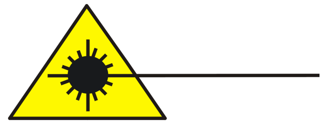
Modems

Model 2240
Fiber Optic Modem
Users Manual



Caution!

This product may contain a laser diode emitter operating at a wavelength of 1300 nm - 1600 nm. Use of optical instruments (for example: collimating optics) with this product may increase eye hazard. Use of controls or adjustments or performing procedures other than those specified herein may result in hazardous radiation exposure.

Under normal conditions, the radiation levels emitted by this product are under the Class 1 limits in 21 CFR Chapter 1, Subchapter J.

ATTENTION!

Cet équipement peut avoir une diode laser émettant à des longueurs d'onde allant de 1300nm à 1600nm. L’utilisation d’instruments optiques (par exemple : un collimateur optique) avec cet équipement peut s’avèrer dangereuse pour les yeux. Procéder à des contrôles, des ajustements ou toute procédure autre que celles décrites ci-après peut provoquer une exposition dangereuse à des radiations.

Sous des conditions normales, le niveau des radiations émises par cet équipement est en dessous des limites prescrites dans CFR21, chapitre 1, sous chapitre J.

Notice!

This device contains static sensitive components. It should be handled only with proper Electrostatic Discharge (ESD) grounding procedures.

NOTE!

Cet équipement contient des composants sensibles aux décharges électro-statiques. Il doit absolument être manipulé en respectant les règles de mise à la terre afin de prévenir de telles décharges.

Notice!

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Model 2240
Fiber Optic Modem

Model Number 2240 - UM
Users Manual

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To reference Technical Advisories and Product Release Notes, go to Canoga Perkins' website: http://www.canoga.com/cservice.htm

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1. Description

1.1 2240 Modem

The 2240 is a full-featured modem for full-duplex operation over fiber optic cable. The 2240 is available in Standalone and Rack-Mount models.

Figure 1-1.
Model 2240
Modem

The 2240 modem operates at speeds from DC (0 bps) to 1.500 Mbps in asynchronous mode, 0 bps to 2.050 Mbps in synchronous mode (depending on the Rate and Mode selection refer to Section 3), including the common rates of 1.536 Mbps, 1.544 Mbps, and 2.048 Mbps. Refer to Section 2, "Installation," for further details.

The 2240s are intended to operate with one of a wide variety of electrical interfaces, as listed below.

RS-423 / 232	CCITT V.35
RS-449	Transparent T1 / E1
RS-449 / RS-423 (MC1)	CCITT V.35 / RS-423 (MC2)
RS-530	Programmable RS-422
Twinax 422	TTL / BNC
Twinaxial Mil-Std 188-114C	DC-37 Mil-Std 188-114

Various configurations of the 2240 provide local and end-to-end modem controls including those listed in Table 1-A.

Various configurations of the 2240 provide local and end-to-end modem controls including those listed in Table 1-A.

Data / Clock	**Controls**
Send Data	Request to Send
Receive Data	Clear To Send
Send Timing	Data Set Ready
Receive Timing	Data Carrier Detect
Terminal Timing	Local Test
	Remote Test
	Sec. Request to Send
	Sec. Data Carrier Detect
	Data Terminal Ready
	Ring Indicator

Table 1-A.
Control Leads
Available

1.1.1 Functions, LEDs and Switches

The 2240 Modem incorporates a Loopback Control switch, labeled "Loop," located on the front panel. Use of this switch is outlined in Sections 5 and 6.

Indicator lights are provided for Power On, Receive and Transmit Data activity, Local and Remote sync, and Loop On. All of these indicators are located on the front panel of the modem in both standalone and rackmount versions.

An 8-position DIP switch on the front panel is for the control of operating modes and internal clock rates. Use of this switch is outlined in Section 3.

The electrical interface connection and fiber optic connections are made at the rear panel of the modem.

The HI / LO optical power switch (refer to Section 2.2.1) is also located at the rear panel of the modem.

1.2 2201 Rack Chassis

The 2201 Rack Chassis (see Figure 1-2) is designed to accommodate up to ten 2200 series modems, except for the MC1 and MC2 interfaces. For the Model 2240 Modem with MC1 and MC2 interfaces, only five modems may be installed in the Rack Chassis. The 2201 Rack Chassis offers a variety of features including local audible / visible and remote power failure alarms, optional redundant power supply. Rack-mount modems are hot-swappable.

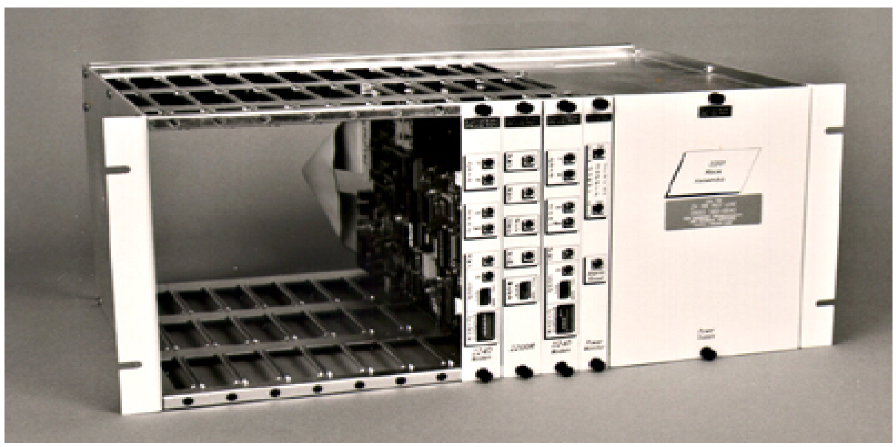


Figure 1-2.
Model 2201
Rack Chassis

1.3 2202 Modem Shelf

The Model 2202 Modem Shelf (see Figure 1-3) is designed to accommodate either one or two standalone 2200 series modems. Hardware is provided for securing the modems side by side in the shelf. The 2202 is designed to fit easily into a 19-inch equipment rack, either flush mount or recess mount.

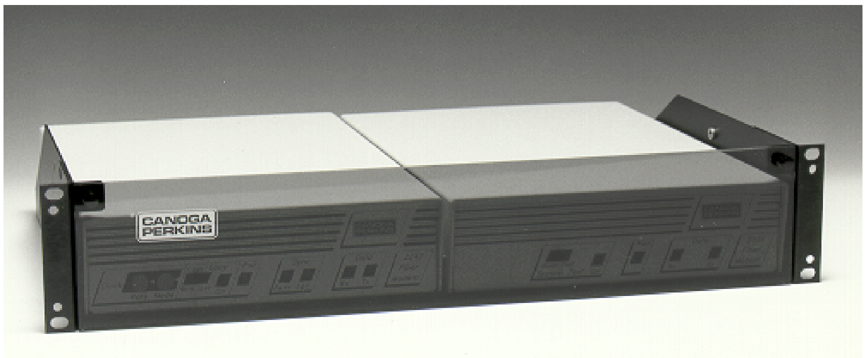


Figure 1-3.
Model 2202
Modem Shelf

1.4 2200R Series Redundant Card

This card allows a single electrical interface to be shared between two modems installed in a 2201 Rack Chassis. This model can be operated in three modes: Remote control, Manual control and Automatic. In the Remote control mode, two contact closure inputs (which are also RS-232 level compatible) are provided to permit forcing the modem to receive on either the primary or secondary link. Transmission occurs only over the selected link.

Two 2240s can operate as a single redundant pair when operating in a 2201 Rack Chassis. The 2200R board is the redundancy controller and signal switch. The combination of these three boards (two rack-mount modem cards and a 2200R card) occupy three slots to provide a redundant fiber optic path. Special interface boards, Redundant Paddle Boards (4PB) are substituted for the normal I/O boards in the two modems. Refer to the 2201 Rack Chassis / 2200R Redundant Modem Card User Manual.

1.5 Modem Operation

1.5.1 General

The 2240 Modem can use an external clock, provide the master clock, or one end can be slaved to the other for either of these cases. The electrical connection between the data equipment and the 2240 Modem differs from model to model depending on which interface is employed (modem is usually DCE). The electronic conversion from voltage level to optical signal level is similar in all applications. For a description of the available interfaces, refer to Section 4. Figure 1-4 provides a functional block diagram of a the 2240 Modem.

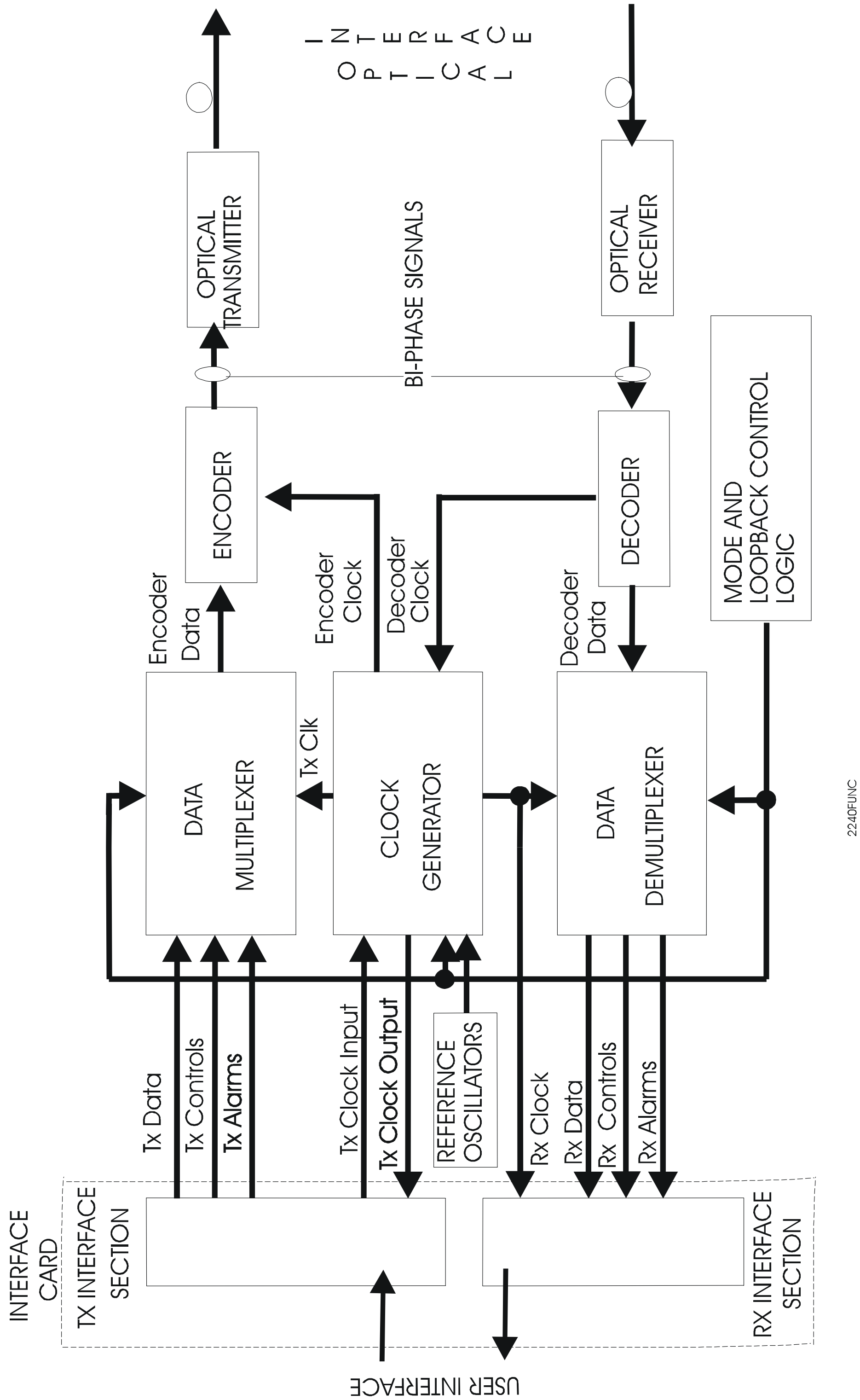


Figure 1-4.
2240 Functional
Block Diagram

The modem functions as a 10-channel multiplexer. The following discussion assumes an 8.19 MHz composite. Lower composite speeds result in proportionally lower submultiples. Clock and data are carried on a 4.096 Mbps and 2.048 Mbps channel, respectively. Each of the three control leads and five Auxiliary lines are carried on a 64 kbps channel. The remaining 1.536 kbps bandwidth splits into 1.024 Mbps for multiplexer synchronization, 256 kbps for low-speed channel synchronization and 256 kbps for supervisory channels. Each 64 kbps channel can be used to carry an async data signal if the user's equipment can tolerate the 16 microseconds of pulse distortion due to sampling.

The composite speed of the 2240 Modem varies between 4.1 and 8.2 Mbps, depending on the selected mode of operation. A detailed description of mode selection is to be found in Section 3. A brief description follows.

The modem has two basic external clock operating modes: "Sampled" and "External Locked." In the Sampled mode, the composite speed is fixed at 8.192 MHz and clock, data and control / auxiliary channels are sampled at 4.096, 2.048 and .064 MHz, respectively. This mode is recommended for low data speed applications (less than 128 kbps).

For the "External Locked" modes, the composite speed is a multiple of an external clock. For T1 and E1, the multiple is four and the resulting composite rates are 6.176 and 8.192 MHz, respectively. Also, for the "External Locked" modes, the sampling frequency for the control and auxiliary channels is 1/128th of the composite rate. Therefore, this sampling rate can vary from 32 to 64 kHz, resulting in sampling jitter of 32 to 16 µsec, respectively.

1.5.2 System Test and Diagnostics

Both Local and Remote test modes can be invoked via a front panel switch. These are useful for diagnosing system problems. Refer to Sections 5 and 6 for more details on these test modes. Two front panel LEDs, Loc and Rem Sync, also help to isolate system problems by indicating whether the local and remote composites are synchronized.

1.5.3 Transmit Section

Each interface signal input to the modem is converted to logic level for use by the modem circuit. The logic level signal is then multiplexed and encoded into a biphase data stream, which in turn is converted to an optical signal for transmission over the fiber optic cable.

The heart of the 2240 transmitter is a ten-channel multiplexer. This multiplexer takes the clock, data and control lead inputs from the interface, multiplexes them, then adds framing and supervisory information. This composite data is then converted into a Manchester-coded signal which drives the modulator of the optical transmitter.

The function of the multiplexer is highly dependent on the operating mode of the modem (refer to Section 3). Supervisory information is related to frame synchronization and loopback status.

1.5.4 Receive Section

An optical receiver circuit converts the incoming signal to a biphase logic signal. It is then de-multiplexed into all necessary interface signals.

The receiver first extracts the clock and data information from the Manchester-coded optical signal. After frame-bit lock is established, the de-multiplexer separates out the clock, data and control lead signals, as well as the supervisory information. The supervisory states are mainly routed to control status indicators, while the remaining signals are routed to the interface circuits. The operation of the receiver is somewhat dependent on the 2240 operating mode, but much less dependent than the transmitter.

1.5.5 Expanded Interface Control Channels

The 400 series of 2200 Series Fiber Optic Modem Interfaces can support additional Control Leads up to a maximum of four. There are three channels dedicated to use for Control. Refer to descriptions of these interfaces in Section 4, "Data Interfaces." The fourth is the Aux Channel 1 input and output which is available on the expanded interface connector.

