Global Traffic Technologies

Operation Manual February 2008

Opticom™ Infrared System

M195/196, M9192, M292, M9592,
M592 Emitters
M511, M521, M522 Detectors
M262, M562 Phase Selectors
M360, M560 System Chassis
M5168, M5575 Interface Cards

The items described in this manual, originally manufactured by 3M have been discontinued. Ongoing support including any warranty if applicable will be handled by Global Traffic Technologies.

Table of Contents

Figures

1. Introduction

The Global Traffic Technologies Opticom™ Infrared System Operation Manual contains the Opticom system operation, maintenance, and troubleshooting information.

The manual is divided into ten sections with two appendices. Section 2 contains an overall operational view of the Opticom components, as well as a description of how they work together in a system.

Sections 3 through 8 are devoted to the individual Opticom system components.

Section 9 describes the maintenance procedures for the Opticom system. Section 10 contains the system and component troubleshooting information.

Appendix A is the glossary and Appendix B is the index.

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2. System Theory of Operation

The GTT Opticom™ Infrared System consists of three major component groups. Vehicle mounted emitters; detectors mounted at or near the traffic intersection, and phase selectors and associated control electronics mounted in the traffic controller cabinet.

The emitter, with an appropriate accessory switch, is mounted on the priority vehicle. It generates a series of optical pulses in the visible and infrared wavelengths.

The pulses generated by the emitter are sensed by the optical detector mounted at the intersection. The detector converts the optical energy into electrical signals that are transmitted by cable to the phase selector, interface card, system chassis combination in the traffic controller cabinet.

The phase selector discriminates between valid emitter signals and other sources of optical energy received from the detectors, and activates its outputs in response to valid emitter signals. The phase selector outputs are connected to the traffic controller's inputs that cause the traffic controller to deliver the desired green for the priority vehicle.

Interface cards are installed in a system chassis in the traffic controller cabinet. Interface cards receive the signals from the phase selector, convert them to signals or pulses the controller will recognize, and send them to the controller (or to other equipment as is the case with the confirmation light card). Interface cards also arbitrate signals from multiple channels on multiple phase selectors to be sure that only one is active at a time. The controller then interrupts the normal intersection light sequence and generates the desired green.

There is one interface card specifically designed to facilitate the manipulation of electromechanical traffic controllers.

The Electromechanical card, a four–channel dual–priority device, interfaces the phase selectors outputs to an electromechanical traffic controller. The card provides interface to traffic controllers light.

operating up to four phases. These controllers usually include a dial mechanism and a cam device. The card is connected electrically in series between these elements. When the priority control system is inactive, the pulses generated by the dial to advance the cam are allowed to pass through the interface card. When the priority control system is active, the circuit connecting the dial to the cam opens and the card generates pulses at a rate selected on the card. The card senses the traffic signal green indications and stops generating pulses when the desired green is sensed. A Recall feature is also included to return the cam to the proper position relative to the dial at the end of the priority control activity. You may set green times for each of four phases and the yellow time.

Confirmation lights are white lights mounted at the intersection and aimed at the approaching traffic. They are intended to alert all vehicle operators and pedestrians to the priority vehicle activity at the intersection.

Confirmation lights are not required for the Opticom system. They are optional.

Ten patterns of confirmation light activity are available. You may select a pattern appropriate for your system needs and for those of the surrounding jurisdictions (if appropriate). You select the pattern by setting a switch to the number that corresponds to the desired pattern as detailed in the installation instructions. The patterns are generated on the printed circuit board. The switching of the AC mains voltage to the lamps is accomplished with other devices not on the circuit board, such as load switches or relays.

When an emitter–equipped vehicle, with the emitter turned on, approaches an equipped intersection, the detector senses the emitter signal, converts the optical signals to electrical signals, and transmits the signals by cable to the phase selector. The phase selector verifies the signal validity, and signals the traffic controller (sometimes with the aid of an interface card to give the approaching vehicle a green

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3. Emitters

The emitter, with an appropriate control switch, is mounted on the priority vehicle. It generates a series of optical pulses in the visible and infrared wavelengths. The optical detector mounted at the intersection senses the pulses.

Emitters consist of three functional blocks: the flash-tube, the power supply, and the pulse timing circuitry.

The flash-tube housing (flash head) contains a reflector and a protective lens. On most emitters the lens is translucent but on some models an opaque lens, that appears black, may be provided. This lens is known as the Visible Light Filter and it filters out wavelengths of light that are visible to the human eye, but allows infrared wavelength energy to pass. This type of operation is useful for transit operations or other modes w3here the visible light from an emitter may be undesirable. Installation of the visible light filter does reduce the effective range of the emitter.

The power supply is electrically connected to the vehicle battery. It converts the vehicle battery voltage to the high voltage required to generate the optical pulses.

The timing circuit generates the control signal that determines the emitter flash rate. The two base flash rates are approximately 14 Hz for High priority and 10 Hz for Low priority.

You can select either High or Low priority operation on some emitter models during the installation process, while other models are factory pre-set for High or Low priority operation.

Encoded emitters generate extra pulses between the base Opticom™ Infrared system pulses. The encoding pulses contain the vehicle class and vehicle identification number.

Encoded emitters can also generate an automated signal intensity threshold setting code. This can be used to set the maximum distance from the intersection at which the phase selector will respond to the approaching vehicle. Note that all intersection equipment will recognize signals from all emitters, but not all intersection equipment can decode an encoded emitter signal to provide vehicle class and identification code and threshold information.

There are three emitter styles: full size, lightbar, and compact. Full size emitters are usually surface mounted on the vehicle, although some may be mounted to a lightbar. Lightbar models are designed to be mounted in Whelen Engineering Co. 9000 series lightbars. Compact emitters may be surface mounted, recess mounted into a vehicle body panel, or mounted in a lightbar.

Although all emitters have flash-tubes, power supplies, and timing circuitry, these functional areas are packaged differently among models. Some models have all three functional areas in one housing, with a separate on/off switch. Other models have the flash-tube and power supply in one housing, with the timing circuitry located in the switch assembly. Still other models have a stand alone flash head containing the flash-tube, and a separate power supply containing the power supply and timing circuits.

Several emitter models have a disable feature that turns off the emitter automatically when a signal is received from an outside source. The M195/M196 emitters do not have the disable feature. Please contact GTT Technical Service for information on implementing a disable feature on these emitters. In the case of emergency vehicle applications the disable signal is usually from an existing vehicle switch, such as a driver's door switch, The switch is activated when the vehicle reaches the site. Without a disable switch, it is possible for the vehicle operator to park the vehicle at the emergency site and forget to turn off the emitter. Any Opticom™ Infrared system equipped intersection in front of the vehicle could be under priority control of the parked vehicle. We recommend the use of the disable feature.

3-1. M195/M196 Emitters

The M195 and M196 emitters (Figure 3-1) are full size emitters. They may be mounted either to an equipment bar or directly to a horizontal vehicle surface. The emitters consist of a flash head and an emitter control switch assembly. The flash head includes the flash-tube, reflector, and power supply. The control switch assembly includes the timing circuitry and an on/off switch for the timing circuitry. Also included with these emitters are cables, circuit breaker, terminal block, battery hookup wire, and mounting hardware.

The user chooses High or Low priority when ordering the emitter. The timing circuitry in the control switch assembly determines the emitter flash rate. The M195 Low priority emitter includes an M193 Low priority control switch assembly. The M196 High priority emitter includes an M194 High priority control switch assembly.

An optional M199 Visible Light Filter is available. The filter is mounted over the front of the emitter, and it blocks all energy in the visible wavelength, but allows infrared wavelength energy to pass.

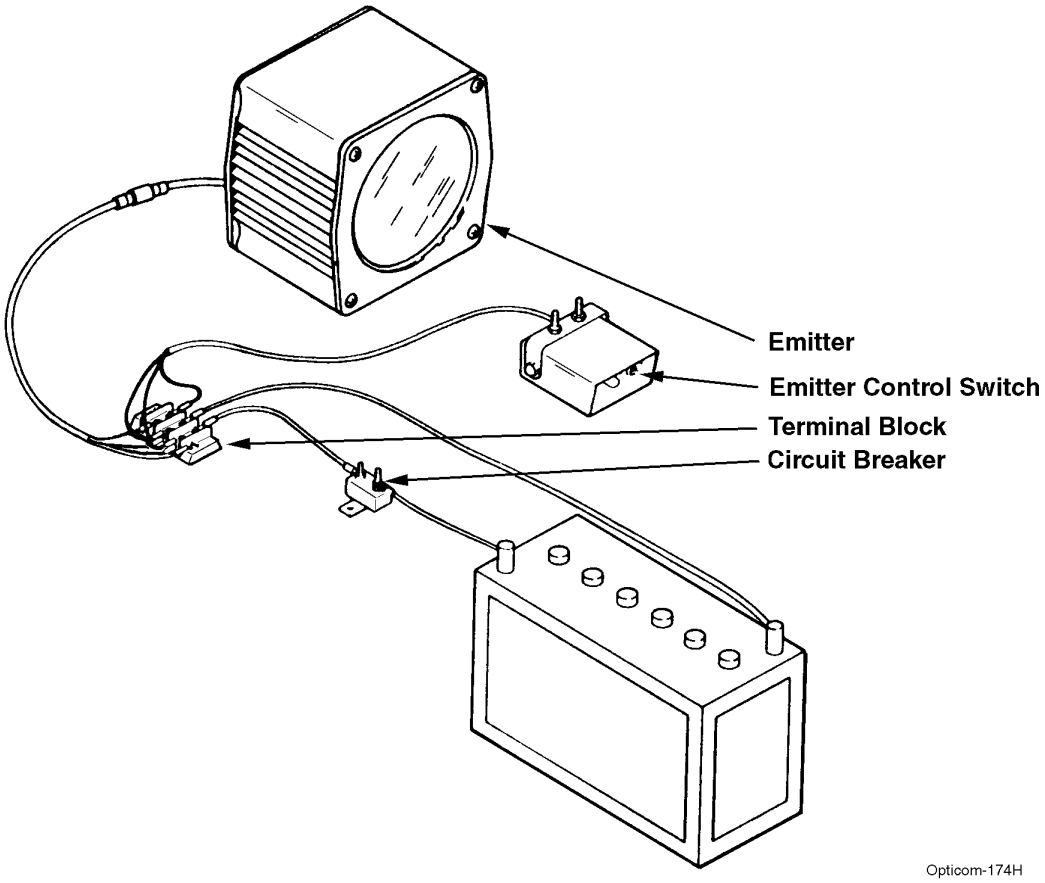


Figure 3-1. Typical M195/M196 Installation

3-1-1. Controls, Indicators, and Wiring

M193 Emitter Control Switch Assembly

The Low priority M193 emitter control switch assembly consists of a control switch and the associated timing circuitry, as well as interconnecting cables, terminal block, circuit breaker, and battery cabling.

M194 Emitter Control Switch Assembly

The High priority M194 emitter control switch assembly consists of a control switch and associated timing circuitry, as well as interconnecting cables, terminal block, circuit breaker, and battery cabling.

Power Indicator

The power indicator is a red light on the front panel of the emitter control switch housing. The indicator is illuminated when the control switch is set to ON.

Circuit Breaker

The 12 Ampere circuit breaker is connected between the terminal block and the positive side of the vehicle battery. The circuit breaker is mounted in a convenient place in the engine or battery compartment.

Emitter Control Switch Cable

The emitter control switch cable is a shielded four-conductor cable that connects the control switch assembly to the terminal block. The cable transmits the timing pulses from the control switch circuitry to the terminal block.

Emitter Cable

The emitter cable is a shielded four-conductor cable that connects the M192 emitter to the terminal block. The cable transmits the timing/trigger pulses from the control switch to the flash head.

3-1-2. Operational Description

This subsection contains the operational description of the M195/M196 emitters.

Vehicle DC voltage is always applied to the power supply in the flash head. DC voltage is also present at the flash head triggering circuit, but without an input from the control switch timing circuit, the trigger circuit is quiescent, and the emitter does not flash. Power supply current draw when the emitter is not flashing is negligible.

When the on/off switch on the control switch box is set to ON, vehicle DC voltage is applied to the timing circuitry in the switch box. The timing circuit oscillates at approximately either 10 Hz (Low priority) or 14 Hz (High priority). The timing circuit output is connected to the flash head trigger circuit, which fires the flash-tube at the rate determined by the timing circuit.

The flash-tube continues to fire until the on/off switch is set to OFF.

3-1-3. Specifications

This subsection contains the M195/M196 emitter specifications, as shown in Table 3-1.

Table 3-1. M195/M196 Emitter Specifications

Physical Characteristics	
Emitter (flash head)	
Height	6.675 inches (16.83 cm)
Depth	5.25 inches (13.34 cm)
Width	7.0 inches (17.78 cm)
Weight (complete assembly)	5.5 lb. (2.5 kg)
Electrical Requirements	
Voltage	10 to 16 VDC
Current, maximum	Less than 8A DC
Environmental Requirements	
Temperature	–30 F to +140 F (–34 C to +60 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Base flash rate	
High priority	14.xxxxx Hz ± 0.xxxxx Hz
Low priority	9.xxxxx Hz ± 0.xxxxx Hz

3-1-4. Block Diagram

The M195/M196 emitters consist of two functional blocks: the control switch assembly and the flash head (Figure 3-2). The flash head itself consists of three functional areas: Power supply, trigger circuit, and flash-tube.

Vehicle DC voltage is applied to the flash head and control switch assembly at all times. Setting the on/off switch to ON turns on the timing circuitry, which enables the trigger circuit which fires the flash-tube.

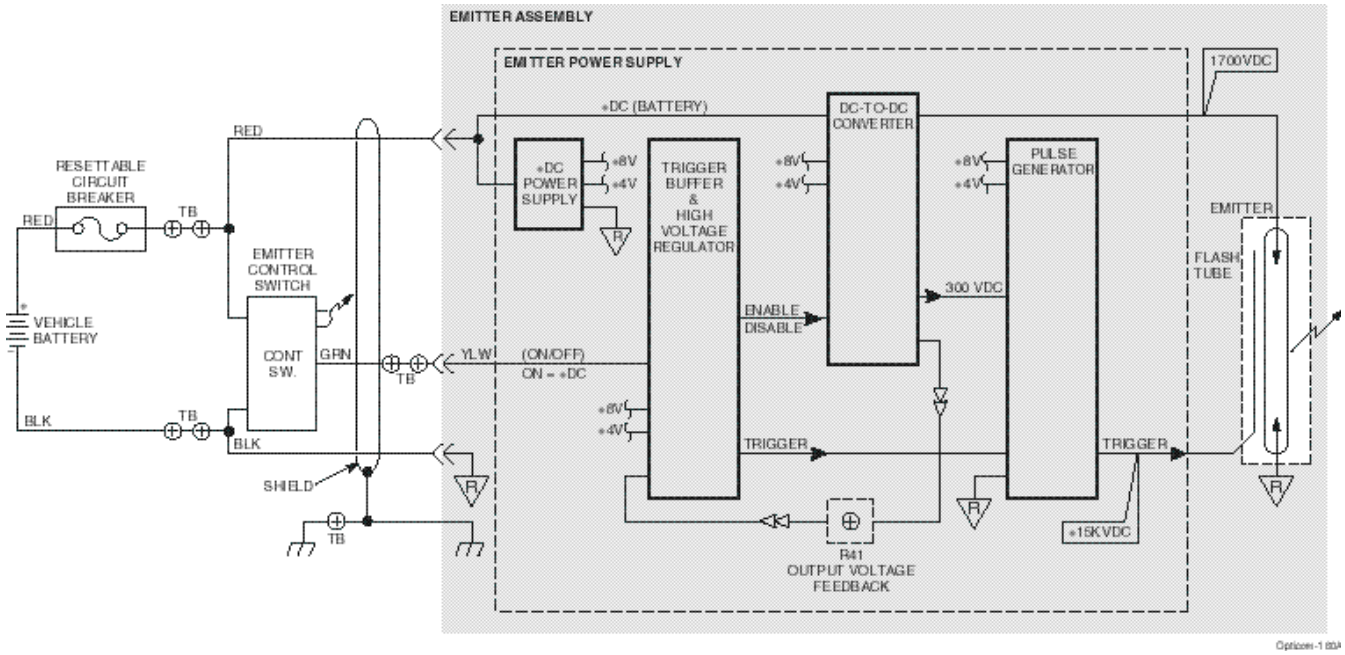


Figure 3-2. M195/M196 Emitter Block Diagram

3-2. M9192 Emitter

The M9192 Opticom™ Infrared system emitter (Figure 3-3) consists of a xenon flash-tube, power supply, and timing circuitry. An on/off switch with mounting bracket is also available. The M9192 is built expressly to fit Whelen Engineering Co. 9000 Series lightbars.

The user chooses High or Low priority when ordering the emitter. The M9192 emitter also has a disable switch option that enables an existing vehicle switch (such as the driver's door switch) to turn off the emitter. Once it is disabled, the emitter remains off until the disable function is deactivated, and the on/off switch is set to OFF, then back to ON.

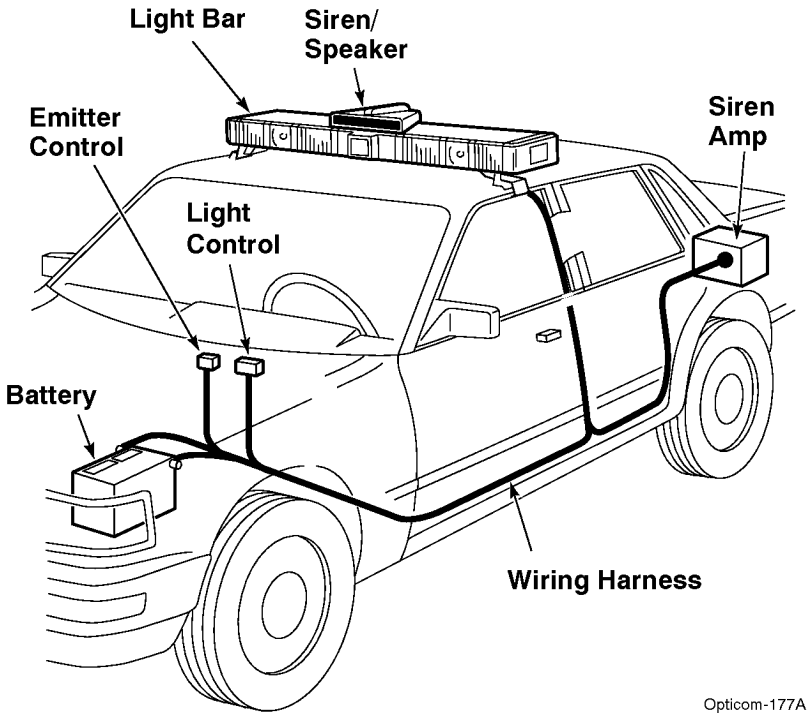


Figure 3-3. Typical M9192 Emitter Installation

3-2-1. Controls, Indicators, and Wiring

On/Off Switch

The on/off switch is a single pole single throw (SPST) switch that supplies vehicle DC voltage to the power supply.

The indicator light is an incandescent lamp that is controlled by the indicator light output from the emitter, and is lighted when the emitter switch is set to ON. If the switch is set to OFF, or if the disable function is activated, the indicator does not light.

Disable Switch

The disable switch is typically an existing vehicle switch, such as a driver's door switch, that would be activated when the vehicle reached the emergency scene. When the switch is activated, it switches to DC-, turning off the emitter. The emitter remains latched off until the disable function is deactivated and the emitter on/off switch is set to OFF, then back to ON.

Wiring

The installation cable (Table 3-2) connects the emitter to the vehicle battery, as well as to the on/off and optional control switches.

Table 3-2. Installation Cable

Color	Function
Black	DC–
Red	DC+
White	Disable input
Green	Indicator light

3-2-2. Operational Description

When the on/off switch is set to ON, vehicle DC voltage is applied to the power supply and timing circuitry in the flash head. The timing circuit oscillates at approximately 10 Hz (Low priority) or 14 Hz (High priority).

The timing circuit output is connected to the flash head trigger circuit, which fires the flash-tube at the rate determined by the timing circuit. The flash head continues to fire until the on/off switch is set to OFF, or the disable input is activated.

The disable switch, when activated, applies a negative voltage to the disable input, which stops the timing circuitry and the flash-tube. The emitter latches off until the disable function is deactivated and the emitter on/off switch is set to OFF, then back to ON.

3-2-3. Specifications

Table 3-3. M9192 Emitter Specifications

Physical Characteristics	
Emitter Height	4.00 inches (10.16 cm)
Depth	3.00 inches (7.62 cm)
Width	11.5 inches (12.7 cm)
Weight (complete assembly)	3.5 lb. (1.6 kg)
Electrical Requirements	
Voltage	13 to 26 VDC
Current, maximum	Less than 5A DC
Environmental Requirements	
Temperature	–30 F to +140 F (–34 C to +60 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Base flash rate	
High priority	14.xxxxx Hz ± 0.xxxxx Hz
Low priority	9.xxxxx Hz ± 0.xxxxx Hz

3-2-4. Block Diagram

The M9192 emitter contains the power supply, the timing circuitry, and the trigger circuitry (Figure 3-4). It also contains a smaller functional block composed of the flash-tube and trigger transformer.

Vehicle DC power is applied to (and removed from) the flash head circuitry by the on/off switch. The power supply provides the high voltage DC to the flash-tube, which remains on until either the on/off switch is set to OFF or the disable input is activated.

