DATA CONNECT ENTERPRISE

User's Manual
IG202T and IGV23 Modem

IG202T - IGV23 Modem User's Manual

520-01005-001 Rev. C

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Chapter 1
Introduction

Thank you for purchasing Data Connect Enterprise's IG202T and IGV23 leased line modem, the finest industrial-grade modem available. This manual will cover both the standalone IG202T, a Bell 202 compatible, and the standalone IGV23, an ITU-V23 compatible modems.

The Data Connect Enterprise IG202T/V23 modem is a 0 to1200 bps modem designed for 4-wire, full-duplex or 2-wire, half-duplex operation over a voice-band leased line or private line. The modem is designed utilizing the stand FSK modulation technology to achieve high performance and low cost.

The IG202T/V23 modem is ideally suited for multi-point communication systems that require fast response time, short training time, and low throughput delay.

This User's Guide describes the IG202T/V23 (AC-powered) and IG202T-DC/V23-DC (DC-powered) stand-alone modems, as well as the rack-mount IG202T-RM plug-in module for the Motorola/UDS RM16M. This manual is designed to get your modem "up and running" as quickly as possible. It contains all the information you need to configure and install your modem. It also contains troubleshooting information in the unlikely event you encounter a problem with your modem.

Features

The IG202T/V23 modem is specifically designed for harsh environments typically associated in utility substations and industrial facilities. Though functionally similar to commercial modems, the IG202T/V23 provides the following unique features that make it well suited for utility and industrial applications.

- Packaged in a rugged, compact enclosure for industrial applications.

- Leased-line interface protected with heavy-duty surge protection devices.

- Built-in hardware watchdog timer for software lock-up prevention without requiring human intervention, making it ideal for unmanned locations.

- Works within an extended temperature range of -40ºC to +85ºC.

- Designed with coupling transformers for high-voltage isolation and common mode noise rejection in industrial and commercial environments.

- Operate over voice-band conditioned or unconditioned leased-line and pilot wires.

- Accepts power from a wide range of AC and DC power supplies:

  - IG202T/V23: 90 to 265 VAC or 100 to 400 VDC

  - IG202T/V23-DC: 10 to 60 VDC

  - IG202T/V23-RM: Plug-in module for the Motorola/UDS RM16M modem nest

- Standard industrial connectors for data, analog, and power interfaces allow reliable interconnection to other industrial equipment.

- Asynchronous data rates 0-1200 bps.

- Easily accessible DIP switches for user configuration and option selection.

- DB9-F connector for RS-232/V.24 interface, and RJ-11 for RS-485.

- Local analog, local digital, and remote digital loopback diagnostics.

- Optional mounting options with wall mount and DIN rail mounting kits

Wall-mount option   DIN Rail mounting option

Applications

The IG202T/V23 modem is designed for point-to-point and multipoint data communications. Figure 1-1 shows a typical point-to-point configuration using the IG202T modem and Figure 1-2 shows a typical multipoint configuration using the IG202T modem.
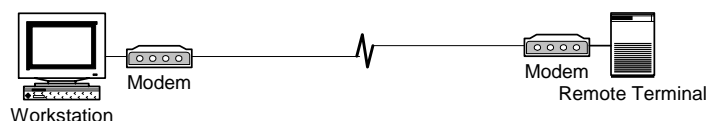
Figure 1-1. Point-to-Point Network Using the IG202T/V23 Modem
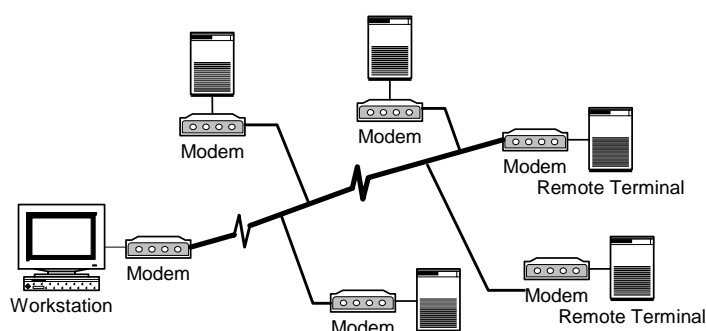
Figure 1-2. Multipoint Polling Network Using the IG202T/V23 Modem

There are a number of factors that can affect the modem's operation and performance. These include:

- Modem speed (i.e. bit error rate, transmission line distance)

- 2-wire or 4-wire configuration

- Transmission line characteristics, noise, and line impairments

- Transmission cable length (pilot wire)

- Network configuration (point-to-point or multipoint)

Chapter 2
Installation

This chapter describes how to configure and install the modem to maximize the performance and to match with your Data Terminal Equipment (DTE) or Remote Terminal Unit (RTU).

Unpacking Your Hardware

Your package should include:

- At least one of the following IG202T or IGV23 modems:

  - Model IG202T or IGV23 for 90 to 265 VAC

  - Model IG202T-DC or IGV23-DC for 10 to 60 VDC

  - Model IG202T-RM or IGV23-RM for RM16M plug-in module

- A switching power supply module for 90-265VAC input (model IG202T or IGV23 only)

- A leased-line cable with optional earth ground conductor (for stand-alone units only)

- A DC power cable (model IG202T-DC or IGV23 modem only)

- This User's Manual or CD-ROM

If your package contents are damaged or missing, contact your place of purchase.