1.5.6 Expanded Interface Auxiliary Channels

The 2240 has five Auxiliary Channels. One of these channels is available on the expanded interface connector and the other four on the Auxiliary Interface Connector (see Figure 3-4). The MC1 and MC2 interfaces make use of all eight control and auxiliary channels (refer to Section 4).

1.5.7 Fiber Optics

Each interface signal input to the modem is converted to logic level for use by the modem circuit. The logic level signal is then multiplexed and encoded into a biphase data stream, which in turn is converted to optical signal level for transmission over the fiber optic cable.

1.6 Loss Budget

The maximum possible transmission distance is dependent on the overall power loss over the fiber optic link. This is called the link loss. The modem's loss budget is determined by comparing the launch power at the modem with receiver sensitivity at the other end of the link. The difference is the loss budget.

For reliable operation over a long term, i.e., several years, the link loss should be at least 3 dB less than the modem's loss budget. This allows for minor increases in link loss through terminations and any slight deterioration in optical power output.

The connectors are clearly marked as to their function, either Transmit (Tx) or Receive (Rx), on the back panel of the 2240 standalone units, and on the rear of the 2201 Rack Chassis.

The 2240 modem can be used with most popular sizes of multimode and single mode optic cable; including 50/125, 62.5/125 and 8-10/125.

> **NOTE: When using 85/125 or 100/140 micron fiber optic cable, an in-line attenuator may need to be installed between the 2240 and the Receive (Rx) fiber optic cable for proper modem operation.**

1.7 Initial Unit Testing

The Remote and Local Sync indicators on the front panel constantly indicate link integrity. The Local Sync indicator blinks off momentarily if an error has been detected. The Loopback Test feature may be used to verify that the fiber optic modem link and electrical interface are installed correctly.

2. Installation and Setup

2.1 Installation

Installation for the 2240 Fiber Optic Modem includes unpacking the unit, and considerations for installing the standalone and rackmount models.

2.1.1 Unpacking the Unit

Each 2240 Modem is shipped factory tested, and packed in protective cartons. Unpack the unit and retain the shipping carton and protective packing for reuse in the event a need arises for returning it to the factory.

To assure proper operation of the modem, please inspect it and its shipping carton carefully for damage. If damage is sustained to the unit, file a liability claim immediately with the freight carrier.

2.1.2 Standalone Modem Installation

Installing the standalone version of the 2240 Modem is relatively straightforward. It should be located conveniently to the operator and the electrical and optical cables. Fiber optics cables should be isolated from foot traffic to prevent possible damage.

The standalone power supply, which is attached to the unit, is a wall-type transformer or in-line for 115/230 VAC. It should be plugged into a standard AC wall outlet that incorporates a ground line.

> **NOTE: The in-line transformer has a slide switch on the bottom which is used to select the AC line voltage being used. This switch must be set correctly.**
>
> **WARNING:**
>
> **AN INCORRECT SETTING MAY DAMAGE THE MODEM AND/ OR THE TRANSFORMER.**

2.1.3 Rack-Mount Modem Installation

The 2201 Rack Chassis is designed for installation in a standard 19-inch wide equipment rack. Tabs are provided on each side of the unit, and are predrilled for standard spacing. Refer to the 2201 Rack Chassis User Manual for more information on installing a 2201.

When installing a modem or panel, the Nylatch retainer should be in an outward, or released condition. Slide the modem card into the rack until it engages fully with the PC board edge connector, then push the Nylatch retainers in.

For each modem installed, compatible communications cables and appropriate fiber optic cables, terminated with the appropriate type connectors, will be required.

2.1.4 Fiber Cable and Connectors

The Transmit (Tx) from the local modem should be connected to the Receive (Rx) at the remote modem and the Receive (Rx) from the local modem should be connected to the Transmit (Tx) at the remote modem.

The connectors are clearly marked as to their function, either Transmit (Tx) or Receive (Rx) on the back panel of the 2240 standalone units. Figure 2-1 is shown with the V.35 Interface.

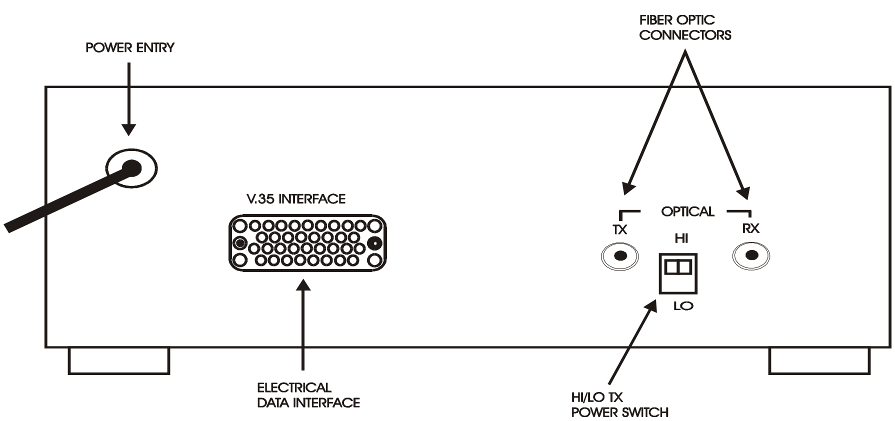


Figure 2-1.
2240 Standalone
Rear Panel Layout

2.1.5 2202 Modem Shelf Installation

The 2202 Modem Shelf is mounted in an equipment rack. Two 2200 Series standalone modems may be installed in the 2202, side-by-side on the shelf. Refer to the 2202 Modem Shelf User Manual for more information about installation.

2.1.6 Custom Oscillator Installation

The third oscillator on the main 2240 board can be installed or changed to allow the use of Group 4 Internal Clock Rates.

Once the board is accessed, notice the four-pin socket located near the two standard oscillators (see Figure 2-2). Ensure that the oscillator pins are straight and that the modem is not powered up. Insert the oscillator in the same orientation as the two standard oscillators, then reinstall the modem.

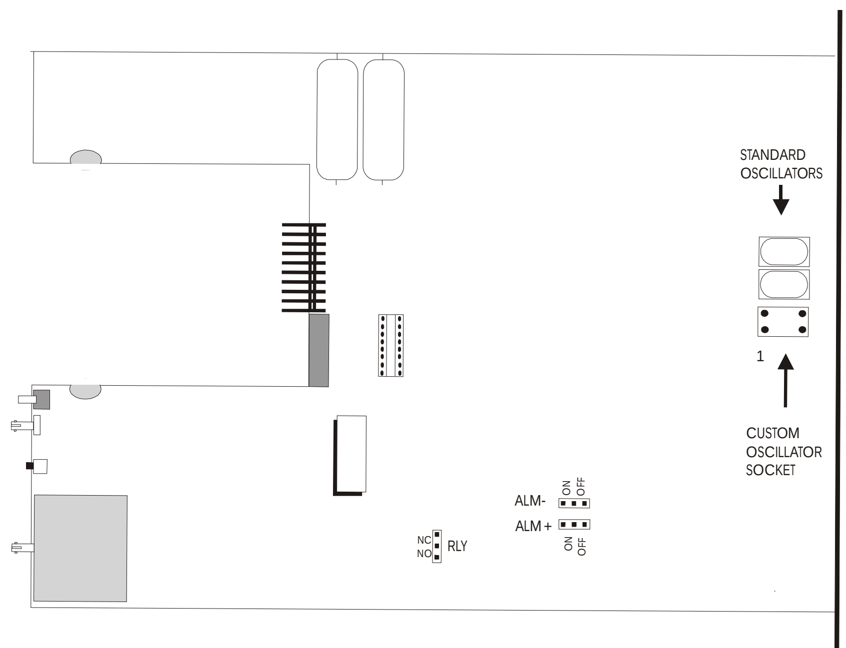


Figure 2-2. Location of Oscillators

2.2 Setup

The setting up of the 2240 Modem includes the two-section HI / LO optic power switch, internal control switches and the signal ground strap. The setup, as described in the following sections, provides the initial configurations for operation of the unit.

2.2.1 HI / LO Optic Power Switch

All versions, except for ELED and LP Lasers models, incorporate an optic power level dual DIP switch for varying the transmit power of the fiber optic LED or Laser (see Figure 2-1). Both sections of the switch must be set the same. The switch for the 2240 standalone is located on the rear panel of its enclosure. (The switch for the 2240 Rack Chassis is located at the rear of the PC card, adjacent to the transmit optical connector.)

The optical power switch provides two settings for optical transmission level. The appropriate switch setting depends on the loss of the fiber optic link. Each optical model has a different transition point in terms of loss. Refer to Table 2-A for the link loss ranges for each optical model.

For example, if the 850nm model is used and the link loss is 5 dB, use the LO setting on that line.

	Link Loss Range	
Model	**HI Power**	**LO Power**
850nm Standard	>6 dB to Max	<6 dB
1310nm HP Laser	>6 dB to Max	<6 dB
1550nm HP Laser	>6 dB to Max	<6 dB
1310nm LP Laser	–	–

Table 2-A.
Link Loss Range

NOTE: The 1310nm LP Laser does not have a HI / LO power switch.

2.2.2 Internal Control Switches

An 8-position DIP switch located on the modem board provides access for internal control options (see Figure 2-3). Switch positions 1 through 6 provide the following options:

- Carrier Detect (CD) Signal Options (1 and 2)
- Clocking Options (7 and 8)

External Clock Mode, switch position 7, and the Divide Ratio Table Select, switch position 8, are described in Section 2.2.2.2.

NOTE: The nomenclature used for this switch is "off" equals "open."

Factory switch settings are shown in Figure 2-3.

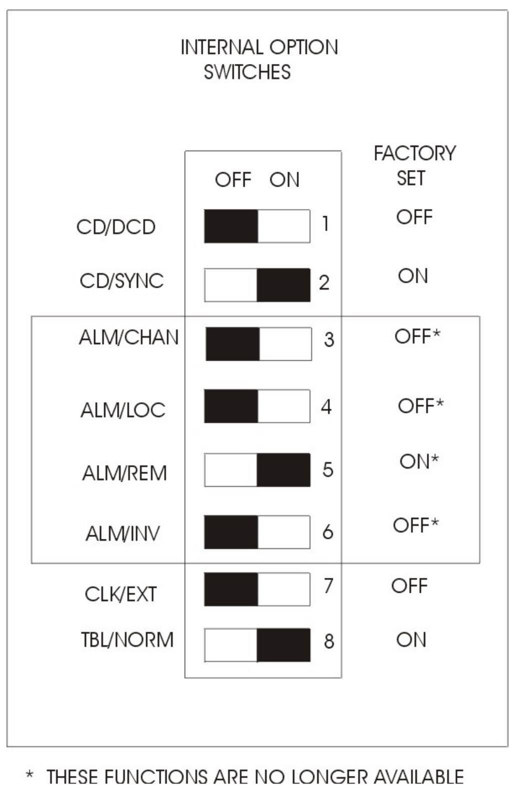


Figure 2-3.
Eight-Position
Internal Options
DIP Switch

2.2.2.1 Carrier Detect (CD) Signal Options

There are two switches on the internal switch block which control the response of the CD signal on the Standard Data Interfaces. These switches operate as a pair and only one switch should be set to ON at any time.

Factory Setting = **CD / DCD set to OFF**
CD / SYNC set to ON

The CD signal may be used as an output for an end-to-end Control Channel by setting the CD / DCD switch to ON and the CD / SYNC switch to OFF. This setting is only used with Standard Data Interfaces which do not support the expanded interface connector.

The factory setting causes the standard data connector CD signal to track the state of the modem's optical receive synchronizer. CD will assert when the modem is in local sync. This also means that CD will track the state of the front panel Local Sync LED.

On expanded data interfaces, the standard data connector CD signal in the CD = local sync mode (factory setting) can be used to gate CTS (or its equivalent signal) OFF when the modem's receiver is out of sync. See Figure 2-4 for an illustration of this factory setting.

Refer to the sections on the RS-449, RS-530, V.35, MC1 and MC2 interfaces for more information about the CD-CTS gating function.

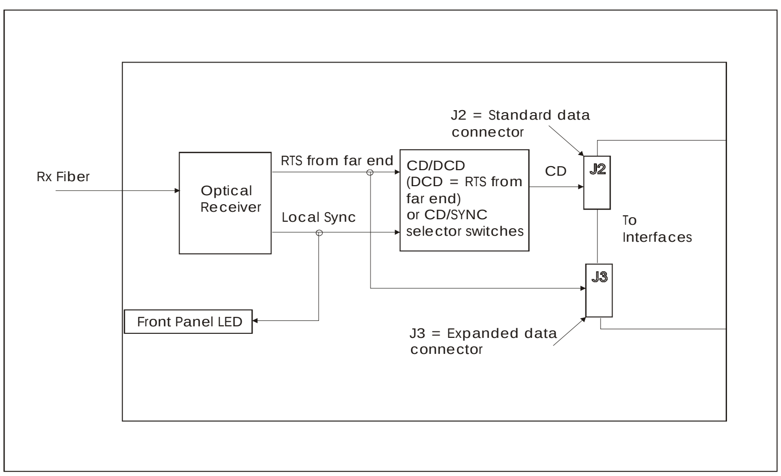


Figure 2-4. Factory Setting for CD / DCD or CD / SYNC Switches

2.2.2.2 Internal Clock Option Switches

There are two switches on the Internal switch block which affect the operation of the Clock circuits:

- TBL / NORM
- CLK / EXT

2.2.2.2.1 TBL / NORM Switch

The TBL / NORM switch controls the Data Rate Table as indicated in Table 3-D. It is configured as ON when shipped from the factory. If it is switched to OFF, the alternate Divide Ratios become active.

Factory Setting = ON

2.2.2.2.2 CLK / EXT Switch

The CLK / EXT switch controls which clock is used for synchronous input. If it is switched to ON, any mode which sources Send Timing (Internal or Slave) will use a turned-around clock coming in on Terminal Timing from the user's equipment. This compensates for round-trip delays in the sourced clock which could otherwise shift the clock-data phasing of the transmit signal and cause errors. This setting can only be used where leads for both are available, and if the user's equipment can turn the Send Timing back around onto the Terminal Timing leads, either internally or at the other end of the cable.

> **NOTE: The ON setting of the CLK / EXT switch is required for operating redundant modems using either internal or slave clocking.**

Factory Setting = OFF

2.2.3 Signal Ground Strap

The jumper selects whether chassis ground is connected directly to signal ground (CHASSIS position) or signal ground is separated from chassis ground (FLOAT position).

> **NOTE: Float can be overridden by chassis ground jumpers on interface cards or by a jumper in the 2201 Rack Chassis.**
>
> **When installed in the 2201 Rack Chassis, any modem main board, interface, or rack chassis jumper being set to SHORT will override the FLOAT and 100_OHM positions on all of the other modems. CONSIDER THIS JUMPER CAREFULLY.**

Factory Setting = FLOAT

2.2.4 SCT Normal / Invert Jumper

This jumper allows the SCT output from the 2240 to be normal phase or inverted phase. The purpose of this jumper is to allow compensation for round trip transmit clock / transmit data phase delays in situations where the customer equipment can *not* return SCT as SCTE (refer to Sections 3.6 and 3.7 for discussions of transmit clock / data phasing and SCTE use).

In the NORM position the 2240 samples TXD at the clock edge corresponding to the appropriate standards, i.e., the 2240 samples TXD at the SCT A lead **FALLING** edge.

In the INV (invert) position the 2240 samples TXD at the clock edge opposite of the appropriate standards, i.e., the 2240 samples TXD at the SCT A lead **RISING** edge.