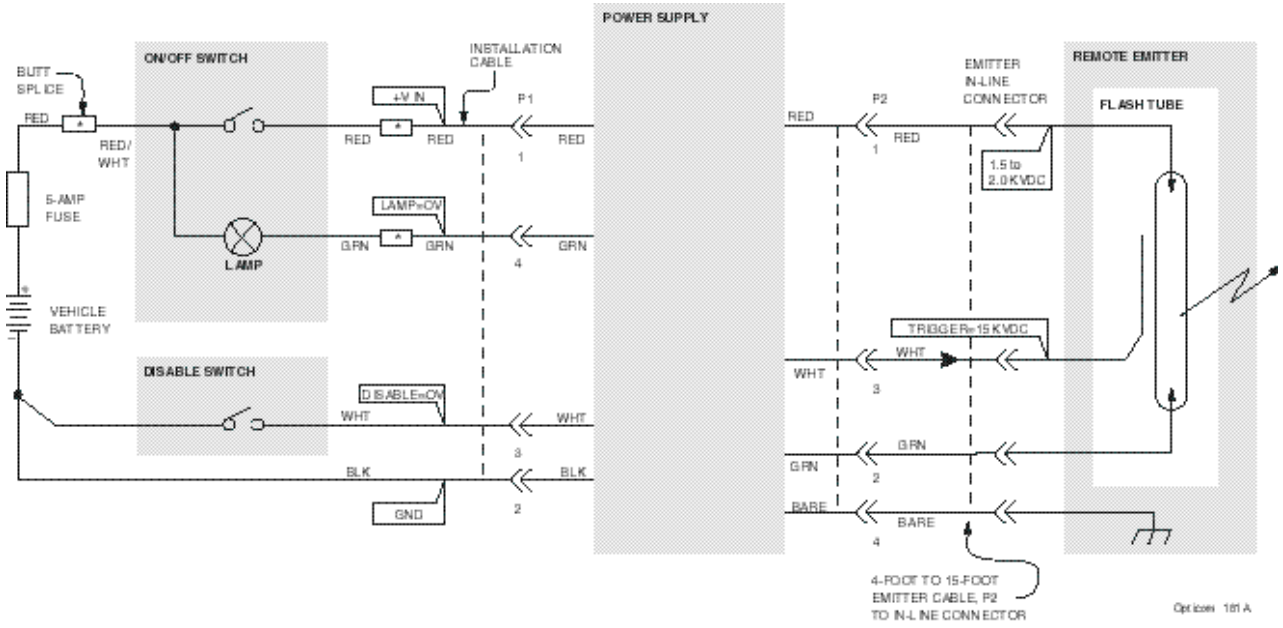


Figure 3-4. M9192 Emitter Block Diagram

3-3. M292 Emitter

The M292 emitter assembly (Figure 3-5) consists of an emitter, two cables, and a power supply. The M292 emitter can be used in either High or Low priority systems, with corresponding flash rates of approximately 14 Hz or 10 Hz respectively. The user chooses High or Low priority when ordering the emitter.

The M292 emitter also has a disable switch option that enables an existing vehicle switch (such as the driver's door switch) to turn off the emitter. Once it is disabled, the emitter remains off until the disable signal is deactivated, and the on/off switch is set to OFF, then back to ON.

The M292 emitter may be surface mounted, recess mounted, or incorporated into a lightbar.

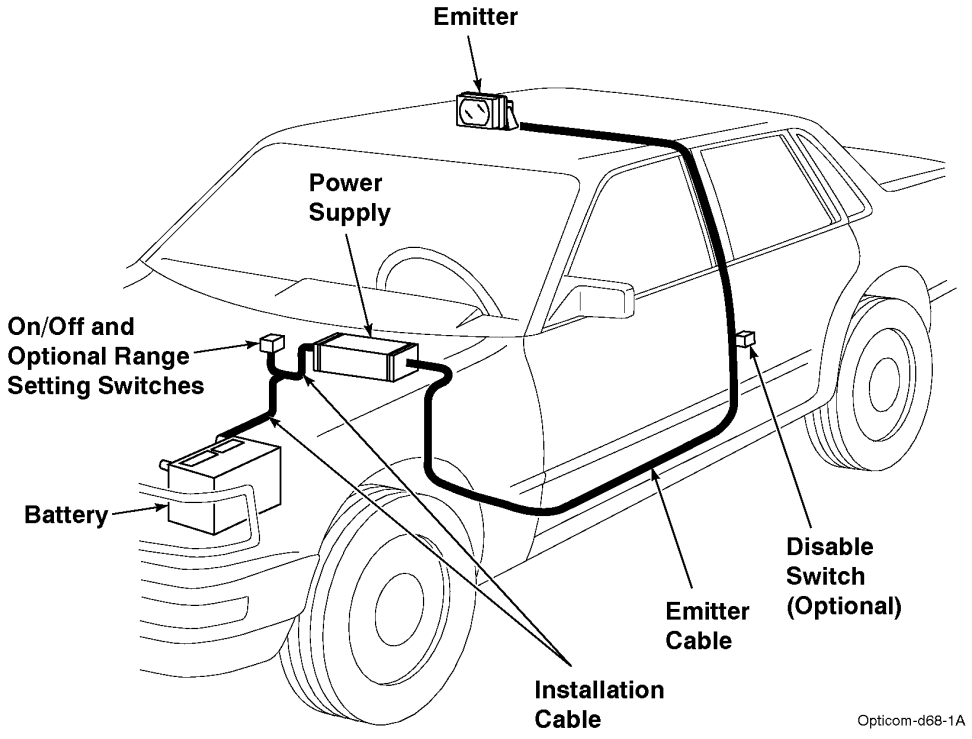


Figure 3-5. Typical M292 Emitter Installation

3-3-1. Controls, Indicators, and Wiring

On/Off Switch - Accessory

The on/off switch is a lighted single pole single throw (SPST) switch that switches vehicle battery voltage to the emitter power supply.

The indicator light lights when the switch is turned on, and turns off either when the on/off switch is set to OFF or the disable input is activated.

Disable Switch

This optional connection to a disable switch (such as a driver's door switch) that would be activated when the vehicle reached the emergency scene causes the emitter to turn off until the disable signal is deactivated and the emitter on/off switch is set to OFF, then back to ON.

Wiring

The installation cable (Table 3-4) connects the power supply to the vehicle battery, as well as to the on/off and optional control switches.

Table 3-4. Installation Cable

Color	Function
Black	Battery–
Red	Battery+
White	Disable input
Green	Indicator light

3-3-2. Operational Description

When the on/off switch is set to ON, vehicle DC voltage is applied to the power supply and timing circuitry in the power supply. The timing circuit oscillates at approximately 10 Hz (Low priority) or 14 Hz (High priority).

The timing circuit output is connected to the flash head trigger circuit in the power supply, which fires the flash-tube at the rate determined by the timing circuit.

The flash head continues to fire until the on/off switch is set to OFF, or the disable switch is activated.

The disable switch is typically a vehicle door switch, parking switch, or any other switch that would be activated when the emergency vehicle reaches its destination and the personnel leave the vehicle.

3-3-3. Specifications

Table 3-5. M292 Emitter Specifications

Physical Characteristics	
Power Supply	
Height	2.80 inches (71.1 mm)
Length	9.75 inches (247.7 mm)
Width	3.50 inches (88.9 mm)
Emitter (w bracket)	
Height	4.00 inches (10.16 cm)
Depth	3.75 inches (95.3 mm)
Width	5.00 inches (127 mm)
Weight (complete assembly)	4.6 lb. (2.1 kg)
Electrical Requirements	
Voltage	10 to 16 VDC
Current, maximum	Less than 4A DC
Environmental Requirements	
Temperature	–30 F to +140 F (–34 C to +60 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Base flash rate	
High priority	14.xxxxx Hz ± 0.xxxxx Hz
Low priority	9.xxxxx Hz ± 0.xxxxx Hz

3-3-4. Block Diagram

The M292 emitter has two functional blocks, the power supply and the flash head. The power supply contains the power supply, the timing circuitry, and the trigger circuit (Figure 3-6). The flash head contains the flash-tube.

Vehicle DC power is applied to (and removed from) the emitter power supply by the emitter on/off switch. The power supply in turn provides the high voltage DC and timing pulses to the emitter, which remains on until either the on/off switch is set to OFF, or the optional disable switch is activated.

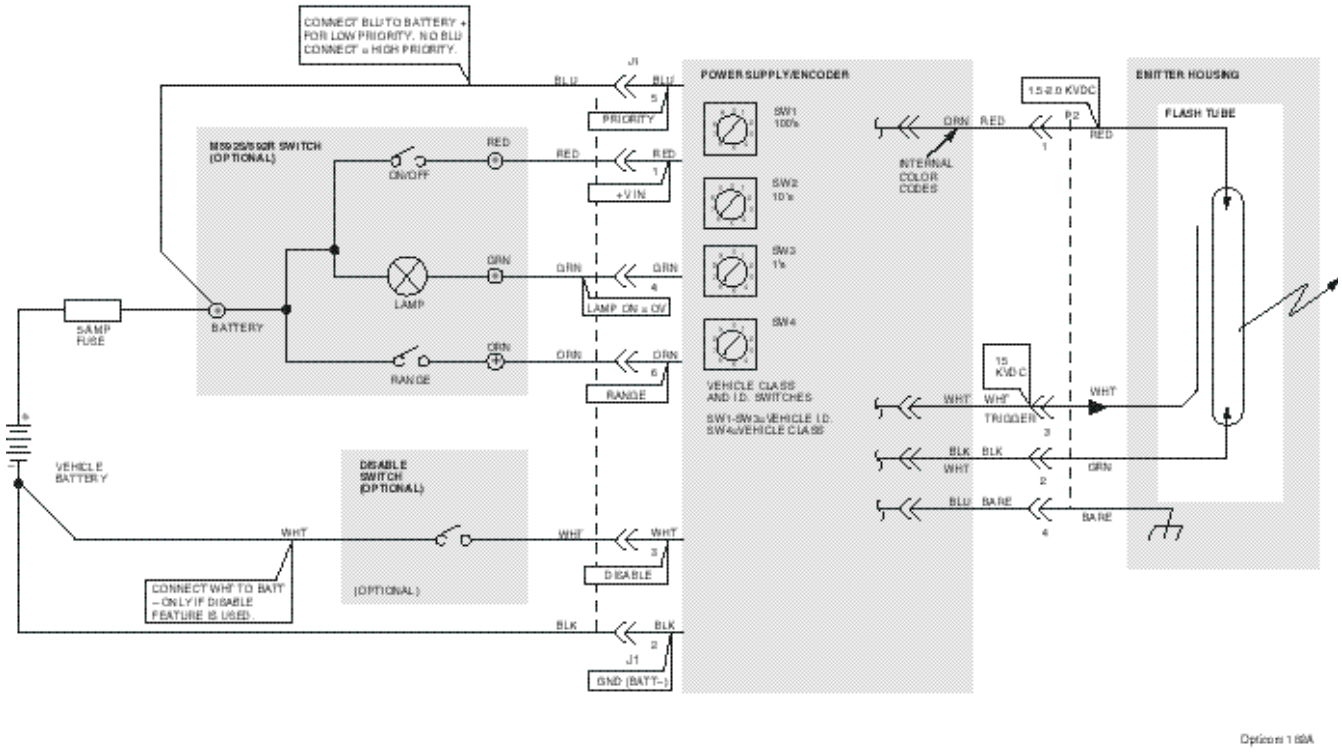


Figure 3-6. M292 Emitter Block Diagram

3-4. M9592 Emitter

The M9592 Opticom™ Infrared system emitter (Figure 3-7) consists of a xenon flash-tube, power supply, and timing circuitry. An on/off switch with mounting bracket is also available. The M9592 is built expressly to fit Whelen Engineering Co. 9000 Series lightbars.

The M9592 emitter can be used in either High or Low priority systems. The user selects the priority during installation. The M9592 emitter also has a disable option that enables an existing vehicle switch (such as the driver's door switch) to turn off the emitter. Once it is disabled, the emitter remains off until the disable function is deactivated, and the on/off switch is set to OFF, then back to ON.

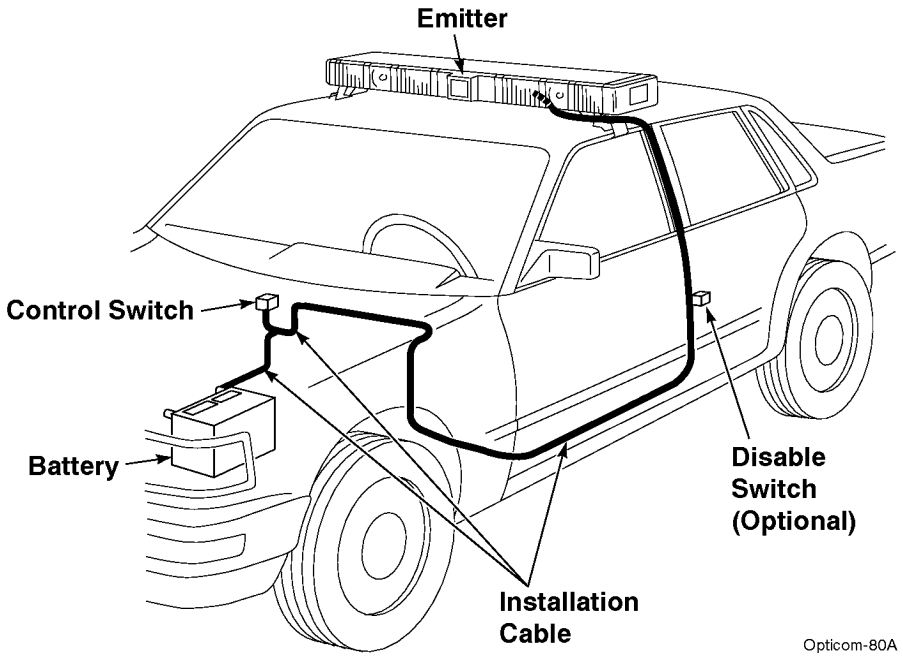


Figure 3-7. Typical M9592 Emitter Installation

3-4-1. Controls, Indicators, and Wiring

On/Off Switch

The on/off switch is a single pole single throw (SPST) switch that supplies vehicle DC voltage to the power supply.

The indicator light is an incandescent lamp that is controlled by the indicator light output from the emitter, and is lighted when the emitter switch is set to ON. If the switch is set to OFF, or if the disable function is activated, the indicator does not light.

Disable Switch

The disable switch is typically an existing vehicle switch, such as a driver's door switch, that would be activated when the vehicle reached the emergency scene. When the switch is activated, it switches to DC-, turning off the emitter. The emitter remains latched off until the disable function is deactivated and the emitter on/off switch is set to OFF, then back to ON.

Wiring

The installation cable (Table 3-6) connects the emitter to the vehicle battery, as well as to the on/off and optional control switches.

Table 3-6. Installation Cable

Color	Function
Black	Battery–
Red	Battery+
White	Disable input
Green	Indicator light

3-4-2. Operational Description

When the on/off switch is set to ON, vehicle DC voltage is applied to the power supply and timing circuitry in the flash head. The timing circuit oscillates at approximately 10 Hz (Low priority) or 14 Hz (High priority).

The timing circuit output is connected to the flash head trigger circuit, which fires the flash head at the rate determined by the timing circuit. The flash head continues to fire until the on/off switch is set to OFF, or the disable input is activated.

The disable switch, when activated, applies a negative voltage to the disable input, which stops the timing circuitry and the flash head. The emitter latches off until the disable function is deactivated and the emitter on/off switch is set to OFF, then back to ON.

3-4-3. Specifications

Table 3-7. M9592 Emitter Specifications

Physical Characteristics	
Emitter	
Height	4.00 inches (10.16 cm)
Depth	3.00 inches (7.62 cm)
Width	11.5 inches (12.7 cm)
Weight (complete assembly)	3.5 lb. (1.6 kg)
Electrical Requirements	
Voltage	13 to 26 VDC
Current, maximum	Less than 5A DC
Environmental Requirements	
Temperature	–30 F to +140 F (–34 C to +60 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Base flash rate	
High priority	14.xxxxx Hz ± 0.xxxxx Hz
Low priority	9.xxxxx Hz ± 0.xxxxx Hz

3-4-4. Block Diagram

The M9592 emitter contains the power supply, the timing circuitry, and the trigger circuitry (Figure 3-8). It also contains a smaller functional block composed of the flash-tube and trigger transformer.

Vehicle DC power is applied to (and removed from) the flash head circuitry by the on/off switch. The power supply provides the high voltage DC to the flash-tube, which remains on until either the on/off switch is set to OFF or the disable input is activated.

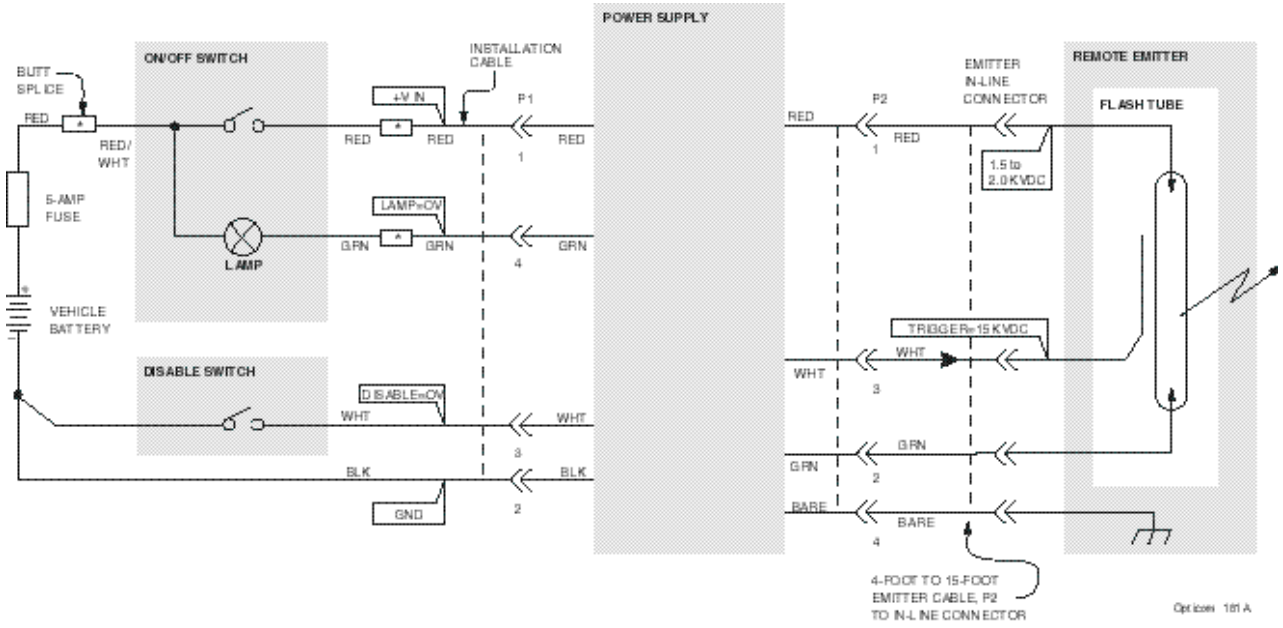


Figure 3-8. M9592 Emitter Block Diagram

3-5. M592 Emitter and M592T Emitter

The M592 emitter assembly (Figure 3-9) consists of an emitter, two cables, an on/off switch, and a power supply. The assembly may also include optional signal intensity threshold level setting and disable switches. The M592 emitter can be used in either High or Low priority systems, with corresponding flash rates of approximately 14 Hz or 10 Hz respectively. The user selects the priority during installation.

The M592 emitter also has a disable switch option that enables an existing vehicle switch (such as the driver's door switch) to turn off the emitter. Once it is disabled, the emitter remains off until the disable function is deactivated, and the on/off switch is set to OFF, then back to ON.

The M592 emitter may be surface or recess mounted, or may be incorporated into the vehicle's lightbar.

The M592T emitter is identical to the M592 except for two features. The M592T comes equipped with a Visible Light Filter installed in place of the lens and it is permanently configured for Low priority.

The filter blocks the visible light normally produced by the emitter and allows only the transmission of infra-red wavelength energy. The M592T also does not allow the user to select High Priority. The emitters are intended for use on transit vehicles or other vehicles operated on Low Priority.

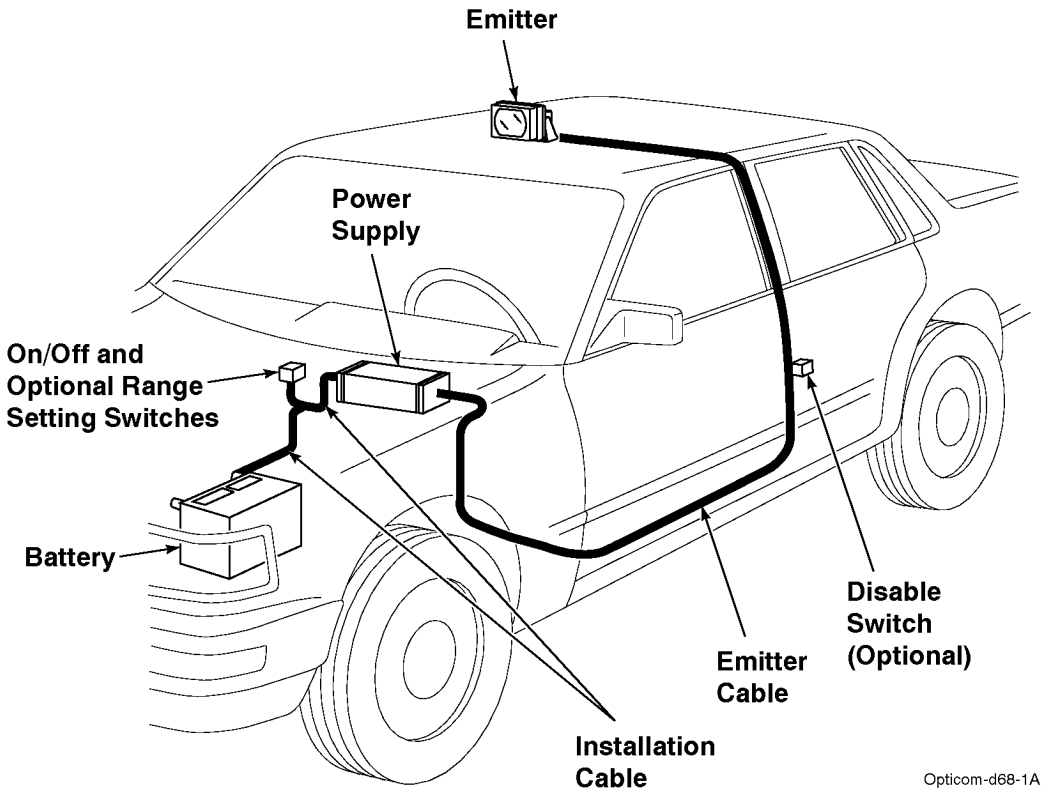


Figure 3-9. Typical M592 Emitter Installation

3-5-1. Controls, Indicators, and Wiring

On/Off Switch

The on/off switch is a lighted single pole single throw (SPST) switch that supplies vehicle DC voltage to the emitter power supply.

