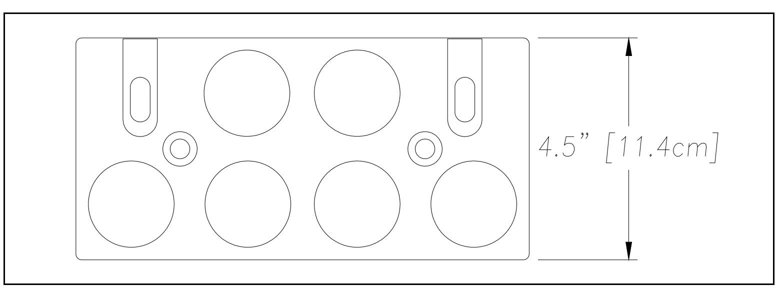
If your site uses transducers that don't look like either of the above, skip the instructions below and call STC for help. If your rail size isn't 115, 122, 127, 132, 136, or 141 pounds per yard (57.05, 60.52, 63.00, 65.48, 67.46, or 69.94 kilograms per meter), skip the instructions below and call STC for help.

One of two mounting plates is packaged with each transducer. The smaller one, which is labeled **112LB-130LB**, is used with lighter rails. The larger one, which is labeled **131LB-141LB**, is used with heavier rails.

If your rail size is 112 to 130 pounds per yard (55.6 to 64.5 kilograms per meter), use the mounting plate that looks like this. If you need this plate and it wasn't sent with your transducers, request it from STC.



If your rail size is 131 to 141 pounds per yard (65.0 to 69.9 kilograms per meter), use the mounting plate that looks like this. If you need this plate and it wasn't sent with your transducers, request it from STC.



To install the transducers with their correct mounting plate:

1 Be sure that you have on hand all the parts for two gating transducers and, if used, all the parts for two advance transducers.

2 Be sure that you have on hand a center punch, a track drill, a 3/8-inch bit, a 9/16-inch torque wrench, a 50-foot (15-meter) or longer tape measure, and an alignment fixture.

3 Determine the size of the rail at your site.

Supported sizes are 115, 122, 127, 132, 136, or 141 pounds per yard (57.05, 60.52, 63.00, 65.48, 67.46, or 69.94 kilograms per meter).

On the rail nearest to the bungalow, you'll next install the gating transducer nearest to the bearing scanner. This transducer is TO1.

4 Using the table below, note the distance for your rail size.

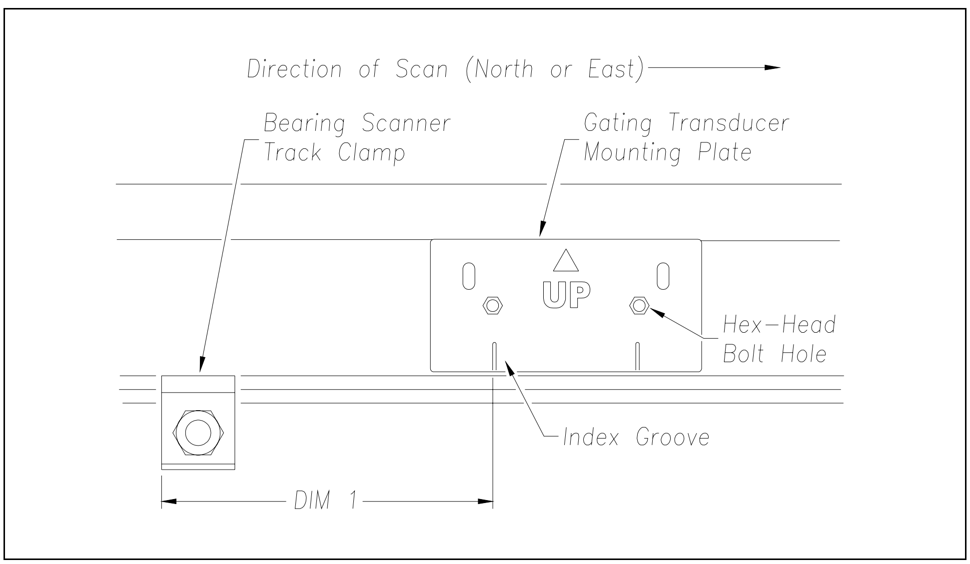
Rail Size pounds/yard	Rail Size kilograms/meter	Distance (DIM1)
115	57.05	10-13/16 inches (27.46 centimeters)
122	60.52	10-31/32 inches (27.86 centimeters)
127	63.00	11-3/16 inches (28.42 centimeters)
132	65.48	11-5/16 inches (28.73 centimeters)
136	67.46	11-3/8 inches (28.89 centimeters)
141	69.94	11-5/8 inches (29.53 centimeters)

For example, if your rail size is 132 pounds per yard (65.48 kilograms per meter), the distance is 11-5/16 inches (28.73 centimeters). This distance is DIM1.

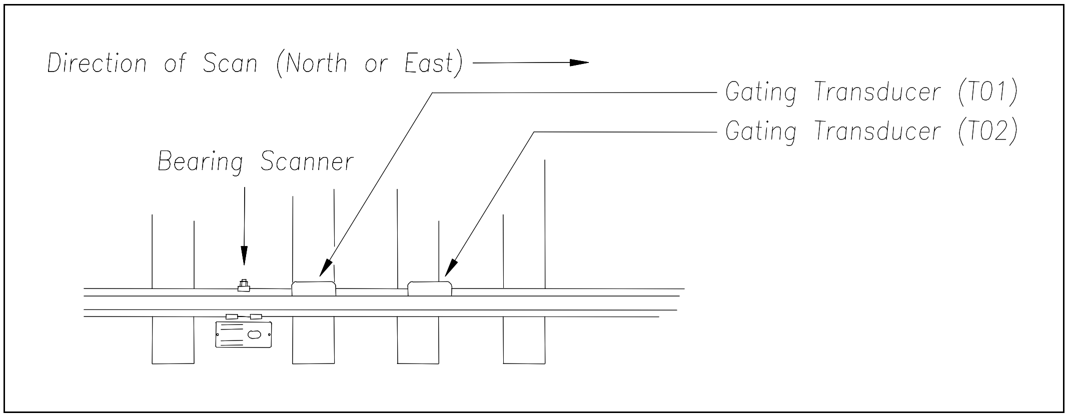
5 Separate the nylon transducer body from the aluminum mounting plate.

6 With the arrow on the plate pointing up, place the mounting plate against the gauge side of the rail.

7 Going north or east from the far edge of the track clamp on the bearing scanner to the closest index groove on the mounting plate, measure the distance obtained in step **4**.



Note that the hole (on top of the bearing scanner cover) faces north or east. Note further that the gating transducers are mounted on the same side as where the bearing scanner is "looking."



8 Hold the mounting plate against the rail and as high against the crown as possible.

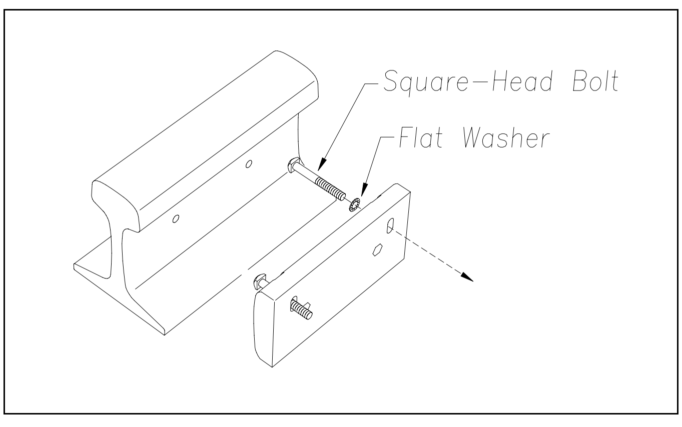
9 Using a center punch and the hex-head bolt holes as your guide, mark the two places on the rail where you'll later drill holes.

10 Remove the mounting plate.

11 Using a 3/8-inch bit, drill the two holes.

12 Place one flat washer on each square-head bolt.

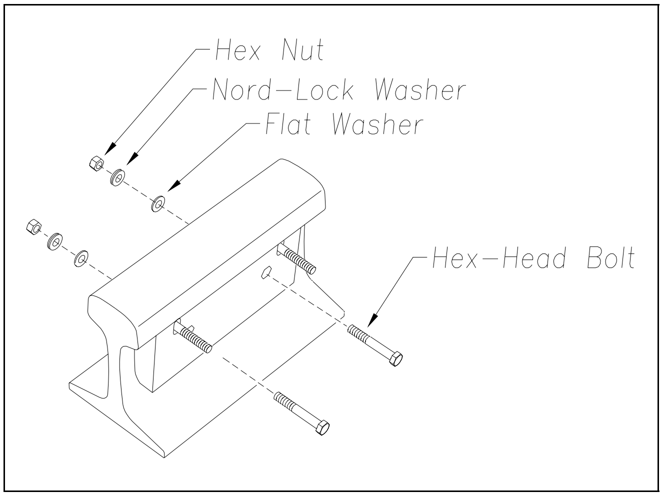
13 Insert the two square-head bolts with flat washers into the slotted holes of the mounting plate.



14 With the arrow on the plate pointing up and the heads of the bolts against the gauge side of the rail, align the hex-head bolt holes in the plate with the drilled holes in the rail.

15 Insert the two hex-head bolts through the aligned holes.

16 Loosely place the flat washers, Nord-Lock washers, and hex nuts onto the hex-head bolts.

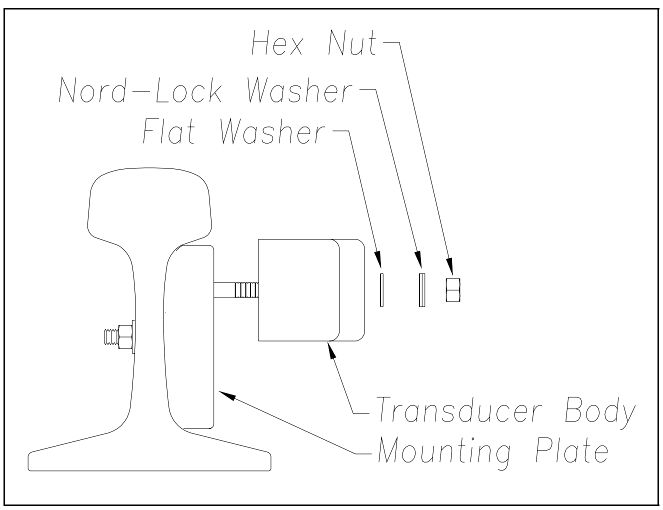


17 Tighten each hex nut with a 9/16-inch torque wrench to a **torque of 10 to 12 foot-pounds (13.6 to 16.3 newton-meters)**.

Don't exceed a torque of 12 foot-pounds (16.3 newton-meters). Doing so can weaken or break a bolt, requiring the bolt to be replaced.

18 With the transducer body's magnetic side up (that is, with the arrow on the transducer body pointing up), slide it onto the square-head bolts.

19 Loosely place the flat washers, Nord-Lock washers, and hex nuts onto the square-head bolts.

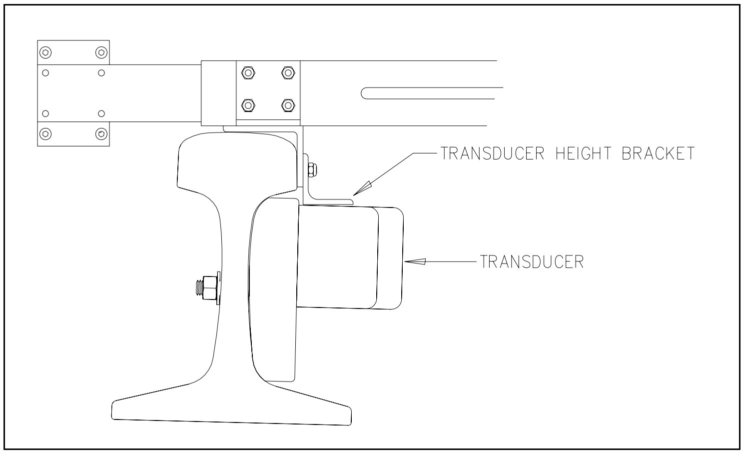


The installed transducer body should be 1-9/16 inches (3.97 centimeters) below the top of the rail <u>and</u> parallel to it. You can meet this requirement by using the transducer height bracket on the bottom of the alignment fixture.

20 Place the alignment fixture across both rails, centered over the transducer.

The fixture should be snug against the top and gauge of both rails.

21 Move the transducer body to where it just touches the height bracket.



22 Tighten each hex nut with a 9/16-inch torque wrench to a **torque of 8 to 10 foot-pounds (10.8 to 13.6 newton-meters)**.

Don't exceed a torque of 10 foot-pounds (13.6 newton-meters). Doing so can weaken or break a bolt, requiring the bolt to be replaced.

The transducer body is now attached to the mounting plate.

23 If this is a single-track site, label the two-wire end of the cable **TO1**.

24 If this is a double-track site, label the two-wire end of the cable **TO1-TRACK1** or **TO1-TRACK2**, whichever is appropriate.

25 Extend the cable into the bungalow and leave it coiled on the floor.

You'll next install the gating transducer farthest from the bearing scanner. This transducer is TO2.

26 Using another transducer, separate the body from the mounting plate.

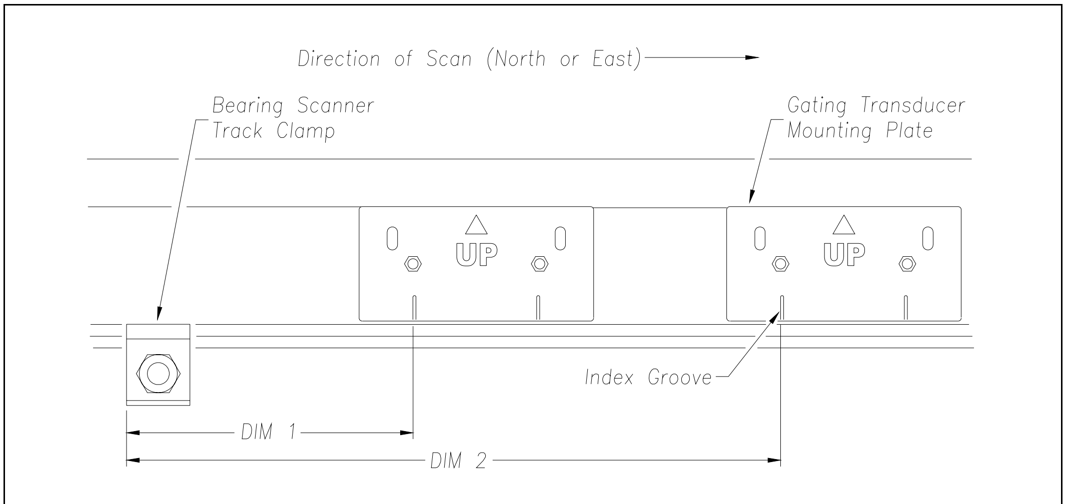
27 Using the table below, note the distance for your rail size.

Rail Size pounds/yard	Rail Size kilograms/meter	Distance (DIM2)
115	57.05	34-13/16 inches (88.42 centimeters)
122	60.52	34-31/32 inches (88.80 centimeters)
127	63.00	35-3/16 inches (89.38 centimeters)
132	65.48	35-5/16 inches (89.69 centimeters)
136	67.46	35-3/8 inches (89.85 centimeters)
141	69.94	35-5/8 inches (90.49 centimeters)

For example, if your rail size is 132 pounds per yard (65.48 kilograms per meter), the distance is 35-5/16 inches (89.69 centimeters). This distance is DIM2.

28 With the arrow on the plate pointing up, place the mounting plate against the gauge side of the rail.

29 Going north or east from the far edge of the track clamp on the bearing scanner to the closest index groove on the mounting plate, measure the distance obtained in step **27**.



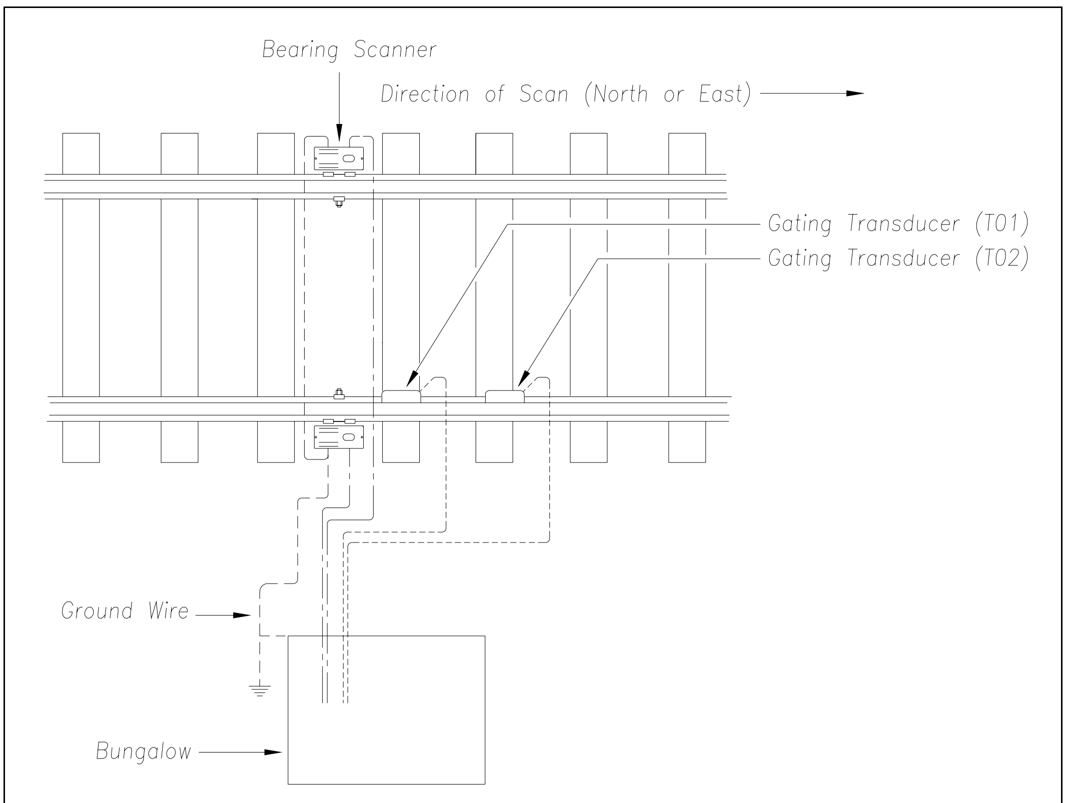
30 Repeat steps **8** through **22**.

31 If this is a single-track site, label the two-wire end of the cable **TO2**.

32 If this is a double-track site, label the two-wire end of the cable **TO2-TRACK1** or **TO2-TRACK2**, whichever is appropriate.

33 Extend the cable into the bungalow and leave it coiled on the floor.

Seen from above, your site would look something like this.



34 If this is a single-track site, go to step **36**.

35 If this is a double-track site, repeat steps **1** through **33** on the second track.

36 If you are going to install a track circuit instead of advance transducers:

- **a** If your site has wheel scanners, go to ***6.3 Wheel Scanners***.
- **b** Go to ***6.4 Track Circuit***.

Do the remaining steps only if your site uses **advance transducers** instead of a track circuit. When used, the two advance transducers are located about 32 feet (9.75 meters) on either side of the bearing scanner on the same rail as the gating transducers. You'll next install the advance transducer to the right of the bearing scanner.

37 Using another transducer, separate the body from the mounting plate.

38 With the arrow on the plate pointing up, place the mounting plate against the gauge side of the rail.

39 Going right from the far edge of the track clamp on the bearing scanner mount to the rightmost index groove on the mounting plate, measure 32 feet (9.75 meters).

40 Repeat steps **8** through **22**.

41 If this is a single-track site, label the two-wire end of the cable **ADV1**.

42 If this is a double-track site, label the two-wire end of the cable either **ADV1-TRACK1** or **ADV1-TRACK2**, whichever is appropriate.

43 Extend the transducer cable into the bungalow and leave it coiled on the floor.

You'll next install the advance transducer to the left of the scanner mount.

44 Using another transducer, separate the body from the mounting plate.

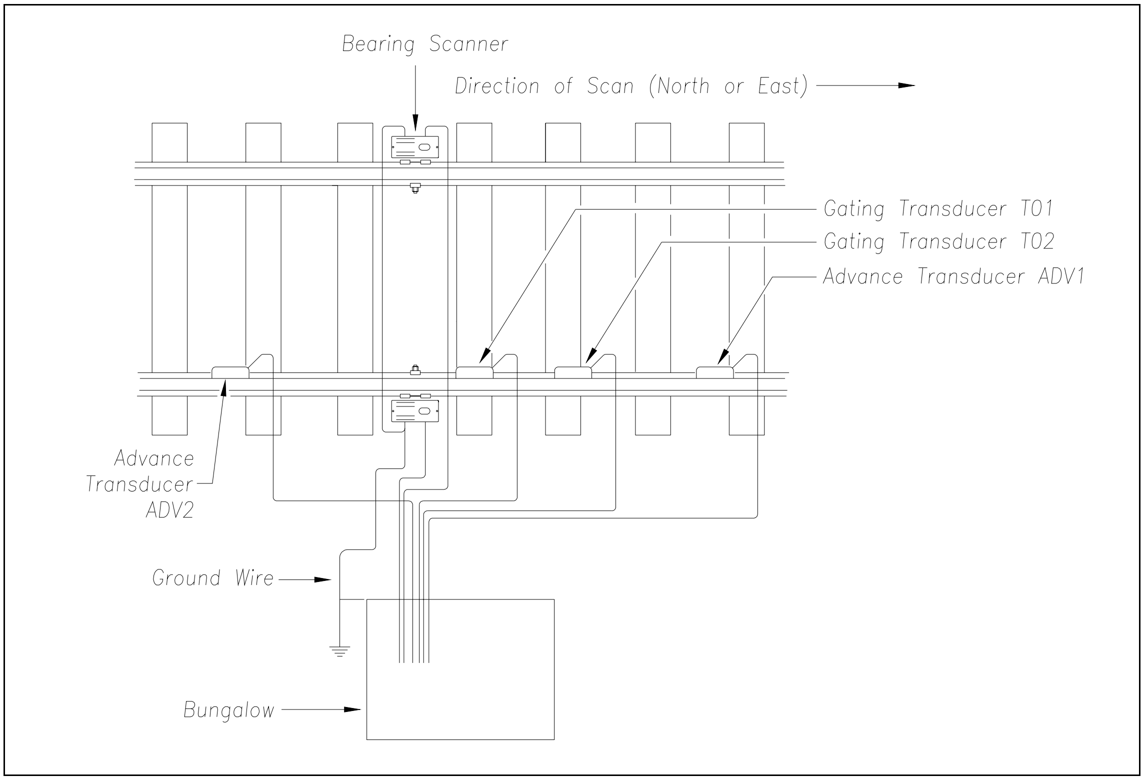
45 With the arrow on the plate pointing up, place the mounting plate against the gauge side of the rail.

46 Going left from the far edge of the track clamp on the bearing scanner mount to the leftmost index groove on the mounting plate, measure 32 feet (9.75 meters).

47 Repeat steps **8** through **22**.

48 If this is a single-track site, label the two-wire end of the cable **ADV2**.

If this is a single-track site, you are done installing all the transducers. Seen from above, your site would look something like this.



49 If this is a double-track site, label the two-wire end of the cable either **ADV2-TRACK1** or **ADV2-TRACK2**, whichever is appropriate.

50 If this is a single-track site:

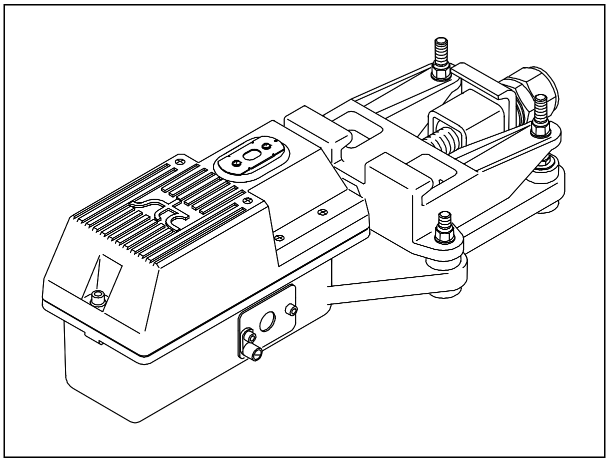
- **a** If your site has wheel scanners, go to ***6.3 Wheel Scanners***.
- **b** Go to ***6.5 AEI Antennas***.

51 If this is a double-track site:

- **a** Repeat steps **1** through **49** on the second track.
- **b** If your site has wheel scanners, go to ***6.3 Wheel Scanners***.
- **c** Go to ***6.5 AEI Antennas***.

6.3 Wheel Scanners

An assembled wheel scanner looks like this.



Not all sites use wheel scanners. If your site doesn't use them, skip the instructions below and go to ***6.4 Track Circuit***.

To install the wheel scanners:

1 Be sure that you have on hand two wheel scanner covers, modules, and mounts.

2 Be sure that you have on hand a short-handle 1-1/2-inch open-end wrench, a T-handle 3/16-inch hex-wrench, a T-handle 1/4-inch hex-wrench, and a 50-foot (15-meter) or longer tape measure.

3 If not done already, select a location to install the wheel scanners.

   The wheel scanners should be centered in the crib of two ties spaced at least 14 inches (35.6 centimeters) apart. The crib of the two ties is the one immediately ahead (and to the north or east) of the bearing scanners. This places one wheel scanner between the two gating transducers. The other one is directly opposite, on the other rail of the track.

4 If not done already, remove ballast from under both rails between the ties.

   You'll next install the first wheel scanner.

5 Using a T-handle 1/4-inch hex-wrench, loosen the two socket-head-cap screws on the cover of a not-yet-installed wheel scanner.

6 Separate the scanner cover, which contains an attached scanner module, from its mount.

7 Store the cover-and-module combination in a safe place until you replace it.

8 Centered between the ties and on the rail closest the enclosure, place the mount so that the moveable track clamp extends under the rail and toward the center of the track.

9 Tighten the inner nut (that is, the clamping nut) by hand.

This should hold the mount in place.

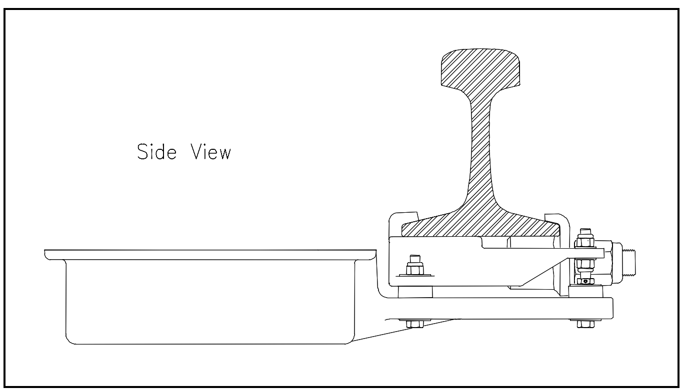
10 Using a short-handle 1-1/2-inch wrench, tighten the clamping nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters)**.

Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.

11 Using a short-handle 1-1/2-inch wrench, tighten the locking nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters)**.

Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.

At this point, your work should look like this.

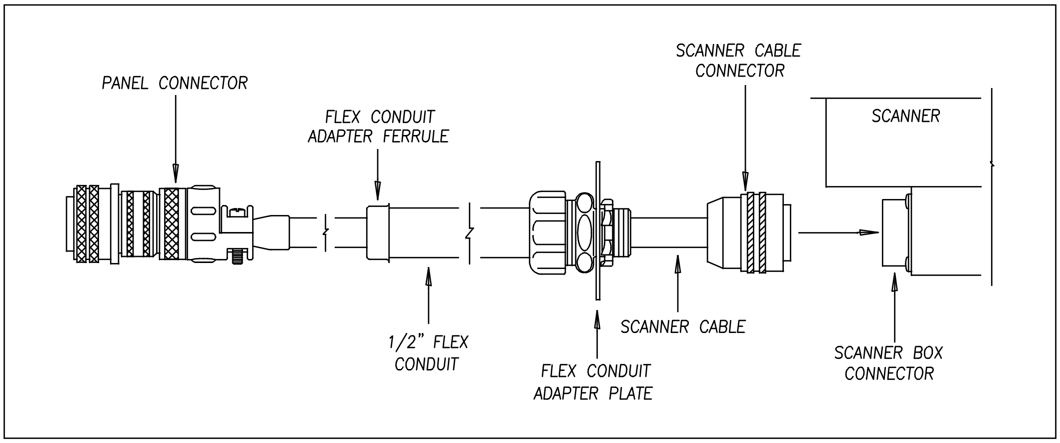


On the side of the mount are a large hole and two socket head cap screws. The longest screw is holding a ground lug and an internal-tooth washer.

12 Using a T-handle 3/16-inch hex-wrench, remove the two socket head cap screws.

13 Store the screws, washer, and lug in a safe place until you're ready to use them.

In the steps that follow, the terms scanner cable connector, panel connector, and flex-conduit-adapter plate are used. Notice where they are on a wheel scanner cable.



Single-track sites have two 65-foot (19.8-meter) wheel scanner cables. Double-track sites have two 65-foot wheel scanner cables for the track <u>closest</u> to the bungalow. For the track <u>farthest</u> from the bungalow, they have either two 85-foot (25.9-meter) <u>or</u> two 100-foot (30.5-meter) wheel scanner cables.

14 If this is a double-track site, select the correct length of cable.

15 Put the scanner cable connector through the round hole in the side of the mount.

16 Align the screw holes in the flex-conduit-adapter plate with the screw holes in the mount.

17 In the screw hole closest to the rail, replace the screw and tighten by hand.

18 In the screw hole farthest from the rail, replace the ground lug, internal-tooth washer, and screw.

19 Tighten by hand.

This should hold the flex-conduit-adapter plate in place.

20 Using a T-handle 3/16-inch hex-wrench, tighten the two socket head cap screws until they are completely tight.

21 Leave 6 inches (15.2 centimeters) of the scanner cable in the mount.

22 Attach the scanner cable connector to the scanner box connector.

23 With the scanner's top hole facing the center of the track, replace the scanner.

24 Using a T-handle 1/4-inch hex-wrench, tighten the two screws (on the scanner cover) until they are completely tight.

25 If this is a single-track site, label the end of the cable that isn't attached to the wheel scanner **W-RAIL1** or **W-RAIL2**, whichever is appropriate.

If the track runs north and south, RAIL1 is the east rail. If the track runs east and west, RAIL1 is the north rail.

26 If this is a double-track site, label the end of the cable that isn't attached to the wheel scanner **W-RAIL1-TRACK1**, **W-RAIL2-TRACK1**, **W-RAIL1-TRACK2**, or **W-RAIL2-TRACK2**, whichever is appropriate.

27 Extend the cable into the bungalow and leave it coiled on the floor.

28 Attach one end of an 8 AWG stranded copper wire to the ground lug on the flex-conduit-adapter plate and the other end to the ground connector on the ground rod.

You'll next install the second wheel scanner on the opposite rail.

29 Using a T-handle 1/4-inch hex-wrench, loosen the two socket-head-cap screws on the cover of the remaining not-yet-installed wheel scanner.

30 Separate the scanner cover, which contains an attached scanner module, from its mount.

31 Store the cover-and-module combination in a safe place until you replace it.

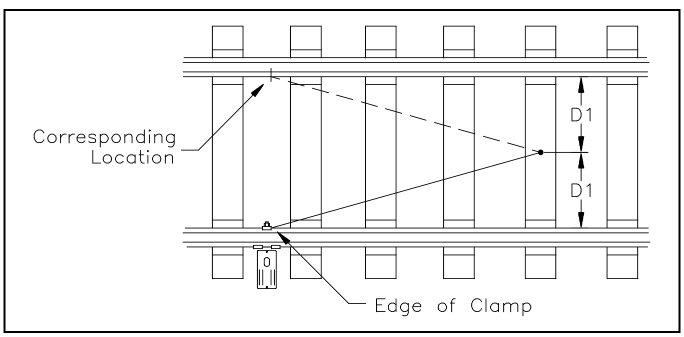
When installing the second wheel mount on the opposite rail, make sure that the two wheel mounts are squared with each other and directly opposite each other. The next step tells how to do this.

32 To locate the second mount on the opposite rail:

a Mark the center of the fourth tie ahead of the just installed mount.

b From this mark, measure to the edge of the track clamp on the just installed mount.

c From the mark, measure the same distance on the opposite rail.



d Mark this location on the rail.

This mark will correspond to the edge of the track clamp on the opposite mount.

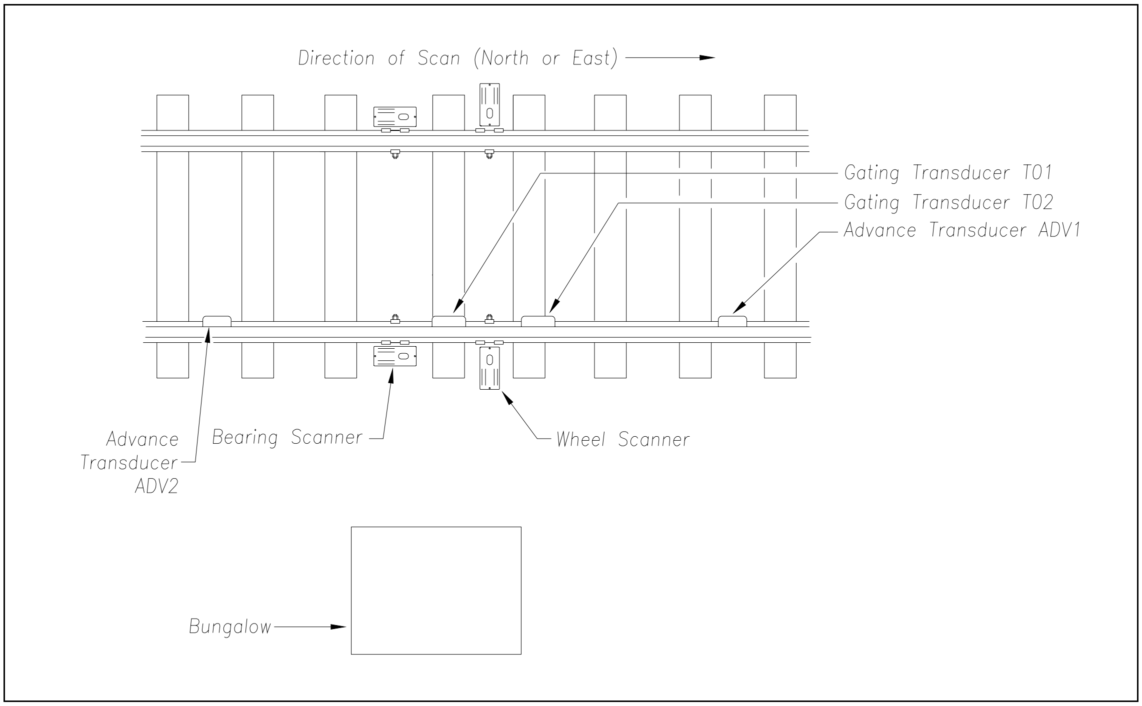
Use a permanent marker, magic marker, lumber crayon, or paint pen to mark the rail. Don't use a file or punch to mark the rail.

33 With the mark as a guide, place the second mount so that the moveable track clamp extends under the rail and toward the center of the track.

34 Repeat steps **9** through **27**.

35 Attach one end of an 8 AWG stranded copper wire to the ground lug on the flex-conduit-adapter plate and the other end to the ground lug on the other scanner mount.

Seen from above, your site would look something like this.



36 If this is a single-track site, go to ***6.4 Track Circuit***.

37 If this is a double-track site:

a Repeat steps **1** through **35** on the second track.

b Go to ***6.4 Track Circuit***.

6.4 Track Circuit

Not all sites use a track circuit. If your site doesn't use one, skip the instructions below and go to ***6.5 AEI Antennas***.

Following the directions that came with your track circuit:

1 Mount both track-wire connectors.

Mount one connector on each rail, directly opposite each other. Mount them within 5 feet (1.5 meters) of the scanners.

2 Attach wires to the track-wire connectors.

Wires should be as short as practical. They should be 9 AWG (or larger) insulated copper wire. Total wire resistance shouldn't exceed 0.2 ohm.

3 If this is a single-track site, label the end of the wires that aren't attached to the track-wire connectors **TC**.

4 If this is a double-track site, label the end of the wires that aren't attached to the track-wire connectors **TC-TRACK1** or **TC-TRACK2**, whichever is appropriate.

5 Extend the wires into the bungalow and leave them coiled on the floor.

6 If this is a single-track site, go to ***6.5 AEI Antennas***.

7 If this is a double-track site:

- **a** Repeat steps **1** through **5** on the second track.
- **b** Go to ***6.5 AEI Antennas***.

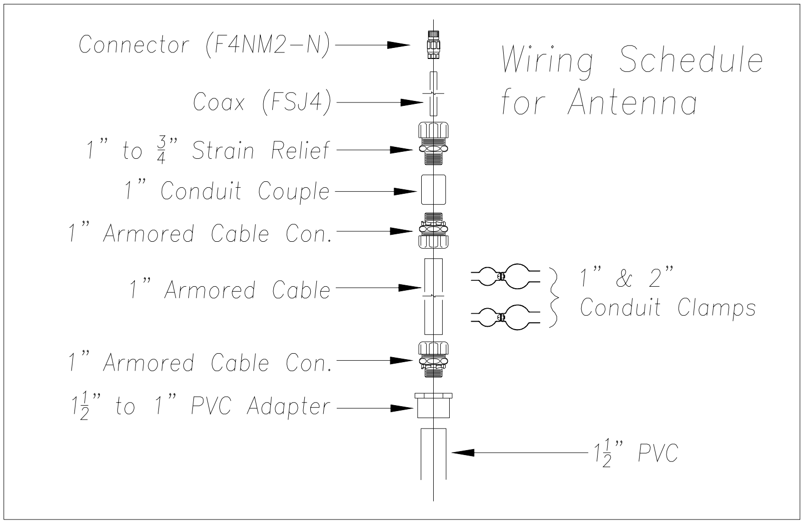
6.5 AEI Antennas

Not all sites use AEI antennas. If your site doesn't use them, skip the instructions below and go to the next chapter. At each SmartScanIS site that uses AEI, two 100-watt Sinclair SRL470 antennas or two 100-watt Scala HP9-915 Parapanel antennas are installed per track. In reference to the track, **antenna1** is the northmost or eastmost antenna. **Antenna2** is the southmost or westmost antenna. (As a means of reference, transducer **TO2** is the northmost or eastmost transducer.)

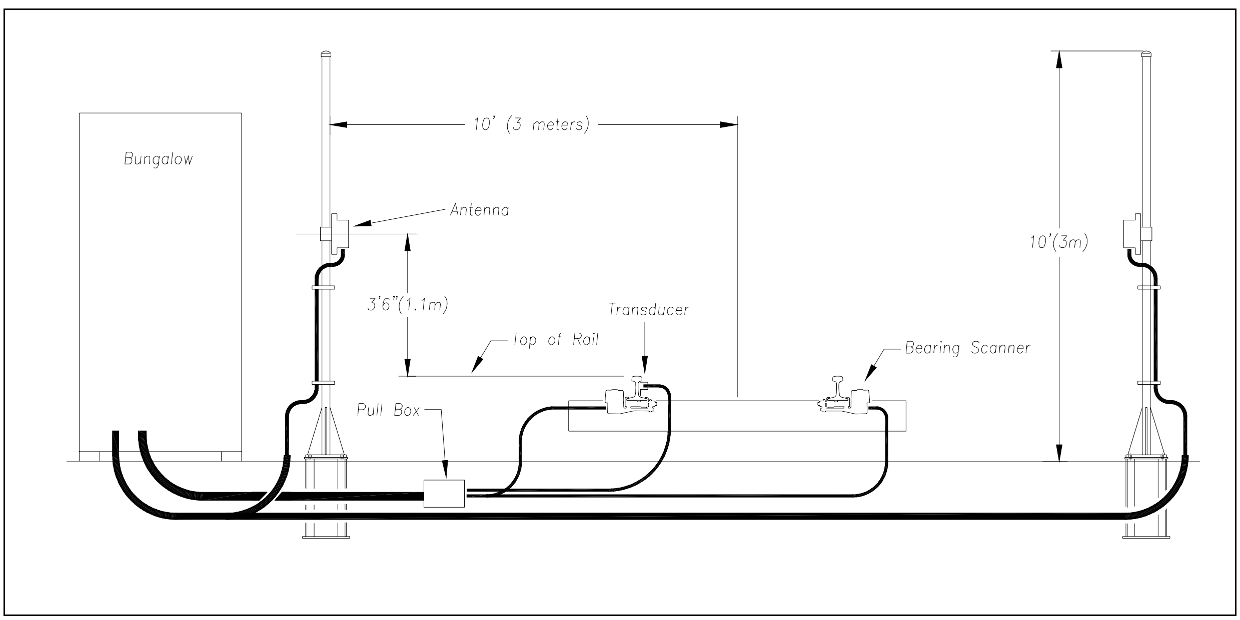
The instructions below assume that the masts that the antennas will be attached to have already been installed. Their installation was described in ***Chapter 5 - Preparation***.

Only the installation of the SRL470 is covered below. The installation of the HP9-915 isn't covered in this guide.

Coaxial antenna cables are cut to length and assembled **on-site**.



Using the figure below as a guide, install the antennas with the face of the antenna parallel to the rails, 3.5 feet (1.1 meters) above the top of the rails, centered between the transducers, and opposite each other. Mount the SRL470 antenna with its N-type socket pointing down.



To install the antenna cables:

1 Run FSJ4 coaxial cable from each AEI antenna to the bottom of the SmartScanIS enclosure.

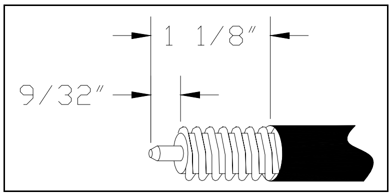
2 Cut each cable to the correct length.

3 In the bungalow, label the cable from the northmost or eastmost antenna **ANTENNA1**.

4 In the bungalow, label the other cable **ANTENNA2**.

5 Install an N-type connector on each end of each cable as follows:

a Trim the cable jacket on the FSJ4 back 1-1/8 inches (28.6 millimeters).

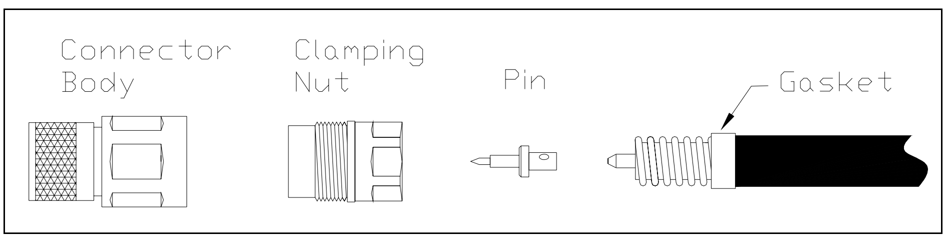


b Remove 9/32 inches (7.1 millimeters) of outer conductor.

c Remove the foam and adhesive from inner conductor.

d Taper the inner conductor.

e Add a gasket.



f Place the supplied heat shield over inner conductor, slide the pin on, and solder.

g Remove the heat shield and trim any excess solder from the pin.

h Add grease to the gasket and to the rubber O-ring (on the clamping nut).

i Thread the clamping nut onto cable until it stops.

j Attach the connector body to the clamping nut.

k Tighten the connector body with a wrench to a **torque of 20 to 22 foot-pounds (27.1 to 29.8 newton-meters)**.

l Apply heat-shrink tube to connector to provide weather seal.

6 Connect the N-type connector on the trackside end of a coaxial cable to the antenna to a **torque of 15 inch-pounds (1.7 newton-meters)**.

Later you'll attach the bungalow end of the coaxial cables to their respective Joslyn surge protectors on the Surge Protection Subassembly. **Antenna1** to the protector labeled **Reader1**. And, **antenna2** to the protector labeled **Reader2**.

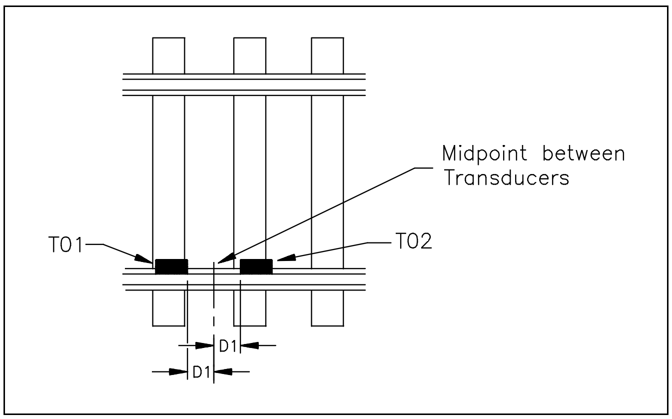
Chapter 7
Adjusting the Track Components

This chapter tells how to adjust the scanners and transducers.

7.1 Bearing Scanners

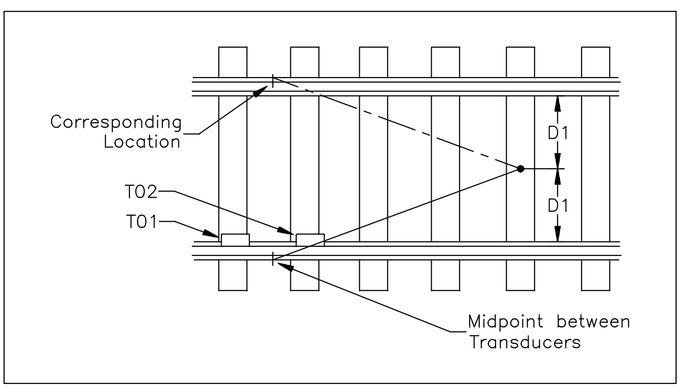
To align the bearing scanners:

1. Be sure that you have on hand a short-handle 1-1/2-inch open-end wrench, a combination 9/16-inch open-end box wrench, and a STC alignment fixture.
2. Turn off all power to the SmartScanIS enclosure.
3. On the outside of the rail, mark the midpoint between TO1 and TO2.



Use a permanent marker, magic marker, lumber crayon, or paint pen to mark the rail. Don't use a file or punch to mark the rail.

4. Mark the center of the fourth tie ahead of this midpoint.
5. From this mark on the fourth tie, measure to the midpoint between the transducers.
6. From the mark on the fourth tie, measure the same distance on the opposite rail.

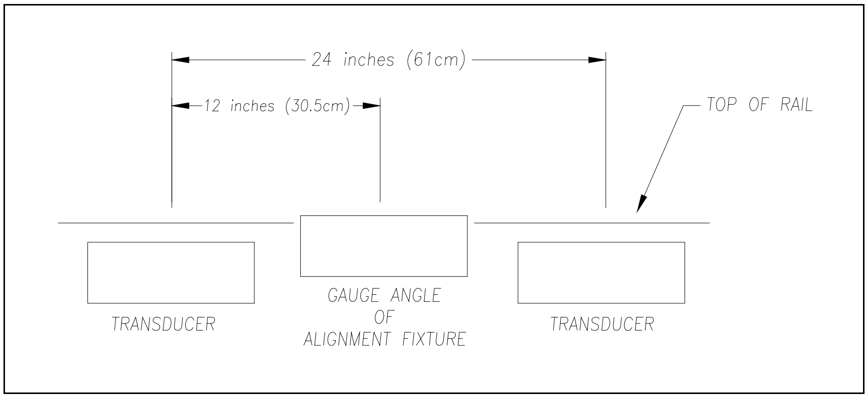


7 On the outside of the rail, mark this location.

This mark should correspond to the first mark on the opposite rail.

Use a permanent marker, magic marker, lumber crayon, or paint pen to mark the rail. Don't use a file or punch to mark the rail.

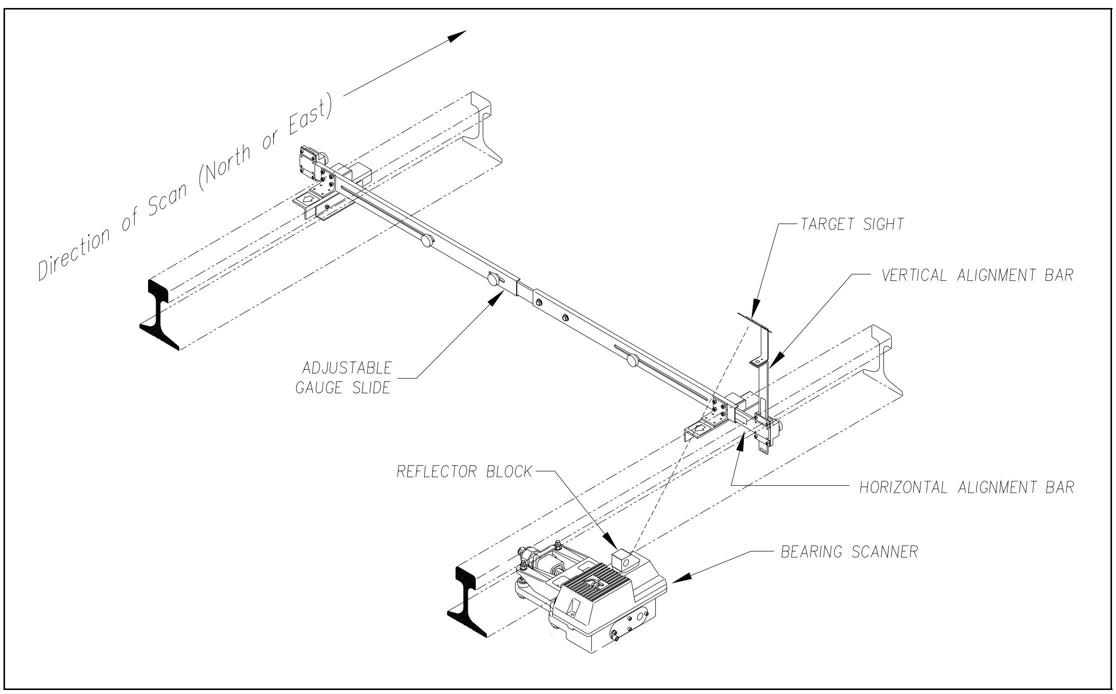
8 Place the alignment fixture across both rails and adjust it so that the north or east side of the adjustable gauge slide is even with the two rail marks.



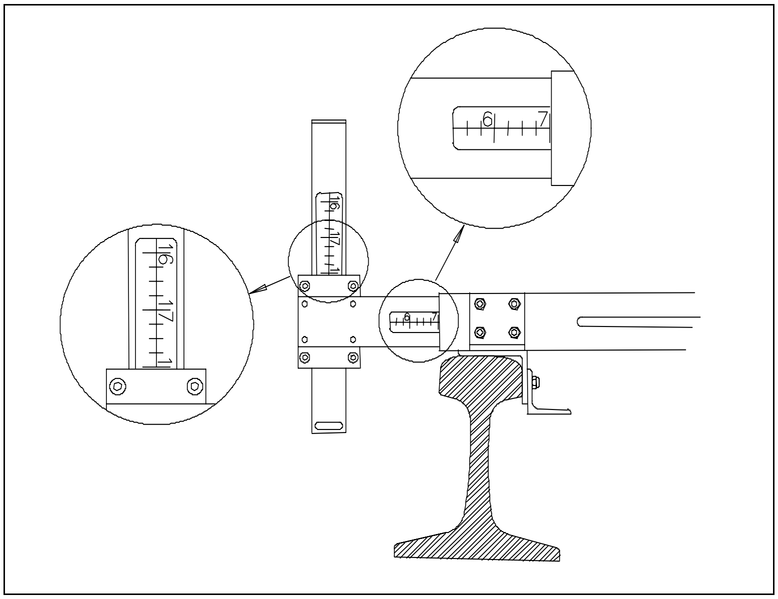
The fixture should be snug against the top and gauge of both rails.

9 Install the optical alignment target on the vertical alignment bar with the target sight tilted toward the bearing scanner.

10 Install the reflector block in the top of the scanner cover with the sloping surface facing the target.



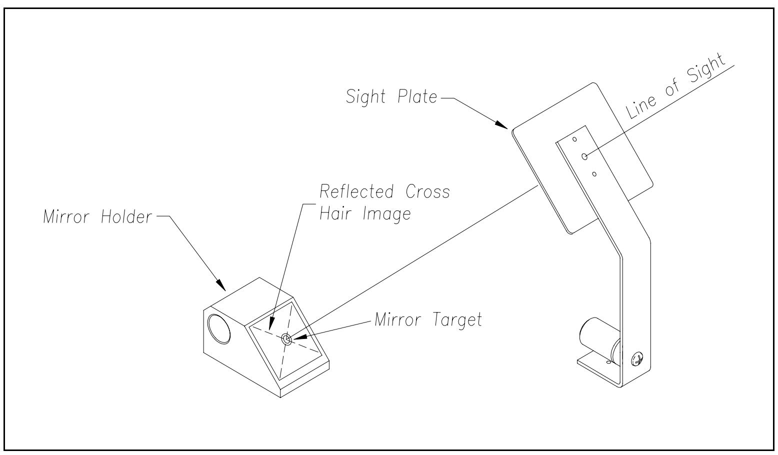
11 Extend the horizontal alignment bar to 7-1/4 ± 1/4 on the scale.



12 Extend the vertical alignment bar to 18 ± 1 on the scale.

13 Look through the hole in the center of the target and note the relationship of the target cross hairs to the circle in the center of the reflector block.

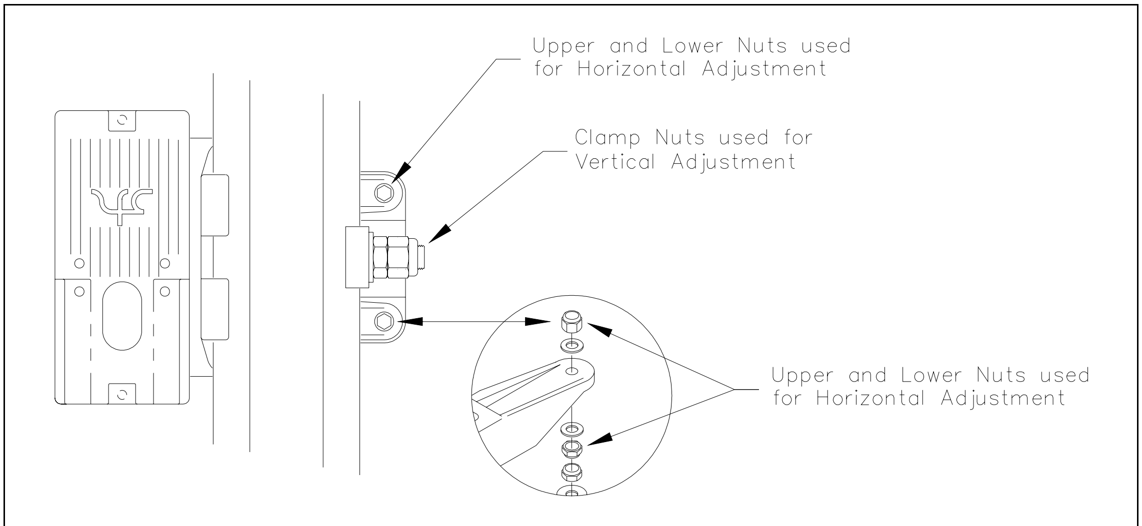
When the cross hairs are centered on the circle, alignment is correct.



14 If the cross hairs are centered on the circle, go to step **18**.

15 If horizontal adjustment is necessary, adjust the upper and lower nuts on the edge of the arm of the bearing scanner mount.

Using a combination 9/16-inch open-end box wrench, turn both upper nuts the same number of turns. Turn both lower nuts the same number of turns. Adjusting these four nuts causes the scanner to pivot about the two shock mounts under the rail. This adjustment moves the cross hairs (on the circle) to the right or left.



16 If vertical adjustment is necessary:

a Using a short-handle 1-1/2-inch wrench, loosen both nuts on the side of the mount.

The inner nut is the clamping nut. The outer nut is the locking nut.

b Slide the entire mount toward or away from the alignment fixture.

Sliding toward the fixture raises the cross hairs on the circle. Sliding away from the fixture lowers the cross hairs on the circle.

c Using a short-handle 1-1/2-inch wrench, tighten the clamping nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters)**.

Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.

d Using a short-handle 1-1/2-inch wrench, tighten the locking nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters)**.

Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.

17 Until the cross hairs are centered on the circle, repeat steps **15** and **16**.

18 Remove the vertical alignment bar, target sight, and reflector block.

19 Repeat steps **9** through **17** for the bearing scanner on the opposite rail.

20 Remove the alignment fixture from the track.

21 If this is a single-track site:

- **a** Store the alignment fixture in the bungalow.
- **b** If your site has wheel scanners, go to ***7.2 Wheel Scanners***.
- **c** If your site doesn't have wheel scanners, go to the next chapter.

22 If this is a double-track site:

- **a** Repeat steps **1** through **20** for the second track.
- **b** Store the alignment fixture in the bungalow.
- **c** If your site has wheel scanners, go to ***7.2 Wheel Scanners***.
- **d** If your site doesn't have wheel scanners, go to the next chapter.

7.2 Wheel Scanners

Not all sites use wheel scanners. If your site doesn't use them, skip the instructions below and go to the next chapter.

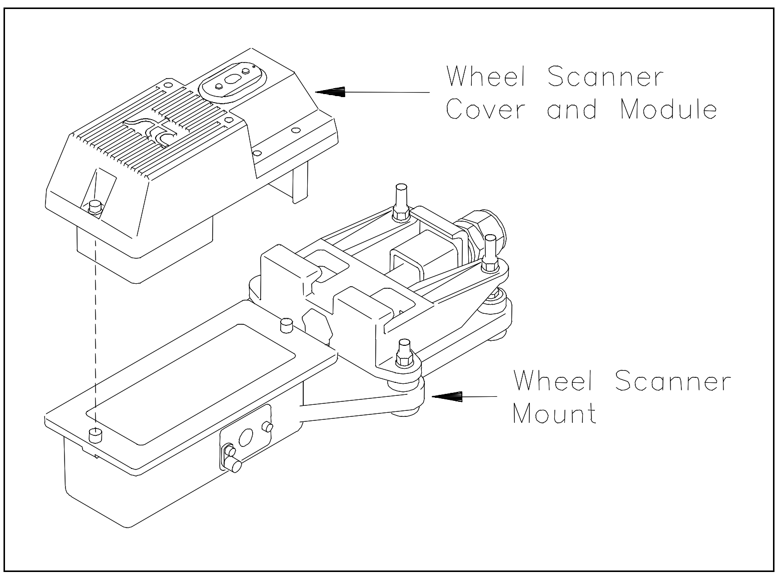
To align the wheel scanners:

1 Be sure that you have on hand a T-handle 1/4-inch hex-wrench, a combination 9/16-inch open-end box wrench, and a STC alignment fixture.

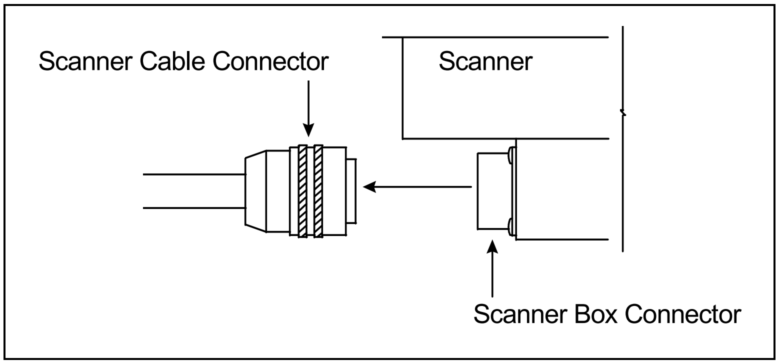
2 Turn off all power to the SmartScanIS enclosure.

3 Using a T-handle 1/4-inch hex-wrench, loosen both scanner-cover screws on one of the wheel scanners.

4 Separate the scanner cover-and-module assembly from its mount.



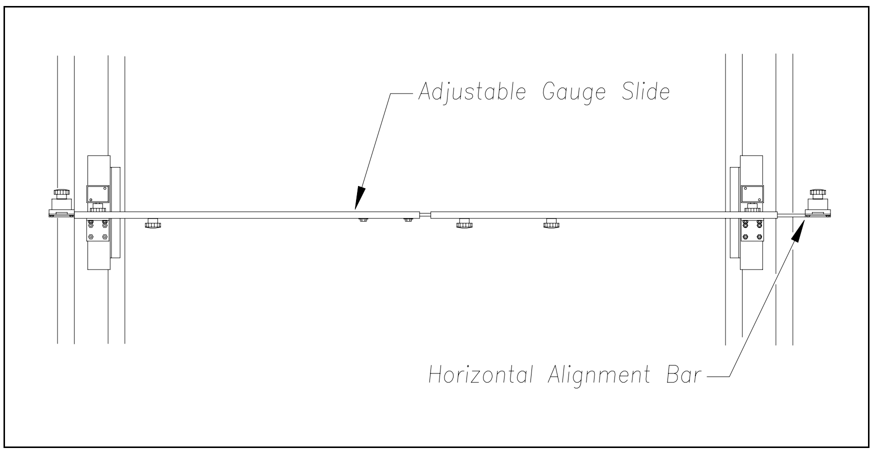
5 Disconnect the scanner cable connector from the scanner box connector.



6 Store the cover-and-module combination in a safe place until you replace it.

7 If not done already, place the alignment fixture on the rails so that the adjustable gauge slide is over both wheel scanners.

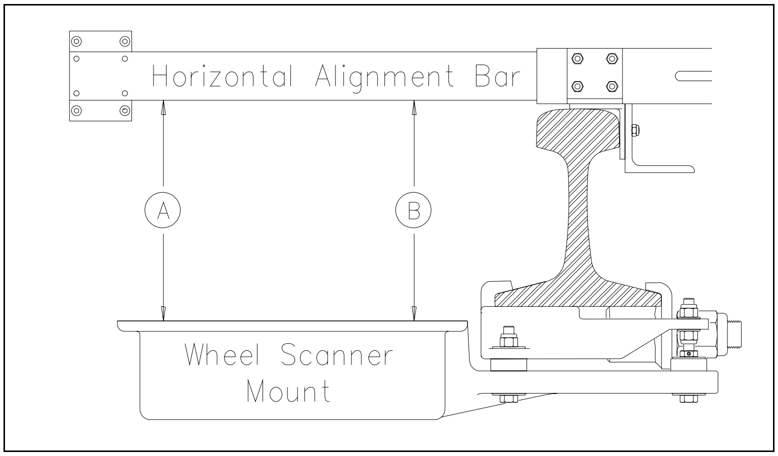
The fixture should be snug against the top and gauge of both rails.



8 Over the scanner mount, extend the horizontal alignment bar of the fixture as far as it will go.

9 Tighten the extended bar.

10 At both ends of the scanner mount, measure from the bottom of the extended bar to the top surface of the mount.



When both measurements are the same, alignment is correct. That is, as shown above, when distance **A** is equal to distance **B**, alignment is correct.

11 If adjustment is necessary, adjust the upper and lower nuts on the edge of the wheel scanner mount's arm.

Using a combination 9/16-inch open-end box wrench, turn both upper nuts the same number of turns. Turn both lower nuts the same number of turns. Adjusting these four nuts causes the scanner to pivot about the two shock mounts under the rail.

12 Until both measurements are the same, repeat steps **10** and **11**.

13 Retract the horizontal alignment bar as far as it will go.

14 Attach the scanner cable connector to the scanner box connector (on the scanner cover-and-module assembly).

15 With the hole (on top of the scanner cover) facing the center of the track, replace the scanner cover-and-module assembly onto its mount.

16 Using a T-handle 1/4-inch hex-wrench, tighten the two screws (on the scanner cover) until they are completely tight.

17 Repeat steps **4** through **16** for the wheel scanner on the opposite rail.

18 Remove the alignment fixture from the track.

19 If this is a single-track site, store the alignment fixture in the bungalow.

20 If this is a double-track site:

- **a** Repeat steps **1** through **18** for the second track.
- **b** Store the alignment fixture in the bungalow.

Chapter 8
Installing the Bungalow Components

This chapter tells how to do the final installation of most of the bungalow components. If you are having problems with or have questions about installing any components, call STC for help. Though slower and more cumbersome, solving your problems and answering your questions by email is also possible.

8.1 Grounding System

The SmartScanIS is equipped with components for surge and lightning protection of the equipment attached to it. However, if the attachment to the earth grounding system isn't made correctly, the surge protection equipment may not work as designed, resulting in damaged or destroyed system components.

Two driven grounds should be installed at opposite corners of the bungalow in which the SmartScanIS enclosure is installed. **A third driven ground** should be installed at the power pole to which the AC power connection is made. All three ground rods should be interconnected and exothermically bonded with a 2 AWG bare stranded copper wire. Two 2 AWG copper transitions welded to the skin of the bungalow should be exothermically bonded to the driven grounds at its corners.

An exothermically bonded pigtail should be run through the floor of the bungalow and terminated at a properly installed ground bus inside the bungalow. There should be one ground bus per bungalow.

8.2 SmartScanIS Enclosure

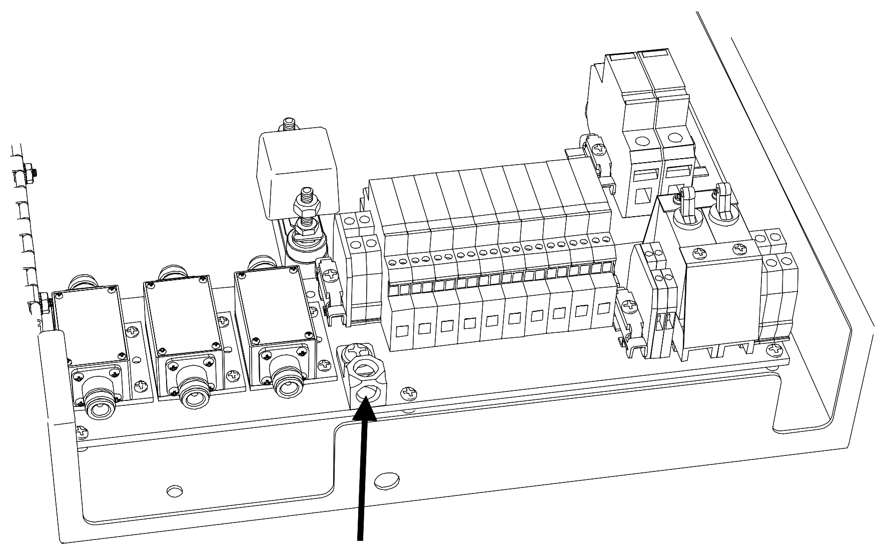
There is one SmartScanIS enclosure per track. At double-track sites, the leftmost enclosure supports track1 and the rightmost one supports track2.

The SmartScanIS enclosure can be mounted to any flat wooden surface. Three-quarter-inch (1.9 centimeters) or thicker plywood works well. Many other flat wooden surfaces may work just as well. The SmartScanIS enclosure can also be rack mounted.

Mount the SmartScanIS enclosure about 2 feet (61 centimeters) above the floor. Doing so positions the enclosure at a convenient height for installation and servicing. Mounting it at this height also allows you to install the batteries below it.

Mount the SmartScanIS enclosure within 4 feet (122 centimeters) of a grounded three-wire 110-120 VAC outlet. The enclosure is provided with a 5-foot power cord. Level the enclosure.

To ground the SmartScanIS enclosure, attach one end of a 6 AWG stranded copper wire to the ground bus and the other end to the copper **ground lug** on the Surge Protection Subassembly (in the SmartScanIS enclosure). At double-track sites, each SmartScanIS enclosure must be grounded.



Ground Lug

8.3 Bearing Scanners

There are two bearing scanners per track.

At double-track sites, the cables from the bearing scanners on track1 are connected to the box connectors in the leftmost SmartScanIS enclosure. The cables from track2 are connected to the box connectors in the rightmost SmartScanIS enclosure.

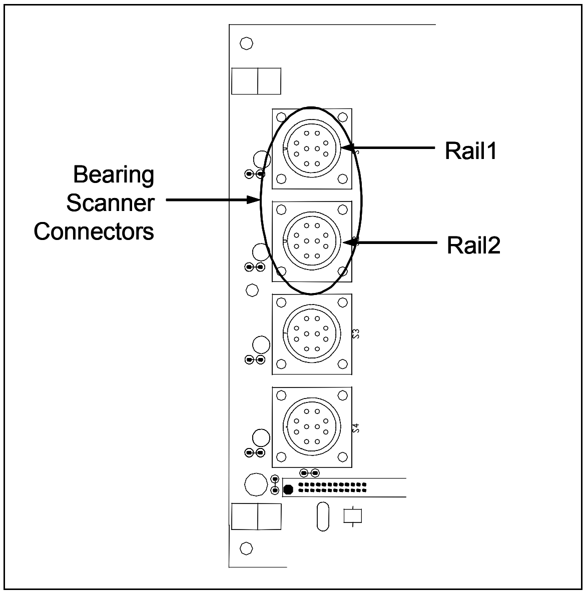
To connect the bearing scanners to the SmartScanIS enclosure:

1 Be sure that both bearing scanners are installed on the track.

At a single-track site, the cable from the bearing scanner on rail1 should be labeled **RAIL1**. The cable from the bearing scanner on rail2 should be labeled **RAIL2**. If the track runs north and south, rail1 is the east rail. If the track runs east and west, rail1 is the north rail.

At a double-track site, they're labeled **RAIL1-TRACK1**, **RAIL2-TRACK1**, **RAIL1-TRACK2**, or **RAIL2-TRACK2**, whichever is appropriate.

2 Plug the connector from the bearing scanner on rail1 (that is, from the north or east rail) into the first (top) box connector on the Scanner Interface board.



3 Plug the connector from the bearing scanner on rail2 (that is, from the south or west rail) into the second box connector on the Scanner Interface board.

4 If this is a single-track site:

a If your site has wheel scanners, go to ***8.4 Wheel Scanners***.

b Go to ***8.5 Gating Transducers***.

5 If this is a double-track site:

a Repeat steps **1** through **3** on the second track.

b If your site has wheel scanners, go to ***8.4 Wheel Scanners***.

c Go to ***8.5 Gating Transducers***.

8.4 Wheel Scanners

Not all sites use wheel scanners. If your site doesn't use them, skip the instructions below and go to ***8.5 Gating Transducers***.

If your site uses them, there are two wheel scanners per track.

At double-track sites, the cables from the wheel scanners on track1 are connected to the box connectors in the leftmost SmartScanIS enclosure. The cables from track2 are connected to the box connectors in the rightmost SmartScanIS enclosure.

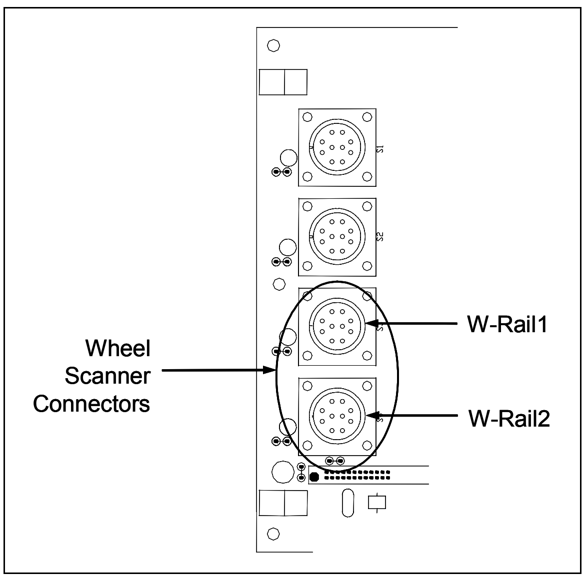
To connect the wheel scanners to the SmartScanIS enclosure:

1 Be sure that both wheel scanners are installed on the track.

At a single-track site, the cable from the wheel scanner on rail1 should be labeled **W-RAIL1**. The cable from the wheel scanner on rail2 should be labeled **W-RAIL2**. If the track runs north and south, rail1 is the east rail. If the track runs east and west, rail1 is the north rail.

At a double-track site, they're labeled **W-RAIL1-TRACK1**, **W-RAIL2-TRACK1**, **W-RAIL1-TRACK2**, or **W-RAIL2-TRACK2**, whichever is appropriate.

2 Plug the connector from the wheel scanner on rail1 (that is, from the north or east rail) into the third box connector on the Scanner Interface board.



3 Plug the connector from the wheel scanner on rail2 (that is, from the south or west rail) into the fourth (bottom) box connector on the Scanner Interface board.

4 If this is a single-track site, go to ***8.5 Gating Transducers***.

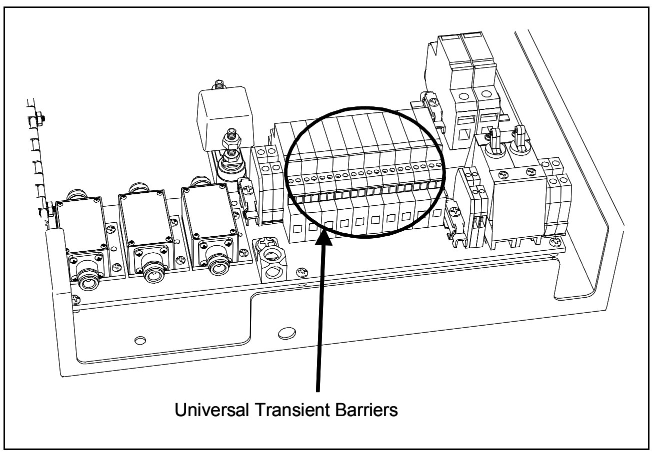
5 If this is a double-track site, repeat steps **1** through **3** on the second track and then go to ***8.5 Gating Transducers***.

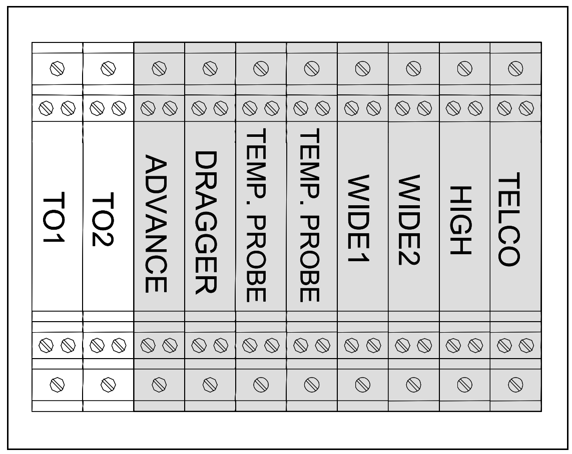
8.5 Gating Transducers

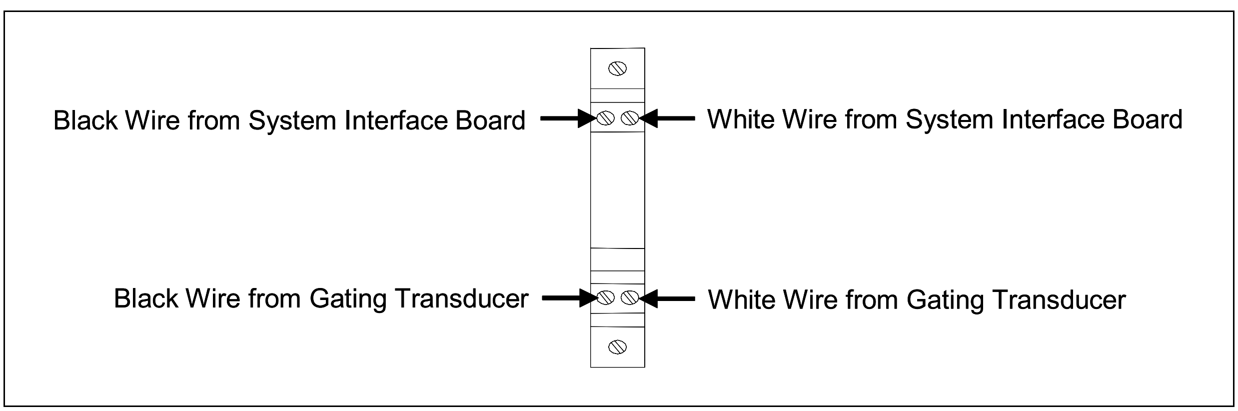
There are two gating transducers per track, each having two wires. One black wire and one white wire. At a single-track site, the cable from gating transducer TO1 should be labeled **TO1**. The cable from gating transducer TO2 should be labeled **TO2**.

At a double-track site, they're labeled **TO1-TRACK1**, **TO2-TRACK1**, **TO1-TRACK2**, or **TO2-TRACK2**, whichever is appropriate. At double-track sites, the cables from the gating transducers on track1 are connected inside the leftmost SmartScanIS enclosure. The cables from track2 are connected inside the rightmost SmartScanIS enclosure.

On the Surge Protection Subassembly (in the SmartScanIS enclosure), there is one UTB assigned to transducer TO1 and another to transducer TO2. These UTBs protect the SmartScanIS from transients and surges, which can be induced onto external wiring by lightning. Each UTB has four rows of connectors. The wires from one gating transducer are terminated at the third row of connectors from the top. The second row from the top is wired at the factory to terminal block TB1 on the System Interface board.







Observe correct polarity when you connect the wires from the transducers. The polarity is correct when the transducer's white wire is connected directly under the existing white wire at row two of the UTB, and the transducer's black wire is connected directly under the existing black wire at row two of the UTB. Connect TO1 first and TO2 second.

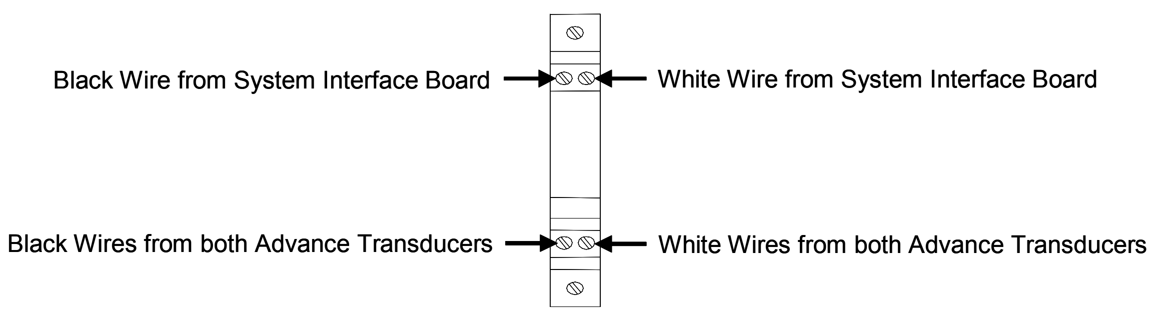
8.6 Advance Transducers

All tracks have either two advance transducers or one track circuit. If your site uses track circuits, skip the instructions below and go to ***8.7 Dragging-Equipment Detector***.

When used, there are two advance transducers per track, each having two wires. One black wire and one white wire. At a single-track site, the cables from the advance transducers should be labeled **ADV1** and **ADV2**.

At a double-track site, they're labeled **ADV1-TRACK1**, **ADV2-TRACK1**, **ADV1-TRACK2**, or **ADV2-TRACK2**, whichever is appropriate. At double-track sites, the cables from the advance transducers on track1 are connected inside the leftmost SmartScanIS enclosure. The cables from track2 are connected inside the rightmost SmartScanIS enclosure.

On the Surge Protection Subassembly (in the SmartScanIS enclosure), there is one UTB assigned to both advance transducers. This UTB protects the SmartScanIS from transients and surges, which can be induced onto external wiring by lightning. This UTB has four rows of connectors. The wires from both advance transducers are terminated at the third row of connectors from the top. The second row from the top is wired at the factory to terminal block TB1 on the System Interface board.



Observe correct polarity when you connect the wires from the transducers. The polarity is correct when the transducers' white wires are connected directly below the existing white wire at row two of the UTB, and the transducers' black wires are connected directly below the existing black wire at row two of the UTB.

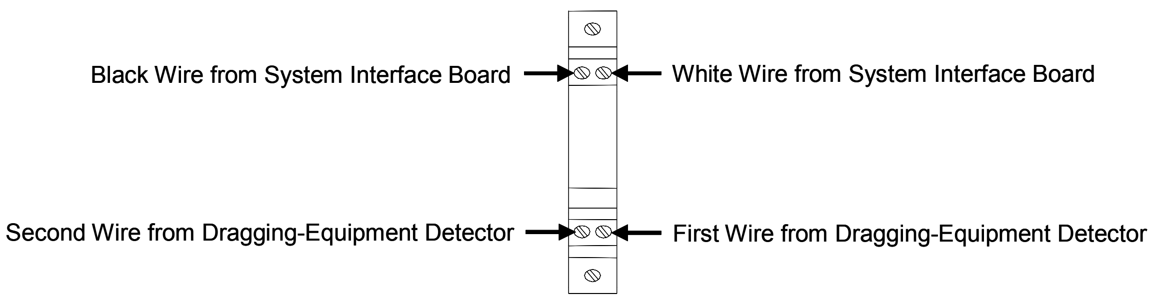
8.7 Dragging-Equipment Detector

Most, but not all, systems use dragging-equipment detectors. If your site doesn't use them, skip the instructions below and go to ***8.8 Track Circuit***.

When used, there is one dragging-equipment detector per track, each having two wires. Usually, one black wire and one white wire. The color of your wires may be different

At double-track sites, the wires from the dragging-equipment detector on track1 are connected inside the leftmost SmartScanIS enclosure. The wires from track2 are connected inside the rightmost SmartScanIS enclosure.

On the Surge Protection Subassembly (in the SmartScanIS enclosure), the UTB labeled **DED** is for the dragging-equipment detector. This UTB protects the SmartScanIS from transients and surges, which can be induced onto external wiring by lightning. The UTB has four rows of connectors. The wires from the dragging-equipment detector are terminated at the third row of connectors from the top. The second row from the top is wired at the factory to terminal block TB1 on the System Interface board.



Correct polarity need not be observed when connecting the wires from the detector. One wire from the detector should be connected directly below the existing white wire at row two of the UTB, and the other wire should be connected directly below the existing black wire at row two of the UTB.

8.8 Track Circuit

Most, but not all, systems use one track circuit per track. If your site doesn't, skip the instructions below and go to ***8.9 Telephone***.

To connect the track circuit to the SmartScanIS enclosure:

1 Be sure that the track circuit is installed on the track.

2 Be sure that you have on hand a wire stripper, a pliers-type crimping tool, and a midsize slotted screwdriver.

3 Mount a terminal block below the SmartScanIS enclosure.

At a single-track site, the cable from the track circuit should be labeled **TC**. At a double-track site, they're labeled **TC-TRACK1** or **TC-TRACK2**, whichever is appropriate.

At a double-track site, the cable from track1 is connected to the leftmost SmartScanIS enclosure.

4 Cut the track-circuit cable to the proper length.

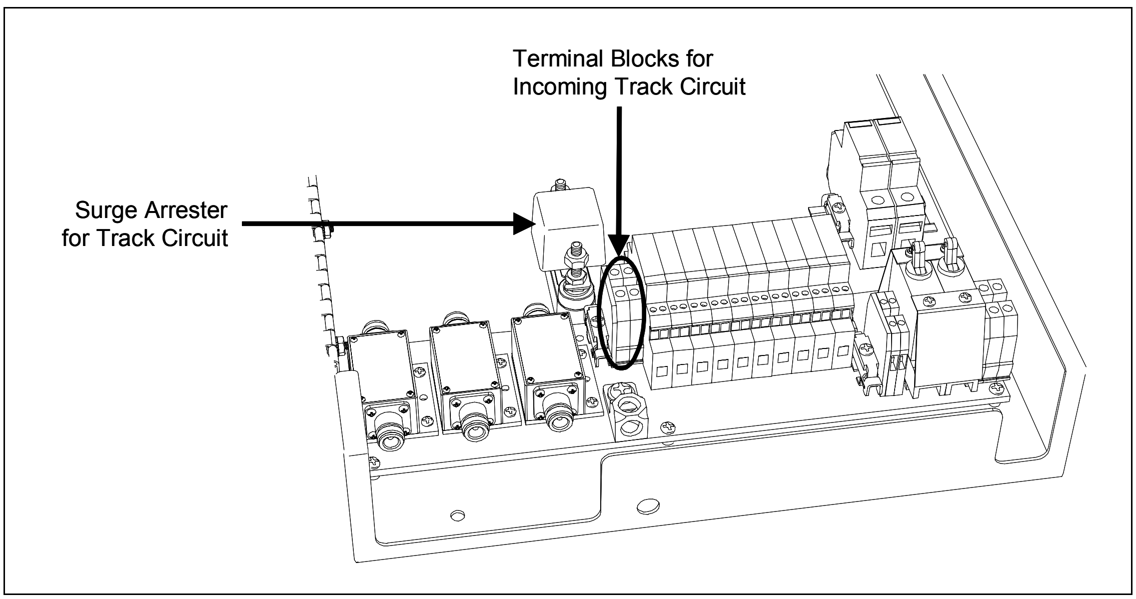
5 Using a wire stripper, remove 1/4 inches (6.4 millimeters) of insulation from the ends of both wires coming from the track circuit.

6 Using ring terminals, crimp one terminal to the end of each of these wires.

7 Fasten one ring terminal to the left side of the terminal block.

8 Fasten the other ring terminal to the right side of the terminal block.

On the Surge Protection Subassembly (in the SmartScanIS enclosure) are two terminal blocks (labeled **SOTC**). One is red and the other is black.



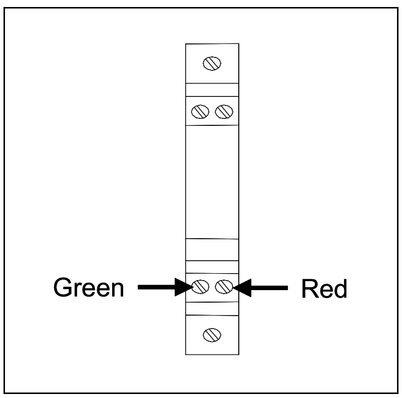
9 Wire from the terminal block to the appropriate terminal blocks on the Surge Protection Subassembly.

8.9 Telephone

Not all sites have telephone service. When present, there is one telephone line per site. If your site doesn't have telephone service, skip this section and go to ***8.10 Shielded Temperature Probe***.

The telephone service provider should terminate their drop on a lightning arrester terminal on the service pole. From the lightning arrester block, run a four-wire service cord to the bungalow and route it to the Surge Protection Subassembly (in the SmartScanIS enclosure). At double-track sites, the service cord is routed to the leftmost SmartScanIS enclosure.

On the Surge Protection Subassembly (in the SmartScanIS enclosure), the UTB labeled **TelCo** is for the telephone line. This UTB protects the SmartScanIS from transients and surges, which can be induced onto external wiring by lightning. The UTB has four rows of connectors. The wires from the incoming telephone line are terminated at the third row of connectors from the top. The second row from the top is wired at the factory. The green wire of the incoming telephone line is terminated on the left. The red wire is terminated on the right. The other two telephone wires aren't required for the SmartScanIS.



At double-track sites, a telephone line is connected to just one SmartScanIS enclosure. That means that only the SmartScanIS enclosure connected to the phone line can be communicated with remotely. However, each SmartScanIS enclosure can still be communicated with locally.

8.10 Shielded Temperature Probe

The shielded temperature probe, which mounts to the outside wall of the bungalow, provides accurate temperature indications over a range of -49°F to +149°F (-45°C to +65°C). Site ambient temperature (at the time the train passed the site) is included with most system reports.

The system supplies 12 volts to the shielded temperature probe. The probe returns 0 to 5 volts. Zero volts indicate a -49°F (-45°C) reading. Five volts indicate a +149°F (+65°C) reading. During normal operation, you should probably never get either reading. Therefore, if you get a -49°F (-45°C) reading, the probe could be malfunctioning, the cable from the probe to the system could be cut, or the wiring to terminal block on the System Interface board could be disconnected. If you get a +149°F (+65°C) reading, the probe could be malfunctioning or the ground wire from the probe to the system could be cut.

There is one shielded temperature probe per system. To install this probe:

1 Be sure that you have on hand the customer-supplied fasteners needed to attach the shielded temperature probe to the outside of the bungalow; a wire stripper; and the fasteners needed to attach the RF-filter assembly to the inside of the bungalow.

2 If you haven't done so already, remove the shielded temperature probe and the RF-filter assembly from its box.

3 Mount the probe onto the outside of the bungalow, preferably on the side of the enclosure where the SmartScanIS enclosure is mounted.

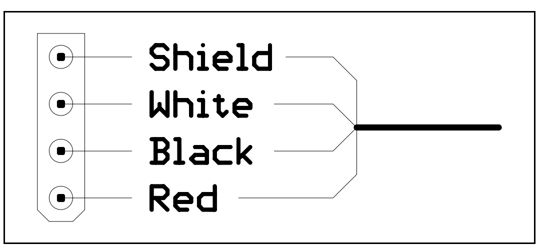
No matter where it is mounted, make sure the whole shielded temperature probe is in the top third of the enclosure.

4 Route the cable from the probe to the SmartScanIS enclosure.

In sheet metal, use a rubber grommet in every hole through which you route the cable.

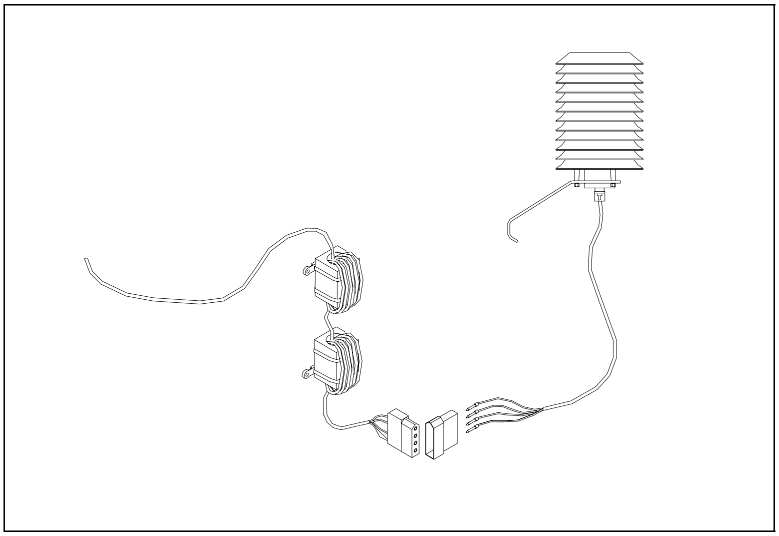
At a single-track site, the cable is routed to the bottom of the SmartScanIS enclosure. At a double-track site, the cable is routed to the bottom of the leftmost SmartScanIS enclosure.