Factory Setting = NORM

2.2.5 EXTRA CLOCK Jumper

This two-pin jumper (W26, labeled XTCLK), in conjunction with the enhanced interfaces (- 422, - 436 and - 430), allows the 2240 to accept BOTH customer clocks for *tail circuit applications*. Refer to the RS-449, V.35 and RS-530 interface sections for more information on the enhanced interfaces. This jumper causes the 2240 to shift data out (RXD) from the 2240 in sync with either the 2240's SCR (present operation) *or* the extra clock pins on enhanced interfaces. In the case of the RS-530 interface there are no unused pins, so a switch on the RS-530 interface is used to select the direction of the SCT leads (refer to RS-530 interface section). In a typical application (see Figure 2-5) these extra clock pins would be cabled to the customer's T1 CSU / DSU's SCT (ST) pins (keep in mind that the 2240s are acting as a tail circuit). This feature is also necessary if older "gapped clock" CSU / DSUs are used.

With the jumper OFF, the 2240 shifts data out (RXD) in sync with its SCR signal.

With the jumper ON, the 2240 shifts data out (RXD) in sync with the extra clock signal.

Factory Setting = OFF

Figure 2-5 illustrates the use of extra clock pins in a tail circuit application at the clock source end.

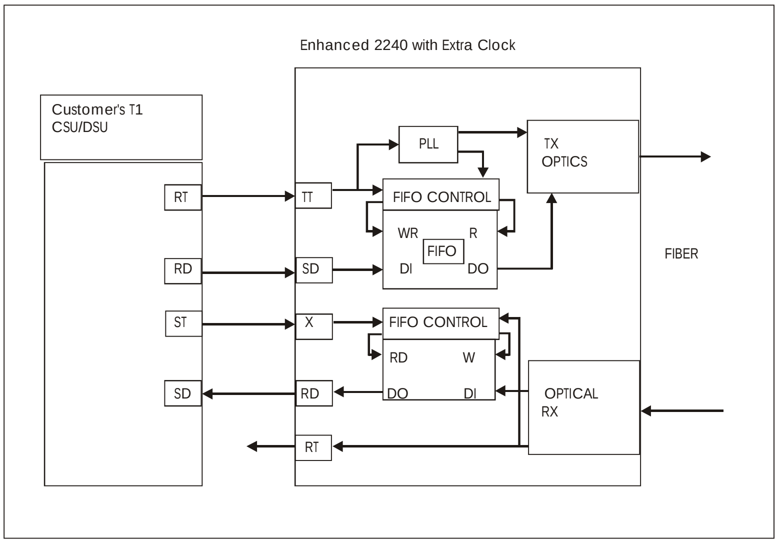


Figure 2-5.
Extra Clock Pins
in Tail Circuit
Application at
Clock Source End

NOTE 1: X equals the extra clock input pins on the enhanced interfaces. "Extra clock" jumper would have to be ON at this 2240.

NOTE 2: Control lead crossovers are not shown for clarity.

NOTE 3: The 2240 in the diagram would be operating in Mode 7, with rate set to match CSU / DSU speed. The 2240 at far end would be operating in slave mode.

3. Mode and Rate Selection

3.1 Operating Mode / Data Rate Selection

The 2240 has eight clock operating modes: seven modes for synchronous data transmission and one asynchronous mode. Each synchronous mode is characterized by one of three transmit clock types: External Clock (clocked from customer's equipment), Internal Clock (modem generates Tx clock and RX clock) and Slave Clock (transmit clock same as received from far-end modem).

The operating mode is selected by setting three of the eight paddle-style switches (positions 5, 6 and 7) on the front panel (see Figure 3-1). Table 3-A lists the modes and the switch positions. The switch positions are numbered from left to right (1 to 8).

NOTE: Front panel DIP switch Position 8 is now functional. It acts as an optical receiver frequency range select. OPEN selects the new low range and CLOSED selects the original (or normal) operating range. This switch should be in the CLOSED position except when the far end modem is operating in Locked External Mode (Mode 7) *and* the far end modem's external clock frequency falls into the LOW range (refer to Table 3-B).

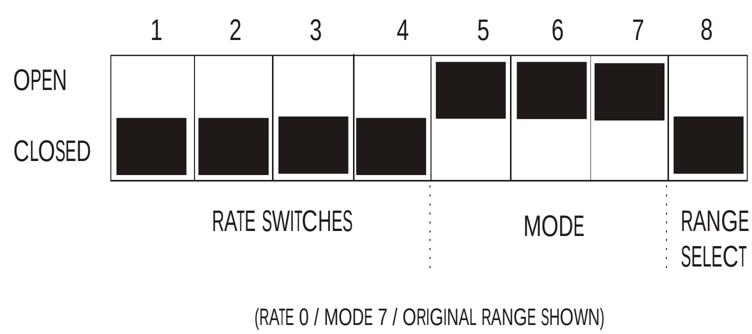


Figure 3-1.
2240 Front Panel
Mode / Rate Switches

Mode	DIP Switches (C) Closed (O) Open 5	6	7	Operating Mode
0	C	C	C	Sampled External Clock up to 1.544 Mbps *
1	O	C	C	Internal Clock Group 1 Rate
2	C	O	C	Internal Clock Group 2 Rate
3	O	O	C	Internal Clock Group 3 Rate
4	C	C	O	Internal Clock Group 4 Rate
5	O	C	O	Slave Clock
6	C	O	O	Asynchronous up to 1.500 Mbps *
7	O	O	O	External Clock with Variable Lock Ratios (refer to Table 3-B)
* Frequency Limit assumes that user's equipment can tolerate 250 ns of pulse distortion on the clock signal.				

Table 3-A.
Mode Switch
Positions

For many modes, the specific data rate must be selected. The data rate is selected by setting four switches on the front panel (positions 1-4). Refer to Tables 3-B and 3-C for the data rate switch settings.

Rate	DIP Switches (C) Closed (O) Open Rate Switches 1 2 3 4	Range Select 8	Allowable Range of External Clock Frequency (Mode 7)
0	C C C C	C (Normal) O (Low)	1.490 MHz to 2.060 MHz 1.026 MHz to 1.480 MHz
1	O C C C	C (Normal) O (Low)	750 kHz to 1.025 MHz 513 kHz to 749 kHz
2	C O C C	C (Normal) O (Low)	375 kHz to 512.5 kHz 256.3 kHz to 374 kHz
3	O O C C	C (Normal) O (Low)	187.5 kHz to 256.2 Hz 128 kHz to 187 kHz

Table 3-B.
Locked External
Rates

Table 3-C.
Standard Internal
Clock Rates

Rate	DIP Switches (C) Closed (O) Open — Rate Switches 1	2	3	4	Data Rates Normal and Alternate Table Switch (TBL / NORM) set to NORM — Group 1	Group 2*	Group 3*
0	C	C	C	C	2.048M	1.536M	1.544M
1	O	C	C	C	1.024M	768K	19.2K
2	C	O	C	C	512K	384K	9.6K
3	O	O	C	C	256K	192K	4.8K
4	C	C	O	C	115.2K**	448K	153.6K
5	O	C	O	C	57.6K**	224K	76.8K
6	C	O	O	C	28.8K**	112K	38.4K
7	O	O	O	C	14.4K**	56K	19.2K
8	C	C	C	O	128K	96K	2.4K
9	O	C	C	O	64K	48K	1.2K

* These Data Rates, except 1.544M, have up to 125 ns of jitter

** These Data Rates actually run 0.7% higher than noted and have up to 125 ns jitter.

3.2 External Clock Modes

The external clock modes are used when it is necessary to have the DTE provide the transmit clock or when the 2240 is used as a tail circuit connecting to a DCE. In these modes, the DTE or DCE sends this clock to the modem on the Terminal Timing (TT) or equivalent signal leads. For an example of a typical complete tail circuit, refer to Section 3.4. There are two different types of External Clock Modes in the 2240: Sampled and Locked.

NOTE: Interfaces which extract the clock from a composite signal, such as T1 or E1, require the use of the Locked External Clock Mode.

3.2.1 Sampled External Clock Mode - Mode 0

In this mode, the 2240 transmits an 8.192 Mbps optical composite signal which is derived from an internal oscillator. One half of the composite bandwidth is used to send the clock signal which is sampled at 4.096 MHz. One fourth of the composite bandwidth is used to send the data signal which is sampled at 2.048 MHz. This sampling results in 244 nanoseconds of pulse distortion on the clock received at the other modem. The distortion is a result of the sampling process. The maximum data rate is limited to 1.544 Mbps where the distortion is 37% of the clock period.

NOTE: The pulse distortion is 37% of the bit period at a data rate of 1.544 Mbps. When using this operating mode, it is important to con sider the effect of this large distortion on the connected equipment.

Sampled External Clock Mode does not use the Rate Switches.

3.2.2 Locked External Clock Mode - Mode 7

When the customer-supplied clock is within certain ranges, this mode allows transmission of clock and data signals with minimal jitter. In the Locked mode, the entire transmitter section of the 2240 is locked to the clock provided by the DTE. The Locked mode is always used for T1 (1.544 Mbps), E1 (2.048 Mbps), any synchronous data transmission between 1.490 Mbps and 2.060 Mbps and possibly at lower speeds if the customer's equipment cannot tolerate the pulse jitter of the sampled external clock mode.

NOTE: Since the customer's equipment supplies the transmit clock in Mode 7, the 2240 turns off its ST or equivalent signal leads.

NOTE: The use of front panel DIP switch position 8 to select the LOW frequency ranges shown in Table 3-B is an enhancement feature added to the 2240 after mid-summer 1996. Earlier versions of the 2240 *do not* have this enhancement.

Set the Rate switches to the appropriate setting for your data rate. Refer to Table 3-B for the rate switch settings and the range of data rates which use the Locked External Clock Mode. If the desired data rate falls below 128 kHz, the Sampled External Clock Mode must be used.

3.3 Internal Clock Modes - Modes 1, 2, 3, 4

The internal clock modes are used to provide the Transmit Clock for the DTE. In these modes, the modem sends the clock to the DTE on the Send Timing (ST), or equivalent, signal leads. Each of the four modes provides a separate group of clock frequencies. Each of the four modes provides a separate group of clock frequencies. The first three groups of clock rates are synthesized from standard frequency references and are shown in Table 3-C. The fourth group allows for a custom set of frequencies to be provided if an additional oscillator is specified for the modem prior to purchase. Oscillators can be changed in the field, if necessary.

Table 3-D.
Group 4 Internal Clock Rate Divide Ratio

Rate	DIP Switches (C) Closed (O) Open — Rate Switches 1	2	3	4	Group 4 Divide Ratios Normal and Alternate Table — NORM (ON) *	TBL (OFF)
0	C	C	C	C	4	16
1	O	C	C	C	8	32
2	C	O	C	C	16	64
3	O	O	C	C	32	128
4	C	C	O	C	48	768
5	O	C	O	C	96	1536
6	C	O	O	C	192	3072
7	O	O	O	C	384	6144
8	C	C	C	O	64	256
9	O	C	C	O	128	512

*** Factory setting**

In Group 4, the Rate Switches select the divider ratio for this oscillator. Refer to Table 3-D and Section 3.3.2 for more details.

3.3.1 Standard Internal Clock Rates (Groups 1, 2 and 3)

If the data rate appears in Table 3-C, select the corresponding internal clock group with the mode switches (refer to Table 3-A). Then set the Rate Switches to complete the rate selection process.

3.3.2 Custom Internal Clock Rates (Group 4)

The Group 4 Internal Clock Mode can be used if an oscillator has been specified or installed in the custom oscillator socket (refer to Section 2.1.6). The available oscillators and their respective clock frequencies are given in Table 3-E. If the rate appears in table, choose the appropriate oscillator option for the modem.

Obtaining the desired divide ratio may require changing the position of the TBL / NORM DIP switch as shown in Table 3-D. The location of the TBL / NORM switch is shown in Figures 2-3 and 3-4.

Table 3-E.
Standard Oscillator
and Divide Factors

DIVIDE RATIO	OSCILLATOR FREQUENCY												
	21.504M	24.704M	16.384M	25.248M	13.824M	921.6K	7.3728M	40.000M	12.928M	6.144M	25.856M	230.4K	24.576M
4	X	X	X	X	X	230.4K	X	X	X	1.536M	X	57.6K	X
8	X	X	X	X	X	115.2K	921.6K	X	X	768.0K	X	28.8K	X
16	1.344M	X	1.024M	X	864.0K	57.6K	460.8K	X	808.0K	384.0K	X	14.4K	1.536M
32	672.0K	772.0K	512.0K	789.0K	432.0K	28.8K	230.4K	X	404.0K	192.0K	808.0K	7.2K	768K
48	448.0K	514.76K	341.33K	526.0K	288.0K	19.2K	153.6K	833.33K	269.33K	128.0K	538.7K	4.8K	512K
64	336.0K	386.0K	256.0K	394.5K	216.0K	14.4K	115.2K	625.0K	202.0K	96.0K	404.0K	3.6K	384K
96	224.0K	257.33K	170.67K	263.0K	144.0K	9.6K	76.8K	416.67K	134.67K	64.0K	269.3K	2.4K	256K
128	168.0K	193.0K	128.0K	197.25K	108.0K	7.2K	57.6K	312.5K	101.0K	48.0K	202.0K	1.8K	192K
192	112.0K	128.67K	85.33K	131.5K	72.0K	4.8K	38.4K	208.33K	67.33K	32.0K	134.7K	1.2K	128K
256	84.0K	96.5K	64.0K	98.63K	54.0K	3.6K	28.8K	156.25K	50.5K	24.0K	101.0K	.9K	96K
384	56.0K	64.33K	42.67K	65.75K	36.0K	2.4K	19.2K	104.17K	33.67K	16.0K	67.3K	.6K	64K
512	42.0K	48.25K	32.0K	49.31K	26.0K	1.8K	14.4K	78.13K	25.25K	12.0K	50.5K	.45K	48K
768	28.0K	32.17K	21.33K	32.88K	18.0K	1.2K	9.6K	52.08K	16.83K	8.0K	33.67K	.3K	32K
1536	14.0K	16.08K	10.67K	16.44K	9.0K	0.6K	4.8K	26.04K	8.42K	4.0K	16.83K	.15K	16K
3072	7.0K	8.04K	5.33K	8.22K	4.5K	0.3K	2.4K	13.02K	4.21K	2.0K	8.42K	.075K	8K
6144	3.5K	4.02K	2.67K	4.11K	2.25K	0.15K	1.2K	6.51K	2.1K	1.0K	4.21K	.0375K	4K
	01	02	03	04	05	06	07	08	09	10	11	12	13
	OSCILLATOR PART NUMBER 2200-C-XX												

X = These data rates are too high for the Group 4 Mode in this switch position.

3.4 Slave Clock Mode - Mode 5

The Slave Clock Mode is used to provide a clock to the DTE which is identical to the clock received from the other modem. In this mode, the clock signal received from the other end of the link is sent to the DTE on both Receive Timing (RT) and Send Timing (ST) or equivalent signal leads. This mode is typically used in tail circuits where the user's DCE normally provides both the transmit and receive clocks to the DTE.

Since modems operating in Slave Mode get the transmit clock from the optical input, the clock to the DTE is only present when a valid optical signal is present (see Figure 3-2). See Figure 3-3 for a diagram of the null cable for the DCE-DCE crossover cable.