Additional Items You Need to Complete Your Installation

To complete your installation and operate your modem, you need these additional items:

- Two- or four-wire transmission line or leased line

- A DB-9 data cable for your RS-232 interface Data Terminal Equipment (DTE) port, or a RJ-11C data cable for your RS-485 DTE.

- Power supply that provides either:

  - 90 to 265 Volts AC, 50 to 60 Hz, single phase or 100 to 400 VDC (if you have the model IG202T/V23 modem), or

  - 10 to 60 Volts DC (if you have the model IG202T-DC modem)

– For the IG202T-RM, consult the documentation for your Motorola/UDS RM16M

Hardware Overview

Front View

Figure 2-1 shows the front view of the IG202T/V23 stand-alone modem. Starting from the left side, this view shows:

- A set of eight LEDs for modem interface status (see Table 2-4 on page 21)

- A loopback control push-button switch (see Loopback Control Switch on page 21)

Figure 2-1. Front View of the IG202T/V23 Modem

Back View

Figure 2-2 shows the back view of the IG202T stand-alone modem. Starting from the left side, this view shows:

- A 4-wire/2-wire configuration block labeled **LEASED LINE**

- An RJ-11 modular jack labeled **RS-485** for connecting the modem to an RS-485 RTU

- A female, 9-pin RS-232 connector labeled **RS-232** for connecting the modem to a standard DTE (RTU)

- A power connector labeled **10-48V DC**

Figure 2-2. Back View of IG202T Modem

Rack-Mount View

Figure 2-3 shows the rack-mount plug-in module.
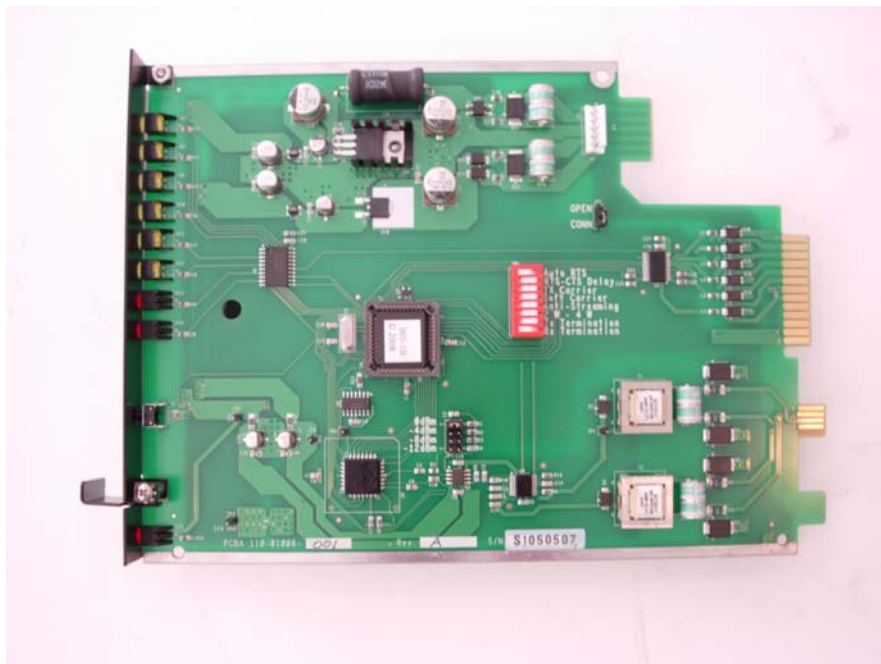
Figure 2-3. Rack-Mount Module for the IG202T-RM Modem Board

Installation Summary

This section describes the steps for installing the modem.

> **NOTE:** It is important to follow the steps below to configure the modem's DIP switches to match your DTE/RTU interface requirement and the transmission line characteristics. If you are not certain about your system's parameters or the leased-line configuration, please contact your network administrator for assistance.

1. Configure the modem using the DIP switches and jumpers. See pages 13 .
2. Connect to a transmission line. See page 18.
3. Connect to a voltage source. See page 19.
4. Connect a DTE device. See page 20.

Configuring the Modem

You configure the modem using the 8-position DIP switch and two sets of configuration jumpers on the printed circuit board of the modem labeled **S1**, **JP1** and **JP2**.

Configuration DIP switches **S1** for the stand-alone and rack-mount modems are identical. Their descriptions in this user's manual apply to both modem versions. Configuration jumper **JP1** for the standalone and rack-mount modem card is used to select transmit output level.

It is important to follow the steps described below, in the order shown, to ensure that you configure your modem properly using the modem DIP switches:

1. Use DIP switch 1 (**S1**) to configure the modem for your host DTE interface and network topology. Using **S1**, you select the modem's serial port to match your host computer or RTU devices, and other DTE specific operating parameters.