5 As shown below, insert the four Molex pins (on the end of the cable of the probe) into the supplied Molex housing.



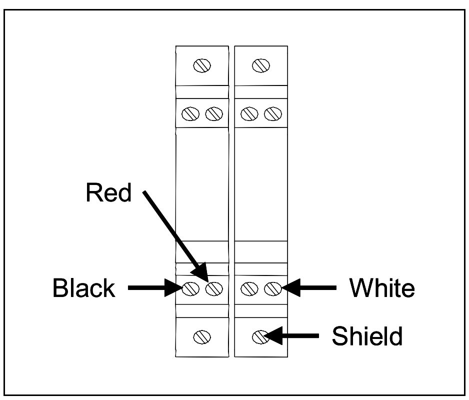
The red wire supplies 12 VDC to the shielded temperature probe.

6 Mate the Molex housing (on the end of the cable of the probe) to the factory-wired Molex socket on the end of the RF-filter assembly.



7 Using a wire stripper, remove 1/4 inches (6.4 millimeters) of insulation from the ends of the four wires coming from the other end of the RF-filter assembly.

On the Surge Protection Subassembly (in the SmartScanIS enclosure), the two UTBs labeled **TempProbe** are for the shielded temperature probe. Each UTB has four rows of connectors. As shown below, the wires from the shielded temperature probe are terminated at the third row and fourth row of connectors from the top. The other connectors on these UTBs are prewired at the factory and need no further wiring.



8 As shown above, terminate the wires from the end of the RF-filter assembly.

9 Mount the two filters of the RF-filter assembly onto the inside of the bungalow.

8.11 Radio Antenna

There is one radio per track. For a radio to work properly, it needs an antenna.

When installing the radio antenna, follow the directions that came with your antenna and:

1 Mount the antenna onto the outside of the bungalow, preferably on the roof of the bungalow.

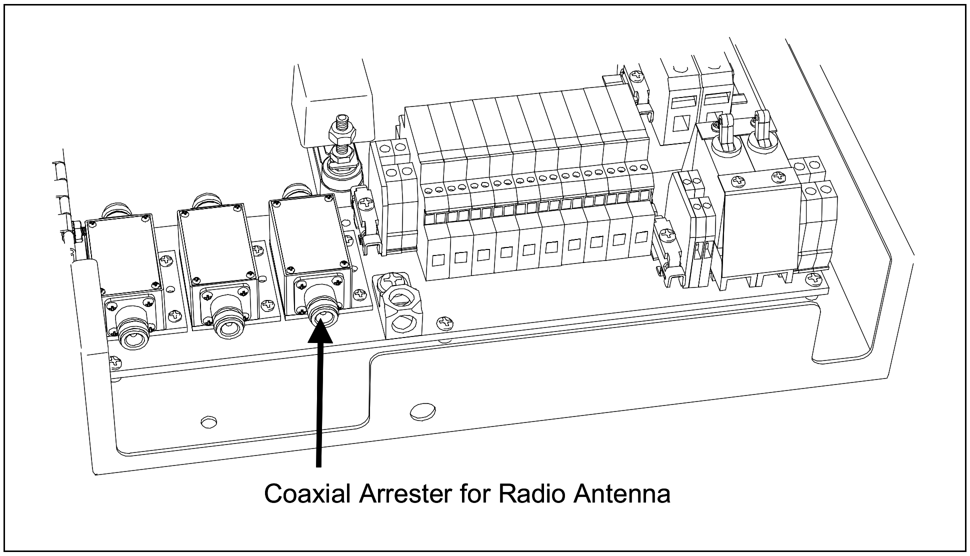
If you mount it on the side of the bungalow, make sure the entire antenna is above roofline.

2 Route the coaxial cable from the antenna-mounting base to the SmartScanIS enclosure.

In sheet metal, use a rubber grommet in every hole through which you route the cable.

3 Install an N-type plug onto the end of the cable.

4 Connect this plug to the coaxial arrestor on the Surge Protection Subassembly (in the SmartScanIS enclosure).



5 If this is a single-track site, go to ***8.12 AEI Antennas***.

6 If this is a double-track site:

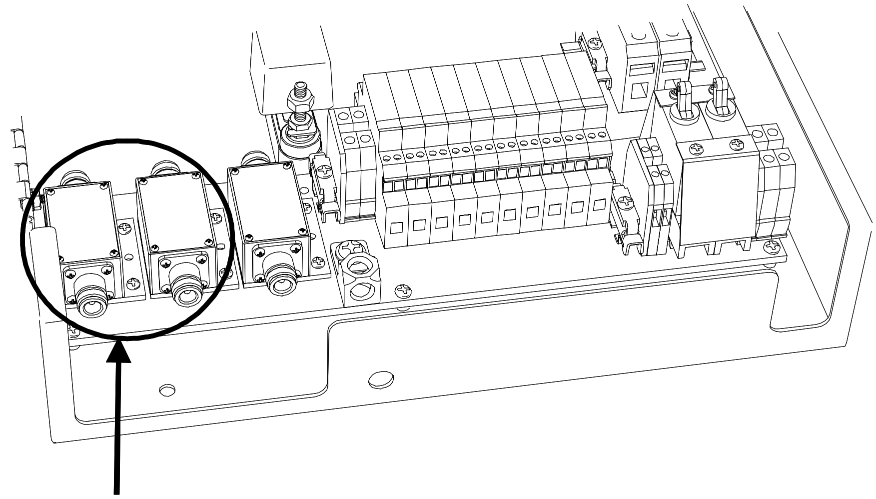
a Repeat steps **1** through **4** for the radio in the other SmartScanIS enclosure.

b Go to ***8.12 AEI Antennas***.

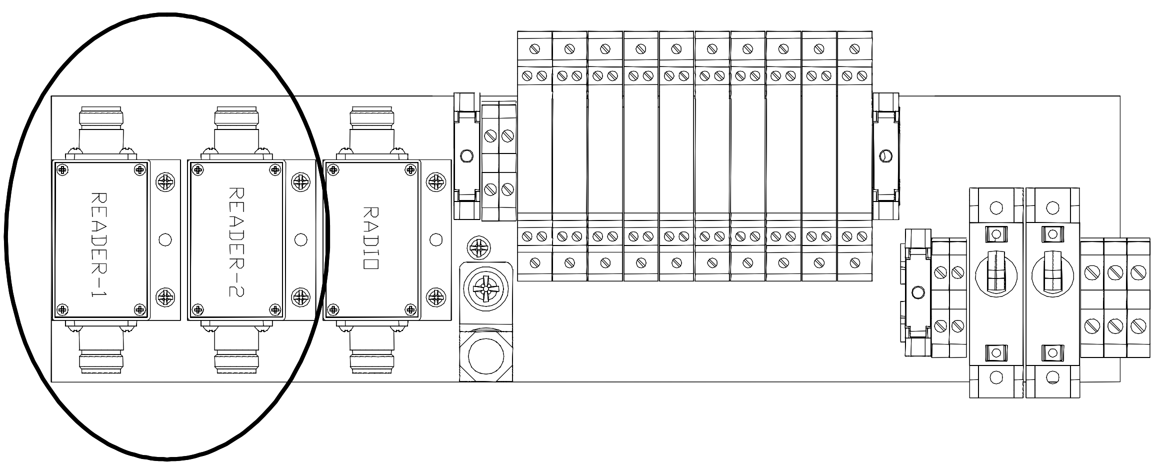
8.12 AEI Antennas

Not all sites have AEI antennas. When present, there are two AEI antennas per track. If your site doesn't have AEI antennas, skip this section and go to ***8.13 Batteries***.

Connect the cable from each AEI antenna to its respective coaxial arrestor on the Surge Protection Subassembly (in the SmartScanIS enclosure). The northmost or eastmost antenna, **antenna1**, connects to reader1. The southmost or westmost antenna, **antenna2**, connects to reader2. This standard must be adhered to for the SmartScanIS to function properly.



Coaxial Arresters for AEI Antennas



8.13 Batteries

The battery subsystem is usually made up of two 12-volt 115-ampere-hour batteries. These batteries should be wired in a series arrangement so that they supply 24 volts with a capacity of 115 ampere-hours. The use of smaller batteries reduces the amount of time that the system can continue to operate after AC power is removed. The use of larger batteries or more than two batteries may exceed the charging capacity of the Power Supply module and could result in its failure.

> **WARNING**
>
> Battery posts, terminals, and related accessories contain lead and lead components, chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm. So, as a minimum, wash your hands after handling batteries.

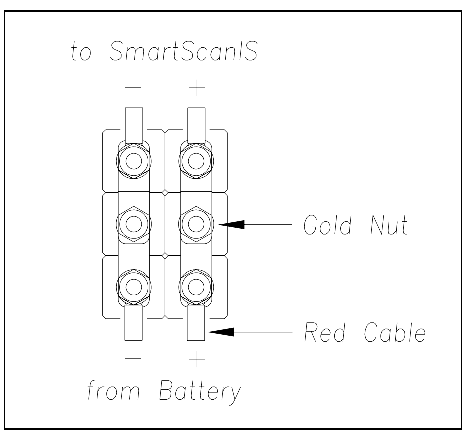
> **WARNING**
>
> Once the batteries are attached to the battery block, touching the terminals of the battery block with a piece of metal could short both batteries. Shorting takes place when you touch any right-sided terminal and any left-sided terminal at the same time. So be careful when using uninsulated tools around the battery block.

The following instructions assume that the batteries, wiring, and optional battery block are supplied by STC. Those materials may be supplied by the customer. In that case, the connections may be different, but these instructions should still serve as a guide.

There are two batteries per system. To install the batteries on a system using a battery block:

1 Be sure you have on hand a 9/16-inch open-end wrench, a 1/2-inch insulated socket wrench, a wire cutter, a wire stripper, a pliers-type crimping tool, a 1/2-inch nutdriver, a midsize slotted screwdriver, two batteries, the optional six-terminal battery block, wiring, and six ring terminals.

2 Using a 1/2-inch insulated socket wrench, loosen the middle gold nut on the right side (that is, the side with the red cables) of the battery block.



3 Cut a red-black 10 AWG 2-conductor wire to fit **between the battery and the battery block**.

4 Using a wire stripper, remove 1/4 inches (6.4 millimeters) of insulation from both ends of both conductors.

5 Using a pliers-type crimping tool, crimp one ring terminal to the end of each of these four conductors.

6 If you haven't done so already, remove the two batteries from their boxes.

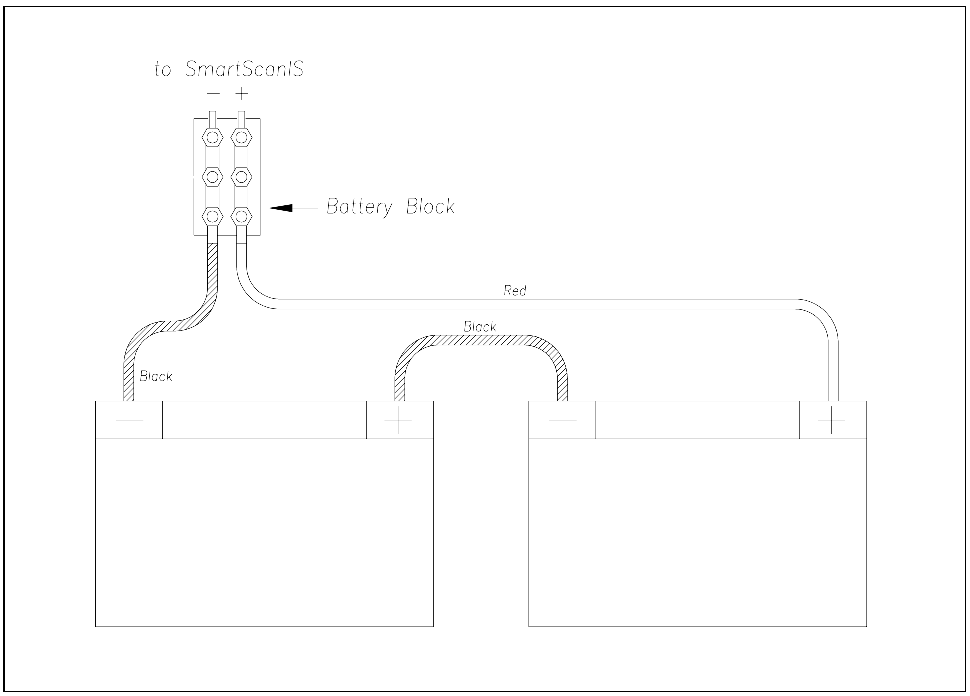
7 Place the batteries on the floor below the battery block.

To prevent damage to the system, attach the red wire before the black wires.

8 Using a 1/2-inch nutdriver, connect the red wire from the positive battery post to the left side of the battery block.

9 Using a 1/2-inch nutdriver, connect the black wire from the negative battery post to the right side of the battery block.

Your connections should now look like this.



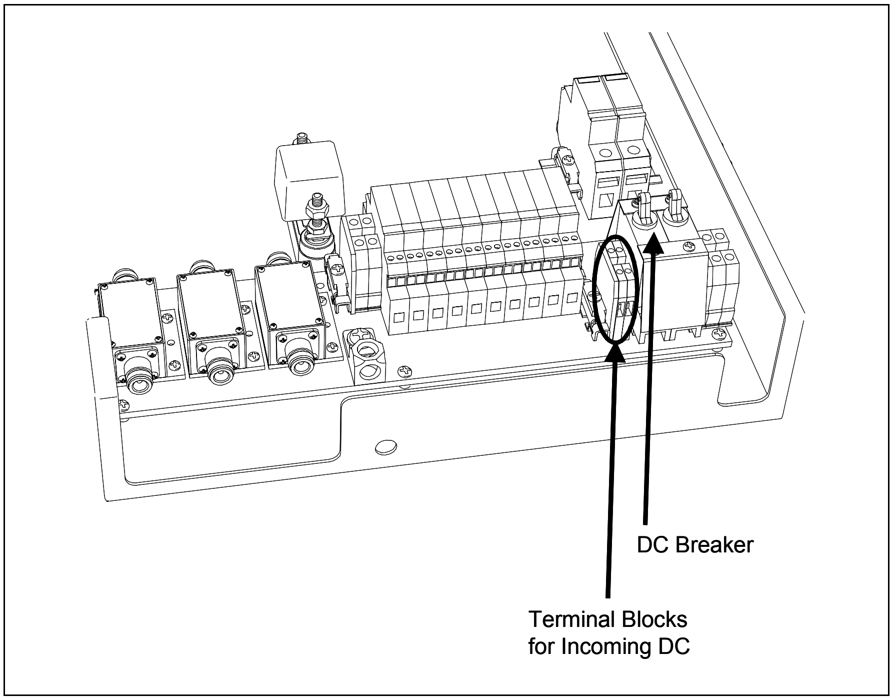
10 Cut a red-black 10 AWG 2-conductor wire to fit **between the battery block and the SmartScanIS enclosure**.

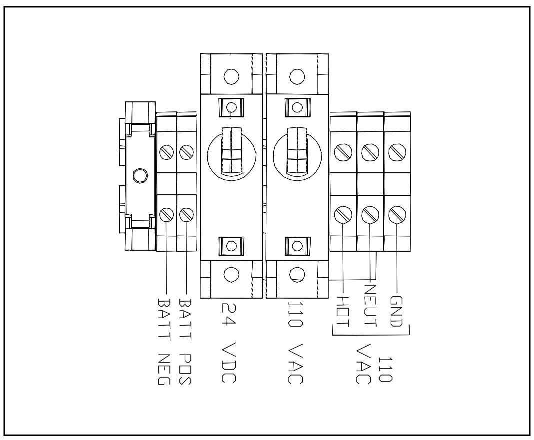
11 Using a wire stripper, remove 1/4 inches (6.4 millimeters) of insulation from both ends of both conductors.

12 Using a pliers-type crimping tool, crimp a ring terminal to the end of the red conductor and another ring terminal to the same end of the black conductor.

The end with the ring terminals attaches to the battery block. The other end attaches to the terminal blocks in the SmartScanIS enclosure. The red conductor (positive) is attached to the red terminal block and the black conductor (negative) to the black terminal.

The figures below show the location of the terminal blocks for incoming DC.





13 Using a 1/2-inch nutdriver, connect the red wire from the positive terminal block to the left side of the battery block.

14 Using a 1/2-inch nutdriver, connect the black wire from the negative terminal block to the right side of the battery block.

15 If this is a single-track site, go to ***8.14 Wind Monitor***.

16 If this is a double-track site:

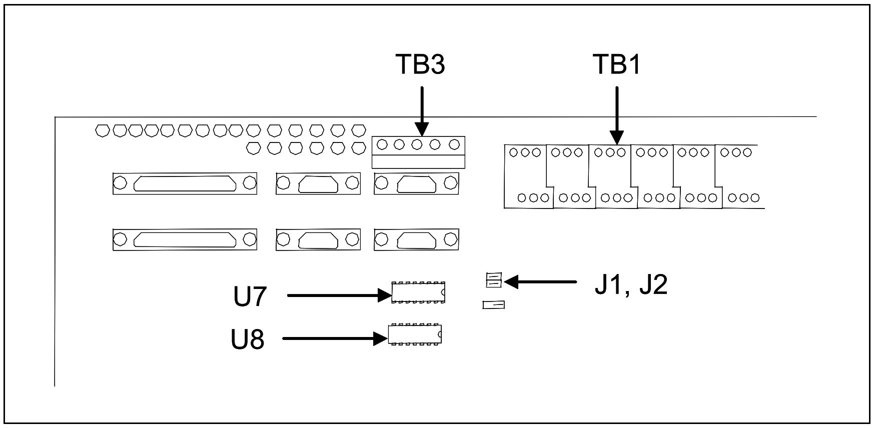
a Repeat steps **1** through **14** for the batteries that power the other SmartScanIS enclosure.

b Go to ***8.14 Wind Monitor***.

8.14 Wind Monitor

Not all sites have a wind monitor. When present, there is one wind monitor per site. If your site doesn't have a wind monitor, skip this section and go to the next chapter.

The R.M. Young Model 09101 Wind Monitor communicates via an RS485 connection, which the SmartScanIS supplies through the communication port provided by terminal block **TB3** on the System Interface board.



Using the wind monitor involves configuring the SmartScanIS and connecting the wind-monitor hardware.

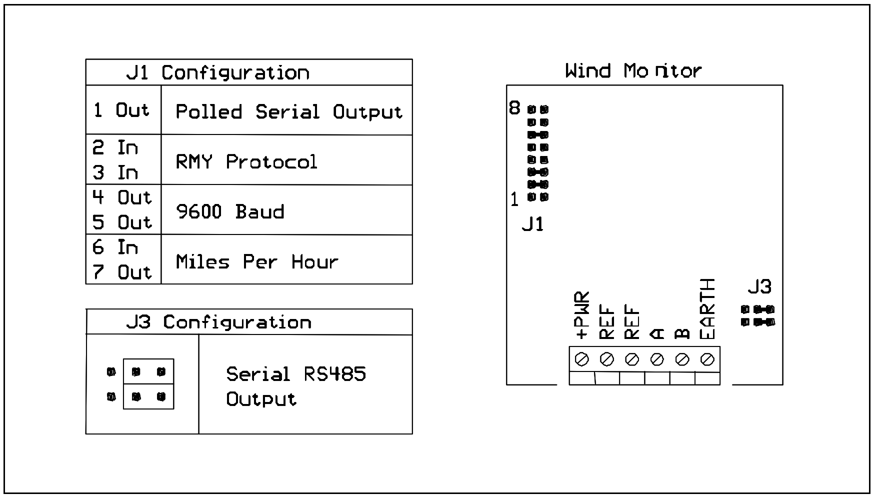
Configuring the SmartScanIS for RS485 Communication

- The baud rate used by the RS485 port must match the baud rate used by the wind monitor. Currently, the RS485 port defaults to 9600 baud.
- Headers must be installed onto the **J1** and **J2** jumpers. These headers should run vertically (that is, one header should connect the upper-left and lower-left pins and one header should connect the upper-right and lower-right pins). SmartScanIS units ship from STC in this configuration.
- For System Interface boards released before 2004, the chips contained in the **U7** and **U8** sockets must be configured for RS485 communications. To configure them, the **U7** socket must be empty and the **U8** socket must contain a 489 communication chip. For System Interface boards released in 2004 or later, this is no longer required. This is because, the newer boards contain a jumper for selecting between RS232 and RS485 on COM1. The newer boards also have chips installed into both the **U7** and **U8** sockets.
- Because the SmartScanIS hardware and firmware supports RS485 communication, no RS232/RS485 converter is needed.

Connecting the Wind-Monitor Hardware

Attaching the wind monitor to the SmartScanIS involves four wires and two resistors. Making the RS485 connection to the SmartScanIS involves using two of its TB3 terminals. One terminal is labeled RX and the other one is labeled RX with a bar over it. In the bulleted list below, they are referred to as RX and RX-BAR, respectively.

- Connect the wind monitor's **EARTH** terminal to an earth ground.
- Connect the wind monitor's **+PWR** terminal to a 12-volt power source.
- Connect the wind monitor's leftmost **REF** terminal to ground.



- Connect the wind monitor's **A** terminal to the SmartScanIS's **RX** terminal.
- Connect the wind monitor's **B** terminal to the SmartScanIS's **RX-BAR** terminal.
- Connect a 2200-ohm resistor (red-red-red-gold) between the wind monitor's **+PWR** terminal and **A** terminal.
- Connect a 2200-ohm resistor (red-red-red-gold) between the wind monitor's leftmost **REF** terminal and **B** terminal.

The firmware doesn't poll the wind monitor while the user is using the serial interface. Otherwise, the firmware polls the wind monitor every 15 seconds.

Chapter 9
Some Final Activities

This chapter describes some of the final things that need to be done before placing a SmartScanIS into service.

9.1 Checking the Trackside Components

To check the correctness of the installation of the trackside components:

1 Be sure that you have on hand a tape measure, a 9/16-inch torque wrench, and the alignment fixture.

2 At trackside, check track conditions on all tracks.

3 If any track is pumping (vertical displacement of the rails) or running (lateral displacement of the rails) more than 2 inches (5 centimeters), have it repaired before proceeding.

4 At trackside, check that all the track-mounted hardware has been installed properly.

5 If any piece of the track-mounted hardware isn't installed or isn't installed properly, install it properly before proceeding.

Chapter 6 - Installing the Track Components tells how to install the scanners, transducers, and track circuit. Trackside installation of dragging-equipment detectors and other auxiliary-alarm detectors isn't covered in this guide.

6 At trackside, check all transducer-mounting bolts on all tracks to make sure that all transducers are snug against the rail.

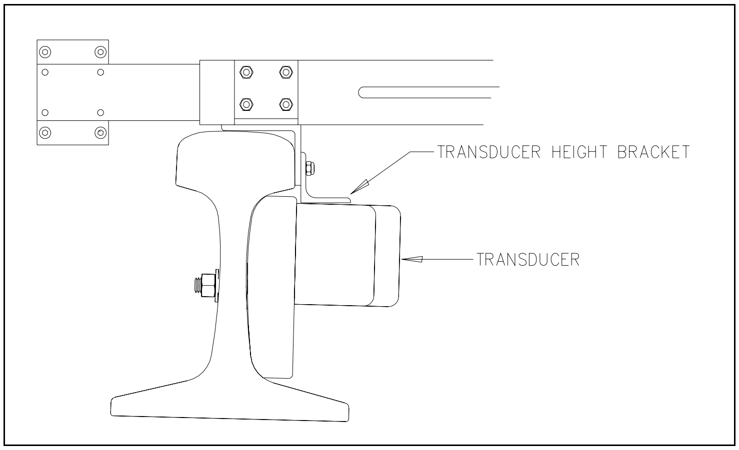
Four bolts are needed to hold the transducer in place. Two square-head bolts go through the mounting plate and transducer body. Two hex-head bolts go through the mounting plate and rail. If any of these bolts are sheared or missing, they must be replaced with the correct replacement bolt. Also, if any washers or nuts are missing, they must be replaced.

7 If all transducers aren't snug against the rail, fix this problem before proceeding.

Each installed transducer body should be 1-9/16 inches (3.97 centimeters) below the top of the rail and parallel to it. Checking for these characteristics should be done with the transducer height bracket on the bottom of the alignment fixture.

8 Place the alignment fixture across both rails, centered over each transducer in turn.

9 Check if each transducer body just touches the bracket.



The fixture should be snug against the top and gauge of both rails. This may be impossible if the transducer body is less than 1-9/16 inches (3.97 centimeters) below the top of the rail or if the transducer body isn't parallel to the top of the rail.

10 If a transducer body doesn't just touch the bracket:

a Loosen the nuts holding the transducer body to its mounting plate.

b By sliding it up and down, adjust the transducer body to the proper height.

c Tighten each hex nut with a 9/16-inch torque wrench to a **torque of 8 to 10 foot-pounds (10.8 to 13.6 newton-meters)**.

Don't exceed a torque of 10 foot-pounds (13.6 newton-meters). Doing so can weaken or break a bolt, requiring the bolt to be replaced.

11 At the trackside, check all scanner-mounting bolts on all tracks.

12 If all scanner mounts aren't snug against the gauge side of the rail, fix this problem before proceeding.

13 From under all scanners, remove ballast that could damage the scanners during train passage.

14 Remove all obstructions to the scan path of each scanner.

9.2 Checking the Bungalow Components

To check the correctness of the installation of the bungalow components:

1 If the radio antenna and the shielded temperature probe haven't been mounted to the outside of the bungalow, mount them.

Chapter 8 - Installing the Bungalow Components tells how to install the radio antenna and the shielded temperature probe.

2 If the bungalow isn't attached to a properly installed outside grounding system, fix this problem before proceeding.

   Chapter 8 - Installing the Bungalow Components tells how to ground the SmartScanIS.

3 Check that all bungalow components have been installed properly.

4 If any component of the bungalow isn't installed or isn't installed properly, install it properly before proceeding.

   Chapter 8 - Installing the Bungalow Components tells how to install the bungalow components.

5 Inside the bungalow, check that there are no loose wires or cables.

6 If there are any loose wires or cables, fix this problem before proceeding.

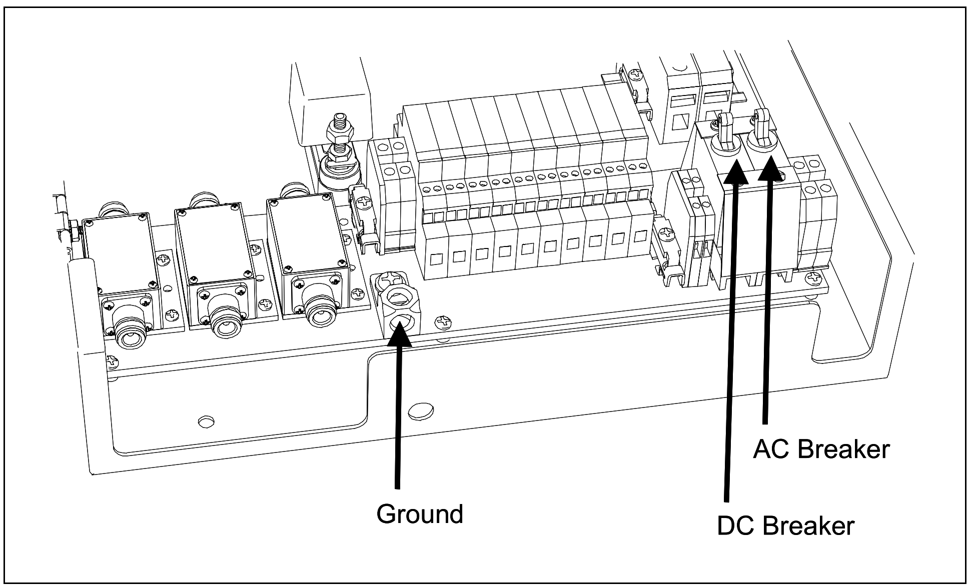
9.3 Powering-up the SmartScanIS

To power-up the SmartScanIS:

1 Be sure that you have on hand a multimeter and a 1/2-inch insulated socket wrench.

2 Open the door on the SmartScanIS enclosure.

3 On the Surge Protection Subassembly, toggle off both breakers.



4 If the SmartScanIS enclosure hasn't been properly grounded, fix this problem before proceeding.

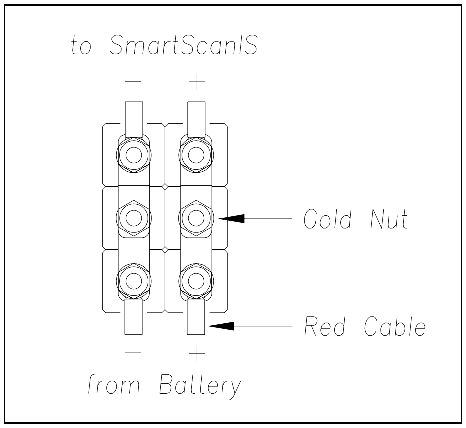
5 Switch on the AC power to the bungalow.

6 At all outlets, verify that the AC power is stable and at least 110 volts at 20 amperes.

7 If the AC power isn't stable or if it isn't at least 110 volts at 20 amperes, fix this problem before proceeding.

8 Plug in the SmartScanIS enclosure.

9 Using a 1/2-inch insulated socket wrench, tighten the middle gold nut on the right side (that is, the side with the red cables) of the battery block, which is usually mounted below the SmartScanIS enclosure.



WARNING

In operation, batteries generate and release flammable hydrogen gas, which, if ignited by a burning cigarette, naked flame, or spark, may cause battery explosion with dispersion of casing fragments and corrosive liquid electrolyte. So, carefully follow manufacturer's instructions for installation and service. Keep all sources of gas ignition away from the batteries and do not allow metallic articles to contact the negative and positive terminals of a battery at the same time.

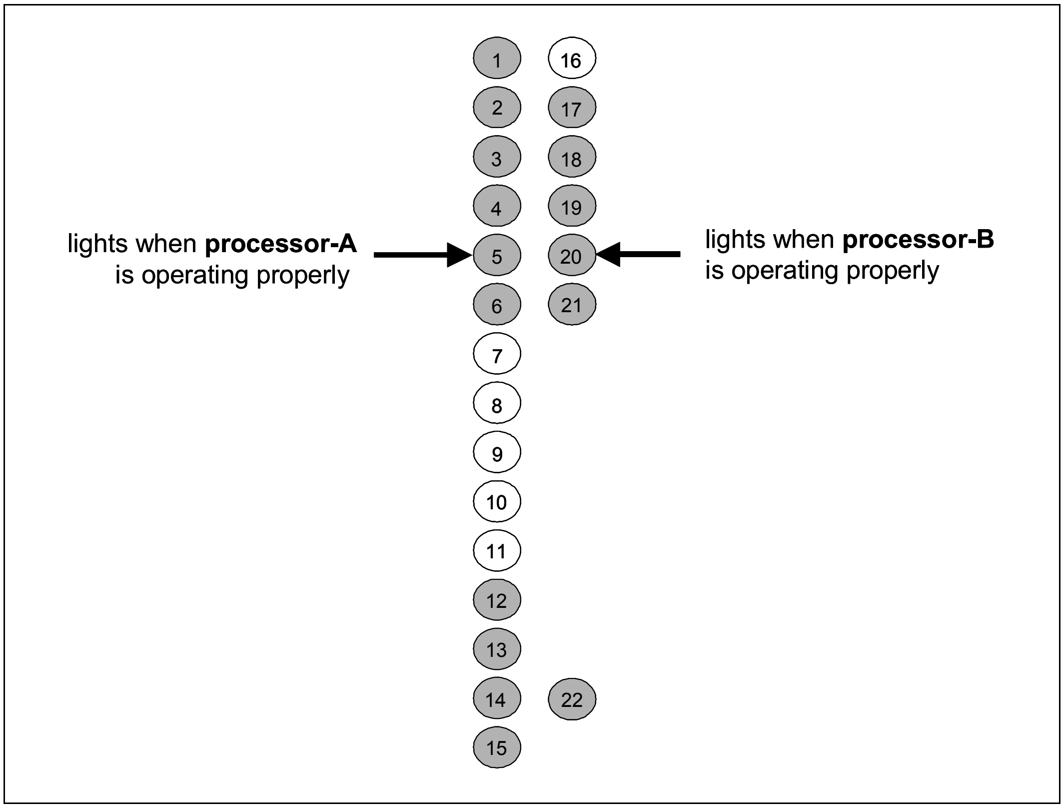
WARNING

A damaged or aged battery, in combination with the connected battery charger, can pose a serious health threat. The battery can produce hydrogen sulfide gas, which is characterized by its unique "rotten egg" smell. So, when a strong sulfurous odor is detected, remove power to the battery charger and check the battery for excessive heating. Do not inhale the fumes.

10 On the Surge Protection Subassembly, toggle on both breakers.

11 Observe the bank of status LEDs on the System Interface board.

On or before 10 seconds, LEDs 5 and 20 should begin to fade slowly off and on.

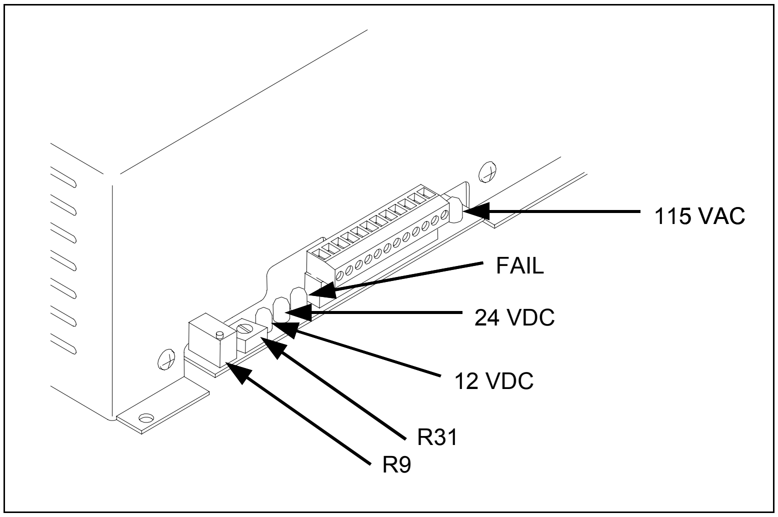


12 After 10 seconds, if LEDs 5 and 20 aren't fading off and on, call STC for help in isolating and fixing the underlining problem.

13 Close the door on the SmartScanIS enclosure.

9.4 Adjusting the Battery Float Voltage

On the front of the 2200-205 Power Supply, potentiometer **R9** is used to adjust the battery float voltage. It was factory adjusted to 28 VDC. At the site, when the voltage is not between 27.8 and 28.2, adjust R9 until a multimeter shows 28 VDC at terminal 4 on TB1 on the Power Supply module. You can do this by turning R9 clockwise to increase the voltage or counterclockwise to decrease the voltage. The batteries must be disconnected while setting the float voltage.



To adjust the battery float voltage:

1. Be sure that you have on hand a multimeter.
2. If the **115 VAC** and **24 VDC** LEDs on the edge of the 2200-205 Power Supply module aren't lit, fix this problem before continuing.
3. Toggle off the DC breaker.
4. Switch the multimeter to the DC volts scale.
5. Touch the black lead of the multimeter to terminal 3 on the Power Supply module.
6. Touch the red lead to terminal 4 on the Power Supply module.
7. If the voltage isn't between 27.8 and 28.2, adjust the potentiometer **R9** (on the Power Supply module) until the multimeter shows 28 VDC.

   Turn R9 clockwise to increase voltage. Turn it counterclockwise to decrease voltage.
8. Toggle on the DC breaker.

9.5 Adjusting the Track Circuit

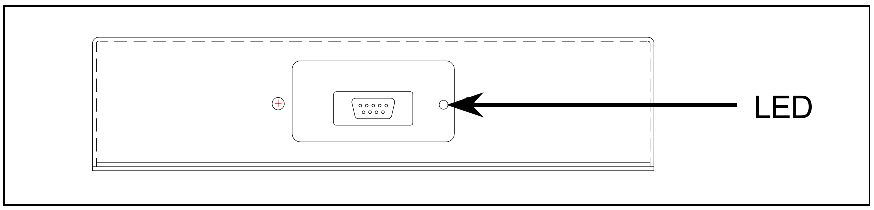
To checkout and adjust the SOTC:

1. From the center of the gating transducer farthest from the track circuit, measure the shortest distance you want the track circuit to pick up the presence of a train.

   The distance must be at least 15 feet (4.6 meters) and no more than 150 feet (45.7 meters).

2. At the point just measured, place a hardwire shunt across both rails.

   When lit, the LED (on the front of the 2200-500 Presence Detector module) indicates a received pulse from the track circuit.



3. Using a small slotted screwdriver, turn potentiometer **R24** (on the back of the Presence Detector module) until the LED (on the front of the Presence Detector module) goes out.
4. Using a small slotted screwdriver, turn potentiometer **R24** until the SOTC relay just picks up the pulse from the track circuit.

   The relay just picks up the pulse when the LED (on the front of the Presence Detector module) first lights.

5. Place a hardwire shunt across both rails at the point two feet beyond the measured point (that is, two feet farther from the gating transducer).
6. If the LED (on the front of the Presence Detector module) is still lit, return to step **1**.
7. Remove the hardwire shunt.

9.6 Calibrating the Scanners

The SmartScanIS self-calibrates its pyrometer interface circuitry. You need only put a preheated calibrated heat source on a scanner and place the system in autocalibration mode. The system then scans all pyrometer inputs until the signal from the calibrated heat source is located. The necessary adjustments to the related interface circuitry are automatically made while the system monitors its own progress by analyzing changes in the heat signals. Once the procedure has been completed, autocalibration mode is disengaged and the calibration results are displayed on your computer. The next two sections contain details for calibrating the bearing and wheel scanners.

9.6.1 Bearing Scanners

STC recommends that you use the calibrated heat source (2100-810NG) only when the outside (ambient) temperature is above 0°F (-18°C) and below 90°F (32°C). If you must use it at other times, do so only when the needle is centered on the front of the temperature meter. If the needle isn't stabilized within ± 2 degrees of set point, the heat source isn't operating properly.

To calibrate the bearing scanners:

1. Be sure that you have on hand a STC calibrated heat source and a laptop computer.
2. On the control panel of the calibrated heat source, toggle the **Gating** switch off.
3. Plug the proper end of the calibrated heat source cable into the **six**-contact circular connector on the front of the calibrated heat source.
4. Plug the other end of the calibrated heat source cable into a grounded three-wire 110-120 VAC outlet in the bungalow.

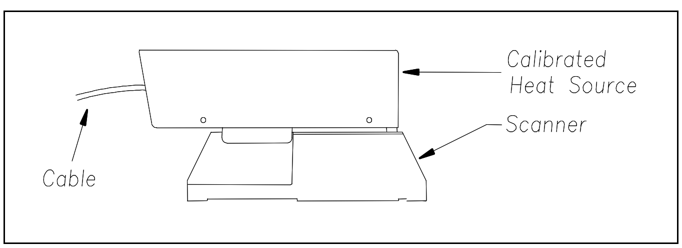
   The function connector that is not being used has live AC present.

5. Cover the function connector that is not being used with the supplied dust cover.
6. On the control panel, turn the temperature knob to **180**.
7. Put the heat source in a shady area, out of direct sunlight.
8. Wait about 8 minutes for the heat source to reach operating temperature and stabilize.

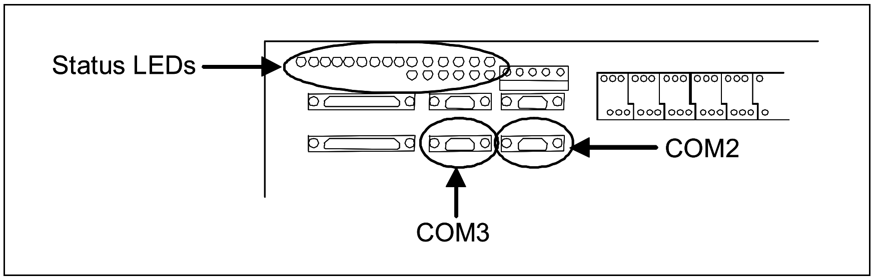
   The heat source has reached operating temperature and stabilized when the temperature meter needle remains centered.

   Once the temperature stabilizes, calibration may begin. Once stabilized, the temperature will change less than plus-or-minus one degree Fahrenheit.

9. Take the calibrated heat source to the bearing scanner on the north or east rail.
10. With the power cord to the front of the scanner, place the calibrated heat source on the scanner.



11 If COM3 has nothing plugged in it, plug your computer into it.



12 If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

13 Be sure that the laptop computer is turned on, that it has appropriate communications software installed, that the communications software is set to use full duplex, that the baud rate is set to 9600, and that a LOG file is opened.

The baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

14 Using the serial interface, display the Main menu.

Chapter 11 - Serial Interface tells how to display the Main menu. The Main menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

15 To display the Setup menu, type **i**

The Setup menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System
  J) Serial Ports
  K) Amtech Reader Parameters
  L) Modem Setup
  X) Exit Menu
?
```

16 To display the System Functions menu, type **h**

The System Functions menu appears.

```
STC Integrated Detector System, Milepost-1234.5, Track:Single
09/30/2004 16:58
System Functions Menu
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
  E) Auto-Calibration
  F) Reset the COP Counters
  G) Remote System RESET
  H) Clear All Stored Train Data
  I) Clear Event Log
  J) Send JC Message
  K) Send JM Message
  L) Send JP Message
  M) Send JS Message
  N) Real-Time Diagnostics
  X) Exit Menu
?
```

17 To start autocalibration, type **e**

The SmartScanIS will now calibrate itself. Follow along on the user interface screen until you see "Auto-Calibration Disengaged." This message is an indication that the system is finished with the calibration procedure. To abort the process, press **[Esc]** (on your computer) or remove the heat source (from the scanner).

18 When "Auto-Calibration Disengaged" is displayed on your computer, remove the calibrated heat source.

19 Take the calibrated heat source to the bearing scanner on the south or west rail.

20 With the power cord to the front of the scanner, place the calibrated heat source on the scanner.

21 Repeat steps **17** through **18**.

22 To return to the Setup menu, type **x**

23 To return to the Main menu, type **x**

24 To exit the serial interface and return the system to normal operation, type **x**

25 If this is a single-track site, store the calibrated heat source and its cable in the bungalow.

26 If this is a double-track site:

- **a** Repeat steps **1** through **24** for the second track.
- **b** Store the calibrated heat source and its cable in the bungalow.

9.6.2 Wheel Scanners

Not all sites use wheel scanners. If your site doesn't use them, skip the instructions below and go to section ***9.7 Checking the Broadcast***.

STC recommends that you use the calibrated heat source (2100-810NG) only when the outside (ambient) temperature is above 0°F (-18°C) and below 90°F (32°C). If you must use it at other times, do so only when the needle is centered on the front of the temperature meter. If the needle isn't stabilized within ± 2 degrees of set point, the heat source isn't operating properly.

To calibrate the wheel scanners:

1 Be sure that you have on hand a STC calibrated heat source and a laptop computer.

2 On the control panel of the calibrated heat source, toggle the **Gating** switch off.

3 Plug the proper end of the calibrated heat source cable into the **six**-contact circular connector on the front of the calibrated heat source.

4 Plug the other end of the calibrated heat source cable into a grounded three-wire 110-120 VAC outlet in the bungalow.

The function connector that is not being used has live AC present.

5 Cover the function connector that is not being used with the supplied dust cover.

6 On the control panel, turn the temperature knob to **180**.

7 Put the heat source in a shady area, out of direct sunlight.

8 Wait about 8 minutes for the heat source to reach operating temperature and stabilize.

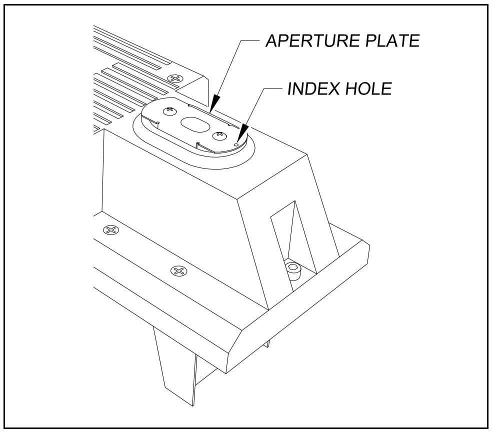
The heat source has reached operating temperature and stabilized when the temperature meter needle remains centered.

Once the temperature stabilizes, calibration may begin. Once stabilized, the temperature will change less than plus-or-minus one degree Fahrenheit.

Wheel scanners have either a plastic attenuation plug or a metal aperture plate.

9 If your wheel scanners use aperture plates:

a From one of the wheel scanners, loosen the two screws holding the aperture plate just enough so it can be removed from the scanner.



Do not completely remove the screws. If you do, the retainer clip will fall into the lower part of the scanner mount.

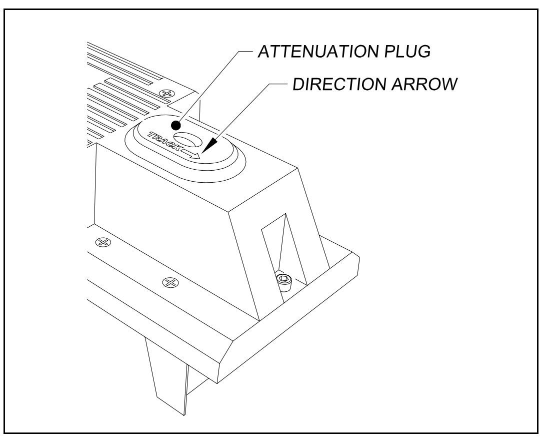
b Remove the plate.

c Store the plate in a safe place until you're ready to replace it.

d For the other wheel scanner, repeat steps **a** through **c**.

10 If your wheel scanners use attenuation plugs:

a From one of the wheel scanners, remove the plug.

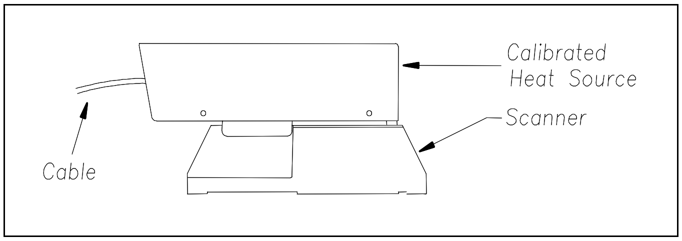


b Store the plug in a safe place until you're ready to replace it.

c For the other wheel scanner, repeat steps **a** and **b**.

11 Take the calibrated heat source to the wheel scanner on the north or east rail.

12 With the power cord to the front of the scanner, place the calibrated heat source on the scanner.



13 Using the serial interface, display the Main menu.

Chapter 11 - Serial Interface tells how to display the Main menu.

14 To display the Setup menu, type **i**

15 To display the System Functions menu, type **h**

16 To start autocalibration, type **e**

The SmartScanIS will now calibrate itself. Follow along on the user interface screen until you see "Auto-Calibration Disengaged." This message is an indication that the system is finished with the calibration procedure. To abort the process, press **[Esc]** (on your computer) or remove the heat source (from the scanner).

17 When "Auto-Calibration Disengaged" is displayed on your computer, remove the calibrated heat source.

18 Take the calibrated heat source to the wheel scanner on the south or west rail.

19 With the power cord to the front of the scanner, place the calibrated heat source on the scanner.

20 Repeat steps **16** and **17**.

21 To return to the Setup menu, type **x**

22 To return to the Main menu, type **x**

23 To exit the serial interface and return the system to normal operation, type **x**

24 If your wheel scanners use aperture plates, replace them both.

Each aperture plate has a small index hole in one end. This hole should be oriented toward the rail.

25 If your wheel scanners use attenuation plugs, replace them both.

Each attenuation plug has a direction arrow molded into the top of the plug. This arrow should be pointing toward the rail.

26 If this is a single-track site, store the calibrated heat source and its cable in the bungalow.

27 If this is a double-track site:

a Repeat steps **1** through **25** for the second track.

b Store the calibrated heat source and its cable in the bungalow.

9.7 Checking the Broadcast

The selection of the Radio Test option (of the System Functions menu) broadcasts a short message through the speaker (in the SmartScanIS enclosure) and through the radio. Similarly, the selection of the 1KHz Test Tone option (of the System Functions menu) broadcasts a continuous tone for about 15 seconds through the speaker and the radio. Using either of these options lets you verify that the speaker and radio are working properly.

At single-track sites, the text of the message is "Testing, U-P detector, milepost (milepost number), testing, one, two, three, four, five, four, three, two, one, testing detector-out." At double-track sites, the text of the message is "Testing, UP detector, milepost (milepost number), track (track designation), testing, one, two, three, four, five, four, three, two, one, testing, detector-out."

To check the operation of the speaker and the radio:

1 Be sure that the speaker (in the SmartScanIS enclosure) is plugged in and that its volume knob is turned to the middle position.

2 Using the serial interface, display the Main menu.

Chapter 11 - Serial Interface tells how to display the Main menu.

3 To display the Setup menu, type **i**

4 To display the System Functions menu, type **h**

The System Functions menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
  E) Auto-Calibration
           .
           .
           .
```

5 To start outputting either the phrases or the tones, type either **a** or **d**

If the system isn't currently making any other voice announcements, it begins the message or tone. If the system is currently making a voice announcement, the firmware waits until it is done to begin the message or tone.

6 If you hear nothing or the speech is too garbled to understand, call STC for help in fixing this problem.

7 To return to the Setup menu, type **x**

8 To return to the Main menu, type **x**

9 To exit the serial interface and return the system to normal operation, type **x**

10 If this is a double-track site, repeat steps **1** through **9** for the other track (that is, for the other SmartScanIS).

9.8 Checking the Speech Data

The selection of the Vocabulary Test option (of the System Functions menu) enunciates all of the stored speech phrases. This announcement is broadcast through the speaker (in the SmartScanIS enclosure), but not through the radio.

Below is a list of the phrases that are announced. The phrases are grouped by chip number.

Chip	Announced Phrases
1	Zero, One, Two, Three, Four, Five
2	Six, Seven, Eight, Nine, No-Defects
3	Detector-Malfunction, Point, Hotwheel, Testing
4	Axle, Dragging-Equipment-Near, North, Rail
5	South, East, West, Track, Hotbox
6	Defect-Detected, M-P-H, Fifth
7	Integrity-Failure, Detector-Out, Sixth
8	Rebroadcast, Train-Too-Slow, Total-Axles, Speed
9	A, B, C, D, E, Temperature, Length, Minus, First, Second
10	F, G, H, I, J, Third, Fourth, Left-Side, Right-Side, *beep*
11	K, L, M, N, O, High-Load, Wide-Load, On, Seventh, Eighth
12	P, Q, R, S, T, S-P-Detector, Milepost, Detector-Working
13	U, V, W, X, Y, Stop-Your-Train, U-P-Detector, Ninth
14	Z, Sliding-Wheel, Car-I-D, From-Head-of-Train, Degrees, Number
15	Multiple-Hot-Journal-and-Dragging-Equipment, Power-Off, High-Wide-Near
16	Detected-From-Axle, To-End-of-Train, Miles-Per-Hour, Multiple-Dragging-Equipment

To check the integrity of the speech data:

1 Be sure that the speaker (in the SmartScanIS enclosure) is plugged in and that its volume knob is turned to the middle position.

2 Using the serial interface, display the Main menu.

Chapter 11 - Serial Interface tells how to display the Main menu.

3 To display the Setup menu, type **i**

4 To go to the System Functions menu, type **h**

The System Functions menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
  E) Auto-Calibration
           .
           .
           .
```

5 From the System Functions menu, type **b**

If the system isn't currently making any other voice announcements, it begins the vocabulary-test announcement. If the system is currently making a voice announcement, the firmware waits until it is done to begin the vocabulary-test announcement.

6 If you hear nothing or the speech is too garbled to understand, call STC for help in fixing this problem.

7 To return to the Setup menu, type **x**

8 To return to the Main menu, type **x**

9 To exit the serial interface and return the system to normal operation, type **x**

10 If this is a double-track site, repeat steps **1** through **9** for the other track (that is, for the other SmartScanIS).

9.9 Checking the Number of Axles

To generate a test train to check the number of axles:

1 Quickly stroke the top of each gating transducer with a metal wrench, alternating between TO1 and TO2 for a total of **ten** simulated axles.

2 Wait for the system to time out and the shutters to close.

3 Produce a Last Train report.

Chapter 12 - Producing Reports tells how to produce this report. From the Main menu, you would type **f**.

The Last Train report is identical to the Train Detail report. The only difference is the way you specify the train on which you want a report. For this report, you don't specify a train. A report on the most current train is produced.

4 On the report, check that the number of axles agrees with the number of times that you stroked the gating transducers.

5 On the report, if the number of axles doesn't agree with the number of times that you stroked the gating transducers, call STC for help in fixing this problem.

6 If this is a double-track site, repeat steps **1** through **5** for the other track (that is, for the other SmartScanIS).

9.10 Checking for Hot Bearing

To generate a test train to check for hot bearings:

STC recommends that you use the calibrated heat source (2100-810NG) only when the outside (ambient) temperature is above 0°F (-18°C) and below 90°F (32°C). If you must use it at other times, do so only when the needle is centered on the front of the temperature meter. If the needle isn't stabilized within ± 2 degrees of set point, the heat source isn't operating properly.

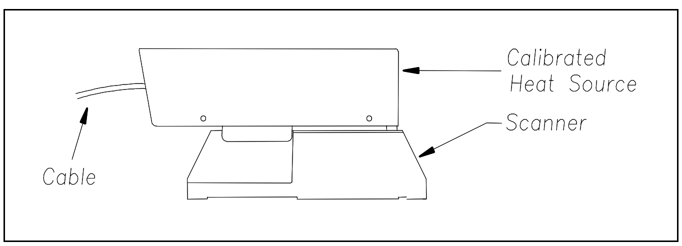
1 Ready the calibrated heat source.

The heat source has reached operating temperature and stabilized when the temperature meter needle remains centered.

2 Stroke both gating transducers four times, starting with TO1.

3 Stroke TO1 one more time.

4 With the power cord to the front of the scanner, place the calibrated heat source on the bearing scanner that is on the rail with the gating transducers.



5 Stroke TO2.

You should hear the real-time defect message from the radio.

6 Wait for the system to time out, which normally takes about 10 seconds.

You should hear an end-of-train message with one Hotbox alarm.

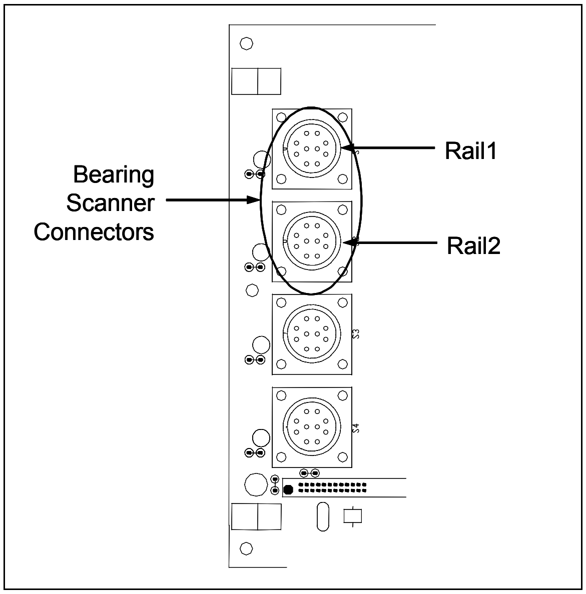
7 Listen to be sure that the Hotbox alarm was announced on the correct side and on axle five.

If you don't hear anything, no alarm-level heat was recorded. No measurable heat from a bearing scanner may be due to loose connections, a scanner not being connected on the Scanner Interface board, a defective shutter motor in the scanner, or a damaged scanner.

8 If you don't hear a Hotbox alarm being announced, fix this problem before proceeding.

9 If the Hotbox alarm is announced for the wrong side, switch the bearing scanner connections on the Scanner Interface board.

Plug the connector from the bearing scanner on rail1 (that is, from the north or east rail) into the first (top) box connector on the Scanner Interface board. Plug the connector from the bearing scanner on rail2 (that is, from the south or west rail) into the second box connector on the Scanner Interface board.



10 Repeat the test, this time placing the calibrated heat source on the bearing scanner on the opposite rail.

11 Verify the results as before.

If the results are correct, your system should function properly when scanning the bearings of real trains.

12 Remove the calibrated heat source.

13 If this is a double-track site, repeat steps **1** through **12** for the other track (that is, for the other SmartScanIS).

14 Store the calibrated heat source and its cable in the bungalow.

9.11 Checking Communication with Harriman Dispatch Center

To check communication with the Harriman Dispatch Center:

1. Using the serial interface, display the Main menu.

   Chapter 11 - Serial Interface tells how to display the Main menu.

2. To display the Setup menu, type **i**
3. To go to the System Functions menu, type **h**

   The System Functions menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
  E) Auto-Calibration
  F) Reset the COP Counters
  G) Remote System RESET
  H) Clear All Stored Train Data
  I) Clear Event Log
  J) Send JC Message
  K) Send JM Message
  L) Send JP Message
  M) Send JS Message
  N) Real-Time Diagnostics
  X) Exit Menu
?
```

4. If the Harriman Dispatch Center requests that the site send a Constant Carrier signal for 15 seconds, type **j**
5. If the Harriman Dispatch Center requests that the site send a Continuous Mark signal for 15 seconds, type **k**
6. If the Harriman Dispatch Center requests that the site send a Mark-Space pattern for 15 seconds, type **l**
7. If the Harriman Dispatch Center requests that the site send a Continuous Space signal for 15 seconds, type **m**
8. To return to the Setup menu, type **x**
9. To return to the Main menu, type **x**
10. To exit the serial interface and return the system to normal operation, type **x**
11. If this is a double-track site, repeat steps **1** through **7** for the other track (that is, for the other SmartScanIS).

9.12 Checking a Train Summary Report

To check a Train Summary report:

1 Be sure that at least three trains have passed over the site.

You aren't done (that is, you have not placed the system in service) until all the steps below are done.

2 Produce a Train Summary report.

Chapter 12 - Producing Reports tells how to produce this report. From the Main menu, you would type **a**.

The Train Summary report lists all trains currently stored in the Trains directory. A line of information is shown for each train entry. The report is divided into a header section and a detail section. The header section contains general information about the site. The detail section contains summary information on each train that passed the site.

3 On the Train Summary report, check the **Avg Bearing** heading.

Under this heading are two columns, one for each rail, containing the average temperature read by the bearing scanners. If track orientation is east and west, rails are north and south. If track orientation is north and south, rails are east and west.

4 If the columns aren't within four degrees, realign and recalibrate the bearing scanners.

Chapter 7 - Adjusting the Track Components tells how to align the scanners. Section ***9.6 - Calibrating the Scanners*** tells how to calibrate the scanners.

5 If you don't have wheel scanners installed at your site, go to step **8**.

6 On the Train Summary report, check the **Avg Wheel** heading.

This heading appears only when Hotwheel alarm reporting is enabled. Under it are two columns, one for each rail, containing the average temperature read by the wheel scanners. If track orientation is east and west, rails are north and south. If track orientation is north and south, rails are east and west.

7 If the columns aren't within four degrees, realign and recalibrate the wheel scanners.

Chapter 7 - Adjusting the Track Components tells how to align the scanners. Section ***9.6 - Calibrating the Scanners*** tells how to calibrate the scanners.

8 On the Train Summary report, check the **Axles** column.

Axle count should be an even number. Odd numbered axle counts are possible indications of gating transducer problems.

9 If there is an even axle count and the values under "Axles," "T01," and "TO2" are the same, skip the remaining steps.

If things are working correctly, all three values for a given train should be equal.

10 At trackside, check all transducer-mounting bolts on all tracks to make sure that all transducers are snug against the rail.

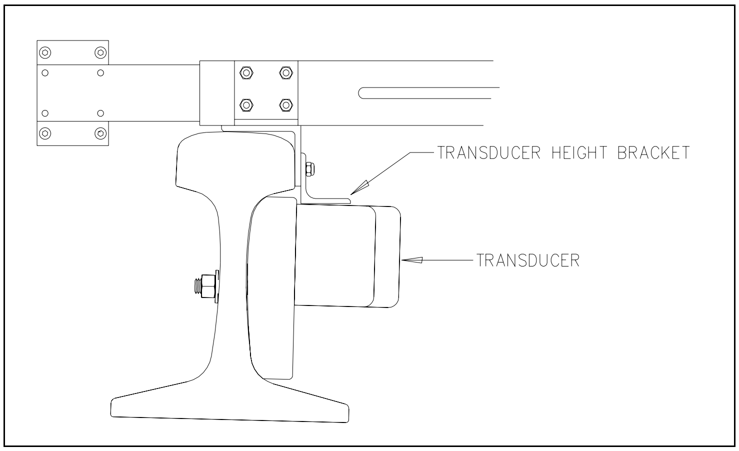
Four bolts are needed to hold the transducer in place. Two square-head bolts go through the mounting plate and transducer body. Two hex-head bolts go through the mounting plate and rail. If any of these bolts are sheared or missing, they must be replaced with the correct replacement bolt. Also, if any washers or nuts are missing, they must be replaced.

11 If all transducers aren't snug against the rail, fix this problem before proceeding.

Each installed transducer body should be 1-9/16 inches (3.97 centimeters) below the top of the rail and parallel to it. Checking for these characteristics should be done with the transducer height bracket on the bottom of the alignment fixture.

12 Place the alignment fixture across both rails, centered over each transducer in turn.

13 Check if each transducer body just touches the bracket.



The fixture should be snug against the top and gauge of both rails. This may be impossible if the transducer body is less than 1-9/16 inches (3.97 centimeters) below the top of the rail or if the transducer body is not parallel to the top of the rail.

14 If a transducer body doesn't just touch the bracket:

a Loosen the nuts holding the transducer body to its mounting plate.

b By sliding it up and down, adjust the transducer body to the proper height.

c Tighten each hex nut with a 9/16-inch torque wrench to a **torque of 8 to 10 foot-pounds (10.8 to 13.6 newton-meters)**.

Don't exceed a torque of 10 foot-pounds (13.6 newton-meters). Doing so can weaken or break a bolt, requiring the bolt to be replaced.

d Wait until three more trains have passed over the site and then return to step **1**.

15 If a transducer body just touches the bracket, call STC for help in fixing the problem that caused the values under "Axles," "T01," and "TO2" to be uneven.

Chapter 10
Defect Detection

This chapter describes the Exception Alarms (aka Defect Alarms and Train Alarms) and how they are detected. Miscellaneous train scanning features are also covered.

10.1 System Activation

System activation is the process used to detect train presence and to prepare for train scanning. It is during the scanning process that the system checks for defects.

The SmartScanIS is equipped with one of two primary means of train arrival detection, which are the track circuit or the advance transducers. In case of a failure in the primary detection method, the gating transducers act as a backup to detect train arrival. Once the system senses a train's presence, it enters scanning mode. In other words, the system has activated. It then opens the scanner's shutters and disables their heaters. It then waits for further evidence of a train at the site in the form of gating transducer activity.

Once the system is active, it reads pulses from the two rail-mounted gating transducers, which are designated TO1 and TO2. On the rail nearest the bungalow, these transducers are mounted near and to the north or east of the bearing scanner. TO1 is the gating transducer closest to the bearing scanner. TO2 is the one farthest from the bearing scanner.

The signals from these gating transducers indicate to the system that passing wheels are in view of the scanners. Furthermore, the speed of the train is determined by using the known distance between TO1 and TO2 versus the time required for a given wheel to pass over them.

Four axles must pass over the gating transducers for the system to consider the event a valid train. This prevents maintenance equipment from generating alarms and causing unwanted voice messages on the road channel.

10.2 System Deactivation

System deactivation is the process used to detect the moment that the train exits the site. This happens in one of two ways, which is dependent upon whether the track circuit or one of the transducers has activated the system.

If the system was activated by the track circuit, it waits for the track-circuit signal to be absent for ten seconds before deactivating. Likewise, if a transducer activated the system, it waits for ten seconds of inactivity from the gating transducers before deactivating.

10.3 Speed Calculation

A train's arrival speed and its exit speed are calculated. The exit speed is the speed shown on generated reports. The arrival and exit speeds are used by Union Pacific's Central Reporting System. The arrival speed is calculated based on the on times of the first eight axles. The exit speed is calculated based on the on times of the last eight axles. Calculated speeds over 99 mph (159 kph) are reported as 99 mph. If a train has fewer than eight axles, its speed is reported as 0 mph.

A train is called "slow" if its exit speed is 6 mph (9.7 kph). It is called "very slow" if its exit speed is less than 6 mph. Trains having an exit speed of 6 mph (9.7 kph) or less generate an Integrity Failure announcement. They also display an Integrity Failure message and either a "Slow Train" or a "Very Slow Train" message, under the System Alarms heading on the Train Detail and Exception Detail reports. However, if a Dragging-Equipment alarm is detected on a Slow or Very Slow train, no Integrity Failure announcement is made, and neither the "Slow Train" nor "Very Slow Train" message appears under the System Alarms heading. Messages generated by any additional Integrity Failures found on such a train will still appear in the System Alarms section of the report header.

The report fragment below, from the header section of a Train Detail report, shows the location of the "Slow Train" and "Very Slow Train" messages. For a given train, only one of these conditions will be flagged and appear on the report. A train won't be both slow and very slow.

```
                        Southern Technologies Corporation
                           Integrated Detector System
                             Union Pacific Railroad
                                  TRAIN DETAIL
===============================================================================
                                     •
                                     •
System Alarms
-----------------------------------------
Slow Train
Very Slow Train
                                     •
                                     •
```

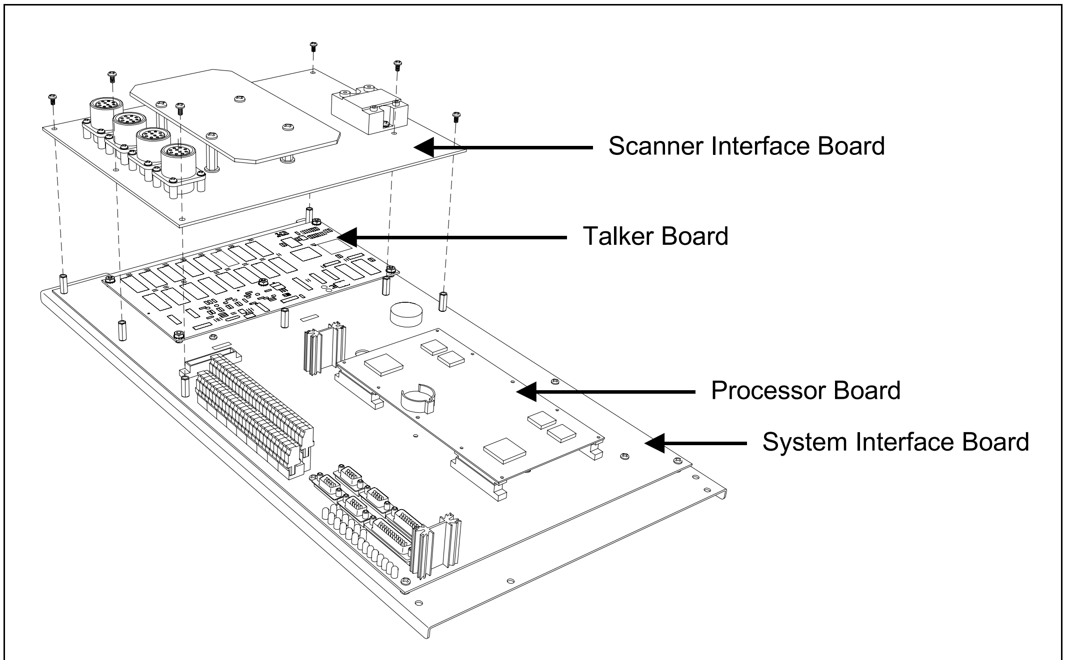
10.4 Train Direction

Train direction is based on whether TO1 or TO2 generated the first gating transducer pulse.

10.5 Transducer Pulse Processing

As a wheel enters the sensing range of a transducer, the transducer should respond with a positive going pulse. The polarization of the two wires from the transducer determines if this pulse is positive or negative.

On the Interface board (in the Controller module), the transducer signals undergo RF filtering and amplification with a gain of 30. For validation, the amplified signals are fed into comparators, which create 5-VDC pulses lasting the period of time that the amplified signals remains above 620 millivolts. Processor-A (on the Processor board) receives these 5-VDC pulses through ports PA0 (TO1) and PA1 (TO2).



A firmware-controlled feature of the comparator circuit allows adjustment of the threshold voltage based on the speed of the train. Trains traveling less than 20 mph (32 kph) use the 620-millivolt threshold setting for maximum sensitivity. However, faster trains will cause the transducers to generate a higher signal voltage, which allows the system to increase the threshold voltage. This improves the signal-to-noise ratio resulting in better signal validation.

Processor-A (on the Processor board) internally generates interrupts on the positive going and negative going edges of each transducer pulse coming from the comparator. The positive edge of each comparator pulse starts a timer. The timer stops with the detection of a negative going edge. The width of each pulse is a determining factor of signal validity. Three milliseconds or greater is considered to be a valid signal. The firmware rejects any pulse width shorter than 3-milliseconds. Rejected pulses don't increment the transducer counters.

In normal operation, the gating transducers fire in sequence, first one then the other. With 24-inch (61-centimeter) gating-transducer spacing, a wheel passes over both gating transducers before the next wheel passes over a gating transducer. Therefore, two consecutive pulses on the same gating transducer aren't physically possible. However, in the unlikely event that a gating transducer is ever caused to fire by another source, such as electrical interference from a locomotive's traction motor, a spike-counter for the gating transducer that misfired will be incremented by one. To increment the axle counter, one pulse from each gating transducer must occur in sequence.

10.6 Axle Scanning

When the train first enters the site, the SmartScanIS begins reading the scanners for a heat signal when the wheel is at the center of the first gating transducer. There after, it starts reading the scanners 16 inches before the center of the first gating transducer. (See ***Appendix D - Predictive Gate Scanning*** for more information about this 16-inch (40.6 centimeter) pregate scanning.) The system continues reading until the wheel is at the center of the second gating transducer. This is the period that the axle is in view of the scanner. A negative going edge of a transducer signal is an indication that the wheel is in the center of that transducer.

The firmware uses Dynamic Scan Rate sampling between the centers of the two transducers (that is, between the gate), which means that heat readings taken every 1/2 inch (1.27 centimeters) of wheel movement are used to detect alarms, regardless of the speed of the train. As a result, the system takes 48 evenly spaced samples as the wheel rolls through the 24-inch (61-centimeter) detection zone that is established by the distance between the gating transducers.

10.7 Hot Bearing Alarms

The SmartScanIS checks for hot bearings during the scanning process. The four types of hot bearing alarms (aka Hotbox alarms) are:

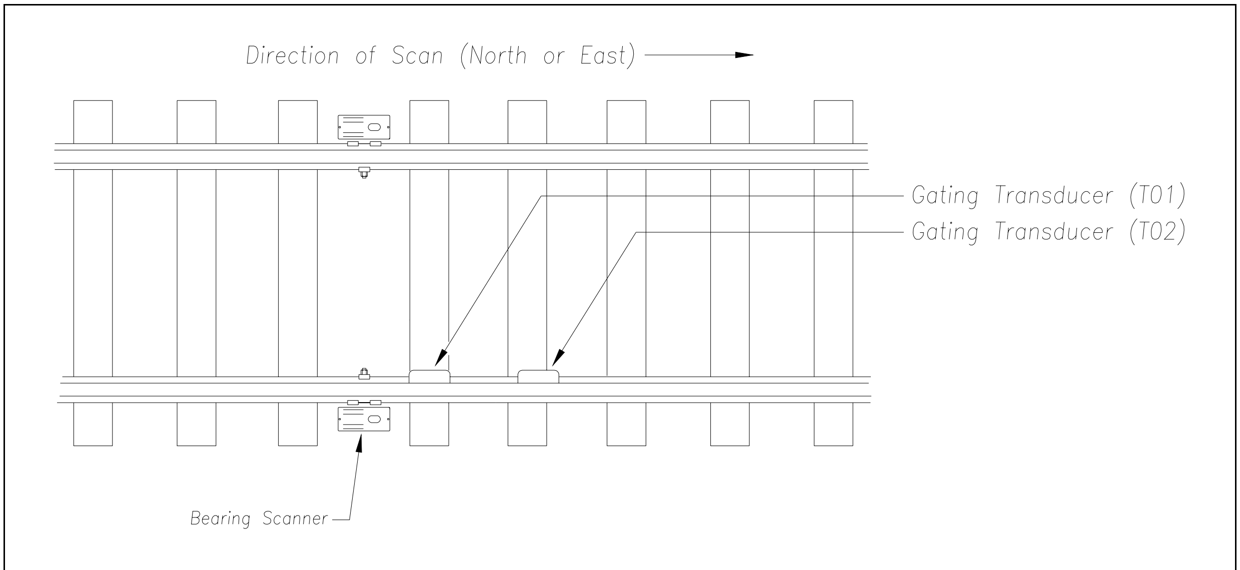
- **Absolute**. To trigger an Absolute alarm, a bearing temperature must exceed the limit that was established using the Absolute option. This alarm limit is an offset, in degrees Fahrenheit, above the ambient temperature.
- **Differential**. To trigger a Differential alarm, a bearing temperature must exceed the opposite side bearing temperature of the same axle by a differential amount established using the Differential option. A Differential alarm doesn't appear on an axle that already contains an Absolute alarm.
- **Pyrometer Saturation**. To trigger a Pyrometer Saturation alarm, an interaxle bearing temperature must exceed the limit that was established using the Absolute option. If an Absolute alarm or a Differential alarm has already been triggered for the axle, a Pyrometer Saturation alarm isn't generated. For more details on the Pyrometer Saturation alarm, see ***Appendix D - Predictive Gate Scanning***.
- **Carside Slope**. To trigger a Carside Slope alarm, a bearing temperature must meet or exceed a calculated alarm level and a minimum heat value. The bearing temperature must also be at least twice the opposite bearing's temperature. If an Absolute alarm or a Differential alarm has already been triggered for the axle, a Carside Slope alarm isn't generated. The minimum heat value is established using the Carside Minimum option.

Absolute, Differential, and Pyrometer Saturation alarms are always checked for by the system. In order for Carside Slope alarms to be processed, they must be enabled using the Carside Slope option of the Equipment submenu.

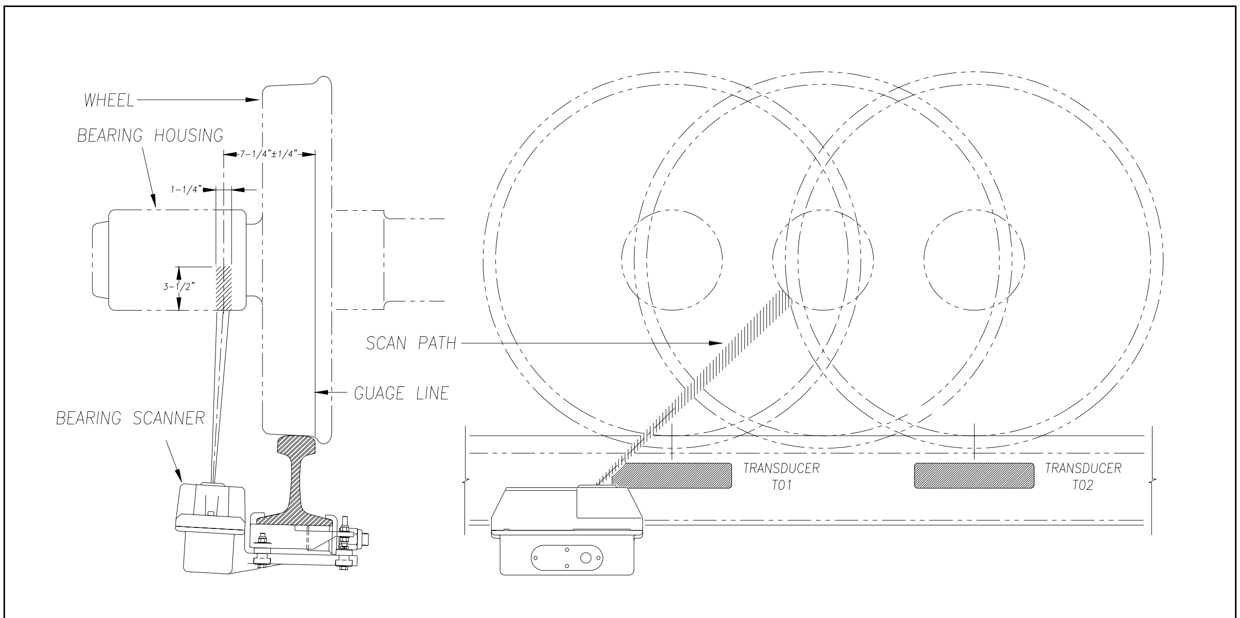
The SmartScanIS detects and records every Hotbox alarm that occurs. However, it is physically impossible to have more than one Hotbox alarm per axle per rail.

10.7.1 Bearing Scan Process

Bearing scanners are mounted in the center of the crib of two ties spaced at least 14 inches (35.6 centimeters) apart. Both bearing scanners are mounted in the crib immediately ahead of the gating transducers (that is, in the crib immediately to the south or west of the gating transducers). They are mounted directly opposite each other, one on each rail of the track. The hole on the top of the scanner covers faces north or east.



The bearing scanners are aligned to scan the bottom 3.5 inches (8.9 centimeters) of the bearing housing, about 7.25 inches (18.4 centimeters) from the gauge line. Bearing temperatures are sampled while the gate is open. (The firmware also scans for temperature between bearings to support detection of Pyrometer Saturation alarms.)



10.7.2 Referencing System

Pyrometers measure rapid changes in infrared energy emitted from objects passing through their field of view. The rail-mounted scanners are aligned to take advantage of this characteristic.

When no axle is present between the gating transducers, the scanner typically sees only the undersides of the cars passing over the site. The undersides of the cars are at or near ambient temperature, thus establishing the reference from which the elevated temperatures of bearings are measured. The pyrometers normalize during this time, producing a zero level signal.

Occasionally, the scanners are exposed to infrared emissions that are colder than the underside of the cars. Typically, this occurs in the gaps between cars when the scanners may reference on clear sky. This could present an erroneous reference if a bearing was scanned immediately following a sky shot, resulting in an abnormally high reading for the bearing. The pyrometers have internal circuitry to prevent the reference from shifting below the established zero reference.

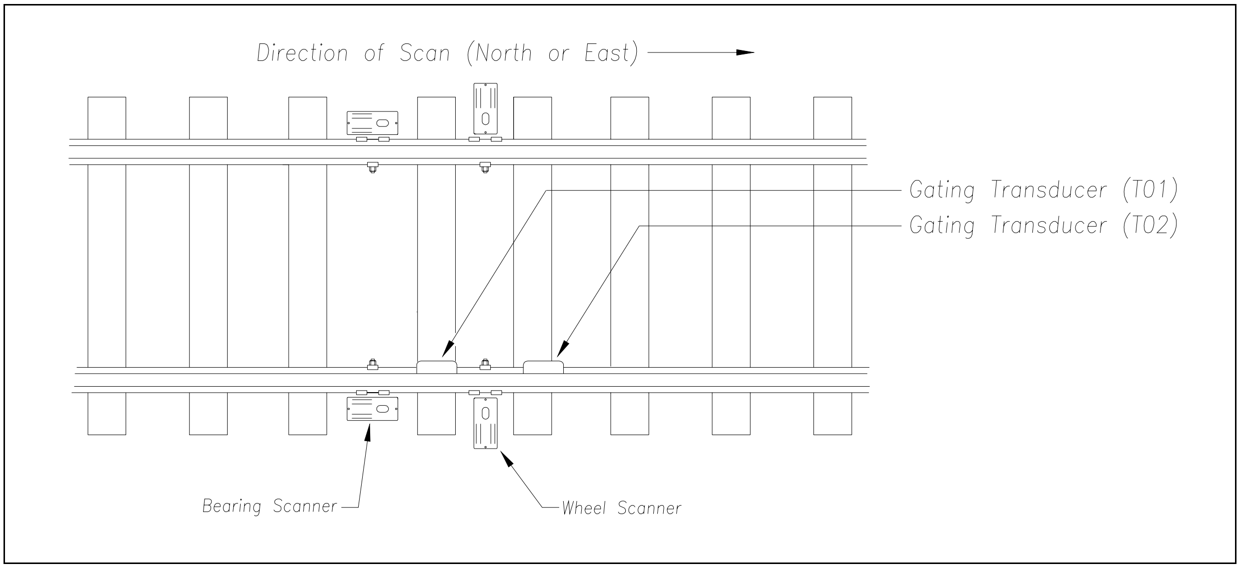
When a bearing passes through the field of view of the scanner, a rapid change in temperature is presented to the internal lithium tantalite crystal. This causes the signal level from the pyrometer to increase proportionally to the amount of exposed infrared energy. When an axle is between the gating transducers, the pyrometer signal is sampled at every 1/2 inch (1.27 centimeters) of wheel movement for a total of 48 samples and the maximum signal level is stored. This signal level, measured in volts, is converted to a digital value and expressed in degrees Fahrenheit above ambient temperature. This value is the basis for the alarm analysis done by the system.

10.7.3 Pyrometer Linearity

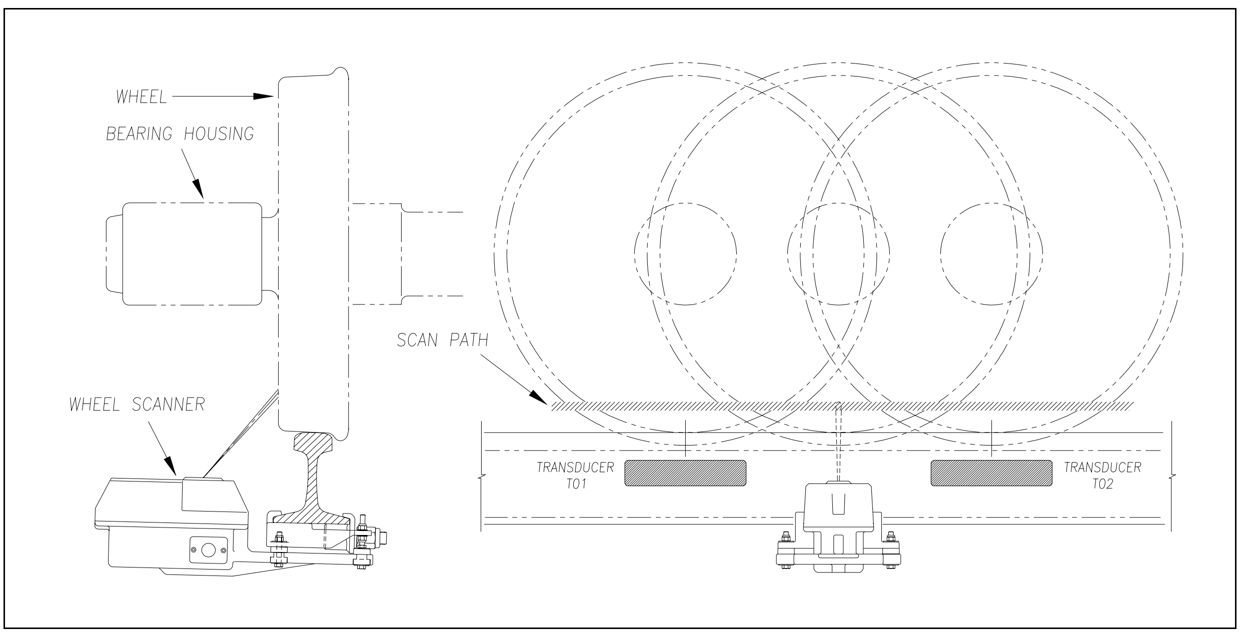
The output of the pyrometers is linear across most of the operating speed range of the system. However, the output of the pyrometers is nonlinear at either end of the operating speed range. To compensate for this nonlinear output, the firmware applies a correction factor to the sampled heat value. The correction factor applied to each bearing sample is based on the speed of the bearing (axle's on time) as it passed through the gate and on the actual value read by the pyrometer. The correction factor is derived from a table that is keyed by the axle's on time and heat value. Due to the fast nature of this lookup table, linearity compensation is done real-time so that detected alarms reflect the heat value after the linearity step has been done.

10.8 Hotwheel Alarms

When used, wheel scanners are mounted in the center of the crib of two ties spaced at least 14 inches (35.6 centimeters) apart. Both wheel scanners are mounted in the crib between the two gating transducers. They are mounted directly opposite each other, one on each rail of the track. The hole on the top of the scanner covers faces the center of the track.



The wheel scanners are aligned to scan about 4 inches (10 centimeters) above the rail.



The SmartScanIS checks for hotwheels during the scanning process. Scan timing is controlled the same as for the bearing scanners.

Wheel scanning alarms are limited to absolute only. To trigger a Hotwheel alarm, wheel scanners must be properly installed, hotwheel alarm reporting must be enabled, and a wheel temperature must exceed the limit that was established using the Hotwheel option of the Alarm Limits submenu. This alarm limit is an offset, in degrees Fahrenheit, above the ambient temperature. Hotwheel alarm reporting is enabled/disabled using the Hotwheel option of the Equipment submenu. When enabled, the SmartScanIS detects and records every Hotwheel alarm that occurs.

10.9 Auxiliary Alarms

The SmartScanIS can support input from as many as four external alarm devices. Any device that provides an open relay contact upon alarm detection can be supported by the system. Auxiliary alarms supported by the SmartScanIS are:

- **Dragging Equipment**. To trigger a Dragging-Equipment alarm, a dragging-equipment detector must be properly installed, dragging-equipment detection must be enabled, and the SmartScanIS must sense an open relay contact from the dragging-equipment detector. Dragging-equipment detection is enabled/disabled using the Dragger option of the Equipment submenu. When enabled, the SmartScanIS detects and records every Dragging-Equipment alarm that occurs on a given train.
- When the SmartScanIS finds a pretrain Dragging-Equipment alarm, the system flags the pretrain condition as an Integrity Failure, disables dragging-equipment scanning for the remainder of the train, and doesn't assign a dragging-equipment condition to any of the axles.
- **High Load** (aka oversized load). To trigger a High-Load alarm, a high-load detector must be properly installed, high-load detection must be enabled, and the SmartScanIS must sense an open relay contact from the high-load detector. High-load detection is enabled/disabled using the High-Load option of the Equipment submenu.
- The firmware's high-load logic is configured for use with a light-beam or trip-wire type of high-load detector. Since Union Pacific uses the trip-wire type of high-load detector, their devices generate the proper alarm signal when something breaks the connected wire. Because a wire can only break once, the firmware only records one High-Load alarm per train, regardless of the high-load status.
- When the SmartScanIS finds a pretrain High-Load alarm, the system flags the pretrain condition as an integrity failure, disables high-load scanning for the remainder of the train, and doesn't assign a high-load condition to any of the axles.

- **Wide Load** (aka shifted load). To trigger a Wide-Load alarm, two wide-load detectors (one on each side of the track) must be properly installed, wide-load detection must be enabled, and the SmartScanIS must sense an open relay contact from either of the wide-load detectors. Wide-load detection is enabled/disabled using the Wide-Load option of the Equipment submenu.
- The firmware's wide-load logic is configured for use with a light-beam or trip-wire type of wide-load detector. Since Union Pacific uses the trip-wire type of wide-load detector, their devices generate the proper alarm signal when something breaks the connected wire. Because a wire can only break once, the firmware only records one Wide-Load alarm per train, regardless of the wide-load status.
- When the SmartScanIS finds a pretrain Wide-Load alarm, the system flags the pretrain condition as an integrity failure, disables wide-load scanning for the remainder of the train, and doesn't assign a wide-load condition to any of the axles.

10.10 Cold Wheel Alarms

The Cold Wheel alarm indicates that the specified minimum acceptable wheel temperature wasn't reached on a given axle.

Cold Wheel alarm detection is enabled/disabled using the Cold Wheel option of the Equipment submenu. The Cold Wheel function is intended to be used where trains are expected to be braking as they approach a site and to identify axles whose brakes have failed.

The Cold Wheel option of the Alarm Limits submenu is used to specify the minimum acceptable wheel temperature. A wheel found with temperature less than this limit will be flagged with a Cold Wheel alarm. Alarms of this type will not produce a voice message, but will be included in the data sent to the Harriman Dispatch Center.

10.11 Sliding Wheel Alarms

The Sliding Wheel alarm indicates that a combination of very low bearing and wheel temperatures were found on a given axle in conjunction with high wheel temperatures recorded on the remaining axles of a car. This condition could mean that the wheels on the affected axle were sliding, rather than rolling, on the rail.

The Sliding Wheel alarm is both an Exception Alarm and a System Alarm. Sliding Wheel alarm detection is enabled/disabled using the Sliding Wheel option of the Equipment submenu. The Sliding Wheel function requires that both bearing and wheel scanners be installed and in operation at a site. The Sliding Wheel detection algorithm is intended to be used where trains travel down a long grade before reaching the site. The algorithm calculates average wheel and bearing heat per train side and per car and attempts to isolate those axles that have extremely low bearing and wheel temperatures in comparison.

The Sliding Wheel Ratio option of the Alarm Limits submenu is used to specify the ratio that is applied when evaluating wheel and bearing temperatures to identify sliding wheels. This ratio is applied to calculated average temperatures to establish minimum acceptable wheel and bearing temperatures that are in turn used to identify sliding wheels.

Chapter 11
Serial Interface

The serial interface allows **on-site** and **off-site** communication with the system. Using this interface is the only way to view reports and to change system parameters. If your site doesn't have telephone service, you cannot communicate with the system remotely (that is, **off-site**).

To use the interface **locally**, you need:

- A computer
- Communications software, which is installed on the computer
- A cable from the computer to a communications port on the System Interface board

To use the interface **remotely**, you need:

- A computer
- Communications software, which is installed on the computer
- A modem, which is connected to the computer
- A nonswitched analog telephone line, which is connected to the computer's modem
- Another modem, which is connected to a communications port on the System Interface board
- Another nonswitched analog telephone line, which is connected to the modem in the SmartScanIS enclosure

This chapter describes the serial interface for the SmartScanIS. It covers how to enter and change the system parameters. The next chapter tells how to use the serial interface to produce reports.