The indicator light lights when the switch is turned on, and shows three conditions:

- The light is on steadily when the emitter is operating normally,
- It flashes every other second when the emitter is disabled, and
- It flashes four times per second when the emitter fails.

Automated Signal Intensity Threshold Level Switch

The optional signal intensity threshold switch should be installed in a maintenance vehicle. When the switch is activated, a special reserved code is transmitted that identifies the vehicle. This code is built into the emitter hardware, and cannot be duplicated with the emitter encoding switches. Refer to the M592 Emitter Installation Instructions manual for complete automated signal intensity threshold level setting instructions.

Disable Switch

The optional disable switch is an SPST switch that when activated, disables or turns off the emitter. The disable switch is typically a vehicle door switch, parking switch, or any other switch that would be activated when the emergency vehicle reaches its destination.

The disable switch output, when activated, drops from vehicle positive voltage to vehicle negative voltage. When the disable switch is deactivated, the emitter does not resume flashing until the on/off switch is set to OFF, then turned back ON.

Emitter Encoding Switches

The four, ten position, emitter encoding switches located in the power supply enable the emitter to generate a coded signal that identifies the specific vehicle using the Opticom™ Infrared System.

One switch sets the vehicle class, while the remaining three switches are used for vehicle identification code. See the M592 emitter installation instructions for detailed setting information.

The installation cable (sometimes called the power supply cable) connects the power supply to the vehicle battery, as well as to the on/off and optional control switches.

Table 3-8. Installation Cable

Color	Function
Black	Battery –
Red	Battery +
White	Disable Input
Green	Indicator light
Blue	High/Low priority
Orange	Range code select

3-5-2. Operational Description

The M592 emitter is an encoded emitter that can send coding pulses for vehicle identification. It is compatible with non-encoded Opticom™ Infrared system equipment. The M592 emitter has two base flash rates of approximately 10 Hz and 14 Hz, which identify it as a valid Opticom™ Infrared system component. The timing circuitry in the emitter power supply generates the base pulse rate as well as the coding pulses. The coding pulses are arranged into a packet that is repeated while the emitter is ON. Refer to the M592 emitter installation instructions for the emitter encoding procedure.

When the Opticom™ Infrared System on/off switch is set to ON, vehicle DC voltage is applied to the power supply and timing circuitry in the power supply.

The power supply microprocessor controls the emitter operation. There are seven microprocessor inputs, three buffered inputs from the emitter options (Low priority, range setting switch, and disable switch), and four inputs from the emitter encoding switches (for vehicle identification code). There are two buffered outputs, one for the on/off switch indicator lamp, the other for trigger output (flash out).

After the microprocessor samples and decodes its control inputs, it generates a pulsed output that feeds the flash out buffer. The buffer output is connected to a circuit that fires the trigger circuit, turning on the emitter flash-tube.

The coding switch configuration inserts the coding packet into the base pulse signal. Enabling Low priority (High priority is the default value) changes the base pulse rate from about 14 Hz to about 10 Hz.

If the range setting switch is set, it overrides the coding switch configuration to send the special reserved hardwired range setting code.

Setting the on/off switch to OFF or activating the disable switch turns off the emitter. When the disable switch is activated, it connects the disable input to negative voltage. Before activating a disable function, the microprocessor requires that:

- First, the emitter is already on and flashing, and second, that the voltage on the disable input drops from high to low (a negative transition).
- If the disable switch is activated first, the emitter still flashes when the on/off switch is turned on, because the microprocessor received the inputs out of order.
- Once the disable function is activated, the emitter latches off and cannot be restarted until the on/off switch is set to OFF, then back to ON.

3-5-3. Specifications

Table 3-9. M592 Emitter Specifications

Physical Characteristics	
Power Supply	
Height	2.80 inches (71.1 mm)
Length	9.75 inches (247.7 mm)
Width	3.50 inches (88.9 mm)
Emitter (w bracket)	
Height	4.00 inches (10.16 cm)
Depth	3.75 inches (95.3 mm)
Width	5.00 inches (127 mm)
Weight (complete assembly)	4.61 lb. (2.1 kg)
Electrical Requirements	
Voltage	10 to 16 VDC
Current, maximum	Less than 4A DC
Environmental Requirements	
Temperature	–30 F to +140 F (–34 C to +60 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Base flash rate	
High priority	14.xxxxx Hz ± 0.xxxxx Hz
Low priority	9.xxxxx Hz ± 0.xxxxx Hz

3-5-4. Block Diagram

The M592 emitter consists of two functional areas, the power supply and the emitter flash head (Figure 3-10). The power supply contains the microprocessor, input and output buffers, and the Power supply. The flash head has two components, a xenon flash-tube and a trigger transformer.

Vehicle DC power is applied to (and removed from) the emitter power supply by the emitter on/off switch. The power supply provides the high voltage DC to the emitter, which remains on until either the on/off switch is set to OFF, or the optional disable switch is activated.

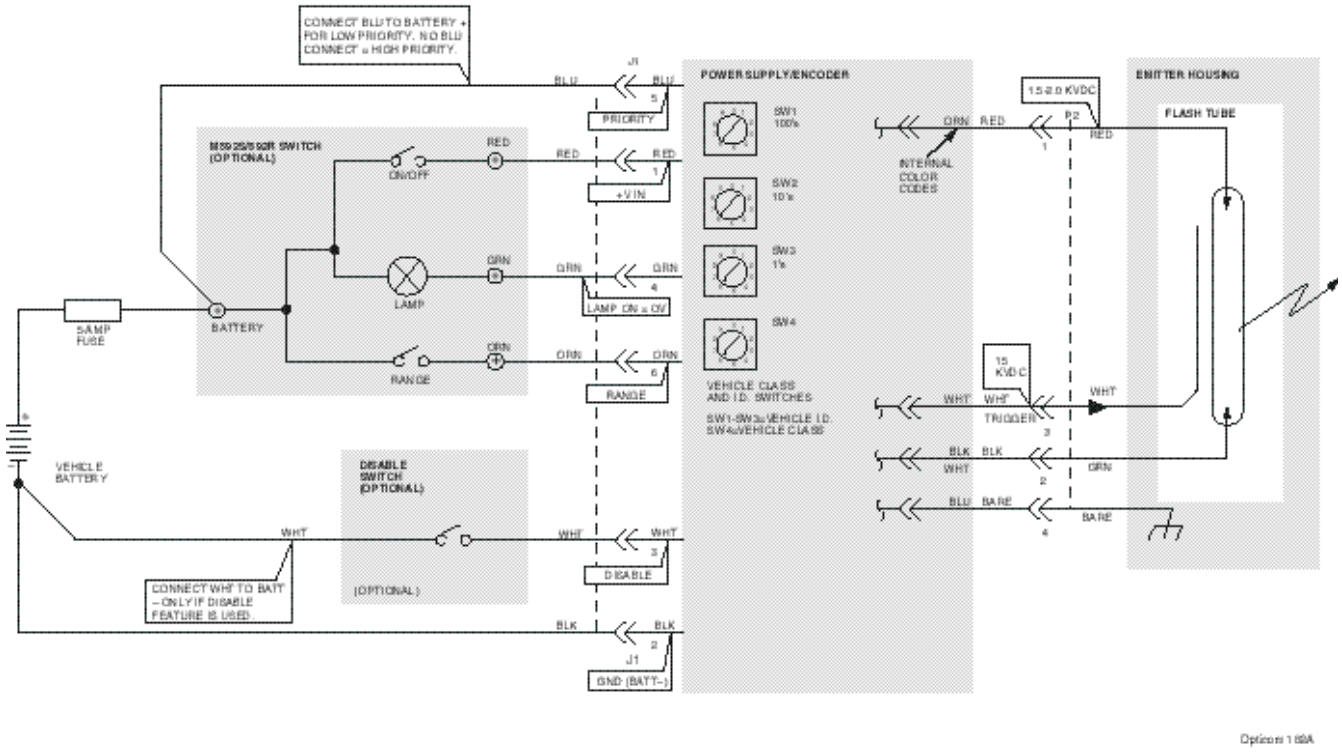


Figure 3-10. M592 Emitter Block Diagram

3-6. M599 Visible Light Filter

The Visible Light Filter is designed to be installed in place of the lens on M592 and M95952 emitters only (Figure 3-11). It blocks the transmission of all energy in the visible wavelengths, but allows infrared wavelength energy to pass. A Opticom™ Infrared System M592 emitter, equipped with the visible light filter, operates with slightly reduced range. These filters are generally used on vehicles where the highly visible light from an emitter may be undesirable.

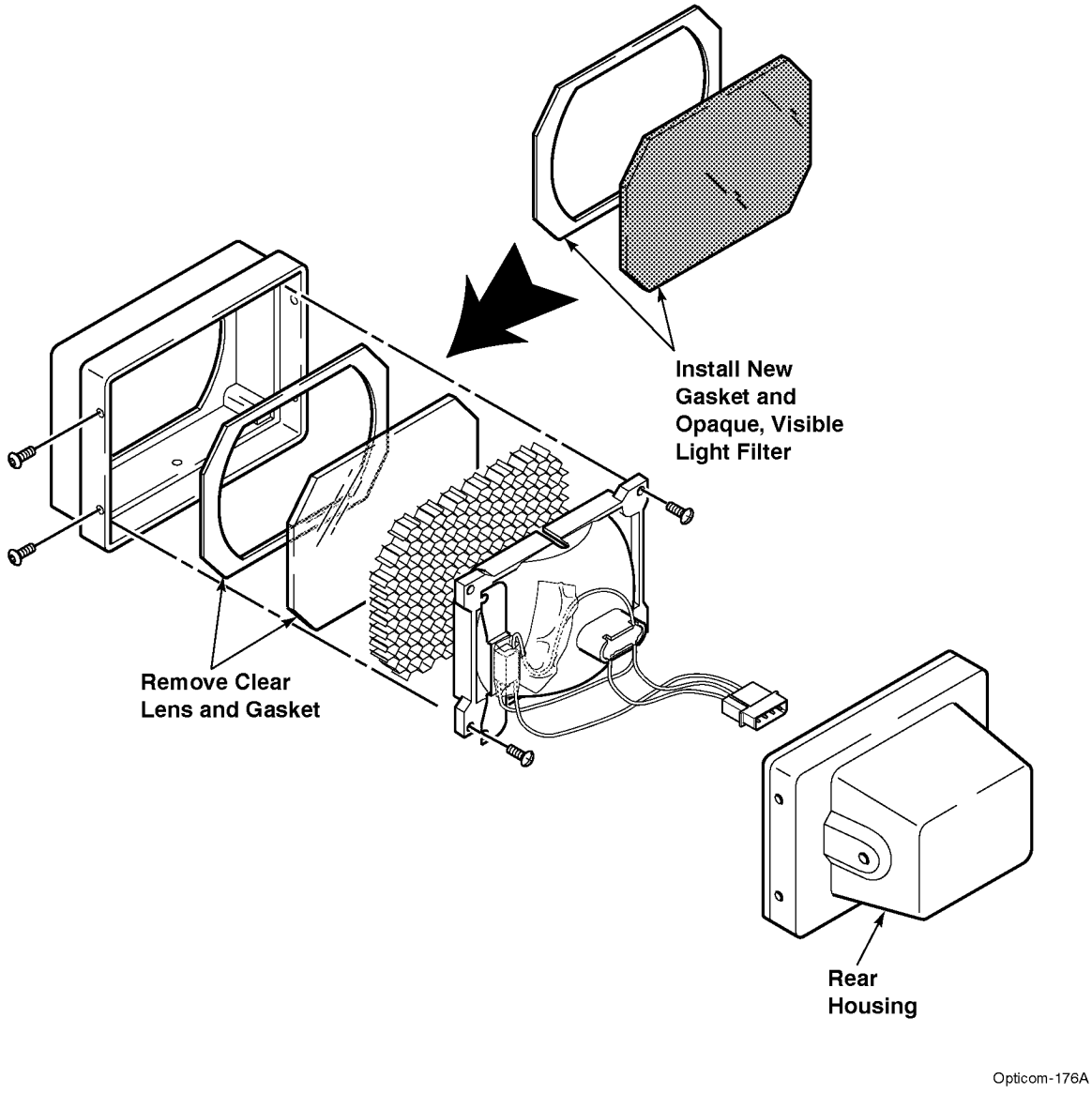


Figure 3-11. M599 Visible Light Filter

4. Detectors

Detectors are mounted at or near the intersection. Detectors are designed to receive light energy in direct line with the source. They are "line-of-sight" devices. As such, you must mount and aim them so that they have an unobstructed view of the approach to the intersection. Multiple detectors can be used on an intersection approach.

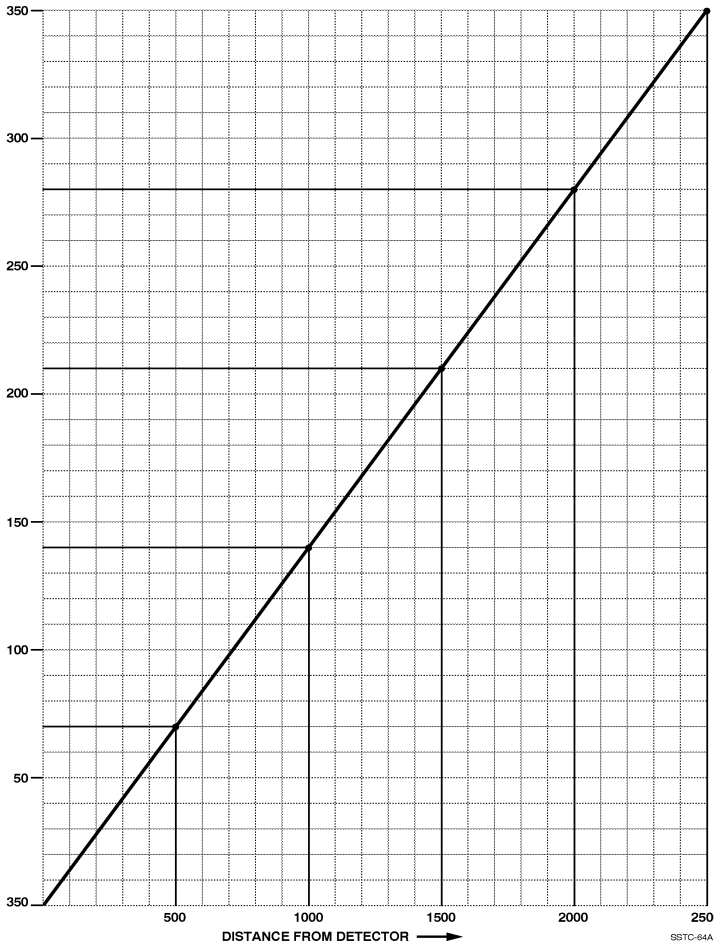
Detectors have an approximately 8 detection angle. The approximate width of the detection area can be easily calculated with the following formula:

0.1399 x n = Width of detection area
Where n is the distance (feet) away from the detector.

Distance Away from Detector (Feet)	Approximate Width of Detection Area (Feet)
100	13
200	27
300	41
400	55
500	69
600	83
700	97
800	111
900	125
1000	139
1100	153
1200	167
1300	181
1400	195
1500	209
1600	223
1700	237
1800	251
1900	265
2000	279
2100	293
2200	307
2300	321
2400	335
2500	349

You may want to use this formula to determine if the detection coverage provided at a particular mounting location meets your expectations. The detection area may appear to be greater than 8 near the detector. This is because of reflections that occur within the detector at close range and it is beneficial. These reflections augment the detection range near the intersection but they do not cause adjacent intersection detection.

Table 4-1 shows some typical distances and widths generated by the formula.



Detectors sense emitter pulses and convert them to electrical signals. The electrical signals are transmitted by cable to the Opticom™ Infrared system components in the traffic controller cabinet.

Detectors may be installed upright or inverted on signal pedestals, poles, or mast arms. They may also be suspended from a span wire over the intersection. Weep holes, to provide a way for moisture to leave the unit, are provided for both mounting configurations. The appropriate weep hole must be opened by the installer. The weep hole in the cap must be opened for inverted or span wire configurations. The weep hole in the base must be opened for upright or pedestal, pole or mast arm installations. Additionally, "drip loops" must be included in the cable whenever the cable is exposed.

⚠ Caution

The detector may be damaged by static or transient voltages if you do not ground it properly. You should always connect the bare wire to earth ground at the controller cabinet to prevent damage to the detector. If you do not install the phase selector, you must strip several inches of insulation from each wire in the M138 cable and connect all of the wires to earth ground.

⚠ Caution

The detector may be damaged if you connect two or more detector signal wires together. To avoid damage to the detector, never connect two or more detector signal wires to the same input on the phase selector. Always use the auxiliary detector inputs to connect multiple detector to the same channel.

There are three detector models:

- M511 — a single-direction-single-output detector
- M521 — a dual-direction-single-output detector
- M522 — a dual-direction-dual-output detector.

4-1. M511 Detector

The M511 detector (Figure 4-1) is a single-direction-single-output unit. It is used when a detector controls a single approach to an intersection.

The M511 detector is also an ideal auxiliary or advance detector.

A typical M511 application is shown in Figure 4-2.

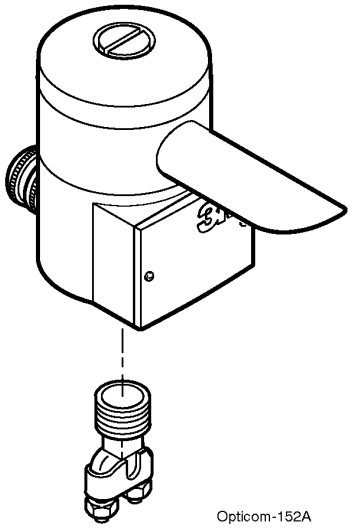


Figure 4-1. M511 Detector

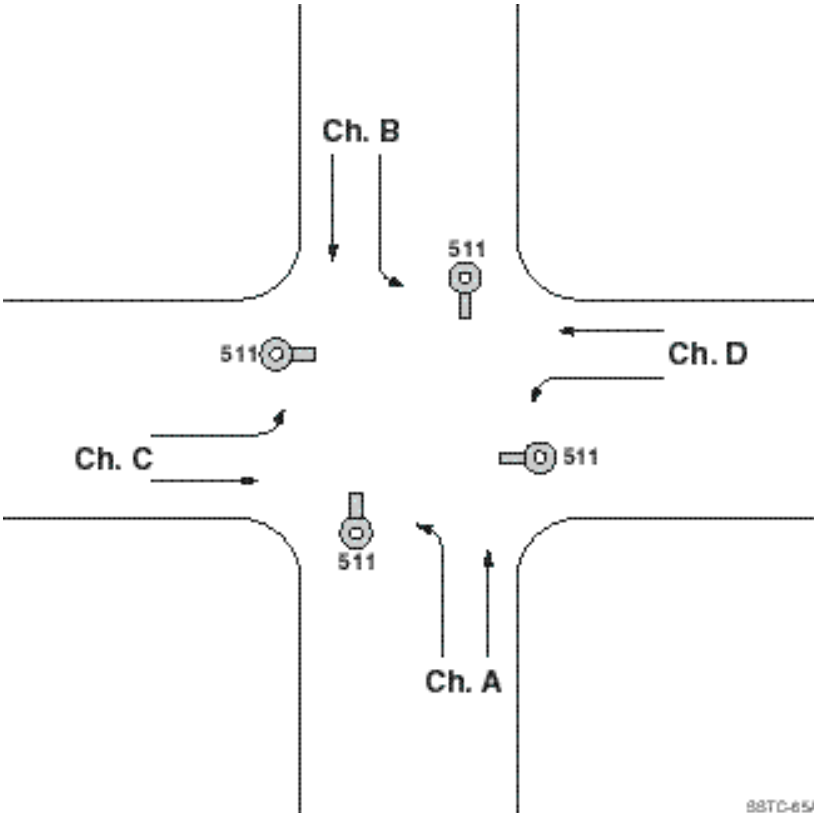


Figure 4-2. 8-Phase, 4-Channel Application Using M511 Detectors

4-1-1. Operational Description

The M511 detector converts the optical pulses from the emitter into electrical signals and transmits the signals to the phase selector module in the traffic controller cabinet.

The M511 consists of a photo detector, signal conditioner, and regulated power supply, in a weather-resistant enclosure. The photo detector senses the emitter optical pulses and converts them into electrical pulses.

The signal conditioner clips and shapes the photo detector output into a shape and amplitude recognizable by the phase selector. It transmits this signal by cable to the phase selector.

The regulated power supply receives its input voltage from the phase selector. The regulated output is used by the signal conditioner.

4-1-2. Specifications

Table 4-2. M511 Detector Specifications

Physical Characteristics	
Height	5.75 inches (14.6 cm)
Width	7.75 inches (19.7 cm)
Weight	0.88 lb. (400 g)
Environmental Requirements	
Temperature	–35 F to +165 F (–37 C to +74 C)
Humidity, relative	5% to 95%
Interface Connections	
Terminal Strip	Connects detector outputs to and receives detector power from card rack
Operating Characteristics	
Detection Angle	8 in the horizontal plane

4-1-3. Block Diagram

The M511 detector (Figure 4-3) consists of a single photo detector, a signal conditioner, and a regulated power supply. It is a single-direction-single-output device.