2. Use Jumper (**JP1**) to select the modem's transmitter output level to match your specific leased line conditions. The **JP2** is used only in the standalone modem for selecting either RS-232 or RS-485 interface.

3. After you change the DIP switch settings, recycle power to the modem to have the settings take effect.

> **NOTE:** The DIP switch settings will not take effect until you recycle power to the modem.

To access the configuration DIP switches and jumpers on the stand-alone modem:

1. Ground yourself to discharge any ESD, which might cause damage to the sensitive devices on the modem board.

2. Use a small Philips screw driver to remove the two screws at the bottom of the enclosure and remove the top cover. The location of the DIP switches and jumpers for the stand-alone modem are shown in Figure 2-4. For DIP switches and jumpers on the rack-mount plug-in module, see Figure 2-5.

3. Replace the top cover after the configuration is completed.
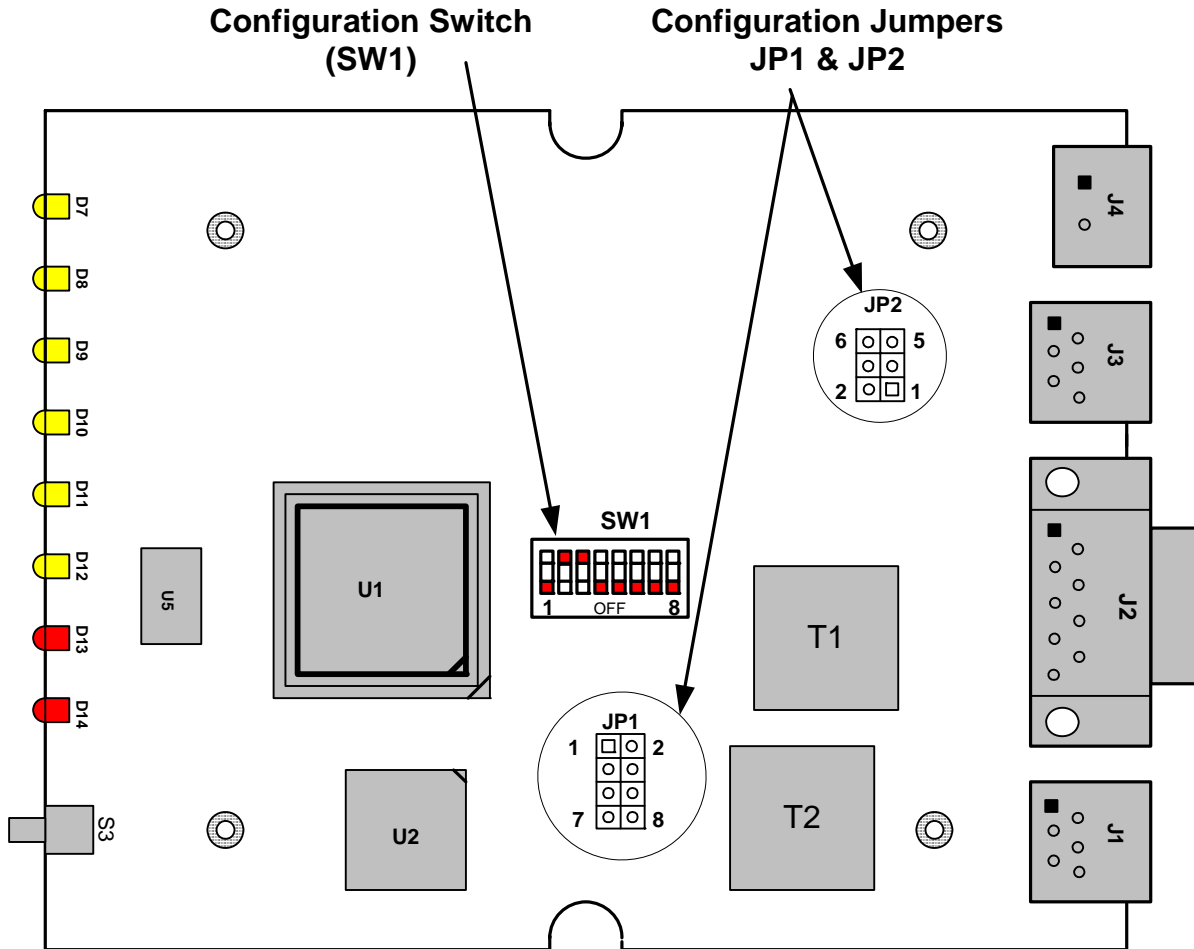
Figure 2-4. IG202T & IGV23 Stand-alone Modem Board
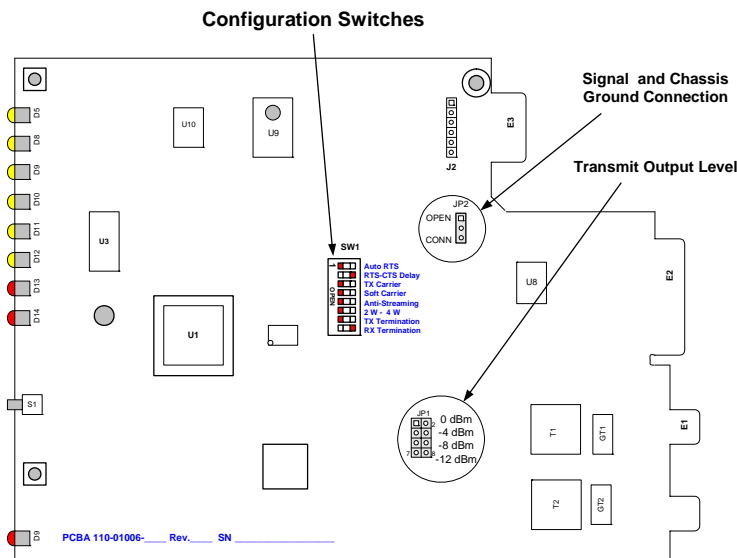
Figure 2-5. IG202T & IGV23 Rack-mount Modem Board