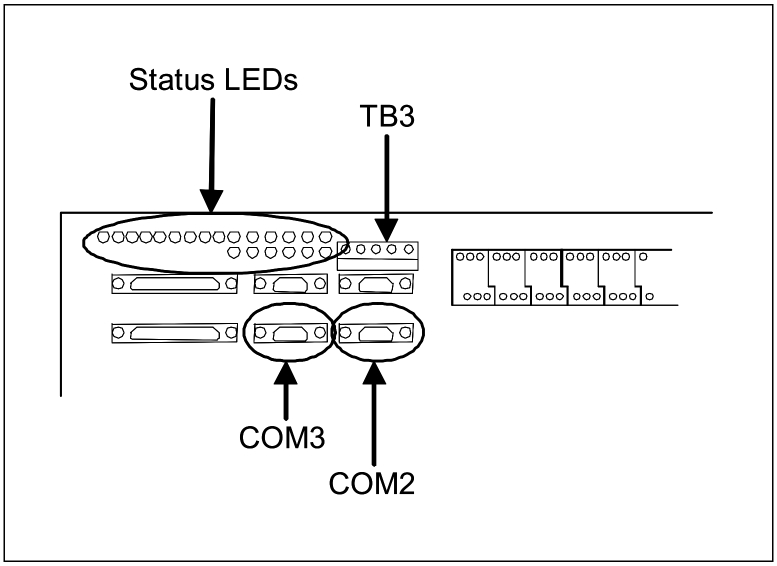
It is necessary to go through a complete setup the first time a SmartScanIS is installed at a new site. (If this is a double-track site, you need to do this for the other SmartScanIS.) After that, the Processor board (in the Controller module) retains the setup information during a power outage or reset. During a power outage or reset, no setup information is lost.

11.1 Serial Ports; RS232 Devices

Relevant to connecting with the serial interface, there are two serial ports on the System Interface board that connect the SmartScanIS to RS232 devices. They are labeled P8 and P10 on the board. P10 is COM2 and P8 is COM3.

COM1 functions as the conduit for communications with RS485 devices and is configured for this protocol when systems are shipped. If anything is connected to this port, you can't just unplug it to free up a spot for your laptop. Other modifications have to be made to the system to let COM1 connect to RS232 devices.

The figure below shows the location of COM2 and COM3.



The table below lists the normal functions for which each of these COM ports is used.

Port	Use
COM2	Union Pacific's Polling System
COM3	Laptop Computer

The table below lists what is normally plugged into each of these COM ports.

Type of Polling System	COM2	COM3
No Polling System	*nothing*	Modem
RFL Polling System	RFL	Modem
Dialup Polling System	Modem	*nothing*

COM2 is dedicated to Union Pacific's Polling System. If your site communicates with the Harriman Dispatch Center over the RFL network, you can't disconnect that link without first obtaining permission from the Harriman Dispatch Center. If your site uses a modem to communicate with the Harriman Dispatch Center, COM3 is unused and available for your laptop.

COM3 is the only port that displays anything as the system boots up. Consequently, you must use it if you want to see what's happening following a power-up or reset. Because COM1 and COM2 already have functions allocated to them, **STC recommends COM3 as the only serial port for use with the serial interface**.

11.2 Main Menu

To display the Main menu:

1 If **on-site**:

- **a** If COM3 has nothing plugged in it, plug your computer into it.
- **b** If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Use your communications software to open a LOG file and capture the whole session to the file. When your session is complete, you may then view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

At the above prompt, you can:

- Produce one of the listed reports by typing one of the letters **a** through **h** or **j**. This is explained in the next chapter.
- Access the Setup menu by typing the letter **i**. This is explained below. It is from the Setup menu that you can set system parameters.

8 When done, close the LOG file.

9 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

When a session ends, if a modem was used, the system sends various commands to the modem to prepare it for future use. If at any time during the disconnect procedure, lines such as "+++ATH0" appear on your screen, these are merely commands preparing the modem for further use. They shouldn't be construed as anything that is meant for the user.

10 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

11.3 Setup Menu

To display the Setup menu:

1 Be sure that the Main menu is displayed.

The Main menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

2 To go to the Setup menu, type **i**

A menu and prompt like this one appears. To access any of the Setup menu options, type the letter that corresponds to the desired menu option.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System
  J) Serial Ports
  K) Amtech Reader Parameters
  L) Modem Setup
  X) Exit Menu
?
```

At any prompt, a timeout mechanism is in place to prevent the system from remaining in that state indefinitely. When a timeout occurs, the serial interface regresses to the previous menu. For example, if a timeout occurs in the Equipment submenu, the system reverts to the Setup menu. If this menu times out, the system reverts to the Main menu. If this menu times out, the system disconnects the modem connection and resumes normal operation. At the Main menu, the timeout is set for five minutes. For all other prompts, the system uses several different timeout values.

3 To return to the Main menu, type **x**

Changes to the system parameters aren't reflected until after you have logged out of the serial interface.

11.3.1 Date and Time

To set or change the **date** setting, the **time** setting, or both settings:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment

           •
           •
           •
```

2 To go to the Date and Time submenu, type **a**

A prompt like this appears.

```
Current date is: 08/17/2006
Enter new date:
```

Dates are in **mm/dd/yyyy** format, where **mm** is month, **dd** is day, and **yyyy** is year. You only type the last two digits of the year. The system automatically inserts the slashes and the first two digits of the year. For days, for months, or for the last two digits of years from 1 through 9, type leading zeros. Thus, for 8 April 2006, type **040806**.

If you want to keep the displayed date, press **[Enter]**. If you don't want to keep the displayed date, type a new date. If you start typing the date and press **[Enter]** before finishing, you will get this message and will be returned to the Setup menu. You'll also get this message if one of the typed values is outside of the legal limits.

```
Invalid date.  Date and Time will not be changed!
```

3 Type a new date or press **[Enter]**.

A prompt like this appears.

```
Current time is: 09:35:00
Enter new time:
```

Time is in 24-hour **hh:mm:ss** format, where 8 a.m. is 08:00:00, noon is 12:00:00, 8 p.m. is 20:00:00, and midnight is 00:00:00. Thus, for 17 seconds past 3:42 p.m., type **154217**. The system automatically inserts the colons. For hours, minutes, and seconds from 0 through 9, type leading zeros.

If you want to keep the displayed time, press **[Enter]**. If you don't want to keep the displayed time, type a new time. If you start typing the time and press **[Enter]** before finishing, the remaining untyped digits will be changed to zeros. For example, if you just type **11** and they press **[Enter]**, the time that is recorded will be 11:00:00.

4 Type a new time or press **[Enter]**.

The Setup menu reappears.

11.3.2 Milepost

To set or change the **milepost** setting:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment

           •
           •
           •
```

2 To go to the Milepost submenu, type **b**

A prompt like this appears.

```
Milepost: 0098.7
New Milepost:
```

Milepost is in **nnnn.n** format. If the desired milepost has less than five digits, type leading zeros. If the desired milepost is an integer, type a trailing zero. Thus, for milepost 30, type **00300**. The system automatically inserts the decimal point.

3 To keep the displayed milepost, press **[Enter]**.

The Setup menu reappears.

4 Type the five-digit milepost.

A prompt like this appears.

```
Milepost: 0098.7
New Milepost: 1234.5
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

5 If the milepost is incorrect:

a Type **n**

b Return to step **4**.

6 If the milepost is correct, type **y**

The Setup menu reappears.

11.3.3 Track Number

To set or change the **track-number** setting:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment

           •
           •
           •
```

2 To go to the Track Number submenu, type **c**

A prompt like this appears.

```
Track Direction is North/South, is this OK (Y/N)?
```

You can now type either **y** (yes) or **n** (no). If North/South is displayed (as it is above), typing **n** changes it to East/West. Typing **y** keeps it North/South. If East/West is displayed, typing **n** changes it to North/South. Typing **y** keeps it East/West.

3 To keep the displayed track direction:

a Type **y**

This prompt appears.

```
Is this a multi-track site (Y/N)?
```

You can now type either **y** (yes) or **n** (no).

b Go to step **5**.

4 To set or change the **track-direction** setting:

a Type **n**

The track direction toggles between east/west and north/south.

b If the track direction is incorrect, return to step **a**.

c If the track direction is correct, type **y**

This prompt appears.

```
Is this a multi-track site (Y/N)?
```

You can now type either **y** (yes) or **n** (no).

5 At this site, if you have only one track:

a Type **n**

The Setup menu reappears.

b Skip the remaining steps.

6 At this site, if you have two or more tracks, type **y**

This prompt appears.

```
Enter track number (1-6):
```

7 Type the track number you want.

If you typed a digit from 1 through 6, the Setup menu reappears.

If you typed an incorrect character, the message below appears followed by the above prompt. If this happens, type a valid track number.

```
Minimum valid value is 1, Maximum valid value is 6
```

11.3.4 Alarm Limits

To set or change one or more of the alarm limits:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0001.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
           •
           •
           •
```

2 To go to the Alarm Limits submenu, type **d**

A menu and prompt like this appears.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute.................. 180°
B) Differential..............  90°
C) Hot Wheel................. 540°
D) Cold Wheel................  30°
E) CS Slope.................. 0.32
F) CS Minimum................  37°
G) Cold Journal..............  10°
H) Cold Wheel Scanner........  30°
I) Cold Trains................   3
J) Sliding Wheel Ratio......... 50%
K) Max Alarms.................   6

Alarm to change or Esc to quit?
```

This menu option allows you to change the various alarm limits that affect system operations. The current setting for each limit is displayed. To change one of the alarm limit settings, start by typing the letter corresponding to the desired option.

3 To leave the Alarm Limits submenu and return to the Setup menu:

a Press **[Esc]**.

The Setup menu reappears.

b Skip the remaining steps.

4 To set or change the **absolute-alarm limit**:

The number after the word Absolute (on the Alarm Limits submenu) is an offset in degrees Fahrenheit above ambient temperature. When a bearing temperature exceeds this value, the system generates an Absolute alarm.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute.................. 180°
B) Differential..............  90°
C) Hot Wheel................. 540°
D) Cold Wheel................  30°
E) CS Slope.................. 0.32

              •
              •
              •
```

a From the Alarm Limits submenu, type **a**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 200
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you typed zero or a value greater than 300, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 300
New Value ?
```

If you type an acceptable value, the Absolute option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

5 To set or change the **differential-alarm limit**:

The number after the word Differential (on the Alarm Limits submenu) is an offset in degrees Fahrenheit between rail1 and rail2. A bearing temperature is compared to the bearing temperature on the opposite end of the same axle. When the difference in temperatures exceeds the value on the screen, the system generates a Differential alarm.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute.................. 180°
B) Differential..............  90°
C) Hot Wheel................. 540°
D) Cold Wheel................  30°
E) CS Slope.................. 0.32

              •
              •
              •
```

a From the Alarm Limits submenu, type **b**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 110
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you typed zero or a value greater than 300, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 300
New Value ?
```

If you type an acceptable value, the Differential option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

6 To set or change the **hotwheel-alarm limit**:

The number after the words Hot Wheel (on the Alarm Limits submenu) is an offset in degrees Fahrenheit above ambient temperature. When a wheel temperature exceeds this value, the system generates a Hotwheel alarm. However, when the Hotwheel option of the Equipment submenu is disabled, Hotwheel alarms aren't generated.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute................... 180°
B) Differential..............  90°
C) Hot Wheel.................. 540°
D) Cold Wheel................  30°
E) CS Slope................... 0.32
              •
              •
              •
```

a From the Alarm Limits submenu, type **c**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 650
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you typed zero or a value greater than 900, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 900
New Value ?
```

If you type an acceptable value, the Hotwheel option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

7 To set or change the **cold-wheel limit**:

The number after the words Cold Wheel (on the Alarm Limits submenu) is an offset in degrees Fahrenheit above ambient temperature. When a wheel is found with a temperature less than this value, the system generates a Cold Wheel alarm. Alarms of this type don't produce a radio message, but are included in the data sent to the Harriman Dispatch Center.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute................... 180°
B) Differential..............  90°
C) Hot Wheel................. 540°
D) Cold Wheel................  30°
E) CS Slope.................. 0.32
              •
              •
              •
```

a From the Alarm Limits submenu, type **d**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 040
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you typed a value greater than 100, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 100
New Value ?
```

If you type an acceptable value, the Cold Wheel option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

8 To set or change the **carside-slope value**:

The number after the words CS Slope (on the Alarm Limits submenu) is the slope value used when doing carside-slope analysis. ***Chapter 10 - Defect Detection*** describes the Carside Slope alarm process.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute.................. 180°
B) Differential..............  90°
C) Hot Wheel................. 540°
D) Cold Wheel................  30°
E) CS Slope.................. 0.32
F) CS Minimum................  37°

              •
              •
              •
```

a From the Alarm Limits submenu, type **e**

This prompt appears.

```
New Value ?
```

Slope value is in **n.nn** format. The system automatically inserts a decimal point between the first and second digits. If the new value has less than three digits, type leading zeros, trailing zeros, or both. Thus, for .98, type **098**. For 1.2, type **120**.

b Type the new three-digit value <u>or</u> press **[Esc]**.

A prompt like this appears.

```
New Value ? 1.40
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

c If the new limit is incorrect, type **n** <u>and</u> return to step **b**.

d If the new value is correct, type **y**

If you typed zero or a value greater than 2.55, this error message and prompt appears.

```
Minimum valid value is 0.01, Maximum valid value is 2.55
New Value ?
```

If you type an acceptable value, the Carside Slope option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

e If you get an error message, return to step **b**.

f If you don't get an error message, return to step **3**.

9 To set or change the **carside-minimum-heat value**:

The number after the words CS Minimum (on the Alarm Limits submenu) is a minimum offset (in degrees Fahrenheit) used when doing carside-slope analysis. ***Chapter 10 - Defect Detection*** describes the Carside Slope alarm process.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute.................. 180°
B) Differential..............  90°
C) Hot Wheel................. 540°
D) Cold Wheel................  30°
E) CS Slope.................. 0.32
F) CS Minimum................  37°
G) Cold Journal..............  10°
               .
               .
               .
```

a From the Alarm Limits submenu, type **f**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 255
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you type zero or a value greater than 300, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 300
New Value ?
```

If you type an acceptable value, the Carside Minimum option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

10 To set or change the **cold-journal value**:

The number after the words Cold Journal (on the Alarm Limits submenu) is an offset, in degrees Fahrenheit, above the ambient temperature. This value pertains to post-train examination of the maximum heats recorded by the bearing scanners. When no bearing on a given rail generates a delta temperature reading greater than this value, the system generates a Cold Rail alarm for the given rail.

```
Milepost-0001.2, Track:Single
Alarm Limits
---------------------------------------------------
A) Absolute................... 180°
B) Differential..............  90°
C) Hot Wheel.................. 540°
D) Cold Wheel................  30°
E) CS Slope................... 0.32
F) CS Minimum................  37°
G) Cold Journal..............  10°
H) Cold Wheel Scanner.........  30°
I) Cold Trains................    3
J) Sliding Wheel Ratio........ 50%
K) Max Alarms.................    6

Alarm to change or Esc to quit?
```

a From the Alarm Limits submenu, type **g**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 12
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you type zero or a value greater than 30, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 30
New Value ?
```

If you type an acceptable value, the Cold Journal option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

11 To set or change the **cold-wheel-scanner value**:

The number after the words Cold Wheel Scanner (on the Alarm Limits submenu) is an offset, in degrees Fahrenheit, above the ambient temperature. This value pertains to post-train examination of the maximum heats recorded by the wheel scanners. When no wheel on a given rail generates a delta temperature reading greater than this value, the system generates a Cold Wheel Scanner alarm for the given rail.

```
              •
              •
              •

G) Cold Journal..............  10°
H) Cold Wheel Scanner.........  30°
I) Cold Trains................   3
J) Sliding Wheel Ratio......... 50%
K) Max Alarms.................   6

Alarm to change or Esc to quit?
```

a From the Alarm Limits submenu, type **h**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 32
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you type a value greater than 100, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 100
New Value ?
```

If you type an acceptable value, the Cold Wheel Scanner option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

12 To set or change the **cold-trains value**:

The number after the words Cold Trains (on the Alarm Limits submenu) is the maximum number (per railside) of consecutive trains, having Cold Rail alarms or Cold Resistor alarms, required to generate an Integrity Failure alarm. The Cold Wheel Scanner alarms, Cold Wheel Scanner Resistor alarms, and Equal Heats Test Failed alarms also use this value to determine when they become Successive Cold Wheels Exceeded alarms, Successive Cold Wheel Resistors Exceeded alarms, and Max Equal Heat Test Failures Exceeded alarms. ***Appendix A - System Alarms*** describes the conditions and events that the system flags as System Alarms. ***Appendix B - Integrity Failures*** describes the conditions and events that the system flags as Integrity Failures.

```
              •
              •
              •

G) Cold Journal..............  10°
H) Cold Wheel Scanner........  30°
I) Cold Trains................   3
J) Sliding Wheel Ratio......... 50%
K) Max Alarms.................   6

Alarm to change or Esc to quit?
```

a From the Alarm Limits submenu, type **i**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 4
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you type zero or a value greater than 9, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 9
New Value ?
```

If you type an acceptable value, the Cold Trains option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

13 To set or change the **sliding-wheel ratio**:

The number after the words Sliding Wheel Ratio (on the Alarm Limits submenu) is the ratio to be applied while evaluating wheel and bearing temperatures to identify sliding wheels. The Sliding Wheel Ratio is applied to calculated average temperatures to establish minimum acceptable wheel and bearing temperatures that are in turn used to identify sliding wheels.

```
                .
                .
                .

G) Cold Journal..............  10°
H) Cold Wheel Scanner........  30°
I) Cold Trains...............   3
J) Sliding Wheel Ratio......... 50%
K) Max Alarms................   6

Alarm to change or Esc to quit?
```

a From the Alarm Limits submenu, type **j**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long or you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 40
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** and return to step **b**.

e If the new limit is correct, type **y**

If you type a value less than 10 or a value greater than 100, this error message and prompt appears.

```
Minimum valid value is 10, Maximum valid value is 100
New Value ?
```

If you type an acceptable value, the Sliding Wheel Ratio option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

14 To set or change the **maximum-alarms limit**:

The number after the words Max Alarms (on the Alarm Limits submenu) is the maximum number of Exception Alarms allowed on a train before generating an Integrity Failure alarm. This limit also controls assignment of the Stuck Dragger alarm. ***Appendix A - System Alarms*** describes the conditions and events that the system flags as System Alarms; of which the Integrity Failure alarm is one.

The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.

The Maximum Exception Alarms Exceeded alarm is generated when the maximum number of Exception Alarms (defined by the Maximum Alarms option) is exceeded on a single train. The Stuck Dragger alarm is generated when the maximum number of consecutive axles (defined by the Maximum Alarms option) had Dragging-Equipment alarms during train passage.

Real-time messages are announced using a 1000-hertz tone. When the first alarm is detected, the tone is issued, followed by the words "defect detected." All subsequent alarm announcements only use the tone. One tone is issued for each alarm detected up to and including twice the maximum number of alarms specified using the Maximum Alarms option.

```
              •
              •
              •

G) Cold Journal..............  10°
H) Cold Wheel Scanner.........  30°
I) Cold Trains................   3
J) Sliding Wheel Ratio......... 50%
K) Max Alarms.................   6

Alarm to change or Esc to quit?
```

a From the Alarm Limits submenu, type **k**

This prompt appears.

```
New Value ?
```

If the new limit has less than three digits, you can type leading zeros to make it three digits long <u>or</u> you can press **[Enter]** after typing one or two digits.

b To not change the value, press **[Esc]** <u>and</u> return to step **3**.

c Type the new limit.

A prompt like this appears. All typed nondigits are ignored.

```
New Value ? 4
Is this correct ?
```

You can now type either **y** (yes) or **n** (no).

d If the new limit is incorrect, type **n** <u>and</u> return to step **b**.

e If the new limit is correct, type **y**

If you type zero or a value greater than 11, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 11
New Value ?
```

If you type an acceptable value, the Maximum Alarms option of the Alarm Limits submenu changes and the Alarm Limits submenu reappears.

f If you get an error message, return to step **b**.

g If you don't get an error message, return to step **3**.

11.3.5 Equipment

To set or change one or more of the equipment parameters:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages

          •
          •
          •
```

2 To go to the Equipment submenu, type **e**

A menu and prompt like this appears.

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger...................... NO
B) Hot Wheel.................... NO
C) High Load.................... NO
D) Wide Load.................... NO
E) Carside Slope................ NO
F) Talker Mode......... Talk Freely
G) Snow Cycle................... NO
H) AEI......................... YES
I) Sliding Wheel............... YES
J) Gate Distance....... 24.0 inches
K) Cold Wheel.................. YES
L) Resistor Integ. Test.... Enabled

Equipment to change or Esc to quit?
```

The current setting for each menu option is displayed. For example, the screen above shows that Wide-Load alarm detection is disabled (NO). To change one of the settings, press the letter corresponding to the desired option. Except for the Gate Width option and the Snow Cycle option, which require value entries, all the other options toggle between two or more settings.

To leave the Equipment submenu and return to the Setup menu:

a Press **[Esc]**.

The Setup menu reappears.

b Skip the remaining steps.

3 To set or change the **dragger** (aka dragging-equipment) setting:

The Equipment submenu shows whether Dragging-Equipment alarm detection is enabled (YES) or disabled (NO). When disabled, Dragging-Equipment alarms won't be announced or stored. Since they aren't stored, these alarms can't be printed. When enabled, Dragging-Equipment alarms will be announced and stored. Since they are stored, they can be printed.

In the presence of a continuous dragger signal, the system alarms consecutive axles. The Maximum Alarms option of the Alarm Limits submenu shows the number of consecutive dragger-alarmed axles allowed before flagging a stuck-dragger condition.

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger..................... NO
B) Hot Wheel................... NO
C) High Load................... NO
D) Wide Load................... NO

             .
             .
             .
```

a From the Equipment submenu, type **a**

The dragging-equipment setting toggles between enabled (YES) and disabled (NO). The Dragger option of the Equipment submenu changes. The Equipment submenu reappears.

If you want Dragging-Equipment alarm detection to occur, be sure that YES appears after the word Dragger on the Equipment submenu.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

4 To set or change the **hotwheel** setting:

The Equipment submenu shows whether Hotwheel alarm detection is enabled (YES) or disabled (NO). When enabled, the SmartScanIS detects and records every Hotwheel alarm that occurs. When disabled, Hotwheel alarms won't be announced or stored. Since they aren't stored, these alarms can't be printed.

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger..................... NO
B) Hot Wheel................... NO
C) High Load................... NO
D) Wide Load................... NO

              •
              •
              •
```

a From the Equipment submenu, type **b**

The hotwheel setting toggles between enabled (YES) and disabled (NO). The Hotwheel option of the Equipment submenu changes. The Equipment submenu reappears.

If you want Hotwheel alarm detection to occur, be sure that YES appears after the words Hot Wheel on the Equipment submenu.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

5 To set or change the **high-load** setting:

The Equipment submenu shows whether High-Load alarm detection is enabled (YES) or disabled (NO). To announce High-Load alarms, YES must appear after the words High Load on the Equipment submenu and NO must appear after the word HiWide on the Messages submenu. To announce High-Wide alarms, YES must appear after the words High Load on the Equipment submenu and YES must appear after the word HiWide on the Messages submenu.

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger..................... NO
B) Hot Wheel................... NO
C) High Load................... NO
D) Wide Load................... NO

              •
              •
              •
```

a From the Equipment submenu, type **c**

The high-load setting toggles between enabled (YES) and disabled (NO). The High-Load option of the Equipment submenu changes. The Equipment submenu reappears.

If you want High-Load alarm detection to occur, be sure that YES appears after the words High Load on the Equipment submenu.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

6 To set or change the **wide-load** setting:

The Equipment submenu shows whether Wide-Load alarm detection is enabled (YES) or disabled (NO).

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger..................... NO
B) Hot Wheel................... NO
C) High Load................... NO
D) Wide Load................... NO
E) Carside Slope............... NO

              •
              •
              •
```

a From the Equipment submenu, type **d**

The wide-load setting toggles between enabled (YES) and disabled (NO). The Wide-Load option of the Equipment submenu changes. The Equipment submenu reappears.

If you want Wide-Load alarm detection to occur, be sure that YES appears after the words Wide Load on the Equipment submenu.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

7 To set or change the **carside-slope** setting:

The Equipment submenu shows whether Carside Slope alarm detection is enabled (YES) or disabled (NO).

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger..................... NO
B) Hot Wheel................... NO
C) High Load................... NO
D) Wide Load................... NO
E) Carside Slope............... NO
F) Talker Mode......... Talk Freely

              •
              •
              •
```

a From the Equipment submenu, type **e**

The carside-slope setting toggles between enabled (YES) and disabled (NO). The Carside Slope option of the Equipment submenu changes. The Equipment submenu reappears.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

8 To set or change the **talker-mode** setting:

The Talker Mode option lets you select when announcements are given during and after train passage. The talk-freely mode is the normal talker mode. In this mode, the system makes announcements even when defects aren't detected. In talk-on-defect mode, the system makes announcements only when a defect is detected. If you don't select a talker mode, it defaults to talk-freely.

If a SmartScanIS, which is in Poll/Standalone mode, doesn't receive a valid poll for five minutes, Talker Mode changes to talk-freely mode. No change occurs when the system already operates in talk-freely mode. The next time a valid poll is received, Talker Mode reverts to the mode that was active before it was changed. If another valid poll isn't received, the system stays in talk-freely mode.

While in Poll/Standalone mode, changing to talk-freely mode also occurs when a ZA or ZU message, sent by the SmartScanIS to the Harriman Dispatch Center, isn't acknowledged after five transmissions. When message acknowledgements are restored, Talker Mode reverts to the mode that was active before it was changed. If a message non-acknowledgment is followed by five minutes of no valid polls, both the acknowledgment failure and the five-minute timeout must be resolved before Talker Mode reverts to the mode that was active before it was changed to talk-freely mode.

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger..................... NO
B) Hot Wheel................... NO
C) High Load................... NO
D) Wide Load................... NO
E) Carside Slope............... NO
F) Talker Mode......... Talk Freely
G) Snow Cycle.................. NO

              •
              •
              •
```

a From the Equipment submenu, type **f**

The talker-mode setting toggles between Talk Freely and Talk On Defect. The Talker Mode option of the Equipment submenu changes. The Equipment submenu reappears.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

9 To set or change the **snow-cycle** setting:

The Equipment submenu shows whether the snow-cycle feature is enabled (YES) or disabled (NO). To avoid errant heat readings caused by moisture on the pyrometer lenses, the scanners have heaters built into them. These heaters are made active, for varying periods of time, depending on the ambient temperature.

The normal heater activation times aren't suitable for extremely cold climates, so the snow-cycle feature compensates for this. When this feature is disabled, the heater controls function normally. When enabled, the system increases the normal running time for the scanner heaters by five minutes every 10 minutes. The snow-cycle feature doesn't affect all the temperature ranges that the scanner heaters will activate on. It affects just the ones that are considered extremely cold.

```
Milepost-0501.2, Track:Single
Equipment
---------------------------------------------------
A) Dragger..................... NO
B) Hot Wheel................... NO
C) High Load................... NO
D) Wide Load................... NO
E) Carside Slope............... NO
F) Talker Mode......... Talk Freely
G) Snow Cycle.................. NO
H) AEI........................ YES

              •
              •
              •
```

a From the Equipment submenu, type **g**

The snow-cycle setting toggles between enabled (YES) and disabled (NO). The Snow Cycle option of the Equipment submenu changes.

If you disabled the snow-cycle setting, the Equipment submenu reappears. If you enabled the snow-cycle setting, this prompt appears.

```
Enter Start Month (1-12)
```

If the new start value is one digit long, you can type a leading zero to make it two digits long or you can press **[Enter]** after typing one digit.

b If you disabled the snow-cycle setting, skip the steps below and return to step **3**.

c To not change the starting and ending values, press **[Esc]** and return to step **3**.

d Type the new starting value.

If you type zero or a value greater than 12, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 12
Enter Start Month (1-12)
```

If you type an acceptable value, this prompt appears.

```
Enter End Month (1-12)
```

e If you get an error message, return to step **c**.

f To not change the ending value, press **[Esc]** and return to step **3**.

g Type the new ending value.

If you type zero or a value greater than 12, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 12
Enter End Month (1-12)
```

If you type an acceptable value, the Equipment submenu reappears, displaying the start and end months that the snow cycle is enabled. For example, if you typed 11 for the start month and 01 for the end month, you'll see a line like this.

```
                •
                •
                •

G) Snow Cycle...... (Nov - Jan) YES

                •
                •
                •
```

If you entered the same value (that is, the same month) for both start and end months, the heaters are enabled year round. For example, if the start month is 12 and the end month is 12, the heaters are enabled year round. If the start month is 12 and the end month is 11, the heaters are also enabled year round. If the start month is 11 and the end month is 12, the heaters are only enabled for November and December.

h If you get an error message, return to step **f**.

i To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

10 To set or change the **AEI** setting:

The Equipment submenu indicates whether the AEI subsystem is enabled (YES) or disabled (NO). When tag readers and attendant antennas and cabling are present, this parameter should be set to YES, so that the system knows to configure the readers and to use the AEI data transmitted from them. When there is no installed AEI subsystem attached to the SmartScanIS, this parameter should be set to NO.

```
               •
               •
               •

G) Snow Cycle.................. NO
H) AEI........................ YES
I) Sliding Wheel.............. YES
J) Gate Distance....... 24.0 inches
K) Cold Wheel................. YES
L) Resistor Integ. Test.... Enabled

Equipment to change or Esc to quit?
```

a From the Equipment submenu, type **h**

The AEI setting toggles between enabled (YES) and disabled (NO). The AEI option of the Equipment submenu changes. The Equipment submenu reappears.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

11 To set or change the **sliding-wheel** setting:

The Equipment submenu indicates whether Sliding Wheel detection is enabled (YES) or disabled (NO). The Sliding Wheel function requires that bearing and wheel scanners be installed and in operation at a site. The Sliding Wheel detection algorithm is intended to be used where trains travel down a long grade before reaching the site. The algorithm calculates average wheel and bearing heat per train side and per car and attempts to isolate those axles that have extremely low bearing and wheel temperatures.

```
               •
               •
               •

H) AEI........................ YES
I) Sliding Wheel.............. YES
J) Gate Distance....... 24.0 inches
K) Cold Wheel................. YES
L) Resistor Integ. Test.... Enabled

Equipment to change or Esc to quit?
```

a From the Equipment submenu, type **i**

The sliding-wheel setting toggles between enabled (YES) and disabled (NO). The Sliding Wheel option of the Equipment submenu changes. The Equipment submenu reappears.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

12 To set or change the **gate distance** (aka gate width) value:

The Equipment submenu shows the number of inches between the centers of the gating transducers.

```
              •
              •
              •

I) Sliding Wheel.............. YES
J) Gate Distance....... 24.0 inches
K) Cold Wheel................. YES
L) Resistor Integ. Test.... Enabled

Equipment to change or Esc to quit?
```

a From the Equipment submenu, type **j**

This prompt appears.

```
Gate Distance:
```

The format for gate width (gate distance) is **nn.n**. If the new value has less than three digits, type leading zeros, trailing zeros, or both. Thus, for 2, type **020**. The system inserts the decimal point for you. The gate width (it is usually 24.0) can be recorded in 1/10-inch increments to reflect the actual transducer spacing. Accurate gating-transducer spacing results in accurate speed calculations.

b Enter the three-digit number.

The Gate Width option of the Equipment submenu changes. The Equipment submenu reappears.

c To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

13 To set or change the **cold-wheel** setting:

The Equipment submenu indicates whether cold-wheel detection is enabled (YES) or disabled (NO). The cold-wheel function is intended to be used where trains are expected to be braking as they approach a site and to identify axles whose brakes have failed.

```
              •
              •
              •

J) Gate Distance....... 24.0 inches
K) Cold Wheel.................. YES
L) Resistor Integ. Test.... Enabled

Equipment to change or Esc to quit?
```

a From the Equipment submenu, type **k**

The cold-wheel setting toggles between enabled (YES) and disabled (NO). The Cold Wheel option of the Equipment submenu changes. The Equipment submenu reappears.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

14 To set or change the **resistor-integrity-test** setting:

The Equipment submenu shows whether the resistor-integrity-test setting is enabled, reduced, or disabled.

After a train clears a site, the system does an integrity test to verify that the scanners are operational and that the system can read alarm level heat. This test consists of reading the temperature of power resistors, mounted to the back of the scanner shutters, after the shutters close. The recorded temperature of the shutter resistors is compared against expected values, which are calculated using the amount of time the shutters were open.

A site can be set up to perform the resistor integrity test in one of three modes. When the resistor integrity test is in enabled mode, the existing algorithm is used to determine the minimum acceptable resistor temperature values for a given train. When in reduced mode, the existing acceptable resistor values are reduced by 15% before the comparison is made to the temperature values read from the resistors. The third mode, disabled, prevents the resistor integrity test from being performed at all.

For a given train duration, the resistor heats expected by both the enabled and reduced modes are as follows.

Train Duration (in seconds)	Expected Resistor Temperatures for Reduced Mode	Expected Resistor Temperatures for Enabled Mode
10 or less	No Test Occurs	No Test Occurs
11 - 19	32°F (0°C)	40°F (4.4°C)
20 - 29	67°F (19.4°C)	80°F (26.7°C)
30 - 39	101°F (38.3°C)	120°F (48.9°C)
40 or more	135°F (57.2°C)	160°F (71.1°C)

Typing the letter **l** toggles from one resistor test mode to another.

```
              •
              •
              •

J) Gate Distance....... 24.0 inches
K) Cold Wheel.................. YES
L) Resistor Integ. Test.... Enabled

Equipment to change or Esc to quit?
```

a From the Equipment submenu, type **l**

The resistor-integrity-test setting toggles from enabled to disabled, from disabled to reduced, or from reduced to enabled. The Resistor Integrity Test Mode option of the Equipment submenu changes. The Equipment submenu reappears.

b To leave the Equipment submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

11.3.6 Messages

To set or change one or more of the message parameters:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE

           •
           •
           •
```

2 To go to the Messages submenu, type **f**

A menu and prompt like this appears. The options on the Messages submenu are used to affect the phrases broadcast to a passing train.

```
Milepost-0501.2, Track:Single
Messages
---------------------------------------------------
A) Axles...................... NO
B) Arrival.................... NO
C) Speed...................... NO
D) Length..................... NO
E) Temperature................ NO
F) Power Off.................. NO
G) HiWide..................... YES
H) Car ID..................... NO
I) No Defects.................. 1

Message to change or Esc to quit ?
```

The ancillary messages are generated by enabling one or more of these options: A (axle count), C (train speed), D (train length), E (site ambient temperature), and F (power off). The other options of the Messages submenu aren't used to generate ancillary messages.

3 To <u>leave</u> the Messages submenu and return to the Setup menu:

a Press **[Esc]**.

The Setup menu reappears.

b Skip the remaining steps.

4 To set or change the **announce-axles** setting:

The Messages submenu shows whether the total axle count is to be announced (YES) or not announced (NO). Typing **a** toggles between what is shown and its opposite.

```
Milepost-0501.2, Track:Single
Messages
---------------------------------------------------
A) Axles...................... NO
B) Arrival.................... NO
C) Speed...................... NO

           •
           •
           •
```

a From the Messages submenu, type **a**

The announce-axles setting toggles between announce (YES) or not announce (NO). The Announce Axles option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

5 To set or change the **announce-arrival-message** setting:

The Messages submenu shows whether the train-arrival message is to be announced (YES) or not announced (NO). Typing **b** toggles between what is shown and its opposite.

```
Milepost-0501.2, Track:Single
Messages
---------------------------------------------------
A) Axles...................... NO
B) Arrival.................... NO
C) Speed...................... NO

           •
           •
           •
```

a From the Messages submenu, type **b**

The announce-arrival-message setting toggles between announce (YES) or not announce (NO). The Announce Train Arrival option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

6 To set or change the **announce-speed** setting:

The Messages submenu shows whether the exit speed of the train is to be announced (YES) or not announced (NO). Typing **c** toggles between what is shown and its opposite.

```
Milepost-0501.2, Track:Single
Messages
---------------------------------------------------
A) Axles...................... NO
B) Arrival.................... NO
C) Speed...................... NO
D) Length..................... NO

            •
            •
            •
```

a From the Messages submenu, type **c**

The announce-speed setting toggles between announce (YES) or not announce (NO). The Announce Speed option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

7 To set or change the **announce-train-length** setting:

The Messages submenu shows whether the train length is to be announced (YES) or not announced (NO). Typing **d** toggles between what is shown and its opposite.

```
Milepost-0501.2, Track:Single
Messages
---------------------------------------------------
A) Axles...................... NO
B) Arrival.................... NO
C) Speed...................... NO
D) Length..................... NO
E) Temperature................ NO

            •
            •
            •
```

a From the Messages submenu, type **d**

The announce-train-length setting toggles between announce (YES) or not announce (NO). The Announce Train Length option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

8 To set or change the **announce-temperature** setting:

The Messages submenu shows whether the ambient temperature (taken at the site by the shielded temperature probe as the train leaves the site) is to be announced (YES) or not announced (NO). Typing **e** toggles between what is shown and its opposite.

```
Milepost-0501.2, Track:Single
Messages
---------------------------------------------------
A) Axles...................... NO
B) Arrival.................... NO
C) Speed...................... NO
D) Length..................... NO
E) Temperature................ NO
F) Power Off.................. NO

           •
           •
           •
```

a From the Messages submenu, type **e**

The announce-temperature setting toggles between announce (YES) or not announce (NO). The Announce Temperature option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

9 To set or change the **announce-power-off** setting:

The Messages submenu shows whether the power-off message is to be announced (YES) or not announced (NO). This message is generated whenever the voltage coming from the battery is at least 18 VDC, but less than 22 VDC. AC power need never have been off to cause this to happen. However, most times it does indicate that AC power has been off, causing the battery to be drained. This message is also generated whenever AC power wasn't on during the end-of-train processing. Typing **f** toggles between what is shown and its opposite.

```
           •
           •
           •

E) Temperature................ NO
F) Power Off.................. NO
G) HiWide..................... YES
H) Car ID..................... NO
I) No Defects.................. 1

Message to change or Esc to quit ?
```

a From the Messages submenu, type **f**

The announce-power-off setting toggles between enabled (YES) and disabled (NO). The Announce Power Off option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

10 To set or change the **announce-high-wide** setting:

The Messages submenu shows whether the high-wide message is to be announced (YES) or not announced (NO). Typing **g** toggles between what is shown and its opposite. Select YES when a single trip wire is used for both high-load and wide-load detection. Doing so will announce high-wide for either a high-load condition or a wide-load condition. Select NO when each high-load and wide-load detector has its own trip wire. Doing so will announce high-load for a high-load condition and wide-load for a wide-load condition.

To announce High-Load alarms, YES must appear after the words High Load on the Equipment submenu and NO must appear after the word HiWide on the Messages submenu. To announce High-Wide alarms, YES must appear after the words High Load on the Equipment submenu and YES must appear after the word HiWide on the Messages submenu.

```
          •
          •
          •

E) Temperature................ NO
F) Power Off.................. NO
G) HiWide..................... YES
H) Car ID..................... NO
I) No Defects.................. 1

Message to change or Esc to quit ?
```

a From the Messages submenu, type **g**

The announce-high-wide setting toggles between enabled (YES) and disabled (NO). The Announce High-Wide option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

11 To set or change the **announce-car-identification** setting:

The Messages submenu shows whether the car-identification message is to be announced (YES) or not announced (NO). When this option is set to YES and an alarm is found on a car, the AEI car identification will be included in the post-train announcement of that alarm. Typing **h** toggles between what is shown and its opposite.

```
            •
            •
            •

   E) Temperature................. NO
   F) Power Off................... NO
   G) HiWide...................... YES
   H) Car ID...................... NO
   I) No Defects................... 1

   Message to change or Esc to quit ?
```

a From the Messages submenu, type **h**

The announce-car-identification setting toggles between enabled (YES) and disabled (NO). The Announce Car Identification option of the Messages submenu changes. The Messages submenu reappears.

b To leave the Messages submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

12 To set or change the **no-defects** setting:

The Messages submenu shows how many times the system makes the no-defects announcement for trains with no Exception Alarms and no Integrity Failures. The entry routine accommodates a single digit and enforces a minimum value of 1 and a maximum value of 3. If set to a value other than 1, a pause of roughly three seconds occurs between each of the no-defects messages. The detector-out message occurs only once and follows the final no-defects announcement. A three-second pause doesn't occur between the final no-defects message and the detector-out message.

```
            •
            •
            •

   E) Temperature................. NO
   F) Power Off................... NO
   G) HiWide...................... YES
   H) Car ID...................... NO
   I) No Defects................... 1

   Message to change or Esc to quit ?
```

a From the Messages submenu, type **i**

This prompt appears.

```
New Value ?
```

b To not change the value, press **[Esc]** and return to step **3**.

c Type the new limit.

If you type zero or a value greater than 3, this error message and prompt appears.

```
Minimum valid value is 1, Maximum valid value is 3
New Value ?
```

If you type an acceptable value, the No Defects option of the Messages submenu changes and the Messages submenu reappears.

d If you get an error message, return to step **b**.

e If you don't get an error message, return to step **3**.

11.3.7 System Functions

To execute any of the system functions:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System

           •
           •
           •
```

2 To display the System Functions menu, type **h**

The System Functions menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
  E) Auto-Calibration
  F) Reset the COP Counters
  G) Remote System RESET
  H) Clear All Stored Train Data
  I) Clear Event Log
  J) Send JC Message
  K) Send JM Message
  L) Send JP Message
  M) Send JS Message
  N) Real-Time Diagnostics
  X) Exit Menu
?
```

3 To leave the System Functions menu and return to the Setup menu:

a Press **[Esc]**.

The Setup menu reappears.

b Skip the remaining steps.

4 To execute the radio test:

Selection of the Radio Test option broadcasts a short message through the speaker and through the radio. At single-track sites, the text of the message is "Testing, U-P detector, milepost (milepost number), testing, one, two, three, four, five, four, three, two, one, testing detector-out." At multitrack sites, the text of the message is "Testing, UP detector, milepost (milepost number), track (track designation), testing, one, two, three, four, five, four, three, two, one, testing, detector-out."

a Be sure that the speaker (in the SmartScanIS enclosure) is plugged in and that its volume knob is turned to the middle position.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
               •
               •
               •
```

b From the System Functions menu, type **a**

If the system isn't currently making any other voice announcements, it begins the message. If the system is currently making a voice announcement, the firmware waits until it is done to begin the message.

c If you hear nothing or the speech is too garbled to understand, call STC for help in fixing this problem.

d Return to step **3**.

5 To execute the vocabulary test:

Selection of the Vocabulary Test option enunciates all of the stored speech phrases. This announcement is broadcast through the speaker, but not through the radio.

Below is a list of the phrases that are announced. The phrases are grouped by chip number.

Chip	Announced Phrases
1	Zero, One, Two, Three, Four, Five
2	Six, Seven, Eight, Nine, No-Defects
3	Detector-Malfunction, Point, Hotwheel, Testing
4	Axle, Dragging-Equipment-Near, North, Rail
5	South, East, West, Track, Hotbox
6	Defect-Detected, M-P-H, Fifth
7	Integrity-Failure, Detector-Out, Sixth
8	Rebroadcast, Train-Too-Slow, Total-Axles, Speed
9	A, B, C, D, E, Temperature, Length, Minus, First, Second
10	F, G, H, I, J, Third, Fourth, Left-Side, Right-Side, *beep*
11	K, L, M, N, O, High-Load, Wide-Load, On, Seventh, Eighth
12	P, Q, R, S, T, S-P-Detector, Milepost, Detector-Working
13	U, V, W, X, Y, Stop-Your-Train, U-P-Detector, Ninth
14	Z, Sliding-Wheel, Car-I-D, From-Head-of-Train, Degrees, Number
15	Multiple-Hot-Journal-and-Dragging-Equipment, Power-Off, High-Wide-Near
16	Detected-From-Axle, To-End-of-Train, Miles-Per-Hour, Multiple-Dragging-Equipment

a Be sure that the speaker (in the SmartScanIS enclosure) is plugged in and that its volume knob is turned to the middle position.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
              •
              •
              •
```

b From the System Functions menu, type **b**

If the system isn't currently making any other voice announcements, it begins the vocabulary-test announcement. If the system is currently making a voice announcement, the firmware waits until it is done to begin the vocabulary-test announcement.

c If you hear nothing or the speech is too garbled to understand, call STC for help in fixing this problem.

d Return to step **3**.

6 To execute the gate test:

Selection of the Gate Test option opens the scanner shutters and simulates a passing train. While in this mode, you can simulate alarms by placing a heat source on a scanner or by opening an auxiliary alarm detector's contacts.

You can stop the gate test by pressing **[Esc]**. If you don't press **[Esc]**, the test continues until 486 axles are simulated. The firmware pauses between railcars and scans for a pressed **[Esc]**. Consequently, the gate test may not terminate immediately after **[Esc]** is pressed. It may need to finish the current car's axles. Pressing keys before pressing **[Esc]** results in the generation of additional cars of axles before aborting. There will be one additional car of axles for each key pressed before pressing **[Esc]**.

After pressing **[Y]** to begin the gate test, the "Running Gate Test..." message appears followed by a four-second pause.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
                •
                •
                •
```

a From the System Functions menu, type **c**

This prompt appears.

```
Start Gate Test?
```

b To not start the gate test:

- Type **n**

  The System Functions menu reappears.

- Return to step **3**.

c To start the gate test, type **y**

This message appears.

```
Running Gate Test...
```

When finished, this message appears followed by the System Functions menu.

```
Running Gate Test...Gate Test Complete
```

d Return to step **3**.

7 To execute the one-kilohertz Test Tone:

Selection of the 1KHz Test Tone option generates a continuous one-kilohertz tone for 15 seconds. This tone is broadcast through the speaker and through the radio.

a Be sure that the speaker (in the SmartScanIS enclosure) is plugged in and that its volume knob is turned to the middle position.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Ton
  E) Auto-Calibration
              •
              •
              •
```

b From the System Functions menu, type **d**

If the system isn't currently making any other voice announcements, it begins the tone. If the system is currently making a voice announcement, the firmware waits until it is done to begin the tone.

c If you hear nothing, call STC for help in fixing this problem.

d Return to step **3**.

8 To start autocalibration:

Selection of the Auto-Calibration option places the system in autocalibration mode.

The SmartScanIS self-calibrates its pyrometer interface circuitry. You need only put a preheated calibrated heat source on a scanner and place the system in autocalibration mode. The system then scans all pyrometer inputs until the signal from the calibrated heat source is located. The necessary adjustments to the related interface circuitry are automatically made while the system monitors its own progress by analyzing changes in the heat signals. Once the procedure has been completed, autocalibration mode is disengaged and the calibration results are displayed on your computer.

a Place a preheated calibrated heat source on the scanner to be calibrated.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Ton
  E) Auto-Calibration
  F) Reset the COP Counters

              •
              •
              •
```

b From the System Functions menu, type **e**

The SmartScanIS will now calibrate itself. Follow along on the user interface screen until you see "Auto-Calibration Disengaged." This message is an indication that the system is finished with the calibration procedure. To abort the process, press **[Esc]** (on your computer) or remove the heat source (from the scanner).

c When "Auto-Calibration Disengaged" is displayed on your computer, remove the calibrated heat source.

d Return to step **3**.

9 To reset the COP counters:

Built into each microprocessor on the Processor board is a Computer Operating Properly (COP) monitor. This feature gives the processor the ability to monitor its own operation and, in the presence of abnormal operating conditions, automatically trigger a system reset. The SmartScanIS maintains a count of these system resets (until 255 is reached), whether initiated automatically by the system <u>or</u> manually by the user via the Remote System Reset option of the System Functions menu. These counters are used for diagnostic purposes only. The current value of these counters appears on the System Status report.

Selection of the Reset the COP Counters option resets each COP counter to zero.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
  E) Auto-Calibration
  F) Reset the COP Counters
  G) Remote System RESET

              •
              •
              •
```

a From the System Functions menu, type **f**

The firmware clears the COP counter for both microprocessors.

The System Functions menu reappears.

b Return to step **3**.

10 To force a system reset:

Selection of the Remote System Reset option forces a system reset through a remote connection. It can also be used locally.

```
              •
              •
              •

  E) Auto-Calibration
  F) Reset the COP Counters
  G) Remote System RESET
  H) Clear All Stored Train Data
  I) Clear Event Log

              •
              •
              •
```

a From the System Functions menu, type **g**

This prompt appears.

```
Are You Sure?
```

b To not reset the system:

- Type **n**

  The System Functions menu reappears.

- Return to step **3**.

c To reset the system, type **y**

This message appears.

```
Will RESET 5 seconds after exit from Serial Interface!
```

The System Functions menu reappears.

d Return to step **3**.

11 To delete all stored train data:

Selection of the Clear All Stored Train Data option erases all of the stored train data. This encompasses all of the trains in the Trains and Exceptions directories. After deleting all train data, there isn't any way of regenerating it. The data is gone forever.

```
              •
              •
              •

    F) Reset the COP Counters
    G) Remote System RESET
    H) Clear All Stored Train Data
    I) Clear Event Log
    J) Send JC Message

              •
              •
              •
```

a From the System Functions menu, type **h**

This prompt appears.

```
Are You Sure?
```

b To not delete all stored train data:

- Type **n**

  The System Functions menu reappears.

- Return to step **3**.

c To delete all stored train data, type **y**

This message appears.

```
Clearing Stored Train Data...
```

Clearing the train data takes about two seconds. When finished, this message appears followed by the System Functions menu.

```
Clearing Stored Train Data...Done
```

d Return to step **3**.

12 To delete all of the events stored in the Event Log:

Selection of the Clear Event Log option erases all of the events stored in the Event Log and displayed on the Event Log report. After deleting the log, there isn't any way of regenerating it. The data is gone forever.

```
                •
                •
                •

    F) Reset the COP Counters
    G) Remote System RESET
    H) Clear All Stored Train Data
    I) Clear Event Log
    J) Send JC Message

                •
                •
                •
```

a From the System Functions menu, type **i**

This prompt appears.

```
Are You Sure?
```

b To not delete all of the events stored in the Event Log:

- Type **n**

  The System Functions menu reappears.

- Return to step **3**.

c To delete all of the events stored in the Event Log, type **y**

The System Functions menu reappears.

d Return to step **3**.

13 To send a Constant Carrier signal to the Harriman Dispatch Center:

Selection of the Send JC Message option sends a Constant Carrier signal for 15 seconds to the Harriman Dispatch Center.

```
                •
                •
                •

     I) Clear Event Log
     J) Send JC Message
     K) Send JM Message
     L) Send JP Message
     M) Send JS Message
     N) Real-Time Diagnostics
     X) Exit Menu
   ?
```

a From the System Functions menu, type **j**

After 15 seconds, the System Functions menu reappears.

b Return to step **3**.

14 To send a Continuous Mark signal to the Harriman Dispatch Center:

Selection of the Send JM Message option sends a Continuous Mark signal for 15 seconds to the Harriman Dispatch Center.

```
                •
                •
                •

     I) Clear Event Log
     J) Send JC Message
     K) Send JM Message
     L) Send JP Message
     M) Send JS Message
     N) Real-Time Diagnostics
     X) Exit Menu
   ?
```

a From the System Functions menu, type **k**

After 15 seconds, the System Functions menu reappears.

b Return to step **3**.

15 To send a Mark-Space pattern to the Harriman Dispatch Center:

Selection of the Send JP Message option sends a Mark-Space pattern for 15 seconds to the Harriman Dispatch Center.

```
                •
                •
                •

    I) Clear Event Log
    J) Send JC Message
    K) Send JM Message
    L) Send JP Message
    M) Send JS Message
    N) Real-Time Diagnostics
    X) Exit Menu
  ?
```

a From the System Functions menu, type **l**

After 15 seconds, the System Functions menu reappears.

b Return to step **3**.

16 To send a Continuous Space signal to the Harriman Dispatch Center:

Selection of the Send JS Message option sends a Continuous Space signal for 15 seconds to the Harriman Dispatch Center.

```
                •
                •
                •

    I) Clear Event Log
    J) Send JC Message
    K) Send JM Message
    L) Send JP Message
    M) Send JS Message
    N) Real-Time Diagnostics
    X) Exit Menu
  ?
```

a From the System Functions menu, type **m**

After 15 seconds, the System Functions menu reappears.

b Return to step **3**.

17 To enable/disable real-time diagnostics:

Selection of the Real-Time Diagnostics submenu enables and disables various diagnostic messages. These messages aren't meant for general-purpose use and should only be enabled in consultation with STC personnel.

```
              .
              .
              .

  L) Send JP Message
  M) Send JS Message
  N) Real-Time Diagnostics
  X) Exit Menu
?
```

a From the System Functions menu, type **n**

A message like this appears.

```
Milepost-1234.5, Track:2
Real-Time Diagnostics
-----------------------------------------------------
A) Harriman Polling System...... NO
B) Train Data Storage.......... YES

Diagnostic to change or Esc to quit?
```

Typing the option letter toggles the diagnostics between enabled (YES) and disabled (NO).

b To change the setting for Harriman diagnostics, type **a**

c To change the setting for train diagnostics, type **b**

d Press **[Esc]**.

The System Functions menu reappears.

e Return to step **3**.

11.3.8 Polling System

The Polling System submenu is the gateway to creating a polling address so that the SmartScanIS can participate in the Central Reporting System. To participate in the Central Reporting System, each SmartScanIS must have a polling address. What the address is depends on which mode you're in. In Poll/Standalone mode, the address is based on a single alpha character designator. In Dialup mode, the address is based on the site name.

To set or change any of the polling-system settings:

1 Be sure that the Setup menu is displayed.

The top part of the Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System
  J) Serial Ports

           •
           •
           •
```

2 To display the Polling System submenu, type **i**

This prompt

```
Polling Mode is Dialup, is this OK (Y/N)?
```

or this one appears.

```
Polling Mode is Poll/Standalone, is this OK (Y/N)?
```

You can configure the SmartScanIS for either dialup mode or poll/standalone mode operation. Dialup mode should be chosen for systems that will be connected to the Harriman Dispatch Center via an external modem. Poll/Standalone mode should be chosen for systems that will be either connected to Harriman via a hardwired microwave connection or not connected to Harriman at all.

Typing **n** toggles between dialup mode and poll/standalone mode. When the correct operating mode is displayed, type **y**.

3 If the displayed operating mode is incorrect, type **n**

The operating-mode setting toggles between dialup and poll/standalone.

4 If the displayed operating mode is correct, type **y**

If you selected dialup mode, this prompt appears.

```
Milepost-1234.5, Track:2
Polling System - Dialup Mode
-----------------------------------------------
A) Primary Phone#.......   Disabled
B) Secondary Phone#.....   Disabled
C) Site ID.................. UP123
D) Calibration Temp........... 180°
E) Wind Monitor........... Disabled
F) Rail Stress Monitor.......... NO
G) High Wind Alarm..........  32mph
H) Rail Stress Lim.  Low:-40 Hi:+40

Parameter to change or Esc to quit?
```

If you selected poll/standalone mode, this prompt appears.

```
Milepost-1234.5, Track:2
Polling System - Poll/Standalone Mode
-----------------------------------------------
A) Poll Address.................. A
B) RFL Delay.................. 200
C) Site ID.................. UP123
D) Calibration Temp........... 180°
E) Wind Monitor........... Disabled
F) Rail Stress Monitor.......... NO
G) High Wind Alarm..........  32mph
H) Rail Stress Lim.  Low:-40 Hi:+40

Parameter to change or Esc to quit?
```

Currently, option **f** (rail stress monitor) and option **h** (rail stress limit) aren't supported in the firmware. Therefore, they won't be discussed below.

5 If you selected Dialup mode:

a If you want to change the primary telephone number, type **a** and then type in the desired phone number.

Dialup mode lets you enter up to two telephone numbers, which the SmartScanIS will use to initiate contact with the Harriman Dispatch Center. You can type up to 18 appropriate characters or you can press **[ENTER]** to cause the phone number to be disabled.

A comma is interpreted by most modems to represent a pause in the dialing process, such as the pause between dialing a number to obtain an outside line and then proceeding to dial the actual telephone number. The amount of time that the modem pauses when encountering a comma is a function of the modems setup parameters.

b If you want to disable the primary telephone number, type **a** and then press **[ENTER]**.

c If you want to change the secondary telephone number, type **b** and then type in the desired phone number.

d If you want to disable the secondary telephone number, type **b** and then press **[ENTER]**.

e Go to step **7**.

6 If you selected Poll/Standalone mode:

a If you want to change the poll address, type **a** and then type in a letter.

Poll/Standalone mode lets you select an address letter. Any letter may be typed. If you don't input a poll address, it defaults to the letter **A**.

b If you want to change the RFL delay, type **b** and then type in a number from 200 through 500.

The number after the words RFL Delay is the amount of delay, in milliseconds, between the system keying of the polling-system radio and the time that the radio is ready to accurately transmit data. If you don't input a value for the RFL delay, it defaults to 200 milliseconds.

7 If you want to change the site name, type **c** and then type in six or less digits, letters, or both digits and letters.

If you don't input a value for site name, it defaults to *NONAME*.

8 If you want to change the calibration temperature, type **d** and then type in a number from 100 through 250.

This option lets you enter the calibration temperature (in degrees Fahrenheit). Once entered, this value is used for display purposes only. It is not an alarm limit.

9 If you want to disable/enable the wind-monitor feature, type **e**

This option shows whether the wind-monitor feature is enabled (YES) or disabled (NO). It doesn't show whether the wind-monitor hardware was installed or not. Typing the letter **e** toggles from enabled to disabled or from disabled to enabled.

10 If you want to change the high wind alarm limit, type **g** and then type in a number from 30 through 100.

This option lets you enter a wind speed in miles per hour. When the wind monitor records a wind speed that matches or exceeds this alarm limit, the detector flags a high wind condition and queues a WX message for transmission to the Harriman Dispatch Center.

11 To leave the Polling System submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

11.3.9 Serial Ports

To set or change any of the serial-ports settings:

1 Be sure that the Setup menu is displayed.

The Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System
  J) Serial Ports
  K) Amtech Reader Parameters
  L) Modem Setup
  X) Exit Menu
?
```

2 To display the Serial Ports submenu, type **j**

A prompt like this appears.

```
Milepost-1234.5, Track:2
Serial Ports
------------------------------------------------
     Port      Tx      Rx    Line Setting
-- --------  ------  ------  ------------
A) COM1-P9     9600    9600  N-8-1
B) COM2-P10    9600    9600  N-8-1
C) COM3-P8     9600    9600  N-8-1

Port to change or Esc to quit?
```

3 To modify the COM1-P9 parameters, type **a**

A prompt like this appears.

```
Milepost-1234.5, Track:2
Serial Ports
COM1-P9  Tx-9600/Rx-9600   N-8-1
------------------------------------------------
A) Increase Tx Baud Rate
B) Decrease Tx Baud Rate
C) Increase Rx Baud Rate
D) Decrease Rx Baud Rate
X) Exit Menu

Parameter to change or Esc to quit?
```

Type either **a** to increase or **b** to decrease the outgoing (aka transmit) baud rate for COM1. Type either **c** to increase or **d** to decrease the incoming (aka receive) baud rate for COM1. Depending on which letter you type and what baud rate was displayed when you typed it, the baud rate changes to either the next or the prior value from these values: 150, 300, 600,1200, 2400, 4800, 9600, and 19200. You can't change the line setting of N-8-1.

a Type the letter of what you want to change.

The prompt reappears.

b If you aren't done changing the parameters for COM1, return to step **a**.

c If you are done changing the parameters for COM1, type **x**

4 To modify the COM2-P10 parameters, type **b**

A prompt like this appears.

```
Milepost-1234.5, Track:2
Serial Ports
COM2-P10 Tx-9600/Rx-9600   N-8-1
------------------------------------------------
A) Increase Tx Baud Rate
B) Decrease Tx Baud Rate
C) Increase Rx Baud Rate
D) Decrease Rx Baud Rate
E) N-8-1
F) E-7-1
X) Exit Menu

Parameter to change or Esc to quit?
```

Type either **a** to increase or **b** to decrease the outgoing (aka transmit) baud rate for COM2. Type either **c** to increase or **d** to decrease the incoming (aka receive) baud rate for COM2. Depending on which letter you type and what baud rate was displayed when you typed it, the baud rate changes to either the next or the prior value from these values: 150, 300, 600,1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200. Type **e** for no parity bit, 8 data bits, and 1 stop bit. Type **f** for even parity bit, 7 data bits, and 1 stop bit.

a Type the letter of what you want to change.

The prompt reappears.

b If you aren't done changing the parameters for COM2, return to step **a**.

c If you are done changing the parameters for COM2, type **x**

5 To modify the COM3-P8 parameters, type **c**

A prompt like this appears.

```
Milepost-1234.5, Track:2
Serial Ports
COM3-P8  Tx-9600/Rx-9600   N-8-1
-----------------------------------------------
A) Increase Tx Baud Rate
B) Decrease Tx Baud Rate
C) Increase Rx Baud Rate
D) Decrease Rx Baud Rate
E) N-8-1
F) E-7-1
X) Exit Menu

Parameter to change or Esc to quit?
```

Type either **a** to increase or **b** to decrease the outgoing (aka transmit) baud rate for COM3. Type either **c** to increase or **d** to decrease the incoming (aka receive) baud rate for COM3. Depending on which letter you type and what baud rate was displayed when you typed it, the baud rate changes to either the next or the prior value from these values: 150, 300, 600,1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200. Type **e** for no parity bit, 8 data bits, and 1 stop bit. Type **f** for even parity bit, 7 data bits, and 1 stop bit.

a Type the letter of what you want to change.

The prompt reappears.

b If you aren't done changing the parameters for COM3, return to step **a**.

c If you are done changing the parameters for COM3, type **x**

6 To leave the Serial Ports submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

11.3.10 Amtech Reader Parameters

The AEI reader parameters directly affect how the AEI readers operate to acquire tags while a train is passing the site.

To set or change any of the reader parameters:

1 Be sure that the Setup menu is displayed.

The Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System
  J) Serial Ports
  K) Amtech Reader Parameters
  L) Modem Setup
  X) Exit Menu
?
```

2 To display the Amtech Reader Parameters submenu, type **k**

A prompt like this appears.

```
Milepost-1234.5, Track:2
Amtech Reader Parameters
-----------------------------------------------------------
A) ID Separation...............  2
B) Consecutive Reads...........  2
C) Uniqueness Timeout...... 120 Sec

Parameter to change or Esc to quit?
```

Shown above are the parameters currently defined in the system.

- ID Separation specifies the number of intervening tags that must be read and reported before a given tag is reported again. Valid values are 1, 2, 3, and 4. The default is 2.
- Consecutive Reads specifies the number of times that a tag must be read before it is considered a valid (reportable) tag. Valid values are 1, 2, 3, and 4. The default is 2.
- Uniqueness Timeout specifies the number of seconds that the ID Separation parameter is in effect for a given tag. When 2200-504 Readers are attached to the system, valid values are 15, 30, and 120. The default is 120. When a 2200-750 Reader is attached to the system, the Uniqueness Timeout parameter is automatically set to 120 seconds. For a 2200-750 Reader, this value cannot be changed.

3 To modify the ID-separation parameter, type **a**

A prompt like this appears.

```
Current ID Separation: 2
Modify ? (Y/N):
```

a Type **y** until the value you want is shown.

Typing the letter **y** toggles from 1 to 2, from 2 to 3, from 3 to 4, or from 4 to 1.

b Type **n**

4 To modify the Consecutive Reads parameter, type **b**

A prompt like this appears.

```
Current Consecutive Reads: 2
Modify ? (Y/N):
```

a Type **y** until the value you want is shown.

Typing the letter **y** toggles from 1 to 2, from 2 to 3, from 3 to 4, or from 4 to 1.

b Type **n**

5 To modify the Uniqueness Timeout parameter, type **c**

A prompt like this appears.

```
Current Uniqueness Timeout: 120 Seconds
Modify ? (Y/N):
```

a Type **y** until the value you want is shown.

Typing the letter **y** toggles from 15 to 30, from 30 to 120, or from 120 to 15.

b Type **n**

6 To leave the Amtech Reader Parameters submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

11.3.11 Modem Setup

To set or change any of the modem-setup settings:

1 Be sure that the Setup menu is displayed.

The Setup menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System
  J) Serial Ports
  K) Amtech Reader Parameters
  L) Modem Setup
  X) Exit Menu
?
```

2 To display the Modem Setup submenu, type **I**

Lines like this appear. These lines show the current modem configuration. Support exists in the firmware for two modem types. The "default" modem type provides a preset series of modem configuration commands. These commands cannot be altered. The "alternate" modem type provides the ability to edit and customize the modem setup commands. This submenu also provides a method for forcing the initialization of the modem.

```
Milepost-1234.5, Track:2
Modem Setup
------------------------------------------------
A) Modem Setup Line 1 = AT&F
B) Modem Setup Line 2 = ATV0 S0=2 &D0 &Q1
C) Modem Setup Line 3 = ATX4 E0 &E3
D) Modem Setup Line 4 = Empty
E) Modem Setup Line 5 = AT&W0

The Default modem is selected, is this OK (Y/N)?
```

Below the current modem configuration, this prompt

```
The Default modem is selected, is this OK (Y/N)?
```

or this one appears.

```
The Alternate modem is selected, is this OK (Y/N)?
```

Typing **n** toggles between default modem and alternate modem. When the correct modem type is displayed, type **y**.

3 If the displayed modem type is incorrect, type **n**

The modem-selection setting toggles between default and alternate.

4 If the displayed modem type is correct, type **y**

If you selected Default, the system reverts to the default modem configuration and this prompt appears.

```
Do you want to initialize the modem now (Y/N)?
```

5 If the selected modem type is Default, go to step **9**.

6 If the selected <u>modem</u> <u>type</u> <u>is</u> <u>Alternate</u>, this prompt appears.

```
Are the setup commands OK (Y/N)?
```

7 If you need to modify one or more of the five displayed lines of modem setup commands, type **n**

This prompt appears.

```
Enter line number to change (1-5):
```

There are five available lines for setup command data, each line having a maximum of 25 characters of data. Entry of a line number is followed by a prompt for entry of the new modem setup data for the selected line number. Type in the desired modem commands, pressing **[Enter]** when done. If an entered command consumes the entire 25 characters of a line, the newly entered data is automatically saved upon entry of the 25th character. The contents of a line can be removed entirely by immediately pressing **[Enter]** when prompted for the new setup data. On the Modem Setup submenu <u>and</u> on the System Status report, lines that have been cleared of data this way will be left blank.

This screen fragment shows an example of erasing the fifth line of setup data. Pressing **[Enter]** to clear the fifth line is shown by **[Enter]** in the example.

```
Are the setup commands OK (Y/N)?n
Enter line number to change (1-5):5
Enter new setup commands (25 characters max):[Enter]
Are the setup commands OK (Y/N)?
```

8 If you don't need to correct any of the five displayed lines of modem setup commands, type **y**

This prompt appears.

```
Do you want to initialize the modem now (Y/N)?
```

9 If you want to initialize the modem now, type **y**

The modem initialization routine uses the current modem setup data. A one-second pause is placed between each line of setup commands as they are outputted to the modem. Empty setup command lines aren't outputted to the modem. After the modem is initialized, the Modem Setup submenu reappears.

10 If you don't want to initialize the modem now, type **n**

The Modem Setup submenu reappears.

11 To <u>leave</u> the Modem Setup submenu and return to the Setup menu, press **[Esc]**.

The Setup menu reappears.

Chapter 12
Producing Reports

The SmartScanIS provides:

- Train Summary report
- Train Detail report
- Exception Summary report
- extended Exception Detail report
- abbreviated Exception Detail report
- System Status report
- Last Train report
- Range of Trains report
- Event Log report
- T94 Train Detail

After plugging a laptop computer into the system, you can produce any of these 10 reports by using the serial interface.

When using a computer, use your communications software to open a LOG file and capture the reports to the file. (You need to do this because reports don't contain logic to pause when the screen is filled.) When your session is complete, you may then view the recorded reports with an editor or print them with a printer.

This chapter shows a sample of each report with instructions on how to use the serial interface to produce it. The contents of each field on each report are also covered. In the sample reports, do not interpret the displayed data as representing real-world conditions or activity. The examples are meant to only illustrate the general appearance of a given report and provide a reference for the location of relevant data.

12.1 Train Summary Report

The Train Summary report lists all trains currently stored in the Trains directory. A train number is shown for each train entry so that a Train Detail report may easily be produced for any train listed on the summary.

Below is a sample of part of a Train Summary report when Hotwheel alarm reporting is <u>disabled</u> using the Hotwheel option of the Equipment submenu. The contents of your report will be different. The version information in the sample below is for illustrative purposes only. It doesn't represent any real release of the firmware.

```
                         Southern Technologies Corporation
                            Integrated Detector System
                              Union Pacific Railroad
                                  TRAIN SUMMARY
                                   06/23/2006
==============================================================================
Version Info.... Analyzer:  1.01  01/10/2006                  Milepost: 1234.5
                   Talker:  2.02  02/20/2006                     Track: Single
             Communicator:  3.03  03/30/2006                    SiteID: NONAME

Alarm Limits..     Absolute: 200°    CS Minimum: 245
               Differential: 150°      CS Slope: 2.34
------------------------------------------------------------------------------
                                                    D
                                            Speed i Max Bearing Avg Bearing
Train#   Date   Time  Cars Axles TO1  TO2 (mph) r East  West  East  West  Tags Battery TO1Hits TO2Hits
-------------------------------------------------------------------------------------------------------
M  178 06/22/06 15:47   18   78   78   78   53  E  16°   16°   56°   21°    0  27.1v     156     156

   177 06/21/06 08:32   18   78   78   78   57  E  37°   38°   36°   37°    0  27.2v     156     156
I  176 06/21/06 07:40   10   46   46   46   57  E 150°    8°   43°    7°    0  27.2v      92      92
   175 06/21/06 06:28   14   62   62   62   57  E  37°   38°   36°   37°    0  27.2v     124     124

   174 06/20/06 11:32   18   78   78   78   53  E  56°   56°   55°   55°    0  27.1v     156     156
I  173 06/20/06 01:19   18   78   78   78   55  E 126°  126°   58°   20°    0  26.7v     156     156

I  172 06/19/06 11:24   53  218  218  218   49  E 116°  116°   54°   18°    0  27.1v     436     436
I  171 06/19/06 01:22    8   38   38   38   53  E 120°  120°   55°   18°    0  27.1v      76      76
                                              .
                                              .
                                              .
```

Below is a sample of part of a Train Summary report when Hotwheel alarm reporting is <u>enabled</u> using the Hotwheel option of the Equipment submenu. The contents of your report will be different.

```
                                          .
                                          .
                                          .
Alarm Limits..     Absolute: 180°    CS Minimum:  60
               Differential: 120°      CS Slope: 0.75
                  Hot Wheel: 540°
------------------------------------------------------------------------------
                                                    D
                                            Speed i Max Bearing Avg Bearing  Max Wheel   Avg Wheel
Train#  Date   Time   Cars Axles TO1  TO2 (mph) r East  West  East  West  East  West  East  West  Tags Battery TO1Hits TO2Hits
------------------------------------------------------------------------------------------------------------------------------
                                          .
                                          .
                                          .
```

The Train Summary report is divided into a header section and a detail section. The header section contains general information about the site. The detail section contains summary information on each train that passed the site.

The SmartScanIS calculates a checksum for each train. This checksum is stored with the train data. Later, when the system retrieves this data, it recalculates the checksum. If the two checksums don't match, the Train Summary report so states in the detail section. So, instead of getting a train record, you'll get a checksum-error line, as shown below.

```
                          Southern Technologies Corporation
                             Integrated Detector System
                               Union Pacific Railroad
                                   TRAIN SUMMARY
                                     06/23/2006
===============================================================================
Version Info.... Analyzer:  1.01  01/10/2006                  Milepost: 1234.5
                   Talker:  2.02  02/20/2006                     Track: Single
             Communicator:  3.03  03/30/2006                    SiteID: NONAME

Alarm Limits..     Absolute: 200°    CS Minimum: 245
               Differential: 150°      CS Slope: 2.34
-------------------------------------------------------------------------------
                                                D
                                          Speed i Max Bearing Avg Bearing
Train#   Date   Time   Cars Axles TO1   TO2 (mph) r East  West  East  West  Tags Battery TO1Hits TO2Hits
-----------------------------------------------------------------------------------------------------------
M  178 06/22/06 15:47   18   78   78   78   53  E  16°   16°   56°   21°    0  27.1v     156     156
   177 CHECKSUM ERROR: StartAddr 134879 EndAddr 134930
I  176 06/21/06 07:40   10   46   46   46   57  E 150°    8°   43°    7°    0  27.2v      92      92
   175 06/21/06 06:28   14   62   62   62   57  E  37°   38°   36°   37°    0  27.2v     124     124

                                          .
                                          .
                                          .
```

The table below lists the fields from the header section and the contents of each field.

Heading	Contents of Field
Version Info	Software version numbers and release dates for the firmware. "Analyzer" is the firmware chip (in socket **U2**) on the Processor board that is run by processor-A (in socket **U1**). "Talker" is the firmware chip (in socket **U3**) on the Talker board that is run by the processor in socket **U1**. "Communicator" is the firmware chip (in socket **U12**) on the Processor board that is run by processor-B (in socket **U11**).
Milepost	The five-digit milepost of the site. ***Chapter 11 - Serial Interface*** tells how to set this value using the Milepost submenu of the Setup menu.
Track	The track designator of the site. For single-track sites, valid value is Single. For multitrack sites, valid values are 1, 2, 3, 4, 5, and 6. ***Chapter 11 - Serial Interface*** tells how to set this value using the Track Number submenu of the Setup menu.

Heading	Contents of Field
SiteID	The name of the site. This can be supplied either by the Harriman Dispatch Center via the Polling System or by the Site ID option of the Polling System submenu. The default is *NONAME*.
Alarm Limits	These are the alarm parameters currently defined in the system setup. These values were in place at the time this report was run and were set using the serial interface. • The value after Absolute is set by the Absolute option of the Alarm Limits submenu. • The value after Differential is set by the Differential option of the Alarm Limits submenu. • The heading Hot Wheel only appears if Hotwheel alarm reporting is enabled. The value after Hot Wheel is set by the Hotwheel option of the Alarm Limits submenu. • The value after CS Minimum is set by the Carside Minimum option of the Alarm Limits submenu. • The value after CS Slope is set by the Carside Slope option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.

The table below lists the fields from the detail section and the contents of each field.

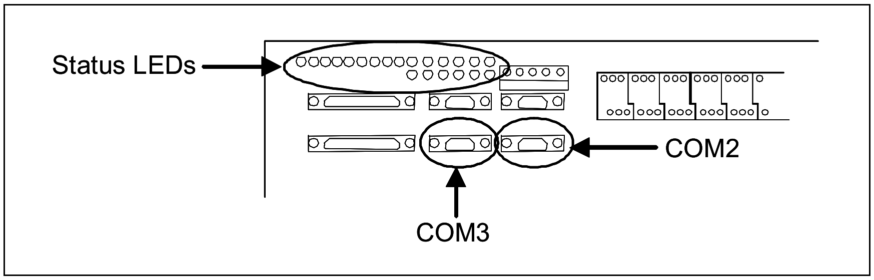
Heading	Contents of Field
Train#	The number that identifies the train in the Trains directory. If the letter **E** precedes this number, one or more Exception Alarms were detected on the train. If the letter **S** precedes, one or more System Alarms were detected. If the letter **I** precedes, one or more Integrity Failures or both Integrity Failures and System Alarms were detected. If the letter **M** precedes, both an Exception Alarm and either an Integrity Failure, a System Alarm, or both were detected. If the letter **L** follows one of the above letters, a Sliding Wheel alarm was found on the train.
Date	The date the train arrived at the site. Date is in mm/dd/yy format.
Time	The time the train arrived at the site. Time is in 24-hour hh:mm format, where 8 a.m. is 08:00, noon is 12:00, 8 p.m. is 20:00, and midnight is 00:00.
Cars	The total number of cars counted by the SmartScanIS.
Axles	The total number of axles counted by the SmartScanIS.
TO1	The total number of hits counted by gating transducer TO1.
TO2	The total number of hits counted by gating transducer TO2.
Speed (mph)	The train's exit speed in miles per hour.
Dir	The direction the train was traveling. Valid values are N, S, E, and W.

Heading	Contents of Field
Max Bearing	Under this heading are two columns, one for each rail, containing the maximum temperature read by the bearing scanners for each railside. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Avg Bearing	Under this heading are two columns, one for each rail, containing the average temperature read by the bearing scanners for each railside. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Max Wheel	This heading appears only when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu. Under this heading are two columns, one for each rail, containing the maximum temperature read by the wheel scanners for each railside. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Avg Wheel	This heading appears only when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu. Under this heading are two columns, one for each rail, containing the average temperature read by the wheel scanners for each railside. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Tags	The total number of AEI tags stored. The number of tag pairs found plus those single tags that lack a match. This heading always appears, even if the AEI subsystem is disabled using the AEI option of the Equipment submenu.
Battery	The backup battery voltage at the time the train passed the site.
TO1Hits	The total number (for a given train) of interrupt firings for gating transducer TO1. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO1 count.
TO2Hits	The total number (for a given train) of interrupt firings for gating transducer TO2. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO2 count.

To produce a Train Summary report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status

               •
               •
               •
```

8 To produce the Train Summary report, type **a**

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

9 When done, close the LOG file.

10 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

11 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.2 Train Detail Report

The Train Detail report provides detailed information on a single train. When choosing this report, you'll be prompted for a train number. When prompted, type a train number from the Train Summary report. The train number appears under the column titled "Train#" in the detail section of that report.

Below is a sample of part of a Train Detail report when Hotwheel alarm reporting is disabled and the AEI subsystem is disabled at the time the report was requested. The contents of your report will be different. The version information in the sample below is for illustrative purposes only. It doesn't represent any real release of the firmware.

```
                         Southern Technologies Corporation
                            Integrated Detector System
                              Union Pacific Railroad
                                   TRAIN DETAIL
==============================================================================
Train#:   5                  Speed:  43               Milepost: 1234.5
  Date: 08/01/2006           Axles: 194                  Track: Single
  Time: 12:55            Direction: East           Temperature: +51°
SiteID: NONAME                                         Battery:  27.7v
==============================================================================
                 Resistor    Transducer
Rail  Max  Avg   Read Req      Counts      Alarm        Limit   CS Slope Parms
---------------  ---------   ----------    ------------------   --------------
North 186°  77°  142° 160°   TO1  194      Absolute      180°     CS Min:  60
South 181°  68°   99° 160°   TO2  194      Differential  100°   CS Slope: 0.75
                                           Hot Wheel     556°

Resistor Integ. Test: Enabled

System Alarms
----------------------------------------
Cold North Resistor
Cold South Resistor
System Integrity Check Passed!

Train Alarms:   5
----------------------------------------
  Axle   46  South Rail Absolute
  Axle   77  South Rail Differential
  Axle  193  North Rail Absolute
  Axle  193  South Rail Absolute
  Axle  194  North Rail Absolute

Firmware Versions
------------------------------------------------------------------------------
Analyzer: 1.01  01/10/2006   Talker: 2.02  02/20/2006   ComBoard: 3.03  03/30/2006

              Rail                         TxdHits
Car  Axle  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------
  1     1   56°   21°    25     0    8   8   2   2
        2   57°   21°    25    59    5   5   2   2
        3   56°   21°    25    59    5   5   2   2
        4   56°   21°    25   362    5   5   2   2
        5   56°   21°    25    59    5   5   2   2
        6   56°   21°    25    59    4   5   2   2

  2     7   56°   20°    25   162    5   5   2   2
        8   56°   21°    25    59    5   5   2   2
                            .
                            .
                            .
      193  186°  181°    25    59    5   5   2   2   North Rail Absolute
                                                     South Rail Absolute
      194  183°  170°    25   641    5   5   2   2   North Rail Absolute
                            .
                            .
                            .
```

Hotwheel alarm reporting is enabled/disabled using the Hotwheel option of the Equipment submenu. The AEI subsystem is enabled/disabled using the AEI option of the Equipment submenu. Where wheel scanners are properly installed, wheel temperatures are always recorded, even if the Hotwheel option is disabled. On the other hand, if the AEI option is disabled, no AEI information is recorded.

Below is a sample of part of a Train Detail report when both the AEI and Hotwheel options are enabled at the time the report was requested. Also, both the AEI and Hotwheel options had to be enabled while the specified train was passing the site. The contents of your report will be different.

```
                       Southern Technologies Corporation
                          Integrated Detector System
                            Union Pacific Railroad
                                  TRAIN DETAIL
==============================================================================
Train#:  16                  Speed:  43                 Milepost: 1234.5
  Date: 08/01/2006           Axles: 194                    Track: Single
  Time: 12:55            Direction: East             Temperature: +51°
SiteID: NONAME                                           Battery:  27.7v
==============================================================================
                 Resistor    Transducer
Rail  Max  Avg   Read Req      Counts      Alarm        Limit   CS Slope Parms
---------------  ---------   ----------    ------------------   --------------
North 167°  35°  275° 160°   TO1  194      Absolute      180°     CS Min:  60
South 181°  68°  202° 160°   TO2  194      Differential  100°   CS Slope: 0.75
                                           Hot Wheel     556°

                 Resistor
Wheel Max  Avg   Read Req
---------------  ---------
North 566°   98°  60° 160°
South 587°   94°  67° 160°

Resistor Integ. Test: Enabled
===============================================================================
AEI System Data

Tags Read          Tags Stored: 15
--------------
Reader 1:  16 [#00:00:32.80 07/04/93]
Reader 2:  13 [#00:00:32.82 07/04/93]
===============================================================================

System Alarms
----------------------------------------
Cold North Wheel Scanner Resistor
Cold South Wheel Scanner Resistor

                            .
                            .
                            .

              Rail       Wheel                         TxdHits
Car  Axle  East  West  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------

                            .
                            .
                            .
```

Below is a sample of part of a Train Detail report when the AEI subsystem is enabled but no AEI equipment is installed. You'll also get this if the AEI equipment is installed but the AEI option was disabled during train passage.

```
                              .
                              .
                              .

===============================================================================
AEI System Data

Tags Read          Tags Stored: 0
--------------
Reader 1:   0 []
Reader 2:   0 []
===============================================================================

                              .
                              .
                              .
```

The SmartScanIS calculates a checksum for each train. This checksum is stored with the train data. Later, when the system retrieves this data, it recalculates the checksum. If the two checksums don't match, the Train Detail report so states, as shown below.

```
                      Southern Technologies Corporation
                         Integrated Detector System
                           Union Pacific Railroad
                                 TRAIN DETAIL
==============================================================================
CHECKSUM ERROR: StartAddr 134879 EndAddr 134930
```

In addition, each axle has a checksum associated with it. If an axle is determined to have an invalid checksum, the Train Detail report so states in the associated axle's row (as shown below).

```
                         Southern Technologies Corporation
                            Integrated Detector System
                              Union Pacific Railroad
                                    TRAIN DETAIL
==============================================================================
Train#:   5                  Speed:  43                Milepost: 1234.5

                            .
                            .
                            .

              Rail                          TxdHits
Car  Axle  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------
  1     1   56°   21°    25     0    8   8   2   2
        2   57°   21°    25    59    5   5   2   2
        3   56°   21°    25    59    5   5   2   2
        4   CHECKSUM ERROR: StartAddr 136416 EndAddr 136427
        5   56°   21°    25    59    5   5   2   2
        6   56°   21°    25    59    4   5   2   2

  2     7   56°   20°    25   162    5   5   2   2
        8   56°   21°    25    59    5   5   2   2

                            .
                            .
                            .
```

The Train Detail report is divided into a header section and a detail section. The header section contains general information about the site (like milepost) and some detail information about the specific train (like train's exit speed) that passed the site. The detail section contains more detailed information (like car number) about the specific train.

The table below lists the fields from the header section and the contents of each field.

Heading	Contents of Field
Train#	The number that identifies the train in the Trains directory.
Date	The date the train arrived at the site. Date is in mm/dd/yy format.
Time	The time the train arrived at the site. Time is in 24-hour hh:mm format, where 8 a.m. is 08:00, noon is 12:00, 8 p.m. is 20:00, and midnight is 00:00.
SiteID	The name of the site. This can be supplied either by the Harriman Dispatch Center via the Polling System <u>or</u> by the Site ID option of the Polling System submenu. The default is *NONAME*.
Speed	The train's exit speed in miles per hour.
Axles	The total number of axles counted by the SmartScanIS.

Heading	Contents of Field
Direction	The direction the train was traveling. Valid values are North, South, East, and West.
Milepost	The five-digit milepost of the site. ***Chapter 11 - Serial Interface*** tells how to set this value using the Milepost submenu of the Setup menu.
Track	The track designator of the site. For single-track sites, valid value is Single. For multitrack sites, valid values are 1, 2, 3, 4, 5, and 6. ***Chapter 11 - Serial Interface*** tells how to set this value using the Track Number submenu of the Setup menu.
Temperature	The ambient temperature, in degrees Fahrenheit, at the time the train passed the site.
Battery	The backup battery voltage at the time the train passed the site.
Rail	Rail orientation for each side of the train. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Max	The maximum temperature (above ambient), in degrees Fahrenheit, recorded by the bearing scanner on a given railside.
Avg	The average temperature (above ambient), in degrees Fahrenheit, calculated from all recorded temperatures from the bearing scanner on a given railside.
Resistor Read	The scanner resistor temperature (read after train passage), in degrees Fahrenheit, recorded by the bearing scanner on a given railside.
Resistor Req	The resistor temperature, in degrees Fahrenheit, required by the bearing scanner on a given railside to avoid a Cold Resistor alarm. This value was calculated using the amount of time the shutters were open and the Resistor Integrity Test Mode in effect at the time the train passed the site. If the Resistor Integrity Test Mode option is disabled, a zero appears in this field.
Transducer Counts	The gating transducer designator (either TO1 or TO2) followed by the total number of hits on that transducer.
Alarm Limit	The Hotwheel alarm level and Hotbox alarm levels for Absolute and Differential. These values were in place at the time the train passed the site. • The value after Absolute is set by the Absolute option of the Alarm Limits submenu. • The value after Differential is set by the Differential option of the Alarm Limits submenu. • The Hot Wheel heading always appears, even if Hotwheel alarm reporting is disabled. The value after Hot Wheel is set by the Hotwheel option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.

Heading	Contents of Field
CS Slope Parms	These are the Carside Slope alarm parameters currently defined in the system setup. These values were in place at the time the train passed the site. • The value after CS Min is set by the Carside Minimum option of the Alarm Limits submenu. • The value after CS Slope is set by the Carside Slope option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.
Wheel	Rail orientation for each side of the train. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Max	The maximum temperature (above ambient), in degrees Fahrenheit, recorded by the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Avg	The average temperature (above ambient), in degrees Fahrenheit, calculated from all recorded temperatures from the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Read	The scanner resistor temperature (read after train passage), in degrees Fahrenheit, recorded by the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Req	The resistor temperature, in degrees Fahrenheit, required by the wheel scanner on a given railside to avoid a Cold Wheel Scanner Resistor alarm. This value was calculated using the amount of time the shutters were open and the Resistor Integrity Test Mode in effect at the time the train passed the site. If the Resistor Integrity Test Mode option is disabled, a zero appears in this field. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Integrity Test	Status of the post-train resistor integrity test at the time the train passed the site. Valid values (aka modes) are Enabled, Reduced, and Disabled. ***Chapter 11 - Serial Interface*** tells how to set this value using the Resistor Integrity Test Mode option of the Equipment submenu.

Heading	Contents of Field
AEI System Data	The number of AEI tags read by each 2200-504 Reader and the total number of tags stored for the train. Where both tags of a tag pair are operational, each Reader will read one tag of the pair. The total number of tags stored represents the number of tag pairs found plus those single tags that lack a match. This heading and the columns under it appear only when the AEI subsystem is enabled using the AEI option of the Equipment submenu.
System Alarms	At least one text message, which can be either: • "System Integrity Check Passed!" only • One or more System Alarm descriptions followed by "System Integrity Check Passed!" • "Integrity Failure" followed by one or more Integrity Failure descriptions • One or more System Alarm descriptions, followed by "Integrity Failure," followed by one or more Integrity Failure descriptions ***Appendix A - System Alarms*** describes the conditions and events that the system flags as System Alarms. ***Appendix B - Integrity Failures*** describes the conditions and events that the system flags as Integrity Failures.
Train Alarms	The number of Exception Alarms found on the train. This is followed by a list of each Exception Alarm found and the axle on which it was found. The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.
Firmware Versions	Software version numbers and release dates for the firmware. "Analyzer" is the firmware chip (in socket **U2**) on the Processor board that is run by processor-A (in socket **U1**). "Talker" is the firmware chip (in socket **U3**) on the Talker board that is run by the processor in socket **U1**. "ComBoard" is the firmware chip (in socket **U12**) on the Processor board that is run by processor-B (in socket **U11**).

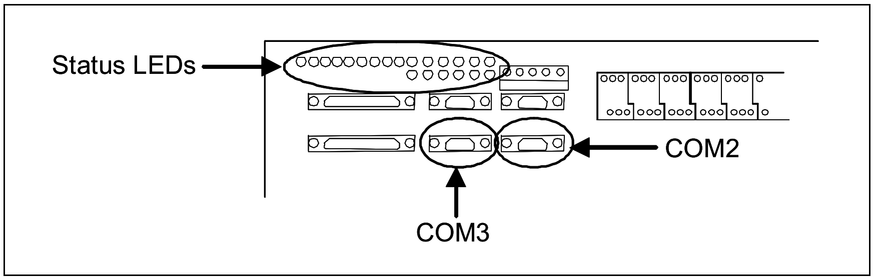
The table below lists the fields from the detail section and the contents of each field.

Heading	Contents of Field
Car	The car number as determined by the firmware.
Axle	The axle number.
Rail	Under it are two columns, one for each rail, containing the temperature read by the bearing scanners. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Wheel	Under it are two columns, one for each rail, containing the temperature read by the wheel scanners. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west. This heading and the two columns under it appear only when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
ON	The number of milliseconds a bearing was scanned.
OFF	The number of milliseconds between axles (when no axle was between the gating transducers).
PW1	The recorded pulse width generated by gating transducer TO1. There is no fixed value for the pulse widths. Slower trains generate wider pulse widths (that is, they generate larger values) than faster moving trains.
PW2	The recorded pulse width generated by gating transducer TO2. There is no fixed value for the pulse widths. Slower trains generate wider pulse widths (that is, they generate larger values) than faster moving trains.
TxdHits TO1	The total number (for a given axle) of interrupt firings for gating transducer TO1. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO1 count.
TxdHits TO2	The total number (for a given axle) of interrupt firings for gating transducer TO2. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO2 count.
Alarms	Any Exception Alarm found on the given axle. The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.

To produce a Train Detail report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status

               .
               .
               .
```

8 To produce the Train Detail report, type **b**

This prompt appears.

```
Train Number ?
```

9 Type the train number.

If you typed a four-digit valid train number, a report for that train is produced. If the typed train number is invalid, the Main menu reappears.