3.4.1 Loopback Clock for Slave Mode

Select a rate from the Group 1 Internal Clock Rates and set the Rate Switches accordingly. Whenever a loopback is active, that clock will be sent to the DTE on the Send Timing (ST) and Receive Timing (RT), or equivalent, signal leads.

> **NOTE: If the local loopback modem is operating in Mode 5 (slave clock mode), the remote device will receive garbled data because of the overall timing configuration. The local loopback will function correctly.**

3.5 Asynchronous Mode - Mode 6

The Asynchronous Mode should be used when a data signal is present without a separate clock signal. The only exception to this is when the signal is bipolar T1 or E1. For those signals, the 2240 interface extracts a clock from the signal.

This mode samples the data signal at 4.096 MHz which results in a pulse distortion of 244 ns. The effect of this distortion on the connected equipment must be carefully assessed.

For a 37% distortion limit, the maximum data rate is 1.544 Mbps for all forms of NRZ coding. For the various forms of Manchester or Biphase coding, the limit is 768 kbps. If the distortion limit is 25%, these limits are reduced to 1.024 Mbps and 512 kbps, respectively.

The Rate Switches do not have any function in asynchronous mode.

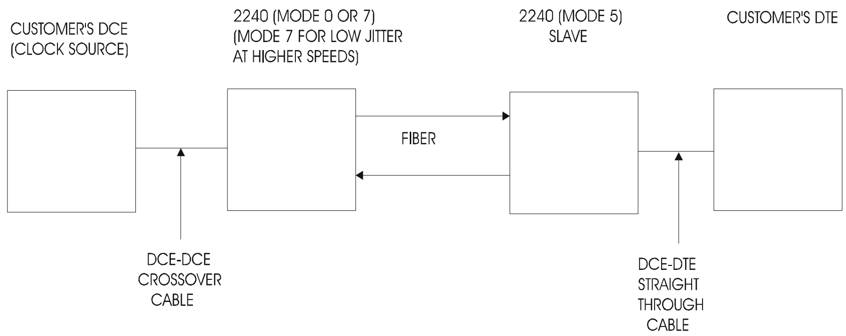


Figure 3-2.
Typical Tail Circuit
Implementation

DCE To DCE Null Cable Pin Assignments

Pin	Signal	Direction	Signal	Pin
4	Send data A	←	Rec data B	6
22	Send data B	←	Rec data B	24
6	Rec data A	→	Send data A	4
24	Rec data B	→	Send data B	22
8	Rec clock A	→	Term Timing A	17
26	Rec clock B	→	Term Timng B	35
17	Term Timing A	←	Rec clock A	8
35	Term Timing B	←	Rec clock B	26
7	RTS A	←	RR A	13
25	RTS B	←	RR B	31
12	DTR A	←	IC A	15
15	IC A	→	DTR A	12
20	Send Common	↔	DTR B	30
19	Signal GND	↔	DTR B	30
19	Signal GND	↔	Signal GND	19
1	Frame GND	↔	Frame GND	1

Figure 3-3.
RS-449 / 422
Null Cable
Diagram
for 2240

NOTE: If the customer's DCE does not support TT (or equivalent) lead, a buffered interface may be needed to realign the data or the extra clock function may be used (refer to Section 4.9). Canoga Perkins offers a wide selection of buffered interfaces.

3.6 Consideration of Propagation Delays

Whenever the modem is sending a transmit clock to the DTE, it is important to understand the effect of the time required for that clock to propagate from the modem to the DTE.

Clock-to-Data phasing is particularly important in any synchronous data link. The modem expects the data to be valid (unchanging) at the point in time when the clock is transitioning to "clock" the data.

When the modem is the source of the transmit clock, there is a finite time delay before that clock arrives at the DTE to clock its transmitter. There is another time delay before the data from the DTE arrives back at the modem.

Since the modem uses its own clock signal to align the data, there is a potential for these delays to make the data invalid at the point of re-alignment. This problem only occurs at high data rates and if the cable to the DTE is very long or has high capacitance.

In such cases it is desirable to use a clock signal sourced from the DTE, because it will experience the same time delays as the data signal. To get an aligned clock signal, loop the clock from the ST to TT leads at the DTE end of the cable (if the DTE does not do this by default).

> **NOTE: The 2240 can be made to use the TT signal for realigning the data by turning ON the CLK / EXT switch on the main board. This switch is position 7 of the internal options switches, as illustrated in Figures 2-3 and 3-4. It is set to the OFF position when shipped from the factory.**

3.7 Internal Clock Option Switches

There are two switches on the Internal switch block which affect the operation of the Clock circuits: TBL / NORM and CLK / EXT (see Figures 2-3 and 3-4 for the locations of these switches).

3.7.1 TBL / NORM Switch

The TBL / NORM switch controls the Data Rate Table as indicated in Table 3-D. It is configured as ON when shipped from the factory. If it is switched to OFF, the alternate Divide Ratios become active.

Factory Setting = ON

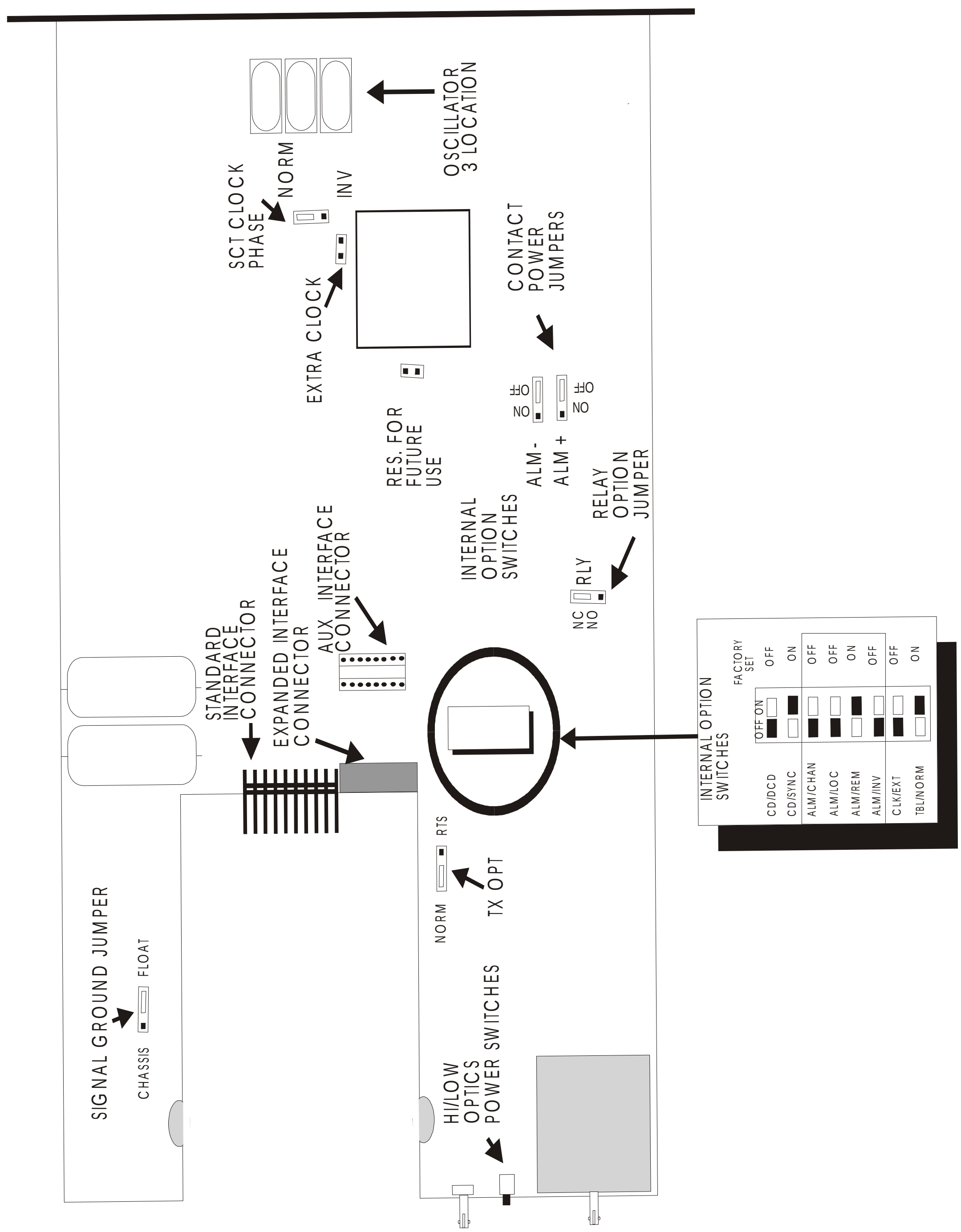
3.7.2 CLK / EXT Switch

The CLK / EXT switch controls which clock is used for synchronous input. If it is switched to ON, any mode which sources Send Timing (Internal or Slave) will use a turned-around clock coming in on Terminal Timing from the user's equipment. This compensates for round-trip delays in the sourced clock which could otherwise shift the clock-data phasing of the transmit signal and cause errors. This setting can only be used where leads for both are available, and if the user's equipment can turn the Send Timing back around onto the Terminal Timing leads, either internally or at the other end of the cable.

> **NOTE: The ON setting of the CLK / EXT switch is required for operating redundant modems using either internal or slave clocking.**
>
> **NOTE: On standalone models, these switches can only be accessed after the top cover has been removed. The cover is fastened by screws on the sides of the case. If the modem is mounted in a 2202 Modem Shelf, it must first be removed from the shelf. Be sure to disconnect power before removing the cover.**

Factory Setting = OFF

Figure 3-4.
Location of
Internal Switches
and Jumpers



Factory Settings are Illustrated

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4. Data Interfaces

4.1 Data Interfaces Overview

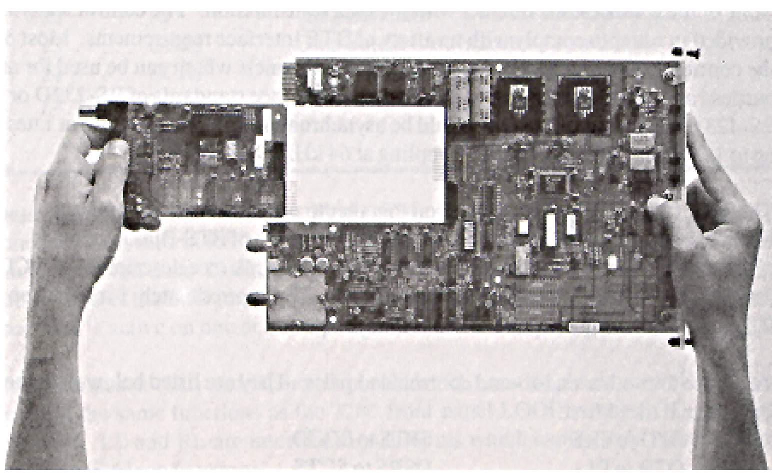
A variety of interfaces are available for the 2240 Modem (see following listing).

RS-423 / 232	CCITT V.35
RS-449	Transparent T1 / E1
RS-449 / RS-423 (MC1)	CCITT V.35 / RS-423 (MC2)
RS-530	Programmable RS-530
TwinAx 422	TTL / BNC
Twinaxial Mil-Std 188-114C	DC-37 Mil-Std 188-114

Each conforms to existing standards. Refer to Section 7, "Specifications," for applicable standards/physical connector types. Refer to Section 7.5, "2240 Fiber Optic Modem Configurations," for a list of available interface options.

In general, all interface modules are configured as Data Communications Equipment (DCE). All devices supports a variety of control leads and auxiliary channels. The 2240 provides these signals as end-to-end paths. See each respective section for a general description of interface features. Figure 4-1 shows the interchangeability of interfaces.

Figure 4-1. Interchangeable Interfaces



4.2 RS-423 / 232D Model 432

NOTE: The maximum data rate for this interface, 153.6 kbps, is limited by the interface driver slew rate.

This interface is electrically compatible with EIA RS-423A. It will also operate with RS-232D systems when adhering to the more limiting RS-232D specifications (20 kbps and 2500 pF cable capacitance). EIA standard RS-423A does not reference physical connector types or pinouts.

This interface uses the physical connector type and pinouts specified in RS-232D (refer to Table 4-A). The RS-423/232D interface uses a 25-pin female D-type connector for the physical connection.

The TD, RD, SCT, SCR and SCTE pins carry the primary clock and data signals. The remaining pins are either ground references or control signals.

Transmit Data (TD) and Receive Data (RD) are the data input and output signals for the modem. Serial Clock Transmit (SCT) is the modem's transmit clock output used for the Internal and Slave modes. Serial Clock Receive (SCR) is always the clock signal for the Receive Data. Serial Clock Transmit External (SCTE) is the clock signal input used in External Clock Mode.

None of the control leads interact with the data transmission. The control leads are provided in order to comply with a variety of DTE interface requirements. Most of the control leads are actually end-to-end signal channels which can be used for any purpose as long as it conforms to the electrical interface standards of RS-232D or RS-423A. One example of this would be asynchronous data transmission at rates up to 19.2 kbps (30% jitter due to sampling at 64 kHz).

The RTS, CTS and DCD pins function together to provide the most common handshake functions. An input to RTS (see description of RTS-Bias jumper) is transmitted to the DCD output at the other end of the link (see description of DCD jumper). CTS follows RTS locally but it is delayed by approximately 1 msec when RTS turns ON (see description of CTS-Gate jumper).

There are four other end-to-end control lead pairs. They are listed below with the input signal listed first:

STD to SRD	SRTS to SDCD
DTR to RI	DSRS to SCTS

Table 4-A.
RS-232D
Pinouts

Pin Number	RS-232D Pin Name (abbrev)	Full Name	Direction
1	PG	Protective Ground	-
2	TD	Transmit Data	to modem
3	RD	Receive Data	from modem
4	RTS	Request to Send	to modem
5	CTS	Clear to Send	from modem
6	DSR	DCE Ready	from modem
7	SG	Signal Ground	-
8	DCD	Receive Line Sig. Det.	from modem
12	SDCD	Secondary Line Sig. Det.	from modem
13	SCTS	Secondary CTS	from modem
14	STD	Secondary TD	to modem
15	SCT	Transmit Clock	from modem
16	SRD	Secondary RD	from modem
17	SCR	Receive Clock	from modem
18	LL	Local Loopback	to modem
19	SRTS	Secondary RTS	to modem
20	DTR	DTE Ready	to modem
21	RL	Remote Loopback	to modem
22	RI	Ring Indicator	from modem
23	DSRS	Data Signal Rate Selector	to modem
24	SCTE	Transmit Clock External	to modem
25	TM	Test Mode	from modem

Data Set Ready (DSR) and Test Mode (TM) are local status leads and follow the functions described in RS-232D. DSR typically indicates that the modem is ready to handle transmit data. During loopbacks, the behavior of this signal is dependent on the position of the DSR jumper (see description of DSR jumper). TM indicates that a loopback is active on one or both modems.

Local Loopback (LL) and Remote Loopback (RL) are loopback control leads and perform the same functions as the 2240 front panel LOOP switch LOC and REM positions. LL and RL are interface signal inputs which can be used to activate the LOC or REM loop functions.

4.2.1 RTS_BIAS Jumper

The RTS_BIAS jumper controls the state that RTS floats to when there is no signal driving the RTS pin. The OFF position forces this signal to the OFF (negated) state when the interface cable is disconnected. The ON position forces it to the ON (asserted) state.