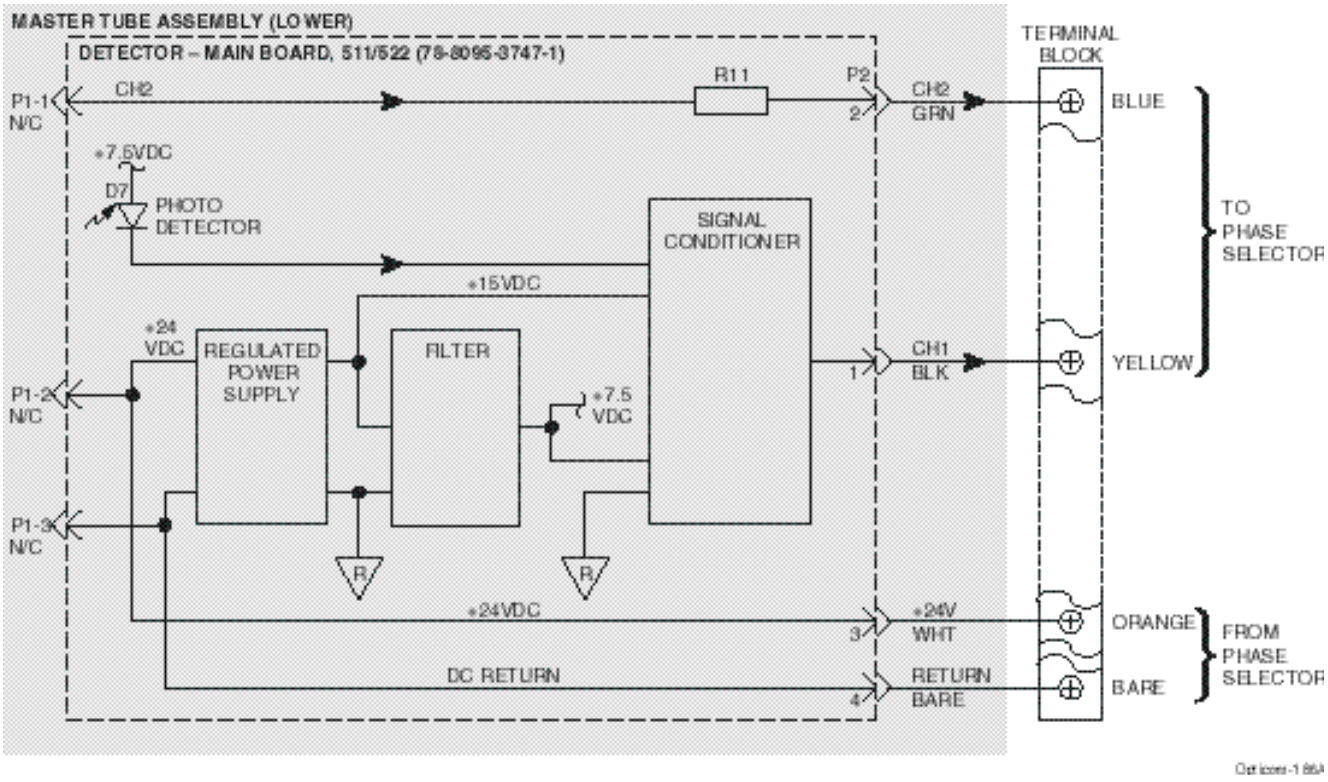


Figure 4-3. M511 Detector Block Diagram

4-2. M521 Detector

The M521 detector (Figure 4-4) is a dual-direction-single-output unit. It is used when two approaches to the intersection will be controlled together.

A typical M521 application is shown in Figure 4-5.

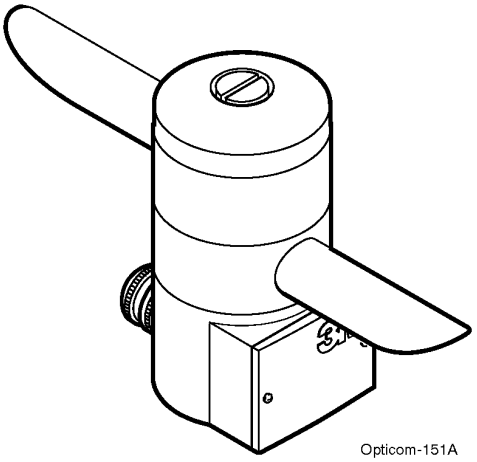


Figure 4-4. M521 Detector

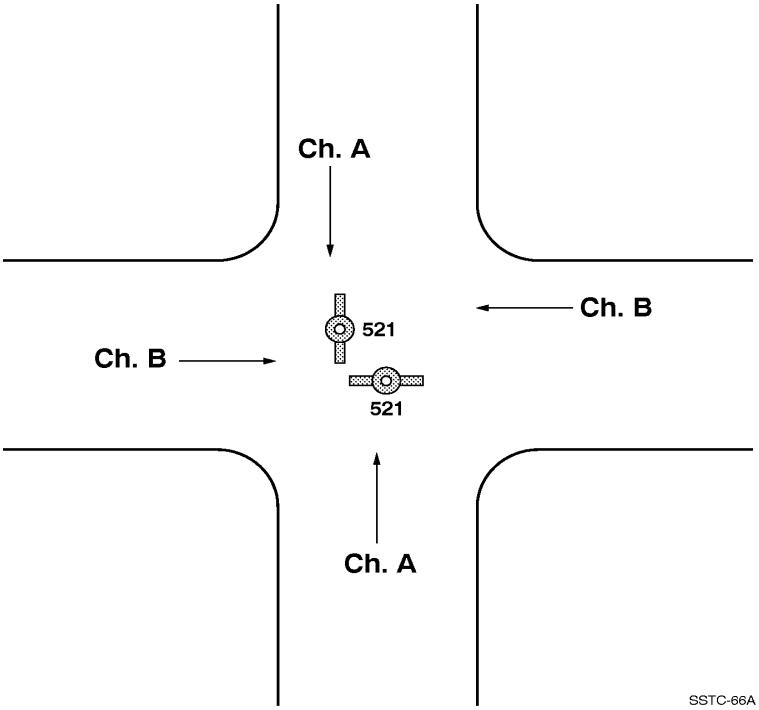


Figure 4-5. 2-Phase, 2-Channel Application Using M521 Detectors

4-2-1. Operational Description

The M521 detector converts the optical pulses from the emitter into electrical signals and transmits the signals to the phase selector module in the traffic controller cabinet.

The M521 consists of two photo detectors, a signal conditioner, and a regulated power supply, all in a weather-resistant enclosure. The photo detectors sense the emitter optical pulses and convert them into electrical pulses.

The signal conditioner clips and shapes the photo detector output into a shape and amplitude recognizable by the phase selector. It transmits this signal by wire to the phase selector.

The regulated power supply receives its input voltage from the phase selector. The regulated output is used by the signal conditioner.

4-2-2. Specifications

This subsection contains the M521 detector specifications.

Table 4-3. M521 Detector Specifications

Physical Characteristics	
Height	7.25 inches (18.4 cm)
Width	11.375 inches (29 cm)
Weight	1.12 lb. (510 g)
Environmental Requirements	
Temperature	–35 F to +165 F (–37 C to +74 C)
Humidity, relative	5% to 95%
Interface Connections	
Terminal Strip	Connects detector outputs to and receives detector power from card rack
Operating Characteristics	
Detection Angle	8 in the horizontal plane

4-2-3. Block Diagram

The M521 detector (Figure 4-6) consists of two photo detectors, one signal conditioner, and one regulated power supply. Since the photo detectors can sense emitter outputs independently but feed the same signal conditioner, the M521 is a dual-direction-single- output device.

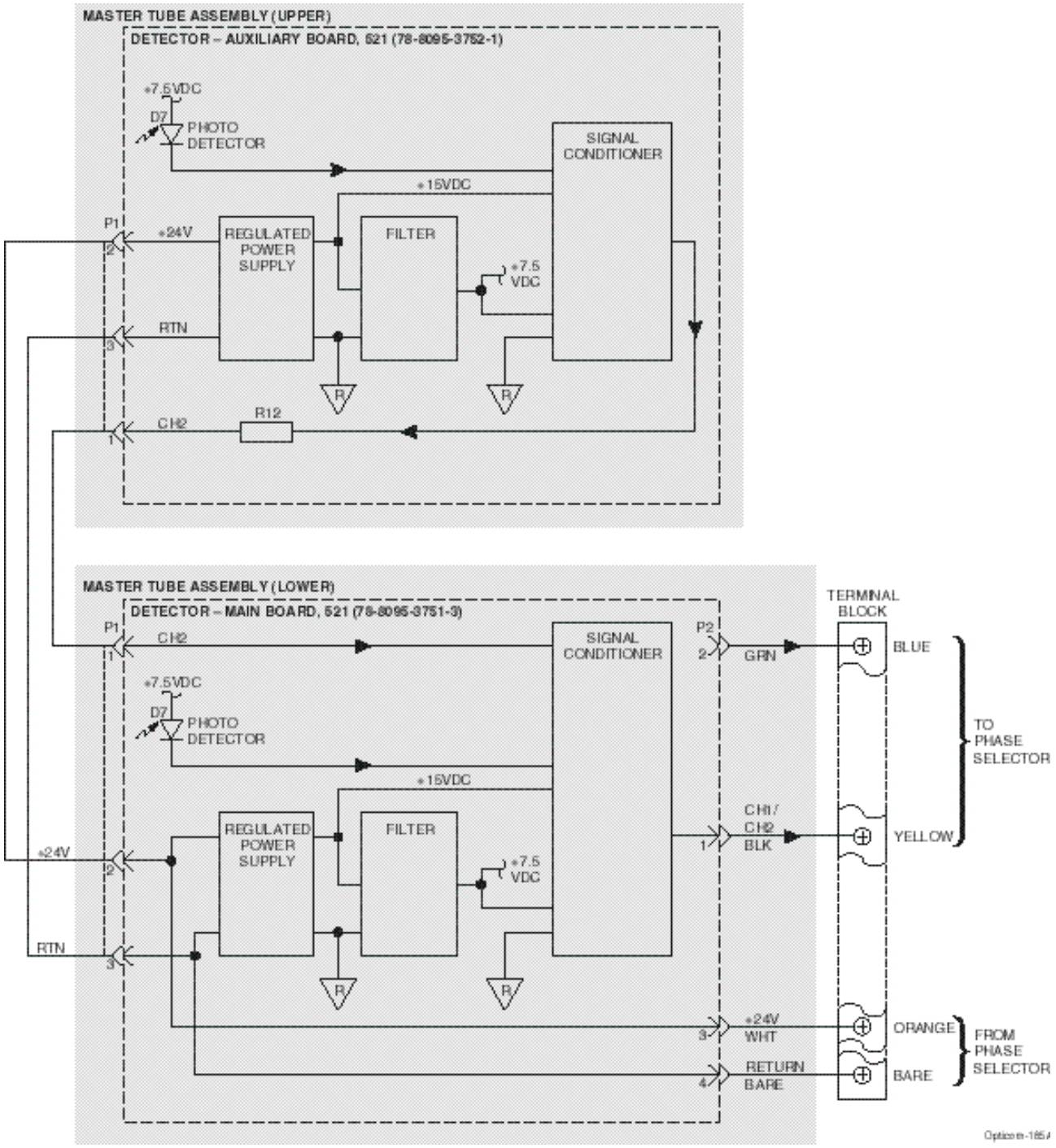


Figure 4-6. M521 Detector Block Diagram

4-3. M522 Detector

The M522 detector (Figure 4-7) is a dual-direction-dual-output unit. It is used when two approaches will be controlled independently.

A typical M522 application is shown in Figure 4-8.

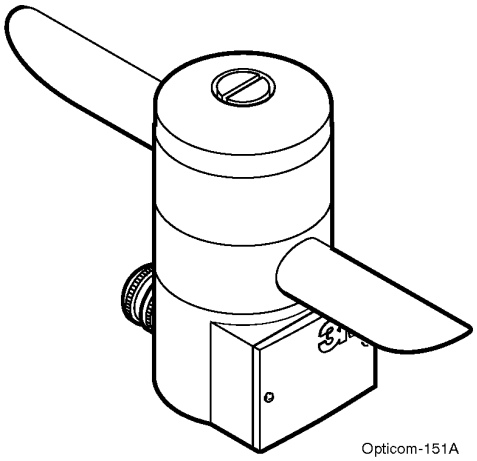


Figure 4-7. M522 Detector

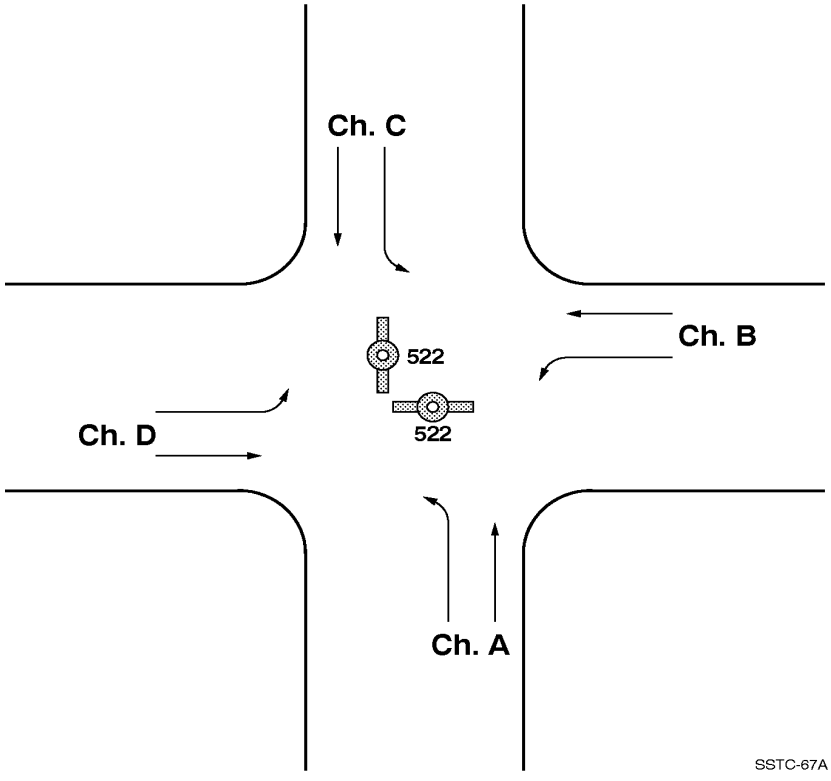


Figure 4-8. 8-Phase, 4-Channel Application Using M522 Detectors

4-3-1. Operational Description

The M522 detector converts the optical pulses from the emitter into electrical signals and transmits the signals to the phase selector module in the traffic controller cabinet.

The M522 consists of two photo detectors, two signal conditioners, and regulated power supply, all in a weather-resistant enclosure. The photo detectors sense the emitter optical pulses and convert them into electrical pulses.

Each signal conditioner clips and shapes its photo detector output into a signal recognizable by the phase selector. It transmits this signal by *cable* to the phase selector.

The regulated power supplies receive their input voltage from the phase selector. The regulated output is used by the signal conditioners.

4-3-2. Specifications

Table 4-4. M522 Detector Specifications

Physical Characteristics	
Height	7.25 inches (18.4 cm)
Width	11.375 inches (29 cm)
Weight	1.12 lb. (510 g)
Environmental Requirements	
Temperature	–35 F to +165 F (–37 C to +74 C)
Humidity, relative	5% to 95%
Interface Connections	
Terminal Strip	Connects detector outputs to and receives detector power from card rack
Operating Characteristics	
Detection Angle	8 in the horizontal plane

4-3-3. Block Diagram

The M522 detector (Figure 4-9) consists of two independent units, each having a photo detector, signal conditioner, and regulated power supply. It is electrically equivalent to two M511 detectors in a single housing.

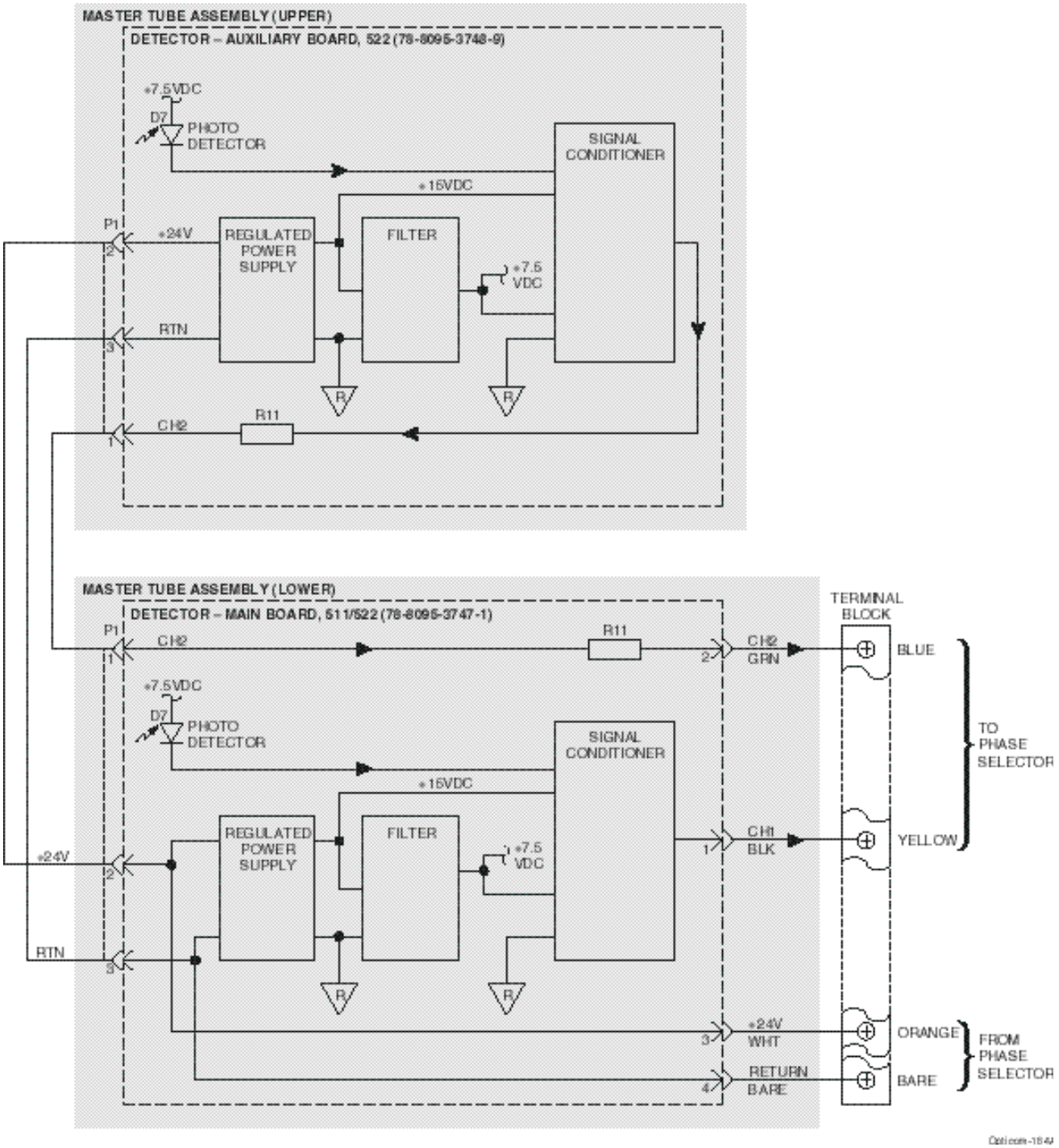


Figure 4-9. M522 Detector Block Diagram

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5. Phase Selectors

The phase selector is a component of the Opticom™ Infrared System. Phase selectors are located in the traffic controller cabinet.

Phase selectors perform discrimination and arbitration functions. Discrimination is the ability of a phase selector to differentiate between a valid emitter signal and optical noise. Arbitration is the ability to treat same priority inputs on a “first-come, first-served” basis, and to override Low priority class I input when a High priority class II input is received. The circuitry arbitrates between conflicting channels requests for priority.

500 series phase selectors are capable of decoding encoded emitter signals and creating and storing information about the activity of the unit. These phase selectors have an RS232 port for local or remote communications through the use of a personal computer.

Once discrimination and arbitration are complete, the phase selector sends a signal to the traffic controller, which interrupts the normal signal sequence to cycle to the desired green. The duration of the signal sent to the controller is equal to the duration of the emitter signal received plus a selectable extension time.

500 series phase selectors are designed for use with CA/NY Type 170 traffic controllers, and may be installed directly into the input files. Some controllers require that a system chassis or card rack be installed to house the phase selectors and facilitate connection of the phase selector to the traffic controller.

Phase selectors will work directly with some N.E.M.A* controllers, but require an interface card when used in other N.E.M.A. and non-N.E.M.A. controllers that cannot acknowledge external priority control signals.

* National Electrical Manufacturer's Association

5-1. M262 Phase Selector

The M262 phase selector is a two channel dual priority device (Figure 5-1). The M262 has three main subassemblies: the front panel, the main printed circuit board and the signal input printed circuit board.

The M262 front panel contains the controls for turning on the phase selector, generating test signals, and setting the sensitivity to emitter signals, as well as indicators.

The main printed circuit board contains the power supply circuits, timing circuits, output circuits, and control circuits. The rear edge of the board is a 44 pin STD edge connector designed to fit into CA/NY Type 170 input files.

The signal input printed circuit board is connected to the main printed circuit board. It contains the range setting potentiometers, priority processing circuits, signal display circuits, and other control circuits.