10 If you typed one, two, or three digits, press **[ENTER]**.

If the typed train number is valid, pressing **[ENTER]** produces a report for it. If the typed train number is invalid, the Main menu reappears.

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

11 When done, close the LOG file.

12 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

13 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.3 Exception Summary Report

The Exception Summary report lists all trains currently stored in the Exceptions directory. A train number is shown for each train entry so that an Exception Detail report may easily be produced for any train listed on the summary.

A train is stored in the Exceptions directory if an Exception Alarm was detected on it as it passed the site. The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.

Below is a sample of part of an Exception Summary report when Hotwheel alarm reporting is disabled using the Hotwheel option of the Equipment submenu. The contents of your report will be different. The version information in the sample below is for illustrative purposes only. It doesn't represent any real release of the firmware.

```
                         Southern Technologies Corporation
                            Integrated Detector System
                              Union Pacific Railroad
                                EXCEPTIONS SUMMARY
                                    07/23/2006
===============================================================================
Version Info.... Analyzer:  1.01  01/10/2006                  Milepost: 1234.5
                   Talker:  2.02  02/20/2006                     Track: Single
             Communicator:  3.03  03/30/2006                    SiteID: NONAME

Alarm Limits..     Absolute: 200°    CS Minimum: 245
               Differential: 150°      CS Slope: 2.34
-------------------------------------------------------------------------------
                                    Speed
Train#  Ref#    Date   Time  Axles  (mph)  Dir  Alarms
-------------------------------------------------------------------------------
   15    422  07/06/04 04:44    78    53    E   Dragging Equipment
   14    421  07/06/04 03:03   122    44    E   Dragging Equipment
   13    420  07/06/04 01:55    64    55    E   Dragging Equipment

   12    392  06/24/04 09:38   432    37    W   North Rail Differential

   11    366  06/01/04 01:30    96    57    E   North Rail Absolute

   10    284  04/17/04 01:26    50    57    E   North Rail Absolute
                                         .
                                         .
                                         .
```

Below is a sample of part of an Exception Summary report when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu. The contents of your report will be different.

```
                                         .
                                         .
                                         .

Alarm Limits..     Absolute: 180°    CS Minimum:  60
               Differential: 120°      CS Slope: 0.75
                  Hot Wheel: 540°
-------------------------------------------------------------------------------
                                    Speed
Train#  Ref#    Date   Time  Axles  (mph)  Dir  Alarms
-------------------------------------------------------------------------------

                                         .
                                         .
                                         .
```

The Exception Summary report is divided into a header section and a detail section. The header section contains general information about the site. The detail section contains summary information on each exception train (that is, each train having one or more Exception Alarms) that passed the site.

The SmartScanIS calculates a checksum for each train. This checksum is stored with the train data. Later, when the system retrieves this data, it recalculates the checksum. If the two checksums don't match, the Exception Summary report so states in the detail section. So, instead of getting a train record, you'll get a checksum-error line, as shown below.

```
                       Southern Technologies Corporation
                          Integrated Detector System
                            Union Pacific Railroad
                              EXCEPTIONS SUMMARY
                                  07/23/2006
===============================================================================
Version Info.... Analyzer:  1.01  01/10/2006                  Milepost: 1234.5
                   Talker:  2.02  02/20/2006                     Track: Single
             Communicator:  3.03  03/30/2006                   SiteID: NONAME

Alarm Limits..     Absolute: 200°    CS Minimum: 245
               Differential: 150°      CS Slope: 2.34
-------------------------------------------------------------------------------
                                    Speed
Train#  Ref#    Date   Time  Axles  (mph)  Dir  Alarms
-------------------------------------------------------------------------------
   15    422  07/06/06 04:44    78    53    E   Dragging Equipment
   14    421  07/06/06 03:03   122    44    E   Dragging Equipment
   13    420  07/06/06 01:55    64    55    E   Dragging Equipment

   12  CHECKSUM ERROR: StartAddr 134879 EndAddr 134930

   11    366  06/01/06 01:30    96    57    E   North Rail Absolute

   10    284  04/17/06 01:26    50    57    E   North Rail Absolute
                                   .
                                   .
                                   .
```

The table below lists the fields from the header section and the contents of each field.

Heading	Contents of Field
Version Info	Software version numbers and release dates for the firmware. "Analyzer" is the firmware chip (in socket **U2**) on the Processor board that is run by processor-A (in socket **U1**). "Talker" is the firmware chip (in socket **U3**) on the Talker board that is run by the processor in socket **U1**. "Communicator" is the firmware chip (in socket **U12**) on the Processor board that is run by processor-B (in socket **U11**).
Milepost	The five-digit milepost of the site. ***Chapter 11 - Serial Interface*** tells how to set this value using the Milepost submenu of the Setup menu.
Track	The track designator of the site. For single-track sites, valid value is Single. For multitrack sites, valid values are 1, 2, 3, 4, 5, and 6. ***Chapter 11 - Serial Interface*** tells how to set this value using the Track Number submenu of the Setup menu.

Heading	Contents of Field
SiteID	The name of the site. This can be supplied either by the Harriman Dispatch Center via the Polling System or by the Site ID option of the Polling System submenu. The default is *NONAME*.
Alarm Limits	These are the alarm parameters currently defined in the system setup. These values were in place at the time this report was run and were set using the serial interface. • The value after Absolute is set by the Absolute option of the Alarm Limits submenu. • The value after Differential is set by the Differential option of the Alarm Limits submenu. • The heading Hot Wheel only appears if Hotwheel alarm reporting is enabled. The value after Hot Wheel is set by the Hotwheel option of the Alarm Limits submenu. • The value after CS Minimum is set by the Carside Minimum option of the Alarm Limits submenu. • The value after CS Slope is set by the Carside Slope option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.

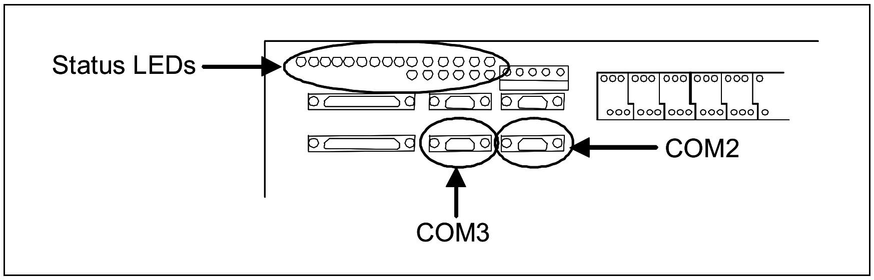
The table below lists the fields from the detail section and the contents of each field.

Heading	Contents of Field
Train#	The number that identifies the train in the Exceptions directory.
Ref#	The number that identifies the train in the Trains directory.
Date	The date the train arrived at the site. Date is in mm/dd/yy format.
Time	The time the train arrived at the site. Time is in 24-hour hh:mm format, where 8 a.m. is 08:00, noon is 12:00, 8 p.m. is 20:00, and midnight is 00:00.
Axles	The total number of axles counted by the SmartScanIS.
Speed (mph)	The train's exit speed in miles per hour.
Dir	The direction the train was traveling. Valid values are N, S, E, and W.
Alarms	A description of the alarms that were detected for the current train.

To produce an Exception Summary report:

1 If **on-site**:

   a If COM3 has nothing plugged in it, plug your computer into it.



   b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

   If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

   For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

   Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

   a From your computer, dial and connect to the modem at the site to which you want to communicate.

   b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status

              •
              •
              •
```

8 To produce the Train Summary report, type **c**

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

9 When done, close the LOG file.

10 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

11 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.4 Extended Exception Detail Report

The extended Exception Detail report provides detailed information for a single train. When choosing this report, you'll be prompted for a train number. When prompted, type a train number from the Exception Summary report. The train number appears under the column titled "Train#" in the detail section of that report.

Below is a sample of part of an extended Exception Detail report when Hotwheel alarm reporting is disabled and the AEI subsystem is disabled at the time the report was requested. The contents of your report will be different. The version information in the sample below is for illustrative purposes only. It doesn't represent any real release of the firmware.

```
                         Southern Technologies Corporation
                            Integrated Detector System
                              Union Pacific Railroad
                                 EXCEPTION DETAIL
==============================================================================
Train#:   5                  Speed:  43               Milepost: 1234.5
  Date: 08/01/2006           Axles: 194                   Track: Single
  Time: 12:55            Direction: East           Temperature: +51°
SiteID: NONAME                                         Battery:  27.7v
==============================================================================
                Resistor    Transducer
Rail  Max  Avg   Read Req     Counts      Alarm        Limit   CS Slope Parms
---------------  ---------   ----------   ------------------   --------------
North 186°  77°  142° 160°   TO1  194     Absolute      180°     CS Min:  60
South 181°  68°   99° 160°   TO2  194     Differential  100°   CS Slope: 0.75
                                          Hot Wheel     556°

Resistor Integ. Test: Enabled

System Alarms
----------------------------------------
Cold North Resistor
Cold South Resistor
System Integrity Check Passed!

Train Alarms:   5
----------------------------------------
  Axle   46  South Rail Absolute
  Axle   77  South Rail Differential
  Axle  193  North Rail Absolute
  Axle  193  South Rail Absolute
  Axle  194  North Rail Absolute

Firmware Versions
------------------------------------------------------------------------------
Analyzer: 1.01  01/10/2006   Talker: 2.02  02/20/2006   ComBoard: 3.03  03/30/2006

              Rail                        TxdHits
Car  Axle  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------
  1     1   56°   21°    25     0    8   8   2   2
        2   57°   21°    25    59    5   5   2   2
        3   56°   21°    25    59    5   5   2   2
        4   56°   21°    25   362    5   5   2   2
        5   56°   21°    25    59    5   5   2   2
        6   56°   21°    25    59    4   5   2   2

  2     7   56°   20°    25   162    5   5   2   2
        8   56°   21°    25    59    5   5   2   2

                            .
                            .
                            .

      193  186°  181°    25    59    5   5   2   2   North Rail Absolute
                                                     South Rail Absolute
      194  183°  170°    25   641    5   5   2   2   North Rail Absolute

                            .
                            .
                            .
```

Hotwheel alarm reporting is enabled/disabled using the Hotwheel option of the Equipment submenu. The AEI subsystem is enabled/disabled using the AEI option of the Equipment submenu. Where wheel scanners are properly installed, wheel temperatures are always recorded, even if the Hotwheel option is disabled. On the other hand, if the AEI option is disabled, no AEI information is recorded.

Below is a sample of part of an extended Exception Detail report when both the AEI and Hotwheel options are enabled at the time the report was requested. Also, both the AEI and Hotwheel options had to be enabled while the specified train was passing the site. The contents of your report will be different.

```
                     Southern Technologies Corporation
                        Integrated Detector System
                          Union Pacific Railroad
                             EXCEPTION DETAIL
==============================================================================
Train#:  16                 Speed:  43                Milepost: 1234.5
  Date: 08/01/2006          Axles: 194                   Track: Single
  Time: 12:55           Direction: East            Temperature: +51°
SiteID: NONAME                                         Battery:  27.7v
==============================================================================
                 Resistor    Transducer
Rail  Max  Avg   Read Req      Counts      Alarm        Limit   CS Slope Parms
---------------  ---------   ----------    -------------------  --------------
North 167°  35°  275° 160°   TO1  194      Absolute      180°     CS Min:  60
South 181°  68°  202° 160°   TO2  194      Differential  100°   CS Slope: 0.75
                                           Hot Wheel     556°

                 Resistor
Wheel Max  Avg   Read Req
---------------  ---------
North 566°   98°  60° 160°
South 587°   94°  67° 160°

Resistor Integ. Test: Enabled
===============================================================================
AEI System Data

Tags Read          Tags Stored: 15
--------------
Reader 1:  16 [#00:00:32.80 07/04/93]
Reader 2:  13 [#00:00:32.82 07/04/93]
===============================================================================

System Alarms
----------------------------------------
Cold North Wheel Scanner Resistor
Cold South Wheel Scanner Resistor
Integrity Failure
Successive Cold Wheel Resistors Exceeded

Train Alarms:   5
----------------------------------------
  Axle   97  North Hot Wheel
  Axle   98  South Hot Wheel

                            •
                            •
                            •

              Rail       Wheel                         TxdHits
Car  Axle  East  West  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
------------------------------------------------------------------------

                            •
                            •
                            •
```

The SmartScanIS calculates a checksum for each train. This checksum is stored with the train data. Later, when the system retrieves this data, it recalculates the checksum. If the two checksums don't match, the extended Exception Detail report so states, as shown below.

```
                          Southern Technologies Corporation
                             Integrated Detector System
                               Union Pacific Railroad
                                  EXCEPTION DETAIL
==============================================================================
CHECKSUM ERROR: StartAddr 134879 EndAddr 134930
```

In addition, each axle has a checksum associated with it. If an axle is determined to have an invalid checksum, the extended Exception Detail report so states in the associated axle's row, as shown below.

```
                          Southern Technologies Corporation
                             Integrated Detector System
                               Union Pacific Railroad
                                  EXCEPTION DETAIL
==============================================================================
Train#:   5                  Speed:  43                Milepost: 1234.5

                             .
                             .
                             .

              Rail                             TxdHits
Car  Axle  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------
  1     1   56°   21°    25     0    8   8   2   2
        2   57°   21°    25    59    5   5   2   2
        3   56°   21°    25    59    5   5   2   2
        4   CHECKSUM ERROR: StartAddr 136416 EndAddr 136427
        5   56°   21°    25    59    5   5   2   2
        6   56°   21°    25    59    4   5   2   2

  2     7   56°   20°    25   162    5   5   2   2
        8   56°   21°    25    59    5   5   2   2

                             .
                             .
                             .
```

The extended Exception Detail report is divided into a header section and a detail section. The header section contains general information about the site (like milepost) and some detail information about the exception train (like train's exit speed) that passed the site. The detail section contains more detailed information (like car number) about the train.

The table below lists the fields from the header section and the contents of each field.

Heading	Contents of Field
Train#	The number that identifies the train in the Exceptions directory.
Date	The date the train arrived at the site. Date is in mm/dd/yy format.
Time	The time the train arrived at the site. Time is in 24-hour hh:mm format, where 8 a.m. is 08:00, noon is 12:00, 8 p.m. is 20:00, and midnight is 00:00.
SiteID	The name of the site. This can be supplied either by the Harriman Dispatch Center via the Polling System or by the Site ID option of the Polling System submenu. The default is *NONAME*.
Speed	The train's exit speed in miles per hour.
Axles	The total number of axles counted by the SmartScanIS.
Direction	The direction the train was traveling. Valid values are North, South, East, and West.
Milepost	The five-digit milepost of the site. ***Chapter 11 - Serial Interface*** tells how to set this value using the Milepost submenu of the Setup menu.
Track	The track designator of the site. For single-track sites, valid value is Single. For multitrack sites, valid values are 1, 2, 3, 4, 5, and 6. ***Chapter 11 - Serial Interface*** tells how to set this value using the Track Number submenu of the Setup menu.
Temperature	The ambient temperature, in degrees Fahrenheit, at the time the train passed the site.
Battery	The backup battery voltage at the time the train passed the site.
Rail	Rail orientation for each side of the train. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Max	The maximum temperature (above ambient), in degrees Fahrenheit, recorded by the bearing scanner on a given railside.
Avg	The average temperature (above ambient), in degrees Fahrenheit, calculated from all recorded temperatures from the bearing scanner on a given railside.
Resistor Read	The scanner resistor temperature (read after train passage), in degrees Fahrenheit, recorded by the bearing scanner on a given railside.
Transducer Counts	The gating transducer designator (either TO1 or TO2) followed by the total number of hits on that transducer.
Alarm Limit	The Hotwheel alarm level and Hotbox alarm levels for Absolute and Differential. These values were in place at the time the train passed the site. • The value after Absolute is set by the Absolute option of the Alarm Limits submenu. • The value after Differential is set by the Differential option of the Alarm Limits submenu. • The Hot Wheel heading always appears, even if Hotwheel alarm reporting is disabled. The value after Hot Wheel is set by the Hotwheel option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.

Heading	Contents of Field
CS Slope Parms	These are the Carside Slope alarm parameters currently defined in the system setup. These values were in place at the time the train passed the site. • The value after CS Min is set by the Carside Minimum option of the Alarm Limits submenu. • The value after CS Slope is set by the Carside Slope option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.
Wheel	Rail orientation for each side of the train. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Max	The maximum temperature (above ambient), in degrees Fahrenheit, recorded by the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Avg	The average temperature (above ambient), in degrees Fahrenheit, calculated from all recorded temperatures from the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Read	The scanner resistor temperature (read after train passage), in degrees Fahrenheit, recorded by the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Req	The resistor temperature, in degrees Fahrenheit, required by the wheel scanner on a given railside to avoid a Cold Wheel Scanner Resistor alarm. This value was calculated using the amount of time the shutters were open and the Resistor Integrity Test Mode in effect at the time the train passed the site. If the Resistor Integrity Test Mode option is disabled, a zero appears in this field. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Integrity Test	Status of the post-train resistor integrity test at the time the train passed the site. Valid values (aka modes) are Enabled, Reduced, and Disabled. ***Chapter 11 - Serial Interface*** tells how to set this value using the Resistor Integrity Test Mode option of the Equipment submenu.

Heading	Contents of Field
AEI System Data	The number of AEI tags read by each 2200-504 Reader and the total number of tags stored for the train. Where both tags of a tag pair are operational, each Reader will read one tag of the pair. The total number of tags stored represents the number of tag pairs found plus those single tags that lack a match. This heading and the columns under it appear only when the AEI subsystem is enabled using the AEI option of the Equipment submenu.
System Alarms	At least one text message, which can be either: • "System Integrity Check Passed!" only • One or more System Alarm descriptions followed by "System Integrity Check Passed!" • "Integrity Failure" followed by one or more Integrity Failure descriptions • One or more System Alarm descriptions, followed by "Integrity Failure," followed by one or more Integrity Failure descriptions ***Appendix A - System Alarms*** describes the conditions and events that the system flags as System Alarms. ***Appendix B - Integrity Failures*** describes the conditions and events that the system flags as Integrity Failures.
Train Alarms	The number of Exception Alarms found on the train. This is followed by a list of each Exception Alarm found and the axle on which it was found. The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.
Firmware Versions	Software version numbers and release dates for the firmware. "Analyzer" is the firmware chip (in socket **U2**) on the Processor board that is run by processor-A (in socket **U1**). "Talker" is the firmware chip (in socket **U3**) on the Talker board that is run by the processor in socket **U1**. "ComBoard" is the firmware chip (in socket **U12**) on the Processor board that is run by processor-B (in socket **U11**).

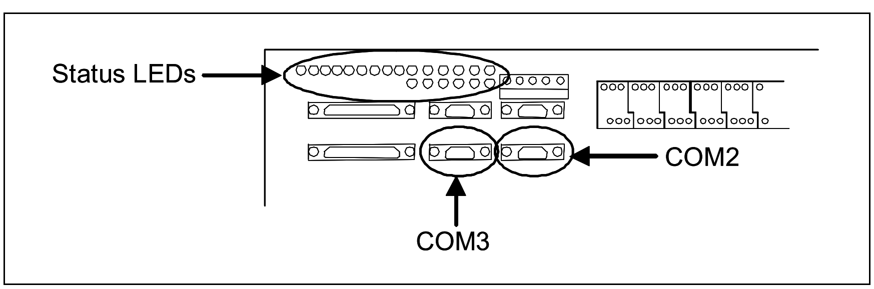
The table below lists the fields from the detail section and the contents of each field.

Heading	Contents of Field
Car	The car number as determined by the firmware.
Axle	The axle number.
Rail	Under it are two columns, one for each rail, containing the temperature read by the bearing scanners. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Wheel	Under it are two columns, one for each rail, containing the temperature read by the wheel scanners. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west. This heading and the two columns under it appear only when Hotwheel alarm reporting is enabled.
ON	The number of milliseconds a bearing was scanned.
OFF	The number of milliseconds between axles (when no axle was between the gating transducers).
PW1	The recorded pulse width generated by gating transducer TO1. There is no fixed value for the pulse widths. Slower trains generate wider pulse widths (that is, they generate larger values) than faster moving trains.
PW2	The recorded pulse width generated by gating transducer TO2. There is no fixed value for the pulse widths. Slower trains generate wider pulse widths (that is, they generate larger values) than faster moving trains.
TxdHits TO1	The total number (for a given axle) of interrupt firings for gating transducer TO1. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO1 count.
TxdHits TO2	The total number (for a given axle) of interrupt firings for gating transducer TO2. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO2 count.
Alarms	Any Exception Alarm found on the given axle. The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.

To produce an extended Exception Detail report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status

                •
                •
                •
```

8 To select the Exception Detail report, type **d**

This prompt appears.

```
Train Number ?
```

9 Type the train number.

If you typed four digits, the prompt below appears.

10 If you typed one, two, or three digits, press **[ENTER]**.

This prompt appears.

```
Abbreviated Listing ?
```

11 To produce the extended Exception Detail report, type **n**

If you typed a valid train number, a report for that train is produced. If the typed train number is invalid, the Main menu reappears.

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

12 When done, close the LOG file.

13 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

14 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.5 Abbreviated Exception Detail Report

The abbreviated Exception Detail report is like the extended Exception Detail report. However, the abbreviated report doesn't display all the recorded axle data. It only displays axle data for:

- The car immediately preceding a car with an alarmed axle.
- The car containing the alarmed axle.
- The car immediately following the car with the alarmed axle.

For example, assume that a train consisted of 3 locomotives and 20 cars, and Exception Alarms were found on cars 3, 10, 15, and 17. The abbreviated Exception Detail report for this train would only list axle data for cars 2, 3, 4, 9, 10, 11, 14, 15, 16, 17, and 18. These car numbers comprise the alarmed cars themselves and all cars just before and just after them.

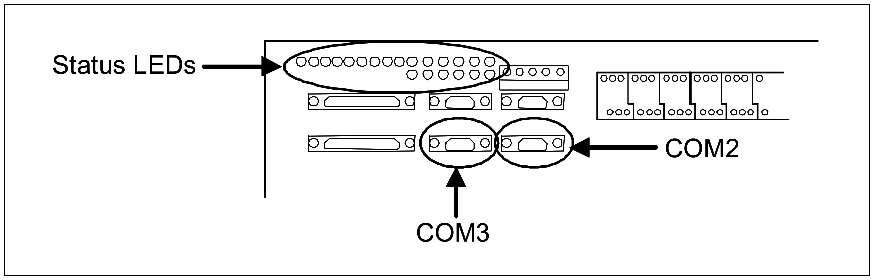
Below is a sample of part of an abbreviated Exception Detail report when Hotwheel alarm reporting is disabled and the AEI subsystem is disabled at the time the report was requested. The contents of your report will be different.

```
                      Southern Technologies Corporation
                         Integrated Detector System
                           Union Pacific Railroad
                       EXCEPTION DETAIL - ABBREVIATED
==============================================================================
Train#: 172                 Speed:  48                Milepost: 1234.5

                                    .
                                    .
                                    .

System Alarms
----------------------------------------
Cold North Resistor

Train Alarms:   6
----------------------------------------
  Axle    6  North Rail Absolute
  Axle   27  Dragging Equipment
  Axle   28  Dragging Equipment
  Axle   37  North Rail Absolute
  Axle  105  North Rail Differential
  Axle  106  North Rail Differential

Firmware Versions
------------------------------------------------------------------------------
Analyzer: 1.01  01/10/2006   Talker: 2.02  02/20/2006   ComBoard: 3.03  03/30/2006

              Rail                             TxdHits
Car  Axle  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------
  1     1   56°   21°    25     0    8   8   2   2
        2   57°   21°    25    59    5   5   2   2
        3   57°   22°    25    59    5   5   2   2
        4   57°   22°    25   562    5   5   2   2

  2     5   56°   22°    25   162    5   5   2   2
        6  189°  110°    25   641    5   5   2   2   North Rail Absolute
        7   57°   22°    25    59    5   5   2   2
        8   57°   22°    25   562    5   5   2   2

  3     9   56°  113°    25   162    5   5   2   2
       10   57°   23°    25    59    5   5   2   2
       11   57°   24°    25    59    5   5   2   2
       12   57°   23°    25   562    5   4   2   2

  6    21   56°   23°    25   162    5   5   2   2
       22   57°   23°    26    58    5   5   2   2
       23   57°   23°    26   561    5   5   2   2
       24   57°   22°    26    58    5   5   2   2

  7    25   56°   22°    25   162    5   5   2   2
       26   57°   21°    26    58    5   5   2   2
       27   57°   22°    26   561    5   5   2   2   Dragging Equipment
       28   57°   23°    26    58    5   5   2   2   Dragging Equipment

  8    29   56°   22°    25   162    5   5   2   2
       30   57°   22°    26    58    5   5   2   2

                                    .
                                    .
                                    .
```

To produce an abbreviated Exception Detail report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status

                •
                •
                •
```

8 To select the Exception Detail report, type **d**

This prompt appears.

```
Train Number ?
```

9 Type the train number.

If you typed four digits, the prompt below appears.

10 If you typed one, two, or three digits, press **[ENTER]**.

This prompt appears.

```
Abbreviated Listing ?
```

11 To produce the abbreviated Exception Detail report, type **y**

If you typed a valid train number, a report for that train is produced. If the typed train number is invalid, the Main menu reappears.

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

12 When done, close the LOG file.

13 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

14 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.6 System Status Report

The System Status report contains the system's current setup configuration. Once the SmartScanIS is set up properly, print this report and keep it in the bungalow for future reference. Should you ever need to set up the system again, you'll have most of the information on this report.

Below is a sample of the top half of a System Status report. The contents of your report will be different.

```
                         Southern Technologies Corporation
                            Integrated Detector System
                              Union Pacific Railroad
                               SYSTEM STATUS REPORT
                                    09/23/2006

===============================================================================

      Milepost....1234.5    Rail....E/W    Track....4    SiteID....NONAME
          Ambient Temp: + 67ø    AC:Off (  0:43)     Battery Voltage: 27.4V
          AC Surge Suppressor:Blown 08/16/2006 10:52

===============================================================================

  Alarm Limits
  -------------------------------------------------------------------------
  Absolute..................... 180°    Differential.................  90°
  Hot Wheel.................... 540°    Cold Wheel...................  30°
  CS Slope..................... 0.32    CS Minimum...................  37°
  Cold Journal.................  10°    Cold Wheel Scanner...........  30°
  Cold Trains..................   3     Sliding Wheel Ratio.......... 50%
  Max Alarms...................   6

  Equipment
  -------------------------------------------------------------------------
  Dragger...................... NO      Hot Wheel..................... YES
  High Load.................... NO      Wide Load...................... NO
  Carside Slope................ NO      Talker Mode............ Talk Freely
  Snow Cycle................... NO      AEI............................ NO
  Sliding Wheel................ NO      Gate Distance.......... 24.0 inches
  Cold Wheel................... NO      Resistor Integ. Test....... Enabled

  Messages
  -------------------------------------------------------------------------
  Axles........................ NO      Arrival........................ NO
  Speed........................ NO      Length......................... NO
  Temperature.................. NO      Power Off...................... NO
  HiWide...................... YES      Car ID......................... NO
  No Defects.................... 1

                          .
                          .
                          .
```

Below is a sample of the bottom half of a System Status report. The contents of your report will be different. The version information in the sample below is for illustrative purposes only. It doesn't represent any real release of the firmware. The Polling System section, which is shown below, changes appearance slightly when the detector is configured for Dialup operation instead of Poll/Standalone operation.

```
                        .
                        .
                        .

Polling System - Poll/Standalone Mode
--------------------------------------------------------------------------
Poll Address.................... A
RFL Delay..................... 200
Site ID.................... NONAME
Calibration Temp............. 180°
Wind Monitor............. Disabled
Rail Stress Monitor............ NO
High Wind Alarm............  32mph
Rail Stress Lim....  Low:-40 Hi:+40

Modem Setup  -  Default Modem Selected
---------------------------------------------------------------------------
Modem Setup Line 1 = AT&F
Modem Setup Line 2 = ATV0 S0=2 &D0 &Q1
Modem Setup Line 3 = ATX4 E0 &E3
Modem Setup Line 4 = Empty
Modem Setup Line 5 = AT&W0

Serial Ports
---------------------------------------------------------------------------
  Port      Tx      Rx    Line Settings
--------  ------  ------  -------------
COM1-P9     9600    9600  N-8-1
COM2-P10    9600    9600  N-8-1
COM3-P8     9600    9600  N-8-1

Amtech Reader Parameters  -   Reader1: AI1200   Reader2: None
---------------------------------------------------------------------------
ID Separation..................  2
Consecutive Reads..............  2
Uniqueness Timeout......... 120 Sec

Real-Time Diagnostics
---------------------------------------------------------------------------
Harriman Polling System........ YES    Train Data Storage............. YES

Scanner Calibration Date
---------------------------------------------------------------------------
Rail1...00/00/2000 00:00       Rail2...00/00/2000 00:00
Wheel1..00/00/2000 00:00       Wheel2..00/00/2000 00:00

Software Versions                    COP Resets
---------------------------------------------------------------------------
Analyzer........  1.01  01/10/2006       4
Talker..........  2.02  02/20/2006     N/A
Com Board.......  3.03  03/30/2006       0


Stack Min: 32471  EEMin: 75
```

The table below lists the fields on the System Status report and the contents of each field.

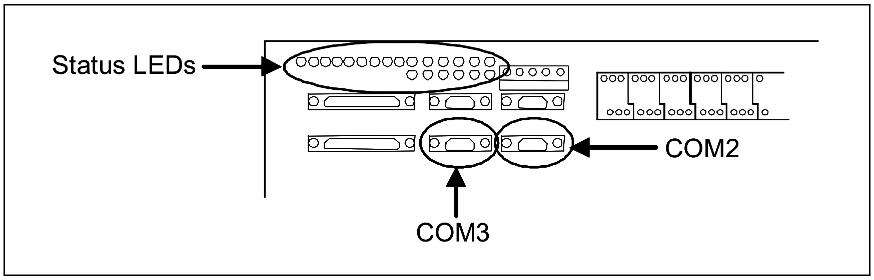
Heading	Contents of Field
Milepost	The five-digit milepost of the site. ***Chapter 11 - Serial Interface*** tells how to set this value using the Milepost submenu of the Setup menu.
Rail	Rail orientation. Tracks running north/south have east/west rails. Tracks running east/west have north/south rails. Valid values are N/S and E/W.
Track	The track designator. For single-track sites, valid value is Single. For multitrack sites, valid values are 1, 2, 3, 4, 5, and 6. ***Chapter 11 - Serial Interface*** tells how to set this value using the Track Number submenu of the Setup menu.
SiteID	The name of the site. This can be supplied either by the Harriman Dispatch Center via the Polling System or by the Site ID option of the Polling System submenu. The default is *NONAME*.
Ambient Temp	The ambient temperature, in degrees Fahrenheit, at the time this report was generated.
AC	The AC signal status, taking the form "AC:xxx (nnn:nn)." The word "Off" or "On" takes the place of the characters "xxx." This is followed by the amount of time, in hours and minutes, that the AC signal has been lost. A display of "AC:Off (123:45)" indicates that AC power is off and that it has been out for 123 hours and 45 minutes (just over 5 days). If the AC signal is present, the item appears as "AC:On (0:00)" and shows a time value of zero.
Battery Voltage	The battery voltage at the time this report was generated.
AC Surge Suppressor	The AC surge suppressor status. When the firmware detects a properly operating surge suppressor, the message "AC Surge Suppressor:OK" appears. When something occurs to blow the surge suppressor, the message "AC Surge Suppressor:Blown mm/dd/yyyy hh:mm" appears, showing the date/time that the failure occurred. For instance, a surge suppressor failure occurring at 12:34 on 27 October 2006, gives an "AC Surge Suppressor:Blown 10/27/2006 12:34" message.
Alarm Limits	The alarm parameters and limits as they are currently defined in the system setup. You change these parameters and limits using the Alarm Limits submenu of the Setup menu.
Equipment	Equipment configuration as currently defined in the system setup. You change this configuration using the Equipment submenu of the Setup menu.
Messages	Message configuration as currently defined in the system setup. You change this configuration using the Messages submenu of the Setup menu.
Polling System	Polling system configuration as currently defined in the system setup. You change this configuration using the Polling System submenu of the Setup menu. Information dealing with the wind monitor and the rail-stress monitor is also displayed here.
Modem Setup	The active modem configuration commands and which modem (default or alternate) is currently selected. You change this configuration using the Modem Setup submenu of the Setup menu.
Serial Ports	Communications port configurations, for COM1, COM2, and COM3, as currently defined in the system setup. You change this configuration using the Serial Ports submenu of the Setup menu.

Heading	Contents of Field
Amtech Reader Parameters	This heading always appears, even if the AEI subsystem is disabled using the AEI option of the Equipment submenu. After Reader1 can be SmartPass, AI1200, <u>or</u> None. (In this case, SmartPass means the 2200-504TA Reader and AI1200 means the 2200-750 Reader.) After Reader2 can be SmartPass <u>or</u> None. (In this case, SmartPass means the 2200-504TB Reader.) Below are the AEI Reader Parameters currently defined in the system setup. These values were in place at the time this report was run. • ID Separation specifies the number of intervening tags that must be read and reported before a given tag is reported again. Valid values are 1, 2, 3, and 4. The default is 2. • Consecutive Reads specifies the number of times that a tag must be read before it is considered a valid (reportable) tag. Valid values are 1, 2, 3, and 4. The default is 2. • Uniqueness Timeout specifies the number of seconds that the ID Separation parameter is in effect for a given tag. When 2200-504 Readers are attached to the system, valid values are 15, 30, and 120. The default is 120. When a 2200-750 Reader is attached to the system, the Uniqueness Timeout parameter is automatically set to 120 seconds. For a 2200-750 Reader, this value cannot be changed. ***Chapter 11 - Serial Interface*** tells how to set these values using the Amtech Reader Parameters submenu of the Setup menu.
Real-Time Diagnostics	This is STC diagnostic information. It isn't meant for general-purpose use and should only be interpreted in consultation with STC personnel.
Scanner Calibration Date	Date and time each scanner was last calibrated. The autocalibration function maintains these fields.
Software Versions	Software version numbers and release dates for the firmware. "Analyzer" is the firmware chip (in socket **U2**) on the Processor board that is run by processor-A (in socket **U1**). "Talker" is the firmware chip (in socket **U3**) on the Talker board that is run by the processor in socket **U1**. "Com Board" is the firmware chip (in socket **U12**) on the Processor board that is run by processor-B (in socket **U11**).
COP Resets	Number of COP resets, for each processor, occurring since the last time the counters were cleared.
Stack Min EEMin	This is STC diagnostic information. It isn't meant for general-purpose use and should only be interpreted in consultation with STC personnel.

To produce a System Status report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train

              •
              •
              •
```

8 To produce the System Status report, type **e**

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

9 When done, close the LOG file.

10 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

11 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

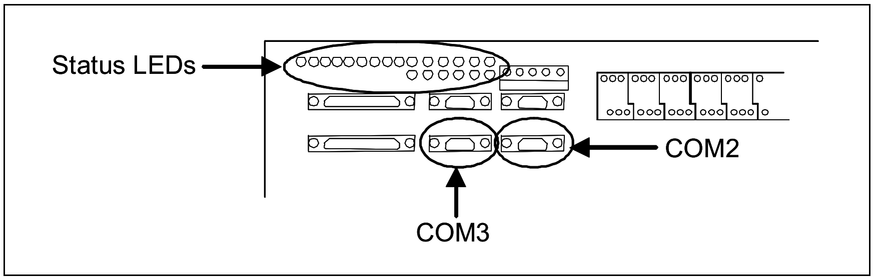
12.7 Last Train Report

The Last Train report is identical to the Train Detail report. The only difference is the way you specify which train you want reported. For this report, you don't have to specify a train; a report on the most current train is produced.

To produce a Last Train report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

8 To produce the Last Train report, type **f**

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

9 When done, close the LOG file.

10 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

11 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.8 Range of Trains Report

The Range of Trains report is a set of Train Detail reports for a range of train numbers. The Train Summary report can be used to get a list of train numbers for trains that are currently stored in the detector.

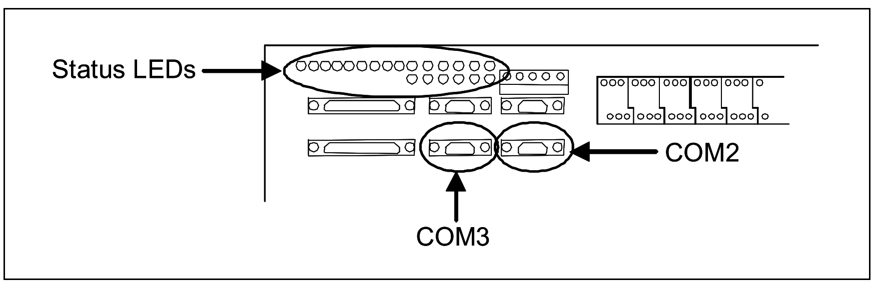
Below is a sample of part of a Range of Trains report. The contents of your report will be different.

```
                      Southern Technologies Corporation
                         Integrated Detector System
                           Union Pacific Railroad
                           RANGE OF TRAINS REPORT
------------------------------------------------------------------------------
TRAIN NUMBERS  3  THROUGH  8
==============================================================================
                      Southern Technologies Corporation
                         Integrated Detector System
                           Union Pacific Railroad
                                TRAIN DETAIL
==============================================================================
Train#:   3                Speed:  56              Milepost: 0059
                                     .
                                     .
                                     .
                      Southern Technologies Corporation
                         Integrated Detector System
                           Union Pacific Railroad
                                TRAIN DETAIL
==============================================================================
Train#:   8                Speed:  51              Milepost: 0059
                                     .
                                     .
                                     .
```

To produce a Range of Trains report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

8 To produce the Range of Trains report, type **g**

This prompt appears.

```
Starting Train#
```

9 Type the starting train number.

If you typed four digits, the prompt below appears.

10 If you typed one, two, or three digits, press **[ENTER]**.

This prompt appears.

```
Ending   Train#
```

11 Type the ending train number.

If you typed a valid four-digit train number, a Range of Trains report is produced, oldest train first. If either of the typed train numbers is invalid, a message like this appears.

```
Train number not in range of currently stored trains.
Current range is:  Oldest Train =  11    Newest Train = 234
```

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

12 If you typed one, two, or three digits, press **[ENTER]**.

If you typed a valid train number, a Range of Trains report is produced, oldest train first. If either of the typed train numbers is invalid, a message like this appears.

```
Train number not in range of currently stored trains.
Current range is:  Oldest Train =  11    Newest Train = 234
```

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

13 When done, close the LOG file.

14 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

15 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.9 Event Log Report

The Event Log report is used for diagnostics. As certain system events occur, entries are posted into the event log. Each time an entry is made into this log, it receives an event number, the date and time that the event was recorded, and an event description.

The entries are stored in a section of SRAM that can hold up to 900 separate entries. Each time an event is recorded which exceeds this maximum, the oldest recorded event is overwritten by the new one. The entries are saved during power outage, but can be deleted with the Clear Event Log option of System Functions menu. Producing the report at this time produces a "No Events" message. If events have been recorded and not cleared, they're listed in chronological order, beginning with the most recently recorded event.

Listed below are many of the system events that are currently available for recording. Not all of the available system events are listed.

- **System Restart** is recorded each time the system is powered-up or reset.
- **System Accessed** is recorded each time the user enters the serial interface. This entry records the serial port used to access the serial interface. For example, accessing the serial interface through the P10 serial port creates a "System Accessed[P10]" entry in the Event Log. Valid port designations are P8, P9, and P10. To delimit any abnormal or error condition, the entry records a designation of P255.
- **System Exited** is recorded each time the user exits from the serial interface.
- **Train Arrival** is recorded each time a train passes the site. To support transmitting ZA messages in real-time for systems operating in Poll/Standalone mode, processor-A (aka Analyzer Processor) alerts processor-B (aka Communications Processor) when a train enters the site. After processor-B receives and processes the alert, it records this entry.
- **Train Stored** is recorded each time the system scans and records a passing train and each time the system generates a gate-test train. In other words, every train gets this entry recorded.
- **Excep. Train Stored** is recorded each time the system scans and records a passing exception train. This entry is recorded just before the **Train Stored** entry for the same train is recorded.
- **Incoming Train Data: Re-Requested** is recorded each time processor-B's (aka Communications Processor's) checksum comparison fails and it asks processor-A (aka Analyzer Processor) to repeat the train data transmission.
- **Talker Mode:Error-Timeout occurred** is recorded, for systems operating in Poll/Standalone mode, when five minutes goes by without the system receiving a valid poll from the Harriman Dispatch Center. This message is also recorded for systems not connected to Harriman. This entry appears each time the talker-mode setting automatically changes due to a loss of communications with Harriman. If the talker-mode setting is talk-on-defect, it changes to talk-freely. If the setting is already talk-freely, it stays talk-freely.
- **Talker Mode:Timeout condition corrected** is recorded when a valid poll is received after a prior **Talker Mode:Error-Timeout occurred** event was recorded. This entry appears each time the system restores its prior talker-mode setting as a result of reestablishing communications with the Harriman Dispatch Center. The talker-mode setting that is restored is the one in existence just before the **Talker Mode:Error-Timeout occurred** event was recorded.

- **Talker Mode:Error-NAK occurred** is recorded, for systems operating in Poll/Standalone mode, when at least five consecutive ZA or ZU polling system messages were sent to the Harriman Dispatch Center without being acknowledged. This entry appears each time the talker-mode setting automatically changes due to an unacknowledged ZA or ZU message transmission. If the talker-mode setting is talk-on-defect, it changes to talk-freely. If the setting is already talk-freely, it stays talk-freely.
- **Talker Mode:NAK condition corrected** is recorded when a ZA or ZU message transmission is acknowledged by the Harriman Dispatch Center after a prior **Talker Mode:Error-NAK occurred** event was recorded. This entry appears each time the system restores its prior talker-mode setting as a result of processing an acknowledged ZA or ZU message transmission. The talker-mode setting that is restored is the one in existence just before the **Talker Mode:Error-NAK occurred** event was recorded.
- **COP RESET Forced** is recorded when the user forces a system RESET through the Remote System Reset option of the System Functions menu.
- **Wind Monitor:Error-Direction suspicious** is recorded when the wind monitor reports a constant wind-direction reading for at least 30 minutes.
- **Wind Monitor:Direction restored** is recorded when the wind monitor reports a different wind-direction reading than the last reported one after a prior **Wind Monitor:Error-Direction suspicious** event was recorded.
- **Wind Monitor:Error-Speed suspicious** is recorded when the wind monitor reports a constant wind-speed reading for at least 30 minutes.
- **Wind Monitor:Speed restored** is recorded when the wind monitor reports a different wind-speed reading than the last reported one after a prior **Wind Monitor:Error-Speed suspicious** event was recorded.
- **Wind Monitor:Error-Loss of communications** is recorded when the wind-monitor hardware fails to produce a valid response for at least two minutes.
- **Wind Monitor:Communications restored** is recorded when the wind monitor correctly responds to a system poll after a prior **Wind Monitor:Error-Loss of communications** event was recorded.

Wind-monitor support must be enabled in order for the system to post any of the wind-monitor events. You can enable wind-monitor support by using the Polling System submenu of the Setup menu.

Below is a sample of an Event Log report containing some events. The contents of your report will be different. The date/time at the top of the report is the system date/time at the time the report was generated. Each line of text (that is, each event) contains these fields.

- The sequential number assigned to the event as it was generated
- The date at which the event was recorded
- The time at which the event was recorded
- The event description

```
                          Southern Technologies Corporation
                             Integrated Detector System
                               Union Pacific Railroad
                                      Event Log

                                08/17/2006 09:45:11
==============================================================================
 152 08/17/06 09:40 <Wind Monitor:Error -- Loss of communications>
 151 08/15/06 08:59 <Talker Mode :Error -- Timeout occurred>

                                       •
                                       •
                                       •

------------------------------  End of Report  ------------------------------
```

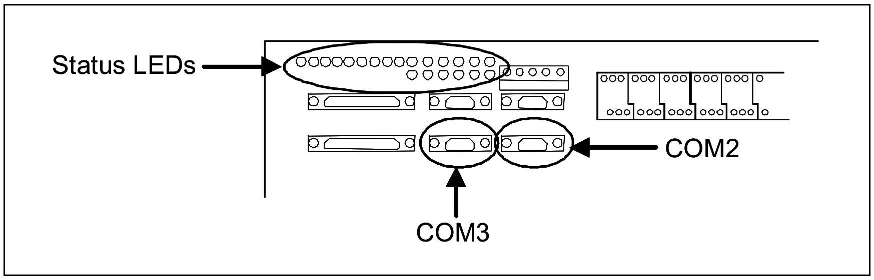
Below is a sample of an Event Log report containing no events. The date/time at the top of the report is the system date/time at the time the report was generated.

```
                          Southern Technologies Corporation
                             Integrated Detector System
                               Union Pacific Railroad
                                      Event Log

                                08/17/2006 09:45:11
==============================================================================
No Entries!


------------------------------  End of Report  ------------------------------
```

To produce an Event Log report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

8 To produce the Event Log report, type **h**

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

9 When done, close the LOG file.

10 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

11 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

12.10 T94 Train Detail Report

The T94 Train Detail report provides detailed information on a single train. It contains information that can be useful in troubleshooting AEI related problems. When choosing this report, you'll be prompted for a train number. When prompted, type a train number from the Train Summary report. The train number appears under the column titled "Train#" in the detail section of that report.

Hotwheel alarm reporting is enabled/disabled using the Hotwheel option of the Equipment submenu. The AEI subsystem is enabled/disabled using the AEI option of the Equipment submenu. Where wheel scanners are properly installed, wheel temperatures are always recorded, even if the Hotwheel option is disabled. On the other hand, if the AEI option is disabled, no AEI information is recorded.

Below is a sample of part of a T94 Train Detail report when both the AEI and Hotwheel options are enabled at the time the report was requested. Also, both the AEI and Hotwheel options had to be enabled while the specified train was passing the site. The contents of your report will be different.

```
                     Southern Technologies Corporation
                        Integrated Detector System
                          Union Pacific Railroad
                                TRAIN DETAIL
==============================================================================
Train#:  16                 Speed:  43                 Milepost: 1234.5
  Date: 08/01/2006          Axles: 194                    Track: Single
  Time: 12:55           Direction: East            Temperature: +51°
SiteID: NONAME                                         Battery:  27.7v
==============================================================================
                 Resistor    Transducer
Rail  Max  Avg   Read Req      Counts      Alarm        Limit   CS Slope Parms
---------------  ---------   ----------    ------------------   --------------
North 167°  35°  275° 160°   TO1  194      Absolute      180°     CS Min:  60
South 181°  68°  202° 160°   TO2  194      Differential  100°   CS Slope: 0.75
                                           Hot Wheel     556°

                 Resistor
Wheel Max  Avg   Read Req
---------------  ---------
North 566°   98°  60° 160°
South 587°   94°  67° 160°

Resistor Integ. Test: Enabled
===============================================================================
AEI System Data

Tags Read          Tags Stored: 15
--------------
Reader 1:  16 [#00:00:32.80 07/04/93]
Reader 2:  13 [#00:00:32.82 07/04/93]
===============================================================================

System Alarms
----------------------------------------
Cold North Wheel Scanner Resistor
Cold South Wheel Scanner Resistor
                            .
                            .
                            .

              Rail       Wheel                         TxdHits
Car  Axle  East  West  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------

  1  6  1 B   0  0  0   0  0 E  ST:000985 ET:001713       0
     6 L?  5 NS      8572   0 P0  001568|000000 001|000  70

  1     1   56°   21°   16°   16°    25     0    8   8   2   2
        2   57°   21°   20°   20°    25    59    5   5   2   2
        3   56°   21°   14°   10°    25    59    5   5   2   2
        4   56°   21°   10°   10°    25   362    5   5   2   2
        5   56°   21°   34°   16°    25    59    5   5   2   2
        6   56°   21°   16°   14°    25    59    4   5   2   2

  2  6  1 B   0  0  0   0  0 E  ST:001713 ET:002566       0
     6 L?  5 NS      8711   0 P0  002428|000000 001|000  70

  2     7   56°   20°   16°   16°    25   162    5   5   2   2
        8   56°   21°   16°   16°    25    59    5   5   2   2
                            .
                            .
                            .
```

Below is part of the T94Train Detail Report that dealt specifically with AEI diagnostic data. These two lines are representative of similar lines added for each vehicle in the consist.

```
 1  6  1 B   0  0  0   0  0 E  ST:000985 ET:001713       0  <-Vehicle related data
    6 L?  5 NS      8572   0 P0  001568|000000 001|000  70  <-Tag related data
```

The <u>first</u> <u>line</u> above contains data that is associated with the vehicle that consists of the axle records that follow. The <u>second</u> <u>line</u> shown contains data that is related to an AEI tag that has been associated with the vehicle.

The table below defines the relevant fields in <u>line</u> <u>one</u> (vehicle related data).

Field Value	Field Definition	AAR Format Only
1	Vehicle number – the standing order number of the associated vehicle in relation to the consist.	No
6	Axle count – the number of axles recorded for the vehicle.	No
1	Tag count – the number of AEI tag records associated with the vehicle.	No
B	The orientation of the vehicle in the consist – **A**-end or **B**-end forward.	Yes
0 0 0 0 0	*Reserved for future diagnostics development.*	-----
E	The direction the vehicle traveled.	No
ST:000985	Vehicle starting timestamp – the timer starts when train presence is detected.	No
ET:001713	Vehicle ending timestamp.	No

In reference to the track, **antenna1** is the northmost or eastmost antenna. **Antenna2** is the southmost or westmost antenna.

The table below defines the relevant fields in line two (tag related data). For those items that contain "Yes" in the last column, when ASCII format AEI tags are being used, these fields aren't available from the tags or cannot be determined due to unavailable tag data. In reference to the track, **antenna1** is the northmost or eastmost antenna. **Antenna2** is the southmost or westmost antenna.

Field Value	Field Definition	AAR Format Only
6	Axle count – from tag data.	Yes
L	Tag pair read indicator – **L** = left tag missing, **R** = right tag missing **G** = both tags present.	Yes
?	*Reserved for future diagnostics development.*	-----
5	Equipment Group Code from tag data.	Yes
NS 8572	AEI vehicle identification.	No
0	*Reserved for future diagnostics development.*	-----
P0	Platform code – from tag data.	Yes
001568	**Antenna1** tag read timestamp – in milliseconds from start of train.	No
000000	**Antenna2** tag read timestamp – in milliseconds from start of train.	No
001	**Antenna1** tag read "handshakes" – the number of times a tag was read.	No
000	**Antenna2** tag read "handshakes" – the number of times a tag was read.	No
70	Vehicle length – from tag data.	Yes

The Train Detail report is divided into a header section and a detail section. The header section contains general information about the site (like milepost) and some detail information about the specific train (like train's exit speed) that passed the site. The detail section contains more detailed information (like car number) about the specific train and the AEI related information described above.

The table below lists the fields from the header section and the contents of each field.

Heading	Contents of Field
Train#	The number that identifies the train in the Trains directory.
Date	The date the train arrived at the site. Date is in mm/dd/yy format.
Time	The time the train arrived at the site. Time is in 24-hour hh:mm format, where 8 a.m. is 08:00, noon is 12:00, 8 p.m. is 20:00, and midnight is 00:00.
SiteID	The name of the site. This can be supplied either by the Harriman Dispatch Center via the Polling System or by the Site ID option of the Polling System submenu. The default is *NONAME*.

Heading	Contents of Field
Speed	The train's exit speed in miles per hour.
Axles	The total number of axles counted by the SmartScanIS.
Direction	The direction the train was traveling. Valid values are North, South, East, and West.
Milepost	The five-digit milepost of the site. ***Chapter 11 - Serial Interface*** tells how to set this value using the Milepost submenu of the Setup menu.
Track	The track designator of the site. For single-track sites, valid value is Single. For multitrack sites, valid values are 1, 2, 3, 4, 5, and 6. ***Chapter 11 - Serial Interface*** tells how to set this value using the Track Number submenu of the Setup menu.
Temperature	The ambient temperature, in degrees Fahrenheit, at the time the train passed the site.
Battery	The backup battery voltage at the time the train passed the site.
Rail	Rail orientation for each side of the train. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Max	The maximum temperature (above ambient), in degrees Fahrenheit, recorded by the bearing scanner on a given railside.
Avg	The average temperature (above ambient), in degrees Fahrenheit, calculated from all recorded temperatures from the bearing scanner on a given railside.
Resistor Read	The scanner resistor temperature (read after train passage), in degrees Fahrenheit, recorded by the bearing scanner on a given railside.
Transducer Counts	The gating transducer designator (either TO1 or TO2) followed by the total number of hits on that transducer.
Alarm Limit	The Hotwheel alarm level and Hotbox alarm levels for Absolute and Differential. These values were in place at the time the train passed the site. • The value after Absolute is set by the Absolute option of the Alarm Limits submenu. • The value after Differential is set by the Differential option of the Alarm Limits submenu. • The Hot Wheel heading always appears, even if Hotwheel alarm reporting is disabled. The value after Hot Wheel is set by the Hotwheel option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.

Heading	Contents of Field
CS Slope Parms	These are the Carside Slope alarm parameters currently defined in the system setup. These values were in place at the time the train passed the site. • The value after CS Min is set by the Carside Minimum option of the Alarm Limits submenu. • The value after CS Slope is set by the Carside Slope option of the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to set these values.
Wheel	Rail orientation for each side of the train. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Max	The maximum temperature (above ambient), in degrees Fahrenheit, recorded by the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Avg	The average temperature (above ambient), in degrees Fahrenheit, calculated from all recorded temperatures from the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Read	The scanner resistor temperature (read after train passage), in degrees Fahrenheit, recorded by the wheel scanner on a given railside. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Req	The resistor temperature, in degrees Fahrenheit, required by the wheel scanner on a given railside to avoid a Cold Wheel Scanner Resistor alarm. This value was calculated using the amount of time the shutters were open and the Resistor Integrity Test Mode in effect at the time the train passed the site. If the Resistor Integrity Test Mode option is disabled, a zero appears in this field. This field only appears when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
Resistor Integrity Test	Status of the post-train resistor integrity test at the time the train passed the site. Valid values (aka modes) are Enabled, Reduced, and Disabled. ***Chapter 11 - Serial Interface*** tells how to set this value using the Resistor Integrity Test Mode option of the Equipment submenu.

Heading	Contents of Field
AEI System Data	The number of AEI tags read by each 2200-504 Reader and the total number of tags stored for the train. Where both tags of a tag pair are operational, each Reader will read one tag of the pair. The total number of tags stored represents the number of tag pairs found plus those single tags that lack a match. This heading and the columns under it appear only when the AEI subsystem is enabled using the AEI option of the Equipment submenu.
System Alarms	At least one text message, which can be either: • "System Integrity Check Passed!" only • One or more System Alarm descriptions followed by "System Integrity Check Passed!" • "Integrity Failure" followed by one or more Integrity Failure descriptions • One or more System Alarm descriptions, followed by "Integrity Failure," followed by one or more Integrity Failure descriptions ***Appendix A - System Alarms*** describes the conditions and events that the system flags as System Alarms. ***Appendix B - Integrity Failures*** describes the conditions and events that the system flags as Integrity Failures.
Train Alarms	The number of Exception Alarms found on the train. This is followed by a list of each Exception Alarm found and the axle on which it was found. The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.
Firmware Versions	Software version numbers and release dates for the firmware. "Analyzer" is the firmware chip (in socket **U2**) on the Processor board that is run by processor-A (in socket **U1**). "Talker" is the firmware chip (in socket **U3**) on the Talker board that is run by the processor in socket **U1**. "ComBoard" is the firmware chip (in socket **U12**) on the Processor board that is run by processor-B (in socket **U11**).

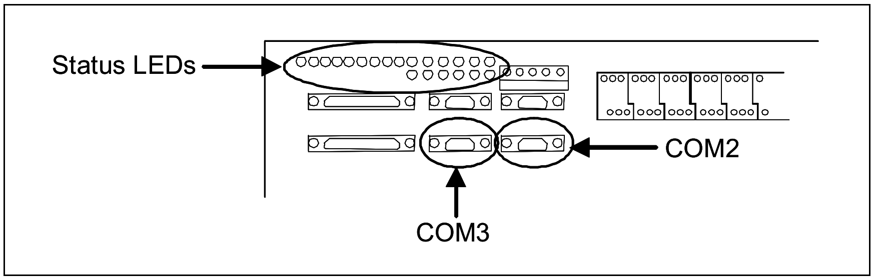
The table below lists the fields from the detail section and the contents of each field.

Heading	Contents of Field
Car	The car number as determined by the firmware.
Axle	The axle number.
Rail	Under it are two columns, one for each rail, containing the temperature read by the bearing scanners. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west.
Wheel	Under it are two columns, one for each rail, containing the temperature read by the wheel scanners. If the track orientation is east and west, rails are north and south. If the track orientation is north and south, rails are east and west. This heading and the two columns under it appear only when Hotwheel alarm reporting is enabled using the Hotwheel option of the Equipment submenu.
ON	The number of milliseconds a bearing was scanned.
OFF	The number of milliseconds between axles (when no axle was between the gating transducers).
PW1	The recorded pulse width generated by gating transducer TO1. There is no fixed value for the pulse widths. Slower trains generate wider pulse widths (that is, they generate larger values) than faster moving trains.
PW2	The recorded pulse width generated by gating transducer TO2. There is no fixed value for the pulse widths. Slower trains generate wider pulse widths (that is, they generate larger values) than faster moving trains.
TxdHits TO1	The total number (for a given axle) of interrupt firings for gating transducer TO1. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO1 count.
TxdHits TO2	The total number (for a given axle) of interrupt firings for gating transducer TO2. Since each interrupt fires once on a signals rising-edge and once on a signals falling-edge, this value should be double the train's TO2 count.
Alarms	Any Exception Alarm found on the given axle. The 10 Exception Alarms are the Absolute, Carside Slope, Differential, Cold Wheel, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, and Sliding Wheel alarms.

To produce a T94 Train Detail report:

1 If **on-site**:

a If COM3 has nothing plugged in it, plug your computer into it.



b If COM3 has something plugged into it, unplug what is connected to COM3 and plug your computer into it.

2 If **off-site**, plug your computer into a modem that is plugged into a nonswitched analog telephone line.

3 Turn on your computer.

4 Be sure that your computer has installed communications software, that it is set to use full duplex, and that the baud rate is set correctly.

If **on-site**, the baud rate of your computer must match the baud rate of the selected serial port because they are in direct, one-to-one, communication with one another. For example, the baud rate for COM3 was set to 9600 at the factory. If this baud rate was changed by the customer, your computer must be set to the changed value.

For **off-site** connections, the baud rate of your computer doesn't have to match the baud rate of the selected serial port because the telephone network between the two modems breaks this direct physical connection. In an **off-site** setup, your computer and its modem have a direct connection, the two modems have a direct connection, and the detector and its modem have a direct connection. Each of these individual direct connections must have matching baud rates. However, the different connection "types" (user computer to modem, modem to modem, detector to modem) don't have to share a common baud rate (although it's simpler if they do).

Opening a LOG file captures the whole session to the file. Then, when your session is done, you can view what you have done with an editor, print it with a printer, or store it for later retrieval.

5 On your computer, open a LOG file.

6 If **off-site**:

a From your computer, dial and connect to the modem at the site to which you want to communicate.

b Wait for the "connect" message from your modem.

7 To get the serial interface to come up, press **[Esc]**.

The Main menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

8 To produce the T94 Train Detail report, type **j**

This prompt appears.

```
Train Number ?
```

9 Type the train number.

If you typed a four-digit valid train number, a report for that train is produced. If the typed train number is invalid, the Main menu reappears.

10 If you typed one, two, or three digits, press **[ENTER]**.

If the typed train number is valid, pressing **[ENTER]** produces a report for it. If the typed train number is invalid, the Main menu reappears.

At this time, you can produce another report by typing one of the letters **a** through **h** or **j**.

11 When done, close the LOG file.

12 To exit the serial interface and return the SmartScanIS to normal operation, type **x**

13 If **on-site** and if you unplugged a device from COM3, plug the device back in after unplugging your computer.

Chapter 13
Radio Announcements

Radio announcements consist of a set of predefined spoken messages with each message triggered by a particular event or set of events. This chapter describes radio announcements. The message formats and announcement criteria are covered below.

13.1 Arrival Messages

The arrival message is used to announce train arrival at the site. This message is an option and is enabled or disabled using the Announce Train Arrival option of the Messages submenu. (In addition to having the message enabled, the system must scan four axles before giving the arrival announcement.) The format of this announcement is:

U-P Detector Milepost (mile) [track indicator]

For example, the announcement is like this.

U-P Detector
Milepost 3-5-9 point 4

13.2 Real-Time Messages

Real-time messages are announcements that occur as the train is passing over the site. They are announced using a 1000-hertz tone. When the first alarm is detected, the tone is issued followed by the words "defect detected." All subsequent alarm announcements only use the tone. One tone is issued for each alarm detected up to and including twice the maximum number of alarms specified using the Max Alarms option of the Alarm Limits submenu of the Setup menu.

For example, at a site having five alarms, the announcement is like this. For this example, the maximum number of alarms was set to a value greater than two.

(tone)
Defect Detected
(tone)
(tone)
(tone)
(tone)

13.3 Post-Train Messages

Post-train (that is, end-of-train) announcements are given after the train has left the site and all the recorded train data has been processed by the SmartScanIS.

These messages consist of four distinct scenarios, each with its own spoken message. The scenarios are:

- Exception Alarms not detected and Integrity Failures not detected
- Exception Alarms not detected and Integrity Failures detected
- Exception Alarms detected and Integrity Failures not detected
- Exception Alarms detected and Integrity Failures detected

Exception Alarms are associated with axles. There are 10 of them. They are the Absolute, Carside Slope, Differential, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, Cold Wheel, and Sliding Wheel alarms.

Integrity Failures are the Dead Resistor, Slow Train, Very Slow Train, Successive Cold Rails Exceeded, Successive Cold Resistors Exceeded, Maximum Transducer Spikes Exceeded, Maximum Exception Alarms Exceeded, Max Equal Heat Test Failures Exceeded, Pretrain Stuck HiLoad, Pretrain Stuck WideLoad, Pretrain Stuck Dragger, and Dead Battery.

The options on the Messages submenu are used to affect the phrases broadcast to a passing train. The ancillary messages are generated by enabling one or more of these options: A (axle count), C (train speed), D (train length), E (site ambient temperature), and F (power off). The other options of the Messages submenu aren't used to generate ancillary messages. In the examples that follow, not all ancillary messages are shown. This is because only total axle count and train speed were enabled. Site ambient temperature, train length, and power off were disabled.

13.3.1 Nothing Detected

When neither an Exception Alarm nor an Integrity Failure is detected, the no-defect message is announced. The format of this announcement is:

[U-P Detector Milepost (mile) [track indicator] No Defects *(3-second pause)*]
[U-P Detector Milepost (mile) [track indicator] No Defects *(3-second pause)*]
U-P Detector Milepost (mile) [track indicator] No Defects
[ancillary messages]
Detector Out

By using the No Defects option of the Messages submenu, you can customize the number of times the detector makes the no-defects announcement. The entry routine accommodates a single digit and enforces a minimum value of 1 and a maximum value of 3. Entering values outside this range produces an error message and returns to the entry prompt.

If the No Defects option was set to 2 or 3, a pause of roughly three seconds occurs between each of the no-defects messages. Any ancillary messages and the detector-out message occur only once and follow the final no-defects announcement.

For example, at a single-track site with the No Defects option set to one, the announcement is like this.

U-P Detector
Milepost 3-2-1 point 4
No Defects
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

At a single-track site with the No Defects option set to three, the announcement is like this.

U-P Detector
Milepost 1-7-9 point 5
No Defects
(3-second pause)
U-P Detector
Milepost 1-7-9 point 5
No Defects
(3-second pause)
U-P Detector
Milepost 1-7-9 point 5
No Defects
Total Axles 1-0-2
Train Speed 5-3-m-p-h
Detector Out

At a double-track site with the No Defects option set to one, the announcement is like this.

U-P Detector
Milepost 2-5-4 point 5
Track-1
No Defects
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

If the system's milepost setting is "0000.0," the firmware eliminates both the word "milepost" and the milepost number from the message. The rest of the message announces as shown above.

13.3.2 Only an Integrity Failure Detected

Integrity failures are caused when the system determines that a condition exists that could prevent proper scanning of a train. They indicate an unusual operating condition that may require maintenance. Integrity failures appear in the header of Train Detail reports and Exception Detail reports.

When no Exception Alarms are detected but an Integrity Failure is detected, only Integrity Failure is announced. The format of this announcement is:

U-P Detector Milepost (mile) [track indicator] Integrity Failure
U-P Detector Milepost (mile) [track indicator] Integrity Failure [ancillary messages]
Detector Out

For example, at a double-track site, the announcement is like this.

U-P Detector
Milepost 2-5-4 point 5
Track-1
Integrity Failure
U-P Detector
Milepost 2-5-4 point 5
Track-1
Integrity Failure
Total Axles 1-2-4
Train Speed 4-8-m-p-h
Detector Out

If the system's milepost setting is "0000.0," the firmware eliminates both the word "milepost" and the milepost number from the message. The rest of the message announces as shown above.

13.3.3 Only Exception Alarms Detected

When one or more Exception Alarms are detected and an Integrity Failure isn't detected, the alarms are announced. The format of this announcement is:

U-P Detector Milepost (mile) [track indicator] [alarm announcements]
U-P Detector Milepost (mile) [track indicator] [alarm announcements] [ancillary messages]
Detector Out

For example, at a single-track site having one Hotbox alarm, the announcement is like this.

U-P Detector
Milepost 3-2-1 point 4
First-Hotbox West-Rail Axle-7-5 From-Head-of-Train
U-P Detector
Milepost 3-2-1 point 4
First-Hotbox West-Rail Axle-7-5 From-Head-of-Train
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

At a single-track site having one Hotwheel alarm, the announcement is like this.

U-P Detector
Milepost 3-2-1 point 4
First-Hotwheel West-Rail Axle-7-5 From-Head-of-Train
U-P Detector
Milepost 3-2-1 point 4
First-Hotwheel West-Rail Axle-7-5 From-Head-of-Train
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

At a single-track site having two Hotbox alarms, the announcement is like this.

U-P Detector
Milepost 3-2-1 point 4
First-Hotbox West-Rail Axle-7-5 From-Head-of-Train
Second-Hotbox East-Rail Axle-8-0
U-P Detector
Milepost 3-2-1 point 4
First-Hotbox West-Rail Axle-7-5 From-Head-of-Train
Second-Hotbox East-Rail Axle-8-0
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

At a single-track site having one Hotbox alarm and one Dragging-Equipment alarm, the announcement is like this.

U-P Detector
Milepost 3-2-1 point 4
First-Hotbox West-Rail Axle-7-5 From-Head-of-Train
First-Dragging-Equipment Near-Axle-8-4
U-P Detector
Milepost 3-2-1 point 4
First-Hotbox West-Rail Axle-7-5 From-Head-of-Train
First-Dragging-Equipment Near-Axle-8-4
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

If the system's milepost setting is "0000.0," the firmware eliminates both the word "milepost" and the milepost number from the message. The rest of the message announces as shown above.

The Announce High-Wide option of the Messages submenu lets you pick how you want a clearance alarm to be announced. Select YES when a single trip wire is used for both high-load and wide-load detection. Select NO when each high-load and wide-load detector has its own trip wire.

In the next example, each high-load and wide-load detector is wired individually to its input. The Announce High-Wide option was set to NO. And, one High-Load alarm is the only Exception Alarm that was encountered at this single-track site.

U-P Detector
Milepost 3-2-1 point 4
First-High-Load Axle-7-5 From-Head-of-Train
U-P Detector
Milepost 3-2-1 point 4
First-High-Load Axle-7-5 From-Head-of-Train
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

13.3.4 Both Exception Alarms and an Integrity Failure Detected

When one or more alarm conditions and an Integrity Failure are detected:

- If any Dragging-Equipment alarms are detected, the Exception Alarms are announced, but Integrity Failure isn't.
- If only non-Dragging-Equipment alarms are detected, Integrity Failure is announced, but the Exception Alarms aren't.

The format of this announcement is:

U-P Detector Milepost (mile) [track indicator] [integrity-failure announcement **<u>or</u>** alarm announcements]
U-P Detector Milepost (mile) [track indicator] [integrity-failure announcement **<u>or</u>** alarm announcements] [ancillary messages]
Detector Out

For example, at a single-track site having one or more Hotbox alarms (<u>and</u> a detected Integrity Failure), the announcement is like this.

U-P Detector
Milepost 3-2-1 point 4
Integrity Failure
U-P Detector
Milepost 3-2-1 point 4
Integrity Failure
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

At a single-track site having three Dragging-Equipment alarms <u>and</u> a detected Integrity Failure, the announcement is like this. For this example, the maximum number of alarms was set to a value greater than three.

U-P Detector
Milepost 3-2-1 point 4
First-Dragging-Equipment Near-Axle-1-2 From-Head-of-Train
Second-Dragging-Equipment Near-Axle-1-4
Third-Dragging-Equipment Near-Axle-1-8
U-P Detector
Milepost 3-2-1 point 4
First-Dragging-Equipment Near-Axle-1-2 From-Head-of-Train
Second-Dragging-Equipment Near-Axle-1-4
Third-Dragging-Equipment Near-Axle-1-8
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

At a single-track site having more Dragging-Equipment alarms than the maximum alarm setting and a detected Integrity Failure, the announcement is like this. For this example, the maximum number of alarms was set to two.

U-P Detector
Milepost 3-2-1 point 4
First-Dragging-Equipment Near-Axle-1-2 From-Head-of-Train
Second-Dragging-Equipment Near-Axle-1-4
Multiple-Dragging-Equipment Detected From-Axle-1-8 To-End-of-Train
U-P Detector
Milepost 3-2-1 point 4
First-Dragging-Equipment Near-Axle-1-2 From-Head-of-Train
Second-Dragging-Equipment Near-Axle-1-4
Multiple-Dragging-Equipment Detected From-Axle-1-8 To-End-of-Train
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

At a single-track site having a combined number of Hotbox alarms and Dragging-Equipment alarms greater than the maximum alarm setting (and a detected Integrity Failure), the announcement is like this. For this example, the maximum number of alarms was set to three.

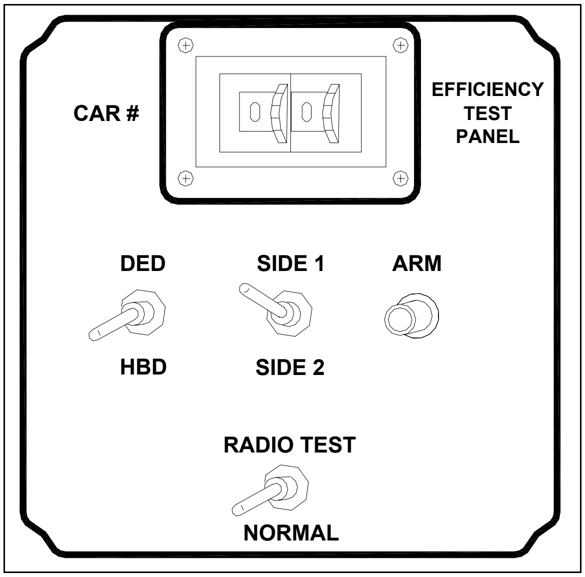
U-P Detector
Milepost 3-2-1 point 4
First-Dragging-Equipment Near-Axle-1-2 From-Head-of-Train
Second-Dragging-Equipment Near-Axle-1-4
First-Hotbox West-Rail Axle-2-5
Multiple-Hotbox and Dragging-Equipment Detected From-Axle-2-8 To-End-of-Train
U-P Detector
Milepost 3-2-1 point 4
First-Dragging-Equipment Near-Axle-1-2 From-Head-of-Train
Second-Dragging-Equipment Near-Axle-1-4
First-Hotbox West-Rail Axle-2-5
Multiple-Hotbox and Dragging-Equipment Detected From-Axle-2-8 To-End-of-Train
Total Axles 1-0-0
Train Speed 4-5-m-p-h
Detector Out

If the system's milepost setting is "0000.0," the firmware eliminates both the word "milepost" and the milepost number from the message. The rest of the message announces as shown above.

Chapter 14
Using the Efficiency Test Panel

This chapter tells how to arm and disarm the Efficiency Test panel.

The figure below shows the part of the Efficiency Test panel that is used for arming and disarming the panel.



14.1 Arming the Efficiency Test Panel

To arm the Efficiency Test panel:

1 Using the thumbwheels, select the number of the car on which the alarm is to be generated.

Pick a number from 01 through 99. When that car is sensed, an alarm (on the first axle of that car) is generated. If that car isn't reached, no alarm is generated and the panel is disarmed at train exit.

2 Using the two-position detector-selection switch, select the type of alarm you want generated.

If you want an absolute Hotbox alarm, toggle HBD. If you want a Dragging-Equipment alarm, toggle DED. If DED is selected, the appropriate alarm is generated only when the Dragger option of the Equipment submenu is enabled.

3 Using the three-position side-selection switch, select the side of the car on which the alarm is to be generated.

Either side can be picked for either alarm. If you want side one (that is, the north or east rail), move the switch up. If you want side two (that is, the south or west rail), move the switch down.

After the switch is pressed, the panel is armed and the LED labeled **ARM** lights. The panel stays armed until the next train exits or until you manually disarm the panel.

14.2 Disarming the Efficiency Test Panel

As long as the LED labeled **ARM** (on the Efficiency Test panel) is lit, the Efficiency Test panel is armed. While armed, changing the wheels or switches doesn't change the settings. The only way to change the settings is to disarm the panel first. For example, if you armed the panel with car number set to 23, the only way to change it to 27 is to disarm the panel first. Or, if you armed the panel with type of alarm set to DED, the only way to change it to HBD is to disarm the panel first.

To disarm the Efficiency Test panel:

1 Using the thumbwheels, select 00.

2 Using the three-way side-selection switch, select either side.

The LED labeled **ARM** ceases to be lit.

Chapter 15
Replacing Chips

This chapter tells how to replace the firmware chip and the speech data chips on the 2058-305 Talker board.

15.1 Replacing Firmware Chip on Talker Board

On the Talker board, the firmware is in a 27C256 or equivalent EPROM.

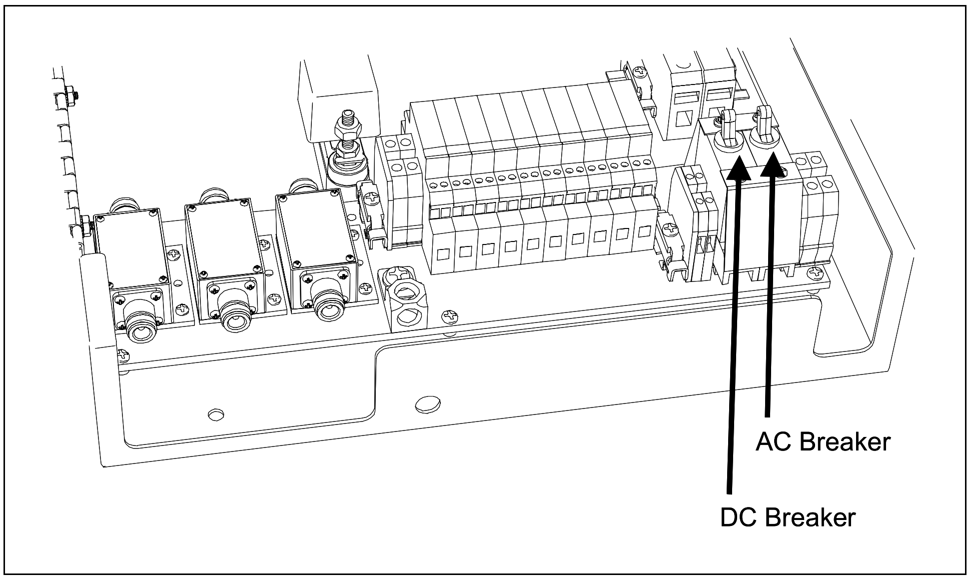
To replace the firmware chip (in socket **U3**) on the Talker board:

1 Be sure you have on hand a chip removal tool (or small slotted screwdriver) and a #2 Phillips head screwdriver.

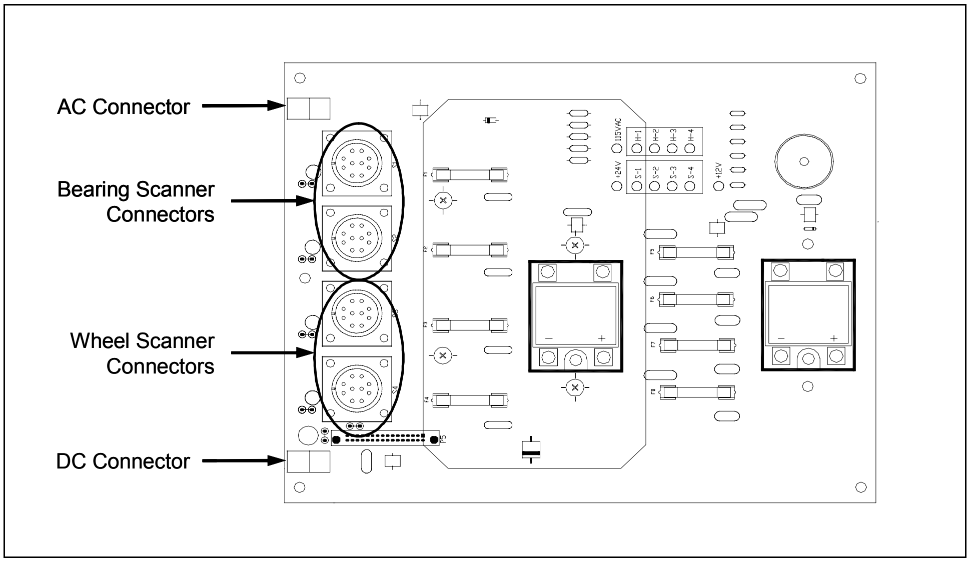
2 Open the door on the SmartScanIS enclosure.

Doing the next step powers down the system.

3 On the Surge Protection Subassembly, toggle off both breakers.



4 Note the location of all cables before unplugging them from the Scanner Interface board.



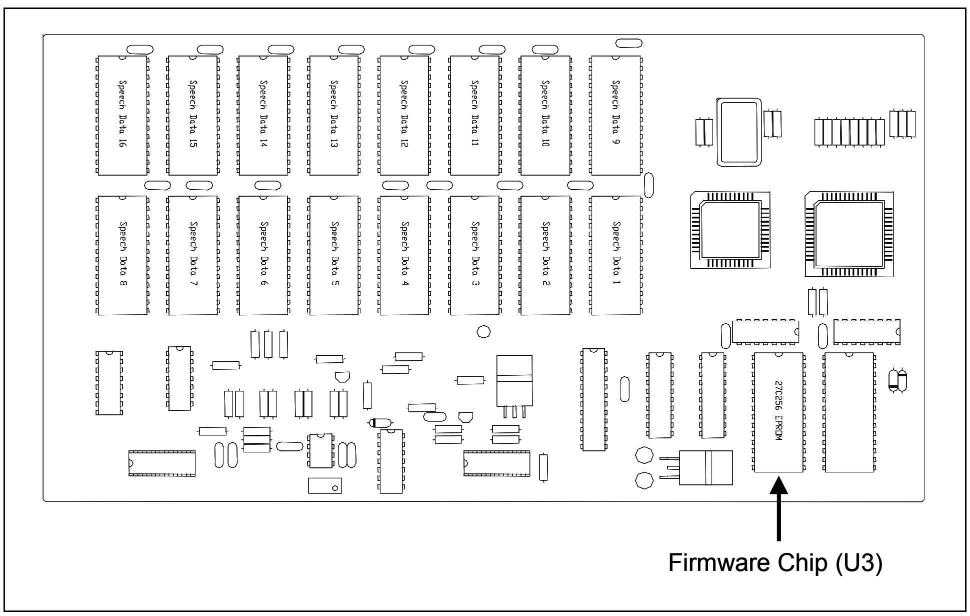
5 Disconnect all cables from the Scanner Interface board.

6 Using a #2 Phillips head screwdriver, remove the six screws that hold the Scanner Interface board to the System Interface board.

7 Store the screws in a safe place until you replace them.

8 Gently remove the Scanner Interface board from the System Interface board.

The Talker board is the board with the components in view.



9 Store the Scanner Interface board in a safe place until you replace it.

10 Using a chip removal tool or small slotted screwdriver, lift the EPROM from U3 by prying gently, one end at a time, until the pins are free of the socket.

11 To insert the new EPROM in U3:

   a Orient the notch on the chip to the notch on the socket.

   Putting the chip in backwards or bending one or more of the pins may damage the SmartScanIS.

   b Line up the pins with the socket contacts.

   c With a firm rocking motion, press the EPROM into the socket.

12 Gently replace the Scanner Interface board onto the System Interface board.

13 Using a #2 Phillips head screwdriver, replace the six screws that hold the Scanner Interface board to the System Interface board.

14 Check the orientation of all cables before plugging them into the Scanner Interface board.

15 Reconnect all cables to the Scanner Interface board.

Doing the next step powers up the system.

16 On the Surge Protection Subassembly, toggle on both breakers.

17 Close the door on the SmartScanIS enclosure.

15.2 Replacing Speech Data Chips on Talker Board

On the Talker board, the 16 sockets, labeled **U14** through **U29**, are for 27C256, 27C512, or equivalent EPROMs. These chips contain the digitized words and phrases required for voice announcements.

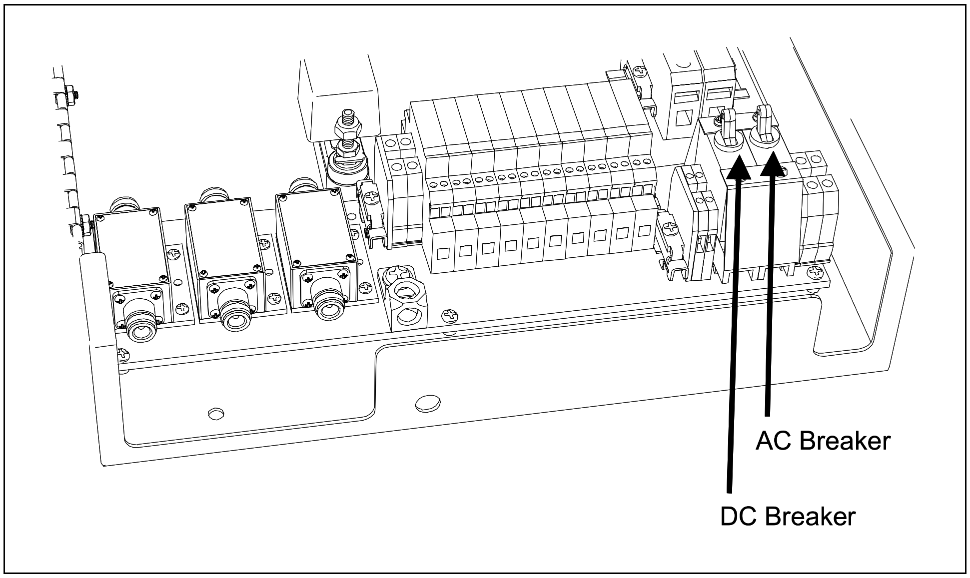
To replace one or more of the speech data chips (in the sockets labeled **U14** through **U29**) on the Talker board:

1 Be sure you have on hand a chip removal tool (or small slotted screwdriver) and a #2 Phillips head screwdriver.

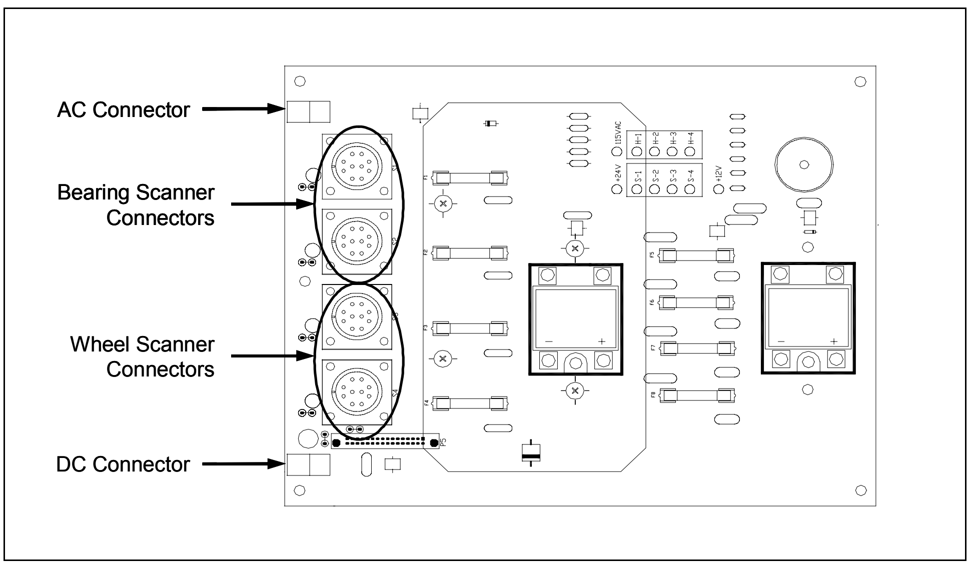
2 Open the door on the SmartScanIS enclosure.

Doing the next step powers down the system.

3 On the Surge Protection Subassembly, toggle off both breakers.



4 Note the location of all cables before unplugging them from the Scanner Interface board.



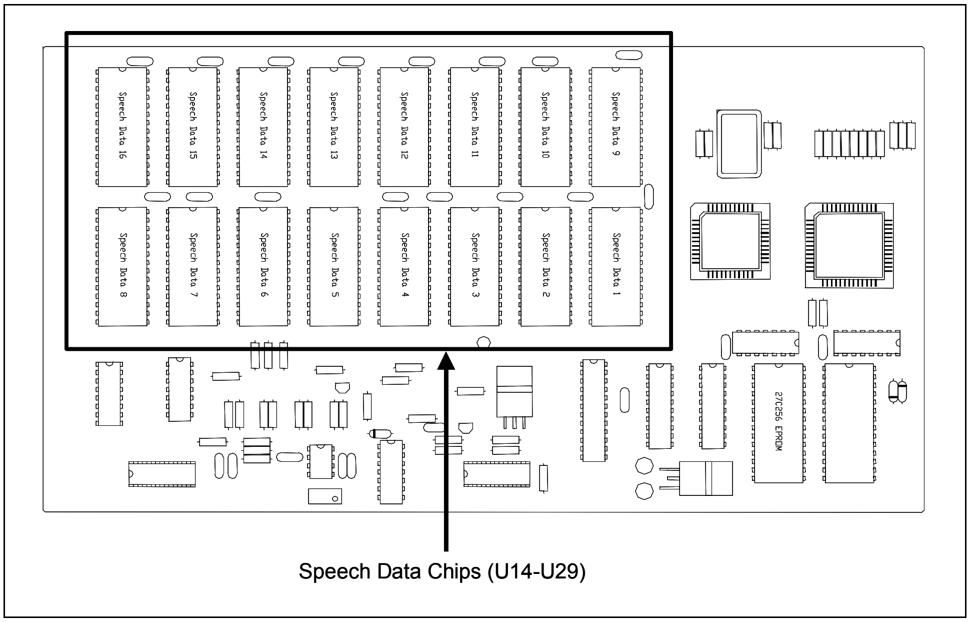
5 Disconnect all cables from the Scanner Interface board.

6 Using a #2 Phillips head screwdriver, remove the six screws that hold the Scanner Interface board to the System Interface board.

7 Store the screws in a safe place until you replace them.

8 Gently remove the Scanner Interface board from the System Interface board.

The Talker board is the board with the components in view.



9 Store the Scanner Interface board in a safe place until you replace it.

If you're replacing all the speech data chips, start with the chip in U14, replacing one chip at a time, until you replace the chip in U29. (On top of the chip that goes into U14 is the wording "SPEECH #01," on top of the chip that goes into U15 is the wording "SPEECH #02," and so on.)

10 Using a chip removal tool or small slotted screwdriver, lift the EPROM from its socket by prying gently, one end at a time, until the pins are free of the socket.

11 To insert the new EPROM in its socket:

a Orient the notch on the chip to the notch on the socket.

Putting the chip in backwards or bending one or more of the pins may damage the SmartScanIS.

b Line up the pins with the socket contacts.

c With a firm rocking motion, press the EPROM into the socket.

12 Repeat steps **10** and **11** until all the speech data chips that are to be replaced are replaced.

13 Gently replace the Scanner Interface board onto the System Interface board.

14 Using a #2 Phillips head screwdriver, replace the six screws that hold the Scanner Interface board to the System Interface board.

15 Check the orientation of all cables before plugging them into the Scanner Interface board.

16 Reconnect all cables to the Scanner Interface board.

Doing the next step powers up the system.