Setting the DIP Switches

SW1 is a 8-position DIP switches used to configure all the options and features of the modem. Table 2-3 shows the setting of the switches.

NOTE: Switches **SW1** are toggle switches. To configure the switches, use a small sharp pin to firmly press down on one end to open or to close each switch. Never leave any switch in half open and half close. Press down on the side of the switch labeled **OPEN** is referring to as **OFF** condition. When the switch is **CLOSED**, it is in the **ON** state.

Table 2-1. Modem Switch Settings

DIP Switches	Switch Settings	
	ON	**OFF (Default)**
DIP Switch S1		
SW1-1: Auto RTS	Enable	Disable
SW1-2: RTS-CTS Delay (Bell 202 mode only)	33 ms	10.0 ms (Bell 202T) 33 ms (V.23 mode)
SW1-3: Transmit Carrier Control	Constant ON	Controlled by RTS
SW1-4: Soft Carrier (Bell 202 mode only)	Enable	Disable
SW1-5: Anti-streaming	Enable (30 seconds)	Disable
SW1-6: 2- or 4-wire leased line	2-wire half duplex	4-wire full duplex
SW1-7: Transmitter Termination	Controlled by RTS	600 ohms
SW1-8: Receiver Termination	600 ohms	High (approx 20K)

SW1-1 – Auto RTS

- SW1-1 ON = Enable Auto RTS
- SW1-1 OFF = Disable Auto RTS (*default*)

For data terminals or RTUs that do not provide Request To Send (RTS), set switch SW1-1 to ON to enable auto RTS mode. In this mode, TXD is detected at the modem and an internal RTS signal and transmit carrier are turned ON. After training completes, the TXD is transmitted to the remote modem. The modem turns the transmit carrier off if no TXD is detected after a pre-determined length of idle time. Auto RTS allows modems to work without the RTS input in the controlled carrier manner; a requirement for multi-point polling connectivity.

NOTE: For point-to-point connections, if the modems do not supply RTS to the modem, you may turn on S1-1 and S1-3 together to force RTS and CTS ON.

SW1-2 – RTS-CTS Delay (Bell 202 Mode Only)

- SW1-2 ON = 33.0 ms delay
- SW1-2 OFF = 10.0 ms delay (*default*)

Switches SW1-2 determines the duration of the RTS-CTS delay in Bell 202 mode. For V23 mode, the RTS-CTS delay is fixed at 33 ms.

SW1-3 – Transmit Carrier Control

- SW1-3 ON = Constant transmit carrier
- SW1-3 OFF = Transmit carrier controlled by RTS (*default*)

DIP switch SW1-3 selects either constant or switched carrier. Constant carrier forces the modem to transmit a modulated carrier to the remote modem regardless the state of RTS signal. Generally, constant carrier mode is used in two different network configurations:

- At the master modem in a point-to-multipoint polling network
- At both modems in a 4-wire point-to-point connection

 When constant carrier is enabled, the modem will not transmit data to the remote modem unless RTS signal is ON and the modem responded by turning CTS ON. In constant carrier mode, RTS-CTS delay is reduced to less than 0.5 ms, as compare to either 10 or 33 ms in

switched carrier mode. The system response timing is faster by reducing the RTS-CTS delay.

IMPORTANT: For point –to– point connection, when the DTE/RTU is not providing RTS signal at the RS-232 or RS-485 interface, setting S1-1 and S1-3 on together will force internal RTS and CTS ON. This feature will allow the modems to work with DTE/RTUs with only a 3-wire interface (TxD, RxD, SG).

.In switched-carrier mode (switch SW1-3 = OFF), the RTS-CTS delay is determined by SW1-2 setting.

SW1-4 – Soft Carrier Control

- SW1-4 ON = Soft Carrier is enabled
- SW1-4 OFF = Soft Carrier is disabled

In Bell 202T mode, when soft carrier mode is enabled, a carrier frequency of 900 Hz is transmitted at the end of a transmission in order to turn off the carrier detect (CD) at the receiving modem. This feature is only use for the Bell 202T modems.