Factory Setting = OFF

4.2.2 DCD Jumper

The DCD Jumper determines the source of the DCD output. In the CTRL position, the DCE output functions as the output for the RTS input at the far end. In the CD jumper position and with local RTS ON, CTS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the state of the RTS signal at the far end (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory Setting = CTRL

4.2.3 CTS_GATE Jumper

The CTS_GATE jumper controls the state of CTS when the local RTS is ON. When the jumper is in the ON position, CTS follows RTS only. The CD position allows the 2240’s standard data interface signal CD to gate CTS. In the CD jumper position and with local RTS ON, CTS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the RTS signal at the far end is ON (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory Setting = ON

4.2.4 DSR Jumper

The DSR jumper controls the behavior of the DSR signal. The EIA position causes the DSR to turn OFF in certain test conditions when the transmit data is blocked and has no end-to-end or loopback path. This condition exists when the far-end 2240 modem has a local loopback active. The TEST position causes DSR to turn OFF (negate) whenever any loopback is active at one or both modems.

Factory Setting = EIA

4.2.5 CH_GND Jumper

The jumper selects whether chassis ground is connected directly to signal ground (SHORT position) or through a 100 Ohm resistor (100_OHM position).

> **NOTE: In the standalone model, the 100_OHM position will only put a 100 Ohm resistor between the two grounds if the 2240's main board SIGNAL GND jumper is set to the FLOAT position.**
> **When installed in the 2201 Rack Chassis, any modem main board, interface, or rack chassis jumper being set to SHORT will override the FLOAT and 100_OHM positions on all of the other modems.**
> **CONSIDER THIS JUMPER CAREFULLY.**

Factory Setting = 100_OHM

4.3 RS-449 / 422 Model 422

This interface complies with EIA Standard RS-449. Electrical characteristics comply with RS-422 for clock and data signals and RS-423 for control signals.

The RS-449 / 422 interface applies the physical connector type and pinouts specified in RS-449 (refer to Table 4-B). The interface uses a 37-pin, female D-type connector for the physical connection.

Pin Number A/B	RS-449 PIN Name (abbrev)	(full name)	Direction
1	SHLD	shield	-
4/22	SD	send data	to modem
5/23	ST	send timing	from modem
6/24	RD	receive data	from modem
7/25	RS	request to send	to modem
8/26	RT	receive timing	from modem
9/27	CS	clear to send	from modem
10	LL	local loopback	to modem
11/29	DM	data mode	from modem
12/30	TR	terminal ready	to modem
13/31	RR	receiver ready	from modem
14	RL	remote loopback	to modem
15	IC	incoming call	from modem
17/35	TT	terminal timing	to modem
18	TM	test mode	from modem
19	SG	signal ground	-
20	RC	receive common	- (tied to SG)
33	SQ	signal quality	from modem
34	NS	new signal	to modem
37	SC	send common	to modem
2/36*	N/A	extra clock for receive data	to modem

* The extra clock is an enhancement added to -422 interfaces. Any -422 interface card outfitted with this capability can be identified via the *lack* of the W16 / W15 BAL_CTRL jumper. The W16 / W15 jumper was never described in the manual, so do not try to find a reference to it in the manual.

Table 4-B.
RS-449 Pinouts

The SD, RD, ST, RT and TT pins carry the primary data and clock signals (conforming to the RS-449 and RS-422 standards). In addition, an extra clock signal input (conforming to RS-422) is provided to make the 2240/-422 combination more "DTE-like" in tail circuit applications at the clock source end (refer to Section 2.2.6). The remainder of the pins are either ground references or control signals. Send Data (SD) and Receive Data (RD) are the data input and output signals for the modem, respectively.

Send Timing (ST) is the modem's transmit clock reference output that is used for the internal and slave clock modes. Receive Timing (RT) is the clock signal for the receive data *unless* the 2240's main PCBA W26 (XTCLK) jumper is ON, in which case the Extra Clock input signal is used to shift receive data out from the 2240 (refer to Section 2.2.6). Terminal Timing (TT) is the transmit clock signal used in either of the External clock modes or when the main board internal CLK / EXT switch is set to EXT (refer to Section 3.7).

The control signal outputs are unbalanced drivers (conforming to the RS-423 Standard). The B-leads of any differential control signal outputs are tied to signal ground to comply with RS-422.

None of the control leads interact with the data transmission. They are provided in order to comply with a variety of DTE interface requirements. Most of the control leads are actually end-to-end signal channels which can be used for any purpose as long as it conforms to the RS-449 interface standards.

Three end-to-end control leads are provided as part of this interface. An input to RS (Request to Send) is transmitted to the RR (Receiver Ready) output at the other end of the link (see description of RS-Bias jumper and RR jumper). CS (Clear to Send) follows RS locally but is delayed approximately 1 millisecond when RS turns ON (see description of CS-Gate jumper). The other two end-to-end control lead pairs are listed below with the input signal listed first:

TR to IC
NS to SQ

DM and TM are local status leads and follow the functions described in RS-449. Data Mode (DM) typically indicates that the modem is ready to handle transmit data. During loopbacks, the behavior of this signal is dependent on the position of the DM jumper (see description of DM jumper).

Local Loopback (LL) and Remote Loopback (RL) are loopback control leads and perform the same functions as the 2240 front panel LOOP switch LOC and REM positions. LL and RL are interface signal inputs which can be used to activate the LOC or REM loop functions. These signals can control the loopback functions only if the front panel switch is in the center OFF position.

4.3.1 RS_BIAS Jumper

The RS_BIAS jumper controls the state that RS floats to when there is no signal driving the RS pin. The OFF position forces this signal to the OFF (negated) state when the interface cable is disconnected.   The ON position forces it to ON (asserted).

Factory Setting = OFF

4.3.2 RR Jumper

The RR Jumper determines the source of the RR output. In the CTRL position, the RR output functions as the output for the RS input at the far end. In the CD jumper position, the RR output will turn ON either when the modem’s fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the far end RTS is ON (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory setting = CTRL

4.3.3 CS_GATE Jumper

The CS_GATE jumper controls the state of CS when the local RS is ON. When the jumper is in the ON position, CTS follows RS only. The CD position allows the 2240's standard data interface signal CD to gate CS. In the CD jumper position and with local RS ON, CS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the RTS signal at the far end is ON (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory Setting = ON

4.3.4 DM Jumper

The DM jumper controls the behavior of the DM signal. The EIA position turns DM OFF when the far-end 2240 modem has a local loopback active. The TEST position causes DM to turn OFF whenever any loopback is active at one or both modems.

Factory Setting = EIA

4.3.5 CH_GND Jumper

The jumper selects whether chassis ground is connected directly to signal ground (SHORT position) or through a 100 Ohm resistor (100_OHM position).

> **NOTE: In the standalone model, the 100_OHM position will only put a 100 Ohm resistor between the two grounds if the 2240's main board SIGNAL GND jumper is set to the FLOAT position.**
> **When installed in the 2201 Rack Chassis, any modem main board, interface or rack chassis jumper being set to SHORT will override the FLOAT and 100_OHM positions on all of the other modems. CONSIDER THIS JUMPER CAREFULLY.**

Factory Setting = 100_OHM

4.3.6 UNBAL_REF Jumper

RS-449 specifies that unbalanced inputs to a DCE are to be referenced to the SC (Send Common) pin. This pin on the DCE is tied to the signal ground of the DTE through the interface cable. If this ground connection is present, and you prefer to use it, move the UNBAL_REF jumpers to SC.

Factory Setting = GND

4.4 RS-530 Interface Model 430

NOTE: The -430 interface supersedes the previous -R30 interface for 2240 applications. The -430 interface is a superset of the -R30. If *exact* compatibility with the older -R30 is desired, the DCD jumper can be moved from the factory strapped CTRL setting (end-to-end RTS-DCD control lead pair always enabled) to CD (DCD function selected by main board CD / DCD and CD / SYNC switches).

This interface conforms to EIA RS-530. The interface uses RS-422 (balanced) electrical signals for all interface circuits (data, clock and control), except for the loopback and test mode pins which use RS-423 (unbalanced bipolar) electrical signals. Jumper options are detailed in the following sections. The DB-25 pin assignments and signals supported are detailed in Table 4-C.

The interface connector is a female DB-25 with a separate 3.5 mm stereo phone jack that can be used as an alarm contact input. Refer to Section 2.2.3 for more information on configuring the alarm contact input.

The TD, RD, SCT, SCR and SCTE pins carry the primary data and clock signals (conforming to the RS-449 and RS-422 standards). In addition, the SCT leads can be reversed via a switch to provide an extra clock signal input (conforming to RS-422) to make the 2240 / -430 combination more DTE-like in tail circuit applications at the clock source (refer to Section 2.2.6). The remainder of the pins are either ground references or control signals. Transmit Data (TD) and Receive Data (RD) are the data input and output signals to the modem, respectively.

Serial Clock Transmit (SCT) is the modem’s transmit clock reference output that is used for the internal and slave clock modes. Serial Clock Receive (SCR) is the clock signal for the receive data *unless* the 2240's main PCBA W26 (XTCLK) jumper is ON, in which case the Extra Clock input signal is used to shift receive data out from the 2240 (refer to Section 2.2.6). Serial Clock Transmit External (SCTE) is the transmit clock signal used in either of the External Clock modes or when the main board internal CLK/EXT switch is set to EXT (refer to Section 3.7).

Table 4-C.
RS-530 Signals and
Pin Assignments

Pin	# A/B	Signal Name	Direction
FG	01	Frame Ground	-
TD	02/14	Transmit Data	to modem
RD	03/16	Receive Data	from modem
RTS	04/19	Request to Send	to modem
CTS	05/13	Clear to Send	from modem
DSR	06/22	Data Set Ready	from modem
SG	07	Signal Ground	-
DCD	08/10	Data Carrier Detect	from modem
SCR	17/09	Receive Clock	from modem
SCT	15/12 *	Transmit Clock	to/from modem
SCTE	24/11	External Tx Clock	to modem
DTR	20/23	Data Terminal Ready	to modem
LL	18 **	Local Loopback	to modem
RL	21 **	Remote Loopback	to modem
TM	25	Test Mode	from modem

* Becomes extra clock input if SCT switch is set to IN position.
** These signals are single ended and activate a modem’s system test. All other signals are balanced.

Two end-to-end control leads are provided as part of this interface. An input to RTS (Request To Send) is transmitted to the DCD (Data Carrier Detect) output at the other end of the link (refer to Sections 4.4.1, "RTS-Bias Jumper," and 4.4.2, "DCD Jumper"). The factory setting (refer to Section 4.4.7, "CTS_OUT Jumper") configures CTS as a local control. In this mode, CTS (Clear To Send) follows RTS locally but is delayed approximately 1 millisecond when RTS turns ON (refer to Section 4.4.6, "C,TS_GATE Jumper"). Changing the CTS_OUT jumper enables the second DTR to CTS control channel. In addition, the CTS (A) jumper allows configuring the CTS(A) output lead for cryptography applications (refer to Section 4.4.8, "CTS (A) Jumper").

4.4.1 RTS_BIAS Jumper

The RTS_BIAS jumper controls the state that RTS floats to when there is no signal driving the RTS pin. The OFF position forces this signal to the OFF (negated) state when the interface cable is disconnected. The ON position forces it to ON (asserted).

Factory Setting = OFF

4.4.2 DCD Jumper

The DCD jumper determines the source of the DCD output. In the CTRL position, the DCD output functions as the output for the RTS input at the far end. In the CD jumper position, the DCD output will turn ON either when the modem's fiber optic receiver is in sync (main board internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* when the far end RTS is ON (main board switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory Setting = CTRL

4.4.3 DSR Jumper

The DSR jumper controls the behavior of the DSR signal. The EIA position turns DSR OFF when the far end 2240 has a local loopback active. The TEST position causes DSR to turn OFF whenever any loopback is active at one or both of the modems.

Factory Setting = TEST

4.4.4 CHASSIS_GND Jumper

The jumper selects whether chassis ground is connected directly to signal ground (SHORT position) or through a 100 Ohm resistor (100_OHM position).

> **NOTE: In the standalone model, the 100_OHM position only puts a 100 Ohm resistor between the two grounds if the 2240's main board SIGNAL GND jumper is set to the FLOAT position.**
> **When installed in the 2201 Rack Chassis, any modem main board, interface or rack chassis jumper being set to SHORT will override the FLOAT and 100_OHM positions on all of the other modems.**
> **CONSIDER THIS JUMPER CAREFULLY.**

Factory Setting = 100_OHM

4.4.5 SCT Switch

This slide switch selects whether the SCT leads are outputs (OUT position) or inputs (IN position). The OUT position makes the 2240 "pure-DCE" and RD data is shifted out in sync with the 2240-supplied SCR clock. The IN position makes the SCT leads inputs and the 2240 will shift RD out in sync with the customer-supplied clock on the SCT leads *if* the main board XTCLK (W26) jumper is ON. Refer to Section 2.2.6 on the use of the XTCLK jumper.

Factory Setting = OUT

4.4.6 CTS_GATE Jumper

> **NOTE: This jumper is functional *only* when the CTS_OUT jumper is in the CTS position.**

Then, the CTS_GATE jumper controls the state of CTS when the local RTS is ON. When the jumper is in the ON position, CTS follows RTS only. The CD position allows the 2240's standard data interface signal CD to gate CTS. In the CD jumper position and with local RTS ON, CTS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the RTS signal at the far end is ON (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory Setting = ON

4.4.7 CTS_OUT Jumper

This jumper selects the source of the CTS output signal. In the CTS position, CTS provides the local CTS function (refer to Section 4.4.6, "CTS_GATE Jumper") In the RI position, the CTS tracks the state of the DTR input at the far end 2240.

Factory Setting = CTS

4.4.8 CTS (A) Jumper

This jumper selects the electrical characteristic of the CTS (A) lead. In the NORM position, the CTS (A) is a normal RS-422 balanced driver, as per RS-530. The KG position is intended for interfacing to cryptography equipment. If you are not interested in KG applications, leave this jumper in the factory NORM position and skip the following KG jumper settings for the -430 interface.

In the KG position, CTS (A) follows the DTR input at the far end *and* the output is driven by an unbalanced driver whose output voltage swing is controlled by the KG_SWING jumper *and* whose sense is controlled by the KG_OUT jumper.

Factory Setting = NORM

4.4.8.1 KG_SWING Jumper

This jumper selects the output swing for the CTS (A) lead when the CTS (A) jumper is in the KG position. Refer to Table 4-D.

4.4.8.2 KG_OUT Jumper

This jumper can invert the sense of the CTS (A) when the CTS (A) jumper is in the KG position. Refer to Table 4-D.

CTS (A)	KG_OUT	KG_SWING	CTS (A) lead when DTR is asserted at far end 2240	CTS (A) lead when DTR is negated at far end 2240
KG	NORM	+6V_GND	+6V	GND
KG	NORM	+6V_-6V	+6V	-6V
KG	NORM	-6V_GND	GND	-6V
KG	INV	+6V_GND	GND	+6V
KG	INV	+6V_-6V	-6V	+6V
KG	INV	-6V_GND	-6V	GND

Table 4-D. Settings For the CTS (A) Jumper

4.5 CCITT V.35 (ISO 2593-1993) Model 436

This interface complies with CCITT Standard V.35 and ISO 2593-1993. Electrical characteristics comply with V.35 for clock and data signals and RS-232 levels for control signals.