17 On the Surge Protection Subassembly, toggle on both breakers.

18 Close the door on the SmartScanIS enclosure.

Chapter 16
Customer Service

At STC, the customer is number one. STC is committed to products that work and customers that are satisfied. Nothing less is acceptable. This chapter tells how to get answers for questions, fixes for problems, and parts for spares.

16.1 Reaching STC

You can reach STC by mail, telephone, fax, and email. By mail, you can reach STC at:

Southern Technologies Corporation
6145 Preservation Drive
Chattanooga, Tennessee 37416-3638
USA

Mail and shipments are replied to as soon as possible, normally within one working day. Equipment repair may take longer.

By telephone, you can reach STC at 423-892-3029, Monday through Friday, from 8:00 a.m. until 5:00 p.m. Eastern time. After business hours, a machine answers the calls. These calls are returned promptly the next business day. By fax, you can reach STC at 423-499-0045. The fax machine can receive faxes at all times. Faxes are replied to as soon as possible, normally within one working day. By email, you can reach STC at email@southern-tech.com. Email is replied to as soon as possible, normally within one working day.

16.2 Returning Equipment for Repair

Return any defective or malfunctioning equipment to STC for repair or replacement. You don't need a return authorization number. You don't even need to make a phone call first. Just ship it directly to the **Repair Department** at the address above.

With the returned equipment, include:

- Complete address where the equipment is to be returned.
- Name and telephone number of person who should be contacted to answer questions about the equipment.
- Written explanation of the equipment defect or malfunction.
- Any reports or other data that would help in diagnosing the problem.
- If out of warranty, Purchase Order Number for the order or credit card number (to be charged) with its expiration date.

16.3 Reporting Problems or Suggestions

If you have any problems, suggestions, or questions related to STC equipment, phone the **Engineering Department** at the telephone number above. When calling, state the equipment about which you are calling. Your call will then be directed to the right person.

16.4 Ordering Spare Parts

If you need any spare parts to support STC equipment, phone or fax the **Sales Department** at the telephone numbers above.

When calling, state that you are calling to order parts. Your call will then be directed to the right person. When placing the order, reference the STC part numbers listed in this guide. However, if you don't have the part numbers, the sales staff can get them for you and provide you with current pricing and availability.

When faxing, include:

- Purchase Order Number for the order or credit card number (to be charged) with its expiration date.
- Complete address where the parts are to be shipped.
- Complete address where the invoice is to be mailed.
- Name and telephone number of the person who should be contacted to answer questions about the order.
- Your fax number, if available.
- For each item ordered, part number, complete description, and quantity needed.

16.5 Checking on Shipments and Orders

If you need to check on the status of any shipment or order, phone or fax the **Sales Department** at the telephone numbers above.

When calling, state that you are checking the status of a shipment or order. Your call will then be directed to the right person. Have your Purchase Order Number ready when you call. However, if you don't have the order number, the sales staff can get it for you and provide you with the status of the shipment or order.

When faxing, include:

- Purchase Order Number for the shipment or order being checked.
- Name and telephone number of the person who should be contacted after the order status is checked.
- Your fax number, if available.

Appendix A
System Alarms

This appendix describes the conditions and events that the SmartScanIS flags as System Alarms. These alarms provide data about passing trains and system status. These alarms are listed in the System Alarms section of the Train Detail and Exception Detail reports. ***Chapter 12 - Producing Reports*** tells how to produce these reports.

Regardless of the train's condition, the System Alarms header appears on the report, followed by at least one text message, which can be either:

- "System Integrity Check Passed!" only
- One or more System Alarm descriptions followed by "System Integrity Check Passed!"
- "Integrity Failure" followed by one or more Integrity Failure descriptions
- One or more System Alarm descriptions, followed by "Integrity Failure," followed by one or more Integrity Failure descriptions

A.1 Integrity Failure

The Integrity Failure alarm indicates that the firmware recognized a condition that could prevent proper scanning of a train. In other words, this alarm indicates the existence of one or more conditions in which the integrity of the system, and its ability to record train data accurately, may be compromised. These conditions, called Integrity Failures, are covered in the next appendix.

A.2 Cold Rail

The Cold Rail alarm indicates that the temperatures of all bearings (of the train) on the designated rail were at or below a given temperature. When no bearing on a given rail generates a delta temperature reading greater than the temperature set by the Cold Journal option of the Alarm Limits submenu of the Setup menu, the system generates a Cold Rail alarm.

There is a different Cold Rail alarm for each rail. That is, there is a Cold North Rail alarm and a Cold South Rail alarm (or, depending on track direction, a Cold East Rail alarm and a Cold West Rail alarm).

The maximum number (per railside) of consecutive trains, having Cold Rail alarms, allowed before generating a Successive Cold Rails Exceeded alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu. Successive Cold Rails Exceeded alarms are covered in the next appendix.

A.3 Cold Resistor

A resistor is mounted to the inside of the bearing scanner's shutter. A voltage is applied to this resistor while the shutter is open, causing it to heat up. After a train has left the site and the shutters have closed, the temperature of the resistor is read by the scanner pyrometer. In this way, a check is made of the system's ability to read heat correctly. The Cold Resistor alarm indicates that the minimum value expected for the temperature of the resistor wasn't met. This minimum value is determined by the firmware and is dependent upon the time it takes a train to pass a site.

If the minimum value wasn't met, a second check compares the recorded resistor temperature against the limit that was established using the Absolute option of the Alarm Limits submenu of the Setup menu. (This alarm limit is an offset, in degrees Fahrenheit, above the ambient temperature.) If the recorded resistor temperature meets or exceeds the absolute-alarm limit, the firmware cancels any previously flagged Cold Resistor alarms.

There is a different Cold Resistor alarm for each rail. That is, there is a Cold North Resistor alarm and a Cold South Resistor alarm (or, depending on track direction, a Cold East Resistor alarm and a Cold West Resistor alarm).

The maximum number (per railside) of consecutive trains, having Cold Resistor alarms, allowed before generating a Successive Cold Resistors Exceeded alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu. Successive Cold Resistors Exceeded alarms are covered in the next appendix.

A.4 Short Train

The Short Train alarm indicates that a train had fewer than 50 axles.

A.5 Blind Pyro

The Blind Pyro alarm indicates that an object may have blocked a scanner for at least 30 axles during train passage. If 30 or more consecutive axles have a bearing temperature of less than 3°F (1.6°C) on one side and greater than 19°F (10°C) on the opposite side, the scanner on the 3°F side is declared as having a "blind" pyrometer.

There is a different Blind Pyro alarm for each rail. That is, there is a Blind North Pyro alarm and a Blind South Pyro alarm (or, depending on track direction, a Blind East Pyro alarm and a Blind West Pyro alarm).

A.6 Low Battery

The Low Battery alarm indicates a float voltage of at least 18 volts, but less than 22 volts, on the standby batteries.

A.7 Stuck Dragger

The Stuck Dragger alarm indicates that the maximum number of consecutive axles had Dragging-Equipment alarms during train passage. You can view or change this value using the Max Alarms option of the Alarm Limits submenu of the Setup menu.

A.8 Advance Turn-On Failure

All tracks use two gating transducers. Some tracks also use two advance transducers or a track circuit. If the advance transducers or the track circuit fail to activate the system, the first hit on a gating transducer automatically activates it.

The Advance Turn-On Failure alarm indicates that this has happened and that the arrival speed of the train was at least 10 mph (16 kph).

A.9 Equal Heats Test Failed

The Equal Heats Test Failed alarm indicates lower than expected heat readings from one railside. The firmware uses the average temperatures for rail1 and rail2 and calculates a percentage difference between them, flagging an alarm if this difference exceeds a predetermined alarm limit. The percentage difference between the two average rail temperatures is calculated using the formula **(b-a)/a*100**, where the variable 'a' represents the lower average rail temperature, and the variable 'b' represents the higher average rail temperature. As an example, for recorded average rail temperatures of 40 and 60 degrees, the calculated percentage difference would be 50% (60-40=20, 20/40*100=50). The alarm limit is 100%, is hardcoded into the firmware, and isn't user configurable.

The maximum number of consecutive trains, having Equal Heats Test Failed alarms, allowed before generating a Max Equal Heat Test Failures Exceeded alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu. Max Equal Heat Test Failures Exceeded alarms are covered in the next appendix.

A.10 Cold Wheel Scanner

The Cold Wheel Scanner alarm represents the wheel scanner's equivalent of the bearing scanner's Cold Rail alarm. When no wheel on a given rail generates a delta temperature reading greater than the temperature set by the Cold Wheel Scanner option of the Alarm Limits submenu of the Setup menu, the system generates a Cold Wheel Scanner alarm. Just like Cold Rail alarms, separate Cold Wheel Scanner alarms exist for each railside.

The maximum number (per railside) of consecutive trains, having Cold Wheel Scanner alarms, allowed before generating a Successive Cold Wheels Exceeded alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu. Successive Cold Wheels Exceeded alarms are covered in the next appendix.

A.11 Successive Cold Wheels Exceeded

The Successive Cold Wheels Exceeded alarm indicates that at least a preset maximum number of consecutive trains, all having Cold Wheel Scanner alarms on the same railside, have passed a site. The maximum number (per railside) of consecutive trains, having Cold Wheel Scanner alarms, allowed before generating this alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu.

A.12 Cold Wheel Scanner Resistor

The Cold Wheel Scanner Resistor alarm represents the wheel scanner's equivalent of the bearing scanner's Cold Resistor alarm. Evaluation of Cold Wheel Scanner Resistor alarm occurs in two stages. The first stage mimics the same logic used in the evaluation of Cold Resistor alarms. After finishing this check, and possibly flagging a Cold Wheel Scanner Resistor alarm, the firmware compares the recorded resistor temperature against a value of one-third the hot wheel alarm limit. If the recorded resistor temperature meets or exceeds this value, the firmware cancels any previously flagged Cold Wheel Scanner Resistor alarm. In this way, the system confirms the scanner's ability to read alarm level heat. Just like Cold Resistor alarms, separate Cold Wheel Scanner Resistor alarms exist for each railside.

The maximum number (per railside) of consecutive trains, having Cold Wheel Scanner Resistor alarms, allowed before generating a Successive Cold Wheel Resistors Exceeded alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu. Successive Cold Wheel Resistors Exceeded alarms are covered in the next appendix.

A.13 Successive Cold Wheel Resistors Exceeded

The Successive Cold Wheel Resistors Exceeded alarm indicates that at least a preset maximum number of consecutive trains, all having Cold Wheel Scanner Resistor alarms on the same railside, have passed a site. The maximum number (per railside) of consecutive trains, having Cold Wheel Scanner Resistor alarms, allowed before generating this alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu.

A.14 Dead Wheel Scanner Resistor

The Dead Wheel Scanner Resistor alarm indicates the presence of two separate conditions. First, the train must contain a Cold Wheel Scanner alarm on a given rail. Second, the recorded temperature for the resistor on that rail must fall below the value set by the Cold Journal option on the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to view or change the Cold Journal option.

There is a different Dead Wheel Scanner Resistor alarm for each rail. That is, there is a Dead North Wheel Scanner Resistor alarm and a Dead South Wheel Scanner Resistor alarm (or, depending on track direction, a Dead East Wheel Scanner Resistor alarm and a Dead West Wheel Scanner Resistor alarm).

A.15 Test Train

The Test Train alarm indicates that a given train was generated by the firmware. These trains are used for testing purposes and don't represent actual trains passing the site.

A.16 Efficiency Test Panel in Use

The Efficiency Test Panel in Use alarm indicates that someone used the Efficiency Test panel to generate a train alarm.

A.17 AC Power Is Off!

The AC Power Is Off! alarm indicates that AC power wasn't on when it was checked during the end-of-train processing. This alarm doesn't say anything about any lack of power during train passage.

A.18 Sliding Wheel

The Sliding Wheel alarm indicates that a combination of very low bearing and wheel temperatures were found on a given axle in conjunction with high wheel temperatures recorded on the remaining axles of a car. This condition could mean that the wheels on the affected axle were sliding, rather than rolling, on the rail.

The Sliding Wheel alarm is both an Exception Alarm and a System Alarm.

A.19 No Basetime Reader 1

The No Basetime Reader 1 alarm indicates that the timestamp message expected from reader1 (2200-504TA Reader or 2200-750 Reader, depending on what is attached to the system) wasn't received upon train arrival. This means that either reader1 isn't functioning properly or the serial communications channel between reader1 and the Processor board has broken down.

A.20 No Basetime Reader 2

The No Basetime Reader 2 alarm indicates that the timestamp message expected from reader2 (2200-504TB Reader) wasn't received upon train arrival. This means that either reader2 isn't functioning properly or the serial communications channel between reader2 and the Processor board has broken down. There isn't a No Basetime Reader 2 alarm when a 2200-750 Reader is attached to the system.

A.21 Basetime Error Reader 1

The Basetime Error Reader 1 alarm indicates that a timestamp message was received from reader1 (2200-504TA Reader or 2200-750 Reader, depending on what is attached to the system), but that the message was corrupted. This could mean that communications between the Processor board and reader1 were temporarily out of synch. If the problem is flagged on many trains, it most likely indicates that the serial communications channel between reader1 and the Processor board is braking down.

A.22 Basetime Error Reader 2

The Basetime Error Reader 2 alarm indicates that a timestamp message was received from reader2 (2200-504TB Reader), but that the message was corrupted. This could mean that communications between the Processor board and reader2 were temporarily out of synch. If the problem is flagged on many trains, it most likely means that the serial communications channel between reader2 and the Processor board is braking down. There isn't a Basetime Error Reader 2 alarm when a 2200-750 Reader is attached to the system.

A.23 Reverse Direction Detected

Trains that are being scanned correctly will have axles whose on times are less than their off times. For each axle of a passing train (except for the first axle), the system checks for an on time that is greater than the off time. If the axle's on time is greater than its off time, the system reverses the direction locked-in by the first gating pulse, reverses the opening and closing gate assignment for TO1 and TO2, and generates a false transducer pulse. The system considers the gate active for the next axle at the time it determines the current axle's opening gate pulse was missed.

The Reverse Direction Detected alarm indicates that the system entered a state where it is scanning for bearing temperatures when the axles are outside the scanning gate. In this state, the transducer that should be opening the scanning gate is considered by the system to be the transducer that is closing the gate. Likewise, the transducer that should be closing the scanning gate is considered to be the transducer that is opening the gate.

Appendix B
Integrity Failures

This appendix describes the conditions and events that the SmartScanIS flags as Integrity Failures. These alarms indicate conditions in which the integrity of the system, and its ability to record train data accurately, may be compromised. These alarms are listed in the System Alarms section of the Train Detail and Exception Detail reports. ***Chapter 12 - Producing Reports*** tells how to produce these reports.

B.1 Dead Resistor

The Dead Resistor alarm indicates the presence of two separate conditions. First, the train must contain a Cold Rail alarm on a given rail. Second, the recorded temperature for the resistor on that rail must fall below the value set by the Cold Journal option on the Alarm Limits submenu. ***Chapter 11 - Serial Interface*** tells how to view or change the Cold Journal option.

There is a different Dead Resistor alarm for each rail. That is, there is a Dead North Resistor alarm and a Dead South Resistor alarm (or, depending on track direction, a Dead East Resistor alarm and a Dead West Resistor alarm).

B.2 Slow Train

The Slow Train alarm is generated when a train had an exit speed of 6 mph (9.7 kph). When this happens, the firmware will generate an "Integrity Failure" announcement and will display "Integrity Failure" and "Slow Train" in the System Alarms section of Train Detail and Exception Detail reports. If a Dragging-Equipment alarm is detected on a slow train, no "Integrity Failure" announcement will be made and no "Slow Train" message will appear in the System Alarms section. However, messages generated by any additional Integrity Failures found on such a train will still appear in the System Alarms section.

B.3 Very Slow Train

The Very Slow Train alarm is generated when a train had an exit speed less than 6 mph (9.7 kph). When this happens, the firmware will generate an "Integrity Failure" announcement and will display "Integrity Failure" and "Very Slow Train" in the System Alarms section of Train Detail and Exception Detail reports. If a Dragging-Equipment alarm is detected on a very slow train, no "Integrity Failure" announcement will be made and no "Very Slow Train" message will appear in the System Alarms section. However, messages generated by any additional Integrity Failures found on such a train will still appear in the System Alarms section.

B.4 Successive Cold Rails Exceeded

The Successive Cold Rails Exceeded alarm indicates that at least a preset maximum number of consecutive trains, all having Cold Rail alarms on the same railside, have passed a site. The maximum number (per railside) of consecutive trains, having Cold Rail alarms, allowed before generating an Integrity Failure alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu.

Under normal circumstances, Cold Rail conditions represent System Alarms, not Integrity Failures. However, if the number of consecutive trains bearing the same Cold Rail alarm equals or exceeds the preset maximum, this condition becomes an Integrity Failure.

B.5 Successive Cold Resistors Exceeded

The Successive Cold Resistors Exceeded alarm indicates that at least a preset maximum number of consecutive trains, all having Cold Resistor alarms on the same railside, have passed a site. The maximum number (per railside) of consecutive trains, having Cold Resistor alarms, allowed before generating an Integrity Failure alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu.

Under normal circumstances, Cold Resistor conditions represent System Alarms, not Integrity Failures. However, if the number of consecutive trains bearing the same Cold Resistor alarm equals or exceeds the preset maximum, this condition becomes an Integrity Failure.

B.6 Maximum Transducer Spikes Exceeded

The Maximum Transducer Spikes Exceeded alarm is generated when more than five transducer spikes are recorded for a given railside.

B.7 Maximum Exception Alarms Exceeded

Exception Alarms are associated with axles. There are 10 of them. They are the Absolute, Carside Slope, Differential, Dragging-Equipment, High-Load, Hotwheel, Pyrometer Saturation, Wide-Load, Cold Wheel, and Sliding Wheel alarms.

The Maximum Exception Alarms Exceeded alarm is generated when the maximum number of Exception Alarms is exceeded on a single train. This maximum number is defined by the Max Alarms option of the Alarm Limits submenu of the Setup menu.

B.8 Max Equal Heat Test Failures Exceeded

The Max Equal Heat Test Failures Exceeded alarm indicates that at least a preset maximum number of consecutive trains, all having Equal Heats Test Failed alarms, have passed a site. The maximum number of consecutive trains, having Equal Heats Test Failed alarms, allowed before generating an Integrity Failure alarm is set by the Cold Trains option of the Alarm Limits submenu of the Setup menu.

B.9 Pretrain Stuck HiLoad

The Pretrain Stuck HiLoad alarm indicates that the high-load detector was active before the scanners started scanning. That is, between the time of first receiving a signal from the track circuit (or the advance transducers) and the time of first receiving a signal from either gating transducer, the SmartScanIS detected an open circuit from the high-load detector.

B.10 Pretrain Stuck WideLoad

The Pretrain Stuck WideLoad alarm indicates that the wide-load detector was active before the scanners started scanning. That is, between the time of first receiving a signal from the track circuit (or the advance transducers) and the time of first receiving a signal from either gating transducer, the SmartScanIS detected an open circuit from the wide-load detector.

There is a different Pretrain Stuck WideLoad alarm for each rail. That is, there is a Pretrain Stuck WideLoad North Side alarm and a Pretrain Stuck WideLoad South Side alarm (or, depending on track direction, a Pretrain Stuck WideLoad East Side alarm and a Pretrain Stuck WideLoad West Side alarm).

B.11 Pretrain Stuck Dragger

The Pretrain Stuck Dragger alarm indicates that the dragging-equipment detector was active before the scanners started scanning. That is, between the time of first receiving a signal from the track circuit (or the advance transducers) and the time of first receiving a signal from either gating transducer, the SmartScanIS detected an open circuit from the dragging-equipment detector.

B.12 Dead Battery

The Dead Battery alarm indicates a float voltage of less than 18 volts on the standby batteries.

Appendix C
System Functions

This appendix lists the system functions provided by the SmartScanIS.

To access the system functions:

1 Using the serial interface, display the Main menu.

Chapter 11 - Serial Interface tells how to display the Main menu. The Main menu looks like this.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Main Menu
------------------------------------------------
  A) Train Summary
  B) Train Detail
  C) Exception Summary
  D) Exception Detail
  E) System Status
  F) Last Train
  G) Range of Trains
  H) Event Log
  I) Setup Menu
  J) T94 Train Detail
  X) Exit Menu
?
```

2 To display the Setup menu, type **i**

The Setup menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
Setup Menu
------------------------------------------------
  A) Set Date and Time
  B) Milepost
  C) Track Number
  D) Alarm Limits
  E) Equipment
  F) Messages
  G) Serial Passwords  - NOT YET AVAILABLE
  H) System Functions
  I) Polling System
  J) Serial Ports
  K) Amtech Reader Parameters
  L) Modem Setup
  X) Exit Menu
?
```

3 To display the System Functions menu, type **h**

The System Functions menu appears.

```
STC Integrated Detector System, Milepost-0501.2, Track:Single
08/17/2006  9:35
System Functions
-------------------------------------------------
  A) Radio Test
  B) Vocabulary Test
  C) Gate Test
  D) 1KHz Test Tone
  E) Auto-Calibration
  F) Reset the COP Counters
  G) Remote System RESET
  H) Clear All Stored Train Data
  I) Clear Event Log
  J) Send JC Message
  K) Send JM Message
  L) Send JP Message
  M) Send JS Message
  N) Real-Time Diagnostics
  X) Exit Menu
?
```

C.1 Radio Test

Selection of the Radio Test option broadcasts a short message through the speaker and through the radio. At single-track sites, the text of the message is "Testing, U-P detector, milepost (milepost number), testing, one, two, three, four, five, four, three, two, one, testing detector-out." At multitrack sites, the text of the message is "Testing, UP detector, milepost (milepost number), track (track designation), testing, one, two, three, four, five, four, three, two, one, testing, detector-out."

C.2 Vocabulary Test

Selection of the Vocabulary Test option enunciates all of the stored speech phrases. This announcement is broadcast through the speaker, but not through the radio.

Below is a list of the phrases announced by the Vocabulary Test option. The phrases are grouped by chip number.

Chip	Announced Phrases
1	Zero, One, Two, Three, Four, Five
2	Six, Seven, Eight, Nine, No-Defects
3	Detector-Malfunction, Point, Hotwheel, Testing
4	Axle, Dragging-Equipment-Near, North, Rail
5	South, East, West, Track, Hotbox
6	Defect-Detected, M-P-H, Fifth
7	Integrity-Failure, Detector-Out, Sixth
8	Rebroadcast, Train-Too-Slow, Total-Axles, Speed
9	A, B, C, D, E, Temperature, Length, Minus, First, Second
10	F, G, H, I, J, Third, Fourth, Left-Side, Right-Side, *beep*
11	K, L, M, N, O, High-Load, Wide-Load, On, Seventh, Eighth
12	P, Q, R, S, T, S-P-Detector, Milepost, Detector-Working
13	U, V, W, X, Y, Stop-Your-Train, U-P-Detector, Ninth
14	Z, Sliding-Wheel, Car-I-D, From-Head-of-Train, Degrees, Number
15	Multiple-Hot-Journal-and-Dragging-Equipment, Power-Off, High-Wide-Near
16	Detected-From-Axle, To-End-of-Train, Miles-Per-Hour, Multiple-Dragging-Equipment

C.3 Gate Test

Selection of the Gate Test option opens the scanner shutters and simulates a passing train. While in this mode, you can simulate alarms by placing a heat source on a scanner or by opening an auxiliary alarm detector's contacts.

You can stop the gate test by pressing **[Esc]**. If you don't press **[Esc]**, the test continues until 486 axles are simulated. The firmware pauses between railcars and scans for a pressed **[Esc]**. Consequently, the gate test may not terminate immediately after **[Esc]** is pressed. It may need to finish the current car's axles. Pressing keys before pressing **[Esc]** results in the generation of additional cars of axles before aborting. There will be one additional car of axles for each key pressed before pressing **[Esc]**.

After pressing **[Y]** to begin the gate test, the "Running Gate Test..." message appears followed by a four-second pause.

C.4 1KHz Test Tone

Selection of the 1KHz Test Tone option generates a continuous one-kilohertz tone for 15 seconds. This tone is broadcast through the speaker and through the radio.

C.5 Auto-Calibration

Selection of the Auto-Calibration option places the system in autocalibration mode.

The SmartScanIS self-calibrates its pyrometer interface circuitry. You need only put a preheated calibrated heat source on a scanner and place the system in autocalibration mode. The system then scans all pyrometer inputs until the signal from the calibrated heat source is located. The necessary adjustments to the related interface circuitry are automatically made while the system monitors its own progress by analyzing changes in the heat signals. Once the procedure has been completed, autocalibration mode is disengaged and the calibration results are displayed on your computer.

C.6 Reset the COP Counters

Built into each microprocessor on the Processor board is a Computer Operating Properly (COP) monitor. This feature gives the processor the ability to monitor its own operation and, in the presence of abnormal operating conditions, automatically trigger a system reset. The SmartScanIS maintains a count of these system resets (until 255 is reached), whether initiated automatically by the system or manually by the user via the Remote System Reset option of the System Functions menu. These counters are used for diagnostic purposes only. The current value of these counters appears on the System Status report.

Selection of the Reset the COP Counters option resets each COP counter to zero.

C.7 Remote System Reset

Selection of the Remote System Reset option forces a system reset through a remote connection. It can also be used locally.

C.8 Clear All Stored Train Data

Selection of the Clear All Stored Train Data option erases all of the stored train data. This encompasses all of the trains in the Trains and Exceptions directories. After deleting all train data, there isn't any way of regenerating it. The data is gone forever.

C.9 Clear Event Log

Selection of the Clear Event Log option erases all of the events stored in the Event Log and displayed on the Event Log report. After deleting the log, there isn't any way of regenerating it. The data is gone forever.

C.10 Send JC Message

Selection of the Send JC Message option sends a Constant Carrier signal for 15 seconds to the Harriman Dispatch Center.

C.11 Send JM Message

Selection of the Send JM Message option sends a Continuous Mark signal for 15 seconds to the Harriman Dispatch Center.

C.12 Send JP Message

Selection of the Send JP Message option sends a Mark-Space pattern for 15 seconds to the Harriman Dispatch Center.

C.13 Send JS Message

Selection of the Send JS Message option sends a Continuous Space signal for 15 seconds to the Harriman Dispatch Center.

C.14 Real-Time Diagnostics

Selection of the Real-Time Diagnostics submenu enables and disables various diagnostic messages. These messages aren't meant for general-purpose use and should only be enabled in consultation with STC personnel.

Appendix D
Predictive Gate Scanning

This appendix describes predictive gate scanning of bearings.

D.1 Overview

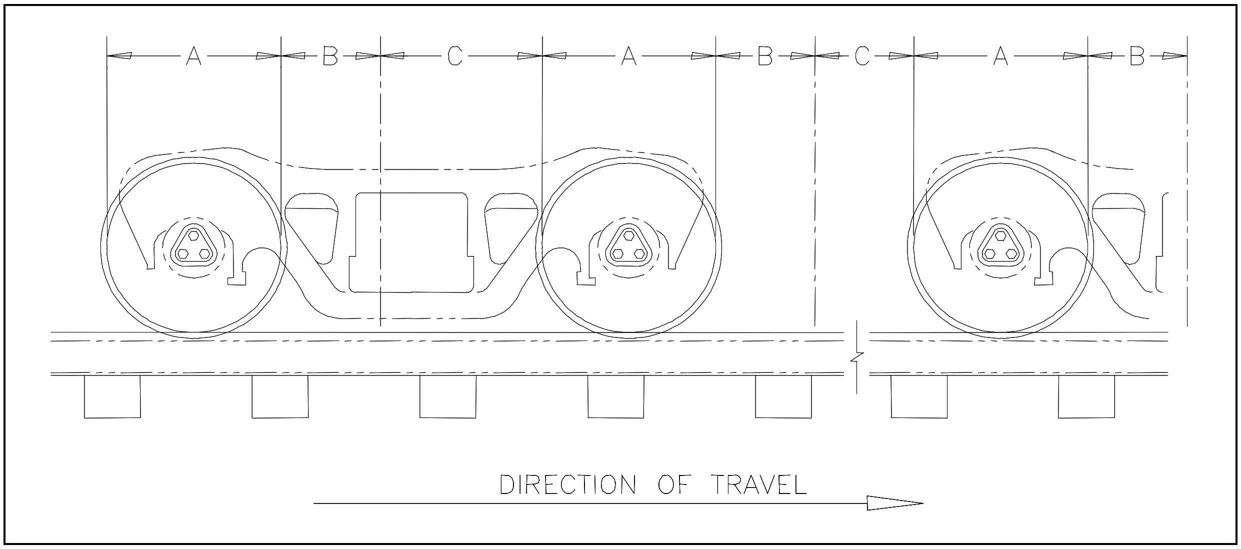
If a pyrometer is exposed to extreme infrared energy emission, the device itself can be driven into a saturated state. When this happens, it is blinded to subsequent changes in infrared energy emission. This blinded state can last up to 1-1/2 seconds.

Under certain circumstances, a pyrometer may be driven into saturation before the opening of the gate for a given axle. If the open-gate period was the only time during which pyrometer readings were sampled and processed, the system might miss an overheated bearing due to a device that was blinded before the opening of the gate. This can happen when a bearing is so overheated that it gives off infrared energy that can be seen by the pyrometer long before the bearing enters the pyrometer's field of view.

To compensate for this, the SmartScanIS includes special logic for processing heat seen by the pyrometers as they scan between the axle gates. The interval between axles has been divided into two parts.

The first part of this interval is the 16 inches (40.6 centimeters) that immediately precede the axle as it approaches the bearing scanners. This interval is treated as a "predictive gate" region in which the actual gate period (the time a bearing is physically in the pyrometer's field of view) is extended by 16 inches. The remainder of the "between-gate" interval forms the second part. Heat values read during this second interval are ignored.

The figure below depicts the three distinct scanning intervals (the in-gate period plus the two between-gate intervals).



The table below defines the intervals.

Interval	Description
A	The normal bearing scanning interval of about 24 inches (61 centimeters), depending on the transducer spacing.
B	A distance of about 16 inches (40.6 centimeters) before a given wheel.
C	The distance between wheels that doesn't fall within interval-B.

D.2 Scanning Process

Interval-A is the normal bearing scanning interval. Interval-B is an extension of interval-A. That is, the greatest value read in either of these two intervals is recorded as the temperature for the axle. This value is checked for alarm levels in the same manner that scanned bearing temperatures are normally handled.

For interval-A: Heat values read during interval-A are processed normally.

For interval-B: Heat values read during interval-B that don't exceed the Absolute alarm threshold are ignored. Values that exceed the Absolute alarm threshold are handled as follows:

- If the interval-A heat value exceeds the Absolute alarm threshold, it is processed normally and the interval-B heat reading is ignored.
- If the interval-A heat value doesn't exceed the Absolute alarm threshold, but interval-B heat value does, a Pyrometer Saturation alarm is flagged and the interval-B heat value is stored and reported for the alarmed axle.

For interval-C: Heat values read during interval-C are ignored.

D.3 Reporting the Pyrometer Saturation Alarm

If a Pyrometer Saturation alarm is detected and assigned to an axle, a printed message will appear on Detail reports.

The figure below shows a Train Detail report with a Pyrometer Saturation alarm. The contents of your report will be different.

```
                       Southern Technologies Corporation
                          Integrated Detector System
                            Union Pacific Railroad
                                 TRAIN DETAIL
==============================================================================
                            .
                            .
                            .

              Rail                             TxdHits
Car  Axle  East  West    ON   OFF  PW1 PW2 TO1 TO2   Alarms
-------------------------------------------------------------------------
  1     1   26°   21°    25     0    8   8   2   2
        2   27°   21°    25    59    5   5   2   2
        3   26°   21°    25    59    5   5   2   2
        4  210°   22°    25   343    5   5   2   2   East Rail Pyro Saturation Alarm
        5   26°   21°    25    59    5   5   2   2
        6   26°   21°    25    59    4   5   2   2

  2     7   26°   20°    25   162    5   5   2   2
        8   26°   21°    25    59    5   5   2   2
                            .
                            .
                            .
```

Appendix E
Central Reporting System

This appendix describes the part the SmartScanIS plays in Union Pacific's Central Reporting System (aka Automated Detector Monitoring System). Covered are the messages sent to and received from their host computer.

For a complete description of the Central Reporting System, refer to Union Pacific documentation. This appendix is only an overview.

E.1 Overview

Union Pacific's Central Reporting System consists of three basic layers. The first layer consists of the trackside detectors. The second layer is the distributed communication network, consisting of either the railroad's communication lines, commercial circuits, or a combination of both. The third layer contains the host computer that communicates with each site, processing and storing the data received.

The SmartScanIS provides support for the Central Reporting System. It sends messages to and receives messages from the host computer.

E.2 Polling Port (COM2)

On the System Interface board, the DB9M plug P10 (COM2) is dedicated to the Union Pacific's Polling System. This port supports split baud rate communications providing a Receive baud rate of 150 to 115200 and a Transmit baud rate of 150 to 115200.

You change the parameters for port COM2 by using the COM2-P10 submenu of the Serial Ports menu. You can pick a baud rate of 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200. You can pick either no parity bit, 8 data bits, and 1 stop bit <u>or</u> even parity bit, 7 data bits, and 1 stop bit.

E.3 Polling Address

To participate in the Central Reporting System, each SmartScanIS must have a polling address. What the address is depends on which mode you're in. In Poll/Standalone mode, the address is based on a single alpha character designator. In Dialup mode, the address is based on the site name.

E.4 Messages

All messages sent between the SmartScanIS and the Central Reporting System use a fixed format. Each has a 10-byte header, followed by the text data, if any, and end with a linefeed character.

E.5 Supported Message Types from Union Pacific

The SmartScanIS responds to the following two-byte message types received from the host computer at the Harriman Dispatch Center.

Type	Function
IC	Initialize - cold start
IW	Initialize - warm start
JC	Test mode - send constant carrier for 15 seconds
JM	Test mode - send continuous mark for 15 seconds
JP	Test mode - send mark/space pattern for 15 seconds
JS	Test mode - send continuous space for 15 seconds
LD	Request list of defective trains
LT	Request list of all trains
RA	Resend train data all the train data for a specified train
SL	Set location name
SM	Set modem parameters for dial-up detectors
SQ	Set hot bearing alarm level
SX	Request parameter value upload
TR	Time read - send back current time and temperature
TS	Time set
WR	Weather read - send back current weather

E.6 Unsupported Message Types from Union Pacific

The SmartScanIS doesn't support all two-byte message types in the Central Reporting System. Some are manufacturer specific, while others don't apply to the SmartScanIS. Thus, the SmartScanIS doesn't respond to the following message types received from the host computer.

Type	Function
HW	High-Wide measurement alarm
MR	Memory read
PR	Port read
PW	Port write
RB	Send the digitized heat information for a specific axle in a train
SN	Set train sequence number
SR	Request current data from the rail stress modules
TO	Time-out/Lockup message
TT	Start a test train at the site

E.7 Supported Message Types to Union Pacific

The SmartScanIS sends the following two-byte message types to the host computer at the Harriman Dispatch Center:

Type	Function
DL	List of the defective trains archived at the field
IP	Power-up initialization has occurred at the SmartScanIS
SZ	Parameter value upload response
TD	Time-of-day and air-temperature report
TL	List of trains archived at the site
WD	Wind speed, wind direction, and air temperature
WM	Problem with wind indication equipment
WX	High wind limit exceeded
XA	Host command accepted
XR	Host command rejected
XX	Self-test compete
ZA	Start-of-train message
ZB	Axle interval and heat data
ZC	Wheel heat data for up to 40 axles of a train
ZD	Dragging-equipment alarm
ZH	Hot bearing detected
ZU	End-of-train message
ZW	Wheel temperature is outside the preset high or low temperature limits
ZX	Auxiliary alarms
ZZ	Final message (all train data sent)

E.8 Modification of Talker Mode

If a SmartScanIS, which is in Poll/Standalone mode, doesn't receive a valid poll for five minutes, Talker Mode changes to talk-freely mode. (In this mode, the system makes announcements even when defects aren't detected.) No change occurs when the system already operates in talk-freely mode. The next time a valid poll is received, Talker Mode reverts to the mode that was active before it was changed.

While in Poll/Standalone mode, changing to talk-freely mode also occurs when a ZA or ZU message, sent by the SmartScanIS to the Harriman Dispatch Center, isn't acknowledged after five transmissions. When message acknowledgements are restored, Talker Mode reverts to the mode that was active before it was changed. If a message non-acknowledgment is followed by five minutes of no valid polls, both the acknowledgment failure and the five-minute timeout must be resolved before Talker Mode reverts to the mode that was active before it was changed to talk-freely mode.

Index

This section lists the page numbers for keywords and phrases used in this guide.

PREFACE

Overview

This section details how to use the Wheel Impact Load Detector (WILD) Manual. It gives descriptions of each chapter and cross references for the different sections for ease of reference.

Chapter Review

This manual contains 15 chapters designed to explain the proper operation of the Mk III WILD System and how to diagnose and fix problems. Chapter 1 explains the concept of the WILD system and gives a good overview for anyone who needs to get familiar with what the system does for their company. Follow-on chapters break the system down into its components and give settings and tips for solving problems with the different components. Reference the table below to see a quick description of each chapter and how to cross reference other chapters:

00 Preface	Description of the Chapters in this document. Explains how to cross reference Chapters to each other.
01 Introduction	Gives an overview of the system and how it works. All other chapters detail the individual components of the system.
02 Strain Gages	Explains how a strain gage works. Use chapter 11 to understand test, repair, and installation of this component.
03 Front End Processor	Gives an overview of Front End Processors (FEPs) and how they operate with the strain gages in Chapter 2 and ISOBus Card in Chapter 4.
04 ISOBus	Explains the operation of the ISOBus card that runs the communication between the FEPs in Chapter 3 and the Central Processing Unit (CPU) in Chapter 5.
05 Central Processing Unit	Explains the operation of the Central Processing Unit (CPU) and how it connects strain gages to communication lines. See Chapter 6 for TCP/IP communication requirements and Chapter 8 for phone communication requirements.
06 TCP/IP Communications	Explains the requirements to setup and use the Ethernet port on the CPU. Chapter 8 offers an alternate phone communication link to the outside world for the Mk III.
07 Modem	Explains the operation of the modem phone interface for a WILD system. This option allows for Zmodem file transfers and ASCII, VT100 remote chatting with SiteMaster. Chapter 6 offers an alternate data communication link to the outside world for the Mk III.
08 Tag Readers	Shows the different Tag Reader options a WILD has and explains operation. See Chapter 14 on how to maintain and swap tag readers. See Chapter 15 on how to choose tag readers for a new site.
09 Power Supply	Details the power options of a WILD system. See Chapter 15 on how to choose a power supply for a new site. Chapter 7 explains tag reader power

	options.
10 Calibration	Salient's method of performing static calibration for strain gages. Calibration must occur once every three years to update measurement changes due to rail wear. Installing new strain gages forces a need to calibrate a site as well. See Chapter 2 for strain gage operation and Chapter 11 for gage repair and installation.
11 Gage Repair and Installation	Explains how to repair and install strain gages. See Chapter 10 on how to calibrate following an installation and Chapter 14 on how to determine when a repair is necessary. Chapter 2 outlines the operation of these devices.
12 System Commands	Shows the core command list for SiteMaster software. This chapter is for advanced users. Chapter 14 shows the commands associated with maintaining a site and Chapter 10 shows the commands to calibrate a site independently of this chapter.
13 System Reports	Contains the detail of how reports operate and supports advanced users. Chapter 14 shows how to use reports for maintenance without using this section.
14 Site Maintenance Checks	Explains how to comprehensively maintain a WILD system including remote system checks. If a site requires strain gauge repair, Chapter 11 explains it. Use Chapter 10 when a site needs calibration. Chapter 12 and 13 are not necessary, but are useful for advanced users of the SiteMaster software. Use Chapter 7 for help to program a tag reader. Chapters 3, 4, 5, 8, and 9 offer help to troubleshoot the FEPs, ISOBus, CPU, modem, and power supply respectively.
15 Site Installation	Details what customers must provide for an installation of a WILD system. Customer supplied material includes track work, an electronics hut, and site information so Salient can provide the proper material. An installation ends with a calibration covered in Chapter 10. Chapter 7 covers tag reader options and Chapter 9 covers power supply options.

Who To Call

Contact Salient Systems at US phone (614) 370-2615 for any questions or concerns involving a Salient Systems Mk III WILD.

CHAPTER 1 — MK III WHEEL IMPACT LOAD DETECTOR OVERVIEW

System Description

Salient System's MARK III (Mk III) Wheel Impact Load Detector (WILD) is a system of strain gages coordinated by a central processing unit (CPU). CPUs send reports to servers under the Wheel Management and Detection System (WDMS) or customer maintained servers to track vehicle health history and dispatch alerts. Customers can establish a network of WILD systems using TCP/IP links, modem communications, or similar methods that allow network or serial ports to communicate over distance. These WILD systems then create a complete picture of vehicle health within a customer's rail network, protecting from derailments and damaged track infrastructure.

The primary measurement tool of the Mk III WILD is strain gages. Vertical strain gages measure the force wheels passing over the rail head exert on the top of the rail. Lateral strain gages measure the force wheels exert on the side of the rail as they travel down the track. Secondly, the Mk III WILD employs tag readers to identify the cars passing over the site. The software can determine the car type from strain gage measurements, but to track the history of a car and easily identify defective cars, tag readers supply an individual name to the vehicles. Thirdly, the WILD system can gather weather conditions from a weather station attached to a serial port. Weather data is useful to determine cross winds, temperature, and rainfall that can create unsafe conditions and influence wheel data.

The CPU employs a Pentium III processing unit running a LINUX operating system. SiteMaster is a software program that coordinates all of the measurements by strain gages and tag readers. Once SiteMaster calculates the measurements made by the WILD system, it dispatches reports to talkers, printers, computers, and servers so that customers get alerted to dangerous conditions and can track the health of vehicles that cross WILD sites. Figure 1.1 illustrates the SiteMaster software concept.

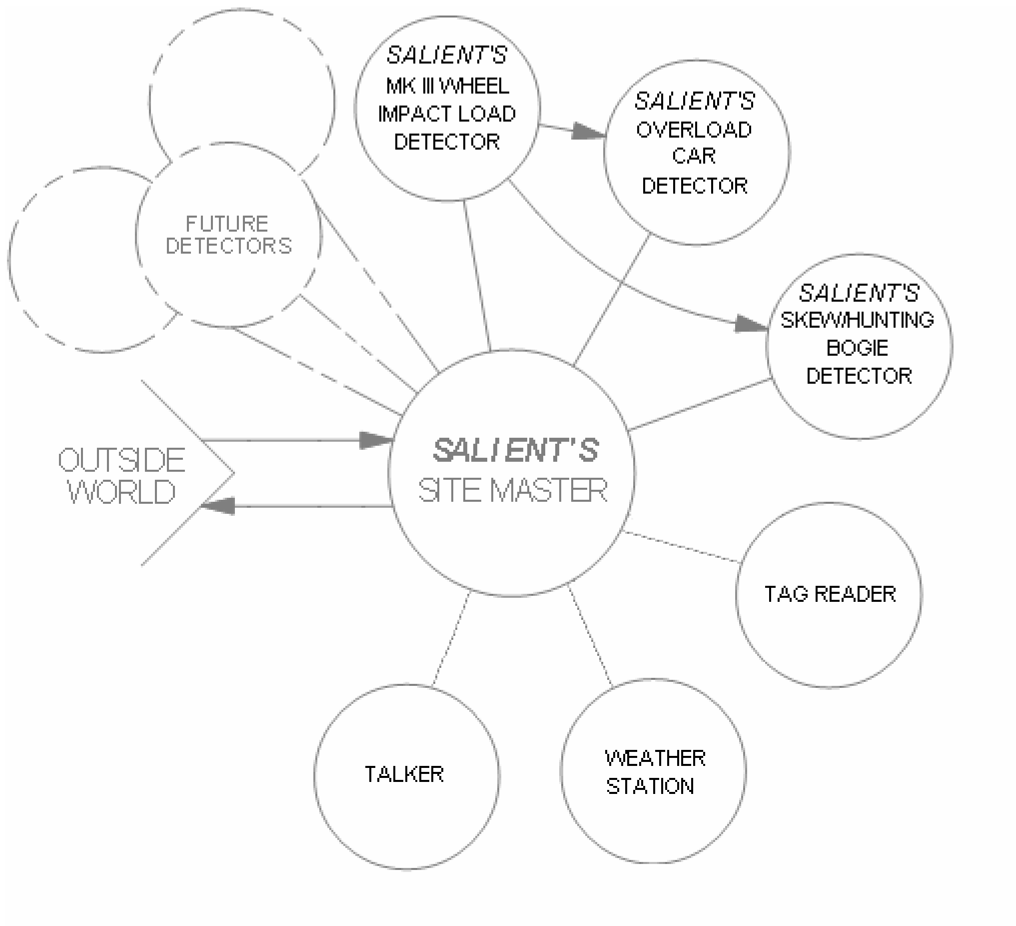


Figure 1.1. SiteMaster Concept.

Depending on the size of the WILD network a customer possesses, there are many ways to report the data from a WILD system. A large set of WILD systems is most efficient when they send their data to central servers for recording the data, tracking history, and issuing alarms. Salient Systems employs the WDMS servers to perform this operation for customers. WILD systems can issue alerts to locally installed Harmon talkers that issue radio reports to the local dispatch stations. Talkers minimize the amount of time it takes to alert local dispatchers to dangerous measurements. For smaller networks, WILD systems can issue text reports to printers or computers for recording conditions. WILD systems can also issue alerts based on threshold conditions selected using SiteMaster.

Features

Some of the features available for the MARK III SiteMaster include:

- **Automatic car counter for most vehicle types.** Considers articulating segments of multi-segment cars as part of a single car, and counts locomotives separately from cars. Recognizes several classes of four and six axle locomotives.

- **Auto-call/auto-answer capability** for TCP/IP 10/100 Mbps and standard modem communications up to 115,200 bits per second (bps).
- **Extensive flexibility** in choosing whether certain reports are automatically sent: e.g., "`send report 4 if eastbound train with more than 110 cars and less than 6000 gross tons`".
- **Extensive interactive mode** (remote or local) for diagnostics and/or research.
- **Extensive diagnostic reports** to monitor health of system elements.

The MARK III SiteMaster uses a high performance computer controlled by a multi-tasking operating system. This allows SiteMaster to work with several detection modules that need service on an "as needed" basis. Multi-track operation at one location is a major benefit of this approach.

The MARK III design incorporates a Pentium III microcomputer operating on a Verso Module Eurocard (VME) bus structure as the "master computer". This computer has built-in random access memory (RAM) for data, read only memory (ROM) for main program, calendar/clock functions, a 512 MB flash card for a hard drive, and TCP/IP and serial communications on the Central Processor Unit (CPU) board. ISOBus cards communicate with the CPU over the VME bus.

SiteMaster Specifications

Below are the hardware specifications of SiteMaster:

- Pentium III CPU with a VME interface:
  - 500 MHz clock frequency
  - 128 MBytes of RAM.
  - Calendar/Time-of-Day Clock (Battery Backed-up), Real-Time Clock
  - Eleven serial ports for local terminal and auxiliary readers/detectors
  - Bus controller
  - 512 MBytes solid state drive
- RS-485 serial ports for ISOBus interface to Front End Processors

Detection Response Hierarchy

SiteMaster assigns software priority based on the speed of the measurements that arrive from different measurement devices.

Highest response priority. *SALIENT's* MARK III Wheel Impact Load Detector (WILD) and Skewed/Hunting Truck Detector require the highest priority response from the SiteMaster because of the high through-put and time critical nature of the data (time resolution on the order of tens of microseconds).

Medium response priority. Major auxiliary tasks such as weather station data or RF tag car identification subsystems require medium priority (time resolution on the order of one millisecond).

Lowest response priority. Incoming calls and outgoing reports are handled at priorities below that of any of the detection equipment; however, they can still occur concurrently with train passage.

Stand-Alone Detectors

Other stand-alone detectors and equipment can be tied to the SiteMaster's dedicated serial ports, thereby allowing for the integration of all information for a passing train into one comprehensive report.

SiteMaster can configure to communicate with the following systems:

1. Tag Readers - SiteMaster has software for communicating with Amtec real-time tag reader units including SmartPass and SAIC non-real-time APU-102 controllers using READI file transfer. SiteMaster can also interface with other types of tag reading systems simply by mapping standard car tag data coming from the tag readers.
2. Modems – SiteMaster supports Hayes compatible modems using RS-232 communication, software flow control, auto baud rate negotiation, and Zmodem transfer. SiteMaster can communicate using other modems using Linux software drivers.
3. Talkers – SiteMaster knows how to issue reports to a Harmon MicroTalker. SiteMaster is capable of issuing reports to other talkers by programming the correct control codes for issuing report requests to a talker system.
4. Weather Stations – SiteMaster has software for communicating with ROSA and QLI50 weather stations. Communication with other types of weather stations is a simple matter of mapping the weather data format issued from the stations.
5. Wheel Spec – SiteMaster can collect Wheel Spec system data and send the report to servers via Zmodem transfer or FTP.
6. Future Systems – SiteMaster has serial port communication and TCP/IP commication built into it. It can use either of these communication links to operate in conjunction with another system. Contact Salient Systems' Engineering department to discuss your requirements and the best method to fulfill them.

Construction

All the electronics comply with the Eurocard format (VME) that has wide acceptance in military and high reliability industrial environments. The SiteMaster utilizes VME bus hardware (also based on the Eurocard standard). Card racks are heavy duty, complying with DIN 41494 specified for vehicle-borne equipment. All circuit cards use DIN 41612 pin and socket connectors, thereby avoiding the problems associated with card edge type connectors.

Wheel Impact Load Detector (WILD) System

The MARK III WILD (Wheel Impact Load Detector) system measures defects in the wheels of rail equipment. It operates on the principle of measuring minute changes in current flow through rail mounted strain gages as the wheels of freight equipment pass over them. Once the system measures, records, and compares these changes, it can then accurately identify defective wheels before they can damage the rails. Loads exceeding user determined thresholds are identified by car and axle position within the train (without aid of any optional equipment), with the resultant exception reports and other useful information merged with other data collected or processed by the SiteMaster.

The front-end processors (FEPs) using sixteen dual-channel units per subsystem, contain all the necessary elements to excite and monitor the rail mounted, vertical load circuits. A single chip microcomputer in each FEP performs initialization procedures for the signal conditioning circuits to prepare the detector for each train as it approaches the system. Each circuit output is digitized at a rate high enough (about 25 kHz) to determine the peak amplitude of any impact induced in the rail-mounted circuit (typically a 1-5 msec pulse), while ignoring false signals (shear waves) caused by impacts outside the influence zone of the rail-mounted load circuit. Front Ends use a low pass filter to better estimate the nominal load (weight) at each load circuit, thereby allowing more accurate estimates of total car weight for both total train weight and overloaded car alarms.

The FEPs communicate over an optically isolated bus to the SiteMaster. The FEPs are also isolated from the rail-mounted load circuits. Along with several transient suppression devices that have been incorporated into the system's design, these isolation techniques are employed to minimize the chances of interference or damage from electromagnetic sources, such as catenary or third rail power, and/or from lightning.

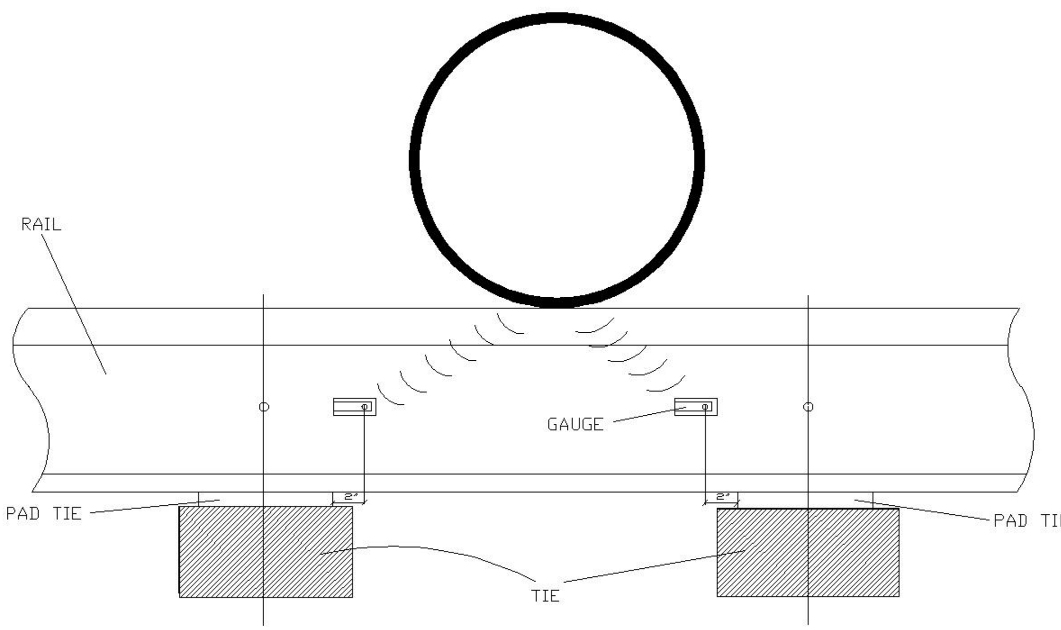


Figure 1.2. Wheel motion recorded by WILD gages

Basic WILD system operation

The typical WILD system operation is as follows:

- As the first wheels of a train enter the WILD site, they pass over **strain gages** mounted on the rails.

  - Rail mounted strain gages react to varying weights of freight equipment and sudden impacts caused by defects in the wheels. As the freight equipment passes over the gages, their inherent resistance value changes, thus affecting the current flow through the circuit. Each set of gages connects to the input circuits of an FEP module located in the WILD equipment bungalow.
  - Typical installations use 10 to 20 sets of gages on each rail to be able to pick up defects in an average freight car wheel.
- The **FEP (Front End Processors) modules** filter and convert the outputs of the strain gages into digital signals. Once a wheel passes over a gage set, a microprocessor calculates the average and peak voltages recorded. It then sends this information to the ISOBus module of the SiteMaster.
- The **ISOBus module** acts as a funnel between the incoming data from the individual FEP modules and the CPU module. It provides isolation between all external equipment and the system CPU.
- The **CPU module** provides the raw processing power to run the system. It processes all the wheel data and compiles it into different reports.
  - When the train first enters the site, the CPU commands the system to turn on the AEI (Automatic Equipment Identification) Tag Reader (if equipped).
  - When the train has passed through the site, the CPU processes all the data and sends out reports to designated locations. It also performs a system self-test to check all the components and prepare for the next train.
  - A **flash memory card** stores the system program, user-settable parameters, and statistics.
- The CPU sends out reports to various locations through a **TCP/IP port**, an **I/O Serial Controller module** directly mounted in the CPU card, or **serial ports** on the main printed circuit board (PCB). The CPU controls data flow between the system and several external serial input devices. These include:
  - AEI tag reader
  - External modem (if equipped)
  - File Transfer Protocol (FTP) using a data connection

  An external **Modem** (if equipped) or data link provides the connection between the system and outside reporting locations (i.e. repair facilities).
- An **AEI Tag Reader** (if equipped) reads each car’s ID as it moves through the site. The Reader includes the following equipment:
  - Two antennas (one on each side of the track)
  - One reader

FEP Processor Specifications

Below are the specifications for the Front End Processors:

- Built-in load circuit excitation (isolated)
- Auto zero, auto gain signal conditioning (isolated)
- DC-1700 Hz bandwidth, digital filtering for optimum peak load detection

- 15-bit A/D converter (25 kHz sample rate)
- No manual adjustments or jumpers
- 20 lb (0.1KN) resolution for wheel loads
- 3,000 lb (13KN) minimum detected load
- 300,000 lb (1,300KN) peak load range

WILD Measurement Specifications

The WILD measures to the following specifications:

- Nominal 32 circuit system (sixteen circuits per rail) can detect impacts along 100% of the circumference of most standard wheel diameters depending on crib spacing and circuit intervals. Each installation is optimized for the local traffic mix.
- Monitors trains with up to 1,000 axles. (Can be expanded.)
- Minimum useful speed: 20 mph (30 km/h) --- because of impact dynamics.
- Total speed range depends on minimum truck wheelbase, circuit spacing and other variables that are determined for a specific application. Typical ranges:
  - 20 - 140 mph (30 - 225 km/h): For combined freight and passenger.
  - 25 - 180 mph (40 - 290 km/h): For high speed passenger only.
  - 20 - 80 mph (30 - 130 km/h): For main line freight only.
  - 15 - 50 mph (24 - 80 km/h): For branch/yard locations.
- Automatic correction for "missing wheels" and other forms of errors that often "confuse" other systems.
- Five remote, user settable impact load thresholds for each of three categories of vehicles (locomotives, passenger coaches, and freight cars), as well as "dynamic increment" thresholds for checking empty or lightly loaded cars and impact load ratios for fleets with constant car weights.
- Automatic turn-off of any front end circuit that fails tolerance test (re-tested after each train).
- Remote manual turn-off of intermittent front end circuits.
- Automatic turn-off of intermittent front end circuits based on disproportionate (improbable) activity (alarms) on one channel.
- Automatic speed calculation.
- Monitors bi-directional traffic.
- Estimates total train tonnage (by train and by week).
- Estimates total train length (first to last axle).
- Creates extensive load statistics (peak, nominal and dynamic) for regular (daily, weekly, or monthly) reports to management or research personnel.
- Analog output for local diagnostics and/or research.
- High voltage isolation (rail-rail, rail-system, system-ground).

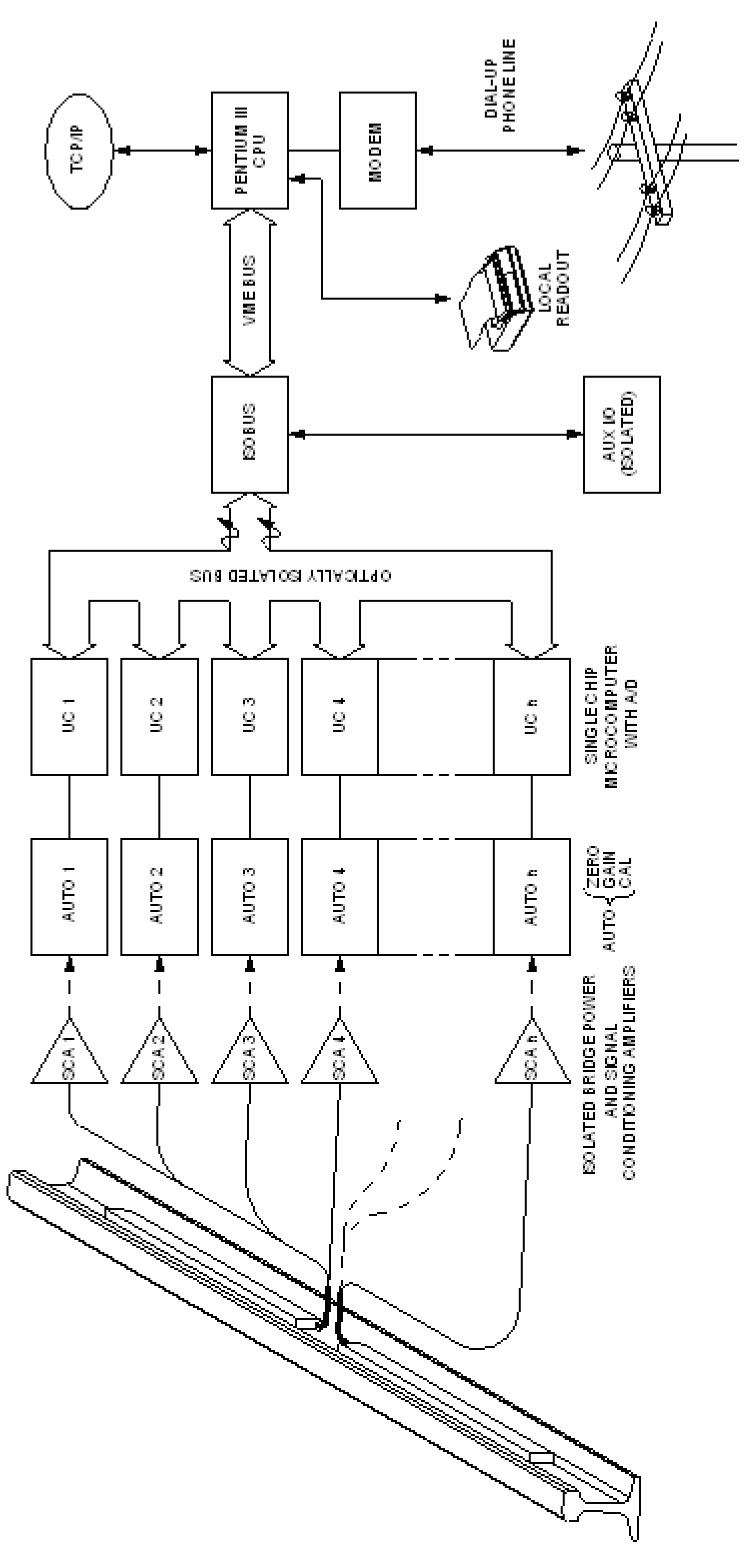


Figure 1.3. Wheel Impact Load Detector (WILD) Block Diagram

SiteMaster System capabilities

Depending on the **measurement options** installed, the MARK III WILD system is capable of checking for:

- wheel impacts
- weight-in-motion
- skewed and hunting trucks
- ambient conditions (temperature, wind direction, wind velocity, etc.)

With this information, the system can send out **reports** of varying complexity for the purposes of identifying defective wheels before they can cause damage. These reports can go to either the repair facilities directly or to central offices for input into databases, where all the data is stored and processed.

For many installations, reports with major wheel defects are treated similarly to "hot box" alarms. The rail traffic controller is notified and can then immediately stop the train and set off the car before any further damage can be caused.

Overloaded Car Detector SiteMaster Module

An Overloaded Car Detector option is available for SiteMaster. This is possible because of use of vertical load circuits to accomplish the detection of wheel tread defects.

Load data is filtered with digital processing: the high frequency data yields peak impact detection, and the low frequency data creates an estimate of the steady state force from each wheel. The total vehicle weight is then estimated from thirty-two separate load estimations. A special algorithm recognizes rough wheels and other anomalies that would normally compromise the weight estimation.

This process is considered to be a "weight estimation" because several dynamic factors can bias the results over what a static scale would measure. The algorithm compensates for many of these factors, thus allowing the Overloaded Car Detector's results to approach low speed weigh bridge results.

A separate alarm report is available (which can be sent to a different location from the impact alarm report), or the results can be merged with an overall summary alarm report. Depending on the specific rolling stock passing over the detector, it is also possible to have different overload thresholds for different vehicles based on recognizing the characteristic truck wheelbase or RF tag associated with each vehicle load capacity.

Skewed/Hunting Truck Detector SiteMaster Module

The Skewed/Hunting Truck Detector option utilizes the same FEPs as the WILD vertical impact detectors. The low frequency circuit of the vertical load circuit in the Wheel Impact Load Detector is used to trigger the lateral load measurement, which is slaved to its mating vertical load circuit while maintaining full electrical isolation at the rail. This provides for proper sampling of the lateral load at the center of the load circuit. (The lateral load can often be zero or negative and, therefore, not reliably self-triggering.)

The lateral load circuit is the most widely used technique to measure lateral wheel/rail loads in North America, and was invented by Harold Harrison when he was with Battelle Memorial Institute.

As with the WILD vertical impact measurements, the sampled and digitized vertical and lateral load values are sent across the optically isolated bus to the SiteMaster where the data are formatted and processed to identify the skewed or hunting trucks. Load values are then compared against adjustable alarm thresholds to prepare an exception report or merged into the SiteMaster's main summary report. The skewed or hunting trucks are identified as in the "leading" or "trailing" position along with the car count in the consist and the RF tag (if any) attached to the vehicle. Alarm thresholds are set for absolute lateral load and for L/V ratios.

Site locations

WILD sites are generally located at convenient entry and exit points to cities with repair facilities. This way defective wheels can be quickly identified, isolated and repaired.

MK III Hardware Organization

System block diagram

The following diagram shows the WILD system main hardware components and their relationships with one another.

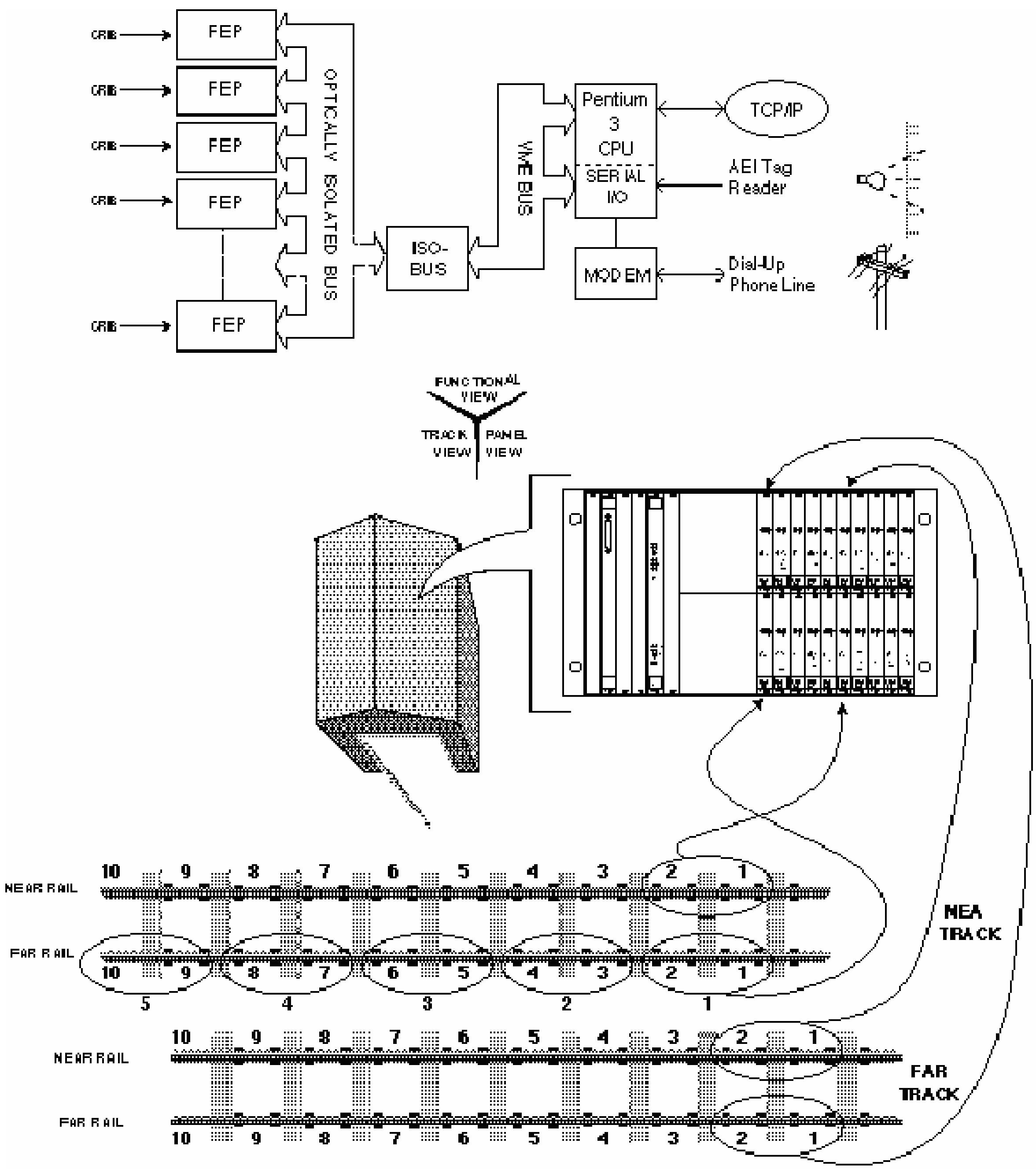


Figure 1.4. WILD system block diagram

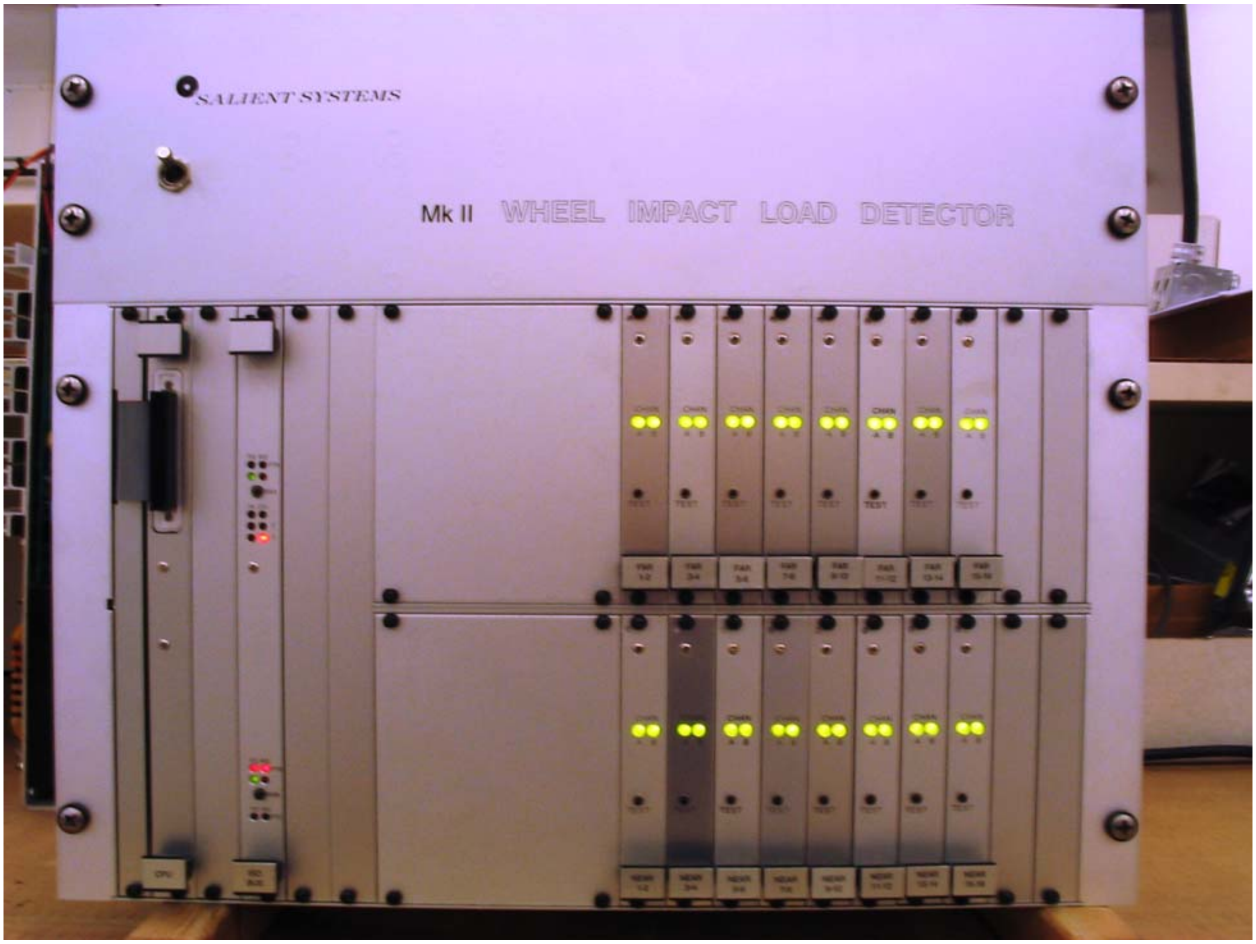


Figure 1.5. Front view of WILD equipment

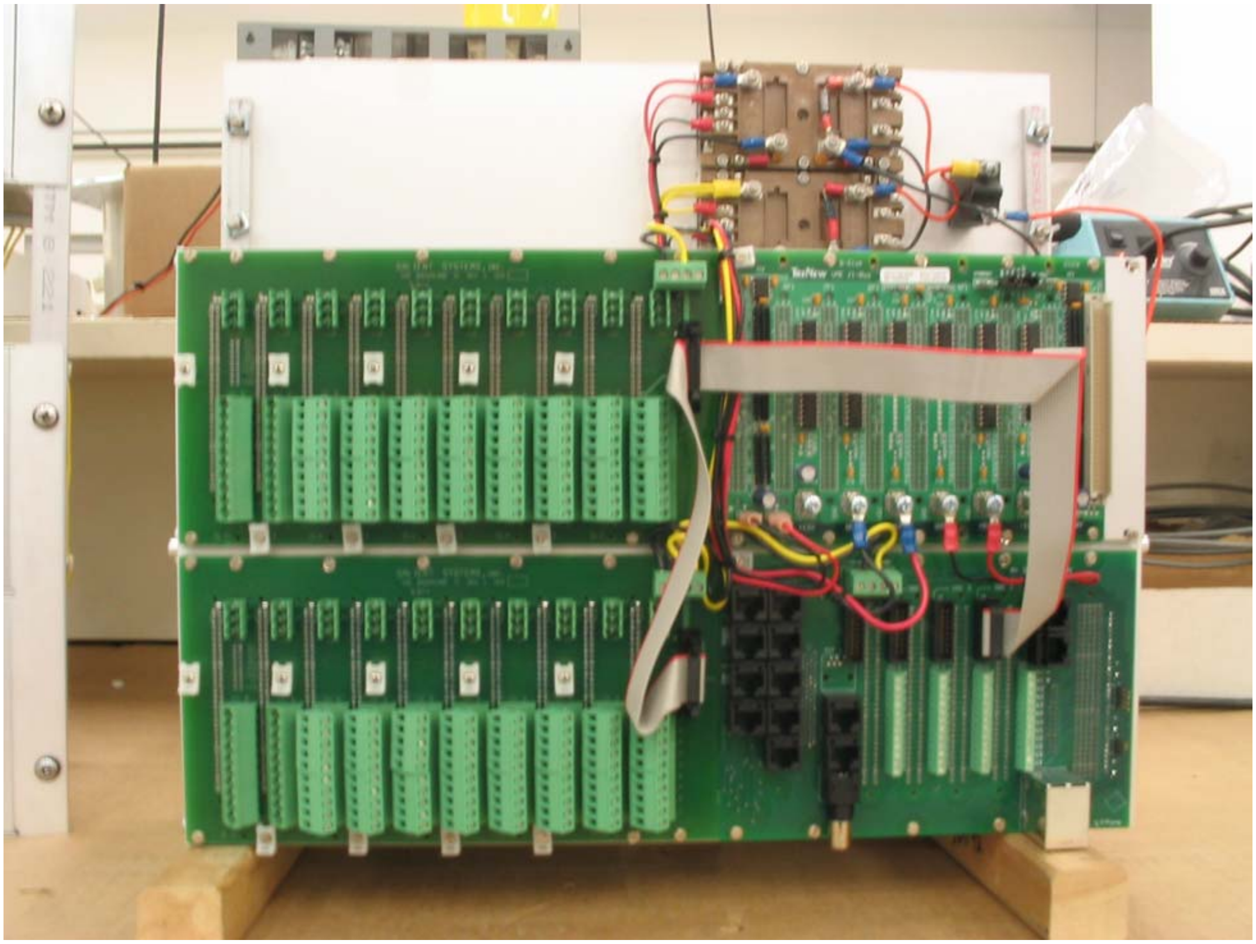


Figure 1.6. Rear view of WILD equipment.

MK III And Rev4 Mk II Comparison

Similarities

The Mk III and Rev 4 Mk II both use the same rail measurement equipment and the same Front End Processors. The Mk III ISOBus units have different firmware on three different chips so that the same hardware can communicate with the faster CPU. The chips are removable from the unit, so it is possible to upgrade a Mk II ISOBus card (Rev 3 or Rev 4) to a Mk III ISOBus card. The electronics rack is the same with the exception of the CPU backplane panel on the lower, right-hand corner of the WILD backplane. The Mk III supports all of the functions of the Mk II.

Rev 3 Mk II units only share the ISOBus card, the VME panel in the upper right-hand corner of the rack backplane, structural components of the electronics rack, strain gages, and tag readers with the Mk III.

Differences

The Mk III CPU replaces the Mk II CPU, I/O serial cards, flash card sled, flash card, hard drive, and RAM card. ISOBus firmware programming supports communication to the faster CPU. The new CPU backplane panel supports, TCP/IP communication, greater ease of connecting second track relay lines, and features a built-in beeper box coaxial connector.

Advantages of the Mk III over the Mk II include:

1. Built-in TCP/IP communication versus external serial adapters. This feature allows 100 MBits per second access to the system versus 19.2 Kbaud access limitations of the Mk II.
2. 500 MHz CPU versus a 33 MHz CPU for faster command processing.
3. Protected operating system (OS) and SiteMaster files versus unsecured file system.
4. Automated diagnostics notification software versus manual queries.
5. 512 Mbytes of software space versus 256 Mbytes. This feature allows software upgrades and diagnostic functions the Mk II cannot support.
6. 11 standard serial ports versus 8 maximum serial ports.
7. Two track screw relay terminals versus one track screw terminal and one track connector terminal.
8. ISOBus card removal unobstructed versus an exposed SCSI cable to the flash card or hard drive.

CHAPTER 2 — STRAIN GAGES

Overview

Gage Operation

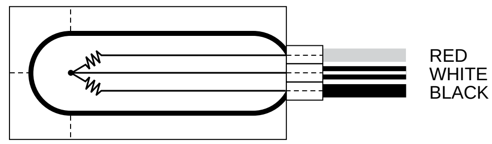


Figure 2.1. WILD Strain Gage

Rail mounted **strain gages**, welded directly to the rail, react to varying weights of freight equipment and sudden impacts caused by defects in the wheels or suspension. Each vertical gage consists of two 350 Ohm variable resistors and each lateral gage consists of one 350 Ohm variable resistor. Lateral strain gages are optional and only present at sites with lateral detection. As the freight equipment passes over the gages, their inherent resistance value changes, thus affecting the current flow through the circuit. Each set of gages connects to the input circuits of an FEP (Front End Processor) module located in the WILD equipment bungalow.

Gage Installation

Refer to Chapter 11 for steps necessary to install strain gages.

Calibration

A physical calibration of all vertical and lateral load-measuring circuits is performed after system installation. This calibration utilizes a track loading fixture reacting against a loaded car or its own load frame to apply known vertical or lateral loads to each circuit. The voltage output of each circuit is measured while this known load is being applied. These measurements are then used to determine the proper calibration constant for each individual circuit.

As the site is calibrated, the calibration constants are stored in a table in the SiteMaster code. The calibration constants are applied to the data from each FEP as they are processed. The load circuits show exceptional consistency with circuit sensitivities being typically within two or three percent of each other, and linearity of better than 0.5 percent.

See the Chapter 10 on calibration for the instructions on calibrating circuits.

Strain Measurement

The system measures the voltage across the gage circuit as the wheel passes over the crib (set of gages). Figures 2.2 and 2.3 show the measurement principle and the WILD gage configuration.

The installation crew welds the gages on both sides of the rail between the cross ties at specific locations along the rail's neutral axis. They then connect them in a Wheatstone bridge configuration. As a wheel passes between the ties, it applies pressure on the rail and bends it in a downward direction. As the rail bends, it distorts the gages to varying degrees. The heavier the rolling equipment, the greater the distortion.

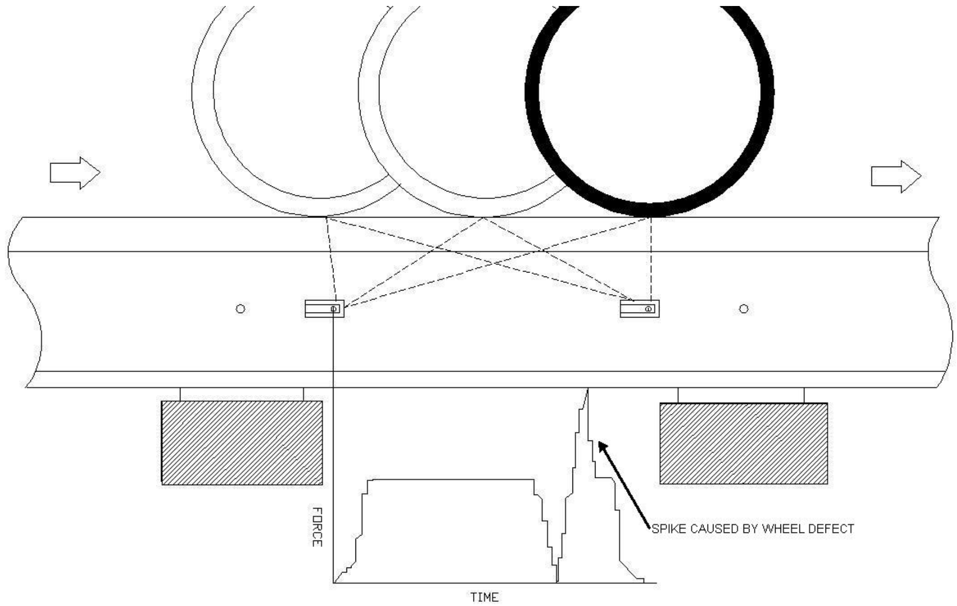


Figure 2.2. Measurement Principle

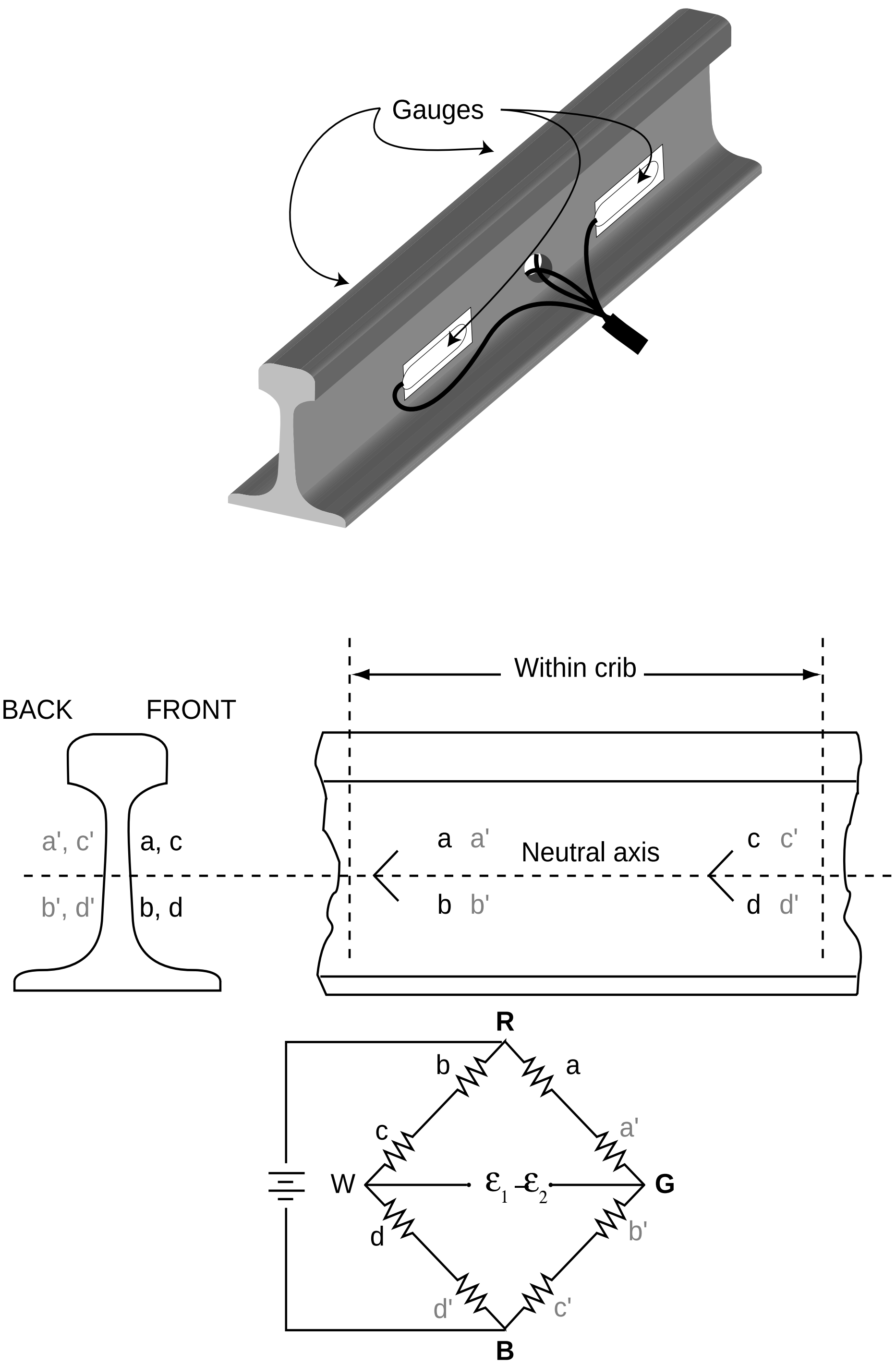


Figure 2.3. WILD Gage Configuration

The internal resistors of the gages are mounted at 45^0 angles to the rail. When a wheel enters the crib (area between the gages), those resistors that are mounted in parallel with the strain lines of force compress while those that are mounted at a perpendicular angle to the lines of force stretch.

As the wheel moves across the crib, the circuit shifts to maintain a constant voltage drop across the bridge dependent upon the weight of the rolling stock.

When a defect rolls over the crib, the strain forces increase proportionally to the degree of the defect and are picked up by the gages.

The system is calibrated as follows:

$$1 \text{ KIP(Kilo pounds)} = 1000 \text{ lbs} \cong 0.1 \text{ mVDC}$$

In a balanced circuit with no load present, the circuit output should be 0.0 VDC.

Figure 2.2 shows a typical voltage waveform as measured across the bridge for a wheel passing through the crib.

- The sharp spike is typical of an out-of-round defect in the wheel.

Gage Interconnections

Figure 2.4 shows the WILD gage interconnections for one crib.

- The wires are color coded to speed identification.
- All junctions are soldered and then sealed with epoxy filled end caps to prevent corrosion (this action prevents circuit noise).

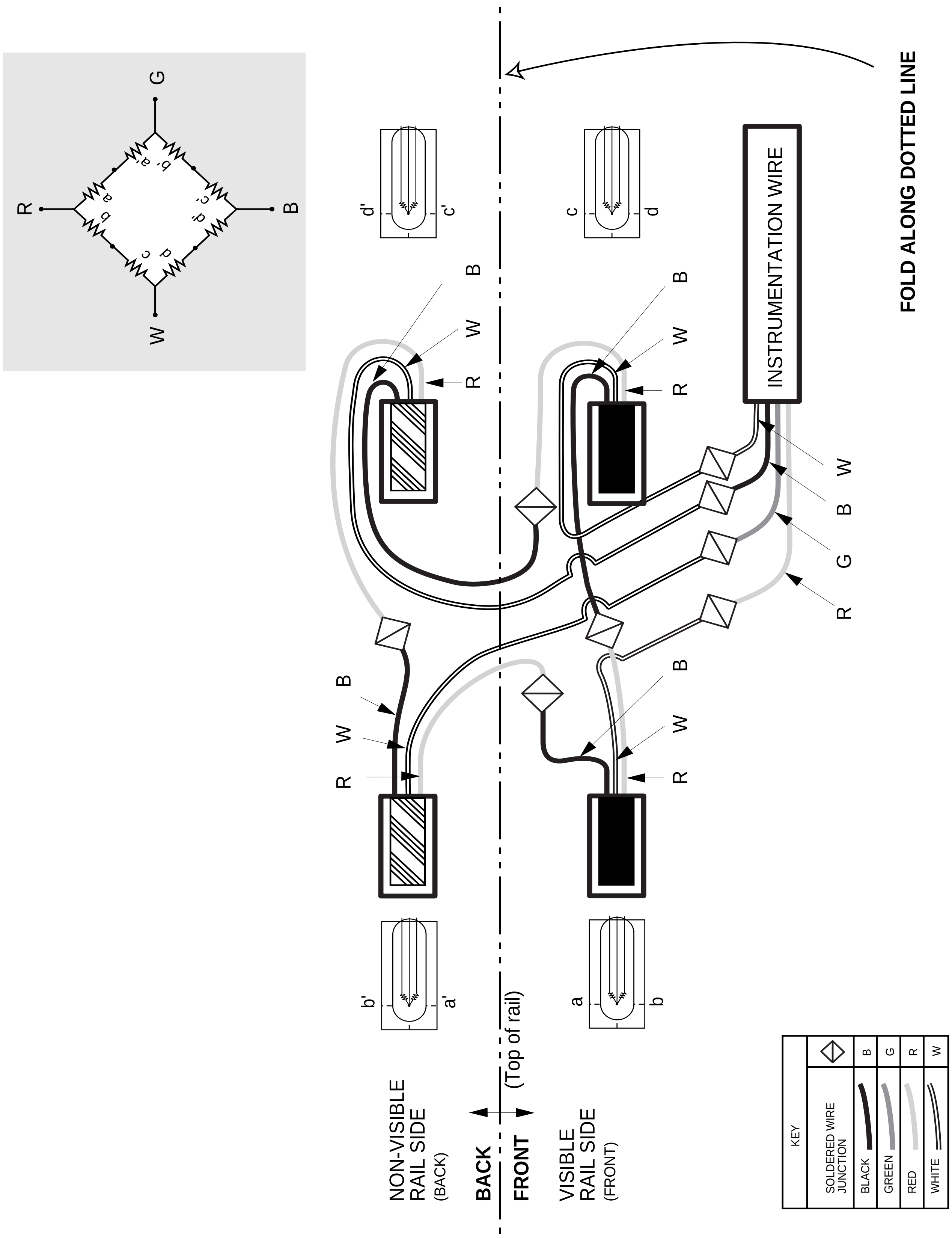


Figure 2.4. Gage Interconnections

Crib Configurations

One consideration when configuring the site is typical wheel diameters of the traffic passing through the site. This directly affects the spacing needed between the ties and which cribs must be active to ensure the best coverage.

There are two main crib configurations used at most WILD sites:

- 5-1-5: In this configuration, the first 6 ties are placed 24" apart while the last 5 ties are placed 26.1" apart. The first five cribs are active, the next one is dead, and the final five are active.
- 5-4-6-4-5: In this configuration, the first nine ties are placed 24" apart and the last 15 cribs are placed 26" apart. The first five cribs are active, the next four are dead, the next six are active, the next four are dead, and the final five are active.