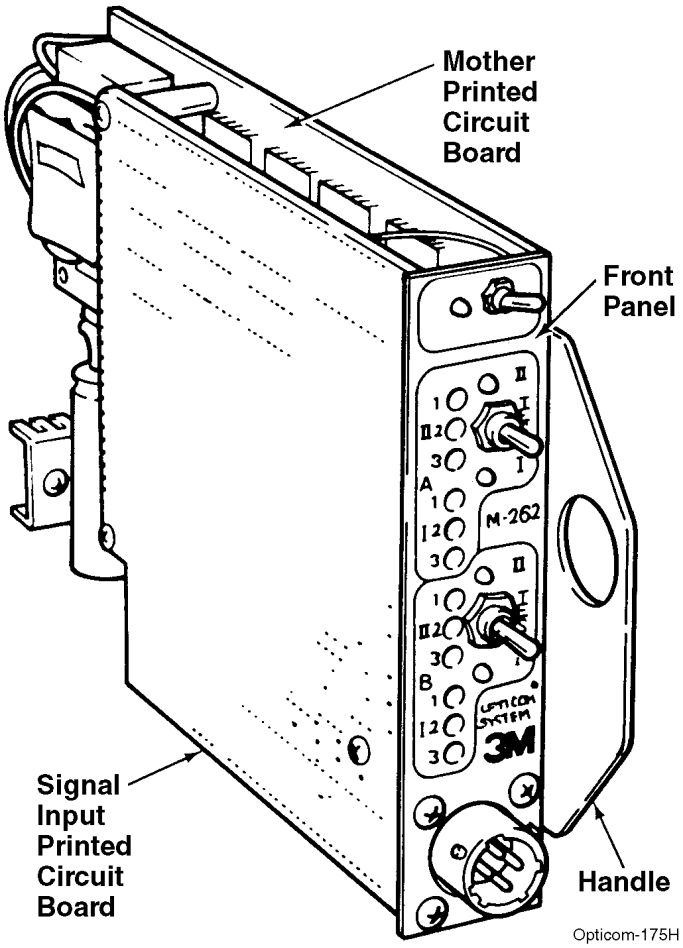

Figure 5-1. M262 Phase Selector

5-1-1. Controls, Indicators, Connectors, and Wiring

On/Off Switch

A two position toggle switch that applies A/C power to the phase selector.

TEST Switch

There are two test switches, one for each channel with both High and Low priority functions. Each test switch is a three position, center off, momentary contact toggle switch. When the switch is held in the up position, it generates a High priority call. When the switch is held in the down position, it generates a Low priority call.

Range Adjusting Potentiometers

The M262 front panel has twelve range adjusting potentiometers (pots), six for each channel. Three in each channel adjust the High priority range, and three adjust the Low priority range.

High priority potentiometers are labeled "II," and Low priority pots are labeled "I." Within each priority group of three, potentiometer #1 adjusts the primary detector range, while #2 and #3 adjust the auxiliary detector ranges.

Power LED

A red LED that lights when the ON/OFF switch is set on (up), and power is applied to the phase selector.

Class I Low Priority LEDs

Two LEDs, one for each channel, that light when a Low priority call is active in a channel.

Class II High Priority LEDs

Two LEDs, one for each channel, that light when a High priority call is active in a channel.

Auxiliary Detector Connector (M262-J2)

A connector on the M262 front panel into which the auxiliary detector harness is connected.

Edge Connector

A 44-pin STD edge connector providing all electrical connections to the phase selector except auxiliary detectors.

Table 5-1 shows the M262 edge connection wiring. The pin assignments are independent of where the phase selector module is installed: CA/NY Type 170 input file, system chassis, or customer supplied card rack

Note that only the pins that are used are shown in Table 5-1. Unused pins are not listed.

Table 5-1. Edge Connector Wiring

Pin	Function
D	Channel A/C primary detector input
E	Detector 24 VDC power output
F	Channel A/C priority control output, collector (+)
H	Channel A/C priority control output, emitter (–), logic ground
J	Channel B/D primary detector output
K	Optical detector DC ground
L	Earth ground
M	AC– in
N	AC+ in (115 VAC)
W	Channel B/D priority control output, collector (+)
X	Channel B/D priority control output, emitter (–), logic ground

Table 5-2 shows the M262-J2 connector wiring.

Table 5-2. M262-J2 Connector Wiring

Pin	Color	Function
A	Orange	Channel A/C 2nd detector
B	Yellow	Channel A/C 3rd detector
C	Violet	Channel B/D 2nd detector
D	Blue	Channel B/D 3rd detector
Bare	Shield	Ground

5-1-2. Operational Description

The M262 phase selector consists of four functional areas: discriminator, priority processor, timing circuits, and power supply.

All inputs to the phase selector are connected to the discriminator circuits. Each discriminator has four input sources: the primary detector, two auxiliary detectors, and the phase selector channel test switch. Primary detector inputs enter the discriminator through the edge connector. Auxiliary detector inputs are routed through the M262-J2 connector on the phase selector front panel. Test switch signals are initiated by the test switches on the phase selector front panel, and are processed the same as detector signals.

When a signal is received, the discriminator processes it to ensure that it is a valid emitter signal. The discriminator then checks the signal amplitude to determine if the signal strength is above that set as the threshold value on the range potentiometers. Signals of sufficient amplitude are transmitted to the priority processor.

The priority processor arbitrates conflicts between channels. If only one channel is active, the priority processor signals the traffic controller. When a second emitter signal is received on another channel the processor checks the priority of the second channel, having already done so with the first channel.

If the priorities are the same or the first channel has a higher priority than the second, the first channel continues active and the second channel is inactive until the first channel becomes inactive. This effectively implements a “first-come, first-served “ operation of the system.

However, if the second channel has higher priority than the first, it will override the first channel. High priority emitter signals are given precedence over a Low priority.

Input signal priority determines the form of the output signal sent to the traffic controller. The phase selector sends a 6.25 Hz pulsed output signal for Low priority, or a continuous low (ground) signal for High priority.

The timing circuits regulate the signal flow within the phase selector as well as output signal timing.

The power supply receives its AC input from the edge connector, and provides DC voltage for all phase selector circuits, as well as for the detectors.

5-1-3. Specifications

Table 5-3. M262 Phase Selector Specifications

Physical Characteristics	
Height	4.50 in. (114.3 mm)
Width	without handle 6.88 in. (174.6 mm) with handle 7.91 in. (200.8 mm)
Length	1.11 in. (28.2 mm)
Electrical Requirements	
Voltage	95 to 135 VAC, 60 Hz
Current, maximum draw	100 milliamperes
Environmental Requirements	
Temperature	–35 F to +165 F (–37 C to +74 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Dual Priority Channels	2 channels
Priority, each M262 module	
Same priority	First-come, first-served
Dual priority	Class II (High priority), overrides Class I (Low priority)
Detector Inputs (module only)	1 per channel on card edge
With cable harness	Two additional (aux.) per channel through front panel
Optical Range Setting Control	6 per channel (3 per class)
Solid-State Indicators (LEDs) Class I signal (each channel) Class II signal (each channel)	Power on
Test Switch	Generates Class I or Class II signal for each channel
Input Signals	
Class I	9.xxx Hz ± 0.xxx Hz
Class II	14.xxx Hz ± 0.xxx Hz
Output Signals	
Class I	Optically isolated NPN pulsed wave at 6.25 Hz ± 0.02 Hz
Class II	Optically isolated NPN steady on
Call Dropout Time	Selectable either 5 or 10 seconds

5-1-4. Block Diagram

The M262 consists of four functional areas: discriminator, priority processor, timing circuits, and power supply (Figure 5-2).

Each of the two discriminators (one per channel) has four inputs: primary detector, two auxiliary detectors, and the test switch. Discriminator outputs are fed to the priority processor, which determines which channel has priority.

The timing circuits regulate the signal flow within the phase selector. The power supply provides DC voltage for all phase selector circuits, as well as for the detectors that feed the phase selector.

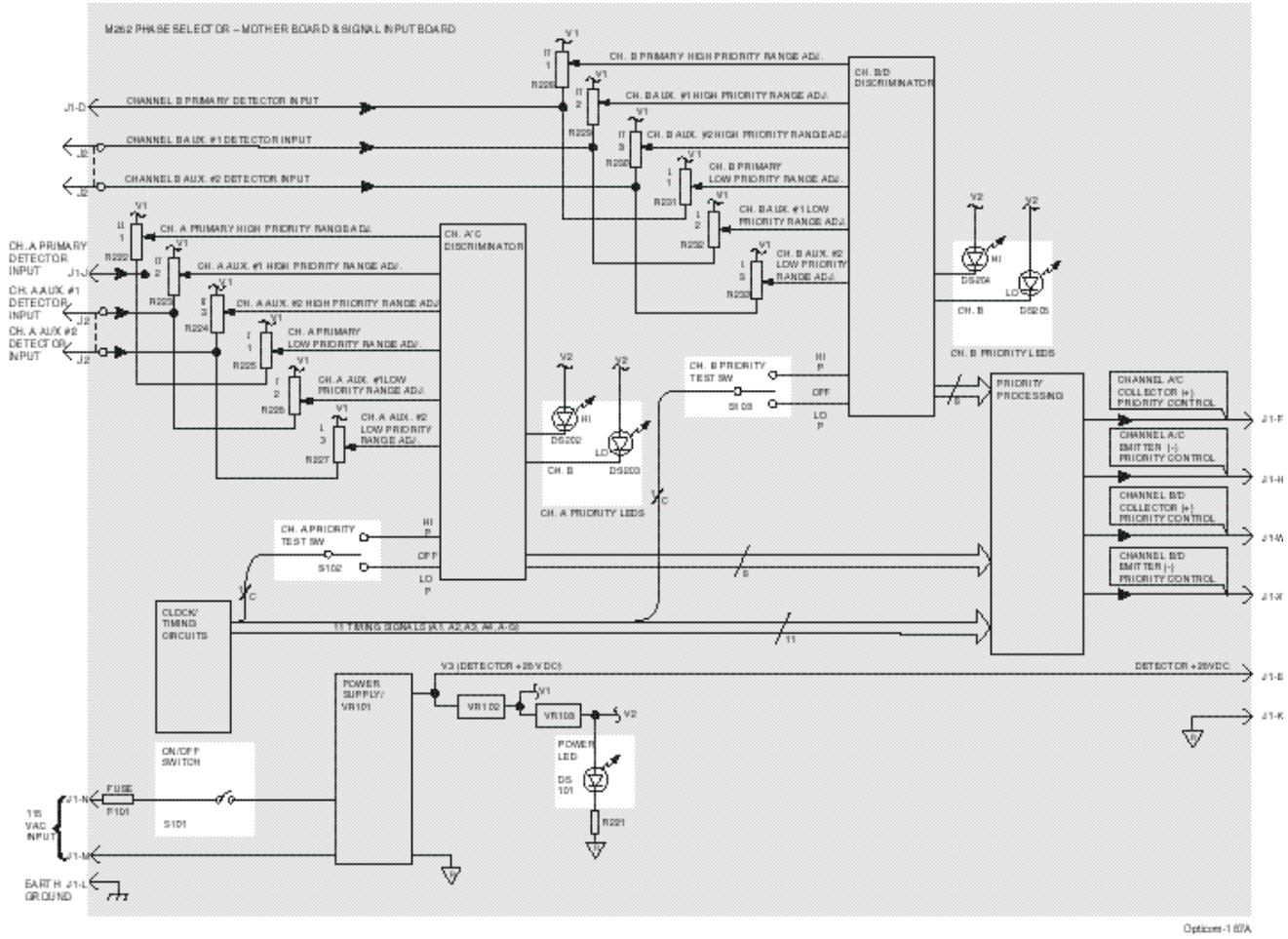

Figure 5-2. M262 Phase Selector Block Diagram

5-2. M562 Phase Selector

The M562 phase selector is a two channel dual priority device (Figure 5-3). The M562 front panel contains the switches for turning on the phase selector and generating test signals. These switches can also be used to reset internal registers to their default value, and set a channels maximum detection range. The M562 front panel also has indicators for observing module operation, and connectors for auxiliary functions.

The M562 can decode information packets sent by 500 series emitters. The information packets contain user programmable vehicle class and vehicle identification codes.

There are ten vehicle class codes and each class has 1000 vehicle identification numbers.

The M562 stores information about calls it has received. The log is stored in non-volatile memory, and contains the following items per entry:

- Vehicle class
- Vehicle ID code
- Priority (High or Low)
- Direction of travel
- Call duration
- Final greens at call end
- Time in final greens
- Time call ended in real time
- Near or Far indication

If a call is received from a non-encoded emitter, it is logged with a zero vehicle class and zero ID. All other call information is retained. The M562 can be programmed to reject any contiguous set of encoded or non-encoded emitters, based on the class and ID number.

The M562 has a communications port that allows remote polling.

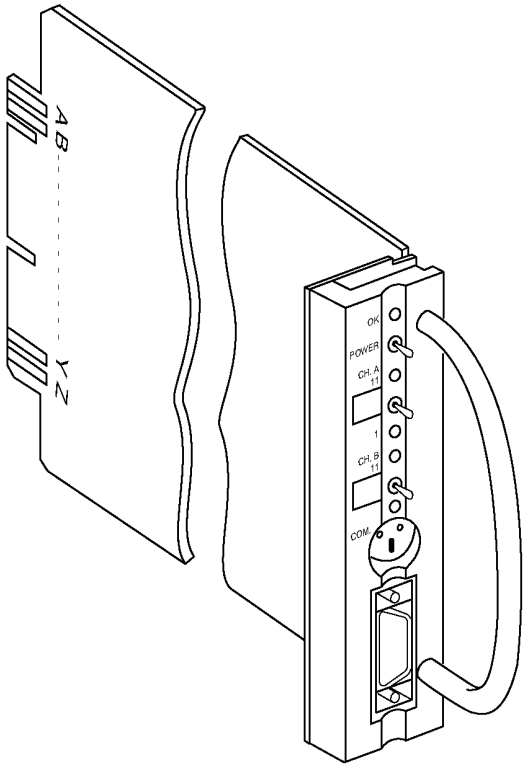

Figure 5-3. M562 Phase Selector

Complete instructions for using the remote capabilities of the M562 are in the M562IS Interface Software User Guide.

The M562 contains a real time clock. The real time clock is set by the user to local time. It records the actual time of calls. The clock has a capacitive power back up circuit, and will retain the correct time for up to 24 hours.

Green signal sensing provides the M562 with the green signal status at the time of a call. The green signal sensing inputs are part of the auxiliary harness. It also provides timing information for limited Low priority control. Limited Low priority control is a phase selector function enabled through the communications port to provide controlled and limited benefit to Low priority vehicles such as buses while minimizing the negative effect of these activities on the operation of the traffic control system.

Each channel has several output control timers. The timers are configured through the communications port.

The Maximum Call Time timer sets the maximum time a channel can be active. It is settable from 10 to 65535 seconds, with a default value of 65535 seconds.

The Call Extension Time timer sets the time a call is held active once the emitter signal is no longer being received. It is settable from 1 to 255 seconds, with a default value of 6 seconds.

The Call Delay Time timer sets the time a call must be recognized before being output as a valid call. It is settable from 0 to 255 seconds, with a default value of 0 seconds.

5-2-1. Controls, Indicators, and Wiring

Power Switch

A two position toggle switch that applies A/C power to the phase selector (Figure 5-3).

TEST Switches

A three position, center off, momentary contact toggle switch. When the switch is held in the up position it generates a High priority call. When the switch is held in the down position it generates a Low priority call. There are two test switches, one for each channel.

The test switches are also used to reset the phase selector to its factory set default values. The default values are detailed in the Operational Description subsection.

Power LED

A red LED that lights when the Power switch is set on (up), and power is applied to the phase selector. The LED flashes to indicate EEPROM or microprocessor faults.

Class I Low Priority LEDs

Two LEDs, one for each channel, that light when a Low priority call is active in a channel.

Class II High Priority LEDs

Two LEDs, one for each channel, that light when a High priority call is active in a channel.

Auxiliary Detector Connector (M562-J1)

A 15-pin D shell jack on the M562 front panel into which the auxiliary detector harness is connected. The connector is also used for green signal sensing.

Communications Port Connector (M562-J2)

A connector on the M562 front panel and a cable connecting M562-J2 to a PC or a modem provides for remote communication with the phase selector.

Edge Connector

A 44-pin STD edge connector providing all electrical connections to the phase selector except auxiliary detectors.

Table 5-4 shows the M562 edge connection wiring.

Table 5-4. Edge Connector Wiring

Pin	Function
D	Channel A/C primary detector input
E	Detector 24 VDC power output
F	Channel A/C priority control output, collector (+)
H	Channel A/C priority control output, emitter (–), logic ground
J	Channel B/D primary detector output
K	Optical detector DC ground
L	Earth ground
M	AC– in
N	AC+ in (115 VAC)
W	Channel B/D priority control output, collector (+)
X	Channel B/D priority control output, emitter (–), logic ground

Table 5-5 shows the M562-J1 connector wiring.

Table 5-5. M562-J1 Wiring

Pin	Function
1	Phase 1 green input
2	Phase 2 green input
3	Phase 3 green input
4	Phase 4 green input
5	Phase 5 green input
6	Phase 6 green input
7	Phase 7 green input
8	Phase 8 green input
9	Channel A aux. detector input
10	Channel A aux. detector input
11	Channel B aux. detector input
12	Channel B aux. detector input
13	not used
14	not used
15	Green sense reference (AC common)

Table 5-6 shows the M562-J2 communications cable connector wiring.

Table 5-6. M562-J2 Connector Wiring

Pin	Function
1	RxD (data in)
2	Ground
3	TxD (data out)

5-2-2. Operational Description

The M562 phase selector consists of two functional areas: discriminator microprocessors (one per channel, a total of two per phase selector), and main microprocessor. The phase selector also has a power supply that converts input AC voltage to the DC voltages necessary for phase selector and detector operation.

Discrimination

All phase selector inputs go to a discriminator microprocessor. Each discriminator has three input sources: the primary detector and two auxiliary detectors. Primary detector inputs enter the discriminator through the edge connector. Auxiliary detector inputs are routed through connector M562-J1 on the phase selector front panel.

The discriminator examines the input signals to determine if they are valid emitter signals, and have sufficient amplitude. If the input signals satisfy both criteria, they are sent to the main microprocessor, which checks the validity of the received code and checks to see if more than one input has been received.

Arbitration

If both discriminator inputs are active, the main microprocessor examines the priority levels. If one input is a High priority, it will override a Low priority, even if the Low priority was received first. If the inputs are the same priority, the microprocessor assigns priority on a “first-come, first-served” basis. Depending on the input priority, the microprocessor will output either a 6.25 Hz pulse for Low priority, or a solid low (ground) for High priority.

Other Inputs/Outputs

Green Signal Sensing

The M562 uses the green signal sensing to measure the average cycle time, and to control limited Low priority control. These inputs are optically isolated to protect the M562 and the equipment connected to it.

Limited Low priority control can be used to extend the green time for a given phase or phases during a Low priority call while still allowing the servicing of opposing phases. The amount of extra time given is subtracted from the green time for the other phase(s). This is done under the control of several software settable registers.

Desired Greens Register

The Desired Greens register has eight bits, one for each phase. Setting a bit on (to 1) tells the M562 that during a Low priority call, the phase represented by the bit will be green (the phase "desires" a green). If none of the Desired Greens bits are set (the register is zero), the limited Low priority function is disabled. Each channel has a Desired Green register settable through the communications port.

Green Time Register

The Green Time register sets the length of time the desired greens will be displayed during a Low priority call. It is settable from 1 to 255 seconds. Each channel has a Green Time register settable through the communications port.

Clearance Time Register

The Clearance Time register sets the length of time it takes the controller to get from any green signal other than the desired green, to the desired green. It is settable from 1 to 255 seconds. Each channel has a Clearance Time register settable through the communications port.

To perform the limited Low priority call function, the M562 needs several pieces of information. They are:

- The average cycle time of the intersection,
- The desired greens that will occur during the call,
- The amount of green time desired during each cycle, and
- The clearance time required to cycle from other phases to the desired phase(s).

The M562 acquires the information from two sources. It measures the intersection's average cycle time directly, while the other data are entered through the communications port.

When a limited Low priority call occurs, the M562 first checks to see if the intersection is already in the desired green state for this call. If the intersection is in the desired green state, the M562 then checks to see how long the intersection has been in the desired green state.

If the desired green state has been active for less time than the value specified in the channel's Green Time register, the M562 places a limited Low priority control call that remains active until the desired green state has been on for a period of time equal to the value in the Green Time register.

For example, channel A's Green Time register has a value of 90 seconds. If a limited Low priority call is issued for channel A and the channel has already been green for 12 seconds, the M562 will hold the call for 78 seconds.

If the intersection is not in the desired green state at the beginning of the call, the M562 checks to see how long it has been since the intersection was last in the desired green state.

If the amount of time since the intersection was last in the desired green state is greater than the intersection average cycle time less the green time less the clearance time, the M562 will place a call for the amount of time in its green time register.

For example, an intersection has an average cycle time of 120 seconds, and it has been 43 seconds since channel A has had valid desired greens when a limited Low priority call is received. Channel A's Green Time register is set to 90 seconds, and the Clearance Time register is set for 4 seconds.

The M562 subtracts channel A's Green Time register contents (90) from the intersection average cycle time (120) to get 30, then subtracts the Clearance Time register contents (4) from 30 to get 26. The 43 seconds since channel A has had a valid desired greens is a larger number than the 26. A limited Low priority call is placed for channel A for the full 90 seconds in its Green Time register.

If the length of time the intersection has not been in the desired green state is less than the average cycle time less the green time less the clearance time, the M562 will wait until this amount of time has expired, and then place the call for the amount of time in the green time register.

Using some of the figures from the previous example, average cycle time (120) less desired green time (90) less clearance time (4) equals 26. If the desired greens have been inactive for less than 26 seconds, the M562 will wait until 26 seconds has elapsed, then it will initiate a limited Low priority call.

When a limited Low priority control call sequence starts, the M562 will alternate between desired green time and an average cycle time less green time less clearance time for as long as the limited Low priority control call is active.