SW1-5 – Anti-streaming

- SW1-5 ON = Anti-streaming is active
- SW1-5 OFF = Anti-stream is inactive (*default*)

Typically, anti-streaming is used in multi-point applications to prevent a malfunctioning slave data terminal or RTU from occupying the line indefinitely. When anti-streaming is active, the modem can transmit data for a maximum of 30 seconds before the transmitter turns off automatically. The modem then looks for an ON-to-OFF RTS transition before proceeding with normal operation.

SW1-6 – 2-Wire or 4-Wire Leased Line Operation

- SW1-6 ON = 2-Wire, Half-Duplex Mode
- SW1-6 OFF = 4-Wire, Full-Duplex Mode (*default*)

Switch SW1-6 configures the modem for either 4-wire full-duplex or 2-wire half-duplex leased line operation. Refer to page 19 for connecting the leased line in 2-wire or 4 wire operation

SW1-7 − Transmitter Termination Impedance

- SW1-7 ON = Controlled by RTS

- SW1-7 OFF = Transmitter set for 600 Ω at all time (*default*)

Switch SW1-7 is used for multi-point configuration networks. When multiple modems are connected on the same metallic circuit:

- The transmitter termination should be of high impedance if the modem is not transmitting in order not put a load on the line.

- The transmitter is only terminated with 600 ohms when RTS is asserted.

This configuration should be used for all slave modems to prevent the transmitting modem from being unnecessarily burdened. To select this configuration, set switch S1-7 ON for the slave modems.

If you use the modem with transmission lines that are transformer-coupled or with an impedance-isolated network (such as a transformer bridge), set switch S1-7 OFF for proper operation.

SW1-8 − Receiver Termination Impedance

- SW1-8 ON = 600 Ω (*default*)

- SW1-8 OFF = Modem receiver is in high input impedance (20K ohms)

Switch SW1-8 is used for multi-point configuration networks. When multiple modems are connected on the same metallic circuit:

In a point to multipoint network configuration, all except one of the slave modem's receiver termination should be set to high impedance if the modems' receivers are connected by the same circuit such that it will not load down the receiver signals. Only one receiving modem should be set to terminated at 600 ohms

The master modem's receiver is always terminated with 600 ohms

JP1 − Transmit Level

JP1-1 through JP1-8 adjust the modem's transmit level. Table 2-2 shows the transmit levels you can select using a 2-position shunt to connect 2 pins from JP1.

Table 2-2. Transmit Levels

Transmit Level	JP1 Jumper Settings
0 dBm	Pin 1 to Pin 2
−4 dBm	Pin 3 to Pin 4
−8 dBm	Pin 5 to Pin 6
−12 dBm	Pin 7 to Pin 8

.

JP2 − RS-232 or RS-485 Serial Interface (Standalone Only)

JP2, a 6-pin header, is used to select the communication port for the modem. You may select to use either the RS-232 or RS-485 port. Only one type of interface is supported by the modem. Table 2-33 shows the two jumpers must be placed to make the selection.

Table 2-3. RS-232 or RS485 Select

RS-232/ V.24 Interface	RS485/RS422 Interface
JP2: Pin 1 to Pin 3 Pin 2 to Pin 4	**JP2:** Pin 3 to Pin 5 Pin 4 to Pin 6

.

JP2 For Rack-Mount Plug-in Modules

Jumper block JP2 is used to connect or separate the chassis ground (earth ground) and the signal ground together. Signal ground is the common voltage return for your DTE RS-232 interface.

Connecting to a Transmission Line

The modem has a transmission line interface (RJ-11C) that can be configured for 2- or 4-wire analog connection, where in 4- wire connection, one pair (Tx-A and Tx-B) is used to transmit data and the other pair (Rx-A and Rx-B) is used to receive data. The transmit pair and receive pair are non-polarized. Table 2-4 shows the pin numbers and corresponding signals for the modem. The RJ-11C shows the pin-out shows the transmission line interface.

NOTE: For communication to occur, the Rx line of one modem must connect to the Tx line of the other modem. The modem's Tx/Rx pair are non-polarized.

NOTE: The modem does not support leased-line operation with DC shielding current. Leased-line connector pin assignments for the rack-mount module can be found in the documentation for your Motorola/UDS RM16M.

Table 2-4. Transmission Line Connector Pin Assignments

This Pin Number…	Corresponds to This Signal…
1	Not Uesd
2	**Rx**
3	**Tx (Tx/Rx)**
4	**Tx (Tx/Rx)**
5	**Rx**
6	Not Used

NOTE: When 2-wire half duplex is used, the center pair must be used for both transmit and receive.

Pin #6   Pin #1
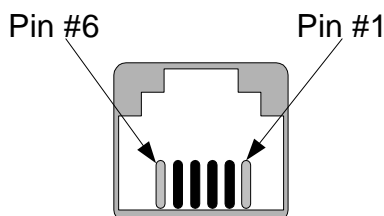
Connecting to a Voltage Source

The back panel of the modem provides a 2-position screw terminal power interface connector. For your convenience, the DC voltage of the input power is non-polarized. To meet your specific application, the modems can be powered from the following power sources:

- Model IG202T (with AC-DC power converter): 90 to 265 Volts AC, 50 to 60 Hz, single phase or 100 to 400 VDC. The output of the converter is a 12 VDC source that will power the modem.