Alternate installations use three other configurations that have slightly less wheel coverage than a 5-4-6-4-5 to avoid welds or rail modifications. They are also used to expand 5-1-5 configurations:

- 5-1-5-7-6: In this configuration, the first six ties are placed 24" apart, the next five ties are placed 26.1" apart, and the final thirteen cribs are placed 26" apart. The first five cribs are active, followed by one dead crib, five active cribs, seven dead cribs, and six active cribs.
- 3-2-5-1-5-2-3: In this configuration, the first three cribs are placed 26" apart, the next eight are placed 24" apart, the next five are placed 26.1" apart, and the final five are placed 26" apart. The first three cribs are active, followed by two dead cribs, five active cribs, one dead crib, five active cribs, two dead cribs, and finally three active cribs.
- 3-2-4-3-2-3-4-2-3. In this configuration, the first three cribs are 26 inches, followed by two dead cribs at 24 inches, 4 active at 25 inches, 3 dead at 25 inches, 2 active at 25 inches, 3 dead at 25 inches, 4 active at 25 inches, 2 dead at 26 inches, and 3 active at 26 inches.

Customer configurations are available to meet specialized needs for wheel coverage. Contact Salient Systems Operations department for a solution to meet your needs.

CHAPTER 3 — FRONT END PROCESSORS

Overview

Purpose of FEP

The MARK III front-end signal processor (FEP) is a dual-channel device which provides the interface from the "real world" load measurement to the SiteMaster. The analog signals that are generated by each rail mounted load circuit are converted into digital values in engineering units, which are then sent to the SiteMaster for further processing. Each message sent consists of the average and peak load for a given wheel crossing one of the FEP's load circuits, along with a "timetag" to indicate the instant the wheel crosses the center of that load circuit.

The resultant digital message is sent across an optically coupled serial data bus (ISOBus) to the SiteMaster as an additional measure of isolating the electrical environment of the FEPs from the SiteMaster.

Mk II Rev 4 FEPs are 100% compatible with Mk III FEPs. Mk II Rev 3 FEPs can damage a Mk III system and should not be in the system.

Signal Flow Through FEP

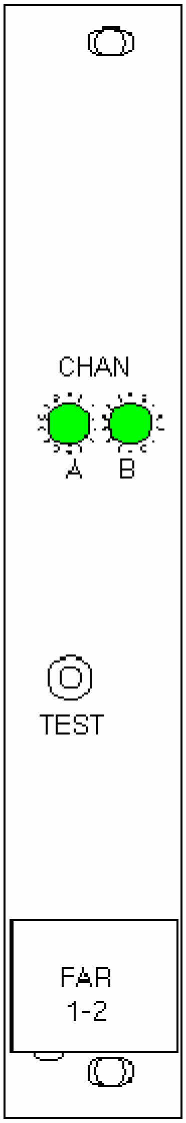


Figure 3.1. FEP Front Panel

Signal flow through the FEP is as follows:

1. The on-board power supply provides 10 VDC to the external crib circuit.
2. The return signal from the crib enters the board through the backplane Green and White wires.
3. Diodes protect the electronics from any high voltage spikes that may enter through the crib inputs. The diodes short to ground above preset levels.
4. An Analog to Digital Converter takes samplings of the input signals, converts them to digital and sends them to the microprocessor for processing.
   - The board takes approximately 30,000 samples per second upon wheel impact. With a train traveling at 60 mph, this represents approximately 1700 scans per inch traveled.
5. The microprocessor processes the signals by:
   - adding a time stamp to the data. Time stamps have a 4 usec resolution.
   - calculating the average impact weight
   - determining the peak values
6. The microprocessor sends the processed data out to the SiteMaster. The message is made up of 15 bytes of data transmitted at 125 Kbits/sec.
   - Transmission time for one message is approximately 1 msec.

Figure 3.1 depicts an FEP front panel.

Figure 3.2 depicts an FEP block diagram.

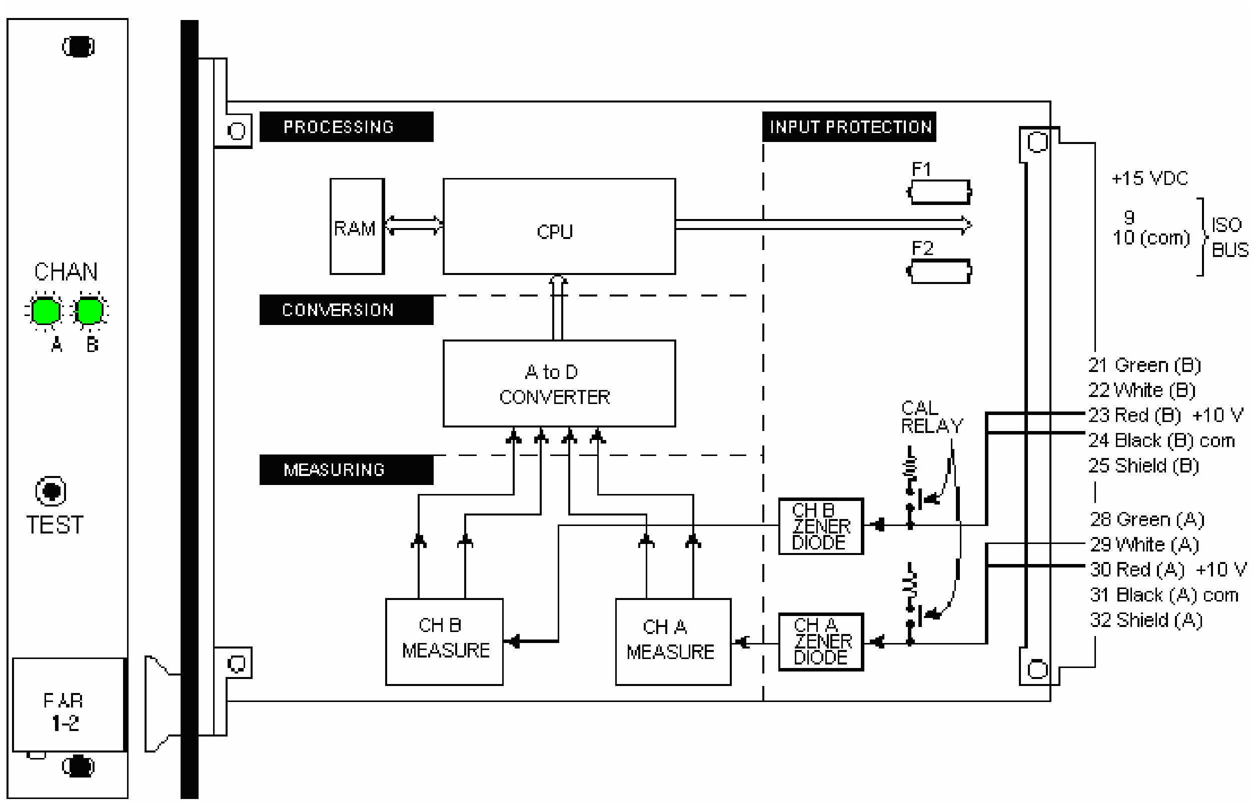


Figure 3.2. REV 4 FEP Block Diagram

REV 4 FEP Overview

As shown in Figure 3.2, the rail mounted load circuits and their respective cabling are electrically isolated from each other, as well as from the rail and surrounding objects. While measuring each peak and average wheel load, the FEP continuously maintains complete electrical isolation from not only the main system power, but also from the adjacent channel on the same FEP and all other FEPs. This significantly reduces the chance of damage to the FEP by lightning strikes or rail return currents on electrified systems. System survivability is further enhanced by each FEP having transient protection diodes on each input as well as its own fused power supply. This prevents the failure of an FEP from disabling the remaining system. The WILD system is flexible enough to operate properly with as few as three working data channels.

FEPs derive all operating power from the +15 VDC power coming from the ISOBus card.

Upon command from the SiteMaster, each of the FEPs performs an initialization sequence which includes:

- Automatically establishing the zero signal level of the circuit;
- Automatically verifying the data path sensitivity; and,
- Performing a noise check.

Component Descriptions

Bridge Excitation

The load circuit mounted on the rail is a standard Wheatstone bridge. As with any resistance type strain gage transducer, the bridge must be excited by a voltage or current source to produce an output.

A regulated and isolated ±5 VDC source provides the bridge excitation in the FEP. Each of the two channels has separate regulation and isolation.

The common of this source is referenced only to the isolated portion of the FEP circuitry to properly establish a reference for common mode rejection in the signal conditioning amplifier. The input data cable shield is also referenced to the common for proper rejection of noise. It is not referenced to any other point in the system.

The exact voltage of the bridge excitation is not critical (except to verify that it is working properly), since the FEP relies on the shunt calibration to determine absolute sensitivity of the combined front-end analog circuitry and of the load circuit itself.

The value of the shunt calibration is determined at installation through a physical calibration, where the reference load is measured with a precision load cell. Only a variation in excitation voltage between the time initialization occurring prior to train arrival and/or at any other time during the train passage would cause an error. The only way to generate an error on an FEP is to have excitation on the Wheatstone bridge without a wheel present. Sources of excitation include moisture seepage, wire insulation failure, or strain gage failure.

Isolated Circuit Amplifier

FEPs offer extensive isolation from the “outside world.” The only exposed component is the circuit that excites the wheel load circuit, amplifies the signal returned, and digitizes the signal.

The four-conductor, shielded cable (which is terminated at the barrier strip on the backplane for the FEPs) is "grounded" only to that voltage source, and does not have a DC path to any other portion of the system or local "earth" tie points. The shield on the input cable is left floating at the rail, and there should be no DC connection with any portion of the load circuit and the rail.

There is at least a 3000 VAC (rms) isolation of the FEP circuit that transfers power to the isolated section and a minimum 2500 VAC (rms) isolation in the digital signal path between the isolated and non-isolated portions of the FEP.

A low impedance path detected between any load circuit and other points in the system or "ground" is a fault condition; however, the system may continue to operate normally, even if such a fault is detected. An increase in noise may be encountered at the output of the front-end processors while operating under this fault condition. More importantly, if the fault condition is not remedied, the system may become more vulnerable to electrical damage from lightning or catenary power transients that produce large fields in the area of the detector.

Filter Stage

REV 4 FEPs filter all data digitally through software; so, no jumpers are needed to set speed ranges or change board operation. The jumpers present on the FEP are only for manufacturing processes.

Analog to Digital Conversion

Each signal is amplified one final increment after filtering to optimize the resolution of the data for the high bandwidth (impact) and low bandwidth ("weight") paths. The A/D converter treats each of the four data paths (two load circuits times two filter paths each) as separate activities and converts them simultaneously with 12-bit resolution at approximately a 30 kHz rate.

Microprocessor

The Rev 4 FEP utilizes a Motorola 68HC812 16-bit, single chip microprocessor with 16 bit registers, operating from an 16 MHz crystal.

The FEP microprocessor contains a built in Serial Communications Interface (SCI) to allow the FEP to send information across an isolated communications bus (ISOBus) to the SiteMaster at 125 Kbaud. The microprocessor contains a second SCI that allows SiteMaster to control the FEP if the primary SCI is busy or disabled.

SCIs enable the FEPs to be remotely programmed through the modem in the SiteMaster. All on board functions, including signal processing and board calibration, are controlled by the microprocessor.

FEP Status

The FEP module front panel LEDs indicate channel activity from the crib and FEP status as follows:

- LED color:
  - Green = Normal ready mode.
  - Flicker Red when a wheel passes = Normal acquire of wheel data.
  - Red while pushing the CAL button = Normal response to the calibration sequence (same as wheel passing).
  - Both orange = Unit has been reset. Collecting longterm zero data, but still functional, as “quick zero” is used until longterm zero is established.
  - Red continuous = strain gage insulation bad or possible board defect.
  - Both off = Board is reset, newly inserted, or no power.
  - Both Flickering orange = Board in reset or program mode.
- TEST button: When pressed, the TEST button energizes an internal relay, which places a 200K Ω resistor across both channel A and B inputs. This simulates a heavy train crossing the crib and helps when troubleshooting the system.

Module Self-Calibration

The FEP module undergoes a circuit self-calibration at regular intervals (power up, after a reset, after a train passes, at timed intervals). The module uses the results of this self-calibration for later measurements of wheels through the crib. This calibration maintains circuit accuracy while generating a diagnostic message, which is then sent to the SiteMaster.

- In the event of a failure to obtain a proper calibration, the FEP sends the details of the failure to the SiteMaster, which determines whether or not to retry the initialization process.

Figure 3.3 depicts the self calibration circuitry of the FEP.

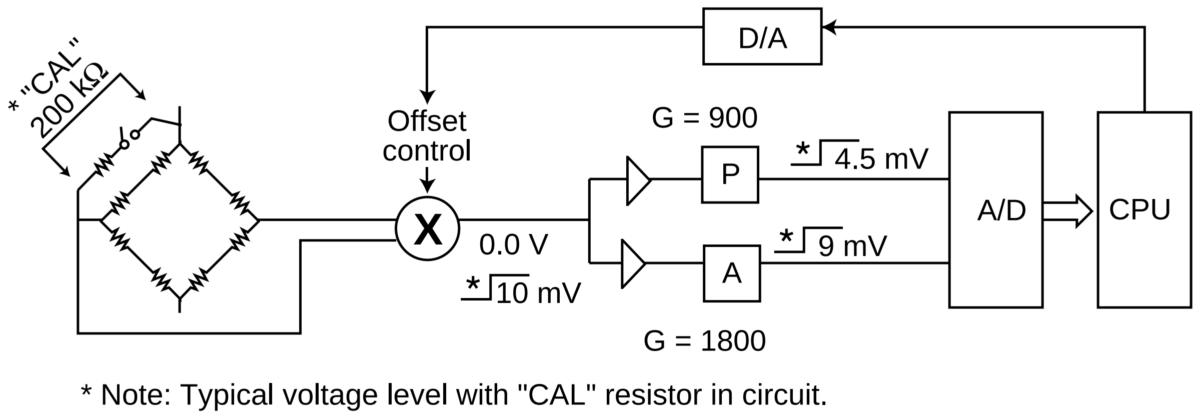


Figure 3.3. Panel Calibration Circuitry Block Diagram.

Zeroing of the Analog Amplifier

The resistance values of individual bridge circuits can change over time due to temperature and aging. The module compensates for this change by adjusting a zero offset value used to produce a zero output of the circuit when no load is present at the crib.

In FEPs, this self calibration involves measuring the “zero” response of the circuit and using that reading as a “floor” or base line for measuring circuit response. This zero reading is continually updated so that changes in circuit response will have no effect on readings.

If the microprocessor is unable to zero out the circuit, a diagnostic message is sent to the SiteMaster indicating a failure to zero out.

Verifying the Data Path Sensitivity

After the zeroing is completed, the self-calibration checks the end-to-end sensitivity of the circuit. This part of the calibration is important in that it takes into consideration the sensitivity of the load circuit the FEP channel is connected to. This is accomplished by the FEP simulating a known load value on the load circuit and reading the analog signal that is generated.

1. The load is simulated by energizing an isolated relay, causing a 200 kΩ shunt calibration resistor to be placed across the positive shoulder of the load circuit.
2. The reference calibration constant for that channel is stored in the SiteMaster configuration. A scale factor is then computed and used as a

variable when computing peak and average loads on that particular channel.

- When troubleshooting, this makes it possible for FEPs to be exchanged or used on different channels without sacrificing accuracy. Although the calibrated sensitivity of each load circuit is slightly different, the FEPs are programmed to recognize the slot they are plugged into.

If the microprocessor is unable to obtain a satisfactory gain value, a diagnostic message is sent to the SiteMaster.

Testing and Troubleshooting

Fault Indications

FEP operation is related to the Wheatstone bridge operation. Logically, the FEP failed OR the Wheatstone bridge failed.

Indications that the FEP failed are the following:

- The LEDs do not come on with the rest of the system,
- The LEDs stay red,
- The reports from the SiteMaster indicate that the FEP has been turned off.
  - If the SiteMaster shuts down an FEP because of inconsistent data, it will insert an * in the report beside the crib number (see Test command, TE).
- The correct firmware value does not report in the TE command return,
- The Wheatstone Bridge fails test using TE.
- Red alarm from the “sitehealth.sf” output.

Indicators of Wheatstone bridge failure are the following:

- The LEDs stay red,
- The Wheatstone Bridge fails test using TE.

To isolate whether the FEP failed or the bridge failed, move the suspect FEP to the position of a working FEP and the working FEP to the position of the suspect FEP then enter “fe –r” at the Track One prompt of SiteMaster. After the move, if the suspect FEP still fails, the FEP is defective and if the working FEP fails the Wheatstone bridge is broken. Note that it is entirely possible that both the FEP and bridge have failed, especially when electrical surge is the source of component failure.

Fault Correction Procedures

If an FEP appears to be defective, try the following fault correction procedures:

- **Swap the suspect module** with another from the same bank.
  - If the problem persists in the same slot, then check the load circuit to the crib (see “Check voltages at the bridge…” below) or the backplane connections.
  - If the problem moves with the card, then replace the module.
- **Reset the FEP bank** by pressing the ISOBus module Reset button or by issuing an ISOBus Reset command (IR) or by issuing a Test command. Note, however, that a fault can temporarily clear and then come back.
  - The suspect FEP will reset and then go through its self-calibration. If an FEP has hung up, this often brings it back on line.
- **Reset the system** by pressing the CPU module Reset button or by issuing a Hard Reset command (HR). This procedure is best for

addressing software-related issues.

- **Check voltages at the bridge** at the back of the module — voltage between Black and Red should be 10 VDC. If significantly different, the bridge may be shorted or the power supply may have failed.
  - Examine the bridge for shorts by checking the resistance between Black and Red; values should be roughly 703 ohms for a vertical circuit and 353 ohms for a lateral circuit.
  - The load circuit voltage (between Green and White) can also be tested. Its voltage should be half the Red-Black voltage. If it is not, or if a voltage greater than 2mV between Green and White exists, a short or open wire in the input cable or bridge may exist, or a strain gage may have partially failed.
- **Check the input power supply fuses F1 and F2.** F1 and F2 are located on the top right side of the board and protect the +15 VDC supply.

Module Replacement Procedure

A person can install an FEP with the power on or off. The FEP does not have any jumpers that need configuration. Use "fe –r" at the SiteMaster command prompt if installing an FEP with the system power on. Make sure a train is not crossing the site if swapping an FEP with the system power on. Run "te" to verify the FEP operates properly after installation.

CHAPTER 4 — ISOBUS

Overview

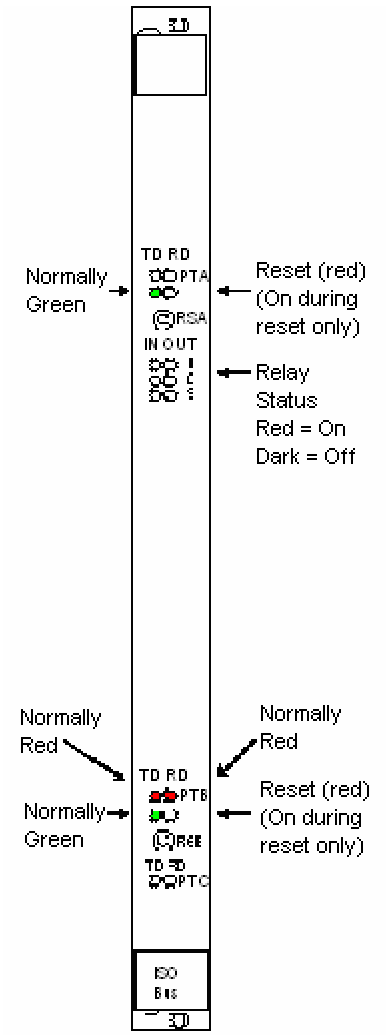


Figure 4.1. Front Panel View

Purpose and Components of the ISOBus

The International Organization for Standardization (ISO) developed ISO 11783 defining the ISOBus (ISO 11783=ISOBus). The ISOBus module is the interface between the Site Master CPU and the Front End Processors (FEPs). In the WILD system, it isolates the CPU from any potentially damaging signals from the field devices. Figure 4.1 shows the front panel.

When a train passes through the site, the FEPs send the wheel data to the ISOBus module which checks the messages for integrity and forwards them to the CPU across the VME bus. Also, the WILD system uses the module to control several Transistor-Transistor Logic (TTL) level inputs and outputs.

Mk II ISOBus cards are compatible with Mk III systems after firmware upgrades to the EPROMs and Altera chip.

Signal Flow Through the ISOBus

The data flow through the module as a train moves through the site is as follows:

1. Once a wheel passes over a crib, the FEP processes the data and prepares to send it to the ISOBus module through the ISO Backplane (RS485).
2. When the RS485 bus is clear (not being used by another card), the FEP transmits its data to the ISOBus module.
   - The ISOBus card polls each FEP for messages.
   - Once the FEP receives its poll, it sends its message and goes back to taking measurements.

3. Once on the module, the incoming data passes through a port isolation buffer. (See Figure 4.2)
4. From the buffers, the data pass across an isolation barrier to the module's microprocessor. The microprocessor checks that the message is valid (checksum and length).
5. If the message is OK, the microprocessor sends the message to the VME controller, which passes it on to the CPU module for processing.

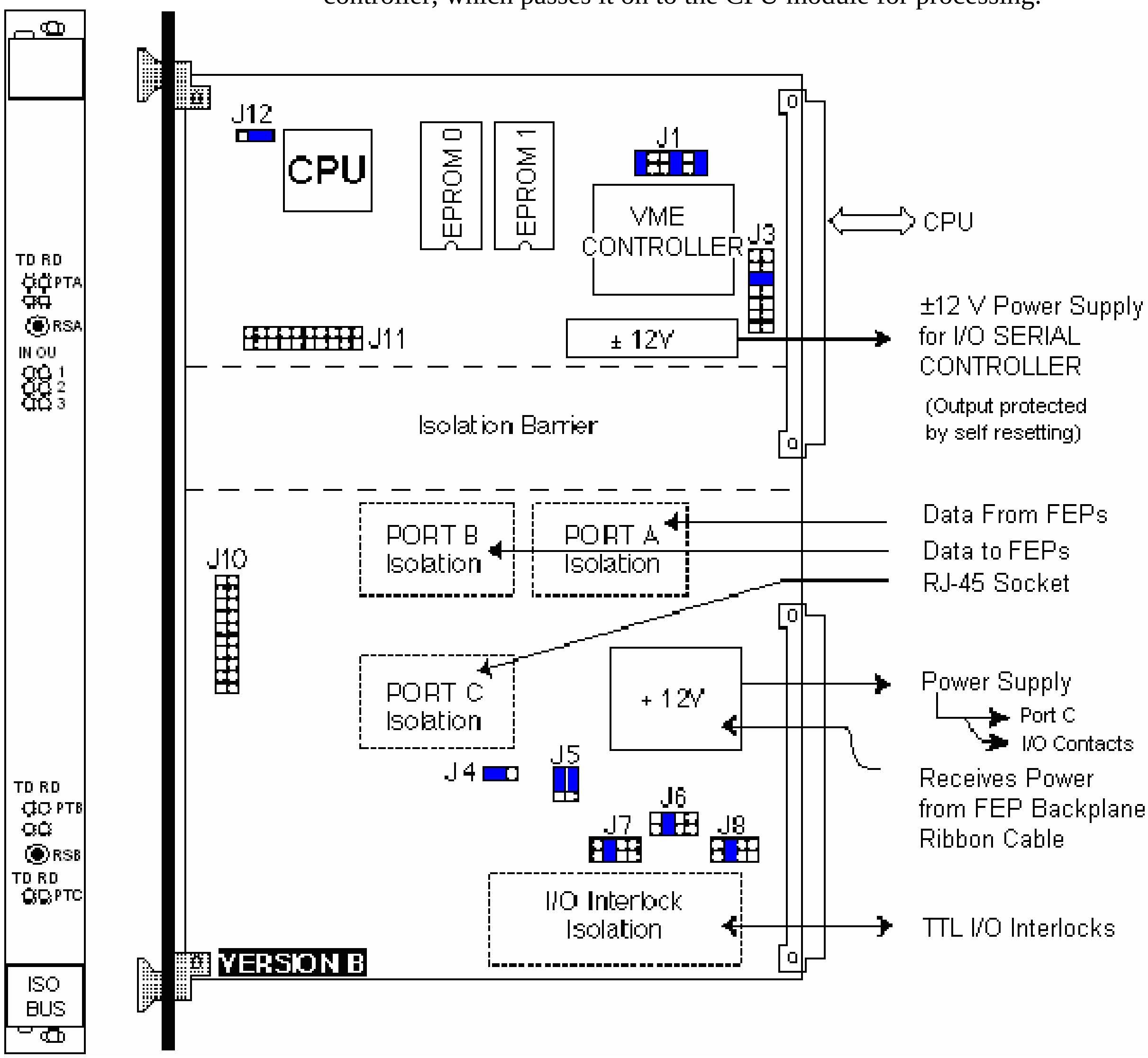


Figure 4.2. ISOBus Printer Circuit Board Layout.

Component Descriptions

Components

Each ISOBus card contains three serial ports, three TTL level outputs, and three TTL level inputs.

Two of the serial ports are configured as isolated RS-485 ports, providing independent communication to one or two racks of FEPs (depending on the number of channels incorporated in the system and the revision level of the FEPs used in the system). The third isolated port can be configured as either RS-232 or RS-485. Through this serial port, various devices can transfer data to and from the SiteMaster.

The three isolated TTL-compatible outputs can be used to trigger external devices, such as tag reader transmitter, modem, third party detectors, etc. The three isolated TTL-compatible inputs can be used when external devices are needed to inform the SiteMaster of an event.

The ISOBus card also supplies ±12V to the VME backplane. This power is needed by the CPU for RS-232 communication between the local port and the local terminal. The hardware watchdog timer, referred to as the plate-spinner, is also located in the ISOBus. The plate-spinner resets the system automatically whenever the SiteMaster's software fails to run properly.

The heart of the ISOBus is the MC68302 integrated multi-protocol processor, a microcomputer designed to be a communications controller. This chip is designed to handle many standard interfaces including HDLC/SDLC, UART, BISYNC, DDCMP, V.110, and transparent mode. The MC68302 has three independent SYNC/ASYNC serial communications lines and several pins that can be configured for parallel interface.

The block diagram in Figure 4.3 shows the basic setup of the MC68302 microcomputer. The core of the chip is the MC68000 processor, which gives access to and control of the other units and building blocks in the chip.

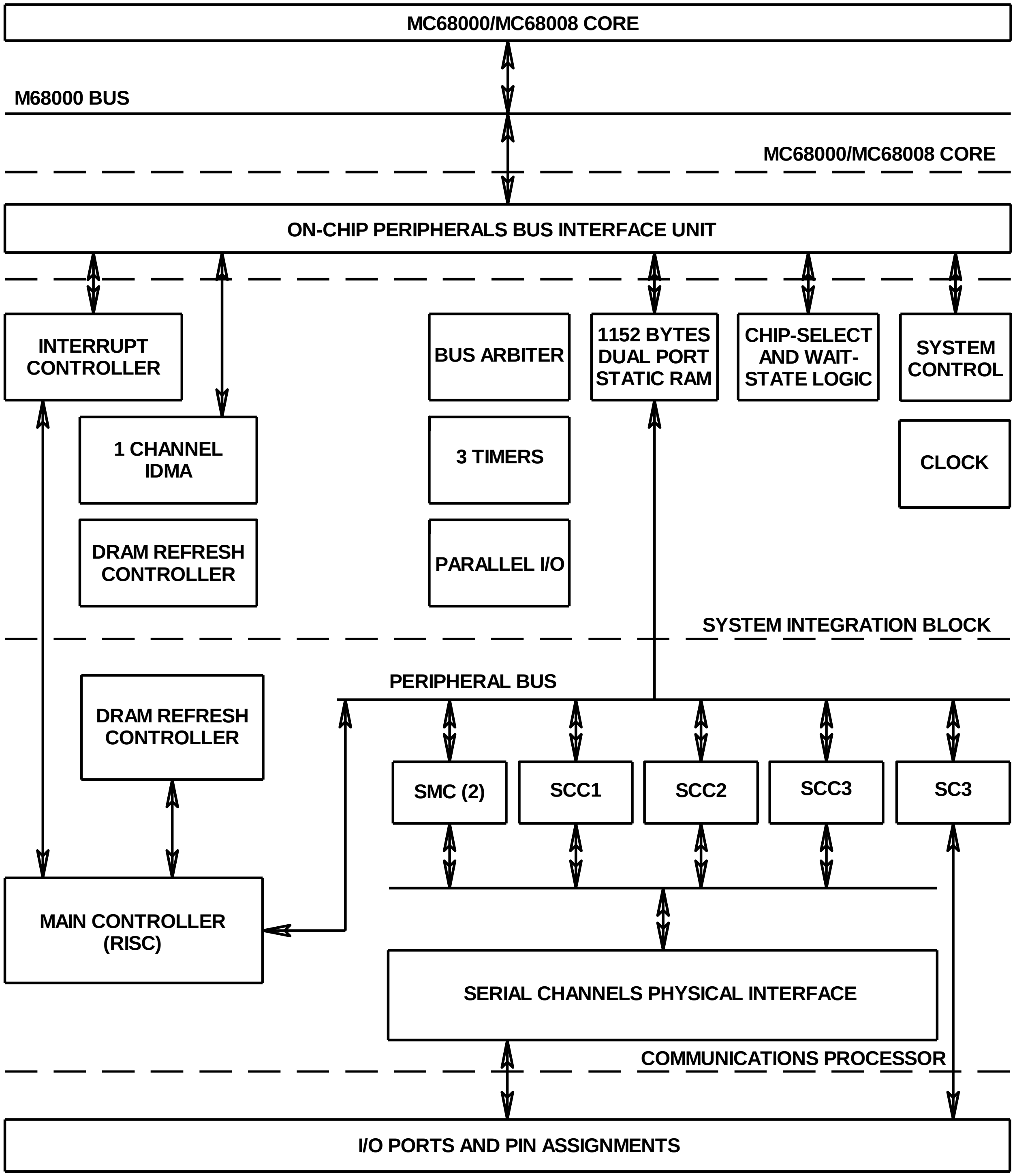


Figure 4.3. MC68302 Microprocessor

In addition to the MC68000 core, there is a Reduced Instruction Set Computer (RISC) processor located within the MC68302. The RISC processor sets the attributes and controls the operation of the following:

- Serial controller units
- DMA channel controllers
- Dynamic RAM refresh controller
- Interrupt controller

The on-chip peripheral bus interface unit is needed to control access to the bus as well as to select what processor will have complete access to the bus at any given moment. (There is more than one processor on MC68302 that can take over control of the bus.)

ISOBus RAM

Dual-ported RAM (Random Access Memory) provides quick communication between the MC68000 and the RISC processor. The use of a unique arbitration scheme and synchronous transfers between the microprocessor and dual-port RAM gives the appearance of zero wait-state operation to the MC68000 microprocessor core. The dual-port RAM can be accessed by the RISC processor once every clock cycle for either READ or WRITE operations.

The other support ICs interface the MC68302 to the VMEBus and provide electrical isolation between the ISO backplane and the VME backplane. The large chip located directly below the P1 (top) VME connector converts +5V input from the VME bus to ±12V for the VME bus. The group of components located in the top left hand corner of the card make up the hardware watchdog timer.

ISO-Interface Backplane

The following diagrams of the ISO-Interface backplane on Mk III system show the interconnections between the ISOBus backplane and the system components.

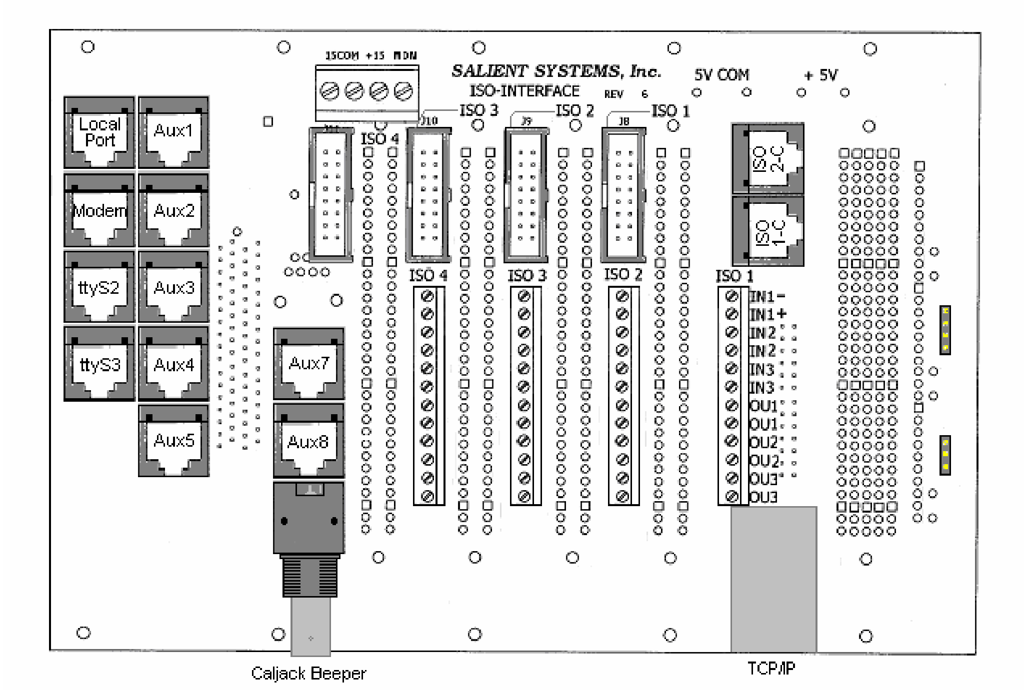


Figure 4.5. An ISO Backplane on a MK III System.

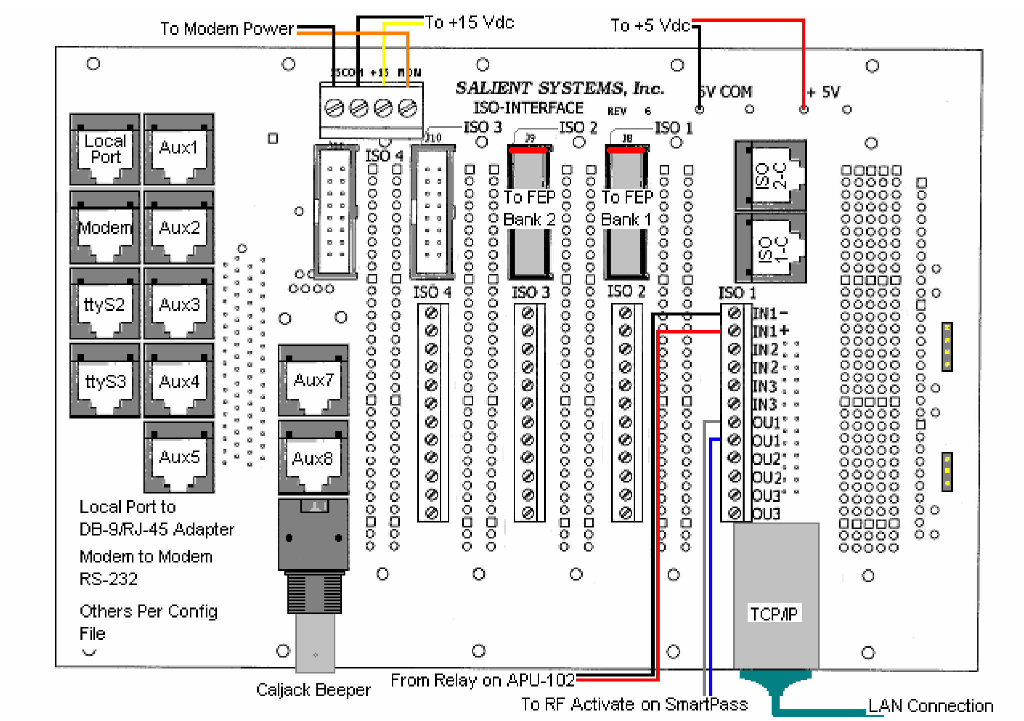


Figure 4.5.B. ISO Backplane wired on a 1-Track MK III System.

Serial Port Descriptions

The ISOBus card uses three isolated serial ports for gathering data from sources external to the Site Master. Front panel LEDs show activity through the ports.

Ports A and B

The system communicates with the FEPs through ports A and B (configured as RS-485). When viewed from the ISO-Interface backplane, the FEP data flows to the ISOBus module through two ribbon cables that connect at the upper center of the backplane.

- Port B serves as the download port from the ISOBus to the FEPs.
- Port A serves as the upload message port from the FEPs to the ISOBus.
- Systems with more than 32 channels (16 FEPs) use multiple ISOBuses.

Port C

The system can use port C to communicate with external devices such as tag readers, video imaging systems, and other external data collection devices (if equipped). Port C connects to the RJ-45 connector located in the upper right of the ISO Backplane labeled ISO 1-C or 2-C respectively.

- Port C normally does not provide service.

I/O Contact Descriptions

In addition to the three serial ports, the ISOBus has three electrically isolated relay outputs and three isolated contact closure (or TTL level) inputs. Typical installations use them to enable an AEI Tag Reader. These contacts are accessible through the ISO-Interface backplane.

For typical installations, the contacts of the first ISOBus connect to:

- IN3+ not used
- IN2+ not used
- IN1+ SAIC Tag Reader timing pulse from APU-102 (if equipped)
- OU3± Reserved for modem power and caljack beeper activation.
- OU2+ not used
- OU1± Contact closure to AEI Tag Reader enable circuit (if equipped)

Outputs

The OU1 to OU3 outputs can be jumper pin programmed to provide a variety of outputs (contact closure, 2K ohm resistor +5 VDC pull up, +5 VDC direct drive), allowing the system a great degree of flexibility though various expansions and integrations. For example, they can be used to trigger the tag reader transmitters, video cameras, and/or transmit a signal to the operator whenever a train is on site. The first ISOBus has its OU1 and OU3 contacts reserved. Remaining ISOBus units only have OU1 reserved to close at train presence.

Inputs

The IN1 to IN3 inputs can be used when other sensing devices are integrated to the system, such as a dragging equipment detector or system main power failure. Various remote control lines can be hooked up to the system via these lines. The first ISOBus unit of each track reserves IN1 to sense train presence closure from a non-real time tag reader data system.

I/O Enabling

For the third serial port and the three TTL outputs to be operational, the primary serial port (port A) **must be connected** to an ISO backplane that has active power supplies connected to it.

Power from the first ISO Backplane passes through an isolated DC to DC converter before being sent to supply the third serial port and the three TTL lines.

Front Panel Description

The ISOBus module front panel LEDs and switch functions include (from the top):

Port A Status

The top most group (PTA group, under the column headings TD and RD) displays the state of the communication line from the FEPs (port A).

- **TD / RD PTA LEDs**: "Transmit" and "Receive" to/from Port A. The TD LED lights when data is transmitted from FEPs to their assigned ISOBus.
- **Normal LED:** Is continuously ON (Green) when the module is operating. It will go OFF when the module is reset.
- **Reset LED**: Flashes Red when the module has been reset.
- **RSA switch**: Port A hard reset button.

I/O Status

The second set of LEDs (labeled IN1, IN2, IN3, OU1, OU2, and OU3) displays the state of the three isolated input sense and output control lines.

- **IN 1, 2, 3 LEDs**: ON when energized from external source = contact closed.
- **OU 1, 2, 3 LEDs**: ON when energized from internal source = output contact closed.

Port B Status

The ISOBus uses Port B to send commands and data to the FEPs.

- **TD / RD PTB LEDs**: "Transmit" and "Receive" to/from Port B. Both of these LEDs are continuously active once the CPU has booted since the ISOBus is constantly controlling communication permission and issuing software requests.
- **RSB** switch: Port B hard reset button

Port C Status

The ISOBus does not normally use Port C.

- **TD / RD PTC LEDs**: "Transmit" and "Receive" to/from Port C. These will flash when the module is acquiring data from port C.

Power Supplies

The ISOBus module contains two internal power supplies that supply power for both on-board and off-board components.

Bottom Power Supply

Located on the bottom half of the module is a +12 VDC supply for the system's Port C and I/O contacts. This helps the module maintain electrical isolation from the input circuits. This supply is located below the port A isolation circuitry.

- The supply receives its power from the top ISO Backplane through the ribbon cable.
- The chip contains internal self-protection circuitry to guard against overload conditions.

Top Power Supply

Located on the top half of the module is a ±12 VDC supply to the system's I/O Serial Controller modules.

- The chip is protected by self-resetting fuses.

Testing and Troubleshooting

Fault Indications

Problems with the ISOBus module generally fall into one of two categories:

- **No data collected from the FEPs:** Port A TD/RD LEDs do not flicker as a wheel moves through the site. Lack of response of the ISOBus can be caused by either a defective component or an improperly installed configuration jumper.

  RESPONSE:

  – Check the jumper settings and adjust as needed.

  – Check that the FEP ribbon cables are correctly installed at the ISOBus backplane. Although the connectors are keyed, they may be inserted incorrectly if the keys are damaged.

- **Auxiliary equipment not enabled:** I/O interlock problems.

  RESPONSE:

  – Check the connections between the auxiliary equipment and the I/O interlocks.

  – Check the output of the +12 VDC power supply (bottom). This chip supplies power to the I/O circuit relays and contacts. A defective supply disables the circuit drivers and prevents energizing and reading of the circuits. **NOTE:** When performing this check, be sure that the top ISO Backplane has power and the ribbon cable is connected to it.

EPROM Changeouts

On those occasions when SALIENT SYSTEMS sends an updated ISOBUS program to the user, the following steps should be taken to ensure a successful EPROM changeout. Refer to Figure 4.2 for the ISOBus EPROM layout.

1. Turn the system power OFF.
2. Be careful to remove any charge from yourself by touching a ground plate **before** touching any electrostatic sensitive parts.
3. Loosen the retaining screws and remove the ISOBUS card from the system.
4. The program chips are the two large IC chips located at the top of the card (U3 and U2). Take note of the orientation of the chips and the position of the notch on the chip.
5. Remove the EPROMs (chips labeled U3 and U2) with a chip remover. If none is available, a small flat head screwdriver is acceptable. Insert the screwdriver between the IC and its socket, and gently pry the chip out. **BE CAREFUL; there is another chip under the EPROM**! Put the chip set in a safe place.

6. Obtain the new chip set and note the labels on each chip. Select the chip labeled "0" and insert it into the first socket (U3). Make sure all the pins on the chip are properly aligned and that the notch on the chip points in the same direction as the one that was removed earlier. It should also match the outline printed on the board.

   Caution: If the ISOBus card is powered up with an incorrectly inserted IC, the chip will be destroyed.
7. Repeat Step 6 for the "1" chip (U2).
8. Recheck the chips. Make sure that all the pins are properly inserted into the socket holes and that each chip is correctly oriented.
9. Return the ISOBUS card to the rack and retighten the retaining screws.
10. Turn the system power ON. If the EPROM changeout was performed successfully, the green and red reset LEDs will sequence and then only the green normal operation LED will remain ON.

Jumper Configuration

This section describes the function of each jumper and its default setting. Refer to Figure 4.2.

NOTE: Normally, the jumper blocks are set properly before the unit is shipped from SALIENT. However, occasion may arise requiring a change in the settings of the unit. The jumpers can be set following the steps presented in this section.

Jumper JP12. The JP12 jumper, located on the top left corner of the card, is the hardware watchdog ENABLE/DISABLE. If the jumper block is over the right two pins (pins 2 and 3), the system can be RESET whenever an error condition occurs. In the left position, over pins 1 and 2, the watchdog is disabled. The default setting is ENABLED, or the jumper connecting pins 2 and 3.

Jumper JP1 JP1, the horizontal six pairs of jumper pins located just above the large programmable controller chip, selects the ISOBUS card's address, interrupt level, and access restriction. The default settings from left to right are as follow:

- One vertical jumper in (for a primary ISOBUS, removed for a secondary);
- Two middle pairs of empty jumpers;
- One vertical jumper in;
- One empty jumper; and,
- the final vertical jumper in.

Jumper JP3. The JP3 jumper, which selects the connection level for the board interrupt to the VME bus, consists of the seven vertical pairs of pins running along the lower end of the upper VME connector. The connection level is set by SALIENT to level 5. The jumper setting from top to bottom should be as follows:

- Two empty jumpers;
- One horizontal jumper in; and,

- Four empty jumpers.

Jumper JP4. The JP4 jumper, in the lower half of the board, in conjunction with jumper JP5, selects between RS-232 and RS-485 operation for port C. If the jumper block is over the right two pins (pins 2 and 3), port C is set for RS-485, operation. In the left position, over pins 1 and 2, port C is set for RS-232 operation. Jumpers JP4 and JP5 must be set in coordination for RS-232 or RS-485 operation of port C.

Jumper JP5. The JP5 jumper set, to the right of JP4, in conjunction with jumper JP4, selects between RS-232 and RS-485 operation for port C. If the jumper blocks are set vertically over the lower two pin sets (pins 3,5 and 4,6), port C is set for RS-485 operation. If set vertically over the upper two pin sets (pins 1,3 and 2,4), port C is set for RS-232 operation. Jumpers JP4 and JP5 must be set in coordination for RS-232 or RS-485 operation of port C.

Jumpers JP6, 7, 8. The JP6, 7, and 8 jumper block sets control the type of output produced by the OU1, 2, and 3 outputs respectively. These can be set for dry contact closure, 2 Kohm +5VDC pull up, and direct +5VDC drive. SALIENT personnel set these jumpers and the customer should not modify them, as damage to the ISOBus or connected equipment may occur.

Jumpers JP10, 11. The JP10 and 11 jumper block sets allow access to CPU control signals in a test environment. Do not apply jumpers to these blocks to avoid damage to the ISOBus CPU.

CHAPTER 5 — CPU

Overview

The CPU (Central Processing Unit) of the MK III WILD system gathers and processes wheel data as it enters from the various cribs of the system. It groups the wheel data into expected car groupings (if possible) and then, if available, it matches the data to the car's ID number from the AEI (Automated Equipment Identification) tag reader.

Once the train has passed, the CPU also compiles the data into reports and sends them to designated locations.

System Configuration

The CPU of the WILD system employs a Pentium III microprocessor along with 128 Mbytes of RAM (Random Access Memory). It uses a 512 MByte flash disk to store the program and system setup data, overflow data during train processing, and archive data for multiple trains.

Figure 5.1 shows the CPU interaction with the rest of the WILD system. Figure 5.2 shows the CPU plug-in.

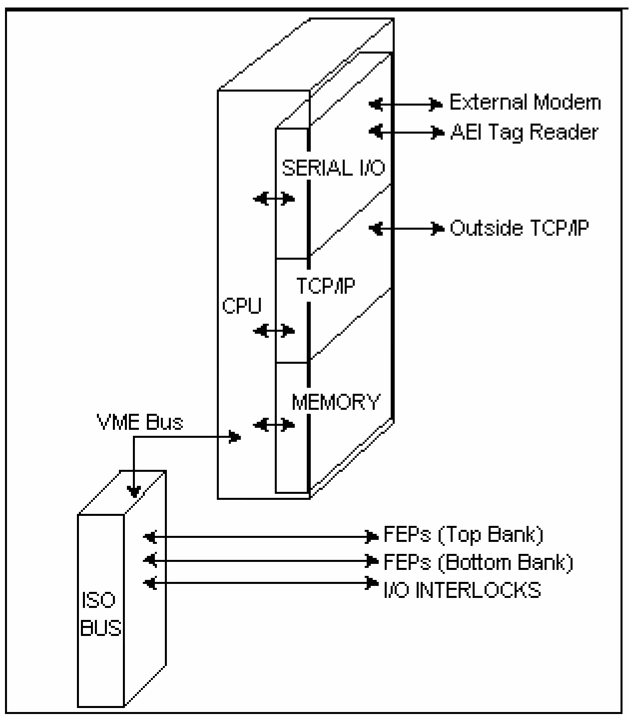


Figure 5.1. System Configuration

CPU Description

CPU Features

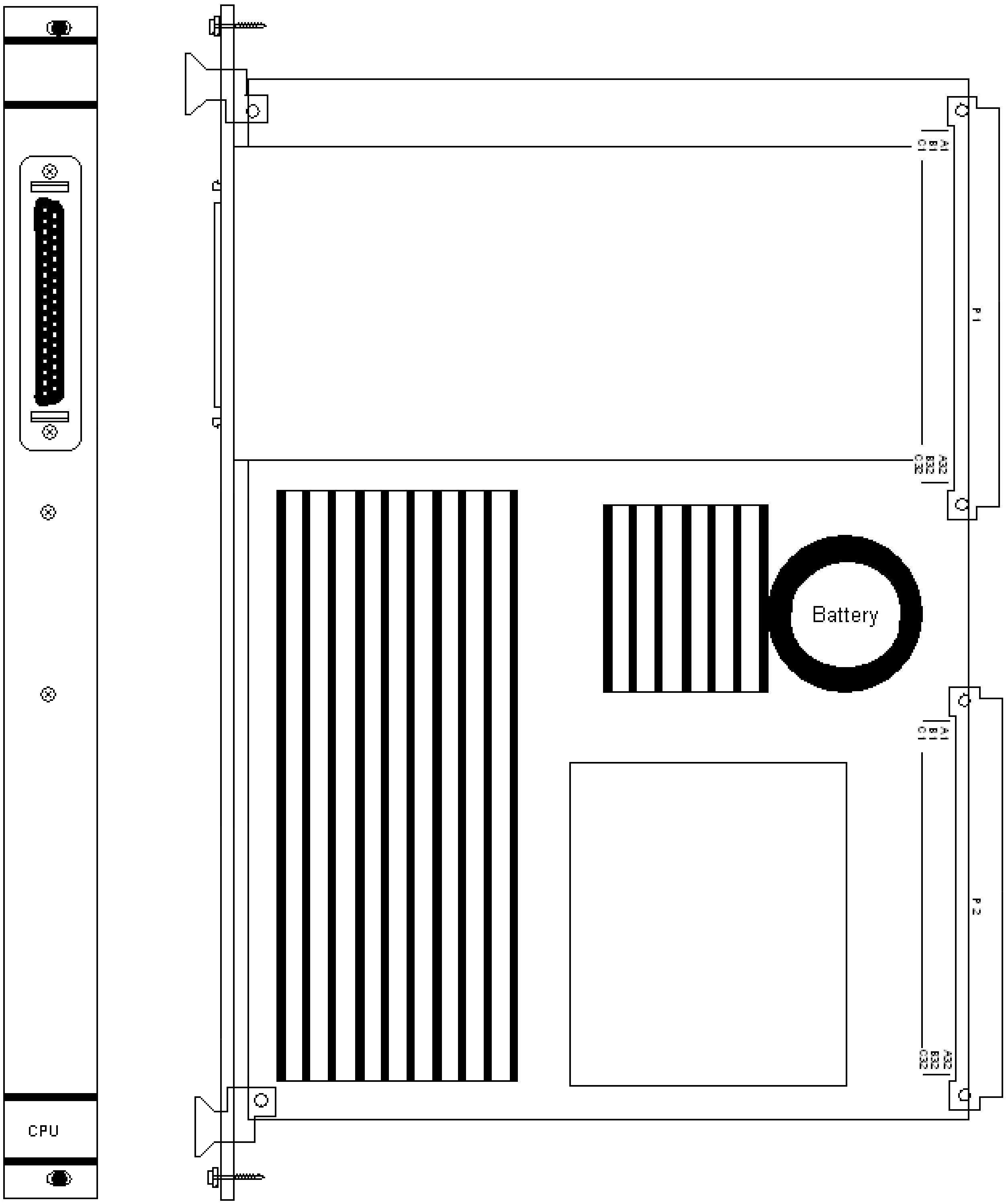


Figure 5.2. Pentium III CPU.

The CPU module has the following features:

- 500 MHz Pentium III microprocessor
- 128 MB of RAM (Random Access Memory)
- Built-In 512 MB Flash Card
- Twelve RS-232 serial ports (1 is unavailable)
- Uses Ethernet RJ-45 port for internet connectivity
- VME bus interface

CPU Front Panel Description

The Pentium III CPU module front panel has a single SCSI style connector with RS-232 serial lines that connect to the ISO Backplane. The connector runs the seven auxillary serial ports on the ISO Backplane (See Chapter 4, ISOBus).

CPU Serial Controller

Each independent serial channel is capable of communication at rates ranging from 300 to 115,200 bits per second (bps). The RS-232 ports require carrier detect signaling and support XON/XOFF software flow control. Serial port 1 is reserved for connection to a local communication device, such as a laptop running a terminal emulation program. Serial port 2 is reserved for modem communications. Port 6 is unavailable on the ISO Backplane. Ports 3 through 12 (minus port 6) are available for connection to AEI readers, weather stations, or other devices that need to exchange data with the Mk III. Serial port connections route to the back of the Mk III, where they terminate in RJ-45 connectors and are available in numbered order at the ISO-Interface Backplane. Figure 5.3 shows the pinouts of the RJ-45 connectors.

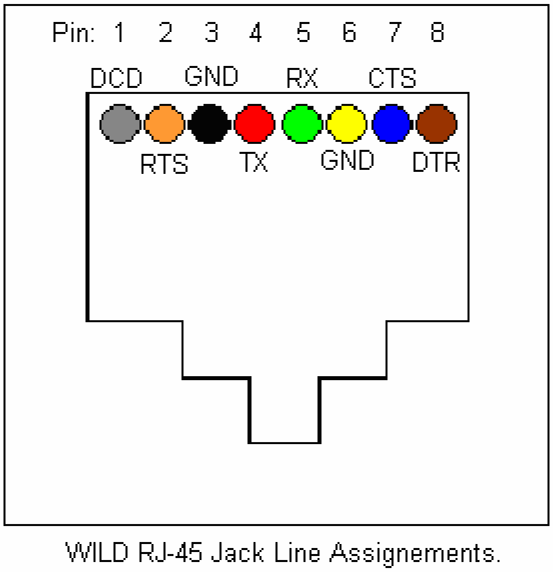


Figure 5.3. RJ-45 Pin Connections.

CPU Modem Communication

Modem communication is conducted via the industry standard Attention (AT) command set. This allows a variety of Hayes compatible modems to be connected to the system. Modems may be selected to deal with particular conditions at the installation site, ranging from normal telco (varying by country), leased line, cellular, or other special requirements, as needed. Salient Systems can accommodate specialized modem requirements and non AT command set communication devices by special arrangement.

CPU Battery Maintenance

The board contains a Rayovac BR2032 3 Volt battery for powering the SRAM. The battery is socketed for easy removal. Small capacitors in the circuit prevent data loss during battery replacement.

- Expected battery life is 4 to 10 years (depending on ambient temperature and power-on duty cycle).
- Do not store the board on any conductive surface. The battery power leads are exposed on the solder side of the board.

Hard Disk Description

The WILD system uses a flash disk to store the main WILD program and wheel data after it has been processed. The CPU accesses the data on the flash disk drive through a connection on its main panel. The Flash disks capacity is 512 Megabytes for an operational WILD system.

VME Backplane Description

The MK III WILD system uses an active VME backplane (Figure 5.4) to interconnect the Site Master modules. It is called an active backplane because of the discrete logic that allows the various modules in the system to be placed into different slots. The logic senses the board's presence and automatically routes the needed enabling signals to the slot.

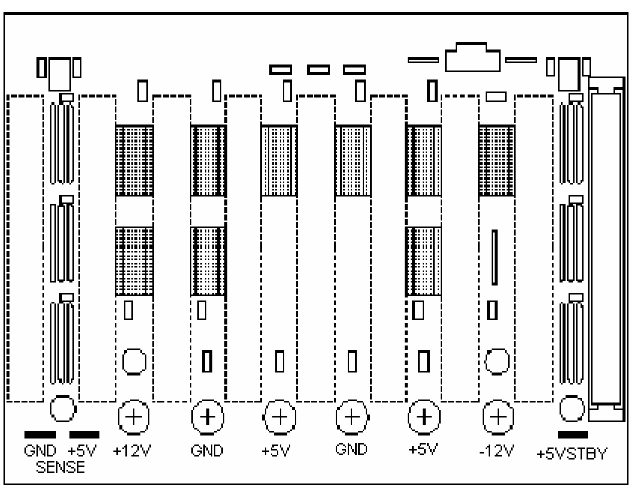


Figure 5.4. VME Backplane.

Testing and Troubleshooting

Fault Indications

If the CPU module is faulty, in most cases it will fail in either of two ways:

- **A major hardware or software failure** causes the system to crash. The CPU does not respond to any external prompts.

  RESPONSE:

  – Check the system power supply for sufficient output.

  – Power off the system. Replace the module. Attempt to power up the system with the new module.

- **A secondary hardware or software failure** causes the system to remain in a reset cycle until all secondary systems are up and running. After processing a train or every 40 minutes, the system initiates a self test cycle where it checks all FEPs and auxiliary elements. If one of these secondary systems does not respond properly, the CPU initiates a soft reset of the system to try to get it to respond. It keeps resetting itself until the secondary system responds as programmed.

  RESPONSE:

  – Check the system's status with a laptop plugged into the module's local port. The display shows which device is not responding.

  – If the secondary system module does not respond even after replacing it, the VME backplane may be malfunctioning. Check the jumper settings on the ISOBus cards and contact Salient Systems.

Module Replacement Procedure

Whenever you have to replace a module, the following procedure shows how to set it up.

1. Power down the system before removing any modules.
2. Install the CPU in the first (leftmost, as viewed from the front) VME bus slot in the system. Install the first ISOBus into slot #3. **NOTE**: The positions for the other boards in the system are not slot dependent.

   – The active VME backplane automatically configures the slot for the board inserted; however, this is not the case for the CPU module that is in control of the system.

CHAPTER 6 — WILD IP COMMUNICATIONS OVER ETHERNET

Overview

The Mk III WILD system uses IP communication for local and remote communication. IP communication can replace modem communication for remote support, work along side modem communication as a primary or backup link, or let the modem handle all remote links. IP communication has the following requirements:

1. Static IP address assignment. Contact your network administrator or data network provider to support this requirement.
2. Ethernet 10/100BaseT connection with auto-negotiation.
3. Allow Secure Shell (SSH) for remote login sessions. Secure Copy (SCP) supports software upgrades.
4. Allow File Transfer Protocol (FTP) to send train data.
5. Optionally, allow Telnet for simple remote maintenance checks.

Configuration

The system's network administrator has to reserve a static IP address for the Mk III system to use. Once the IP address is reserved for the WILD, Salient Systems provisions the system with the following information supplied by the network administrator:

1. IP address.
2. Subnet Mask.
3. Broadcast IP address.
4. Default Gateway.
5. System Host Name.

Once Salient Systems provisions these values in the system and reboots the Mk III, the IP communications become active and ready to use.

Physical Connection

The Ethernet port is an RJ-45 jack on the ISO Backplane located in the lower right hand corner of the WILD backplane. It is in a silver colored metal case next to two USB connectors and facing downwards. Do not plug an Ethernet cable into the black RJ-45 recepticals for serial ports. Damage can occur to the WILD by connecting serial lines to the Ethernet port or Ethernet lines to the serial ports. See Figure 6.1 for the location of the Ethernet port.

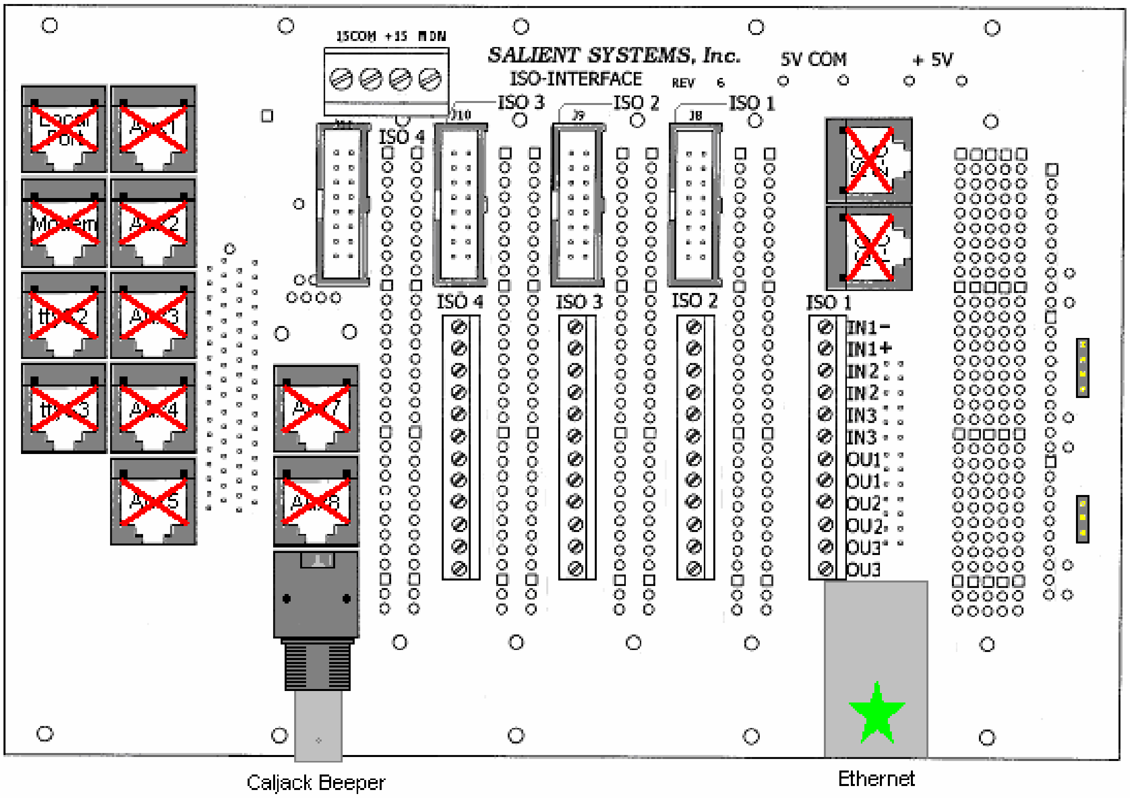


Figure 6.1. Location of the Ethernet port. Only connect an Ethernet cable to the port marked with a green star. DO NOT use ports marked with a red "X" for Ethernet.

Testing and Troubleshooting

Fault Indications

Problems with the Ethernet connection will generally fall into one of three categories:

- **Communication problems with external devices due to problems with the external devices themselves or with the connections to them.**

  RESPONSE:

  – Check that the Ethernet cables are securely connected to the ISO Backplane and the device providing the Ethernet service.

  – Check that the external devices are turned ON and operating properly.

- **Communication problems with external devices due to configuration problems.** This most commonly happens when either the WILD CPU or the network equipment has been changed out.

  RESPONSE:

  – If necessary, contact Salient Systems to change the IP configuration of the WILD system.

  – Ensure network equipment has correct configuration information.

- **Communication problem with the CPU.** This indicates a hardware failure on the CPU or ISO Backplane.

  RESPONSE:

  – Contact Salient Systems to swap out the working CPU with the spare CPU. Do not plug or unplug a CPU card with the power on for the WILD system.

CHAPTER 7 — MODEM

Salient Modem

Overview

The Mk III WILD system supports the use of an external modem for remote access and sending train files. Modems must have the following specifications:

- RS-232 Connection (8 pin RJ-45, 9 pin DB-9, or 25 pin DB-25)
- Hayes compatible using the Attention (AT) command set in verbose mode.
- Carrier Detect signal support (DTR and DCD).
- Software flow control (Xon/Xoff).
- 2400 to 115200 baud automatic sensing.
- V.90 compatible.

The WILD system uses Zmodem transfer to send train data files. Any external modem running from a WILD serial port must allow Zmodem transfers from the WILD to the server receiving the train files.

Contact Salient Systems if a site will use a modem other than the Salient provided modem. Salient reviews the technical specifications and command requirements of modems for compatibility before installation to avoid service disruption. Salient will also provide the correct serial adapter to connect the RS-232 port to the modem port on the ISO Backplane.

Salient employs a MultiTech Systems external modem to provide phone communication with a WILD system. It connects to the phone service present at the WILD site using an RJ-11 jack.

Specifically, the modem is a Multitech Systems, Multimodem, model MT5600ZDX. It is a Hayes compatible 56K Data/Fax modem that conforms to V.90. SiteMaster's AT command programming fully supports this type of modem. SiteMaster allows for user specified modem command programming.

The modem can implement auto-dialing and auto-answering functions in both TONE and PULSE modes on a standard plain old telephone system (POTS) line.

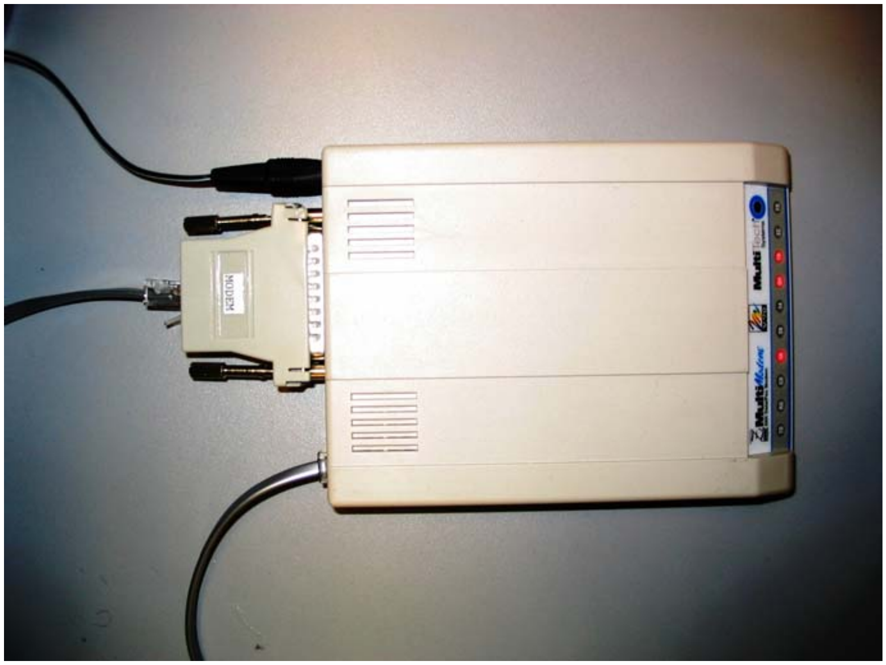


Figure 7.1. Salient Modem

Modem Configuration

SiteMaster configures the Multitech modem for normal factory default operation and then automatically changes the operation to use Xon/Xoff, software flow control. SiteMaster normally connects to the RS-232 port on the modem at 19200 baud. It is possible to reduce the baud rate for noisy phone lines using one of the 3 ASCII lines SiteMaster can send to the modem before transmission. Figure 7.2 shows a modem in an idle powered state. Figure 7.3 shows a modem off-hook without data passing. Figure 7.4 shows a modem actively passing data.

Figure 7.2. Modem idle with Transmit Ready (TR) and 56K (56) lit.

Figure 7.3. Modem off-hook without data passing. 56, TR, and Off-Hook (OH) lit.

Figure 7.4. Modem actively transmitting. Carrier Detect (CD), 56, OH, and CR lit. Transmit Detect (TD), Receive Detect (RD), and Error Correction (EC) blinking.

The modem has 4 connections in the back illustrated by Figure 7.5

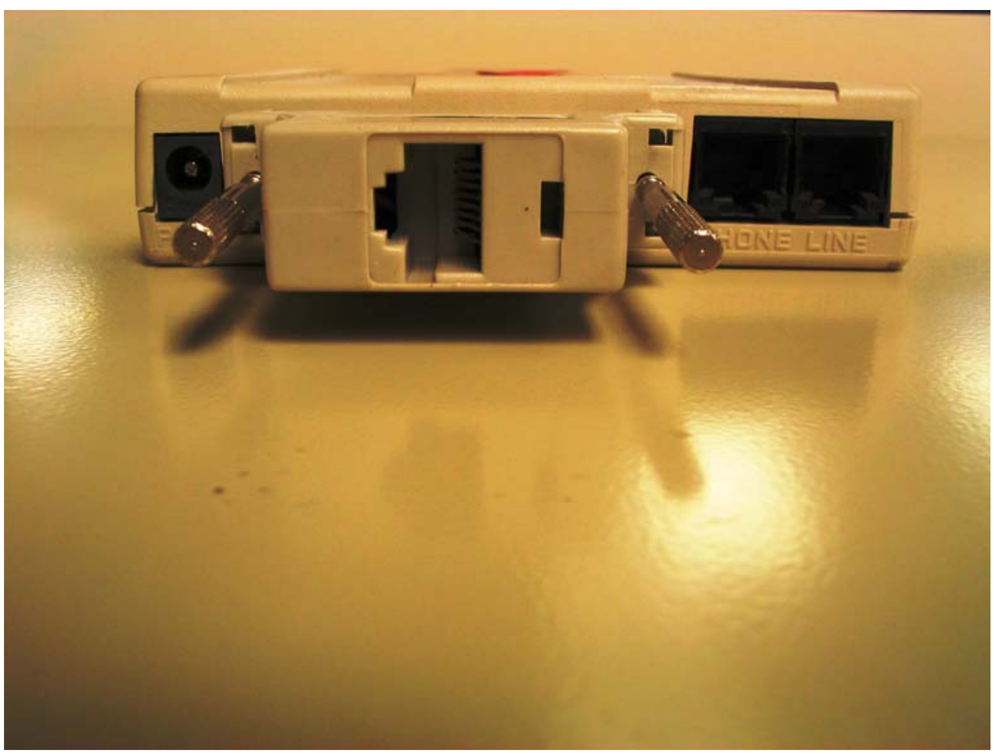


Figure 7.5. Modem Connections. Left to right: Power, Serial RJ-45, Phone Set, POTS Line.

Testing and Troubleshooting

Fault Indications

As with most modems, typical problems generally fall into one of two categories:

- Improper system configuration — this is the most common problem when one of the active components has changed.

  RESPONSE:

  – Check that the phone line is still active.

  – Check the CPU/modem connections (on external modems). Check the cable type and connections.

  – Check the system/modem configurations. Use the "ph" command to ensure the callout locations are enabled and dialing the correct number. Use the "re" command to ensure the correct reports run on the modem callouts.

- Hardware problems in the modem — generally the first indication is a lack of response in the front panel LEDs.

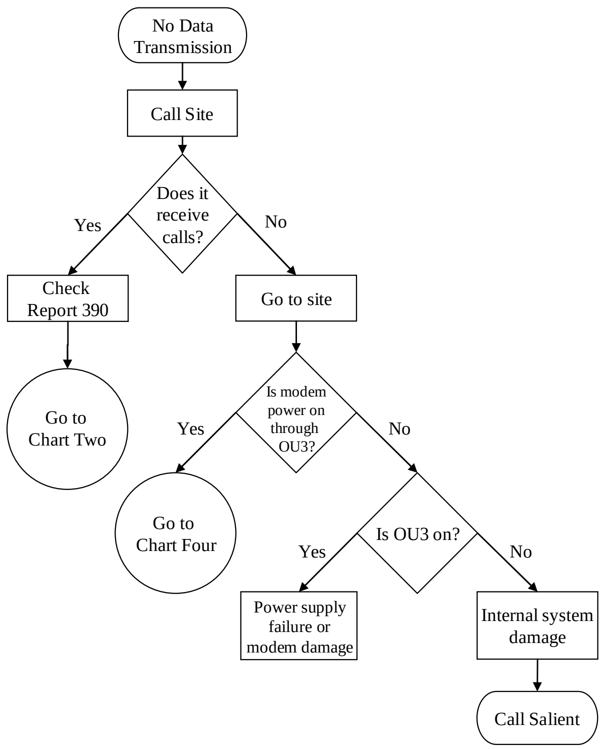
  RESPONSE:

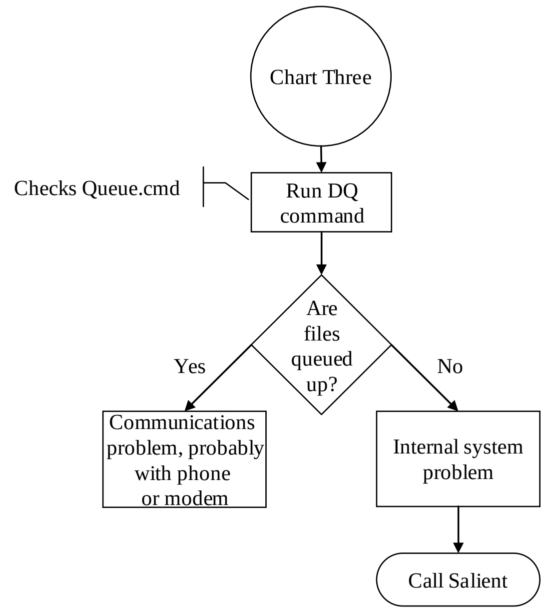
  – Check that the modem is powered up and connected properly.

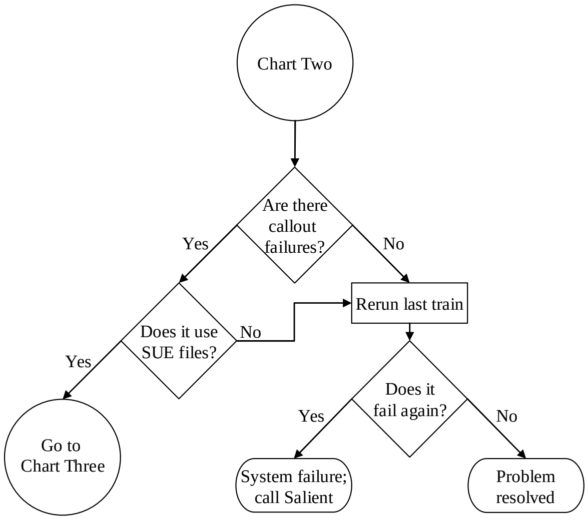
  – Check any modem configuration switches for proper settings.

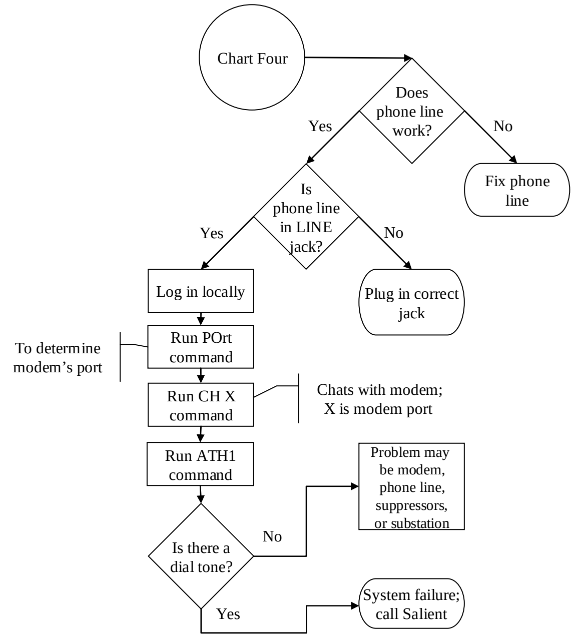
The following diagram shows a standard procedure to troubleshoot modem communication problems.

Troubleshooting Procedure Flowchart









Proper Connections

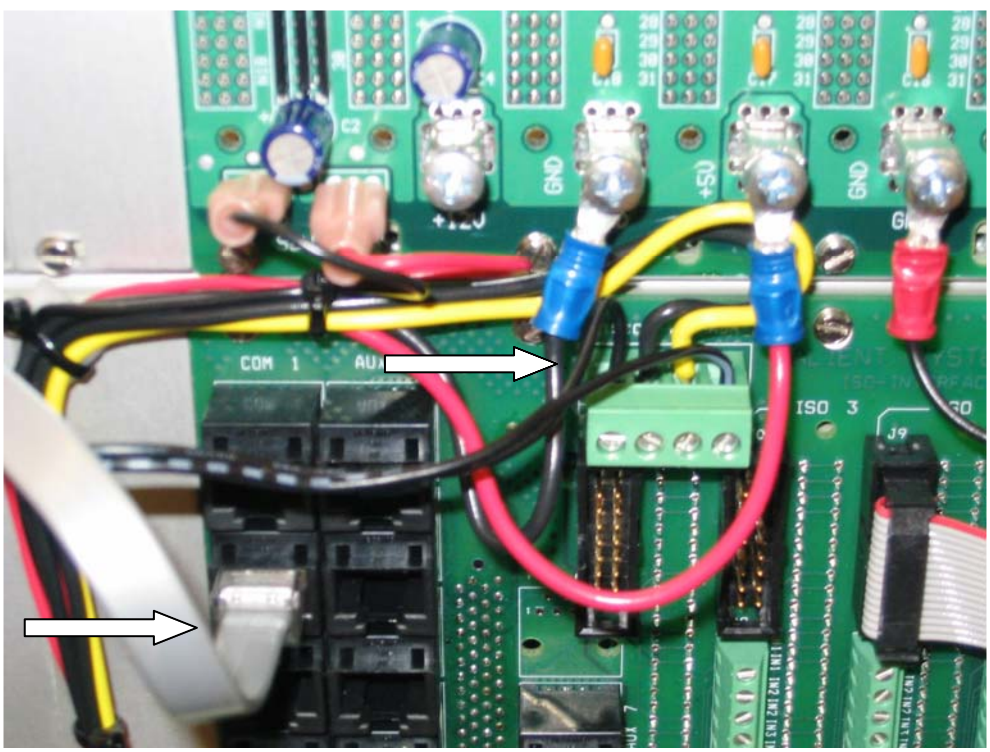
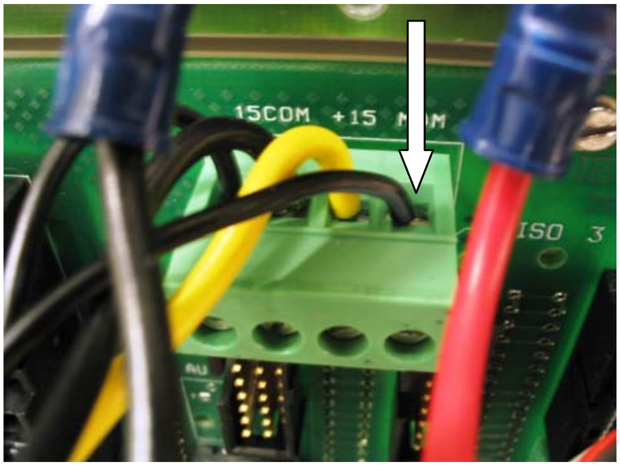


Figure 7.6 (above). The arrows display the locations for the proper connections for the external Multitech modem (Serial on left, power on right). The photos below show power connection details.



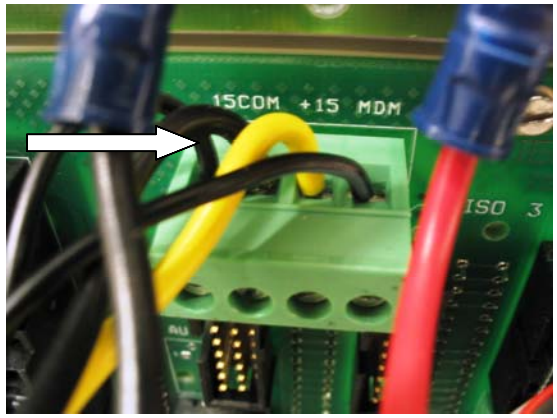


Figure 7.7 (above). The arrow shows the proper location for the ground (all black) lead from the modem. It should be plugged into the leftmost socket on the connector.

Figure 7.8 (left). The arrow points to the proper location for the +15 Volt lead (black with white stripe). It connects to the rightmost socketon the connector.

Report 390 Example

The WILD SiteMaster program has a report that tells how many callout attempts have passed and how many have failed. Typically, callout failures are a result of a busy phone line to the file server. If more than 50% of the callouts are failing, something more serious may be present, such as a faulty or failed phone line or a faulty or failing modem. The example below shows a healthy set of numbers for callouts. Use the “ph” command, described in the software command chapter, to determine which hardware port is responsible for the “location” listed in the 390 report.

```
Track ONE > se 390

Report 390

  --------------------------------------------
    CURRENT Statistics for Stuttgart, Track (ONE)
    PHONE CONNECTION

  system resets          0

           PORT      0      1      2      3      4    ALL
   modem cycles      0      0      0      0      0      0
 login attempts      0      1      0      0      0      1
       failures      0      0      0      0      0      0

Callouts:
   LOCATION attempts failures
       0        0        0
       1       68        0
       2        0        0
       3        0        0
       4        0        0
       5       68        0
       6      103       36
       7        0        0
       8        0        0
       9        0        0
```

"`se 390`" is the command entered to display Report 390. The crucial data are the figures in the "`failures`" column in the "`Callouts`" section. In this example, 36 failures occurred at location 6.

Run Train Example

Many times during troubleshooting, it is necessary to verify modem operation. Unless a train crosses the site after the system has power cycled or reset, the system will not have a train file loaded to callout. In this situation, you must rerun a train to get a file that is available for callout. This section describes how to load a train into volatile memory to callout reports for the train.

The first step to rerun the train is to ensure SiteMaster is not already processing a train. (This step is most valuable when working remotely, but probably is not necessary if actually in the bungalow.) Issue the "`st`" command as shown below.

```
Track ONE > st
 Archived Statistics Period: WEEKLY
 Weekly Statistics Reset Time = Sun 00:01
 Archived Statistics Reset is ENABLED
 Statistics were initialized Sat Oct 13 13:03:14 2001
 Number of trains through the site since midnight = 18
     Process     Status
   ----------   ---------------
       TRACK     Ready
       TRAIN     Absent
     ACQUIRE     Idle
    (ISOACQ)     Idle
    (TAGACQ)     Idle
     PROCESS     None
     STORAGE     None
     CALLOUT     None
```

In the case above, the track is ready and no train is present, so work can proceed. Change to the train file directory:

```
Track ONE > trainDIR
```

Identify the most recent rain fil,e using the "`ls`" command.

```
Track ONE > ls -lh

                     Directory of /h0/TRACK1/TRAIN 09:45:14
 Owner    Last modified  Attributes Sector Bytecount Name
-------   -------------  ---------- ------ --------- ----
  0.0     03/08/28 1925   ------wr   100A5     21660 Cart_0828_I1_005_4.lzh
  0.0     03/08/28 2249   ------wr   10143      5657 Cart_0828_I1_006_4.lzh
  0.0     03/08/28 2344   ------wr   10149     40522 Cart_0828_I1_007_4.lzh
  0.0     03/08/28 1034   ------wr   1006F     16361 Cart_0828_N1_019_4.lzh
   .
   .
   .
  0.0     03/09/02 0846   ------wr    70B1     37714 Cart_0902_S1_017_4.lzh
```

The desired train has the filename of `Cart_0902_S1_017_4.lzh`, but the file has been compressed, so it must first be uncompressed using the "`lha –x`" command. Type *`lha –x`* and then the `filename`.

```
Track ONE > lha -x Cart_0902_S1_017_4.lzh
Cart_0902_S1_017_4.stf  - Melted
Command successful!
```

Finally, use the "`rt`" command to reprocess the train. Type *`rt –r`* and then the `filename`.

```
Track ONE > rt -r Cart_0902_S1_017_4.stf
New R4 STF class
Reading input file...
Signalling start of train
```

The train reports are present in the volatile memory after reprocessing the train. Type *md –s 3* to have SiteMaster send the callouts for the train present in volatile memory. Exit the system by typing *exit* and SiteMaster will callout the train files according to the callout and report lists. You may view the lists using the "ph" and "re" commands.

DQ Example

The "`dq`" command allows the user to see the queue file, listing how many train files are waiting to be sent. Simply enter *`dq`*.

```
Track ONE > dq
PH[00]
PH[01]
PH[02]
PH[03]
PH[04]
PH[05]       Time Now [09-02 13:33] Mode[0] Queued[0]
PH[06]       Time Now [09-02 13:33] Mode[0] Queued[0]
PH[07]
PH[08]
PH[09]
```

In this case, there are zero trains queued on both connections 5 and 6.

LINE Jack Photo

The phone jack must plug into the socket labeled, "LINE," not the jack labeled, "PHONE." The phone jack is to allow access by another modem or phone to dial out on the line. The line jack is the only jack the modem is allowed to answer and take off the hook by itself.

Figure 7.9. Plug the phone jack into the "LINE" socket.

Port Example

To execute the port command, simply enter *po*

```
Track ONE > po <RETURN>

Ports used by USER#1:

device PORT  type   protocol   baud pause XON/XOFF | path throttle
------ ---- ------ --------- ------ ----- -------- + ---- --------
/term    0  LOCAL   LOCAL     9600    NO      YES |   3      0
/m0_n    1  X.25    SER:X25   9600    NO      YES |   4      0

Other Processes:

Process    Portname    Type    Speed
ISOACQ        /iso0    ----    -----
TAGACQ          /t2    TR1      9600   (All Antennas)
```

The modem usually is on port 1, and that is confirmed by observing the display from the port command. The x.25 under the type column is the name of a modem protocol, so port 1 connects the modem. "XMODEM" also indicates the presence of a modem on a port. In general, if "modem" is not listed under the device column, any modem protocol in the type column will show the modem's location. Modem protocols usually consist of a letter, a period, and a two-digit number.

CHAPTER 8 —TAG READERS

Overview

When equipped, Amtech SmartPass or SAIC Automatic Equipment Identification (AEI) Tag Readers read car ID numbers and send them to the WILD SiteMaster through the Serial Communication ports. Sitemaster compiles this information in the WILD reports for car identification when defects occur. Consult site configuration information to determine which tag reading system operates at a site. The Mk III system is 100% compatible with any tag reader system operating with a Mk II system.

SmartPass Components

TransCore manufactures the SmartPass Tag Reader used in WILD sites. Units read tags passing up to 160 miles per hour (mph). SmartPass uses the same ASCII code chat commands that the Amtech AEI system uses. The system includes the following components:

- 1620 SmartPass system with pole mount and external connector. The system includes the controller, RF modulator, and antenna in one physical package.
- SmartPass cable. The cable connects the box to data cable using simple screw terminals.

Figure 8.1 shows a SmartPass tag reader with cable.

Figure 8.1. SmartPass 1620 System.

SmartPass Configurations

Each SmartPass needs a serial port to the WILD to pass tag information and receive programming. SmartPass systems on track 1 need to connect to OU 1 of ISOBus 1. SmartPass systems on track 2 need to connect to OU 1 of the first ISOBus card (usually ISOBus 3) for track 2. The OU relays tell the SmartPass when to activate RF and read tags. The WILD system uses the strain gages to determine that a train is on site and activate the OU 1 for the track with a train. SmartPass systems each require 24 VDC from the customer supplied power or to connect a transformer to a 110 VAC power source. Each SmartPass draws 800 mA maximum. Use Table 8-3 at the end of this chapter to program a SmartPass tag reader. Figure 8.2 shows the connections for a two track, two tag reader per track system. Figure 8.3 shows the detail of how the transient and noise suppressors connect to the wiring between the tag readers and the WILD system. Figure 8.4 gives a visual reference for the actual suppressor board.

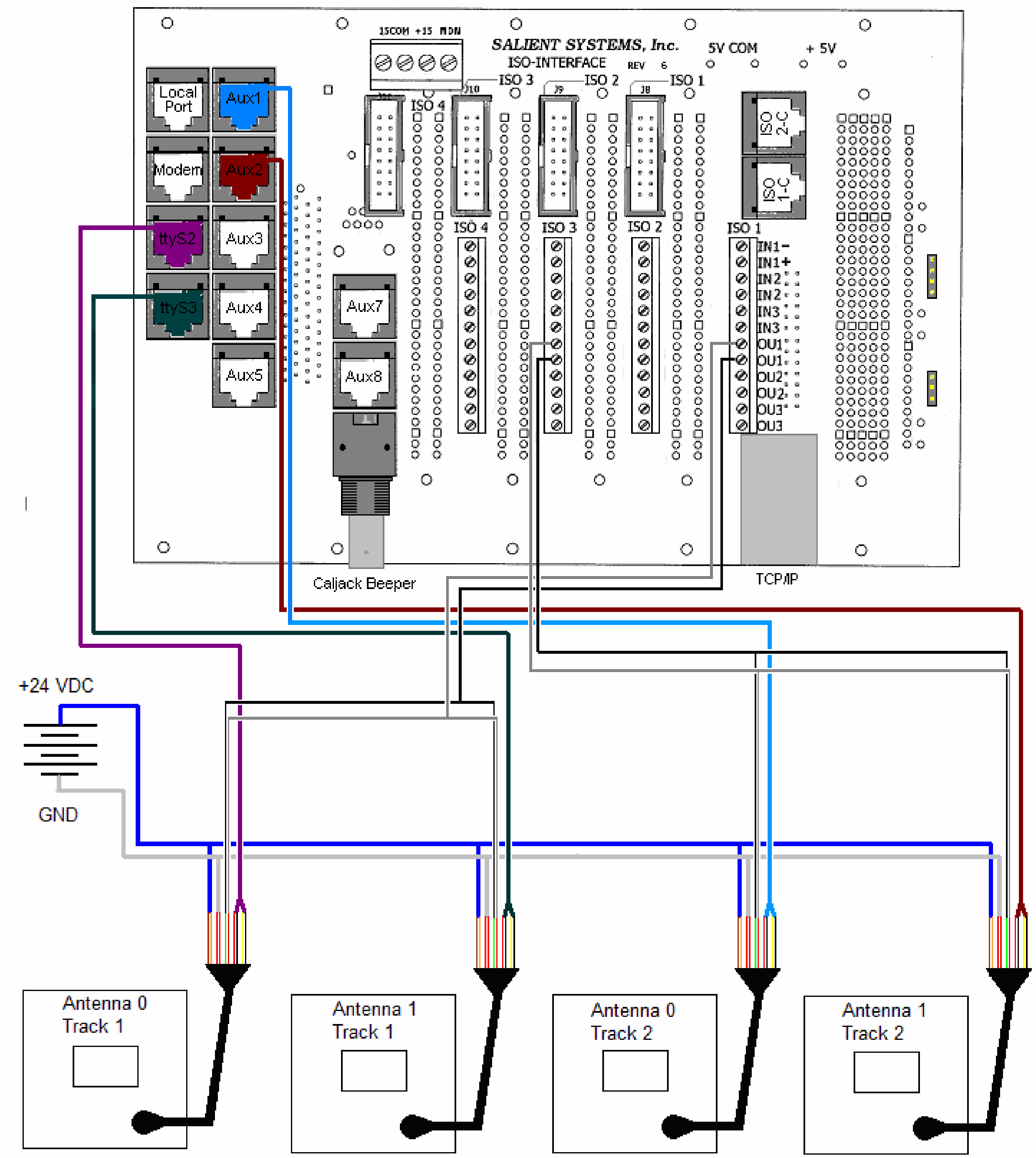


Figure 8.2. SmartPass Connections.