Activity Log

The main microprocessor detects and decodes the coding packet sent by a 500 series emitter, and stores the information in its call log. The log is stored in an Electrically Erasable Programmable Read Only Memory (EEPROM) with enough space for the last 100 Opticom™ Infrared System calls. Each log entry includes:

Vehicle class

Vehicle ID code

Priority (High or Low)

Direction of travel

Call duration

Final greens at call end

Time final greens showing

Time call ended in real time

If vehicle passed through intersection

The microprocessor writes data into the call log at the end of the call. The call log contents can be retrieved remotely by traffic maintenance personnel through the communications port.

Communications Port

The communications port is configured to the RS232 standard. It allows users to interrogate the main microprocessor and display the call log. The communications port also enables personnel to set the internal control registers.

Real Time Clock

The real time clock is set by the user to local time. It is controlled by the main microprocessor and is used as an input to the microprocessor. When a valid call is received, the main microprocessor uses the real time clock to log the actual time the call was serviced.

Test Switches

The M562 front panel test switches generate High or Low priority calls, depending on switch setting. The switches mimic detector signals, and are processed identically.

The test switches can also be used to set the range, as well as reset phase selector values to the default configuration. When the unit is reset to the default configuration the internal registers are set to the following values:

Log: Clears all log entries.

Primary Detector Range: Set at maximum.

Auxiliary Detector Range: Set at maximum.

High priority codes: Set all codes valid.

Low priority codes: Set all codes valid.

Maximum call time: Both channels set to 65535 seconds.

Call extension time: Both channels set to 6 seconds.

Call delay time: Both channels set to 0 seconds.

Desired greens: Both channels cleared, thus disabling the limited Low priority control call function.

Green time: Both channels set to 0 seconds.

Clearance time: Both channels set to 0 seconds.

Intersection name: Cleared.

5-2-3. Specifications

Table 5-7. M562 Phase Selector Specifications

Physical Characteristics	
Height	4.50 in. (114.3 mm)
Width	Without handle 6.90 in. (175.2 mm) With handle 8.10 in. (205.7 mm)
Length	1.12 in. (28.4 mm)
Electrical Requirements	
Voltage	95 to 135 VAC, 60 Hz
Current, maximum draw	200 milliamperes
Environmental Requirements	
Temperature	–35 F to +165 F (–37 C to +74 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Dual Priority Channels	2 channels
Priority, each M562 module	
Same priority	First-come, first-served
Dual priority	Class II (High priority), overrides Class I (Low priority)
Detector Inputs (module only)	1 per channel on card edge
With cable harness	Two additional (aux.) per channel through front panel
Optical Range Setting Control	Either through remote communications port or by using a range setting emitter
Solid-State Indicators (LEDs)	Power on
Test Switch	Generates Class I or Class II signal for each channel
Input Signals	
Class I	9.xxx Hz ± 0.xxx Hz
Class II	14.xxx Hz ± 0.xxx Hz
Output Signals	
Class I	Optically isolated NPN pulsed wave at 6.25 Hz ± 0.02
Class II	Optically isolated NPN steady on
Output Control Timers (one timer per channel)	
Call Extension Time	Settable from 1 to 255 seconds in 1 second intervals
Maximum Call Time	Settable from 10 to 65535 seconds in 1 second
Call Delay Time	Settable from 0 to 255 seconds in 1 second intervals
Low Priority Desired Green Time	Settable from 1 to 255 seconds in 1 second intervals
Low Priority Clearance Time	Settable from 1 to 255 seconds in 1 second intervals
Call Log	Stores the 100 most recent calls

5-2-4. Block Diagram

The M562 has three functional areas: discriminators, main microprocessor, and power supply (Figure 5-4).

Each discriminator (one per channel) has three inputs: one from the primary detector and two auxiliary detectors.
Discriminator outputs are fed to the main microprocessor, which determines which channel has priority.

The main microprocessor also uses green signal sensing to control green timing, accepts test switch inputs and controls
indicator outputs, controls activity log access, controls the communications port, and generates the real time clock.

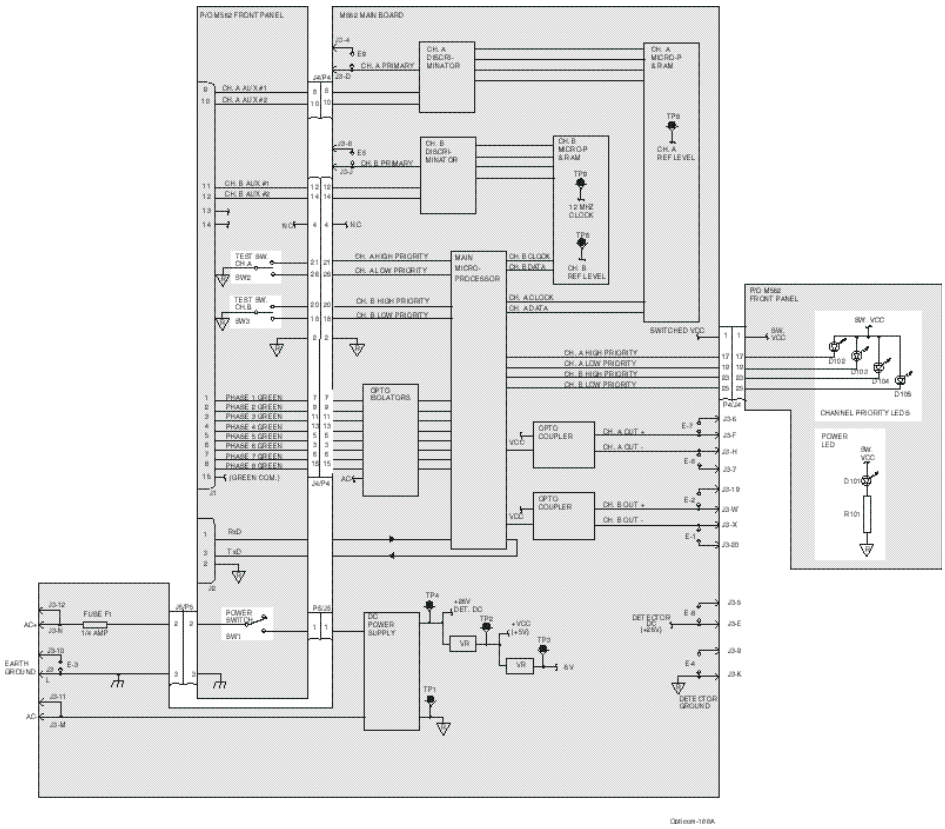

Figure 5-4. M562 Block Diagram

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6. System Chassis

The system chassis is a component of the Opticom™ Infrared System.

The two system chassis models both provide a convenient way to install phase selectors and interface cards into controllers that do not have card racks or input files.

The system chassis is mounted in the controller cabinet. All power and signal connections between the controller and the system components are made to terminal blocks or connectors on the system chassis front panel, or to connectors on the phase selectors.

6-1. M360 System Chassis

The M360 system chassis (Figure 6-1) has three card slots. The center and right slots (X2 and X3) are for phase selectors, and the left slot (X1) is for the M362 interface card. The card slot edge connectors are factory wired to two terminal strips (TB1 and TB2) and one connector (M360-J1), all on the system chassis front panel.

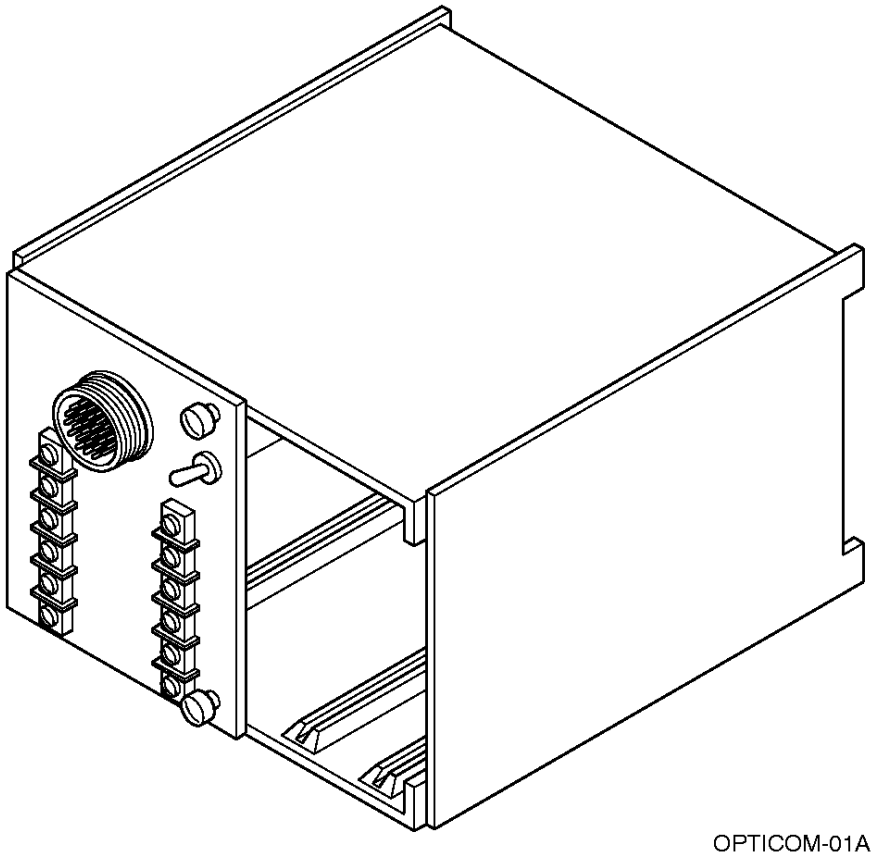

Figure 6-1. M360 System Chassis

6-1-1. Controls and Wiring

On/Off Switch

The on/off switch is a SPST toggle switch that applies 115 VAC to X1, X2 and X3 edge connectors pins M (AC–) and N (AC+).

Table 6-1. M360 Terminal Strip Connections

Terminal	Function
TB1-1	Channel A primary detector input
TB1-2	Channel B primary detector input
TB1-3	Detector power
TB1-4	Detector ground
TB2-1	Channel C primary detector input
TB2-2	Channel D primary detector input
TB2-3	Detector power
TB2-4	Detector ground

Table 6-2. M360-J1 Connections

Pin	Function
1	AC+ in (115 VAC)
2	AC– in
3	Earth ground
4	Logic ground
5	Channel A High priority output
6	Channel B High priority output
7	Channel C High priority output
8	Channel D High priority output
9	Channel A output
10	Channel A Low priority output
11	Channel B Low priority output
12	Channel C Low priority output
13	Channel D Low priority output
14	Channel B output
15	Channel C output
16	Channel D output

Table 6-3. M360 X1 Connections

Pin	Function
A	Channel 1 High priority output
B	Channel 1 Low priority output
C	Channel 3 optically isolated input from X3-F
D	Channel 1 optically isolated input from X2-F
E	Not used
F	Channel 2 High priority output
H	Channel 2 Low priority output
J	Channel 2 optically isolated input from X2-W
K	Logic ground
L	Not used
M	AC– in
N	AC+ in (115 VAC)
P	Not used
R	Not used
S	Not used
T	Channel 3 High priority output
U	Channel 3 Low priority output
V	Channel 4 optically isolated input from X3-W
W	Channel 4 High priority output
X	Channel 4 Low priority output
Y	Not used
Z	Optically isolated logic supply return from X1-K

Table 6-4. M360 X2 Connections

Pin	Function
A	Not used
B	Not used
C	Not used
D	Channel A primary detector input
E	Detector DC power output
F	Channel A output, collector (+)
H	Channel A output, emitter (–), logic ground
J	Channel B primary detector output
K	Optical detector DC ground
L	Earth ground
M	AC– in
N	AC+ in (115 VAC)
P	Not used
R	Not used
S	Not used
T	Not used
U	Not used
V	Not used
W	Channel B output, collector (+)
X	Channel B output, emitter (–), logic ground
Y	Not used
Z	Not used

Table 6-5. M360 X3 Connections

Pin	Function
A	Not used
B	Not used
C	Not used
D	Channel C primary detector input
E	Detector DC power output
F	Channel C output, collector (+)
H	Channel C output, emitter (–), logic ground
J	Channel D primary detector output
K	Optical detector DC ground
L	Earth ground
M	AC– in
N	AC+ in (115 VAC)
P	Not used
R	Not used
S	Not used
T	Not used
U	Not used
V	Not used
W	Channel D output, collector (+)
X	Channel D output, emitter (–), logic ground
Y	Not used
Z	Not used

6-1-2. Operational Description

The M360 system chassis is an electrically passive device that does not generate or modify signals. It houses phase selectors and interface cards.

The system chassis distributes voltages and signals between the traffic controller and the system components.

Distribution is made through the system chassis edge connectors into which phase selectors and interface cards are connected, the M360 front panel terminal strips TB1 and TB2, the system chassis front panel connector M360-J1, and phase selector connectors M262-J1 or M562-J1.

Controller cabinet AC power is supplied to the M360 system chassis through M360-P1, which mates with M360-J1 in the system chassis front panel. AC power is distributed from M360-J1 through internal wiring to the system chassis edge connectors.

Input signals from the primary optical detectors are connected to TB1 and TB2 on the system chassis front panel. TB1 is wired internally to the X2 edge connector, and TB2 is wired internally to the X3 edge connector. Each terminal strip accepts signals from two primary detectors, one detector per channel, for a total of four channels per system chassis. (Auxiliary detectors connect to the phase selector front panel.)

All output signals are routed from the system chassis edge connectors through internal wiring to M360-J1 on the system chassis front panel, and out to the controller through installation harness M360-P1.

6-1-3. Specifications

Table 6-6. M360 System Chassis Specifications

Physical Characteristics	
Height	4.71 in. (119.6 mm)
Width	7.38 in. (187.4 mm)
Length	7.13 in. (181.1 mm)
Shipping Weight	2.8 lb. (1.3 kg)
Environmental Requirements	
Temperature	–35 F to +165 F (–37 C to +74 C)
Humidity, relative	5% to 95%
Interface Connections	
Phase Selector	1 or 2 module connectors
Interface Card	1 card connector
Internal Wiring	Connects phase selectors and interface card connectors with front panel jack
Front Panel Terminal	Connects detector inputs and detector power to system chassis from detector cables

6-1-4. Block Diagram

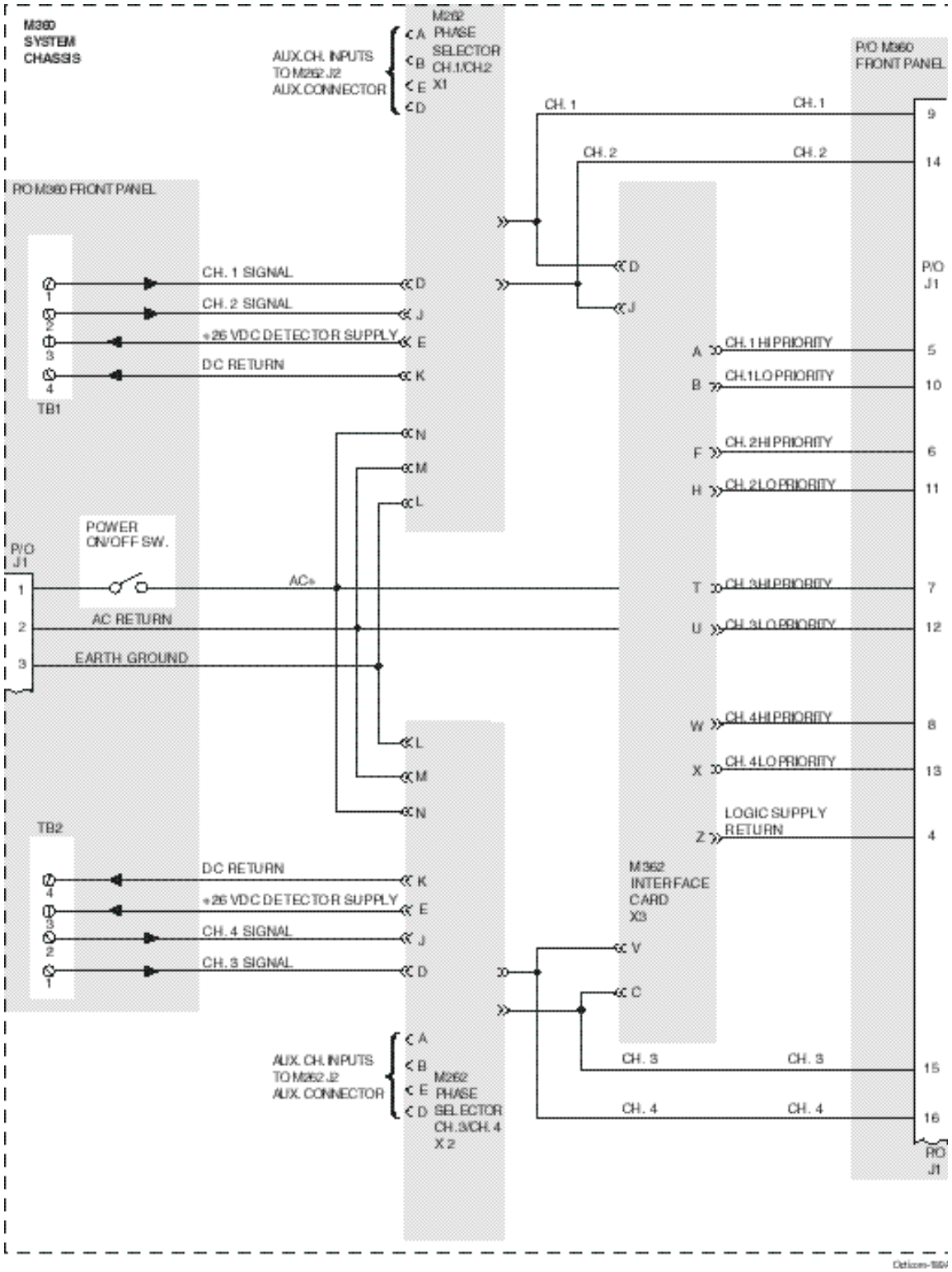

Figure 6-2. M360 Block Diagram

6-2. M560 System Chassis

The M560 system chassis (Figure 6-3) has three slots identified as X1 through X3, from left to right. Slots X1 and X2 are for phase selectors, and slot X3 is for an interface card. The card slot edge connectors are factory wired to two terminal strips (TB1 and TB2) and two connectors (M560-J1 and M560-J2), all on the system chassis front panel.

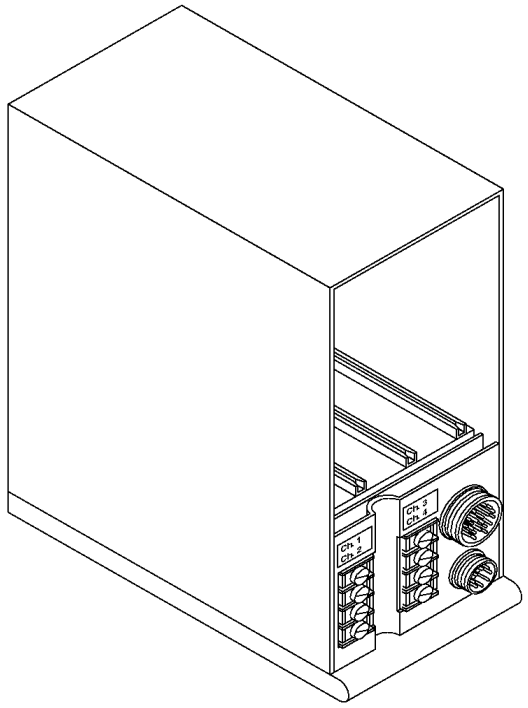

Figure 6-3. M560 System Chassis

6-2-1. Controls and Wiring

Table 6-7. M560 TB1 and TB2 Connections

Terminal	Function
TB1-1	Channel A primary detector input
TB1-2	Channel B primary detector input
TB1-3	Detector power
TB1-4	Detector ground
TB2-1	Channel C primary detector input
TB2-2	Channel D primary detector input
TB2-3	Detector power
TB2-4	Detector ground

Table 6-8. M560-J1 Connections

Pin	Function
1	AC+ in (115 VAC)
2	AC– in
3	Chassis ground
4	Logic ground
5	Channel B priority control output
6	Channel A priority control output
7	Channel D priority control output
8	Channel C priority control output

Table 6-9. M560-J2 Connections

Pin	Color	Function
1	Orange	*Varies by card*
2	Yellow	*Varies by card*
3	Yellow/Brown	*Varies by card*
4	White/Black	*Varies by card*
5	White/Blue	*Varies by card*
6	Yellow/Orange	*Varies by card*
7	Yellow/Green	*Varies by card*
8	White/Brown	*Varies by card*
9	Yellow/Blue	*Varies by card*
10	White/Red	*Varies by card*
11	Blue	*Varies by card*
12	Yellow/Black	*Varies by card*
13	Brown	*Varies by card*
14	Yellow/Gray	*Varies by card*
15	Yellow/White	*Varies by card*
16	Violet	*Varies by card*
17	White/Gray	*Varies by card*
18	White	*Varies by card*
19	White/Orange	*Varies by card*
20	Yellow/Red	*Varies by card*
21	White/Violet	*Varies by card*
22	White/Green	*Varies by card*
23	Gray	*Varies by card*
24	Yellow/Violet	*Varies by card*
25	White/Yellow	*Varies by card*
26		No Connection
27		No Connection
28		No Connection

Table 6-10. M560 X1 Connections

Pin	Function
D & 4	Channel A primary detector input
E & 5	Detector DC power output
F & 6	Channel A output, collector (+)
H & 7	Channel A output, emitter (–), logic ground
J & 8	Channel B primary detector output
K & 9	Optical detector DC ground
L & 10	Chassis ground
M & 11	AC– in
N & 12	AC+ in (115 VAC)
W & 19	Channel B output, collector (+)
X & 20	Channel B output, emitter (–), logic ground

Table 6-11. M560 X2 Connections

Pin	Function
D & 4	Channel C primary detector input
E & 5	Detector DC power output
F & 6	Channel C output, collector (+)
H & 7	Channel C output, emitter (–), logic ground
J & 8	Channel D primary detector output
K & 9	Optical detector DC ground
L & 10	Chassis ground
M & 11	AC– in
N & 12	AC+ in (115 VAC)
W & 19	Channel D output, collector (+)
X & 20	Channel D output, emitter (–), logic ground

Table 6-12. M560 X3 Connections

Pin	Function
A	Connection to J2-25
B	Connection to J2-12
C	Channel C Call Input
D	Channel A Call Input
E	Connection to J2-8
F	Connection to J2-3
H	Connection to J2-2
J	Channel B Call Input
K	Logic Ground
L	Chassis Ground
M	AC– Input
N	AC+ Input
P	Connection to J2-11
R	Connection to J2-5
S	Connection to J2-9
T	Connection to J2-15
U	Connection to J2-22
V	Channel D Call Input
W	Connection to J2-10
X	Connection to J2-19
Y+Z	Connection to J2-13
1	Connection to J2-24
2	Connection to J2-20
3	Connection to J2-14
6	Connection to J2-7
7	Connection to J2-6
8	No Connection
9	No Connection
10	No Connection
11	No Connection
12	No Connection
13	No Connection
14	Connection to J2-1
15	Connection to J2-4
16	Connection to J2-16
17	Connection to J2-21
18	Connection to J2-23
19	Connection to J2-18
20	Connection to J2-17

6-2-2. Operational Description

The M560 system chassis is an electrically passive device; it does not generate or modify signals. It houses phase selectors and interface cards.