This interface uses the physical connector type and pinouts specified in ISO 2593-1993 (refer to Table 4-E). The V.35 interface uses a 34 pin female Winchester connector for the physical connection.

Note that the table lists the function name shown in ISO 2593 and an *aka* where applicable. The rest of this section refers to the ISO 2593 function name and *aka* interchangeably. For example, the *aka* Serial Clock Transmit (SCT) is the same as ISO 2593 Transmitter Signal Element Timing.

The TXD, RXD, SCT, SCR and SCTE pins carry the primary data and clock signals (conforming to the V.35 standard). In addition, an extra clock signal input is provided to make the 2240 / -436 combination more "DTE-like" in tail circuit applications at the clock source end (refer to Section 2.2.6). The remainder of the pins are either ground references or control signals. Transmit Data (TXD) and Receive Data (RXD) are the data input and output signals for the modem, respectively.

Serial clock Transmit (SCT) is the modem’s transmit clock reference output that is used for the internal and slave clock modes. Serial Clock Receive (SCR) is the clock signal for the receive data *unless* the 2240's main PCBA W26 (XTCLK) jumper is ON, in which case the Extra Clock input signal is used to shift receive data out from the 2240 (refer to Section 2.2.6). Serial Clock Transmit External (SCTE) is the transmit clock signal used in either of the External clock modes or when the main board’s internal CLK / EXT switch is set to EXT (refer to Section 3.7).

Function	Pin (A/B)	CCITT Circuit Number	Direction
Shield	A	101	-
Signal Ground	B	102	-
Request to Send (aka RTS)	C	105	to modem
Clear to Send (aka CTS)	D	106	from modem
Data Set Ready (aka DSR)	E	107	from modem
Data Channel Receive Line Signal Detector (aka DCD)	F	109	from modem
Data Terminal Ready (aka DTR)	H	108	to modem
Calling Indicator (aka RI)	J	125	from modem
Local Loopback	L	141	to modem
Remote Loopback	N	140	to modem
Received Data (aka RXD)	R/T	104	from modem
Receiver Signal Element Timing, DCE Source (aka SCR)	V/X	115	from modem
Transmitted Data (aka TXD)	P/S	103	to modem
Transmitter Signal Element Timing, DCE Source (aka SCT)	Y/AA	114	from modem
Transmitter Signal Element Timing, DTE Source (aka SCTE)	U/W	113	to modem
Test Indicator (aka TM)	NN	142	from modem
Secondary Transmit Data (aka STD)	K*	-	to modem
Secondary Receive Data (aka SRD)	M*	-	from modem
Extra Clock for Receive Data	FF/DD*	-	to modem

NOTE 1: The 2240 connects the Shield pin to chassis ground.

* These pins carry signals which are not defined by V.35 or ISO 2593-1993. If a straight-through cable is used, verify compatibility of this pin usage with the customer's equipment.

Table 4-E.
CCITT V.35
Pinouts

NOTE: The previous V.35 interface, Model -435, did not conform to the ISO 2593 pinout and was the predecessor to the -436 interface. The signals listed in Table 4-F have different pinouts on the -435 versus the -436. The -435 also did not support the Extra Clock for the receive data signal. This pinout difference table is only included as a reference.

Table 4-F.
Pinout Differences
(-435 vs. -436)

Function	**Pin (A/B)**	**CCITT Circuit Number**	**Direction**
Test Indicator	C C	142	from modem
Secondary Receive Data	L	119	from modem
Local Loopback	E E	141	to modem
Remote Loopback	D D	140	to modem

None of the control leads interact with the data transmission. They are provided in order to comply with a variety of DTE interface requirements. Most of the control leads are actually end-to-end signal channels which can be used for any purpose as long as it conforms to the V.35 interface standards.

The RTS, CTS and DCD pins function together to provide the most common handshake functions. An input to RTS (see description of RTS-Bias jumper) is transmitted to the DCD output at the other end of the link (see description of DCD jumper). CTS follows RTS locally but it is delayed by approximately 1 msec when RTS turns on (see description of CTS-Gate jumper). There are two other end-to-end control lead pairs. They are listed below with the input signal listed first:

DTR to RI

STD to SRD

Data Set Ready (DSR) typically indicates that the modem is ready to handle transmit data. During loopbacks, the behavior of this signal is dependent on the position of the DSR jumper (see description of DSR jumper). Test Mode (TM) is turned ON (asserted) ONLY when a loopback is active on either one or both modems.

Local Loopback (LL) and Remote Loopback (RL) are loopback control leads and perform the same functions as the 2240 front panel LOOP switch, LOC and REM positions. LL and RL are interface signal inputs which can be used to activate the LOC or REM loop functions. These signals can control the loopback functions only if the front panel switch is in the center or OFF position.

4.5.1 RTS_BIAS Jumper

The RTS_BIAS jumper controls the state that RTS floats to when there is no signal driving the RTS pin. The OFF position forces this signal to the OFF (negated) state when the interface cable is disconnected. The ON position forces it to ON (asserted).

Factory Setting= OFF

4.5.2 DCD Jumper

The DCD jumper determines the source of the DCD output. In the CTRL position, the DCD output functions as the output for the RTS input at the far end. In the CD jumper position and with local RTS ON, CTS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the state of the RTS signal at the far end (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory Setting = CTRL

4.5.3 CTS_GATE Jumper

The CTS_GATE jumper controls the state of CTS when the local RTS is ON. When the jumper is in the ON position, CTS follows RTS only. The CD position allows the 2240's standard data interface signal CD to gate CTS. In the CD jumper position and with local RTS ON, CTS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the RTS signal at the far end is ON (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory Setting = ON

4.5.4 DSR Jumper

The DSR jumper controls the behavior of the DSR signal. The CCITT turns DSR OFF when the far-end 2240 modem has a local loopback active. The TEST position causes DSR to turn OFF (negate) whenever any loopback is active at one or both modems.

Factory Setting = CCITT

4.5.5 CH_GND Jumper

The jumper selects whether chassis ground is connected directly to signal ground (SHORT position) or through a 100 Ohm resistor (100_OHM position).

> **NOTE: In the standalone model, the 100_OHM position will only put a 100 Ohm resistor between the two grounds if the 2240's main board SIGNAL GND jumper is set to the FLOAT position.**
> **When installed in the 2201 Rack Chassis, any modem main board, interface or rack chassis jumper being set to SHORT will override the FLOAT and 100_OHM positions on all of the other modems.**
> **CONSIDER THIS JUMPER CAREFULLY.**

Factory Setting = 100_OHM

4.6 Multi-Channel Interfaces

4.6.1 RS-449 / RS-423 Model MC1

This interface includes two physical connectors. The RS-449 / 422 uses a 37-pin, female D-Type connector and the RS-423 uses a 25-pin, female D-Type connector.

A typical application for this interface is to transport data and dialer information from a video location to the network equipment over fiber optic cable. The RS-449 interface can carry the Video Codec data with the control lead used for call set up. The RS-423 interface can carry either serial RS-232 data or parallel RS-366A data for the dialing equipment, when used with the appropriate RS-366A adapter (2240-366-ACE or 2240-366-DTE) or equivalent cables.

Table 4-G delineates the adapter wiring necessary to utilize the RS-423 for both the DTE (Data Terminal Equipment) and ACE (Automatic Calling Equipment) ends.

DTE ADAPTER				END-TO-END	ACE ADAPTER			
DTE	RS-366A	MODEM		SIGNAL FLOW	MODEM		RS-366A	ACE
1	SHIELD	1	PG		PG	1	SHIELD	1
2	DPR	2	TD	→	RD	3	DPR	2
3	ACR	3	RD	←	TD	2	ACR	3
4	CRQ	4	RTS	→	DCD	8	CRQ	4
5	PND	8	DCD	←	RTS	4	PND	5
6	PWI	16	SRD	←	STD	14	PWI	6
7	SG	7	SG	——	SG	7	SG	7
13	DSC	13	SCTS	←	DSRS	23	DSC	13
14	NB1	14	STD	→	SRD	16	NB1	14
15	NB2	19	SRTS	→	SDCS	12	NB2	15
16	NB4	20	DTR	→	RI	22	NB4	16
17	NB8	23	DSRS	→	SCTS	13	NB8	17
18	RC	7	SG				RC	18
19	SC				SG	7	SC	19
22	DLO	22	RI	←	DTR	20	DLO	22

Table 4-G.
RS-366A Adapters

4.6.1.1 RS-449 / DC-37 Interface

This interface complies with EIA Standard RS-449. Electrical characteristics comply with RS-422 for clock and data signals and RS-423 for control signals. The interface uses the physical connector type and pinouts specified in RS-449 (refer to Table 4-H). The RS-449 / 422 interface uses a 37-pin, female D-Type connector for the physical connection.

Table 4-H.
RS-449 Pinouts
for Model MC1

Pin Number A/B	**RS-449 Pin Name (abbrev)**	**(full name)**	**Direction**
1	SHLD	shield	-
4/22	SD	send data	to modem
5/23	ST	send timing	from modem
6/24	RD	receive data	from modem
7/25	RS	request to send	to modem
8/26	RT	receive timing	from modem
9/27	CS	clear to send	from modem
10	LL	local loopback	to modem
11/29	DM	data mode	from modem
12/30	TR	terminal ready	to modem
13/31	RR	receiver ready	from modem
14	RL	remote loopback	to modem
15	IC	incoming call	from modem
17/35	TT	terminal timing	to modem
18	TM	test mode	from modem
19	SG	signal ground	-
20	RC	receive common	-
37	SC	send common	to modem
2/36	N/A	extra clock for receive data	to modem

The SD, RD, ST, RT and TT pins carry the primary data and clock signals (conforming to the RS-449 and RS-422 standards). In addition, an extra clock signal input (conforming to RS-422) is provided to make the 2240 / -422 combination more "DTE-like" in tail circuit applications at the clock source end (refer to Section 2.2.6). The remainder of the pins are either ground references or control signals. Send Data (SD) and Receive Data (RD) are the data input and output signals for the modem, respectively.

Send Timing (ST) is the modem’s transmit clock reference output that is used for the internal and slave clock modes. Receive Timing (RT) is the clock signal for the receive data *unless* the 2240's main PCBA W26 (XTCLK) jumper is ON, in which case the Extra Clock input signal is used to shift receive data out from the 2240 (refer to Section 2.2.6). Terminal Timing (TT) is the transmit clock signal used in either of the External clock modes or when the main board internal CLK / EXT switch is set to EXT (refer to Section 3.7).

> **NOTE: The extra clock signal is an enhancement added to -422 interfaces. The -422 interfaces with this capability can be identified by their *lack* of the W16 / W15 BAL_CTRL jumper. The W16 / W15 jumper was never described in the manual, so do not try to find a reference to it in the manual.**

Two end-to-end control leads are provided as part of this interface. An input to RS (Request to Send) is transmitted to the RR (Receiver Ready) output at the other end of the link (see description of RS-Bias jumper and RR jumper). CS (Clear to Send) follows RS locally but is delayed approximately 1 millisecond when RS turns ON (see description of CS-Gate jumper). The other end-to-end control lead pair is listed below with the input signal listed first :

TR to IC

This path, in conjunction with crossover cables at the DCE-DCE end, can be used to implement incoming call handshaking (see Figure 3-2).

Local Loopback (LL) and Remote Loopback (RL) are loopback control leads and perform the same functions as the 2240 front panel LOOP switch LOC and REM positions. LL and RL are interface signal inputs which can be used to activate the LOC or REM loop functions. These signals can control the loopback functions only if the front panel switch is in the center or OFF position.

4.6.1.1.1 RS_BIAS Jumper

The RS_BIAS jumper controls the state that RS floats to when there is no signal driving the RS pin. The OFF position forces this signal to the OFF (negated) state when the interface cable is disconnected. The ON position forces it to ON (asserted).

Factory Setting = OFF

4.6.1.1.2 RR Jumper

The RR jumper determines the source of the RR output. In the CTRL position, the RR output functions as the output for the RS input at the far end. In the CD jumper position, the RR output will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* when the far end RTS is ON (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory setting = CTRL

4.6.1.1.3 CS_GATE Jumper

The CS_GATE jumper controls the state of CS when the local RS is ON. When the jumper is in the ON position, CTS follows RS only. The CD position allows the 2240's standard data interface signal CD to gate CS. In the CD jumper position and with local RS ON, CS will turn ON either when the modem's fiber optic receiver is in sync (main board internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the RTS signal at the far end is ON (main board internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory setting = ON

4.6.1.1.4 CH_GND Jumper

The jumper selects whether chassis ground is connected directly to signal ground (SHORT position) or through a 100 Ohm resistor (100_OHM position).

NOTE: In the standalone model, the 100_OHM position will only put a 100 Ohm resistor between the two grounds if the 2240's main board SIGNAL GND jumper is set to the FLOAT position.

When installed in the 2201 Rack Chassis, any modem main board, interface or rack chassis jumper being set to SHORT will override the FLOAT and 100_OHM positions on all of the other modems. CONSIDER THIS JUMPER CAREFULLY.

Factory Setting = 100_OHM

4.6.1.1.5 UNBAL_REF Jumper

RS-449 specifies that unbalanced inputs to a DCE are to be referenced to the SC (Send Common) pin. This pin on the DCE is tied to the signal ground of the DTE through the interface cable. If this ground connection is present, and you prefer to use it, move the UNBAL_REF jumpers to SC.

Factory Setting = GND

4.6.1.2 RS-423 / DB-25 Interface

NOTE: The maximum data rate for this interface is 9.6 kbps.

This interface is electrically compatible with EIA RS-423A. It will also operate with asynchronous RS-232D systems.

This interface uses the physical connector type and pinouts specified in RS-232D (refer to Table 4-I). The RS-423/232D interface uses a 25-pin, female D-type connector for the physical connection.

There are six end-to-end control lead pairs. They are listed with the input signal listed first.

TD to RD
STD to SRD
DTR to RI
SRTS to SDCD
DSRS to SCTS
RTS to DCD

Table 4-I.
RS-423 Pinouts
for Model MC1

Pin Number	**RS-232 Pin Name (abbrev)**	**(full name)**	**Direction**
1	PG	Protective Ground	-
2	TD	Transmit Data	to modem
3	RD	Receive Data	from modem
4	RTS	Request to Send	to modem
5	CTS	Clear to Send	from modem
6	DSR	DCE Ready	from modem
7	SG	Signal Ground	-
8	DCD	Receive Line Sig. Det.	from modem
12	SDCD	Secondary Line Sig. Det.	from modem
13	SCTS	Secondary CTS	from modem
14	STD	Secondary TD	to modem
16	SRD	Secondary RD	from modem
19	SRTS	Secondary RTS	to modem
20	DTR	DTE Ready	to modem
22	RI	Ring Indicator	from modem
23	DSRS	Data Signal Rate Selector	to modem
25	TM	Test Mode	from modem

4.6.2 V.35 / RS-423 Model MC2

This interface includes two physical connectors. The CCITT V.35 uses a 34-pin, female Winchester connector and the RS-423 uses a 25-pin, female D-Type connector.

A typical application for this interface is to transport data and dialer information from a video location to the network equipment over fiber optic cable. The V.35 interface can carry the video Codec data with the control lead used for call set up. The RS-423 interface can carry either serial RS-232 data or parallel RS-366A data for the dialing equipment when used with the appropriate RS-366A adapter (2240-366-ACE or 2240-366-DTE) or equivalent cabling.

Table 4-J delineates the adapter wiring necessary to utilize the RS-423 for both the DTE (Data Terminal Equipment) and ACE (Automatic Calling Equipment) ends.