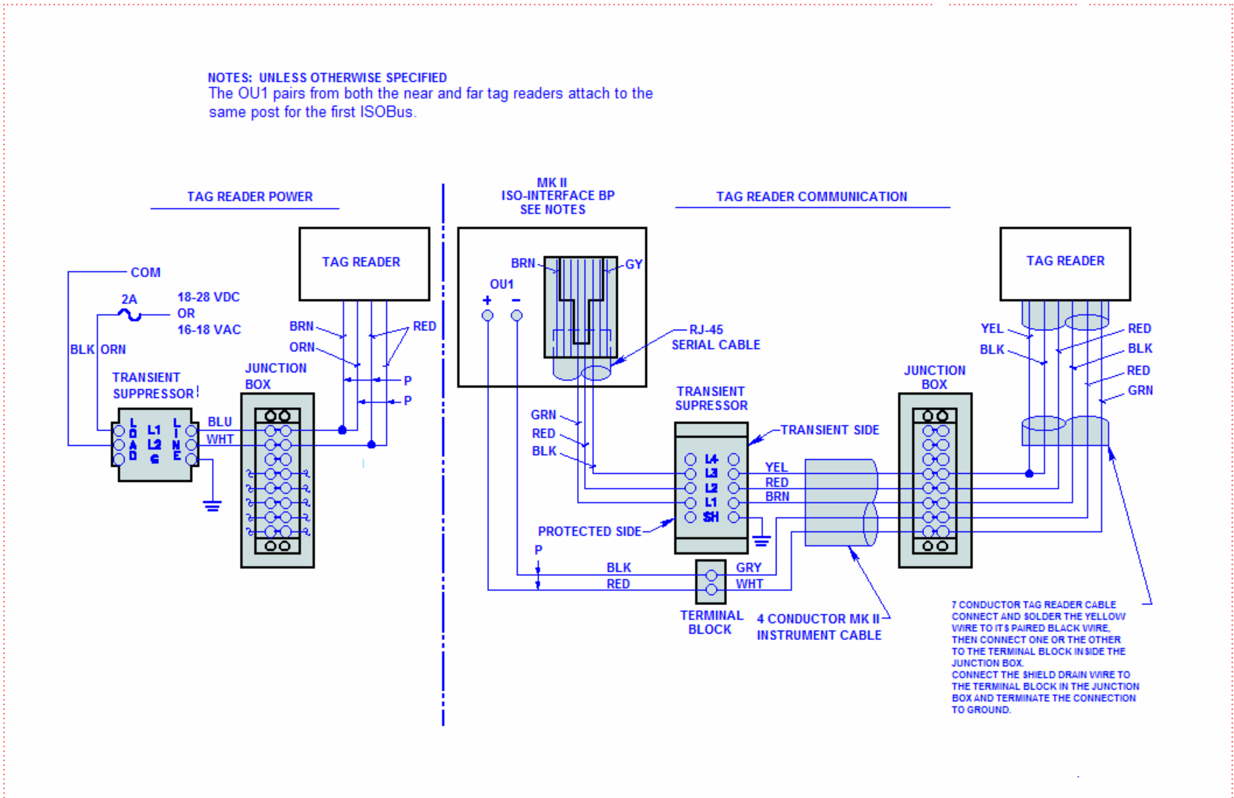


Figure 8.3. Suppressor Connections between Antenna and WILD System.

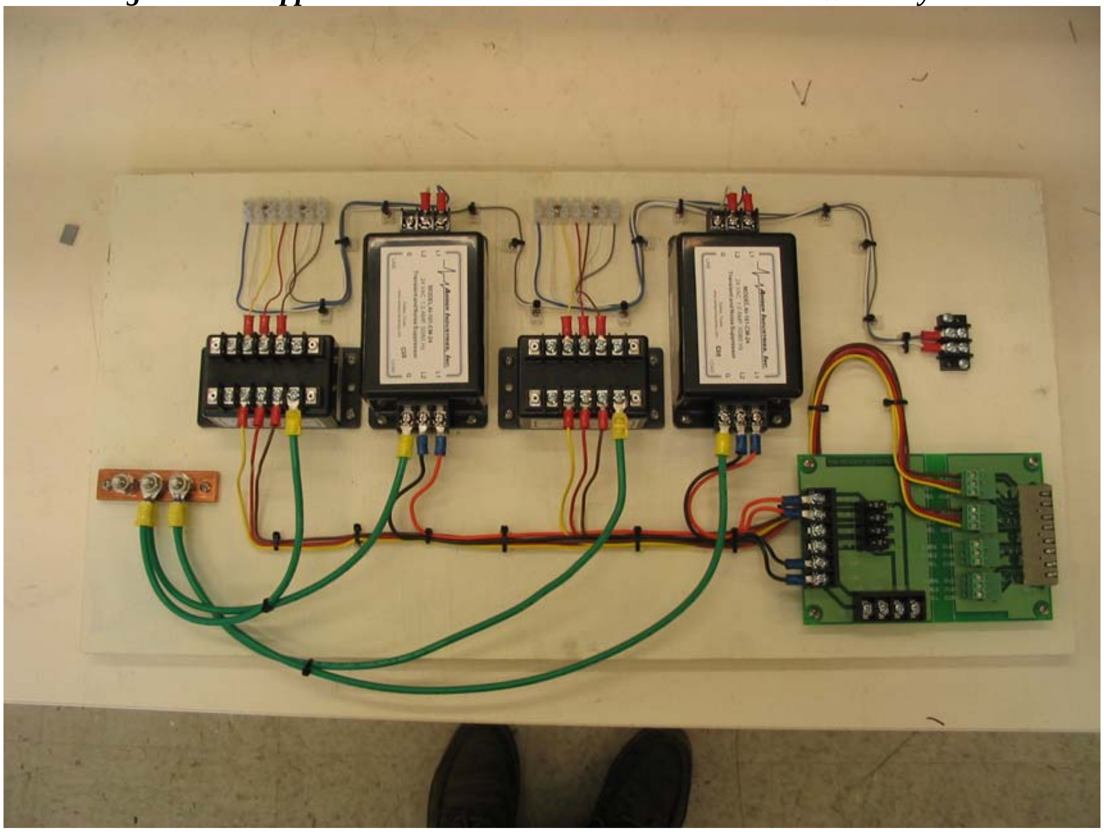


Figure 8.4. Picture of Typical Two-Antenna Suppressor Board.

SAIC Configurations

SiteMaster operates with SAIC AEI tag reader systems when they are configured for connecting to SiteMaster. An SAIC AEI tag reader system can collect tags traveling at 160 mph. A single track system has the following components:

- **APU-102 system controller**
- **Two antennas**

In order to operate properly with SiteMaster, SAIC AEI units require special software modules and drivers. Be sure SAIC knows if a system will connect to Salient's SiteMaster at the time of purchase. The system transmits a file in a Real-time External Data Interface (REDI) format. It also sends contact closure on a wire pair at the instant the SAIC system reads the first tag. SiteMaster uses the contact closure to synchronize the tag file with the axle data in a train. Figure 8.5 shows an example of the interconnections between an SAIC non-real time AEI tag reader and a WILD. The figure assumes that an operator programmed the SAIC APU-102 to transmit the REDI file on Aux1 and use 1-9 and 1-10 for the relay closure. It is possible to program other configurations and owners should consult the SAIC user manuals for their options. Salient supplies the RJ-45 to DB-25 adapter as part of the WILD system.

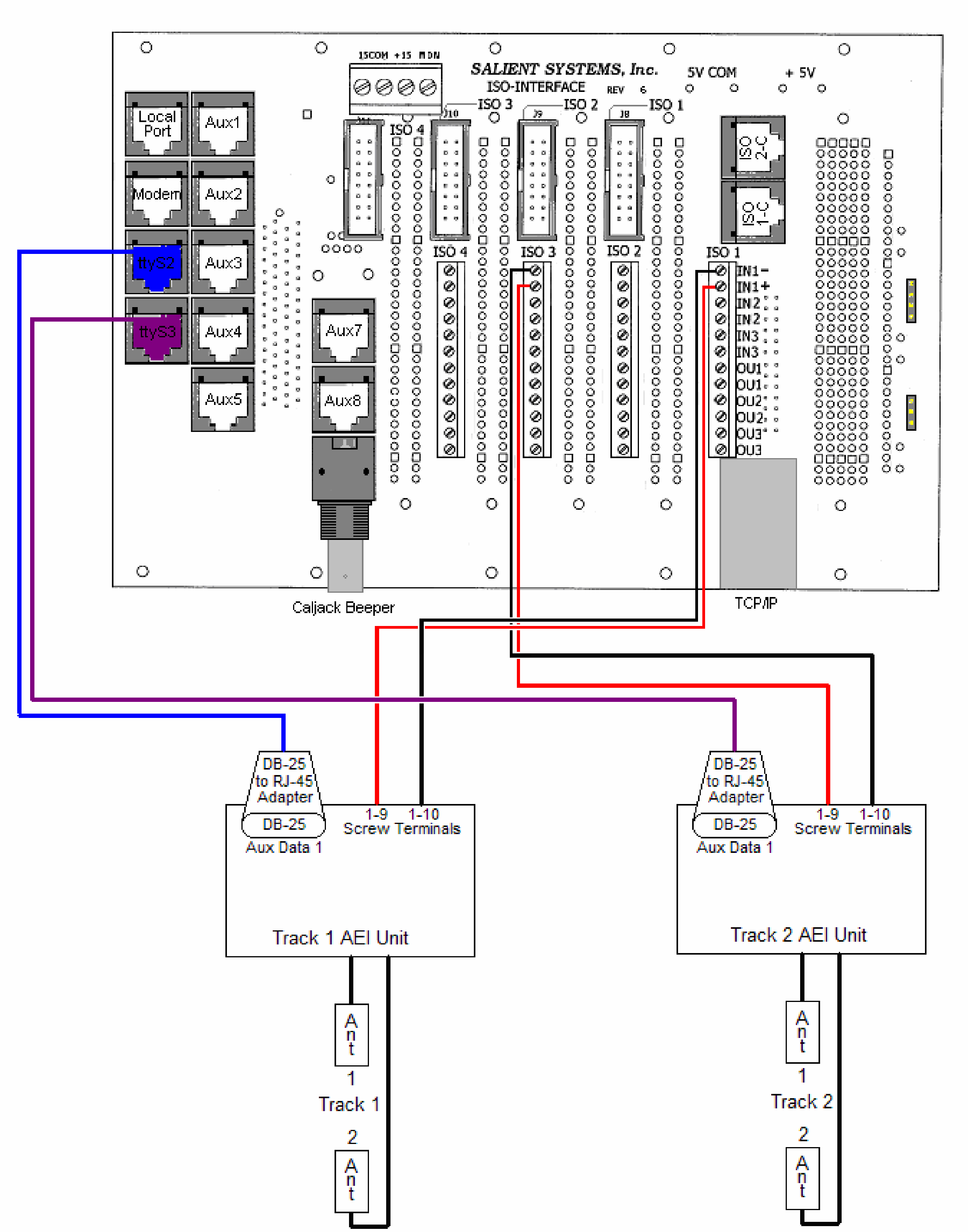


Figure 8.5. SAIC AEI Equipment Connections to WILD Backplane.

Testing and Troubleshooting

Fault Indications

SiteMaster has two reports that will show tag health. One report is the se -6 report that shows the raw tag data from the last train that passed the system OR the last train loaded into volatile memory. The other report is the se 220 (last train), 320 (current statistics period), and 420 (previous statistics period) report. This report gives statistics on tag reads from the tag reader. These reports will reveal one of two failure conditions:

- Antenna Communication Failure caused by:
    - Physical damage to the tag reader
    - RS-232 failure between SiteMaster and the Tag Reader Controller
    - Power failure to the tag reader
- Poor Antenna Performance caused by:
    - Physical dislodgement of the antenna
    - Radio Frequency (RF) component health degrading
    - Gain values or logical offset values incorrect

SE -6 Report

The se -6 report gives the raw tag information for the last train on the track OR the last train loaded into volatile memory on the track. Use the report to look for repeating patterns that indicate tag reader trouble OR to check individual tag performance on cars. The report looks like this:

```
Track SOUTH > se -6


#### Processing Train ####
EASTBOUND Train passed WILD, Track (SOUTH),
Impact Detector at 10:20  24 Jan 2006
Train speed = 32.1 MPH, total length = 6661 feet
2 Loco(s), and 37 Car(s) counted
Loco axles = 12, Total axles = 296
Gross tons - Loco(s): 392  Car(s): 6122  Total: 6514

Real-time tag reader
tag tag-time tag-string  R  A  N ES  G  X err consist adjust
--- -------- ----------  -  -  - --  -  - --- ------- ------
  1   2.068  UP  3931    0  0  3 FR  5  6   0      1L    +41
  2   3.632  NS  2681    0  0 20 RL  5  6   0      2L    +29
  3   4.709  NS  2681    0  1  1 FR  5 -2   0      2L    -74
  4   4.804  NS  2681    0  1  1 FR  5 -2  -3     -3      +0
  5   4.841  @@@@######  0  0  2 ??  0 -2 -90     -1      +0
  6   5.077  DTTX750956  0  0 13 AR 19 12   0      1     -19
  7  10.441  DTTX750956  0  1  1 BL 19 12   0      1     +17
  8  10.647  FEC 72300   0  0 21 AR 19  4   0      2     +38
  9  12.195  FEC 72300   0  1 10 BL 19  4   0      2     -41
 10  12.434  DTTX62015   0  0 22 BL 19 12   0      3     -40
 11  17.901  DTTX62015   0  1  8 AR 19 12   0      3     -13
 12  24.231  DTTX62750   0  1  7 AR 19 12   0      4      -4
```

…

The columns indicate the following information:

1. Tag: This is the count of the tag in the train as logically assigned by SiteMaster.
2. Tag-Time: This is the clock count in seconds from the start of the train to when the tag reader read the tag as determined by SiteMaster.
3. Tag-String: This is the ASCII string the tag reader read from the tag. In the example above, Tag #5 is corrupt and the tag reader read a bad set of ASCII characters.
4. R: This is the tag reader identification number as reported by the tag reader. If a tag reader is programmed to operate with SiteMaster, this column will read “0”. If a tag reader is programmed to operate with something other than SiteMaster, a value will appear according to the identification a programmer loaded into the tag antenna controller.
5. A: This is the antenna number as determined by SiteMaster. SiteMaster assigns an antenna number by the serial port the tag reader uses OR by the format of the file sent by an SAIC or Amtech AEI controller. 0 normally addresses the tag reader closest to the electronics hut and 1 normally addresses the tag reader on the opposite side of the track from the electronics hut. Provided that a car has both of its tags operational and in the correct positions, a car tag should have its identification read by Antenna 0 and Antenna 1. In the above example, Tags 8 and 9 are a clean pair of tags read off the same car by each antenna. If one of the antennas is habitually missing for most or all of the cars, it is time to check the se 320 report for tag reader performance.
6. N: This is the number of times a tag reader read the specific tag. Normally, for a one track site, a tag reader should read a healthy tag at least 4 times. For a two track site or a site with antennas mounted close to the ground, a tag reader may only get 1 or 2 reads on a tag due to the angle of reflection on the RF surfaces.
7. ES: This is the orientation code of the tag. For locomotives, FR is the right tag and RL is the left tag. On cars, AR is the right tag and BL is the left tag. SiteMaster uses this information to determine the right and left side of a car since they may be traveling frontward or backwards on the track. A “??” denotes the tag did not read correctly.
8. G: This is the group number of the tag. A 5 denotes a locomotive and a 19 denotes a car. A zero in this field indicates the tag did not read correctly.
9. X: This is the axle count associated with a tag. A negative value indicates that the tag did not have the information or that the tag reader could not read the information.
10. Err: A zero in this column indicates an error free read. Any other value indicates that SiteMaster determined the tag was invalid or that it could not find a geometric solution to match the tag to a set of axles measured by the strain gages. In the above example, Tag 4 is actually a weak read of Tag 3 and SiteMaster discards it due to being out of time range. Tag 5 is an invalid tag that SiteMaster discards.
11. Consist: The value in this column indicates which vehicle SiteMaster assigned the tag with after computing axle spacing and train times. A negative value in this column indicates that SiteMaster could not use the tag information because it did not fit OR the tag data itself was invalid.
12. Adjust: This column indicates the distance in inches that SiteMaster logically moved the tag to assign it to its car indicated under consist. SiteMaster calculates distance spacing based on the tag-time field and the train speed and then does a “best fit” for the tag onto axle data from the strain gages. Adjustments vary based on two major factors. The first factor is the placement of the tag on the vehicle and the second factor is when the tag enters and leaves the read field of the tag reader. Note that radio frequency (RF) reflections are a very real part of when a tag reader reads a tag as well. Tags that do not make assignment will never receive an adjustment value and “+0” will show in this column as a default. If a tag reader consistently needs an

adjustment to fit tags, Salient Systems can adjust the logical positioning of the tag reader reading zone in SiteMaster. Car mounting variation is impossible to correct as are RF variances caused by temperature, weather, and metal structures on site. This value needs to be within 300 inches of zero for SiteMaster to use the tag.

Use the "se -6" report to check for patterns from the tag reads or to look at individual tag performance on a given car. If Antenna 0 picks up several tags that Antenna 1 never saw, it indicates that Antenna 1 may be having problems. If the adjustment is consistently high for one or both of the antennas in one direction, Salient may need to set the logical offset of the tag reading zone in SiteMaster to the correct value. The failure to assign tags may be from logical offset in SiteMaster, noisy tags, or a sick tag reader.

SE 320 Report

The "se 320" report has 3 different versions. The 220 version gives the statistics for the last train that passed the track OR the last train loaded into volatile memory. The 320 version compiles all of the trains from either direction on the track for the current statistical period as set using the "st" command. The 420 version compiles all of the trains from either direction on the track for the previous statistical period. This report is the best indicator that something is physically wrong with a tag reader. Here is what it looks like:

```
Track SOUTH > se 320

Report 320

  ---------------------------------------------
    CURRENT Statistics for WILD, Track (SOUTH)
    TAG ASSIGNMENT
    Accumulated from 12:01  22 Jan 2006 to 10:11  24 Jan 2006
    For EASTBOUND traffic

                 Antenna 0  Antenna 1
     min adjust     -287.1     -275.4
     avg adjust      -28.2      -19.4
     max adjust       71.9      258.0
          count       1647       1648
          reads      21410      10012
      avg reads       13.0        6.1
      low reads         87        772
   parse errors         14          0
       no match          4         49
       replaced         10         21
      both ends          1          1

unassigned cars         28
   both sides A          6
   both sides B          5
```

```
      Loco tags        229
       EOT tags         34
   Railcar tags       3083
  Group 14 tags          0
Multimodal tags          0
  unknown group         70
 suspcious tags        124
axle mismatch tag/tag         15
          tag/consist         49

                      1      2      3      4      5      6      7    ALL
    tagset size     217   1528      2      2      0      0      1   1750
drawbar by tags       0     44     38      1      0      0      0     83
       by axles       0      2      1      0      0      0      0      3
failed searches          5

  ---------------------------------------------
    CURRENT Statistics for WILD, Track (SOUTH)
    TAG ASSIGNMENT
    Accumulated from 12:01  22 Jan 2006 to 05:00  24 Jan 2006
    For WESTBOUND traffic

                 Antenna 0  Antenna 1
     min adjust     -101.3     -178.0
     avg adjust      -20.5      -34.9
     max adjust      164.3       76.8
          count        537        527
          reads      13171       5611
      avg reads       24.5       10.6
      low reads         11         94
   parse errors          1          0
       no match          9          9
       replaced          0          1
      both ends          0          1

unassigned cars          7
   both sides A          0
   both sides B          1
      Loco tags         49
       EOT tags          7
   Railcar tags       1015
  Group 14 tags          0
Multimodal tags          0
```

```
  unknown group         12
 suspcious tags         20
axle mismatch tag/tag          2
          tag/consist         11

                        1      2      3      4      5      6      7    ALL
    tagset size        23    519      1      0      0      0      0    543
drawbar by tags         0      5      5      0      0      0      0     10
       by axles         0      0      0      0      0      0      0      0
failed searches          3
```

The report statistics are self explanatory. The most valuable diagnostic information is in the average offset and the average number of reads. If the average number of reads is zero, then communication has failed with the tag reader OR the tag reader RF module or antenna has failed. If the average adjustment is large, then the logical offset of the tag reader reading zone may be incorrect under the "ta" command OR the tag reader may have been physically moved to change its reading zone. For a single track site, if the average number of reads per tag is less than 5, then the RF module or antenna are not operating properly. They may need adjustment, repair, or replacement. For a two track site, the tag readers in between tracks or near to the ground may have average reads less than 2 but greater than 1. Average reads below 1 indicate trouble. Tags on upright posts in a two track site should still get at least 3 average reads per tag.

TA Command

The TA command allows a person logged into SiteMaster to view the logical offsets and to set logical offsets for tag readers if they need moving. The output of the command looks like this:

```
Track TWO > ta

NOTE: If the tag reader and the approaching train
      are on OPPOSITE sides of the Salient detector,
      then the offset should be a NEGATIVE number
tag offset is refered to the center of 0
WESTBOUND tag offset (Antenna 0) = 200 (inches)
WESTBOUND tag offset (Antenna 1) = 50 (inches)
EASTBOUND tag offset (Antenna 0) = -120 (inches)
EASTBOUND tag offset (Antenna 1) = -30 (inches)

  Max adjust threshold = 300
  Min reads warning    = 5

Track TWO >
```

Tag reader offset values are in inches and measure from the center of the site. A site's center is the line with the same distance from the centerlines of the two far ties of the instrumented zone. To measure the offset measure the distance from the center of the site to the center of the tag reader. Determine the sign of the offset (positive or negative) for each direction. Use + if the tag reader is closer to the point of entry of the train into the site than the center of the site. Use – if the tag reader is closer to the point of exit for the train than the center of the site.

Note that the values are not the same for WESTBOUND and EASTBOUND trains in the example provided. This situation arises when a Salient support technician uses a more advanced method of calculating offset. The difference in the values occurs from the size of the radio frequency lobes on the tag readers and transmission delay of the tag readers. Note that the radio frequency lobes change shape with temperature and the age of the tag reader; so, offsets can still drift over time. Drifts are not a problem as long as they are less than 100 inches on average. Contact Salient Systems if drift is a problem.

Diagnosis

Once a problem is indicated on a tag reader from the se -6 or se 320 report, it is necessary to isolate the problem. Use the Tables below to find the fault:

Table 8-1. Low Number of average reads in the se 320 Report.

Possible Cause	Diagnosis
1. Tag Reader Misalignment	1. Check tag reader position. Correct any problems and recheck tag reader performance.
2. Antenna or RF operation abnormal.	2. Replace the antenna component or RF module component and recheck tag reader performance. Use Table 8-3 to program replacements.
3. Wrong RF Frequency	3. Replace the antenna component (SmartPass 1603 or AEI). For a SmartPass 1620, chat with all tag readers in the system and record their frequency settings using the #527 command. Set the frequency setting for the unit with the wrong frequency using the #642xx command. See Table 8-3 on how to program a SmartPass tag reader.
4. Logical Offset Incorrect	4. Check the se 320 report for average offset. If the value is more than +/- 100 inches, contact Salient Systems to have offset corrected.

Table 8-2. No Tags from the Tag Reader in se -6 and se 320 reports.

1. Physical damage to the tag reader.	1. Check tag reader physical condition. Replace if there is evidence of a physical strike. Use Table 8-3 to program replacements.
2. RS-232 Communication Failure.	2. Connect a laptop to the serial port from the tag reader. Verify if ASCII communication works using the “ch” command from SiteMaster and a terminal emulation program active on the tag reader serial port. SmartPass units and Amtech AEI systems already use ASCII. Sending “#00” will result in a “Done” response from a working Amtech or SmartPass tag reader.
3. RS-232 Communication Wire Cut	3. Check continuity from the RJ-45 jack plugging into SiteMaster to the serial port line into the tag reader controller. Validate TxD, RxD, and Signal Ground
4. RF or Antenna Failure	4. Replace the antenna component or RF module and check operation.
5. Power Failure	5. Check voltage at the power input to the tag reader.
6. Relay Activation Failure	6. Check continuity on the relay lines to the tag reader from OU1 on the WILD by manually closing the contact on the OU1 + and - and checking for tag reader activation. Ensure the OU1 LED lights when a train is present on the track. Check for closure on the relay when a train passes. Ensure JP 6, 7, and 8 are correct on ISOBus. Replace the ISOBus card if manually closing the lines restores tag reader operation.
7. Bad Logical Offsets	7. The se -6 report will show unassigned tags and the se 320 report will show no reads for the antenna. Call Salient Systems.

Table 8-3. Programming Amtech Tag Readers. DO NOT skip any steps or you will permanently lose tag data.

ch	System will reply with a list of ports. Choose the port number <N> with the antenna requiring programming.
<N>	Start chatting with port <N>. Command prompt will go away and a notice to enter 'Cntl-A' to exit will appear. Port <N> must be a tag reader port.
#01	Put the tag reader in command line mode. Tag reader will stop reading tags. The tag reader responds to this command with '#DONE' if received successfully.
#311	Enable auxiliary information on tag data. '#DONE' indicates success.
#300	Disable time information on tag data. '#DONE' indicates success.
#642<ff> (Only with SmartPass 1620)	Turn on frequency code <ff>. Near Track, Ant 0 <ff> = 10. Near Track, Ant 1 <ff> = 27. Far Track, Ant 0 <ff> = 01. Far Track, Ant 1<ff> = 1C. '#DONE' indicates success. ONLY AVAILABLE WITH SMARTPASS 1620.
#524	Check tag data format. 'IDAP T0 D0 X1' indicates proper format. Use '#300' and '#311' to set the proper format.
#527	Check RF operation. 'RFST C1 O0 T1' indicates proper RF status. Use '#641' to change an appearance of 'C0' to 'C1'. 'O1' indicates tag reader activation. SMARTPASS 1620 ONLY: Returns 'RFST C1 O0 T1 F<ff> R1F' and <ff> should match the frequency code entered on the '#642<ff>' command.
#00	Put the tag reader into tag collection mode. '#DONE' indicates success. Failure to put the tag reader into tag collection mode will result in lost tag data.
Cntl-A	Exit the chat session. The 'Track ONE>' prompt should appear.

CHAPTER 9 — POWER SUPPLY

Overview

The MK II Site Master with the Wheel Impact Load Detector (WILD) can be configured to be powered either by 230 VAC, 115 VAC, or 24 VDC. The power modules then convert the input voltages into:

- 5 VDC/100 watts -- which powers the digital circuitry on all the VMEbus cards in the system and the Hard Disk Drive / Solid State Drive.
- 15 VDC/150 watts -- which powers the analog circuitry on the Front End Processors (FEP), including the input to the individual DC-DC converters that power the load circuits mounted on the rails, and on the ISOBus where it is used to drive the RS-232/485 port and the auxiliary TTL I/O ports.

The supply contains feedback circuitry that keeps the outputs to within 5% of rated voltage.

Mk II power supplies are 100% compatible with Mk III systems.

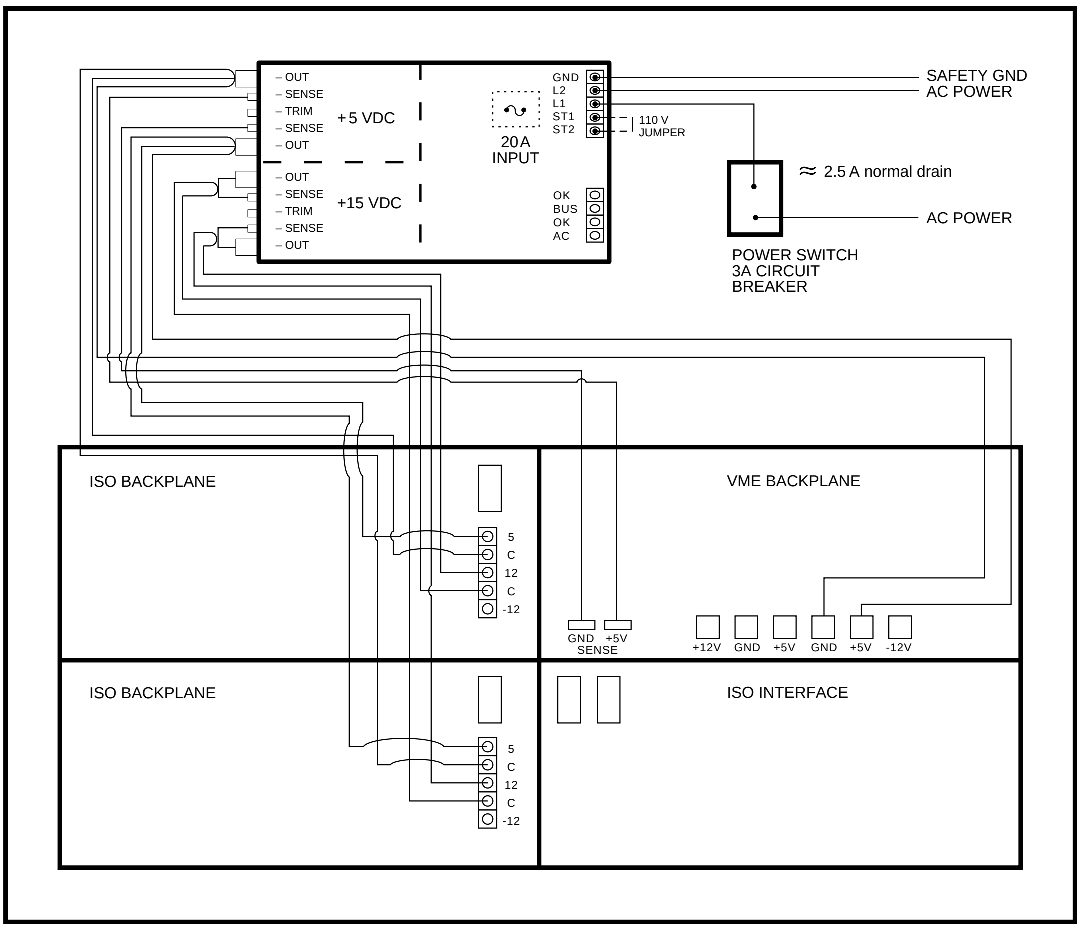


Figure 9.1. Power supply connection diagram

Component Descriptions

System protection

Input protection

The power supply is protected with a resettable circuit breaker (10-25 amps for DC, 3-10 amps for AC) which is contained in the main ON/OFF switch. The breaker terminals can only be accessed from the rear of the rack.

Transient protection

Transient protection of the regulated DC power from lightning strikes and other fault conditions is handled by individual transient protection diodes ("Zapistors") mounted on the ISO backplane. Additionally, the power leads are routed directly from the supplies to each load instead of "daisy-chaining" them. This reduces ground bounce and the probability of high speed faults carrying over from one section to another.

Internal module protection

The individual DC/DC power modules within the power supply have internal protection for output voltage and current overloads. The average voltage limit is 125 percent of the nominal output voltage and the current limit is 115 percent of the rated output current.

AC input connections

Newer AC power supply automatically adjusts for operation with either 90 - 135 VAC or 180 - 270 VAC. Older models use jumper settings to select voltage ranges, connecting ST1 and ST2 for the 115 VAC range, and leaving them open for the 230 VAC range.

Field connections for the AC line are completed by connecting the “hot” line to the bottom terminal of the main power switch, and the neutral line to the AC input at the top of the supply. Safety ground is also tied to its designated terminal on the supply input.

DC input connections

The DC power supply is normally run from unregulated 24 VDC furnished by either a DC supply or by batteries and a charger. The battery charger is programmed to continually charge the batteries until power is lost (a data sheet is included with the system to show proper setup values for the charger). When this happens, the Mk II WILD will run from the batteries for five to twenty-four hours, depending upon the type of batteries used.

There are two DC power configurations. Figure 9.3 depicts the first configuration. Power connections run from the 24 VDC supply (or charger and batteries) to the power modules. The positive line goes to the bottom terminal of the main power switch, and the top terminal is connected to each of the power modules. The common (negative) line runs directly to each of the power modules. The power and ground lines are connected to the backplanes as illustrated and the 5 VDC module's sense lines are connected to the VME BACKPLANE 5 VDC sense connections.

Figure 9.4 shows the second configuration. Separate power modules are used to power each backplane for greater isolation. There is one main power switch and circuit breaker. With multiple supplies, failures in one portion of the system will not necessarily cause the entire system to fail.

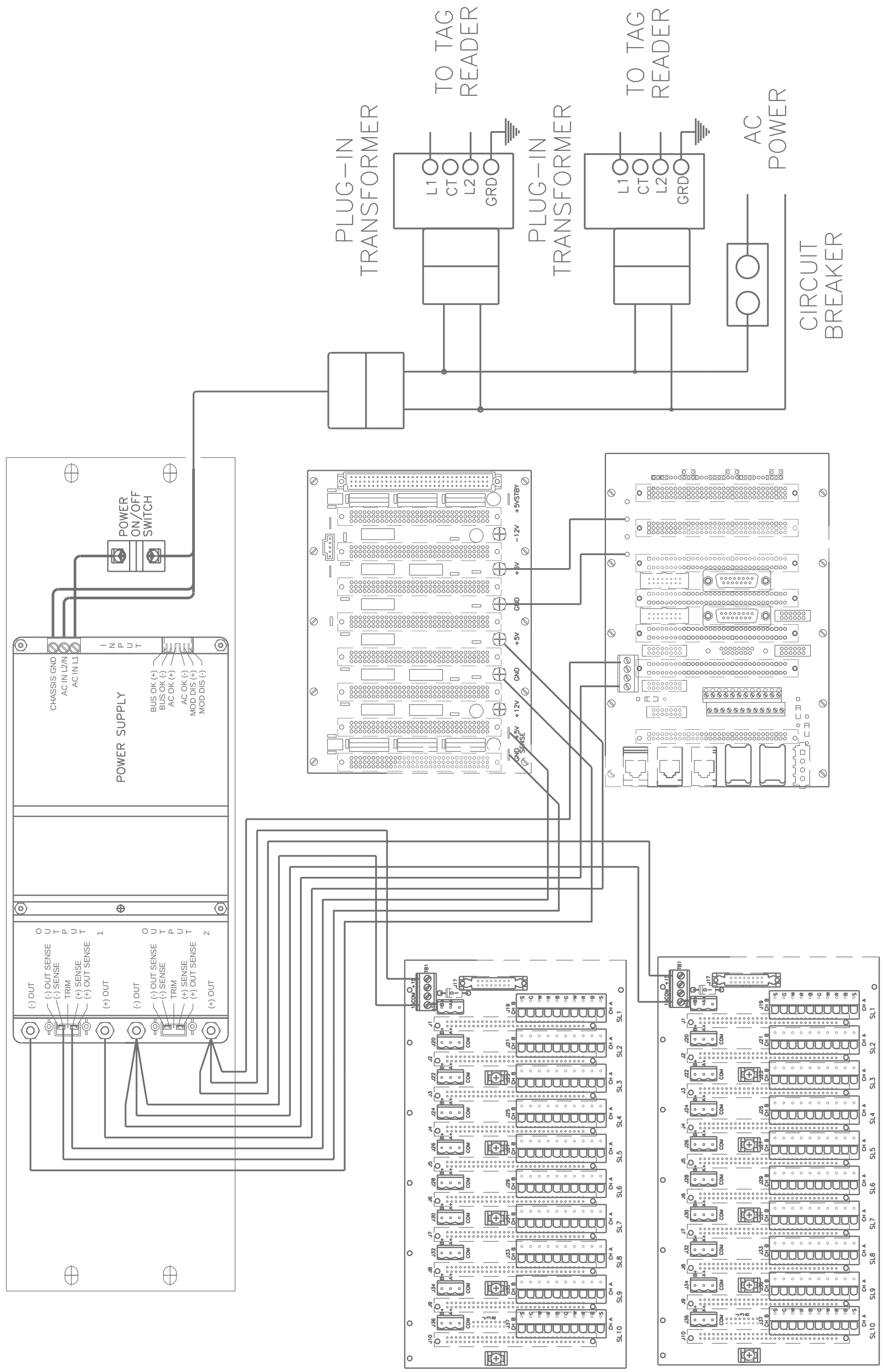


Figure 9.2. MK II WILD System AC Power Wiring Diagram

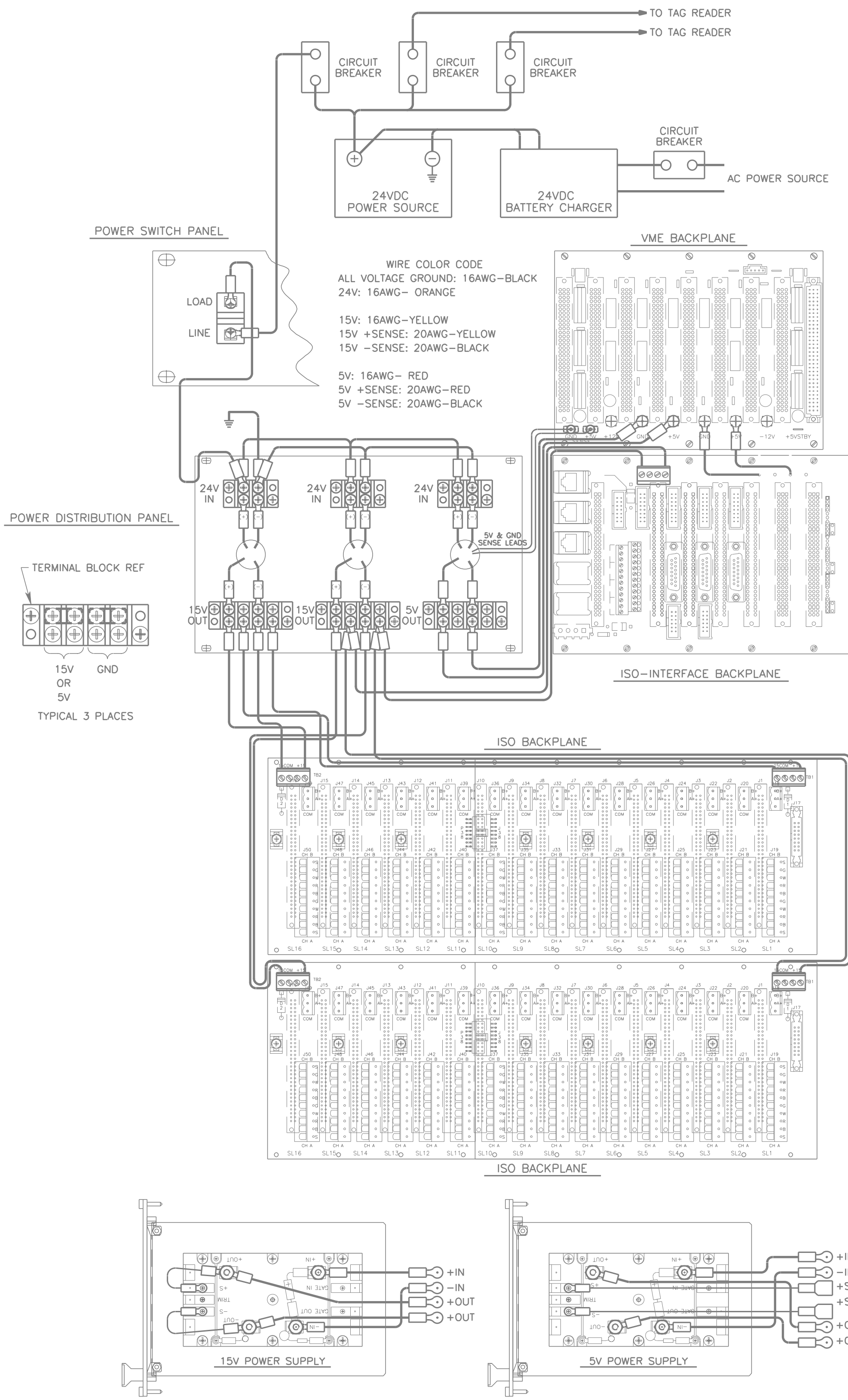


Figure 9.3. DC Power Wiring Diagram

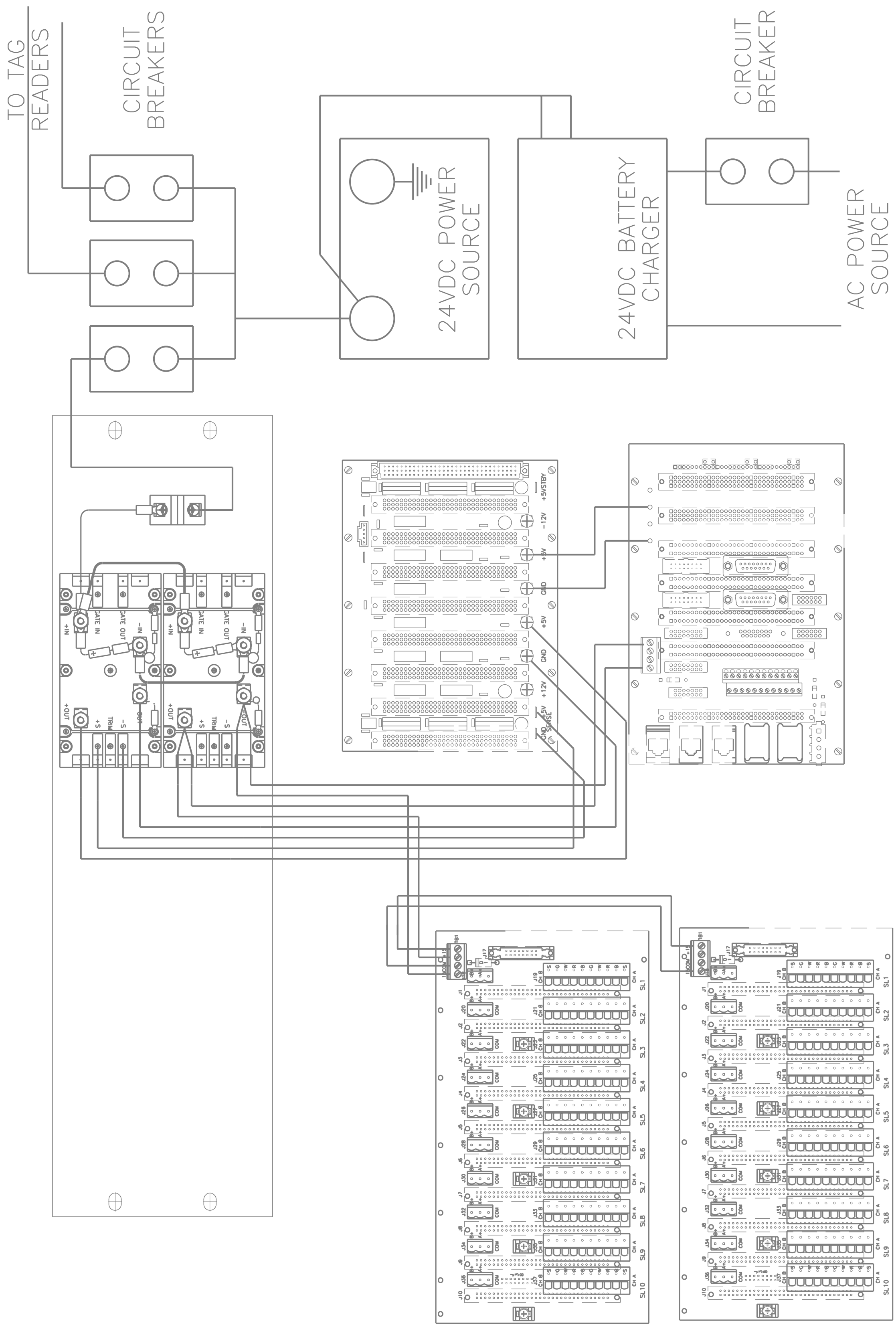


Figure 9.4. DC Power Wiring Diagram

5 VDC output connections

In a one track system, 5 VDC is supplied to two locations - the ISO backplane and the VME backplane. In a two track system a third connection is made to the second ISO backplane, matching the connection to the first ISO backplane. The sense lines of the 5 VDC module supplying the VME backplane are connected to the VME backplane 5 VDC sense connections. The sense lines of the other modules are looped back directly to their outputs: +SENSE to +OUT and -SENSE to -OUT.

15 VDC output connections

15 VDC is connected to each ISO backplane. The sense lines are looped back **directly** to their outputs: +SENSE to +OUT and -SENSE to -OUT.

Testing and Troubleshooting

Fault indications

Problems with the power supply generally fall into the following categories:

- All outputs dead.
  - Check for proper input voltage at the power supply input terminals. Although the main switch may be ON, the internal breaker may have tripped.
  - Check the internal fuses in the panel.
- One output dead (either 5 VDC or 15 VDC). Most probable cause is a short on one of the system modules. A voltage or current overload will cause the thermal protection to open the circuit.
  - Disconnect the output connections from the problem power supply. Wait a few minutes for the overload to cool and re-test the outputs.
- One output producing incorrect voltage. Tolerances for voltages are 4.95 V to 5.15 V for the 5 VDC supply, and 14.9 and 15.2 V for the 15 V supply.
  - Contact Salient.

CHAPTER 10 — FIELD CALIBRATION

Mk III Systems

Description

This document describes the procedure used to perform a field calibration on a MKIII IMPACT DETECTOR. The calibration determines the load sensitivities of the strain gage circuits by using a calibration fixture that attaches to the rail and applies a known downward force to the rail for vertical circuits or a known sideways force to the rails for lateral circuits.

As the downward (or sideways) force is applied, the system detects and records loads measured by the strain gages under test. These loads are represented by Analog-to-Digital (A/D) converter counts, which are generated by the MKIII FEP card that is connected to the strain gages under test. The known force created by the calibration fixture is also collected by interfacing the precision load cell within the fixture to one channel of an FEP card within the MKIII DETECTOR. This connection is achieved by using an interface cable from the load cell to the terminal strip located behind the FEP card on the FEP-BACKPLANE. The force applied by the calibration fixture is also reported as an A/D count value.

Both the force exerted on the rail by the calibration fixture and the load reported by the gages under test are collected and processed by the SiteMaster software. The calculated results of the calibration are presented to a user that is logged into the system and stored in a capture file on the system flash card. The user may capture the data into an ASCII text file using TELIX, ProComm, or a similar communication software package. The system allows the user to review new calibration values by comparing them to existing calibration values and then loads the new values when commanded by the user. Once SiteMaster knows the calibration values to a channel, any FEP card can be inserted into any slot and the values produced will be properly scaled to produce accurate readings.

Materials Required

The Calibration fixture requires no hand tools to assemble. The disassembled fixture consists of several components:

The primary component of the CalJack is the main cylinder. It is attached to two large I-beams at one end, (Figure 10.1)

Figure 10.1 Main Cylinder

two small I-beams, (Figure 10.2)

Figure 10.2 Small I beams

two rail clamps with blue release handles, (Figure 10.3)

Figure 10.3 Rail Clamps

four bolts and nuts, (Figure 10.4)

Figure 10.4 Bolts and Nuts

one load cell, which houses the screw to create the force exerted on the rail, (Figure 10.5)

Figure 10.5 Load Cell

two rail height adjustment blocks, (Figure 10.6)

Figure 10.6 Rail-height Adjustment Blocks

a shunt resistor box, (Figure 10.7)

Figure 10.7 Shunt Resistor Box

and two handles for turning the screw (Figure 10.8).

Figure 10.8 Handles

The CalJack also includes two adapters for fitting it to test lateral gages (Figures 10.9 and 10.10).

Figure 10.9 Lateral Modification

Figure 10.10 Lateral Modification

Finally, each CalJack has a few electrical connection cords. The first is an interface cord to connect to the FEP Backplane. It is identified by its green connector with five multicolored wires (Figures 10.11 and 10.12).

Figure 10.11 Interface Connection Cord

Figure 10.12 Interface Connection Cord, detail.

Another connection cable is the coaxial cable with connectors (Figures 10.13 and 10.14).

Figure 10.13 Coaxial Cable

Figure 10.14 Coaxial Cable, detail.

Equipment Preparation

Calibration Fixture

This is the general layout of the CalJack components (Figure 10.15). To prepare the calibration fixture, complete the following steps.

Figure 10.15 CalJack Components

1. Place the large black rail clamp, small I-bar, and large I-bar together, and fasten with a bolt and nut, finger-tight. Repeat on the other side (Figures 10.16 (1 and 2)).

1. **2.**

Figure 10.16 Assembly of Small I beam Connection

2. Place the rail height adjustment blocks in the sockets on the small I-beams (Figure 10.17). **NOTE**: When the CalJack is placed on the rail, these must be adjusted, using the screws, to rail height so the small I-beams are supported by them.

Figure 10.17 Insertion of Rail Height Adjustment Blocks

3. Insert the load cell into the main cylinder. Make sure the electrical connection socket (with metallic cover) is facing up. Pull the pin in the cylinder to allow the load cell to be inserted completely. When snug against the cylinder, release the pin, locking the load cell in place. Next, fasten the small I-beams finger-tight to the load cell using the bolts in the same manner as before (Figure 10.18).

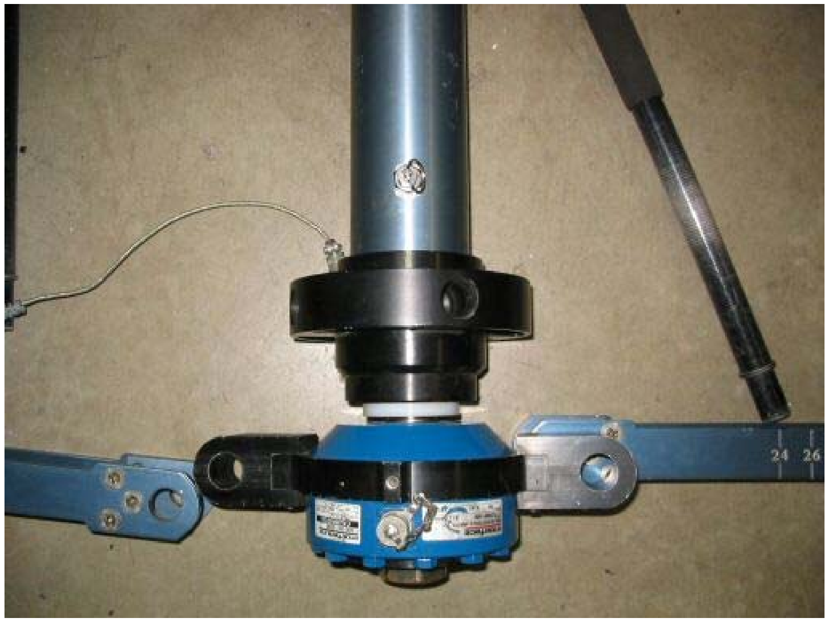


Figure 10.18 Attachment of Small I-beams to Load Cell

4. Attach the shunt resistor box to the small I-beam, making sure the decal is visible. The box should be positioned so that the attached cord is pointed towards the load cell (Figure 10.19). Strap the box in place with tie wraps.

Figure 10.19 Placement of Shunt Resistor Box

5. Connect the cord from the shunt resistor box to the connection jack on the load cell (Figure 10.20).

Figure 10.20 Connection of Shunt Resistor Box to Load Cell

6. Insert the handles into the load cell (Figure 10.21 (1 and 2)). Figure 10.22 shows the finished product.

1. 

2. 

Figure 10.21 Insertion of Handles into CalJack

Figure 10.22 Finished Product

Lateral Strain Gauge

In order to calibrate lateral circuits, the CalJack is assembled slightly differently.

1. Remove the main cylinder from the large I-beams by removing two screws (Figure 10.23 (1 – 3)). Save the screws and wing nuts for the next step.

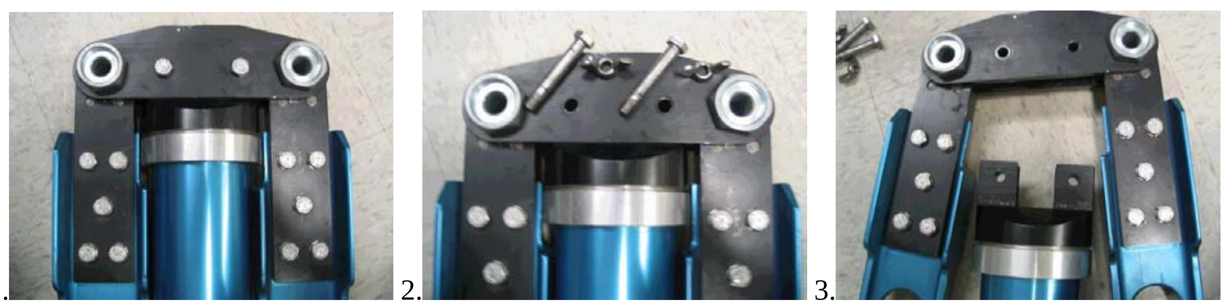
1.


Figure 10.23 Removal of Large I-beams

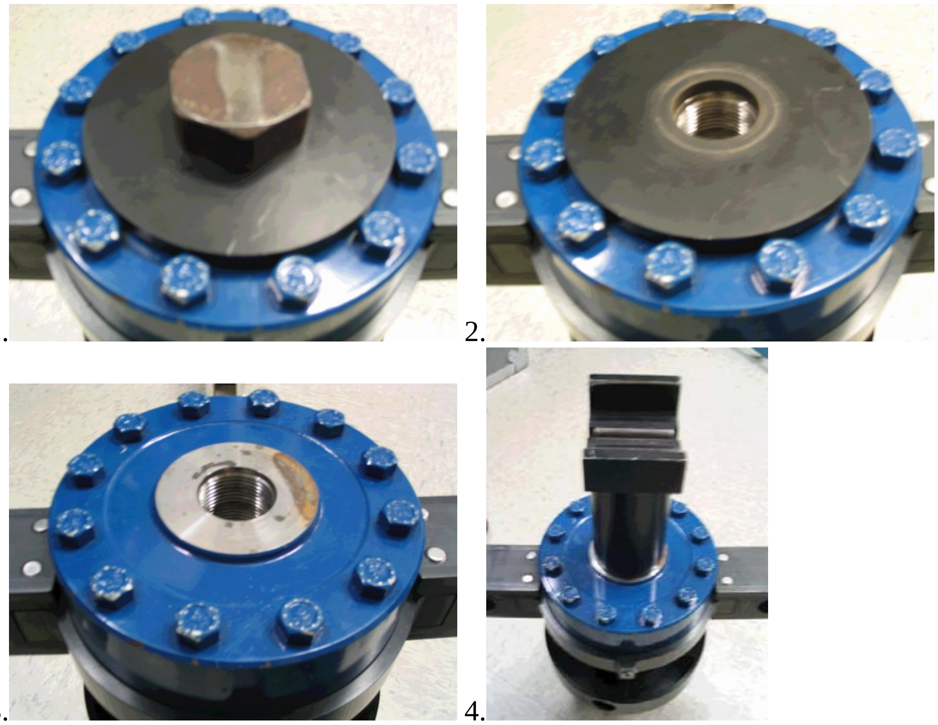
2. Place the U-shaped lateral adapter in the same position on the main cylinder and attach it with the old bolts and wing nuts (Figure 10.24 (1 – 3)).

1.


Figure 10.24 Attachment of U-shaped Lateral Adaptor

3. Modify the load cell. At its bottom, remove the bolt and black plate, and in their place, screw the cylinder-shaped lateral adapter into the load cell

(Figure 10.25 (1 – 4)). **NOTE**: The serial number on the load cell must match the number on the lateral adapter, or the screws will not line up correctly.



1. 2. 3. 4.

Figure 10.25 Attachment of Load Cell Lateral Adaptor

4. Attach the load cell to the main cylinder in the same manner as the vertical setup (Figure 10.26). NOTE: Often, one small I-beam is fastened to the load cell so there is a place to attach the shunt resistor box (not shown). In this configuration, large I-beams and rail clamps are not used.

Figure 10.26 Attached Load Cell Lateral Adaptor

CALIBRATION BASICS

First, an overall review of some of the terminology used throughout this document is needed:

A “**circuit**” refers to a set of four strain gages mounted on a rail within a single crib. The four gages are wired together to create a single Wheatstone Bridge circuit.

A “**channel**” refers to a signal path used to read a single set of strain gages that make up a rail “circuit.” Each FEP has two channels, channel A and channel B. At sites with only vertical gages, the two channels of each FEP connect to two consecutive cribs on the same rail. Systems that incorporate lateral circuits as well as vertical circuits have channel A connected to a vertical circuit and channel B connected to the corresponding lateral circuit on the same rail in the same crib.

A “**bank**” refers to a set of FEPs in the WILD System: FEPs are organized into rows, called banks. At a site with only vertical gages, each bank of FEPs reads the “circuits” on both rails of a single track. Thus a single-track, vertical-only site will use one bank of FEPs, while a double-track, vertical-only site will use two banks. At a site with vertical and lateral gages, each bank of FEPs connects with both the vertical and lateral circuits of one rail. Consequently, a single-track site with vertical and lateral gages uses two banks of FEPs and a double-track site with both vertical and lateral gages uses four banks.

In a WILD System, each FEP has one terminal strip on the FEP Backplane. Normally, the circuits on the rail are connected through these ports. Each terminal strip is long enough for two connections. The lower connection is the Channel A connection, and the upper connection is the Channel B connection. Figure 10.27 shows the channel layout.

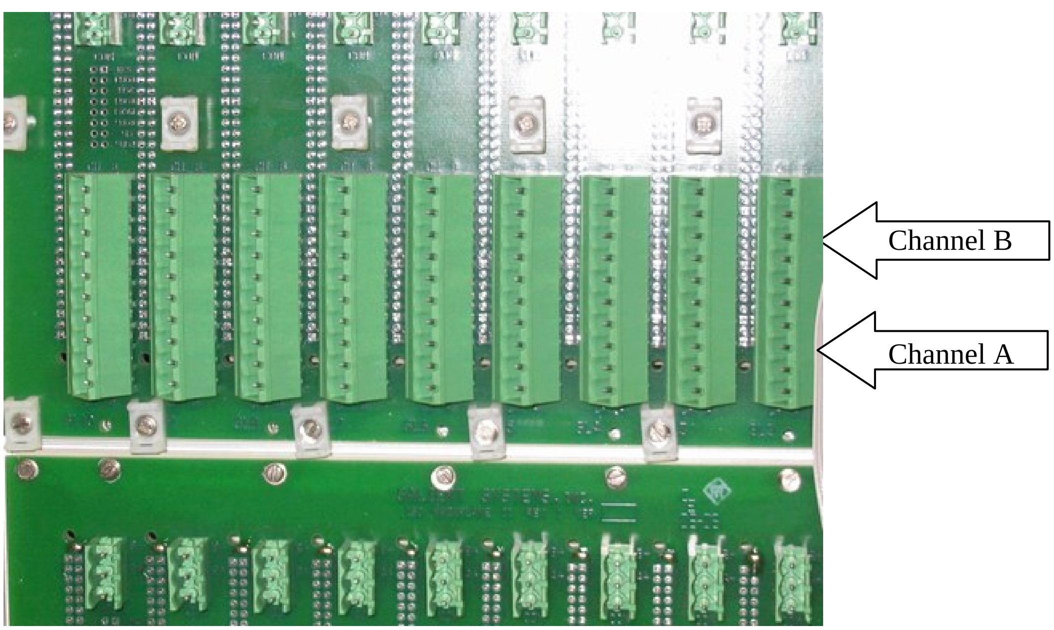


Figure 10.27 Channel Layout

The organization of these connections differs, depending on the layout of the site. If the site has only vertical circuits, then each FEP connects with two adjacent circuits in the same rail—the first of the two circuits through Channel A and the second of the two through Channel B. For instance, the first FEP (from the front of the WILD System, left-to-right) interfaces with circuits one and two of the far rail. Circuit 1 connects through Channel A, and circuit 2 connects through Channel B. Also, the first half of the FEPs (again, left-to-right from the front of the WILD) interfaces with the rail farthest from the bungalow. The second half interfaces with the near rail. Finally, the site uses only one bank of FEPs for both rails of a track.

In a site with both vertical and lateral circuits, each FEP connects with one vertical and one lateral circuit. The vertical circuits always connect through Channel A, and the lateral circuits through Channel B. Thus the first FEP connects with the first vertical circuit on the far rail through Channel A and the first lateral circuit on the far rail through Channel B. The system has two banks of FEPs for each track; the upper bank connects with the far rail circuits, and the lower bank connects with the near rail circuits.

If there is any confusion, the FEPs are clearly labeled at each site.

When calibrating a site, the CalJack connects to the WILD System through the interface cable to one of these terminal strips. Because this calibration connection must replace a connection from one of the circuits, the circuit replaced must not be a circuit being calibrated at that time. So, if you were working at a site with only vertical circuits and wanted to calibrate the far rail, you would connect the interface cable to a near rail Phoenix strip (which would be an FEP on the left as you look at them from the rear). If you were working with a site with both verticals and laterals and wanted to calibrate the vertical circuits on the far rail, you would connect the interface cable to a Channel B (upper) slot of a far rail FEP.

The other end of the interface cable connects to the shunt resistor box.

If this were a **single-track, vertical-only site with 20 channels**, the following connections would occur (Figure 10.28):

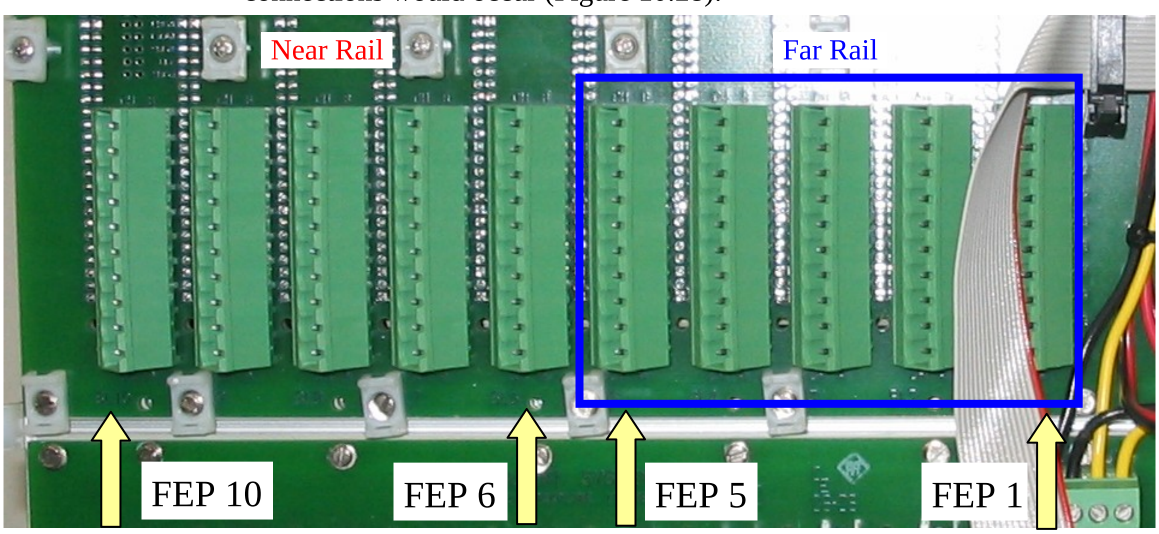


Figure 10.28 Single-Track, Vertical Only Layout

FEP 1—Connects with vertical circuits 1 and 2 on the far rail

FEP 5—Connects with vertical circuits 9 and 10 on the far rail

FEP 6—Connects with vertical circuits 1 and 2 on the near rail

FEP 10—Connects with vertical circuits 9 and 10 on the near rail

NOTE: The FEP Numbering is reversed (the first one is from right-to-left) because this photo views the WILD System from the rear.

If this were a site with vertical and lateral circuits, the following would occur (Figure 10.29)**:**

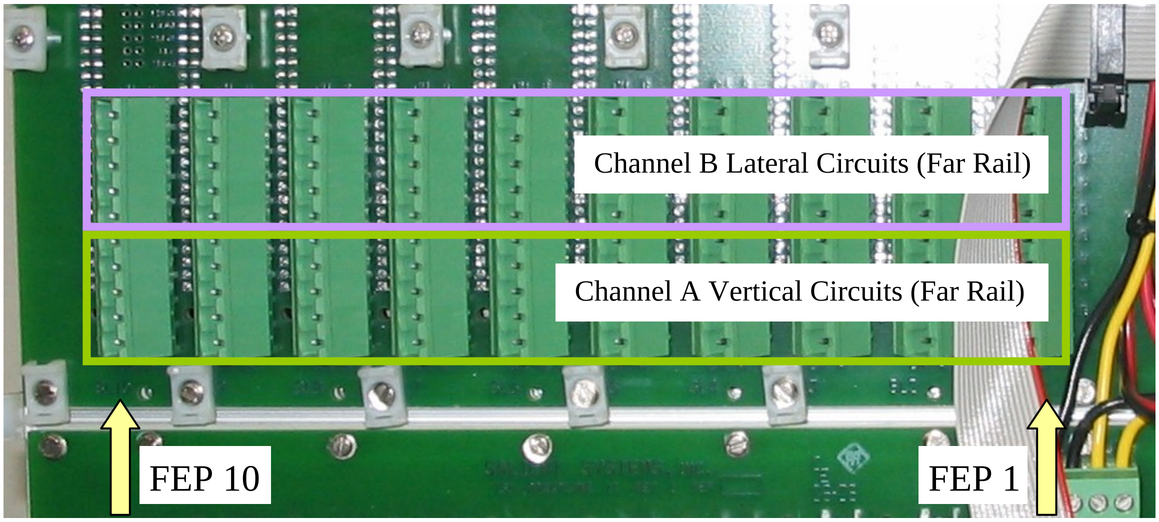


Figure 10.29 Vertical and Lateral Layout

FEP 1 connects with vertical circuit 1 and lateral circuit 1 on the far rail.

FEP 10 connects with vertical circuit 10 and lateral circuit 10 on the far rail

The FEP numbering is again reversed because this shot is from the rear of the WILD system.

All near rail FEPS are in another bank below this one.

The BNC cable also connects from the shunt resistor box to the WILD System. Before making this connection, disconnect the modem power jack from the back of the external modem if equipped for your WILD. The modem and beeper box use the same relay. The BNC cable carries voltage controlled by an ISOBus relay to the beeper integrated into the shunt resistor box. The beeps provide cues for certain calibration actions. One end of the BNC cable connects to the shunt resistor box, and the other connects to a special jack on the bottom of the ISO VME Backplane (See Figure 10.30.).

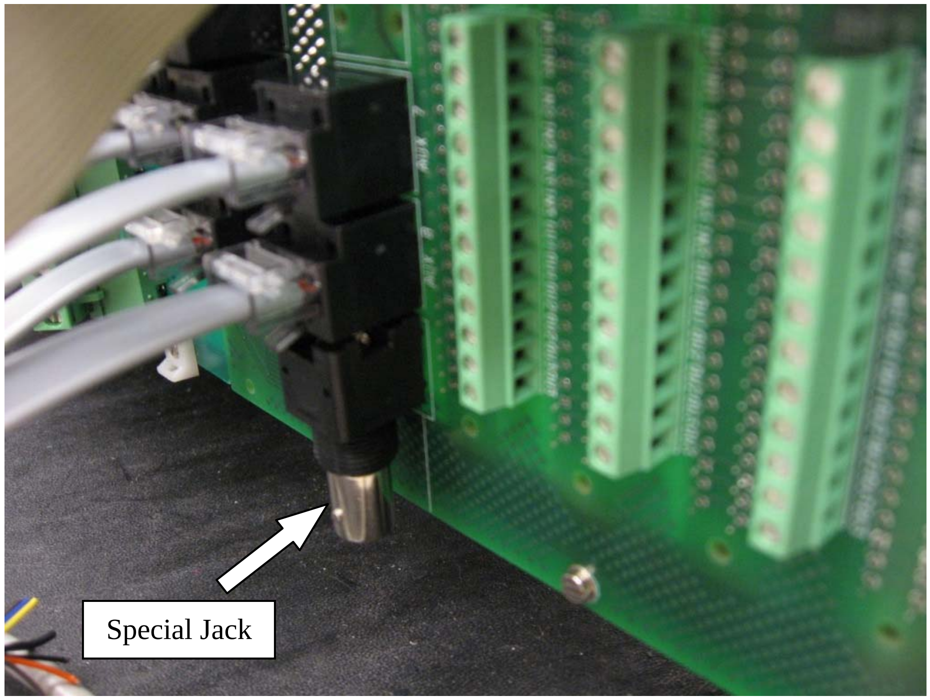


Figure 10.30 Special Jack Location

Beginning Calibration

Perform the following steps to begin calibration.

1. Turn off the phone modem and set the laptop to capture all data collected on its screen. Give the capture file a name that describes the site being calibrated, the channels being calibrated, and the date.

   For example, if the site is named Marysville, the far rail circuits are being calibrated, and the date is March 4, 2002, call the capture file "Marysville_Far_Rail_03042002.CAL".

2. Set the CalJack up on the rail in preparation for calibrating. If the phone modem is still on, turn it off. Align the calibration fixture over the center of the crib to be calibrated. Crank the fixture counterclockwise until the load cell is not touching the rail. This is important in order to get the "zero load" value for the rail circuit and load cell. Make sure the calibration switch on the Shunt resistor box is in the "off" (NORM) position. Log into the system and reset the front ends to rezero the circuits.

```
Track ONE > fe -r
Requesting Reset for all front ends for current track
Waiting for confirmation...
Reset completed.
```

3. Issue a TEst command to check circuit response.

```
Track ONE > te
Requesting test:
    Test command sent...
<ISOACQ#0  1| Ready to Calibrate!>
    Evaluation completed...

Current time: Wed Nov 14 17:44:15 2001

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   1W-V YES    0s 34632  8411            +1    +1
   2W-V YES    0s 33284  8310            -2    +0
   3W-V YES    0s 32378  8331            +0    +0
   4W-V YES    0s 35645  8328            +0    +0
   5W-V YES    0s 34314  8382            +3    +1

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   6W-V YES    0s 34145  8385            +3    +1
   7W-V YES    0s 31328  8408            +0    +0
   8W-V YES    0s 33036  8408            +0    +1
   9W-V YES    0s 33088  8469            +1    +1
  10W-V YES    0s 29983  8468            +1    +1

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
```

```
 ----- ---- ---- ------ ----- ------- ----- -----
   1E-V YES    0s 32378  8418           +0    +0
   2E-V YES    0s 33608  8412           +1    +1
   3E-V YES    0s 32716  8383           -2    +1
   4E-V YES    0s 34617  8367           +2    +1
   5E-V YES    0s 33943  8487           -5    +1

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   6E-V YES    0s 31892  8485           -2    +1
   7E-V YES    0s 31817  8479           +2    +0
   8E-V YES    0s 34458  8479           +1    +1
   9E-V  NO    0s 32427  4185*          +0    +0
  10E-V YES    0s 31522  8418           -2    +1


Isobus Firmware:
   bank [1]: 1.10
```

In the example above, the load cell of the calibration fixture is connected to circuit 9E. The circuit connected to the load cell fails the test because the load cell responds at half the level of a normal vertical circuit. This is normal and will not affect the calibration.

In above example the “W” (west) circuits are the far rail circuits and the “E” (east) circuits are the near rail circuits. Thus, in the example, the load cell is attached to the A (bottom position) channel of the last FEP.

4. Use the HElp command to review the CaliBrate command options.

```
Track ONE > he cb
Usage:
  CB --HELP                         // more detailed usage
  CB -V                             // view calibration table
  CB --ENABLE                       // enable calibration mode
  CB -D                             // disable calibration mode
(broken!)
  CB -P <crib><rail>[-L]            // select primary channel
  CB -C <crib1><rail1> [<crib2><rail2>] // vertical calibration
  CB -L -C <crib1> [<crib2>]        // lateral calibration
  CB -O                             // configure options
  CB -R [-S]                        // restore default [simulation]
options
  CB --SCAN                         // load readings for all channels
  CB --STEP                         // calstep for all channels
  CB -B <code>                      // test beeper
```

5. Disconnect the power cord to the external modem if the WILD uses phone communication and then enable calibration mode.

```
Track ONE > cb –e
Enable Calibration mode!
<ISOACQ#0  2| Track Ready->Calibrate!>
Please wait for configuration to complete...
<ISOACQ#0  1| Ready to Calibrate!>
Calibration mode set.  Remember to do a new TEST every hour.
```

6. Set the primary channel. This is the channel with the load cell attached to it. In the example below, it is circuit 9E (The 9th circuit on the east rail.)

```
Track ONE > cb -p 9e
Primary=' 9E-V'
```

7. Set the options. The only critical options are the Primary Step Value and the Maximum Vertical Load. The Primary Step Value ***must*** match the value listed on the decal on the Shunt resistor box. The Maximum Vertical Load should be 30,000 pounds unless unusual circumstances require otherwise. Use 30,000 pounds unless instructed otherwise by qualified personnel. In case of any question, contact Salient Systems, Inc., for clarification.

```
Track ONE > cb -o
Configure calibration options:
  Empty response keeps current value.
  Enter 'B' to go back, 'Q' to quit.
             Primary Step Value (pounds) [ 30302] ? 30007
           Minimum Primary Step (counts) [ 20000] ?
          Maximum Vertical Load (pounds) [ 31000] ? 30000
          Minimum Vertical Load (pounds) [    25] ? q
```

8. Review the settings to make sure they are correct.

```
Track ONE > cb -o
Configure calibration options:
  Empty response keeps current value.
  Enter 'B' to go back, 'Q' to quit.
             Primary Step Value (pounds) [ 30007] ?
           Minimum Primary Step (counts) [ 20000] ?
          Maximum Vertical Load (pounds) [ 30000] ?
          Minimum Vertical Load (pounds) [    25] ? q
```

9. Now proceed to calibrate the channels on the rail opposite the one to which the caljack is attached. In the example below, the far (west) rail is calibrated.

```
Track ONE > cb -c 1w 10w

-------------------------------------------
---     Results are not being saved!    ---
---        Capture to a log file!       ---
```

```
------------------------------------------
Johnson City, Track (ONE)
Channel Calibrate, time now = Wed Nov 14 17:10:40 2001
Primary =  9E-V, Secondary[1] =  1W-V
```

10. The "beeper" in the Shunt resistor box beeps to indicate it is ready. Move the calibration switch on the Shunt resistor box to the on (CAL) position.

```
### Position CalJack, then flip switch ON
#  switch_target(start=32485 min=52485 max=65535)
#  Primary start=32485 current=32485
#  Primary start=32485 current=32485
#  Reached target! 32485 --> 56232
### Flip switch OFF to begin
```

11. The "beeper" trills to indicate the code is ready for the next step. Move the calibration switch on the Shunt resistor box to the "off" (NORM) position (Figure 10.31).

Figure 10.31 Switching the Shunt Resistor Box

```
#  switch_target(start=56232 min=32385 max=32585)
#  Primary start=56232 current=56232
#  Primary start=56232 current=56233
#  Primary start=56232 current=56233
#  Primary start=56232 current=56232
#  Reached target! 56232 --> 32485
### Getting Steady Zeros (1)
### Getting Secondary CalSteps (1)
### Flip CalJack switch ON
```

12. The "beeper" trills to indicate the code is ready for the next step. Move the calibration switch on the Shunt resistor box to the "on" (CAL) position.

```
#  switch_target(start=32484 min=52484 max=65535)
#  Primary start=32484 current=32484
#  Reached target! 32484 --> 56232
### Getting Primary Steady Step (1)
### Flip CalJack switch OFF
```

13. The “beeper” trills to indicate the code is ready for the next step. Move the calibration switch on the Shunt resistor box to the “off” (NORM) position.

```
#  switch_target(start=56232 min=32384 max=32584)
#  Primary start=56232 current=56232
#  Reached target! 56232 --> 32485
### Getting Steady Zeros (2)
### OK to load!
```

14. The “beeper” gives a tone to indicate it is OK to begin loading the circuit. Using the crank handles supplied with the fixture, rotate the central column clockwise. Considerable force is developed during this process. **Use two people, one for each handle (Figure 10.32).** Do not let the handles come free from the unit. Do not let the handles slip free or allow the central column to spin free out of control. Apply the force in a steady manner. The “beeper” clicks once for each 500 pounds of load applied.

Figure 10.32 Applying force to the rail

```
# z1=32484 z2=32484 s1=23748 z= 32484 ppc=   1.264 n= -1000
 P:      1 C:     1    1
 P:    582 C:   461   63
 P:   1116 C:   884  120
 P:   1751 C:  1386  187
 P:   2491 C:  1972  264
 P:   3381 C:  2676  358
 P:   4419 C:  3498  466
 P:   5181 C:  4101  545
 P:   5921 C:  4686  622
 P:   6513 C:  5155  684
 P:   7227 C:  5720  758
 P:   7912 C:  6262  829
 P:   8630 C:  6830  902
 P:   9283 C:  7347  971
 P:   9735 C:  7705 1017
 P:  10093 C:  7988 1054
 P:  10632 C:  8415 1110
 P:  11022 C:  8723 1151
 P:  11590 C:  9173 1210
 P:  12279 C:  9718 1281
 P:  12612 C:  9982 1316
 P:  13122 C: 10385 1369
 P:  13556 C: 10729 1414
 P:  14237 C: 11268 1485
 P:  14760 C: 11682 1539
 P:  15253 C: 12072 1591
 P:  15671 C: 12403 1633
 P:  16099 C: 12741 1678
 P:  16550 C: 13098 1725
 P:  17031 C: 13479 1775
 P:  17691 C: 14001 1842
 P:  18008 C: 14252 1876
 P:  18603 C: 14723 1938
 P:  19006 C: 15042 1980
 P:  19746 C: 15628 2057
 P:  20270 C: 16042 2112
 P:  20900 C: 16541 2176
 P:  21465 C: 16988 2235
 P:  21801 C: 17254 2269
 P:  22030 C: 17435 2293
 P:  22570 C: 17863 2349
 P:  23094 C: 18277 2403
 P:  23560 C: 18646 2452
 P:  24029 C: 19017 2500
 P:  24513 C: 19400 2550
 P:  25014 C: 19797 2602
 P:  25503 C: 20184 2653
 P:  26036 C: 20606 2707
 P:  26503 C: 20975 2756
 P:  27027 C: 21390 2810
 P:  27602 C: 21845 2870
 P:  28038 C: 22190 2915
 P:  28508 C: 22562 2964
```

```
 P:  29049 C: 22990  3020
 P:  29521 C: 23364  3069
 P:  30009 C: 23750  3119
### Hold load...
```

15. The "beeper" gives a long tone to indicate the loading should stop. Hold the handles at this position until the next tone sounds. That is the signal to begin unloading the circuit. Keeping the crank handles under control, allow them and the central column to rotate counterclockwise. **Do not let the handles come free from the unit. Do not let the handles slip free or allow the central column to spin free out of control until the force has dissipated. Remove the force in a steady manner**. The "beeper" sounds a tone when the force has been reduced to zero. Continue to rotate the column until the load cell is free of contact with the rail.

```
### Remove load
 P:  30319 C: 23995  3151
 P:  29960 C: 23711  3112
 P:  29165 C: 23082  3030
 P:  28548 C: 22594  2965
 P:  27905 C: 22085  2899
 P:  27267 C: 21580  2832
 P:  26463 C: 20944  2749
 P:  25600 C: 20261  2659
 P:  24580 C: 19453  2552
 P:  23728 C: 18779  2464
 P:  22960 C: 18171  2384
 P:  22282 C: 17635  2315
 P:  21514 C: 17027  2234
 P:  20564 C: 16275  2135
 P:  19581 C: 15497  2033
 P:  18235 C: 14432  1892
 P:  16545 C: 13094  1716
 P:  15134 C: 11978  1571
 P:  14146 C: 11196  1468
 P:  13242 C: 10480  1375
 P:  11656 C:  9225  1208
 P:  10602 C:  8391  1100
 P:   9771 C:  7733  1014
 P:   9131 C:  7227   947
 P:   8213 C:  6500   851
 P:   7135 C:  5647   739
 P:   5993 C:  4743   619
 P:   4529 C:  3585   468
 P:   3367 C:  2665   348
 P:   2290 C:  1813   236
 P:   1379 C:  1092   142
 P:    645 C:   511    66
 P:    324 C:   257    33
 P:     21 C:    17     1
### Getting Steady Zeros (3)
### Getting Secondary CalSteps (2)
```

```
### Flip CalJack switch ON
```

16. The “beeper” trills to indicate the code is ready for the next step. Move the calibration switch on the Shunt resistor box to the “on” (CAL) position.

```
#  switch_target(start=32490 min=52490 max=65535)
#  Primary start=32490 current=32490
#  Reached target! 32490 --> 56239
### Getting Primary Steady Step (2)
### Flip CalJack switch OFF
```

17. The “beeper” trills to indicate the code is ready for the next step. Move the calibration switch on the Shunt resistor box to the off (NORM) position. The SiteMaster code now automatically calculates the circuit sensitivity (gain).

```
#  switch_target(start=56238 min=32390 max=32590)
#  Primary start=56238 current=56238
#  Reached target! 56238 --> 32491
### Getting Steady Zeros (4)
######### Sample Statistics
             9E-V     1W-V
 Zero(1)    32484    32192
 Step(1)    23748     8318
 Zero(2)    32484    32192
  Steady    56549    35351
 Zero(3)    32490    32191
 step(2)    23748     8318
 Zero(4)    32490    32191
########## Options
 Primary pounds =  30007
 Threshold      =   1000
 Maximum Load   =  30000
########## Old Algorithm Results
  P   =  1430007

Channel:  1W-V
  Rat =    17886
  Cal =  79949

########## Regression Analysis
Channel:  1W-V (ONE)
    Inc: slope= 0.13108 int0=  7 intS=63403 (80113) ratio=63459
(80184)
    Dec: slope= 0.13137 int0= -2 intS=63340 (80034) ratio=63320
(80009)
    All: slope= 0.13118 int0=  4 intS=63379 (80083) ratio=63408
(80120)
```

After this, the “beeper” gives a double beep to indicate success and that it is ready to move to the next circuit.

```
-------------------------------------------
---     Results are not being saved!    ---
---        Capture to a log file!       ---
-------------------------------------------
Johnson City, Track (ONE)
Channel Calibrate, time now = Wed Nov 14 17:14:20 2001
Primary =  9E-V, Secondary[1] =  2W-V
.
```

18. Continue in this manner until all the circuits included on the “cb -c” command have been calibrated. If there is a failure during the calibration sequence, the “beeper” gives three long beeps. If this occurs, or if the calibration sequence must be stopped for any reason (e.g., train coming), type “<CONTROL>c” to abort and then restart the process. The circuits successfully calibrated are skipped and the “cb -c” command starts at the first uncalibrated circuit. On successful completion or failure, the system leaves calibration mode.

19. Once the first rail has been calibrated, calibrate the second rail using steps 1-18. Remember to move the caljack circuit to the first rail and to reconnect the original circuit the caljack replaced.

    In this example the caljack circuit has been moved to the 1W circuit.

```
Track ONE > te
Requesting test:
    Test command sent...
<ISOACQ#0  1| Ready to Calibrate!>
    Evaluation completed...

Current time: Wed Nov 14 17:44:05 2001

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   1W-V  NO    1s 32188  4184*           +0  +239*
   2W-V YES    1s 33293  8309            -3    -8
   3W-V YES    1s 32378  8331            -1    +0
   4W-V YES    1s 35667  8328            +1   -21
   5W-V YES    1s 34298  8381            +4   +17

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   6W-V YES    1s 34134  8385            +3   +12
   7W-V YES    1s 31333  8407            -1    -4
   8W-V YES    0s 33035  8407            +2    +2
   9W-V YES    0s 33090  8470            -1    -1
  10W-V YES    0s 29979  8469            +1    +4

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
```

```
   1E-V YES    0s 32375  8417            -1    +4
   2E-V YES    0s 33611  8411            +2    -2
   3E-V YES    0s 32721  8383            -2    -4
   4E-V YES    0s 34607  8366            +1   +11
   5E-V YES    0s 33931  8488            -6   +13


   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   6E-V YES    0s 31902  8486            -2    -9
   7E-V YES    0s 31820  8479            +1    -2
   8E-V YES    0s 34466  8479            +0    -7
   9E-V  NO    0s 32488  8412            +2  +2144*
  10E-V YES    0s 31533  8419            -2   -10


Isobus Firmware:
   bank [1]: 1.10
```

20. Remember to reset the front ends to rezero the circuits every ½ hour.

```
Track ONE > fe –r
Requesting Reset for all front ends for current track
Waiting for confirmation...
Reset completed.

Track ONE > te
Requesting test:
    Test command sent...
<ISOACQ#0  1| Ready to Calibrate!>
    Evaluation completed...

Current time: Wed Nov 14 17:44:15 2001

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   1W-V  NO    0s 32427  4185*           +0    +0
   2W-V YES    0s 33284  8310            -2    +0
   3W-V YES    0s 32378  8331            +0    +0
   4W-V YES    0s 35645  8328            +0    +0
   5W-V YES    0s 34314  8382            +3    +1

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   6W-V YES    0s 34145  8385            +3    +1
   7W-V YES    0s 31328  8408            +0    +0
   8W-V YES    0s 33036  8408            +0    +1
   9W-V YES    0s 33088  8469            +1    +1
  10W-V YES    0s 29983  8468            +1    +1

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   1E-V YES    0s 32378  8418            +0    +0
   2E-V YES    0s 33608  8412            +1    +1
```

```
   3E-V YES    0s 32716  8383            -2    +1
   4E-V YES    0s 34617  8367            +2    +1
   5E-V YES    0s 33943  8487            -5    +1


   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   6E-V YES    0s 31892  8485            -2    +1
   7E-V YES    0s 31817  8479            +2    +0
   8E-V YES    0s 34458  8479            +1    +1
   9E-V YES    0s 34632  8411            +1    +1
  10E-V YES    0s 31522  8418            -2    +1


Isobus Firmware:
   bank [1]: 1.10
```

21. Reenable calibrate mode if you have to reset the system from a train passing.

```
Track ONE > cb –e
Enable Calibration mode!
<ISOACQ#0  2| Track Ready->Calibrate!>
Please wait for configuration to complete...
<ISOACQ#0  1| Ready to Calibrate!>
Calibration mode set.  Remember to do a new TEST every hour.
```

22. Set the new primary channel whenever you change rails.

```
Track ONE > cb -p 1w
Primary=' 1W-V'
```

23. Always check that the options are properly set whenever you have to reset the system or if a train passes the site. If the system has not been reset, the values should still be valid.

```
Track ONE > cb –o
Configure calibration options:
  Empty response keeps current value.
  Enter 'B' to go back, 'Q' to quit.
             Primary Step Value (pounds) [ 30007] ?
           Minimum Primary Step (counts) [ 20000] ?
          Maximum Vertical Load (pounds) [ 30000] ? q
```

24. Calibrate the new circuits after ensuring you have the correct primary channel and the correct options set.

```
Track ONE > cb -c 1e 10e

-------------------------------------------
---     Results are not being saved!    ---
---        Capture to a log file!       ---
-------------------------------------------
Johnson City, Track (ONE)
Channel Calibrate, time now = Wed Nov 14 17:55:25 2001
Primary =  1W-V, Secondary[1] =  1E-V

### Position CalJack, then flip switch ON
#  switch_target(start=32423 min=52423 max=65535)
#  Primary start=32423 current=32423
#  Primary start=32423 current=32424
#  Primary start=32423 current=32423
#  Reached target! 32423 --> 55888
### Flip switch OFF to begin
#  switch_target(start=55888 min=32323 max=32523)
#  Primary start=55888 current=55888
#  Reached target! 55888 --> 32424
### Getting Steady Zeros (1)
### Getting Secondary CalSteps (1)
### Flip CalJack switch ON
#  switch_target(start=32423 min=52423 max=65535)
#  Primary start=32423 current=32423
#  Reached target! 32423 --> 55888
### Getting Primary Steady Step (1)
### Flip CalJack switch OFF
#  switch_target(start=55887 min=32323 max=32523)
#  Primary start=55887 current=55887
#  Reached target! 55887 --> 32422
### Getting Steady Zeros (2)
### OK to load!
# z1=32423 z2=32422 s1=23464 z= 32422 ppc=   1.279 n= -1000
 P:      1 C:     1     0
 P:    647 C:   506    73
 P:   1104 C:   864   123
 P:   1571 C:  1229   174
 P:   2507 C:  1961   275
 P:   3399 C:  2658   372
 P:   4360 C:  3410   474
 P:   5307 C:  4150   577
 P:   6056 C:  4736   655
 P:   6716 C:  5252   726
 P:   7371 C:  5764   797
 P:   8293 C:  6485   897
 P:   9021 C:  7054   974
 P:   9889 C:  7733  1067
 P:  10509 C:  8218  1134
 P:  11058 C:  8647  1194
 P:  11674 C:  9129  1260
```

```
 P:  12150 C:  9501  1313
 P:  12941 C: 10120  1396
 P:  13741 C: 10745  1481
 P:  14531 C: 11363  1566
 P:  15610 C: 12207  1683
 P:  16387 C: 12814  1764
 P:  16911 C: 13224  1820
 P:  17664 C: 13813  1901
 P:  18393 C: 14383  1980
 P:  19083 C: 14922  2052
 P:  19837 C: 15512  2134
 P:  20703 C: 16189  2228
 P:  21592 C: 16884  2323
 P:  22163 C: 17331  2382
 P:  22755 C: 17794  2446
 P:  23360 C: 18267  2511
 P:  23858 C: 18656  2563
 P:  24111 C: 18854  2592
 P:  24681 C: 19300  2652
 P:  25179 C: 19689  2705
 P:  25539 C: 19971  2742
 P:  26092 C: 20403  2801
 P:  26534 C: 20749  2849
 P:  27155 C: 21234  2915
 P:  27800 C: 21739  2984
 P:  28463 C: 22257  3055
 P:  29038 C: 22707  3115
 P:  29646 C: 23182  3181
 P:  30114 C: 23548  3231
### Hold load...
### Remove load
 P:  30830 C: 24108  3305
 P:  30239 C: 23646  3242
 P:  29339 C: 22942  3146
 P:  28347 C: 22166  3039
 P:  27018 C: 21127  2897
 P:  26048 C: 20369  2796
 P:  24857 C: 19437  2666
 P:  23518 C: 18390  2521
 P:  22342 C: 17471  2397
 P:  21314 C: 16667  2287
 P:  20030 C: 15663  2149
 P:  18749 C: 14661  2012
 P:  17088 C: 13362  1832
 P:  15327 C: 11985  1645
 P:  13668 C: 10688  1467
 P:  12237 C:  9569  1313
 P:  10877 C:  8506  1168
 P:   9803 C:  7666  1053
 P:   8579 C:  6709   921
 P:   7249 C:  5669   778
 P:   5804 C:  4539   624
 P:   4184 C:  3272   450
 P:   2892 C:  2262   312
 P:   1700 C:  1330   184
```

```
 P:    768 C:   601    85
 P:    297 C:   233    34
 P:     24 C:    19     6
### Getting Steady Zeros (3)
### Getting Secondary CalSteps (2)
### Flip CalJack switch ON
#  switch_target(start=32421 min=52421 max=65535)
#  Primary start=32421 current=32421
#  Reached target! 32421 --> 55886
### Getting Primary Steady Step (2)
### Flip CalJack switch OFF
#  switch_target(start=55886 min=32321 max=32521)
#  Primary start=55886 current=55886
#  Reached target! 55886 --> 32422
### Getting Steady Zeros (4)
######### Sample Statistics
             1W-V     1E-V
 Zero(1)    32423    32378
 Step(1)    23464     8416
 Zero(2)    32422    32378
  Steady    56540    35684
 Zero(3)    32421    32379
 step(2)    23465     8417
 Zero(4)    32421    32379
########## Options
 Primary pounds =  30007
 Threshold      =   1000
 Maximum Load   =  30000
########## Old Algorithm Results
  P   =  1146942

Channel:  1E-V
  Rat =    14646
  Cal =  78306

########## Regression Analysis
Channel:  1E-V (ONE)
    Inc: slope= 0.13696 int0=  8 intS=61390 (78509) ratio=61450
(78585)
    Dec: slope= 0.13705 int0=  2 intS=61393 (78513) ratio=61407
(78531)
    All: slope= 0.13698 int0=  6 intS=61393 (78513) ratio=61438
(78570)


-------------------------------------------
---     Results are not being saved!    ---
---        Capture to a log file!       ---
-------------------------------------------
Johnson City, Track (ONE)
Channel Calibrate, time now = Wed Nov 14 17:56:46 2001
Primary =  1W-V, Secondary[1] =  2E-V
```

25. Continue calibration until all circuits have been calibrated. Skip steps 26 to 31 if lateral circuits still need calibration and come back to step 26

once all of the lateral circuits are calibrated.