- Model IG202T-DC (DC version): 10 to 60 Volts DC. The model IG202T-DC comes with a power cord for making this connection.

Figure 2-2 on page 10 shows the connection to the Model IG202T's power interface shows the connection to the Model IG202T-DC's power interface.

WARNING: Before you connect a voltage source, observe the following power supply voltage guidelines. Otherwise, you will void your warranty if the wrong voltage is applied.

- Be sure the voltage source is within the permitted ranges shown above. Otherwise, your modem and any attached devices may be damaged.

- Customer-supplied cables must be suitable for the site environmental conditions.

- Screw terminals on the power interface accept 24 to 16 AWG. However, surge protection is effective only if there is a solidly earthed ground connection greater than 18 AWG.

- Be sure the power source is not controlled by a wall switch, which can be inadvertently turned off, shutting off power to the modem.

Connecting to an RS-232 Device

The modem back panel provides a female, 9-pin RS-232 connector that accepts an attached RS-232 device (see Figure 2-2 on page 10). This connector accepts a standard connection to a DTE (RTU) that conforms to the pin assignments shown under "RS-232 (DTE) Interface" on page 26.

Connecting to an RS-485 Device

The modem rear panel provide an RJ-11C module jack connector for a 4-pin RS-485 or RS-422 interface in the event that your DTE or RTU does not support the RS-232 interface (see Figure 2-2 on page 10 and Figure 2-6).

The pin assignments for the RS-485 interface are listed in Table 2-3.
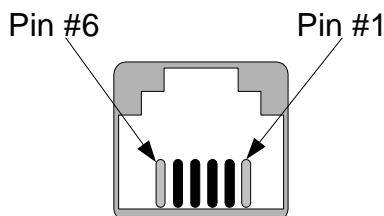
Pin #6   Pin #1

Figure 2-6. Pin Locations on the Modem's RJ-11C Jack

Table 2-3. RJ-11C Modular Jack Pin Assignments

RJ-11 Pin Number…	Corresponds to Signal Name	Modem Input or Output
1	Not Used	NA
2	RxD+	Output
3	RxD-	Output
4	TxD+	Input
5	TxD-	Input
6	Not Used	NA

LEDs

The front panel of the modem provides the LEDs shown in Table 2-3.

Table 2-4. Modem LEDs

LED	Color	Description
RTS	Yellow	Request To Send
CTS	Yellow	Clear To Send
TD	Yellow	Transmit Data
RD	Yellow	Receive Data
CD	Yellow	Carrier Detect
MR	Yellow	Modem Ready
ALB	Red*	Local Analog Loopback
DLB	Red*	Local Digital Loopback
* When the modem is in remote loopback (V.54 Loop 2), both the **ALB** and **DLB** LEDs go ON.		

Loopback Control Switch

The front panel of the modem has a push button for initiating the following loopback diagnostic tests:

- Local digital loopback — started by pressing the button one time. The **DLB** LED should be ON. When a DTE is connected to the RS-232 port of the modem, the transmit data is loop back to the DTE as receive data. This test will verify the modem's RS-232 interface along with the cable attached.

- Local analog loopback — started by pressing the button two times. The **ALB** LED should be ON. When a DTE is connected to the RS-232 port of the modem, the transmit data is loop back to the DTE as receive data. This test will verify the modem transmitter, receiver, and its RS-232 interface along with the connecting cable.

- Remote digital loopback — Press the local modem's diagnostics test button three times. Both the **ALB** and **DLB** LEDs should be ON. In this mode, the modem is performing a loop back to the remote modem (V.54 loop 2 configuration). The This test will verify both modems' transmitters, receivers, and the leased line