DTE ADAPTER				END-TO-END	ACE ADAPTER				
DTE	RS-366A	MODEM		SIGNAL FLOW	MODEM		RS-366A	ACE	
1	SHIELD	1	PG		PG	1	SHIELD	1
2	DPR	2	TD	→	RD	3	DPR	2
3	ACR	3	RD	←	TD	2	ACR	3
4	CRQ	4	RTS	→	DCD	8	CRQ	4
5	PND	8	DCD	←	RTS	4	PND	5
6	PWI	16	SRD	←	STD	14	PWI	6
7	SG	7	SG	—	SG	7	SG	7
13	DSC	13	SCTS	←	DSRS	23	DSC	13
14	NB1	14	STD	→	SRD	16	NB1	14
15	NB2	19	SRTS	→	SDCS	12	NB2	15
16	NB4	20	DTR	→	RI	22	NB4	16
17	NB8	23	DSRS	→	SCTS	13	NB8	17
18	RC	7	SG				RC	18
19	SC				SG	7	SC	19
22	DLO	22	RI	←	DTR	20	DLO	22

Table 4-J.
RS-366A
Adapters

4.6.2.1 CCITT V.35 / MRC 34 Interface

This interface complies with CCITT Standard V.35 and ISO 2593-1993. Electrical characteristics comply with V.35 for clock and data signals and RS-232 levels for control signals.

This interface uses the physical connector type and pinouts specified in ISO 2593-1993 (refer to Table 4-K). The V.35 interface uses a 34-pin female Winchester connector for the physical connection.

Note that the table lists the function name shown in ISO 2593 and an *aka* where applicable. The rest of this section refers to the ISO 2593 function name and *aka* interchangeably. For example, the *aka* Serial Clock Transmit (SCT) is the same as ISO 2593 Transmitter Signal Element Timing.

The TXD, RXD, SCT, SCR and SCTE pins carry the primary data and clock signals (conforming to the V.35 standard). In addition, an extra clock signal input is provided to make the 2240 / -MC2 combination more "DTE-like" in tail circuit applications at the clock source end (refer to Section 2.2.6). The remainder of the pins are either ground references or control signals. Transmit Data (TXD) and Receive Data (RXD) are the data input and output signals for the modem, respectively.

Serial clock Transmit (SCT) is the modem's transmit clock reference output that is used for the internal and slave clock modes. Serial Clock Receive (SCR) is the clock signal for the receive data *unless* the 2240's main PCBA W26 (XTCLK) jumper is ON, in which case the Extra Clock input signal is used to shift receive data out from the 2240 (refer to Section 2.2.6). Serial Clock Transmit External (SCTE) is the transmit clock signal used in either of the External clock modes or when the main board's internal CLK / EXT switch is set to EXT (refer to Section 3.7).

Two end-to-end control leads are provided as part of this interface. An input to RTS is transmitted to the DCD output at the other end of the link (see description of RTS-Bias jumper and DCD jumper). CTS (Clear to Send) follows RTS locally but is delayed approximately 1 millisecond when RTS turns ON (see description of CTS-Gate jumper). The other end-to-end control lead pair is listed below with the input signal listed first:

DTR to RI

This path, in conjunction with crossover cables at the DTR end, can be used to implement incoming call handshaking.

Function	Pin (A/B)	CCITT Circuit Number	Direction
Shield	A	101	-
Signal Ground	B	102	-
Request to Send (aka RTS)	C	105	to modem
Clear to Send (aka CTS)	D	106	from modem
Data Set Ready	E	107	from modem
Data Channel Receive Line Signal Detector (aka DCD)	F	109	from modem
Data Terminal Ready (aka DTR)	H	108	to modem
Calling Indicator (aka RI)	J	125	from modem
Local Loopback	L	141	to modem
Remote Loopback	N	140	to modem
Received Data (aka RXD)	R/T	104	from modem
Receiver Signal Element Timing, DCE Source (aka SCR)	V/X	115	from modem
Transmitted Data (aka TXD)	P/S	103	to modem
Transmitter Signal Element Timing, DCE Source (aka SCT)	Y/AA	114	from modem
Transmitter Signal Element Timing, DTE Source (aka SCTE)	U/W	113	to modem
Test Indicator (aka TM)	NN	142	from modem
Extra Clock for Receive Data	FF/DD *	-	to modem

* These pins carry signals which are not defined by V.35 or ISO 2593-1993. If a straight-through cable is used, verify compatibility of this pin usage with the customer's equipment.

NOTE 1: The 2240 connects the Shield pin to chassis ground.

NOTE 2: The extra clock signal is an enhancement added to -MC2 interfaces. MC2 interfaces with this capability can be identified by the addition of a heatsink on the voltage regulator, VR1.

Table 4-K. CCITT V.35 Pinouts for MC2

The previous V.35 interface Model MC2 / 435, did not conform to the ISO 2593 pinout and was the predecessor to the MC2 / 436 interface. The MC2 / 436 went into production during mid-summer 1996. The signals listed in Table 4-L have different pinouts on the MC2 / 435 versus the MC2 / 436. The MC2 / 435 also did not support the Extra Clock for the receive data signal. This pinout difference table is only included as a reference. MC2 / 436 interfaces can be identified by the addition of a heatsink on the voltage regulator, VR1.

Table 4-L. Pinout Differences (MC2 / 435 vs. MC2 / 436)

Function	**Pin (A/B)**	**CCITT Circuit Number**	**Direction**
Test Mode	C C	142	from modem
Local Loopback	E E	141	to modem
Remote Loopback	D D	140	to modem

4.6.2.1.1 RTS_BIAS Jumper

The RTS_BIAS jumper controls the state that RTS floats to when there is no signal driving the RTS pin. The OFF position forces this signal to the OFF (negated) state when the interface cable is disconnected. The ON position forces it to ON (asserted).

Factory Setting = OFF

4.6.2.1.2 DCD Jumper

The DCD jumper determines the source of the DCD output. In the CTRL position, the DCD output functions as the output for the RTS input at the far end. In the CD jumper position and with local RTS ON, CTS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the state of the RTS signal at the far end (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory setting = CTRL

4.6.2.1.3 CTS_GATE Jumper

The CTS_GATE jumper controls the state of CTS when the local RTS is ON. When the jumper is in the ON position, CTS follows RTS only. The CD position allows the 2240's standard data interface signal CD to gate CTS. In the CD jumper position and with local RTS ON, CTS will turn ON either when the modem's fiber optic receiver is in sync (main PCBA internal switch S1 CD / DCD = OFF and CD / SYNC = ON) *or* the RTS signal at the far end is ON (main PCBA internal switch S1 CD / DCD = ON and CD / SYNC = OFF). Refer to Section 2.2.2.1 for more information on the internal switch S1 CD / DCD and CD / SYNC positions.

Factory setting = ON

4.6.2.1.4 CH_GND Jumper

The jumper selects whether chassis ground is connected directly to signal ground (SHORT position) or through a 100 Ohm resistor (100_OHM position).

NOTE: In the standalone model, the 100_OHM position will only put a 100 Ohm resistor between the two grounds if the 2240's main board SIGNAL GND jumper is set to the FLOAT position.

When installed in the 2201 Rack Chassis, any modem main board, interface or rack chassis jumper being set to SHORT will override the FLOAT and 100_OHM positions on all of the other modems.

CONSIDER THIS JUMPER CAREFULLY.

Factory Setting = 100_OHM

4.6.2.2 RS-423 / DB-25 Interface

NOTE: The maximum data rate for this interface is 9.6 Kbps.

This interface is electrically compatible with EIA RS-423A. It will also operate with asynchronous RS-232D systems.

This interface uses the physical connector type and pinouts specified in RS-232D (refer to Table 4-I). The RS-423 / 232D interface uses a 25-pin, female D-type connector for the physical connection. These signal channels operate independently from the main data channel of the V.35 interface. A worst case sampling jitter of 21 microseconds will be experienced on these channels.

There are six end-to-end control lead pairs. They are listed below with the input signal listed first:

TD to RD
STD to SRD
DTR to RI
SRTS to SDCD
DSRS to SCTS
RTS to DCD

4.7 T1 / E1 Interfaces

4.7.1 Transparent Bipolar - Models 4BX

NOTE: This interface replaces the 4T (1-3) and 4E (1-3) models. It is completely compatible with these previous interface models.

The 4Bx interfaces are compatible with any bipolar, line-coded T1 or E1 data (1.544 or 2.048 Mbps). All types of codes, including AMI, B8ZS, B7S or HDB3, will be accurately transmitted/received. Five DIP switches are used in configuring particular applications (refer to Table 4-M). Switch positions 1 and 2 select T1 or E1. Positions 3 through 5 select line build out values for T1 usage.

There are three different types of interface connectors, and each is identified by the number at the end of the interface code of the order number (refer to Table 4-N). The connectors are female DA-15 (4B1); four-position terminal block (4B2); or two female BNCs (4B3). Figure 4-2 shows how the input and output pairs are wired to these connectors.

Table 4-M. Configuration Switch Settings

Switch Positions for 4Bx						
1	2	3	4	5		
E1	T1	LENO	LEN2	LEN1	Mode of Operation	
ON	OFF	ON	ON	ON	E1 CCITT	E1
OFF	ON	OFF	ON	OFF	0-133 FT	DSX-1 ABAM & PIC
OFF	ON	ON	OFF	ON	133-266 FT	
OFF	ON	OFF	OFF	ON	266-399 FT	
OFF	ON	ON	OFF	OFF	399-533 FT	
OFF	ON	OFF	OFF	OFF	533-655 FT	
OFF	ON	ON	ON	OFF	part 68 opt. A	CSU
OFF	ON	OFF	ON	OFF	T1C1.2	

Table 4-N. Transparent Bipolar Line Interfaces

Model #	Interface Connector Type	Speed
4B1	DA-15	1.544 Mhz T1 or 2.048 Mhz E1
4B2	Terminal Block	1.544 Mhz T1 or 2.048 Mhz E1
4B3	BNC (75 ohm)	1.544 Mhz T1 or 2.048 Mhz E1
These interfaces are fully transparent to line codes such as B8ZS or HDB3. Three DIP switches (3, 4 and 5) are provided for selecting various line build out settings as indicated in Table 4-M. Standard factory settings are T1 at 0-133 feet for all three models. Two DIP switches (1 and 2) are provided to select CCITT speed (2.048 Mhz) or T1 speed (1.544 Mhz).		

This interface performs jitter attenuation of the transmit line input signal. It is also designed to propagate an all "1's" AMI stream if the end-to-end line is interrupted at any point.

When using any of the Transparent Bipolar Interfaces, the 2240 modem rate and mode front panel DIP switches should be set as follows: 1-4 = closed, 5-7 = open (Rate 0, Mode 7). In addition, the first two positions of the internal DIP switch S1 must be:
CD / DCD = OFF and CD / SYNC = ON. Refer to Section 2.2.2.1.

If the interface signal is lost, Loss of Signal (LOS), the all "1's" Alarm Indication Signal (AIS) is sent to the other end.

Factory Setting = Both jumpers are OFF

These interfaces allow full inter-operation with any of the synchronous data interfaces when the customer's T1/E1 is AMI-coded (see Figure 4-3). This interface will *not* inter-operate with synchronous data interfaces if the T1 / E1 is B8ZS or HDB3.

Two jumper straps are provided for setting the line termination impedance to either 100 ohm for T1 or 120 ohm for E1 applications. These straps are located near the middle of the interface board and are provided only for the 4B1 and 4B2 versions. For the 4B3 version (BNC connectors) the termination impedance is fixed at 75 ohms.

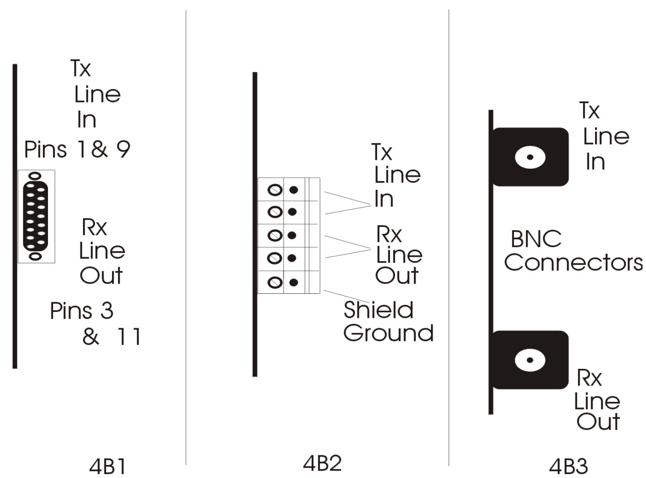


Figure 4-2.
Transparent Bipolar
Interface Connectors

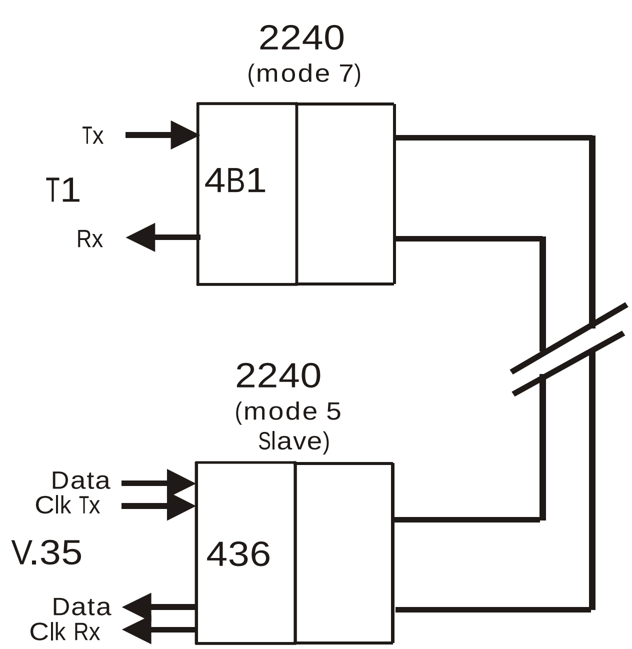


Figure 4-3.
Example of Link
Between Bipolar
and Clocked
Interface

4.8 TTL / BNC Interface Model -BN

This model uses BNC (bayonet) connectors for the physical interface. The electrical signal characteristics are unbalanced TTL levels, with only the clock and data circuits supported. Four BNC connectors are supplied for connection to a DTE device.

High speeds and long distances (clock and data only) can be achieved using this interface.

This interface version has a switchable dual purpose port for the Send Timing (SCT) and Terminal Timing (SCTE) clock signals. A two-position slide switch (S1) on the interface card controls the port direction.

When the switch is set towards the BNC connectors, the port is configured as an input (for the SCTE clock). Sliding the switch away from the BNC connectors configures the port as an output (for the SCT clock). (See Figure 4-4 for connectors and refer to Table 4-O for signals supported.)

NOTE: When setting up the clock select, the proper main circuit board clock mode must be set correctly, i.e., external for the SCTE clock input, slave or internal for the SCT clock output.