The system chassis distributes voltage and signals between the traffic controller and the system components.

Distribution is made through system chassis edge connectors into which phase selectors and interface cards are connected, system chassis front panel terminal strips TB1 and TB2, system chassis front panel connectors M560-J1 and M560-J2, and phase selector connectors M262-J1 or M562-J1.

Controller cabinet AC power is supplied to the M560 system chassis through M560-P1, which plugs into M560-J1 in the system chassis front panel. AC power is distributed from M560-J1 through internal wiring to the system chassis edge connectors.

Input signals from the primary detectors are connected to TB1 and TB2 on the system chassis front panel. TB1 is wired to the X1 edge connector, and TB2 is wired to the X2 edge connector. Each terminal strip accepts signals from two primary detectors, one detector per channel, for a total of four channels per system chassis. (Auxiliary detectors connect into the front of the phase selectors.)

All output signals are routed from the system chassis edge connectors through the wiring harness to M560-J1 and M560-J2 on the system chassis front panel.

6-2-3. Specifications

This subsection contains the M560 system chassis specifications.

Table 6-13. M560 System Chassis Specifications

Physical Characteristics	
Height	8.44 in. (214.4 mm)
Depth	8.25 in. (209.6 mm)
Width	4.10 in. (104.1 mm)
Shipping weight	5.4 lb. (2.4 kg)
Environmental Requirements	
Temperature	–30 F to +140 F (–34 C to +60 C)
Humidity, relative	5% to 95%
Interface Connections	
Phase Selector	1 or 2 module connectors
Interface Card	1 card connector
Internal Wiring	Connects phase selectors and interface card connectors with front panel jack
Front Panel Terminal	Connects detector inputs and detector power to system chassis from detector cables

6-2-4. Block Diagram

This subsection contains the M560 system chassis block diagram (Figure 6-4).

Two examples are shown, one without an interface card (top) and one with an interface card (bottom). The M560 is shown at the left and right sides of the illustration.

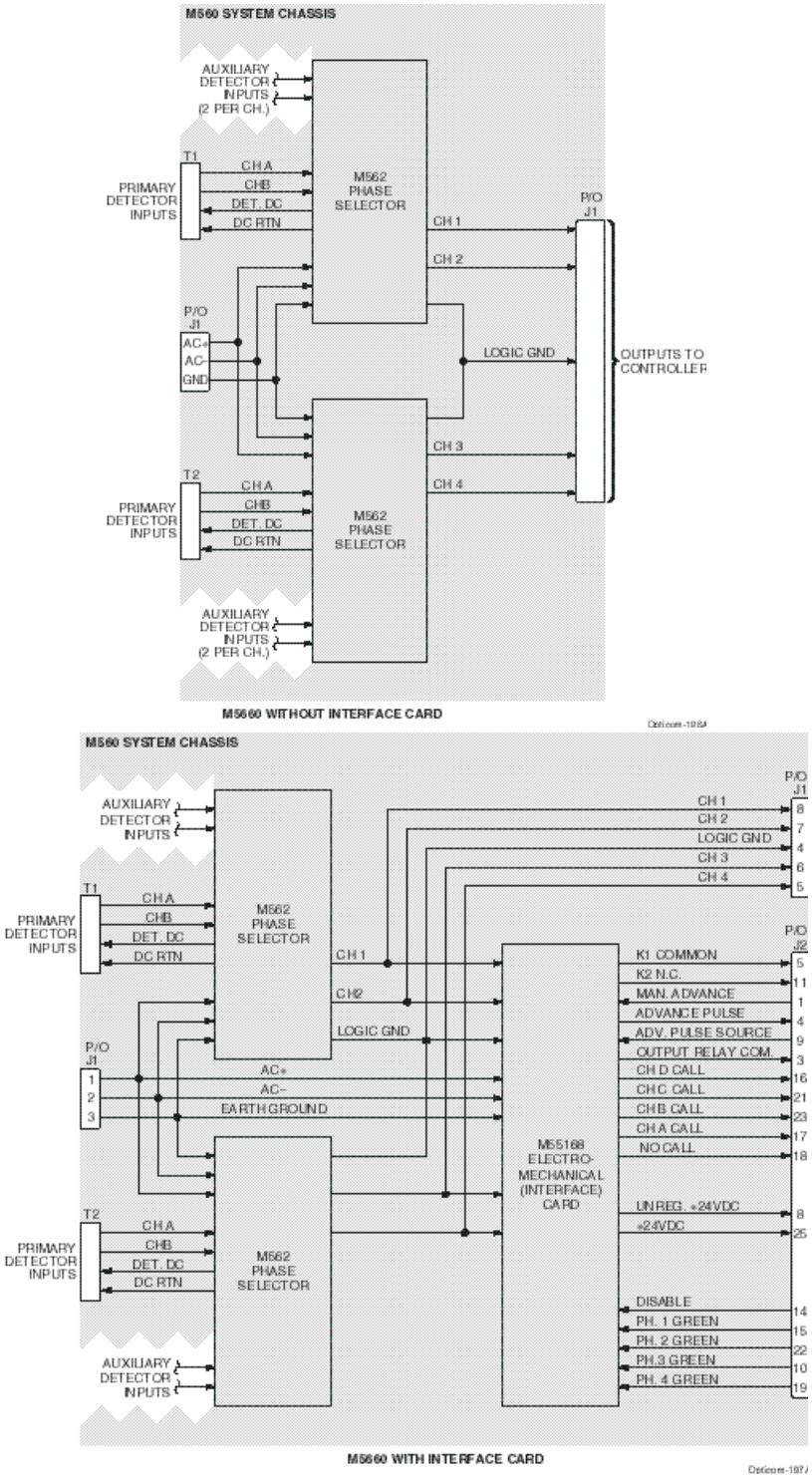

Figure 6-4. M560 Block Diagram

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7. Interface Cards

Opticom™ Infrared System Interface cards are installed in system chassis in the traffic controller cabinet. Interface cards receive priority control signals from the phase selector, translate them into signals or pulses the controller will accept, and send the translated signals to the controller. The controller then interrupts the normal intersection light sequence and generates a priority control green.

The confirmation light card generates patterns of confirmation light activity in response to the priority control signals.

Interface cards and phase selectors both have arbitration capabilities. Phase selectors arbitrate between channels, while interface cards arbitrate between phase selector outputs. One interface card can arbitrate between two two-channel phase selector modules. Since each phase selector channel can have two outputs (one each for High and Low priority), interface cards are four channel devices.

7-1. M5168 Electromechanical Card

The M5168 Electromechanical Card (Figure 7-1) is one of several interface cards available for the Opticom™ Infrared system. The M5168 provides electrical interface, cam/solenoid control, signal indication sensing, and critical system logic for proper traffic controller operation when M262 or M562 phase selectors are used with electromechanical controllers.

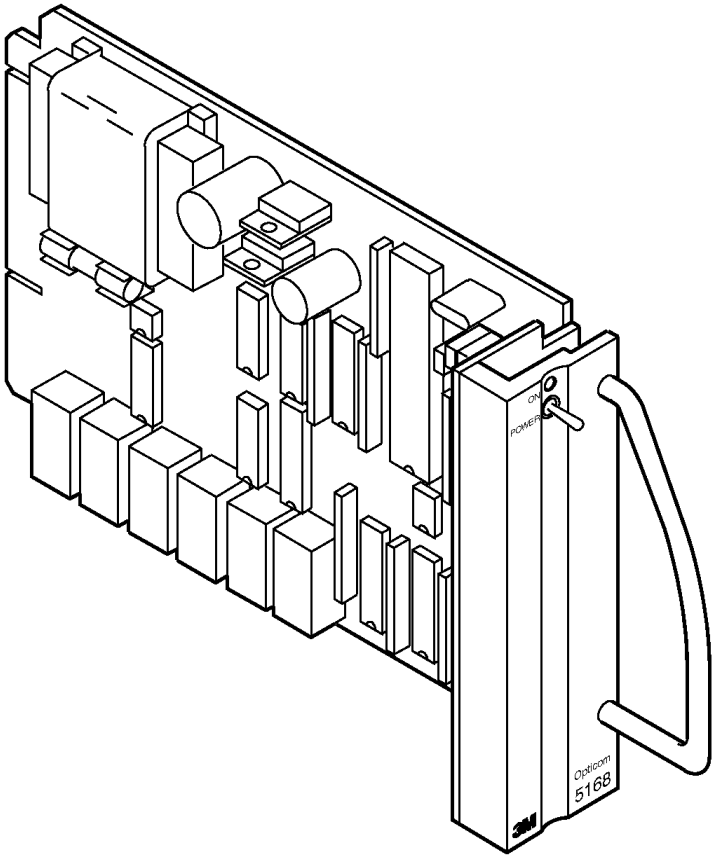

Figure 7-1. M5168 Electromechanical Card

7-1-1. Indicators and Wiring

This subsection contains a description of the M5168 indicators and wiring.

One LED on the M5168 front panel is driven in parallel with the reset circuit. If the LED is lit steadily, the interface card is operating correctly. If the LED is not lit, the unit is not receiving AC power.

If the LED flashes, there may be a problem with the interface card, or one of the six rotary switches has an invalid switch setting.

Table 7-1. M5168 Edge Connector Pin Assignments

Function	Pin	Pin	Function
No Connection	1	A	No Connection
No Connection	2	B	No Connection
Disable Input	3	C	Channel 3 High/Low Priority Input
No Connection	4	D	Channel 1 High/Low Priority Input
No Connection	5	E	Unregulated +24 VDC Output
No Connection	6	F	No Connection
No Connection	7	H	No Connection
No Connection	8	J	Channel 2 High/Low Priority Input
No Connection	9	K	DC Common
No Connection	10	L	Earth Ground
No Connection	11	M	AC– (Neutral)
No Connection	12	N	AC+ (Hot)
No Connection	13	P	K1 Normally Closed
"A or B Channel Called Relays"	14	R	K1 Common
"Cam Advance Pulse" - Output	15	S	Advance Pulse Source
Channel 4 Call Output	16	T	Phase 1 Green Input
Channel 3 Call Output	17	U	Phase 2 Green Input
Channel 2 Call Output	18	V	Channel 4 High/Low Priority Input
No Call Output	19	W	Phase 3 Green Input
Channel 1 Call Output	20	X	Phase 4 Green Input
No Connection	21	Y	Output Relay Common
No Connection	22	Z	Output Relay Common

7-1-2. Operational Description

The M5168 inputs are connected to the phase selector outputs. The M5168's microcontroller continuously samples its channel inputs to determine if there are any calls.

Once it confirms that a call is present, the M5168 energizes K1, the Channel Called relay. Energizing K1 opens the electrical connection between the traffic controller's timer and its cam advance solenoid. The timer continues to cycle, but no longer has any effect on intersection signal timing. The M5168 now controls intersection timing and it generates all cam advance pulses.

The M5168 monitors its green sense inputs to see if the desired green is active. If the intersection is already in the desired green state, the M5168 does nothing (since the timer has been isolated, the intersection will remain in the desired green state).

If the intersection is not in the desired green, the M5168 reads the green time switch for the phase that's active, waits for the amount of time indicated on the switch to elapse and energizes relay K2 once. K2 generates a cam advance pulse, which advances the cam one increment. The M5168 repeats this sequence until the desired green is active.

If there is no green state active (during yellow and all-red), the M5168 reads the non-green time switch and uses its setting to determine the length of time between cam advance pulses. As before, the M5168 repeats the sequence until the desired green is active.

After the call is completed, if the call was on **B** channel, the interface will automatically "recall" to A channel to allow the cam stack and timer to re-synchronize. **A** channel must be connected to the re-synchronization phase and the "green" key on the timer dial must be placed in the last interval of "A phase" green. During recall, the M5168 advances the cam an increment at a time until A phase green is active. The length of time between advance pulses is again determined by the interface card switch settings for each active phase through which the cam stack cycles. Once A phase green is active, the M5168 de-energizes relay K1, which eliminates the M5168 from the circuit and electrically reconnects the timer and the cam advance solenoid.

The traffic controller's re-synchronization circuitry, however, holds A phase green active, and ignores any pulses from the timer until the timer reaches A phase green. Then the traffic controller latches up the timer and cam stack, and the intersection returns to normal operation.

If the priority call becomes inactive before the traffic controller reaches the desired green state, the M5168 will still generate cam advance pulses until the desired green is reached. This is the M5168's "Commit to Green" feature. When the desired green phase becomes active, the M5168 will initiate a recall operation, and return control to the timer.

The M5168 has five outputs that can be used to interface to the traffic controller: There is one output for each of the four channels, and a no call output. When the channel outputs are inactive, they are electrically "floating" (they're not connected to any voltage source). When active, the outputs switch to a voltage level determined by the user during installation (all outputs switch to the same level when active). The no call output is generated by the Normally Closed contacts of the four channel relays. When all four channel relays are de-energized the no call output is active. When any channel becomes active the no call output is inactive.

The Disable input allows you to disable M5168 operation. Connecting the input to AC+ disables the M5168, but doesn't affect normal traffic controller operation. Connecting the input to AC- or not connecting it to any terminal enables the M5168.

The cam advance pulse duration (length of time K2 is energized) is factory set to 500 ms., but has a 350 ms. to 700 ms. operating range, adjustable in 50 ms. increments on the circuit board. The length of time between M5168 generated cam advance pulses is determined by the individual green time switch settings. Please see the M5168 Installation Instructions for the cam advance pulse and green time switch setting procedures.

7-1-3. Specifications

This subsection contains the M5168 Electromechanical Card specifications.

Table 7-2. M5168 Electromechanical Card Specifications

Physical Characteristics	
Height	4.5 in. (11.5 cm)
Length	6.5 in. (16.5 cm)
Width	less than 1 inch
Electrical Requirements	
Voltage	95 to 135 VAC, 60 Hz
Current, maximum draw	100 milliamperes
Environmental Requirements	
Temperature	–30 F to +171 F (–34 C to +77 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Channels	4
Inputs from Phase Selectors	2 per channel, up to 8 total
Solid-State Indicators (LEDs)	2 per channel, up to 8 total each; channel 1, Classes I and II
Input Signals	Class I optically-isolated NPN pulsed wave at 6.25 Hz. +/– 0.2 Hz Class II optically-isolated NPN steady on signal

7-1-4. Block Diagram

This subsection contains the M5168 block diagram (Figure 7-2).

The microcontroller has four call inputs, one for each phase (A through D), as well as a disable input that, when active, prevents the M5168 from operating. The microcontroller has the four green sense inputs to determine where the traffic controller is in the intersection cycle. The five timers control the timing between advance pulses. Four of the timers control the green times for up to four phases and the fifth timer controls the yellow time for all phases. The timers are adjustable from 1 to 15 seconds in one second increments.

There are seven outputs, six of which are relay drivers, and one solenoid driver.

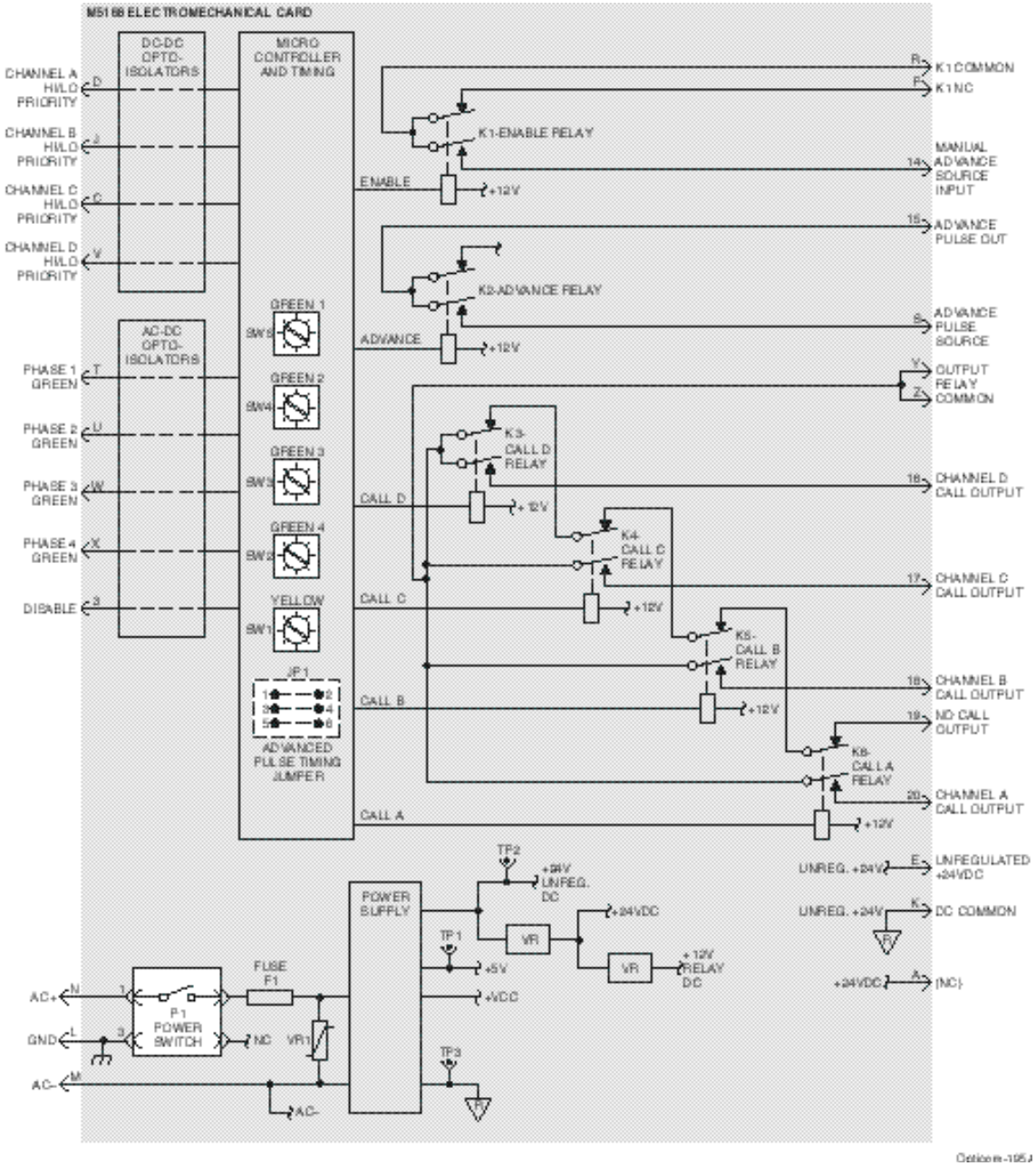

Figure 7-2. M5168 Block Diagram

7-2. M5575 Confirmation Light Card

7-2-1. Operational Description

The M5575 confirmation light card (Figure 7-3) is one of several interface cards available for the Opticom™ Infrared System. The card is designed to be installed in an M560 system chassis. The card interfaces the output of the phase selector to the confirmation light switching device. The switching device is typically a load switch or a relay in the traffic controller cabinet. The power switching device turns on the power to the confirmation light. The card activates its outputs based on the inputs received from the phase selector and the inputs received through the monitoring of the green signal indications. The card implements the appropriate pattern of confirmation light activity, as selected by the user, from the inventory of patterns available. The patterns are described below.