26. Go to the track ONE prompt and authorize calibration values. If any of the values are out of range, recalibrate the circuit until the correct calibration value occurs. Ensure wiring is correct and the Caljack is on the correct crib to get the calibration value. If most or all of the strain gages have been replaced for a crib, the old value may not be pertinent anymore. Simply override the old value.

```
If you are done calibrating, run 'cb --auth'to verify the calibration values.
TRACK ONE >cb --auth
Could not load properties from /var/etc/cal1.properties.
/var/etc/cal1.properties does not exist.
Calibration values for Track 1
Circuit 1N-V calibrate value: 81193
Circuit 1N-V calstep value: 8500
Circuit 1N-L calibrate value: 16206
Circuit 1N-L calstep value: 4250
Circuit 1S-V calibrate value: 81418
Circuit 1S-V calstep value: 8500
Circuit 1S-L calibrate value: 19919
Circuit 1S-L calstep value: 4250
.
.
.
Circuit 10S-V calibrate value: 83131
Circuit 10S-V calstep value: 8500
Circuit 10S-L calibrate value: 16031
Circuit 10S-L calstep value: 4250

************Calibration Values Authenticated****************
You must run 'cb --apply' to make these changes permanent.
```

27. Go to the Track ONE prompt and apply the calibration values.

```
You must run 'cb --apply' to make these changes permanent.
TRACK ONE >cb --apply
/var/etc/cal1.properties does not exist.
Copying /var/etc/newcal1.properties to /var/etc/cal1.properties.

************Calibration Values Applied****************
Calibration time set to Thu Jun 22 15:59:22 2006

TRACK ONE >
```

28. Go to the Track TWO prompt if the system is a two track system. Authorize the calibration values for the second track, recalibrating as necessary and overriding old values as necessary.

```
If you are done calibrating, run 'cb --auth'to verify the calibration values.
TRACK TWO >cb --auth
Could not load properties from /var/etc/cal2.properties.
/var/etc/cal2.properties does not exist.
Calibration values for Track 2
Circuit 1N-V calibrate value: 81193
Circuit 1N-V calstep value: 8500
Circuit 1N-L calibrate value: 16206
Circuit 1N-L calstep value: 4250
Circuit 1S-V calibrate value: 81418
Circuit 1S-V calstep value: 8500
Circuit 1S-L calibrate value: 19919
Circuit 1S-L calstep value: 4250
.
.
.
Circuit 10S-V calibrate value: 83131
Circuit 10S-V calstep value: 8500
Circuit 10S-L calibrate value: 16031
Circuit 10S-L calstep value: 4250


************Calibration Values Authenticated****************
You must run 'cb --apply' to make these changes permanent.
```

29. Apply the calibration values to Track TWO if the system is a two track system.

```
You must run 'cb --apply' to make these changes permanent.
TRACK TWO >cb --apply
/var/etc/cal2.properties does not exist.
Copying /var/etc/newcal2.properties to /var/etc/cal2.properties.

************Calibration Values Applied****************
Calibration time set to Thu Jun 22 15:59:22 2006

TRACK TWO >
```

30. Set the calibration time and save the system settings.

```
TRACK ONE >cb -settime

Calibration time set to Thu Jun  8 15:55:32 2006


TRACK ONE >sa
TRACK ONE >
```

31. Turn the phone modem back on and reset the system.

```
TRACK ONE > hr

Are you sure you want to reset the system? yes
```

Calibration Certification

Contact Salient Systems to certify your calibration. Supply Salient Systems with the serial number of your Caljack. Salient Systems cannot certify your calibration without knowing which Caljack you used. Salient systems will collect the calibration values from the system using remote login and get the time of the calibration. If remote login by Salient Systems is not possible, you will have to send a capture file containing the calibration values of all the circuits and send the calibration time to Salient Systems.

Lateral Site Calibration

For lateral calibration, the CalJack is assembled with the lateral modifications in Figures 10.23 to 10.26. Moreover, the electrical connections are the same as in vertical calibration, since the Shunt Resistor box connects to the same locations on the WILD System. The interface cable connects to the terminal strip location of the vertical channel for any FEP. This connection does not need to be moved throughout calibration—unlike for vertical testing.

Figure 10.33. CalJack assembled for lateral calibration

Once all the connections have been made, complete the following steps:

1. Set the primary connection from the computer console to the circuit connection it replaced. In this instance, the connection was made at the terminal strip, which corresponds to the second vertical circuit on the south rail.

```
Track ONE > cb -p 2s
Primary=' 2S-V'
```

2. Set the options as before, except now the values of interest are the Primary Step Value (as in the vertical calibration) and the Maximum Lateral Load. The Maximum Lateral Load must be much less than the vertical load. At values approaching or exceeding 15,000 pounds, there is a risk of rolling the rail over. This value should be no more than 12,000 pounds, and 10,000 is recommended. Contact appropriate rail personnel with any questions.

```
Track ONE > cb –o
Configure calibration options:
  Empty response keeps current value.
  Enter 'B' to go back, 'Q' to quit.
             Primary Step Value (pounds) [ 30007] ?
           Minimum Primary Step (counts) [ 20000] ?
          Maximum Vertical Load (pounds) [ 30000] ?
          Minimum Vertical Load (pounds) [    25] ?
          Vertical Load Display (pounds) [   500] ?
        Vertical Load Threshold (pounds) [  1000] ?
               Vertical Load Ratio Error [   300] ?
           Maximum Lateral Load (pounds) [ 10000] ?
           Minimum Lateral Load (pounds) [    25] ? q
```

3. Lay the CalJack on the track in the center of the crib so its lateral adaptors clasp both rail heads (Figure 10.34 – 10.37).

Figure 10.34. Lateral CalJack in proper position.

Figure 10.35. Lateral adaptors clasping rail head.

Figure 10.36. Lateral adaptors clasping rail head.

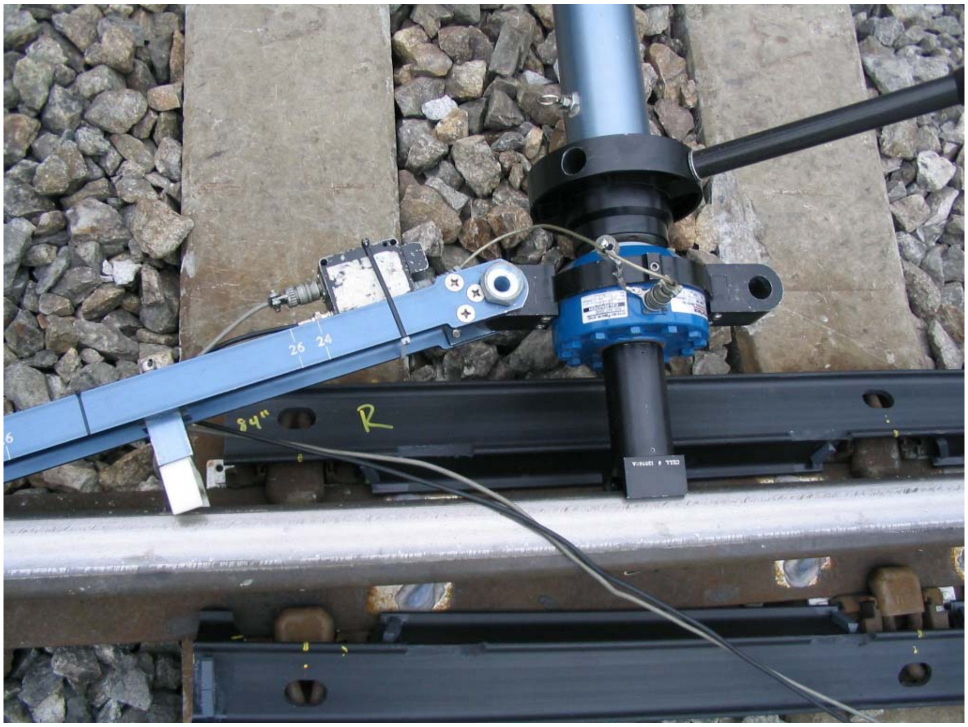


Figure 10.37. Connected arm with beeper.

4. Invoke the calibration (cb -l -c) command with the lateral option and proceed as for a vertical calibration. Because the caljack is pressing on both rails, the opposing circuits on each rail are calibrated simultaneously.

NOTE: The method of cranking the load cell is essentially the same as for a vertical circuit, but because the cylinder is now horizontal, techniques must be adjusted accordingly. The pressures involved are only 1/3 of those required for vertical calibration, so it takes much less cranking to complete the process.

```
Track ONE > cb -l -c 1

-------------------------------------------
---     Results are not being saved!    ---
---        Capture to a log file!       ---
-------------------------------------------
Duluth, Track (ONE)
Channel Calibrate, time now = Thu Feb 28 17:00:01 2002
Primary =  2S-V, Secondary[1] =  1N-L, Secondary[2] =  1S-L

### Position CalJack, then flip switch ON
#  switch_target(start=32742 min=52742 max=65535)
#  Primary start=32742 current=32742
#  Reached target! 32742 --> 56380
### Flip switch OFF to begin
#  switch_target(start=56380 min=32642 max=32842)
#  Primary start=56380 current=56380
#  Reached target! 56380 --> 32743
### Getting Steady Zeros (1)
### Getting Secondary CalSteps (1)
### Flip CalJack switch ON
#  switch_target(start=32741 min=52741 max=65535)
#  Primary start=32741 current=32741
#  Reached target! 32741 --> 56386
### Getting Primary Steady Step (1)
### Flip CalJack switch OFF
#  switch_target(start=56384 min=32641 max=32841)
#  Primary start=56384 current=56384
#  Reached target! 56384 --> 32742
### Getting Steady Zeros (2)
### OK to load!
# z1=32741 z2=32740 s1=23643 z= 32740 ppc=   1.266 n= -1000
 P:      3 C:     3     0     2
 P:   1238 C:   978   254   225
 P:   2043 C:  1614   425   366
 P:   3986 C:  3148   842   708
 P:   4958 C:  3916  1042   874
 P:   5685 C:  4490  1193  1000
 P:   6259 C:  4943  1309  1100
 P:   7042 C:  5561  1465  1234
 P:   7546 C:  5959  1565  1317
 P:   8252 C:  6517  1704  1435
 P:   8513 C:  6723  1753  1474
 P:   9036 C:  7136  1856  1557
 P:   9701 C:  7661  1983  1664
 P:  10142 C:  8009  2066  1730
### Hold load...
### Remove load
 P:   9974 C:  7877  2030  1699
 P:   9260 C:  7313  1878  1570
```

```
 P:   8313 C:  6565  1684  1406
 P:   7030 C:  5552  1424  1183
 P:   5454 C:  4307  1103   911
 P:   4567 C:  3607   922   759
 P:   4259 C:  3364   859   709
 P:   3395 C:  2681   679   558
 P:   1969 C:  1555   388   322
 P:   1287 C:  1017   253   210
 P:    358 C:   283    67    55
 P:     11 C:     9    -3    -5
### Getting Steady Zeros (3)
### Getting Secondary CalSteps (2)
### Flip CalJack switch ON
#  switch_target(start=32743 min=52743 max=65535)
#  Primary start=32743 current=32743
#  Reached target! 32743 --> 56390
### Getting Primary Steady Step (2)
### Flip CalJack switch OFF
#  switch_target(start=56389 min=32643 max=32843)
#  Primary start=56389 current=56389
#  Reached target! 56389 --> 32742
### Getting Steady Zeros (4)
######### Sample Statistics
             2S-V     1N-L     1S-L
 Zero(1)    32741    29521    33104
 Step(1)    23643     4245     4173
 Zero(2)    32740    29520    33106
  Steady    40679    31570    34816
 Zero(3)    32743    29513    33100
 step(2)    23646     4245     4173
 Zero(4)    32742    29509    33103
########## Options
 Primary pounds =  29940
 Threshold      =    500
 Maximum Load   =  10000
########## Old Algorithm Results
  P   =   139921

Channel:  1N-L
  Rat =     6755
  Cal =  20712

  P   =   139921

Channel:  1S-L
  Rat =     5753
  Cal =  24317

########## Regression Analysis
Channel:  1N-L (ONE)
    Inc: slope= 0.25766 int0= 22 intS=16391 (20757) ratio=16475
(20863)
    Dec: slope= 0.25883 int0=-12 intS=16450 (20831) ratio=16401
(20769)
    All: slope= 0.25927 int0=  1 intS=16368 (20727) ratio=16373
```

```
(20734)

Channel:  1S-L (ONE)
    Inc: slope= 0.21489 int0= 28 intS=19290 (24428) ratio=19419
(24591)
    Dec: slope= 0.21720 int0=-18 intS=19302 (24443) ratio=19213
(24330)
    All: slope= 0.21730 int0=  0 intS=19204 (24319) ratio=19204
(24319)
```

Continue the procedure until all circuits to be calibrated have been completed. Go to step 26 in the vertical calibration to finalize calibration and load lateral calibration values into the system.

Before you leave the site, contact Salient Systems and get the data reviewed for correct values. Salient Systems will inform you if any of the values need verification before you leave the site. Call U.S. number (614) 370-2615 to get a review of the calibration data.

Calibration Certification

Contact Salient Systems to certify your calibration. Supply Salient Systems with the serial number of your Caljack. Salient Systems cannot certify your calibration without knowing which Caljack you used. Salient systems will collect the calibration values from the system using remote login and get the time of the calibration. If remote login by Salient Systems is not possible, you will have to send a capture file containing the calibration values of all the circuits and send the calibration time to Salient Systems.

CHAPTER 11 — REPAIRING AND INSTALLING STRAIN GAGES

Fault Indications

The actual voltage drop produced by the strain gage Wheatstone bridge is a ratio between the compressed and stretched resistors of the gages. When measurements fall out of bounds of expected readings, the system shuts down the crib and ignores its readings.

Expected readings are programmed into the system and stored on the FEP modules. For this reason, the system can accommodate minor changes to gage alignment and integrity.

Gage measurements that become suspect are generally caused by the following conditions:

- **Gage alignment** changes within the crib;
- **Circuit continuity** changes between the **gage**s (open, short, floating resistance, or cable damage);
- **Noise** injected into the circuit due to leakage to the rail at the **gage** or cable;
- **Power supply** for the channel may be failed on the FEP module (described in Chapter 3).

Note

Use the Report -5 to check for cribs that have been turned off due to misalignment.

Gage Alignment

Since the gages are welded directly to the rails, the only way their alignment can change is from physical damage to the gage. However, a much more common condition that also affects the system's integrity is when the cross ties shift their position in relation to the gages. If this shift becomes great enough, gage deflection in one crib is magnified, while in the adjoining crib deflection is reduced.

- In the smaller crib (tie shifted toward the crib), the output voltage will be lower. Use Report -5 and check for average loads detected.

Visual Check

When you arrive at a WILD site, to quickly determine if the tie is properly aligned in the crib, check the gage cover bolt position over the tie. The bolt should be positioned over the center of the tie.

Record and report any tie/bolt misalignment. The maximum misalignment allowed is 1" off center.

Figure 11.1 depicts strain gage alignment.

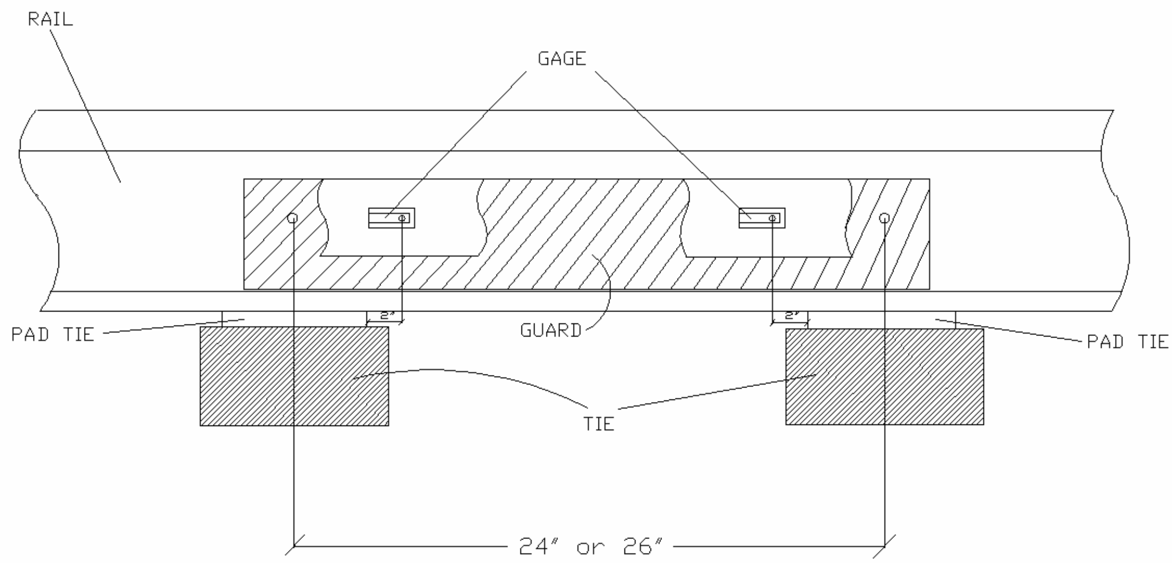


Figure 11.1. *Gage Alignment*

Circuit Continuity, Noise, and Power Supply Failure

The most common WILD circuit continuity problems are due to cabling problems: open, short, ground. This section helps you to quickly isolate these problems in the crib circuits.

Check Diagnostic Reports

Run the test command (TE) and look at reports 380, 480, 382, and 482. The test command will check the voltage levels on the individual data cable wires for you and find any obvious noise issues in the voltage from the strain gages. Reports 380 and 480 will tell you if a circuit (set of 4 gages) has produced any readings that did not become part of a train measurement over the past two weeks. Reports 382 and 482 will show the total high level readings collected by each circuit on the track over the past two weeks.

Execution of a TEst Command

The TEst command, available through the computer console, is a comprehensive and detailed tool for evaluating the strain gages. The command routes instructions through the ISOBus to the FEP cards. This command checks voltage and resistance on the strain gages for you. Any circuit that does not have the correct voltage and resistance on it cannot pass the test command.

The FEP boards connect to two calibration resistors during the test that simulate a total load of 8000 lbs for vertical circuits and 4000 lbs for lateral circuits. The FEP receives the circuit response from the strain gages, digitizes the result, and transmits the information back to the console through the ISOBus and CPU. The results indicate the health of the FEPs and the strain gages.

The response data from the FEP boards can be analyzed to determine the integrity of the strain gages. The data displays as shown below:

```
Track ONE > te

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   1W-V YES    0s 34632  8411   Varies   +1    +1
   2W-V YES    0s 33284  8310   Varies   -2    +0
   3W-V YES    0s 32378  8331   Varies   +0    +0
   4W-V YES    0s 35645  8328   Varies   +0    +0
   5W-V YES    0s 34314  8382   Varies   +3    +1

   Circ Pass Time  Zero  Step  Version  HS#   QZ#
  ----- ---- ---- ------ ----- ------- ----- -----
   6W-V YES    0s 34145  8385   Varies   +3    +1
   7W-V YES    0s 31328  8408   Varies   +0    +0
   . . . .
```

The first column, `Circ`, displays the strain gages' locations. The number refers to the crib, the first letter refers to the rail (in this case, the west rail) and the last letter distinguishes between vertical and lateral circuits.

The second column, `Pass`, displays whether the FEP board passed all of the diagnostic tests, which are displayed in the next columns. If a strain gage is faulty, the FEP board will also fail, so this column is the most pertinent for testing strain gages.

The third column, `Time`, displays the amount of time since the FEP responded to the SiteMaster's instructions. If the time is too great and exceeds a tolerance level, the FEP will not pass.

The fourth column, `Zero`, displays the zero level of the FEP in discreet counts. The nominal zero point is 32768. The count range is from 0 to 65536. Zeros should stay within 8000 counts of nominal for vertical gages and 12000 counts of nominal for lateral gages. This value varies due to temperature changes and self calibration calculations. An FEP recalculates this value every 2 minutes.

The fifth column, `Step`, displays the step value—or load induced by the resistors—in discreet counts from zero. The value should be near 8000 counts for vertical gages and 4000 counts for lateral gages.

The sixth column, `Version`, displays the version of the software on the FEP board. Contact Salient Systems if this value is not the same for all FEPs in a system.

The seventh column, `HS#`, displays the Half Step value. This value is the load variance induced by only one of the resistors, and shows the accuracy of those resistors. It should be within +/- 100 counts for vertical gages and +/- 50 counts for lateral gages.

The eighth column, `QZ#`, displays the quick zero value. This value is the difference between the long-term zero taken from the fourth column and the quick zero taken immediately after the resistors took a measurement. The long term zero is a zero value tabulated every 2 minutes by a front-end. This value naturally moves due to temperature changes and self calibration calculations. If this value is too far from zero, it means that the FEP will not have time to reset in between wheels. The change should be +/- 50 counts for both types of gages.

A ninth column, EMF, displays if the FEP is configured with optional extended memory. The EMF, or Extended Memory Failure, column responds positively if the memory module fails. This information is only required for Truck Performance Detectors. WILD systems do not use extended FE memory.

Run the 380 and 480 Reports

The 380 and 480 reports tabulate the number of false starts a circuit generates over a given statistics period. A false start is an impact message sent by a front end channel that is not associated with a vehicle defined in the car library of SiteMaster. Circuit noise, maintenance vehicles, and impacts from objects that are not trains will all generate false starts.

Statistics periods are usually at one week. You can confirm the statistics period using the ST command:

```
Track ONE > st
 Archived Statistics Period: WEEKLY
```

****The line above tells the statistics period****

```
 Weekly Statistics Reset Time = Sun 00:15
 Archived Statistics Reset is ENABLED
 Statistics were initialized Tue Dec 14 13:08:33 2004
 Number of trains through the site since midnight = 24
     Process     Status
   ----------   ---------------
       TRACK     Ready
       TRAIN     Absent
     ACQUIRE     Idle
    (ISOACQ)     Idle
    (TAGACQ)     Idle
     PROCESS     Success
     STORAGE     Success
     CALLOUT     Success
```

When the statistics period is weekly, the 380 report tells the number of false starts for the current week. The 480 report tells the number of false starts during the past week. This is the 380 and 480 report:

```
Track ONE > se 380
Report 380
  ---------------------------------------------
```

```
    CURRENT Statistics for WILD, Track (ONE)
    FRONT END NOISE

False start of trains:

    1      2      3      4      5      6      7      8
E   2      0      1      0      0      0      0      0
W   0      0      0    104      0      0      0      0

    9     10     11     12     13     14     15     16
E   0      0      2      0      0      0      0      0
W   0      0      0      1      0      2      0      0


Track ONE > se 480
Report 480
  ---------------------------------------------
    ARCHIVED Statistics for WILD, Track (ONE)
    FRONT END NOISE

False start of trains:

    1      2      3      4      5      6      7      8
E   0      2      0      0      0      0      2      0
W   0      1      0   1048      0      0      0      0

    9     10     11     12     13     14     15     16
E   0      0      0      0      1      0      0      0
W   0      0      0      0      0      1      0      0
```

In the above example 4W is showing excessive noise while other circuits show minor activity probably generated by high railers crossing the site. In the event that maintenance equipment crosses the site, all of the front ends could have 75 to 150 counts added to them by the number of wheels that cross them.

Any circuit that has 100 or more counts above the rest of the circuits is a noise suspect and should undergo the wet meg test described below.

Check the 382 and 482 Reports

The 382 and 482 reports tabulate the number of hits each circuit measures over a range of thresholds. They are not a comprehensive indication of health by themselves and they are the least reliable reports to determine if a circuit is noisy or not. Below is what the reports look like:

```
Track ONE > se 382


Report 382


  ---------------------------------------------
    CURRENT Statistics for WILD, Track (ONE)
    PEAK VALUES BY CHANNEL

V-Peak    150   140   130   120   110   100    90    80    70
    1S      0     0     0     0     0     1     3     8    26
    1N      0     0     0     0     0     3    10    28    65
    2S      0     0     0     0     0     0     2     8    24
    2N      0     0     0     0     0     0     3    16    53
    3S      0     0     0     0     0     0     0     4    22
    3N      0     0     0     0     1     2    11    21    61
    4S      0     0     0     0     0     1     6    24    55
    4N      0     0     0     0     0     1     8    38    82
    5S      0     0     0     0     1     2     4     9    37
    5N      0     0     0     0     0     2     6    20    51
    6S      0     0     0     0     0     0     3    16    42
    6N      0     0     0     0     0     0     4    32    80
    7S      0     0     0     0     1     3     4    13    42
    7N      0     0     0     0     0     3     5    19    48
    8S      0     0     0     0     0     0     2    11    27
    8N      0     0     0     0     1     1     3    12    36

V-Peak    150   140   130   120   110   100    90    80    70
    9S      0     0     0     0     0     1    10    27    57
    9N      0     0     0     0     0     0     1     9    32
   10S      0     0     0     0     0     3    13    31    67
   10N      0     0     0     0     0     0     4    14    39
   11S      0     0     0     0     1     2    14    28    64

   11N      0     0     0     0     0     2     2    15    44
   12S      0     0     0     0     0     1     5    21    51
```

12N	0	0	0	0	0	0	0	12	39
13S	0	0	0	0	0	1	3	23	40
13N	0	0	0	0	0	0	2	7	47
14S	0	0	0	0	0	2	6	18	52
14N	0	0	0	0	0	5	13	31	70
15S	0	0	0	0	0	0	1	12	41
15N	0	0	0	0	0	1	2	15	44
16S	0	0	0	0	0	0	2	7	23
16N	0	0	0	0	1	1	5	16	47

L-Peak	38	34	30	26	22	18	14	10	6
1S	0	0	0	0	0	0	0	1	15
1N	3	3	3	3	3	3	3	3	19
2S	0	0	0	0	0	0	0	1	15
2N	1	1	1	1	2	2	2	3	40
3S	1	1	1	1	1	1	1	2	17
3N	1	1	1	1	1	1	1	1	25
4S	0	0	0	0	0	0	0	0	16
4N	0	0	0	0	0	0	0	0	9
5S	0	0	0	0	0	0	0	0	9
5N	0	0	0	0	0	0	0	0	26
6S	0	0	0	0	0	0	0	0	12
6N	0	0	0	0	0	0	0	0	18
7S	0	0	0	0	0	0	0	0	7
7N	0	0	0	0	0	0	0	0	9
8S	0	0	0	0	0	0	0	0	14
8N	0	0	0	0	0	0	0	0	17

L-Peak	38	34	30	26	22	18	14	10	6
9S	0	0	0	0	0	0	0	0	11
9N	0	0	0	0	0	0	0	0	9
10S	0	0	0	0	0	0	0	0	17
10N	0	0	0	0	0	0	0	0	17
11S	0	0	0	0	0	0	0	0	12
11N	0	0	0	0	0	0	0	0	12
12S	0	0	0	0	0	0	0	0	9

```
    12N       0     0     0     0     0     0     0     0    12
    13S       0     0     0     0     0     0     0     0    12
    13N       0     0     0     0     0     0     0     0     9
    14S       0     0     0     0     0     0     0     1    15
    14N       0     0     0     0     0     0     0     1    32
    15S       0     0     0     0     0     0     0     0     6
    15N       1     1     1     1     1     1     1     1    13
    16S       1     1     1     1     2     2     2     2     8
    16N       1     1     1     1     1     1     1     1     8

Track ONE > se 482

Report 482

  ---------------------------------------------
    ARCHIVED Statistics for WILD, Track (ONE)
    PEAK VALUES BY CHANNEL

V-Peak    150   140   130   120   110   100    90    80    70
    1S      0     0     0     1     1     1     6    15    67
    1N      0     0     0     0     1     7    17    49   138
    2S      0     0     0     0     0     0     7    22    52
    2N      0     0     0     0     2     3    13    49   151
    3S      0     0     0     0     1     1     5    16    50
    3N      0     0     0     0     1     2    12    44   139
    4S      0     0     0     0     5     6    16    49   117
    4N      0     0     0     0     4     8    27    75   190
    5S      0     0     0     0     0     3     9    26   101
    5N      0     0     0     0     2     7    23    66   161
    6S      0     0     0     1     1     4    10    40   131
    6N      0     0     0     0     2     5    12    49   168
    7S      0     0     0     0     0     0     7    27    76
    7N      0     0     0     0     0     3    11    47   134
    8S      0     0     0     0     0     0     1    17    55
    8N      0     0     0     0     0     1     4    34   113
```

V-Peak	150	140	130	120	110	100	90	80	70
9S	0	0	0	1	4	11	21	61	145
9N	0	0	0	0	0	1	8	32	95
10S	0	0	0	0	1	4	14	48	134
10N	0	0	0	0	1	2	14	50	130
11S	1	1	1	1	1	4	18	48	127
11N	1	1	1	1	1	5	12	33	109
12S	0	0	0	0	0	4	12	43	114
12N	0	0	0	0	2	4	14	39	92
13S	0	0	0	0	0	1	12	44	139
13N	0	0	0	0	1	5	18	43	119
14S	1	1	1	2	2	3	8	33	127
14N	1	1	1	1	3	6	19	62	145
15S	0	0	0	0	0	3	9	33	85
15N	0	0	0	0	1	3	13	41	140
16S	0	0	0	0	1	4	12	28	80
16N	0	0	0	0	0	0	4	35	116

L-Peak	38	34	30	26	22	18	14	10	6
1S	5	5	5	5	6	6	6	7	24
1N	1	1	1	2	2	3	4	5	47
2S	0	1	1	1	2	2	2	3	21
2N	5	6	7	7	7	7	9	10	86
3S	8	9	9	11	11	13	14	14	34
3N	5	5	5	5	5	7	7	8	42
4S	1	1	1	1	1	1	1	2	24
4N	0	0	0	0	0	0	0	1	17
5S	0	0	0	0	0	0	0	1	12
5N	0	0	0	0	0	0	0	1	47
6S	0	0	0	0	0	0	0	0	20
6N	0	0	0	0	0	0	0	1	28
7S	0	0	0	0	0	0	0	1	11
7N	0	0	0	0	0	0	0	1	17
8S	0	0	0	0	0	0	0	1	18
8N	0	0	0	0	0	0	0	1	35

L-Peak	38	34	30	26	22	18	14	10	6
9S	0	0	0	0	0	0	1	1	12
9N	0	0	0	0	0	0	0	1	19
10S	0	0	0	0	0	0	1	1	19
10N	0	0	0	0	0	0	1	1	30
11S	0	0	0	0	0	0	0	0	13
11N	0	0	0	0	0	0	1	1	22
12S	0	0	0	0	0	0	1	1	13
12N	0	0	0	0	0	0	1	1	29
13S	0	0	0	0	0	0	1	1	17
13N	0	0	0	0	0	0	0	1	23
14S	0	0	0	0	0	0	1	1	20
14N	0	0	0	0	0	0	1	2	78
15S	1	1	1	1	1	1	1	2	8
15N	3	3	3	3	4	4	4	5	42
16S	7	8	8	8	8	8	8	9	13
16N	7	7	7	7	7	7	7	9	35

The first column has the circuit name. The columns to the right are the counts for the various KIP levels as defined by the first row. Vertical circuits have counts for KIP measurements from 70 to 150. Lateral circuits have counts for KIP measurements from 6 to 38.

To determine potential noise problems, look in the 150 KIP column for vertical circuits and the 38 KIP column for lateral circuits. Noisy circuits will have counts three times the average for all of the gages on the track. In the example above, 1N-L may have noise under the 382 report and the following circuits show potential noise problems under the 482 report: 1S-L, 2N-L, 3S-L, 3N-L, 16S-L, and 16N-L. Skewed averages in the lower KIP ranges may indicate a weak spot in the ballast, rail, a calibration shift caused by rail wear, or a noisy circuit.

You can test a circuit that shows deviations under this report and you may or may not find a problem. Recalibration can sometimes even the statistics in this report as well, but may not change trends caused by ballast, tie, or rail latent defects. Lateral circuits are particularly irregular because situations outside of the instrumented zone will send forces down a train that will cause vehicles to move side to side inside the instrumented zone. In the above example, the site may have perfect gage health and insulation, but curves around the track generate occasional bumps on the side of the rail for vehicles with loose suspension.

This report is most powerful when a wheel shop reports callouts that do not have a defect associated with them. Often, the 382 or 482 reports will quickly show the circuit responsible for the noise so a maintainer can disable it with the kill command.

Circuit Repair

This section tells you the steps to check and repair circuits with potential issues from the 380 or 382 reports or failed circuits from the test function.

Check FEP Connections

If you suspect a continuity problem in a crib circuit, check for loose or broken connections of the gage inputs at the rear terminals of the FEPs (located in the WILD bungalow).

Figure 11.2 depicts the wire pattern between the data wire from the gage circuits and the backplane connector of the WILD system.

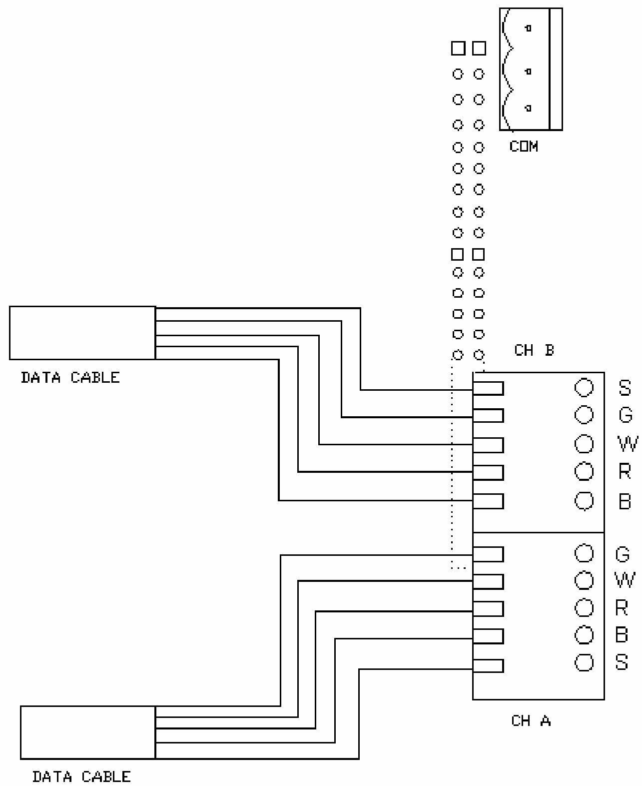


Figure 11.2. FEP Backplane

Measurements

A gage circuit is comprised of four strain gages in a Wheatstone bridge. The system applies 10 VDC across the bridge with the output around common and the input common around 5 VDC. See Figure 11.3 for a visual representation of a gage circuit.

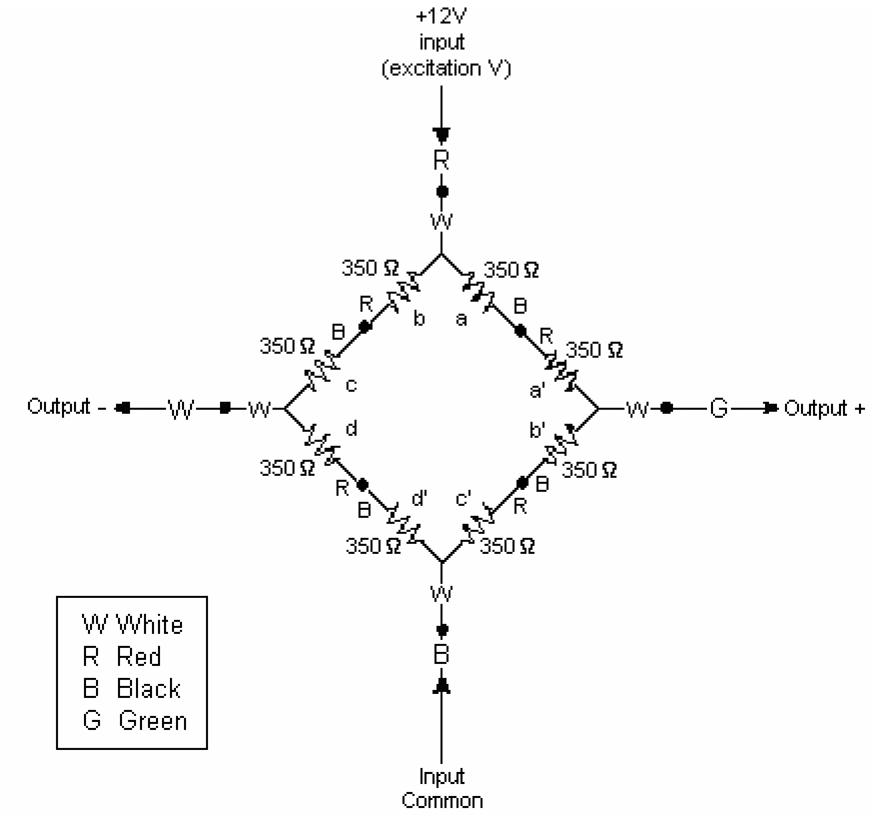


Figure 11.3. WILD Vertical Gage Configuration

The total resistance of each leg of the normal vertical Wheatstone bridge is 700 Ω. The following table lists the expected voltages and resistance values of a normal circuit with no wheel present in the crib.

- When taking resistance measurements, remove the FEP module of the circuit you are testing. This allows you to measure the circuit without disconnecting the wires from the block.

Measurement Points on a System for Vertical Circuits	Expected Value (no power, FEP removed)	Expected Value (power, FEP installed)
Green to White	700 Ω, ±5%	0 VDC ± 0.1 V
Red to Black	700 Ω, ±5%	9.8 VDC ± 0.1 V
Green to Red / Black	525 Ω, ±5%	4.9 VDC ± 0.1 V
White to Red / Black	525 Ω, ±5%	4.9 VDC ± 0.1 V

Measurement Points on a System for Lateral Circuits	Expected Value (no power, FEP removed)	Expected Value (power, FEP installed)
Green to White	350 Ω, ±5%	0 VDC ± 0.1 V
Red to Black	350 Ω, ±5%	9.8 VDC ± 0.1 V
Green to Red / Black	262.5 Ω, ±5%	4.9 VDC ± 0.1 V
White to Red / Black	262.5 Ω, ±5%	4.9 VDC ± 0.1 V

Isolating Faulty Gages

Problems in the circuit give you an odd reading for one of the legs.

- A shorted resistor of one of the vertical gages gives the following resistance values:
  - ~ 325 Ω across the faulty leg
  - ~ 500 Ω across other legs
  - ~ 0 Ω across the faulty resistor
  - ~ 300 Ω across any normal resistors
- An open resistor of one of the vertical gages gives the following resistance values:
  - ~ 2100 Ω across the faulty leg
  - ~ 700 Ω across other legs
  - ~ 2450 Ω across the faulty resistor
  - ~ 350 Ω across any normal resistor
- Occasionally, the resistance material of a gage may float across its neutral point, causing the circuit to unbalance. In this case, check for lower or higher voltage and resistance values across one leg to identify suspect gages.
  - The first indication of this situation is an abnormally high difference between Green and White bridge wires (maximum is 12mV).

Isolating Individual Resistors

By utilizing the resistance values in the tables above, individual failed resistors can be identified, so that only one gage needs to be replaced, instead of an entire crib. Follow the steps below to find gages with bad resistor values.

1. Identify the suspect resistors in the faulty leg(s) (e.g., a and a′).
2. Refer to Figure 11.3 to locate the suspect gage wires to check.
3. At the rail interconnections, measure directly across the suspect resistors (see Figures 11.4 through 11.7).
4. Disconnect only the faulty resistor and recheck your measurement to confirm gage is defective.
5. Replace the defective gage.

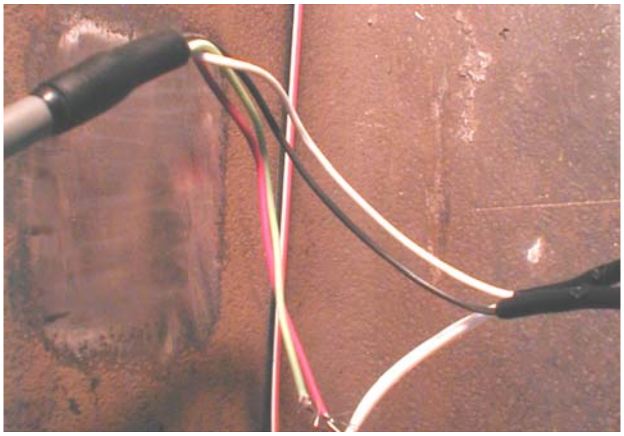


Figure 11.4. In this example, the leg between the white and black leads is tested.

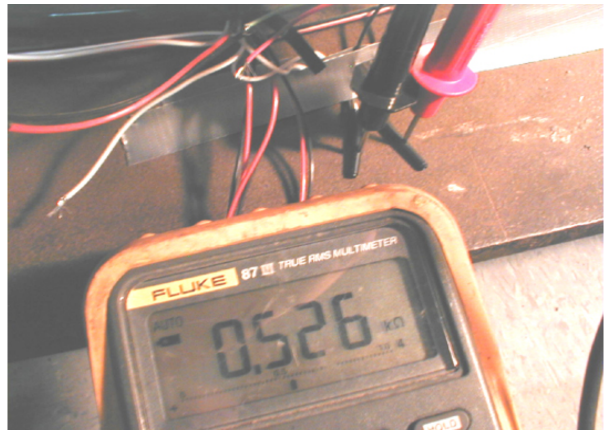


Figure 11.5. Force the needle probe through the shrink caps, and measure the resistance. In this case, the reading is normal.

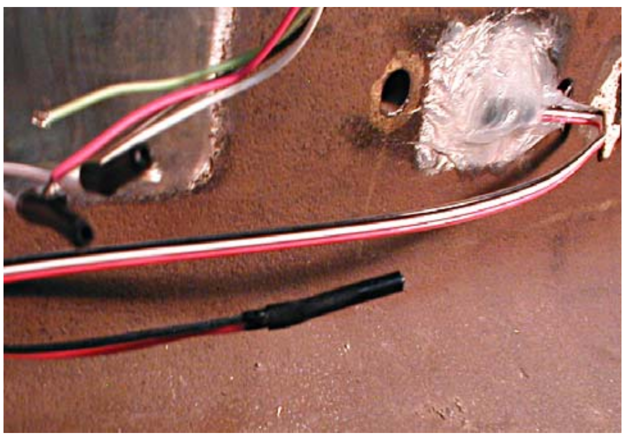


Figure 11.6. If the resistance of the individual legs is to be measured, the correct connection between strain gages must be tested. Check with Figure 11.4 to determine the right connection.

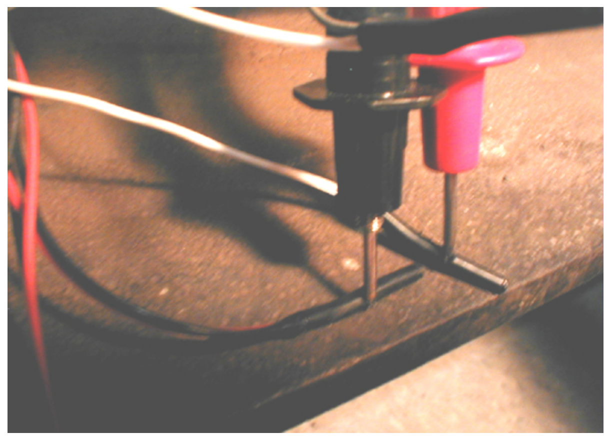


Figure 11.7. Use the same procedure for measurement as before.

Reseal All Joints

During installation, the installation crew solders and seals all joints in the circuit to prevent moisture from entering the joints. Therefore, when breaking a soldered joint becomes necessary, **always resolder the joint and seal it properly with approved joint sealing compound**.

Megger Test for Noisy Circuits

A common problem with the crib circuits is noise injected into the circuit due to humidity either through the bridge circuit itself or through the cable shield. The following megger test will help you to quickly identify potentially noisy circuits.

1. Pull the associated FEP module from the cage.
2. Disconnect the associated shield wire from the ISO Backplane.

3. Megger between the individual circuit wires and the shield: should be ~ ∞ Ω.
4. Megger between the individual circuit wires and the rail: should be ~ ∞ Ω.
5. Megger between the shield wire and the rail: should be ~ ∞ Ω.
6. Spray the strain gage wires with water and repeat steps 3 through 5, but run your fingers along the wires towards the gage to find any shorts from wire to wire due to nicks in the insulation.
7. If the nick is far enough from the strain gage, you can be repair it by sleeving with heat shrink. Cut the shoulder off a shrink cap (so only a tube remains), slide it down to the affected area and shrink with a heat gun.

Note

Use the Test command (See section on "Circuit Continuity") to identify potentially noisy circuits that are shut down by the system. If a circuit is shut down, the crib will be shut down and may show abnormally high levels of false train starts.

Gage Replacement

Changing a gage requires special jigs and should be performed only by specially trained personnel. The replacement procedure consists of:

- Gage replacement on the rail;
- Soldering and then sealing the joint connections with epoxy filled end caps;
- Re-calibration of FEP software to accommodate a change in circuit resistance ratios.

Testing

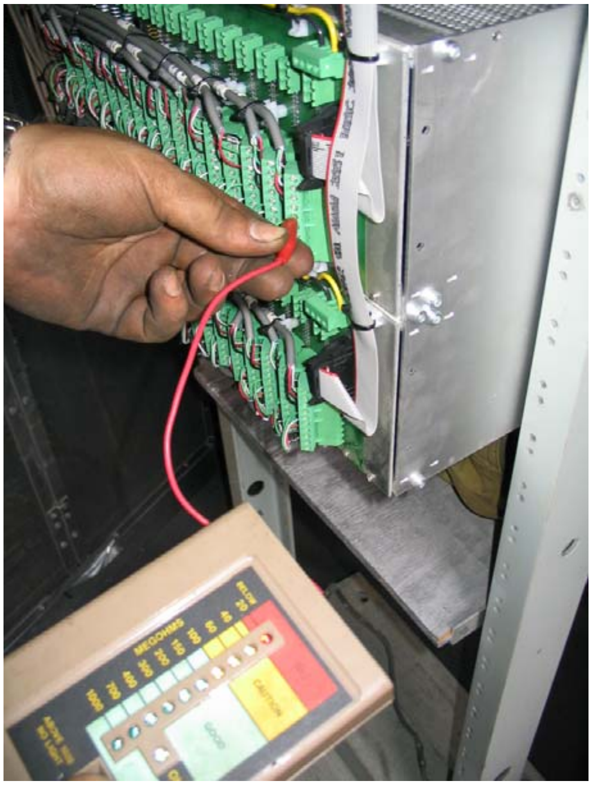


Figure 11.9 (top). Megger testing inside bungalow.

Figure 11.10 (above). Applying water to wires on rail.

A common problem with the crib circuits is noise injected into the circuit due to humidity either through the bridge circuit itself or through the cable shield. The following megger test helps you to quickly identify potentially noisy circuits.

1. Pull the associated FEP module from the cage and disconnect the associated cable from the ISO Backplane.
2. From inside the bungalow at the WILD backplane, megger between the individual circuit wire and the shield, between the individual circuit wires and the rail, and between the shield and the rail (Figure 11.9). **NOTE:** Meggering between any wire and the rail requires running a wire from one lead to the rail. The resistance in each of these cases should be ∞ Ω, signifying that there are no shorts.
3. Have an assistant spray the strain gage wires with water (Figure 11.10). Perform the same three megger tests while the assistant runs his fingers from the end of the wires towards the gage to test for shorts from wire to wire due to nicks in the insulation. **NOTE:** If there is a nick, it can be fixed by cutting the shoulder off a shrink cap and sliding it down the wires to the damaged area. Then shrink with a heat gun.

Grinding

If a gage is faulty, use a punch to mark the gage's four corners so that the new gage can be easily placed in the same location. Then remove the faulty gage with a scraper. It should come off fairly easily. Next, polish the rail surface underneath the gage using a smooth, up-and-down motion with a rotary grinder and 120 grit discs (Figure 11.11).

Figure 11.11 Grinding the rail.

Welding

Figure 11.12. Welding the metal coupon.

Follow these steps to perform welding:

1. Place new strain gages within the punch marks of the old gages, ensuring that the wires are all oriented in the same direction, and weld the gages into place. **NOTE:** The gage welder is a custom-manufactured model produced by Salient Systems.
2. Place the gage welder's magnetic ground pin on the rail head close to the gage, and then press the welder tip against the gage's metallic coupon. A subsequent beep indicates the welder has fired, and its internal capacitor has fully recharged.

A welding pattern determines the order and placement of each weld.

1. Weld twice at the horizontal center of the gage—once on each side of the black housing for the resistors.
2. Weld from these two points away from the wiring and against the black resistor housing.
3. Weld against the housing towards the wiring.
4. Weld an exterior ring against the edge of the metal coupon. This process is illustrated in Figures 11.12 – 11.14.

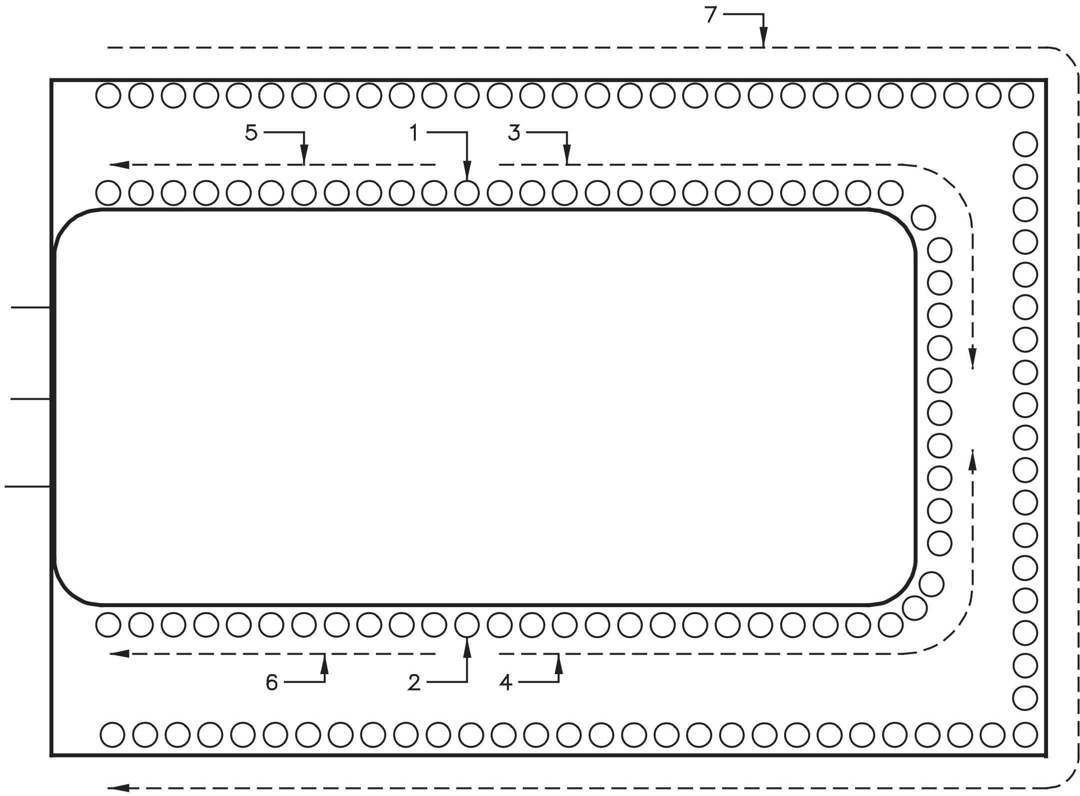


Figure 11.13. Diagram for welding

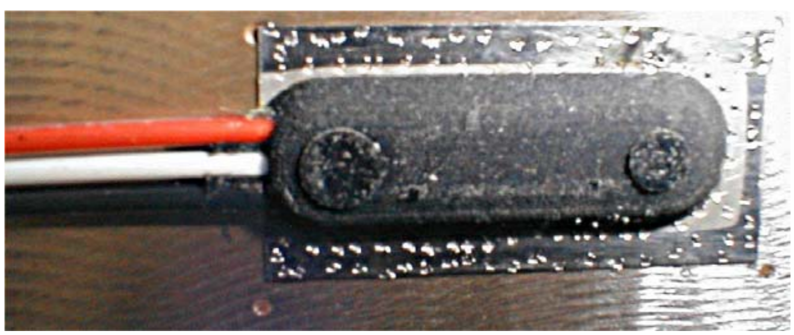
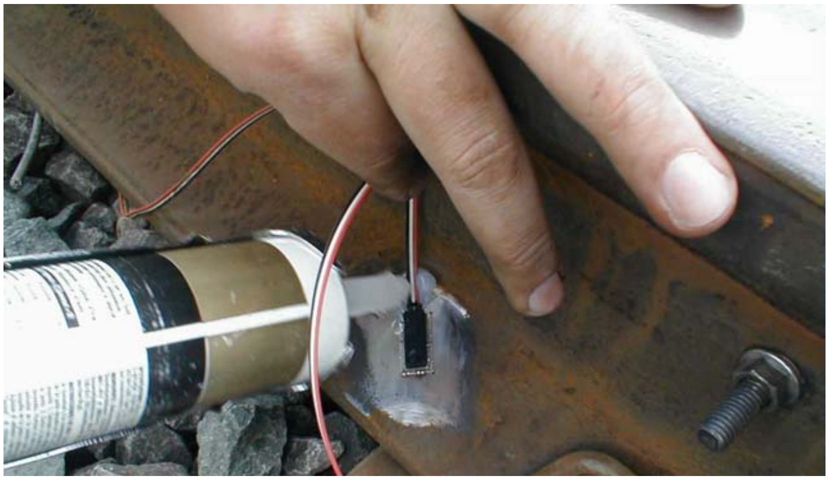


Figure 11.14 Welded strain gage.

Caulking



After welding, the gages must be sealed with caulk to prevent water damage (Figures 11.15 – 11.16).

1. First, caulk underneath the wiring of the gage, then go around the outside of the gage, forming a rectangle.
2. Spread caulk in a line down the top of the gage. Do not create air bubbles.
3. Smooth the caulk around with a finger to force out any air pockets and smoothly taper the edges of the caulk.

Figure 11.15. Caulking the gage.

Figure 11.16. Caulked strain gages

Terminating

Figure 11.17. Stripping the leads.

Follow these steps to terminateall the wires for the newly-replaced strain gage.

1. Strip and tin the ends of the wires (Figure 11.17).
2. Solder the ends according to the correct diagram below: Figure 11.18 for vertical strain gages, Figure 11.19 for lateral strain gages on the far rail, and Figure 11.20 for lateral strain gages on the near rail.
3. After the wires have been soldered, place a shrink cap on the solder joint and heat until secure.
4. Bind all the wires together with tie wraps. **NOTE:** All vertical gage wires should be to one side, so that the instrumentation wires from data cable are not bent. The lateral wires should be to the other side, as the lateral data cable comes from the opposite direction.
5. Lay all wires flat against the data cables, not pinched behind them. Proper wire binding is illustrated below in Figure 11.21.
6. Replace all the guards. Place the guards back onto the studs, and secure with the cams, washers and nuts. Make sure no wires are pinched by the guards.

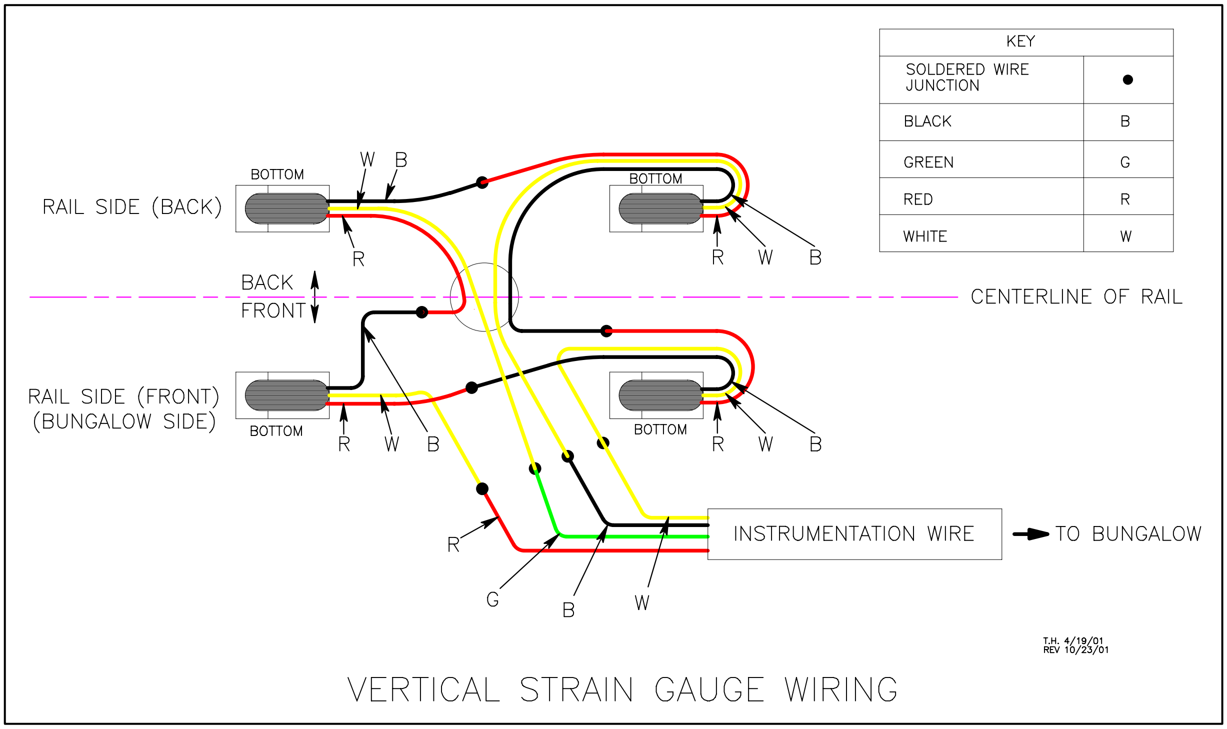


Figure 11.18.

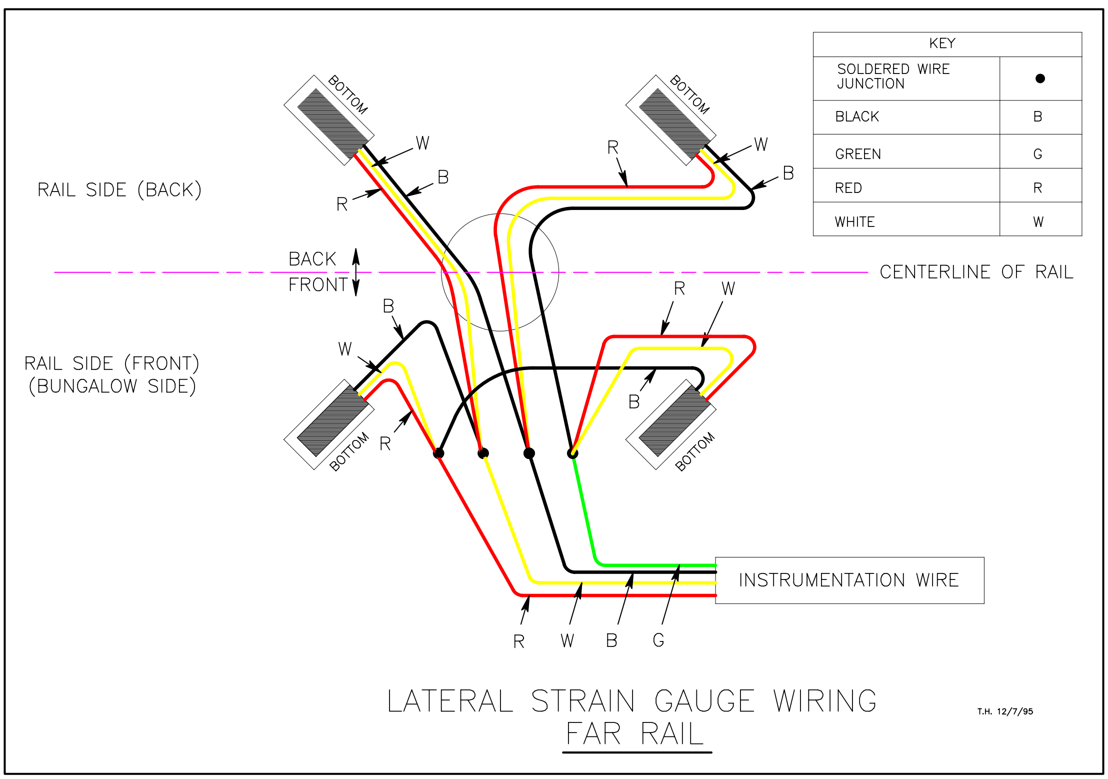


Figure 11.19.

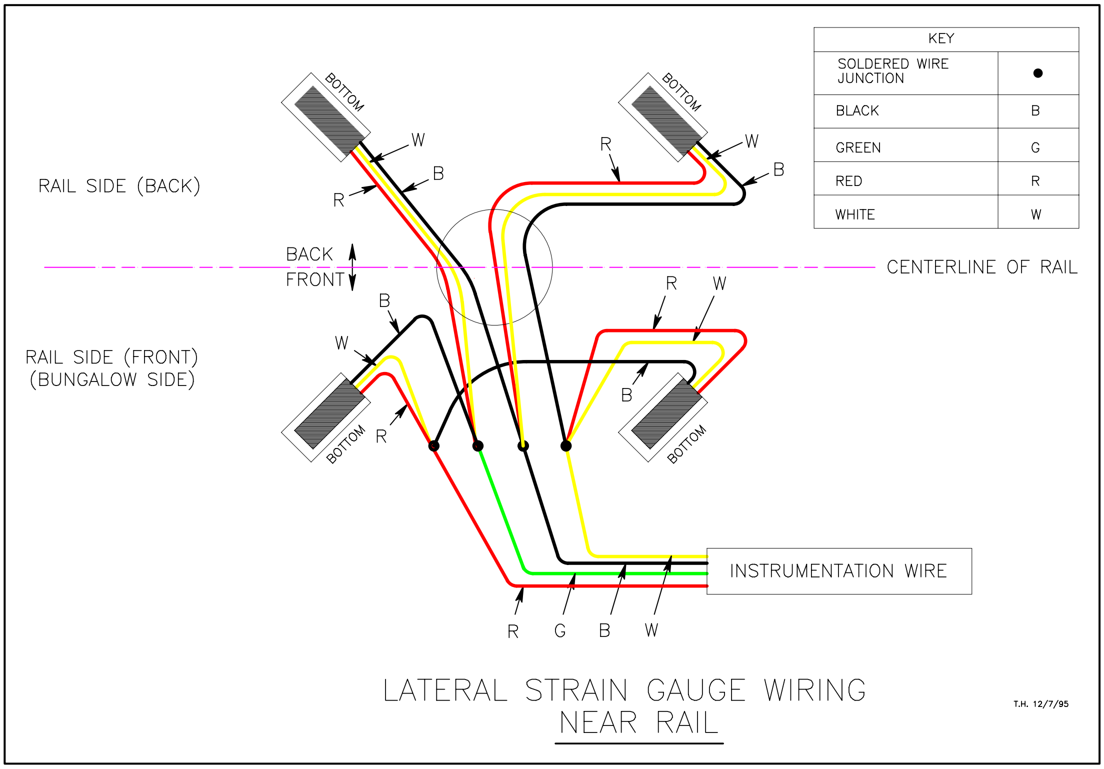


Figure 11.20.

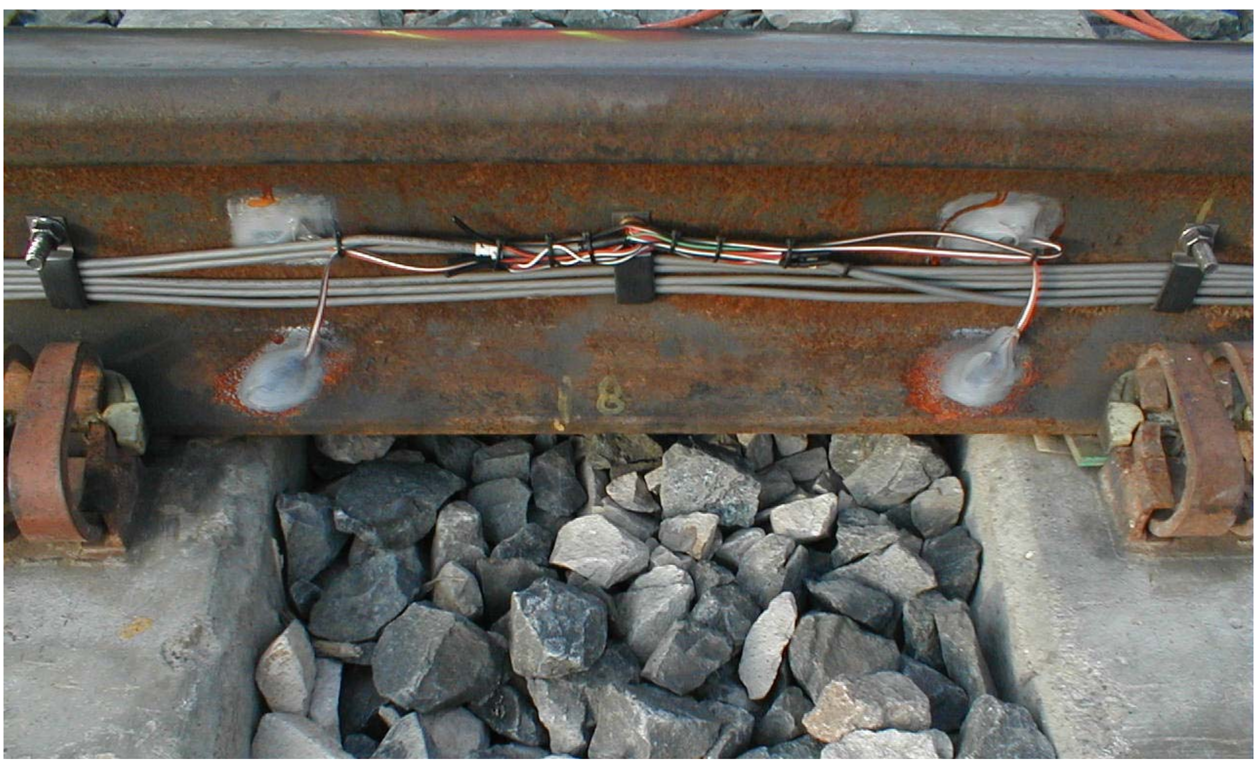


Figure 11.21. Strain gage wiring bound together.

Strain Gage Installation

Follow these steps to install strain gages:

1. Select a 200 yard stretch of rail with 0% elevation and straight track. In the center of the stretch, there must be 150 feet of track without any field welds. In the center of the 150 feet, there must be 52 feet of track without any factory welds.
2. Get a site configuration drawing from Salient Systems that shows what the instrumented zone measurements are from a bird's eye view.
3. Reduce the tie pads from 7" rail contact to 5" rail contact for all ties that will be next to strain gages.
4. Replace the wood ties with concrete ties for the 150 feet of field weld free track. Use the reduced tie pads for the concrete ties that will be next to strain gages. The concrete ties must be centered on the instrumented zone where the gages will reside. Ties will eventually have to have spacing that matches their particular configuration. Contact Salient Systems for exact tie spacing.
5. Resurface the 200 yard stretch of straight rail to reduce vertical rail deflection to less than ½ inch. If the ballast is already meeting this requirement or simple tamping will correct any deficiencies, then resurfacing is not necessary. If the ballast is pulverized to cement quality in the 200 yard stretch, resurface to remove the condition.
6. Have Salient Systems drill holes in the rail to match the tie spacing mentioned in step 2.

Grinding

7. Using 30 grit grinding pads and a disc grinder, remove the raised lettering from the sides of the holes to the point where the rail is flat in a one inch diameter from the center of the hole.
8. Using a 45 degree metal carbide grinding tip and a drill, take the burrs off the edge of the holes and round the edges of the holes. This action removes metal edges that might damage wires or mounting bolt threads.
9. Bump the concrete ties to be within 1/8 of an inch centerline with the centerline of the holes over the ties. Holes will be at 12 inch or 13 inch spacing. Ties will be at 24 inch or 26 inch spacing. The hole between ties is for strain gage wires that must route to the opposite side of the rail.
10. Install the mounting bolts to the holes above the centerline of the ties. These bolts are guides for the gage pad templates and gage mounting templates.
11. Mark the gage pads by mounting the metal gage pad template over the mounting bolts. Use a yellow or white paint marker to color the rail where the pad must lay. The pad template labeled "front" applies to the side of the rail where the data cable from the hose assembly resides. The pad template labeled "rear" applies to the side of the rail that does not have the data cable running along it.
12. Using 30 grit grinding pads and a disc grinder, polish the rail to a flat

finish where the pad markings are. The rail must be flat without any rust or rust pits, without pits from engraved letters or numbers, and without bumps from raised letters or numbers on the side of the rail. Work from left to right so grinding debris does not collect on the polished pads.

13. Using 120 grit grinding pads and a disc grinder, polish the pads to a smooth finish. Ensure no grit or debris rests on the pad. Check the finish by putting your finger nail to the pad and making out the ridges of your nail from the reflection of the pad. The pad should be flat and reflective.

Welding

14. Place the correct gage welding template to the rail. For each instrumented crib, the “front” side is the side where the data cable runs down the rail and the “rear” side is the side without data cable from the hose assembly. The “front” of the gages is the side opposite the strain gage wires and they should face to the left. The “rear” of the gages is the side where the strain gage wires attach to the strain gage case.

    Use the “left front” welding template against the left-hand mounting bolt when facing the “front” side of the rail. Use the “right front” welding template against the right-hand mounting bolt when facing the “front” side of the rail. Use the “left rear” welding template on the left-hand bolt when facing the “rear” side of the rail. Use the “right rear” welding template against the right-hand bolt when facing the “rear” side of the rail.

    The end of the arm of the welding template must fit snuggly to the mounting bolt. The crease of the welding template must fit snuggly into the transition of the rail from the neck to the boot. The opening where the strain gages fit must have contact to the polished welding pad around the edges.

15. Ready the gage welding tool.

16. Place the strain gage into the gage template opening. **NOTE: Make sure the gage is centered and squared in the opening.** The gage foil can slip under the welding template and cause misalignment. The wires should leave the gages on the right-hand side of the gages on the “front” side of the rail. The gage wires should leave the gages on the left-hand side of the gages on the “rear” side of the rail. The templates have a notch on the side of the strain gage opening to allow clearance for the gage wires.

17. Weld the strain gage onto the side of the rail.

18. Seal the strain gage using neutral cure, clear, pure silicon, sealant. General Electric’s Silicone II is an excellent example. Ensure the sealant is on the gage before night, rain, or dew and within 20 minutes of welding the gage to the side of the rail. It is important to keep moisture off the gage and the foil of the gage. Place a dollop under the gage wire where it exits the black plastic gage case. Run a caulk line around the outer edge of the gage foil. Coat the top side of the gage. Ensure the silicon covers the gage with at least a ¼ inch thickness. Ensure the

silicon coverage extends a minimum of ½ inch on the rail around the strain gage. Massage all air bubbles out of the silicon to ensure a water tight seal. Add silicon as necessary to keep the thickness and width of the seal beyond minimum requirements. Be generous with the silicon because the seal must last 15 years.

19. Tuck the gage wire under the nearest tie clip or through the center crib rail hole to prevent a train wheel from running over the wire.
20. Finish welding all of the gages and wait for the silicon to cure.

Connecting

21. Route the data cables from the hose assembly down the rail.
22. At the first crib (a crib is the span between two ties), locate the four strain gages that belong to it. The gages are over the edges of the ties that mark the border of the crib. Route the two "rear" strain gage wires through the center rail hole. Face the "front" side of the rail. Route the data cable and two "front" strain gage wires to the center rail hole and make a pig tail with the wires from all four gages and the data cable extending from the center rail hole to your body. Cut the wires to an even length at the point where the "left rear" gage wire limits the maximum length of the pigtail. The "left rear" gage wire has the longest route because it exits the gage towards the mounting bolt instead of the center hole, and it must pass through the center hole.
23. Remove the outer shield of the data cable from the base of the pigtail to the tip of the pigtail.
24. Clip off the bare shield wire in the data cable at the base of the pigtail where the outer shield ends.
25. Place shrink cap sealing putty (ABM's AK-22 works well) around the four data wires where they exit the outer data cable shield at the base of the pigtail.
26. Clip the closed end off the top of a shrink cap. The shrink cap must have industrial temperature rating (-40 Celsius to 65 Celsius) and be moisture proof rated. Place the shrink cap half way over the outer shield of the data wires and half way over the data wires at the base of the pigtail.
27. Being careful not to melt or damage the data wire insulation, shrink the shrink cap over the end of the outer data cable shield so that moisture will not get inside the outer data cable shield or contact the bare shield cable.
28. Remove ¼ inch of the insulation from the end of the gage wires and the data wires.
29. Connect the wires together in the proper pattern by twisting the bared ends together.
30. Make sure the different connections are not touching the ground, rail, or each other. Run a test on the circuit using SiteMaster. If the circuit passes the test, the connections are valid and it is good to proceed. If the circuit fails, ensure the wires did not shift, and contact something with

the bare ends or find where the connection pattern is not correct.

31. Tin the twisted connections together with solder.
32. Place shrink cap sealing putty (ABM's AK-22 works well) inside the wire joints and place a shrink cap over the wire joints. The shrink cap must have industrial temperature rating (-40 Celsius to 65 Celsius) and have a moisture proof seal. Shrink the shrink caps over the joints ensuring that the bare ends of the wire are sealed from any moisture. Be careful not to melt or damage the insulation on any of the wires.
33. Test the circuit using SiteMaster to ensure the connections are sound and that the insulation on the wires is good.
34. Dress the wires to the side of the rail by zip tying the pigtail into a neat line and then zip tying the pigtail to the data cable where the pigtail rests against the shielded data wire along the rail. Make sure the strain gage cables and unshielded part of the data cables do not pinch or rest against the rail. Do not tighten zip ties to the point where they damage the insulation of the wires, but make them snug so they stay still with rail vibration.
35. Once all of the cribs are complete, place the plastic guards over the gages and wire. Ensure the guards do not rest on any strain gages and do not pinch any wire. Guards should rest on the mounting bolts and rail. Guards should have left and right movement play, so they can contract and expand without interference with the rail. If a mounting bolt is snug to the right or left of a mounting hole in the guard, open the guard mounting hole with the drill and 45 degree carbide grinding tip to allow at least ¼ inch movement. Ensure the guards are clear of the tie clips. Open the notches of the guard if they do not clear the tie clips. Ensure the guards do not rest on lateral strain gage wires. Open the notches on the inside of the guard to keep them away from lateral gage wires, if necessary.
36. Once the guards fit properly, mount them to the rail by using the washers and nylon insert nuts on the mounting bolts.
37. Calibrate the circuits. Any circuit with an invalid calibration value may have a wiring pattern problem. Negative calibration values indicate a certain wiring pattern problem.

CHAPTER 12 — SYSTEM COMMANDS

System configuration

This section lists the various on-line commands that you can use to test, configure, and maintain the WILD system.

Logging on

You can log-on to a WILD site using any standard VT100 emulation program. When you dial in, the site presents you with a standard login ID prompt.

- At the ID prompt, enter *picard*. This gives you access to the system at its lowest security level.
- At the Password prompt, enter *malibu*. No password is needed for this security level.

If a train passes through the site while you are logged on, this may prevent the system from processing the train (depending on what tests you are running).

Also, failure to log off when the system prompts you may cause the system to lose critical train data.

Entering commands

Once you are logged-on to the system, you access the commands by typing in the first 2 letters of the command.

- Entering a space following by X after a command will list all the commands options available.
- Entering HE (Help) will list all available commands.
- When you type in a command without any parameter changes, the program will list the current system settings.
- When you type in a command with parameter changes, the program will perform the command and return you to the prompt.

Security levels

The Level column in the Command Listing table (following pages) indicates the level of security needed to perform the command.

- 0 is the lowest security level. All level 0 commands are available without a password.
- Level 1 is the security level for system administrators and is only accessible with a security password.
- Level 2 is the highest security level used by system programmers to access the WILD program code. It also is only accessible with a security password.

Command/Function	Abbreviation	Level	Description
BYE	**BY**	0	logs user off the system
CALIBRATE	**CB**	4	automatic front end calibration
CALLOUT QUEUE	**CQ**	4	display callout queue
CAR LIBRARY	**CARLIB**	3	retrieve car library info
CHANGE DIRECTORY	**CD**	0	change working directory
CHANNEL STATUS	**CS**	3	display channel status
CHAT	**CH**	4	establish two-way communications with given port
CLEAR	**CL**	4	clear the system setup and restore default
COMPRESS	**LHA**	3	compress or decompress .lzh files
DEBUG	**DB**	5	enable process debug
DIAMETER TABLE	**DT**	4	configure diameter tables
DISPLAY DRIFT	**DR**	3	display FE drift fixes
DISPLAY EVENTS	**EVENTS**	0	display events
DISPLAY TEXT	**ECHO**	0	display text
EXTENDED WHEEL	**EX**	5	display extended wheel data
FE-PROGRAM	**FEPR**	3	program front ends
FILTER	**FILTER**	4	allows user to check, enable, or disable any of the available filter functions
FRONT END CONTROL	**FE**	3	reset, synch, configure, and evaluate front ends
HARD RESET	**HR**	4	resets the system
HELP	**HE**	1	displays a listing of all the system commands with a short description of each command

Command/Function	Abbreviation	Level	Description
ISOBUS RESET	**IR**	3	performs a software reset of the ISOBUS Interface Card
KILL	**KI**	3	allows user to check status, enable or disable any or all FEPs
LIST FILES	**LS**	3	display directory contents
MESSAGE STATS	**ME**	3	display ISOBus message statistics
MODEM STRING	**MS**	3	configure modem initialization strings
NOISE FILTER	**NO**	3	configure POSTP parameters
OFFSET	**OF**	0	view/set front end test range parameters
PHONE	**PH**	3	allows user to review, set or clear any/all of the 10 report calling locations
PORT	**PO**	3	configure port settings
PROCESS TABLE	**PT**	3	display information about processes
RECEIVE FILE	**RZ**	5	receive a file using Z-Modem
REMOVE	**RM**	3	delete files
REPORT	**RE**	3	allows user to review/change the report status of any/all calling locations
RETRY DELAY	**RD**	3	view/set failed callout retry delay
SAVE SETUP	**SA**	3	save current track setup data to memory
SEND REPORT	**SE**	2	allows user to view reports
SEND Z-MODEM	**SZ**	3	send a file using Z-modem protocol

Command/Function	Abbreviation	Level	Description
STATISTICS	**ST**	3	allows user to set up and view the train statistics data
STATUS INTERVAL	**SI**	3	set time interval between status message
STF LOAD TRAIN	**RT**	3	load and process a train from an .STF file
STF SAVE TRAIN	**SV**	3	manually create an STF file
SUBSTITUTE USER	**SU**	0	log in as different user
TAG READER	**TA**	3	check/set distance from tag reader antenna to site center
TAG TABLE	**TT**	3	check/set table of tags and thresholds for conditional callouts
TEST	**TE**	3	test front end status
THRESHOLD	**TH**	3	allows user to review, set or clear thresholds
TIME	**DATE**	3	allows user to check system clock
TRACK	**TR**	0	select track number (for multi-track systems)
TRACK MODE	**MD**	3	allows user to set one of several diagnostic track modes
UNIT CHANGE	**UN**	4	temporarily change displayed units
UPTIME	**UPTIME**	3	process ages
VERSION	**VE**	3	displays software version number
VIEW FILE	**CAT**	3	view file contents
VIEW SETUP	**VI**	3	allows user to view current status of all configurable settings stored in battery-backed memory
WEATHER	**WE**	3	displays current weather data
WHOAMI	**WHOAMI**	0	display login information

INTRO

DESCRIPTION

This section describes, in alphabetical order, the user commands and their syntax for the Wheel Impact Load Detector (WILD) system. Each command has an associated manual page describing the function and input to the command. Each manual page will consistently contain four sections comprised of **NAME, SYNOPSIS, DESCRIPTION**, and **EXAMPLE**. In addition to this, other descriptive sections may be detailed where applicable. These consist of **OPTIONS, USAGE, SEE ALSO, BUGS**, and **HISTORY**.

The **NAME** section of the manual page gives the name and a brief description of the command. It is intended for identification purposes only.

The **SYNOPSIS** section contains abbreviated input formats for each version of a command and a description of its function. The following is an example of a typical command line format:

COmmand { switch list } <argument>

The `COmmand` is followed by a `switch list` indicating any switches that may be used with the command. These switches allow for activation or modification of various features within a command. The `switch list` may be empty, contain a single switch, or contain a list of switches enclosed in braces `[ ]`. The braces indicate that one of the enclosed switches must be chosen. Switches are easily identified since they are always preceded by the minus sign (`-`). Switches allow the user to modify the function of a command, usually to change a setting. The commands have been carefully designed to perform a nondestructive task in the default form (i.e., no switch selected), and may only change current settings when used with the proper switch. Some commands require no switches, in which case none are described.

The argument portion of the command line indicates information that must accompany the command. Some commands may allow for the `select All option (-A)` to be used in place of the argument. In these cases, the argument format will indicate that either an argument ("or" is represented by the vertical bar **|**), or the `select All option` must be present. Then the command line format looks like:

```
COmmand { switch list } (-A | argument)
```

For commands that require arguments (enclosed in `< >`), a separate **OPTIONS** section is included that details the parameter description. This section describes what information should be entered in place of those carets.

Again, some commands require no arguments, in which case none are described.

Command line entries can be made in either upper or lowercase, and the `BACK SPACE` key may be used to make corrections. Two significant letters are required for the interpreter to recognize the command.

The **DESCRIPTION** section is a detailed description of the command and its options. Working examples of commands are given to help the user become more familiar with the actual use and function of each command. The examples are given in both the long and abbreviated format.

USAGE is a section that describes different actions the command can perform and the equivalent synopsis for each one.

In the **EXAMPLES** Normal Text denotes system responses and prompts while **Bold Text** indicates the user entry. This section details specific situations in which the command might be used and the system's responses to the command.

The **SEE ALSO** section contains names of other related section pages which may be useful for further explanation and understanding of the command.

BUGS is a section that details any known glitches you may encounter while using the command.

The **HISTORY** of a command will give information on how the command came about as well as any other names it may have been called previously.

BYE

NAME

Bye -- log out of system

Equivalent commands:

- BYE
- BY
- LOGOUT
- EXIT

Access Level: Nobody

SYNOPSIS

BYE	end login session

DESCRIPTION

This command will end the login session. If the user is logged in remotely, the connection will be closed and the modem initialized. The user will be given the option to save the configuration before exiting. If the configuration is not saved, any changes made may be lost if the system is reset before the next automatic save.

Entering "No, not yet!" at the save prompt will abort the logout process and return the user to the track prompt.

EXAMPLE

```
Track ONE> by <RETURN>

Save Setup? (Y/N)   [N] Y <RETURN>
BYE
```

CALIBRATE FE

NAME

Calibrate FE -- calibrate front ends

Equivalent commands:

- `CB`

Access Level: Administrator

SYNOPSIS

`CB --HELP`	more detailed usage
`CB -V`	view calibration table
`CB --ENABLE`	enable calibration mode
`CB -D`	disable calibration mode
`CB -P <crib><rail>[-L]`	select primary channel
`CB -C <crib1><rail1> [<crib2><rail2>]`	vertical calibration
`CB -L -C <crib1> [<crib2>]`	lateral calibration
`CB -O`	configure options
`CB -R [-S]`	restore default [simulation] options
`CB --SCAN`	load readings for all channels
`CB --STEP`	calstep for all channels
`CB -B <code>`	test beeper

OPTIONS

Parameter Description:

`<crib>`	crib number
`<rail>`	rail letter designation
`<code>`	beep code number

DESCRIPTION

This command allows site calibration. Each crib circuit is tested with a known load and the sensitivity of circuit response is measured and recorded. This measured sensitivity can be stored in the system and used to convert measurements made by each crib circuit into equivalent pound loads. This command should only be used during calibration by qualified personnel.

The `cb -v` command can be used to view the current calibration table. This will show the calibration set value in use for each crib.

USAGE

To view a set of instructions for performing a calibration:

```
CB -- HELP
```

To display the calibration table:

```
CB -V
```

EXAMPLE

Display calibration help command.

```
Track ONE> cb -- help <RETURN>

Using the new calibration command:

Calibration mode must first be enabled with the --ENABLE option.
The beeper should be attached to OU-2 of the first system ISOBus.
Next, select the primary channel that the caljack is attached to
using the -P option (for lateral sites, add the -L switch when the
*caljack* is attached to a lateral channel).  Begin the
calibration routine with the [-L] -C options.  Finally, disable
calibration mode with the -D option.

Hit ^C at any time to abort.  Warnings will be signaled with 6
short beeps; last channel done (or fatal error) will be 3 long
beeps.
```

Display current calibration table.

```
Track ONE> cb -v <RETURN>

Circ        Calibration          Current
----- | --- ------ ----- ----- | ----- -----
 1N-V    NO  78885  8511  9.27    8537  9.24
 1N-L    NO  17291  4278  4.04    4282  4.04
 1S-V    NO  77053  8418  9.15    8504  9.06
 1S-L    NO  17656  4262  4.14    4271  4.13

.                  .                        .
.                  .                        .
.                  .                        .

Circ        Calibration          Current
----- | --- ------ ----- ----- | ----- -----
16N-V    NO  79409  8458  9.39    8497  9.35
16N-L    NO  15506  4251  3.65    4267  3.63
16S-V    NO  80286  8360  9.60    8449  9.50
16S-L    NO  16114  4236  3.80    4242  3.80
```

Set primary channel for calibration to crib 10, North rail.

```
Track ONE> cb -p 10n <RETURN>
```

CALLOUT QUEUE

NAME

Callout Queue -- display and manipulate queued files

Equivalent commands:

- `CQ`
- `DQ`

Access Level: Administrator

SYNOPSIS

`CQ`	display callout queue settings
`CQ <loc>`	display callout queue data for 1 phone location
`CQ -S <loc>`	display callout queue statistics for 1 phone location

OPTIONS

Parameter Description:

`<loc>`	phone table location

DESCRIPTION

The callout queue is a list of saved reports to be sent to each location. The queue itself is saved to disk, meaning the saved reports may be sent even after events such as another train passage, a system reset, loss of power, or many failed connections.

USAGE

Display the callout queue:

```
CQ
```

Display call out data for a location:

```
CQ <loc>
```

Display statistics for a location:

```
CQ -S <loc>
```

EXAMPLE

Display the callout queue. This site has no queued reports enabled.

```
Track ONE> cq  <RETURN>

PH[00]
PH[01]
PH[02]
PH[03]
PH[04]
PH[05]
PH[06]
PH[07]
PH[08]
PH[09]
```

Display the callout queue. This site has a queued report enabled in location 5. There have been no failures and there are no reports waiting to be called out.

```
Track ONE> cq <RETURN>

PH[00]
PH[01]
PH[02]
PH[03]
PH[04]
PH[05]      Time Now [11-02 16:54] Mode[0] Queued[0]
PH[06]
PH[07]
PH[08]
PH[09]
```

Display the callout queue. This site has a queued report enabled in location 5. There was a connection failure, the last attempt being on 03 November at 08:12. There is one report waiting to be called out.

```
Track ONE> cq <RETURN>

PH[00]
PH[01]
PH[02]
PH[03]
PH[04]
PH[05]      Time Now [11-03 08:13] Mode[0] Queued[1] Fails[0]
            Last Attempt [11-03 08:12]
PH[06]
PH[07]
PH[08]
PH[09]
```