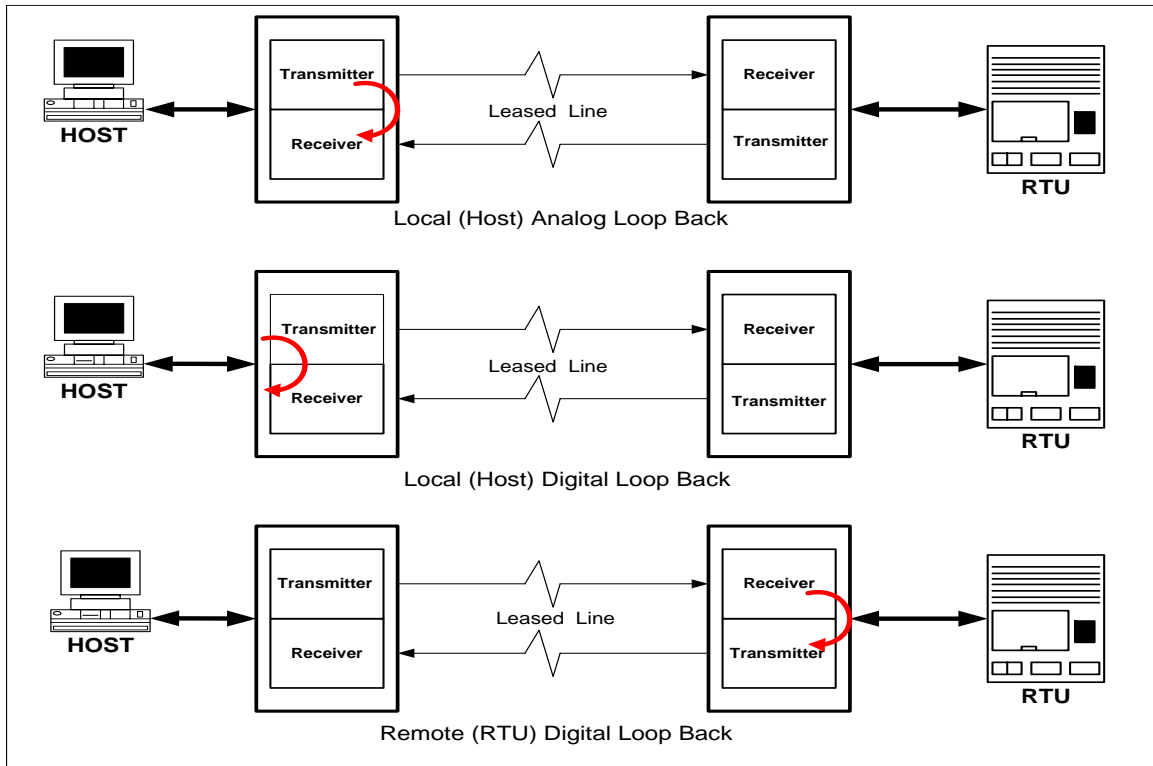Figure 2-7 shows these three loopback diagnostics.

Figure 2-7. Loopback Diagnostic Modes

User's Manual - IG202T - IGV23 Modem

Appendix A
Troubleshooting

In the event you encounter a problem using your Data Connect Enterprise modem, refer to the troubleshooting information in this appendix.

IMPORTANT: If you encounter a problem with your modem, be sure the switches on the modem are set to the appropriate positions (see Table 2-1 on page 13). If a switch is halfway between an on and off setting, the modem will not operate properly.

Problem Solving

Table A-1 offers troubleshooting solutions for modem problems.

Table A-1 Problem Solving

If…	Perform These Procedures…
No LEDs are ON at the front panel	Check the power supply source. Be sure the input power to the modem's power connector is between 10 to 60VDC
Modem does not respond to the attached DTE and the all LEDs are off.	Check the connecting RS-232 or RS-485 cable between the DTE and the modem. The MR LED (Modem Ready) on the front panel should be ON when the modem is idle.
Modem does not receive data, and the **DCD** and **RxD** LEDs are off.	Check the DIP switches of both modems to make sure that the same data rate and operating parameters are identical on both modems. The receive line pair may be disconnected from the modem. Make sure the transmission line connection to the modem is accurate and secure. The receive signal level may be below the CD threshold. Set switch S1-5 ON to see whether configuring the modem for a −43 dBm threshold resolves the problem. If this problem remains unresolved, perform a local ALB loopback test to determine if the modem's receiver is functioning correctly.
The **RTS**, **CTS**, and **TxD** LEDs do not blink.	The attached terminal or DTE may not be sending data to the modem. Verify that data is being transmitted. If data is being transmitted, make sure the RS-232 cable is sound and securely connected to the modem and terminal or DTE.

Appendix B
Specifications

General Specifications

Data rate:	0-1200 bps
Data format:	Transparent to DTE
DTE interface:	EIA RS-232/V.24, or RS-485 compatible
Line conditions:	TELCO voice band 4- or 2-wire leased line, conditioned or unconditioned lines. Private metallic circuits
Operating modes:	2-wire half-duplex or 4-wire full-duplex
Modulation:	FSK, Bell 202T or V.23 compatible

- Mark = 1200 Hz (1300 Hz, V.23)
- Space = 2200 Hz (2100 Hz, V.23)
- Soft Carrier = 900 Hz (Bell 202T only)

RTS-CTS Delay:	10 or 33 ms (Bell 202T) 33 ms (V.23)
Receiver dynamic range:	0 to –43 dBm
Operating temperature:	-40°C to +85°C
Power supply:	Wide range switching power supply:

- IG202T (AC version): 90 to 265 Volts AC, 50/60 Hz, single phase or 90 to 400 VDC
- IG202T-DC (DC version):10 to 60 Volts DC

Surge protection:	Leased line, up to 15KV
Carrier control:	Constant or switched, DIP switch selectable
Carrier loss recovery:	Automatically
Auto RTS:	Support DTE without hardware RTS
Anti-streaming:	30-second timer to prevent transmitter lock-up network

Mechanical Specifications

Enclosure:	ABS with removable top cover
Dimensions:	4.1" wide x 4.9" long x 1.40" high

Weight: 0.5 lbs without AC to DC power converter module

Interface connectors

     Leased Line: 4-position RJ-11C modular Jack

Data Terminal Equipment: DB-9 female connector (for RS-232)

            RJ-11C module jack (for RS-485)