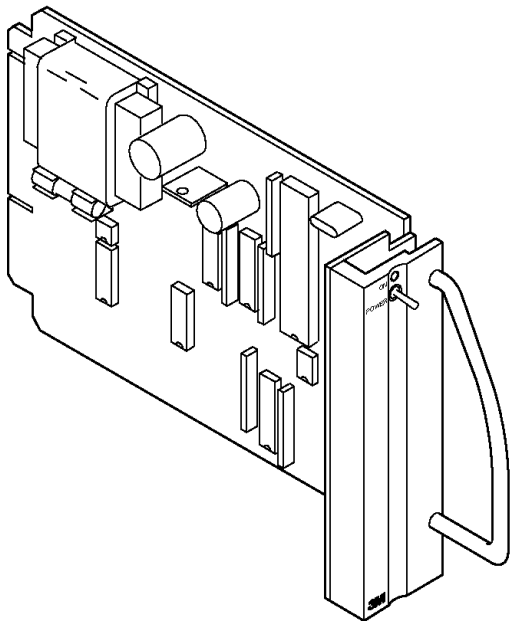

Figure 7-3. M5575 Confirmation Light Card

7-2-2. Specifications

This subsection contains the M5575 interface card specifications

Table 7-3. M5575 Confirmation Light Card Specifications

Physical Characteristics	
Height	4.5 in. (11.5 cm)
Length	6.5 in. (16.5 cm)
Width	less than 1 inch
Electrical Requirements	
Voltage	95 to 135 VAC, 60 Hz
Current, maximum draw	100 milliamperes
Environmental Requirements	
Temperature	–30 F to +171 F (–34 C to +77 C)
Humidity, relative	5% to 95%
Operating Characteristics	
Dual Priority Channels	4
Priority	Same priority, first come first served Dual priority Class II (High) priority overrides Class I (Low) priority any channel
Inputs from Phase Selectors	4
Solid-State Indicators (LEDs)	1
Input Signals	Class I optically-isolated NPN pulsed wave at 6.25 Hz +/– 0.2 Hz Class II optically-isolated NPN steady on signal
Output Signals	Optically-isolated NPN steady on signal

7-2-3. Block Diagram

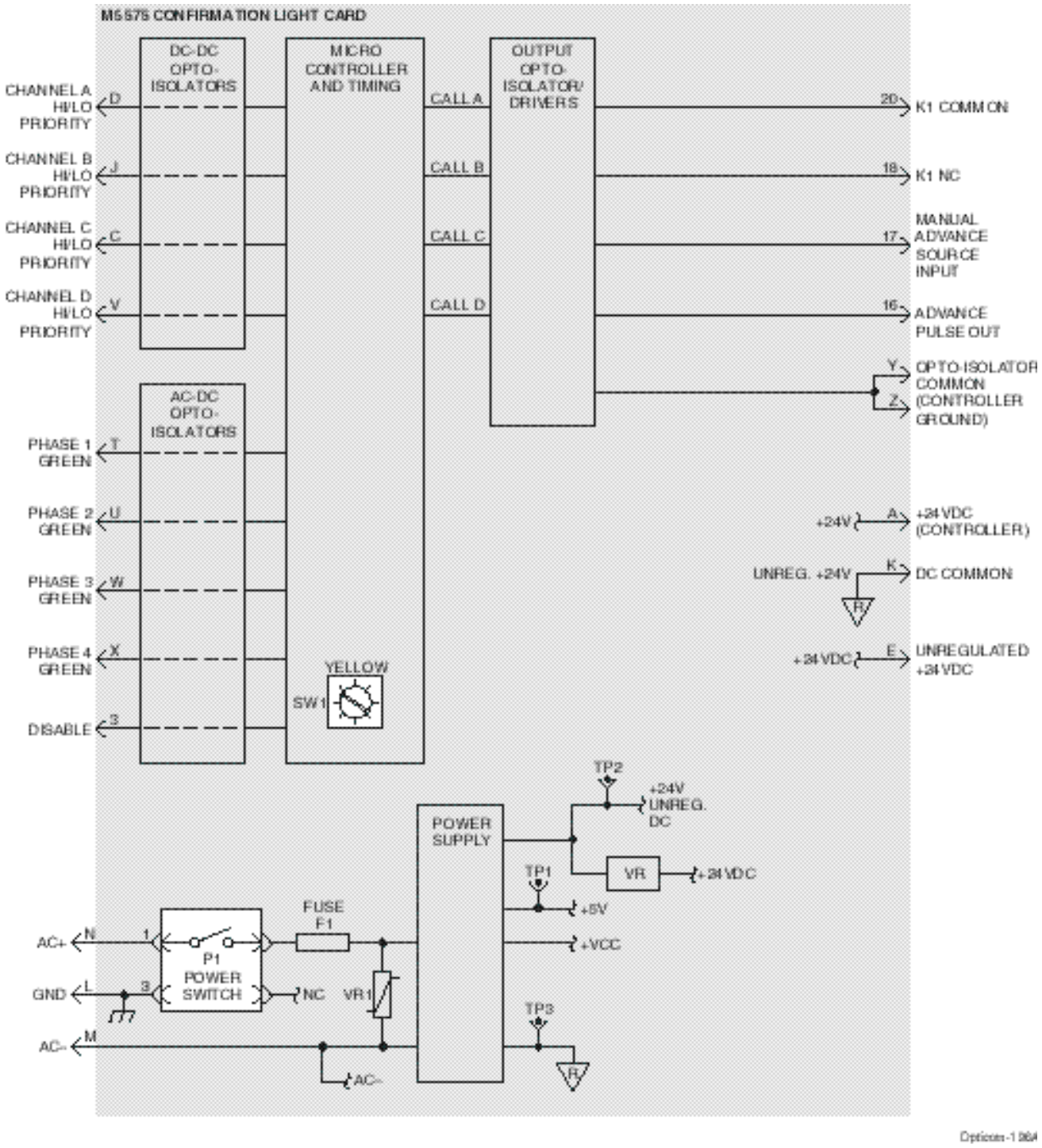

Figure 7-4. M5575 Block Diagram

8. Confirmation Lights

8-1. M175 and M575 Confirmation Lights

Confirmation lights are white lights installed in conspicuous locations on each approach to the intersection and aimed in the direction of the approaching traffic. Confirmation lights are intended to alert all of the vehicle operators and pedestrians of priority control system activity at the intersection. The user agency determines the need and appropriateness of these optional lights

8-1-1. Confirmation Light Components

The confirmation light is composed of common electrical construction components. These components include wired lamp holders and gaskets, a condulet box and plugs for unused holes, a short pipe nipple and lock rings. Lamps are not included. These components are unassembled.

8-1-2. Operational Description

The confirmation light kits are intended to be assembled and installed at the desired location at the intersection. The installation process includes wiring of the assembled confirmation light to the controlling device. The Opticom™ Infrared System M5575 Confirmation Light Card is designed for this and it is discussed later.

Many times the confirmation lights and the optical detectors are assembled together and installed in one location. We recommend caution in planning an installation of this type especially when combining M522s and confirmation lights on span wire or any other mounting where a cable entrance is required other than through the pipe nipple. The condulet box is a “X” configuration with an access cover on one side and four threaded entrances. When one of the threaded entrances is used for the span wire clamp only three others remain for the lamp holders and the base of the detector. Remember, the span wire clamp is not a cable entrance. The optical detector cable could be routed through the cable entrance on the detector but we do not recommend routing the wiring for the confirmation lights through the detector.

Separate mounting locations should be considered for these types of installations. The M522 detector could be assembled to one condulet box and one lamp holder leaving one threaded entrances available for the confirmation light wiring. Another confirmation light could be mounted nearby for the second channel.

8-1-3. Specifications

The components meet the applicable sections of the National Electrical Code.

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9. Maintenance

The Opticom™ Infrared system components are designed for reliable operation. Inspect the components at regular intervals to ensure proper system operation.

We recommend that all detectors be cleaned and inspected at least every twelve months. We also recommend that each intersection and vehicle system be inspected and tested at least every twelve months to ensure that it functions to your specifications and requirements. Intersection systems should be tested with known good emitters. Similarly, vehicle based emitter systems should be tested with known good intersection systems.

You should develop a test plan that both fits your department's operations and meets the needs of your system. We recommend that you keep accurate and up-to-date records of system performance and test results.

9-1. Preventive Maintenance

1. Clean and inspect emitters when required, as determined by observation, but no less frequently than every twelve months. Accumulation of dust, dirt, mud, road-spray, bugs or other materials on the lens should be removed immediately. Wet the lens with soapy water and wash it with a soft cloth. Rinse with clean water and allow it to air dry.

   Carefully inspect the lens and the entire emitter assembly daily or at intervals you believe to be adequate. If any defects are detected in the emitter assembly, arrange to have it repaired or replaced. Test the emitter each day to be sure that it functions properly. Stand off to the side of the emitter and observe the reflected light. The flash pattern of an encoded emitter can be observed in this manner. The 500 series emitters all include self-diagnostic circuits that provide a visible output through the indicator light on the emitter switch. The indicator flashes at the rate of 4 Hz. if faults are detected. (The slower rate of flashing indicates an emitter that is disabled by the disable input.)

2. Clean detectors when required, as determined by observation, but no less frequently than every twelve months. Accumulation of dust, dirt, mud, road-spray, bugs or other materials on the lens should be removed immediately. Wet the lens with soapy water and wash it with a soft cloth. Rinse with clean water and allow it to air dry.

   Verify that the detector is aimed in the appropriate direction. Re-align improperly aimed detectors and tighten the mountings. Test all re-aligned detectors with an emitter equipped vehicle and your established test procedure.

3. Test the phase selector as outlined below:

   a. Hold the channel A test switch up. The controller should recognize a channel A High priority request (the channel A II LED will light). Release the test switch.

   b. If the controller does not recognize the High priority request, substitute a spare unit into the system and re-test. If the problem persists with the spare unit the problem may be in the wiring from the phase selector/system chassis or the traffic control system.

      If the phase selector is the problem return it 3M for repair.

   c. In a dual priority system, hold the channel A test switch down. The controller should recognize a channel A Low priority request (the channel A I LED will light). Release the test switch.

   d. If the controller does not recognize the Low priority request, substitute a spare unit into the system and re-test. If the problem persists with the spare unit the problem may be in the wiring from the phase selector/system chassis or the traffic control system.

   e. Repeat steps a through d for channel B.

   f. Repeat steps a through e for a second phase selector.

9-1-1. System Maintenance

Global Traffic Technologies recommends testing all intersections at regular intervals you find to be appropriate for your system but no less frequently than every twelve months. Use the following steps to test an intersection.

1. Locate a vehicle within the range set for the intersection approach to be tested.
2. Wait until the signal light turns yellow, then turn on the emitter.
3. The desired green should be delivered, if it is not please refer to the Troubleshooting section of this manual.
4. If this approach functions correctly, test the remaining approaches at the intersection before repeating the tests at another intersection.

10. Troubleshooting

Symptom/Indication	Model Number	Possible Cause/Solution
Emitter does not flash when it is turned on	All	Check the emitter fuse or circuit breaker, reset circuit breaker, replace fuse or circuit breaker if bad.
	M192	Check all wiring, including the on/off switch. Re-seat all Opticom system connectors. Replace the emitter. Replace the emitter control switch. Call your Traffic Control Systems dealer.
	M4192/M9192	Check all wiring, including the on/off switch. Make sure that disable function is not activated. Replace the emitter. Call your Traffic Control Systems dealer.
	M292	Check all wiring, including the on/off switch. Re-seat all Opticom system connectors. Make sure that disable function is not activated. Replace the flash head. Replace the power supply. Call your Traffic Control Systems dealer.
	M592	Check all wiring, including the on/off switch, and re-seat all Opticom system connectors. If the indicator light in the on/off switch is flashing four times per second (2 Hz), replace the flash head. If the indicator light in the on/off switch is flashing every other second (0.5 Hz), the disable function is active. Deactivate it. Replace the emitter power supply. Be sure to encode the supply before re-testing. Call your Traffic Control Systems dealer.
Emitter flashes, but very slowly	All	Emitter possibly is not getting enough current. Ensure that correct installation cable was used, that all connections are clean, tight, and made to the battery where specified in the installation instructions, and that vehicle battery voltage is correct.
	M192	Replace the emitter. Replace the emitter control switch. Call your Traffic Control Systems dealer.
	M4192/M9192	Replace the emitter. Call your Traffic Control Systems dealer.
	M292	Replace the power supply. Call your Traffic Control Systems dealer.
	M592	Replace the power supply. Encode the new supply before re-testing. Call your Traffic Control Systems dealer.

Symptom/Indication	Model Number	Possible Cause/Solution
Emitter will not place a call	All	Clean the glass in front of the emitter. Ensure the emitter is level, pointed forward, and is not obstructed.
	M192	Replace the emitter. Replace the emitter control switch. Call your Traffic Control Systems dealer.
	M4192/M9192	Replace the emitter. Call your Traffic Control Systems dealer.
	M292	Replace the power supply. Call your Traffic Control Systems dealer.
	M592	Ensure the power supply is encoded with a valid Opticom system class and identification numbers. Replace the power supply. Encode the new supply before re-testing. Call your Traffic Control Systems dealer.
Phase selector power LED flashes	M562	Reset the M562. (Turn off the power switch, hold the "A channel test switch" down and "B channel test switch" up. Then turn the power switch on.) If the M562 power LED continues to flash, return the unit.
Phase selector and interface card power on/off LED is not lit	All	Check all phase selector and interface card on/off switch and fuses. Replace if necessary. Check controller AC power. Set a multimeter to read 120 VAC. Check between pins M and N at the back panel. If there is no 115 VAC, restore controller AC and retry.
Phase selector and interface card power and on/off LEDs are lit, but call LEDs do not light	All	Initiate a High priority test call on channel A of a phase selector. If the call light does not light, replace the phase selector. If it does light, repeat the test with a Low priority test call on channel A. If the call light does not light, replace the phase selector. If it does light, repeat the above tests with channel B.
	CA/NY Type 170 controller	No +24 VDC from phase selector(s) to detector(s). Set a multimeter to read at least 30 VDC. Measure voltage between pin E and pin K. Replace the phase selector if voltage is less than 20 VDC.
	M360/M560 system chassis	Measure voltage between TB1-3 and TB1-4. If a second phase selector is installed, check between TB2-3 and TB2-4. Replace the phase selector if voltage is less than 20 VDC.
	All	Back the phase selector(s) out of the slot, check resistance between all combinations of optical detector wires. All readings must be greater than 5000 ohms. If any resistance reading is less than 5000 ohms, there is a short either in the detector(s) or in the wiring between the detector(s) and the traffic controller.

<table>
<tr><th>Symptom/Indication</th><th>Model Number</th><th>Possible Cause/Solution</th></tr>
<tr><td rowspan="3">Phase selector and interface card power and on/off LEDs are lit, but call LEDs do not light (cont.)</td><td>All</td><td>Disconnect M262-J2 or M562-J1, whichever applies, and check voltage again. Leave the cables disconnected until the problem is corrected.
Auxiliary Detectors:
M262-J2
<table><tr><th>Pin</th><th>Wire</th><th>Connection</th></tr><tr><td>A</td><td>Orange</td><td>Ch A/C 2nd detector</td></tr><tr><td>B</td><td>Yellow</td><td>Ch A/C 3rd detector</td></tr><tr><td>C</td><td>Violet</td><td>Ch B/D 2nd detector</td></tr><tr><td>D</td><td>Blue</td><td>Ch B/D 3rd detector</td></tr><tr><td>–</td><td>Bare</td><td>Shield (Gnd.)</td></tr></table>M562-J1
<table><tr><th>Pin</th><th>Connection</th></tr><tr><td>9</td><td>Ch A/C 2nd detector</td></tr><tr><td>10</td><td>Ch A/C 3rd detector</td></tr><tr><td>11</td><td>Ch B/D 2nd detector</td></tr><tr><td>12</td><td>Ch B/D 3rd detector</td></tr></table></td></tr>
<tr><td>All detectors</td><td>Check for +26 VDC at the detector(s), measuring between the orange wire and ground.
Make sure the detectors are clean, level, aligned correctly, and have an unobstructed view of the intersection approach.</td></tr>
<tr><td>All controllers</td><td>⚠ Caution
Shorting phase selector inputs may cause serious damage to the phase selector. Remove the phase selectors from the 170 input files or Opticom system card rack/system chassis before checking continuity.
Pull the phase selector for the suspect detector out of its slot. If auxiliary detectors will be checked, disconnect M262-J2 or M562-J1, whichever applies.
If auxiliary detectors are connected, unplug M262-J2 or M562-J1, whichever applies, and check voltage again. Leave cables unplugged until the problem is corrected.
Remove all of the wires from the suspect detector and tie (short) them together.
Check for continuity between all combinations of two detector input wires at the phase selector.
If an open is found, repair and recheck continuity. If there is no open wire, replace the detector and try again.
Call your Traffic Control Systems dealer.</td></tr>
</table>

Symptom/Indication	Model Number	Possible Cause/Solution
Phase selector call LEDs light but intersection will not acknowledge signal	M262/M562	Set a multimeter to read at least 30 VDC. Measure the phase selector outputs at the pin side of the edge connector: pin F for channel A/C, pin W for channel B/D. A solid low (ground) is a High priority call, a 6.25 Hz square wave is a Low priority call, and +24 VDC is no output (no call active). Replace phase selector if output is not correct.
	All interface cards	If phase selector output is correct and the intersection won't acknowledge, change the interface card. If the controller has no interface cards, troubleshoot the traffic controller.
High priority will not override Low priority	M262/M562	Hold the channel A test switch down on one of the phase selectors to initiate a Low priority call. When the channel A LED lights, keep holding the A test switch down and initiate a High priority call on channel B by holding the channel B test switch up. The channel B LED should light, and the channel A LED should blink. If this test fails, replace the phase selector and re-test. If OK, retry, but initiate a Low priority in channel B and a High priority in channel A. Repeat the tests on the other phase selector.
	All interface cards	If the second phase selector tests good, initiate a Low priority test call on one phase selector and a High priority test call on the other. If a failure occurs, change the interface card (if present).
	All controllers	If there is no interface card, the controller software has probably failed. Troubleshoot the controller.
Same priority calls not treated on a first come first served basis	M262/M562	Replace the phase selector.
Green terminates before priority vehicle clears the intersection	M262	Check the drop out time jumper in the upper left corner of the M262 mother board. If jumper is soldered to "5," remove it and solder it to "10." Try again.
	M562	Check the call extension time setting. If it is too short, increase it and try the intersection again. If the time cannot be adjusted, or it still cuts off too soon despite adjusting it, replace the phase selector and try again.
Intersection very slow to respond	All vehicles	Clean the emitter. Check that emitter is level and aimed forward.
	Intersection	Check all detectors, primary and auxiliary, for: aiming, dirty, misalignment, visual obstructions, and faulty detectors. Check signal intensity threshold setting adjustment, adjust if necessary.

Symptom/Indication	Model Number	Possible Cause/Solution
Call will not drop	M262/M562	Phase selector hung up. Replace phase selector.
	All interface cards	Interface card defective. Replace interface card.
	All detectors	Detector oscillating. Replace detector.
	All controllers	Troubleshoot the controller.

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A. Glossary

Activity Log

Information recorded during a priority vehicle call. Includes vehicle class and code, priority, direction, call duration, green status when the call ended, duration of final greens, actual time the call ended (seconds, minutes, hours, day month, year), and the Near or Far intersection indication.

Approach Direction

The term used to describe the direction from which an Opticom™ Infrared System equipped vehicle moves toward, or approaches, an Opticom equipped intersection.

Arbitration

The ability to allow only one request for priority control to be active at one time regardless of how many channels are active on the phase selector or selectors.

First-Come, First-Served

The ability to treat same priority inputs on a first come first served basis.

High Overrides Low

Allows High priority class II inputs to override Low priority class I inputs.

Automated Signal Intensity Threshold Level Setting

The ability of the 500 series phase selector that allows the installer to automatically adjust the sensitivity of the individual detector channels by depressing the Automatic Signal Intensity Threshold switch in a 500 Series equipped maintenance vehicle.

System Chassis

A device that houses printed circuit boards (cards). The system chassis supplies logic voltages and input/output signals through edge connectors into which the printed circuit boards are inserted.

Coding Packet

A group of 29 data pulses optically transmitted by a 500 series emitter.

Communications Port

An RS232 standard serial interface that allows communication between a phase selector module and external computers.

Controller

An electrical or electromechanical device that controls the sequence, duration, and timing of traffic signal lights.

Desired Green

The anticipated result of an Opticom call. The desired green is that which grants right-of-way to the priority vehicle

Detector, Auxiliary

One or two detectors wired to the auxiliary inputs on the phase selector used to increase or widen the detection angle or distance over which an emitter could be detected.

Detector Primary

The optical detector connected to the phase selector primary detector input.

Discrimination

The ability of a phase selector to recognize and differentiate between Opticom emitter signals and other light sources.

Emitter

A single source of pulsed optical energy used to activate the Opticom system.

Green Signal Indication

A traffic controller generated signal that is active when the phase to which the signal is assigned has a green light.

Input File

A device in California/New York Type 170 traffic controllers to house printed circuit boards.

Interface Board

An electronic printed circuit board that manipulates phase selector output signals to the traffic controller.

Lightbar

A mechanical device containing a combination of warning lights, speakers, sirens, etc. mounted on an emergency vehicle.

N.E.M.A.

National Electrical Manufacturers Association

Optical Detector (see Detector)

Optical Emitter (see Emitter)

Phase Selector

An Opticom™ Infrared system component housed in the traffic controller. The phase selector processes the detector signal to ensure that it is an Opticom signal and has sufficient amplitude.

Phase

The right-of-way, change, and clearance intervals in a given traffic cycle are assigned to an independent movement of traffic.

Power Supply

The component of the emitter assembly that boosts the 12VDC battery voltage to the high level required for the emitter to flash. The power supply also generates the flash timing.

Preemption

The transfer of control from the normal mode of traffic signal operation to a special control mode.

Priority, High

A mode of operation that elicits a particular response from the phase selector.

Priority, Low

A mode of operation that elicits a particular response from the phase selector.

Signal Intensity Threshold Level Setting

The ability of the Opticom system that allows the installer to adjust the sensitivity of the individual detector channels.

System Chassis

A device that houses printed circuit boards, and is pre-wired to accept Opticom phase selectors and interface cards.

B. Index

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GTT warrants future system operability coverage as described herein. The warranties set forth in this document shall not apply to (A) incandescent lamps (confirmation lights) or (B) to any Opticom infrared system components which have been (1) repaired or modified by persons not authorized by GTT; (2) subjected to incorrect installation, misuse, neglect or accident; (3) damaged by extreme atmospheric or weather-related conditions; or (4) subjected to events or use outside the normal or anticipated course.

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Global Traffic Technologies, LLC
7800 Third Street North
St. Paul, Minnesota 55128-5441
1-800-258-4610
651-789-7333
www.gtt.com

Global Traffic Technologies Canada, Inc.
157 Adelaide Street West
Suite 448
Toronto, ON M5H 4E7
Canada
1-800-258-4610

75-0500-0048-0 Rev. B