Interface Connector Pin Assignments

Table B-1. Leased Line RJ-11C Pin Assignments

This Pin Number…	Corresponds to This Signal…
1	Not Uesd
2	**Rx**
3	**Tx (Tx/Rx)**
4	**Tx (Tx/Rx)**
5	**Rx**
6	Not Used

NOTE: When 2-wire half-duplex is used, the TX pair must be used for both transmit and receive.
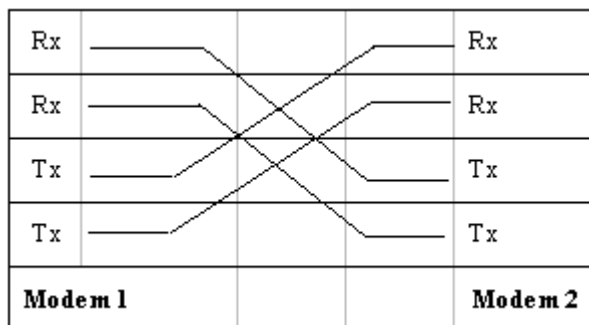

Figure 2-8. Back-to-Back Connection to a Second Modem

RS-232 (DTE) Interface

Table B-2. RS-232 (DTE) Interface

Signal Name	Modem Input/Output	DB-9 Pin	Description
DCD	Output	1	Data Carrier Detected
RXD	Output	2	Receive Data
TXD	Input	3	Transmit Data
SG	—	5	Signal Ground
DSR	Output	6	Data Set Ready (Modem Ready)
RTS	Input	7	Request To Send
CTS	Output	8	Clear To Send

RS-485 (DTE) Interface

Table B-3. RS-485 (DTE) Interface

RJ-11 Pin Number…	Corresponds to Signal Name	Modem Input or Output
1	Not Used	NA
2	RxD+	Output
3	RxD-	Output
4	TxD+	Input
5	TxD-	Input
6	Not Used	NA

Environmental Specifications

Operating temperature: -40 to + 85° C

Storage temperature: -40 to +125° C

Operating humidity: 5 to 95 %, non-condensing

Line isolation: 3750 V RMS

Surge protection: Leased line up to 15K VA

Appendix C
Limited Product Warranty

Data Connect Enterprise warrants that the Product sold will be free from defects in material and workmanship and perform to Data Connect Enterprise' applicable published specifications for a period of 24 months from the date of delivery to Customer. The liability of Data Connect Enterprise hereunder shall be limited to replacing or repairing, at its option, any defective Products that are returned F.O.B. to Data Connect Enterprise's facility (or, at Data Connect Enterprise's option, refunding the purchase price of such products). In no case are Products to be returned without first obtaining permission and a customer return order number from Data Connect Enterprise. In no event shall Data Connect Enterprise be liable for any consequential or incidental damages.

Products that have been subject to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation are not covered by the warranty. Data Connect Enterprise shall make the final determination as to the existence and cause of any alleged defect. No liability is assumed for expendable items such as lamps and fuses. No warranty is made with respect to custom products or Products produced to Customer's specifications except as specifically stated in writing by Data Connect Enterprise in the agreement for such custom products.

> **Warranty is voided if the serial number label on the printed circuit assembly of returned modems is removed, defaced, or destroyed. This label contains the serial number that will provide proof of the date of manufacturing.**

This warranty is the only warranty made by Data Connect Enterprise with respect to the goods delivered hereunder, and may be modified or amended only by a written instrument signed by a duly authorized officer or Data Connect Enterprise and accepted by Customer.

This warranty and limitation extends to customer and to users of the product and is in lieu of all warranties with respect to the product whether express, implied, or statutory, including without limitation the implied warranties of merchantability and fitness for a particular purpose.

Appendix D
RMA Procedure

Before returning any Data Connect Enterprise product, an RMA number must be obtained. Before asking for an RMA number, ascertain that the product was purchased from Data Connect Enterprise. If you bought the product from a Distributor or Systems Integrator, the product should be returned to that vendor.

The most convenient method to obtain an RMA number for a product purchased from Data Connect Enterprise is to send an email to Data Connect Enterprise. Information required must include

- Company name
- Address (including any Mail Stop or specific delivery information)
- Name, contact information, and e-mail address for the technical contact(s) at your company

If the above information is on your letterhead, that format is acceptable.

For each item you wish to return, please include:

- The product model number (usually found on the serial number tag)
- The serial number for each item you wish to return
- A description of the problem you are encountering
- The cause of the problem (if known)

The product must be properly packed and returned to:

Data Connect Enterprise.
3405 Olandwood Court,
Olney, MD 20832
Attn: RMA Technical Support

The RMA number must be legibly displayed on the shipping carton. No RMAs will be issued without a product review. DCE will not be responsible for any product returned without an RMA number.

If you believe the product may be out of warranty, include a method of payment for repairs (either a Purchase Order number or credit card number), card holder name, date of expiration on the RMA request. Repairs currently require 5 working days and are returned UPS second day air.

Contact us by e-mail mspellerberg@data-connect.com or call: (301)924-7400 x 25 if you should have any questions.

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