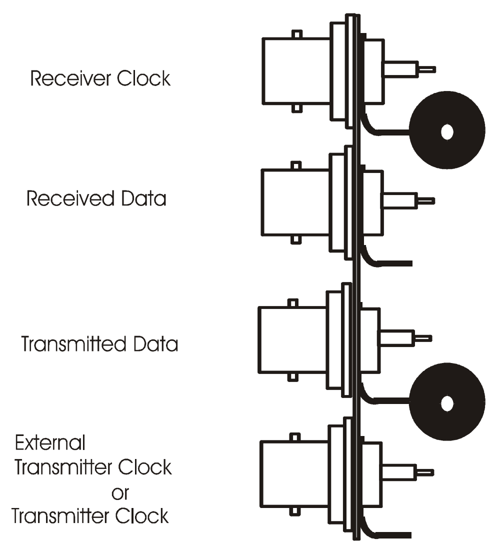


Figure 4-4.
BNC Connectors

Signal	Full Name	Direction
TxD	Transmit Data	To Modem
RxD	Receive Data	From Modem
SCR	Serial Clock Receive	From Modem
SCT	Serial Clock Transmit	From Modem
SCTE	External Clock Transmit	To Modem

Table 4-O.
BNC Supported
Signals

4.9 Programmable Buffered Interface / Model P53

The Model P53 Interface Module complies with EIA Standard RS-530 while all clock, data and control signals follow the RS-422 standard. The basic configuration of the P53 interface is a DCE device (w/Fem DB-25) and two connector adapters are provided with the interface: the DCE / DTE adapter which converts the interface to the DTE form (w/Male DB-25) and the "Legacy" adapter which converts the interface to the original Model P2 interface.

This interface implements a set of circuits (resources) which can be interconnected in various ways to satisfy a host of differing applications. These resources are:

- a 16-bit FIFO (first-in, first-out) buffer
- an inverter
- a switchable delay line

The FIFO can be utilized to buffer either the received or the transmitted data (not both). The Delay Line, in conjunction with a four-position DIP switch, provides an option for fine tuning the relationship between clock and data timing. Table 4-P defines the delay lines versus switch settings for the Model P53 Interface.

A wire wrap header (J3) provides the means to interconnect these resources together with the standard modem transmit and receive circuits to perform the intended function. Figure 4-5 illustrates how the resources are tied into the J3 header. Specific applications are satisfied by wire wrap connections between appropriate pins.

Four pre-wrapped headers are provided with the interface. These implement the most common applications. See Figures 4-7, 4-9,4-11 and 4-13. Numerous other configurations are possible by different wired versions of the header, P3. The four versions included are identified by part number labels affixed to the underside of the header. The version included in the socket as shipped is P/N 610030-001 (see Figure 4-13).

The P53 can be used to interface with encryption devices on the BLACK side where modems act as the network and supply clocking in a synchronous configuration, or to the RED (clear) side of a data encryption (KG) equipment. In the RED side application, the interface acts as the "tail-circuit adapter" device. This configuration allows the modem to accept two synchronous clocks (typically, DCE devices only accept one): one for transmit (external clock) and one for receive (FIFO input clock).

Another common application is with systems that communicate over geosynchronous satellites. In this application, the FIFO is used to make up for clock drift (Doppler shift) caused by the satellite's elliptical orbit around the earth.

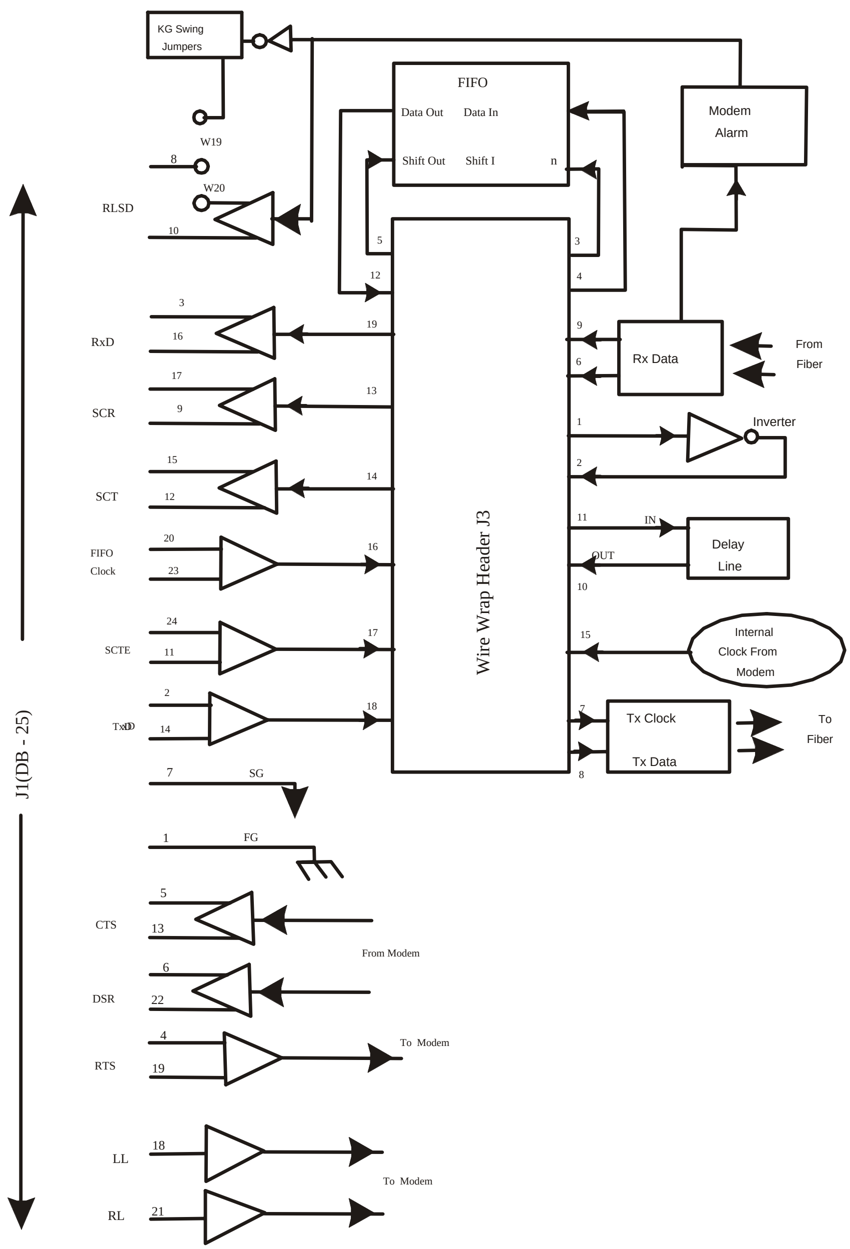


Figure 4-5.
Available Strapping Options for Programmable Buffered Interface

Table 4-P.
Delay Times for Programmable Buffered Interface

SW1 Position (O)pen (C)losed				**Delay Time P53**
1	**2**	**3**	**4**	
C	C	C	C * *	20 ns
O	C	C	C	30 ns
C	O	C	C	40 ns
O	O	C	C	50 ns
C	C	O	C	60 ns
O	C	O	C	70 ns
C	O	O	C	80 ns
O	O	O	C	90 ns
C	C	C	O	100 ns
O	C	C	O	110 ns
C	O	C	O	120 ns
O	O	C	O	130 ns
C	C	O	O	140 ns
O	C	O	O	150 ns
C	O	O	O	160 ns
O	O	O	O	170 ns
**** * Default setting as shipped***				

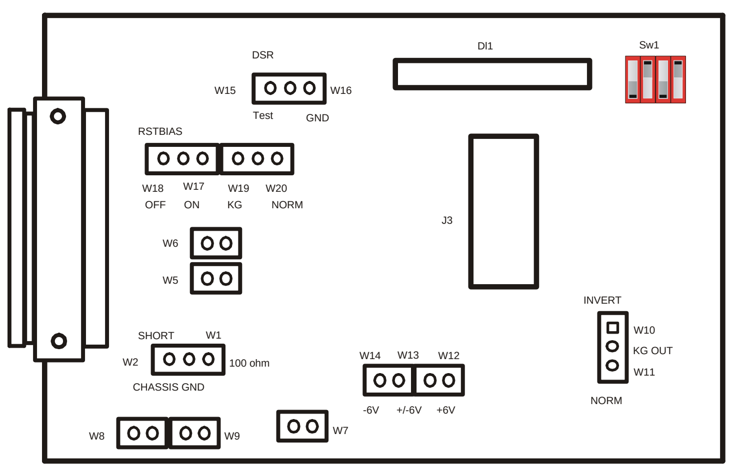


Figure 4-6.
Board Layout for Programmable Buffered Interface

Jumper	Description	Notes	Factory Setting
W1 / W2	Chassis Ground	W1 - 100 ohms / W2 - Short	W1 Default
W5, W6, W7	RCVR Terminations		All Out
W8 / W9	Legacy Config.		Both Out
W10 / W11	RLSD Output Swing		W11
W12 / W13 / W14	RLSD Output Swing		W13
W15 / W16	DSR	W15 - Test / W16 - GND	W16 Default
W17 / W18	RTS Bias	W17 - On / W18 - Off	W18 Default
W19 / W20	RLSD	W19 - Single Ended / W20 - Differential	W20 Default

Table 4-Q. Jumper Settings and Descriptions

4.9.1 Jumper Settings

All jumper settings and descriptions are listed in Table 4-Q. This interface has strap option jumpers to configure the RLSD Output at J1-8 (DB-25) to support the KG-194 Resync functionality. Jumper straps W10 / W11 (adjacent to U11) and W12 / W13 / W14 (adjacent to U8) implement this function (refer to Table 4-Q and Figure 4-6). Jumper straps W10 / W11 control the ON / OFF level and W12 / W13 / W14 configure the RLSD Output to Bipolar (+6 V and -6 V) or single-ended (+6 and 0 or -6 and 0).

STRAP CONFIGURATIONS	CD OUTPUT (AT J1-8 * *) VOLTAGE LEVEL ±1 V ON/OFF
W11 and W14	+6/-6
W11 and W12	+6/0
W11 and W13	0/-6
W10 and W14	-6/+6
W10 and W12	0/+6
W10 and W13	-6/0
**** * J1-6 when using the "Legacy" (P2) Converter***	

Table 4-R. Strap Configurations for RLSD (CD) Output

The W1 / W2 strap connects chassis ground to signal ground (W2 position), connects chassis ground through 100 ohms to signal ground (W1 position), or isolates chassis ground from signal ground (jumper out). The W5, W6 and W7 jumpers, when installed, ground the midpoints of the 100 ohm termination resistances of the FIFO CLK, SCTE and TxD line receivers. These jumpers may provide improved performance in cases where the RS-422 inputs are bipolar rather than the more common unipolar types. The W8, W9 and W15 / W16 jumpers are used for converting to the Legacy configuration (see Figure 4-15).

4.9.2 Generic Interface

Figure 4-7 illustrates basic DCE configurations, which bypass all the "feature" circuits provided by the P53 Interface.

PROGRAMMABLE BUIFFERED INTERFACE
MODEL P53, GENERIC DCE RS-530
P/N 6100030-006

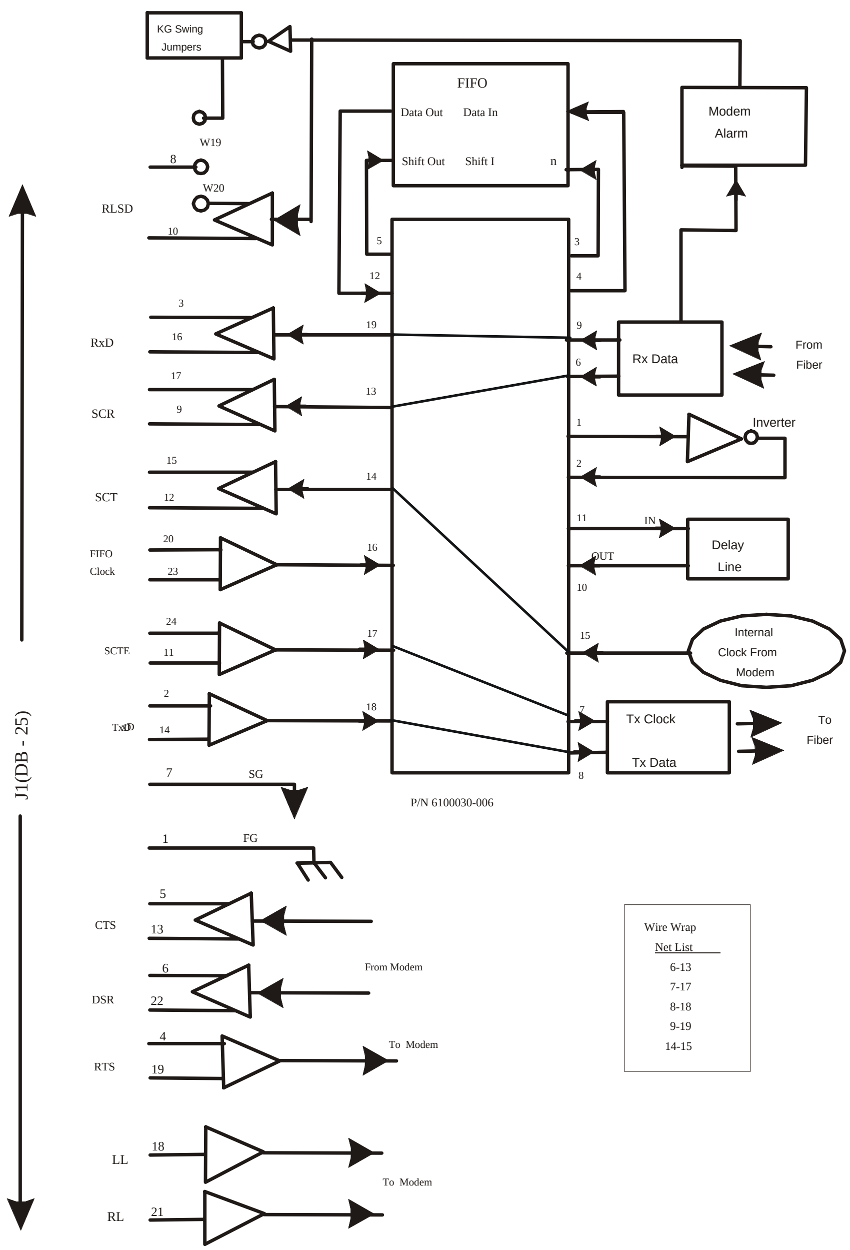


Figure 4-7. Programmable Buffered Interface, Model P53, Basic DCE RS-530

4.9.3 External Station

The External Station is used when an external station clock is providing timing (see Figures 4-8 and 4-9). When connecting KG or KIV encryptors together on the Black side, using an external timing device you should install the external station clock strapped header in the J3 position. In this application, the modems are acting as the network, although the timing input is from an outside source. The modem in which the timing source is connected should be set for external and the other modem set for slave. This header is provided with the interface.

Typical External Station Clock Application

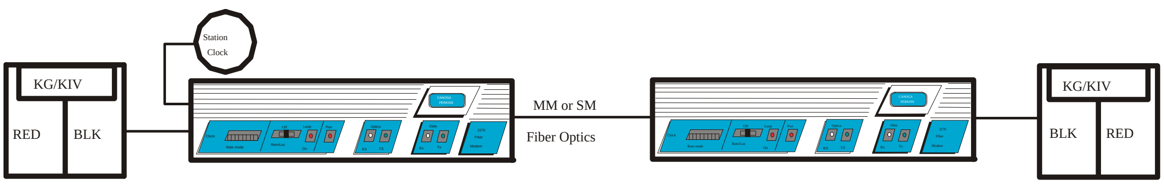


Figure 4-8.
External Station

P/N 6100030-004

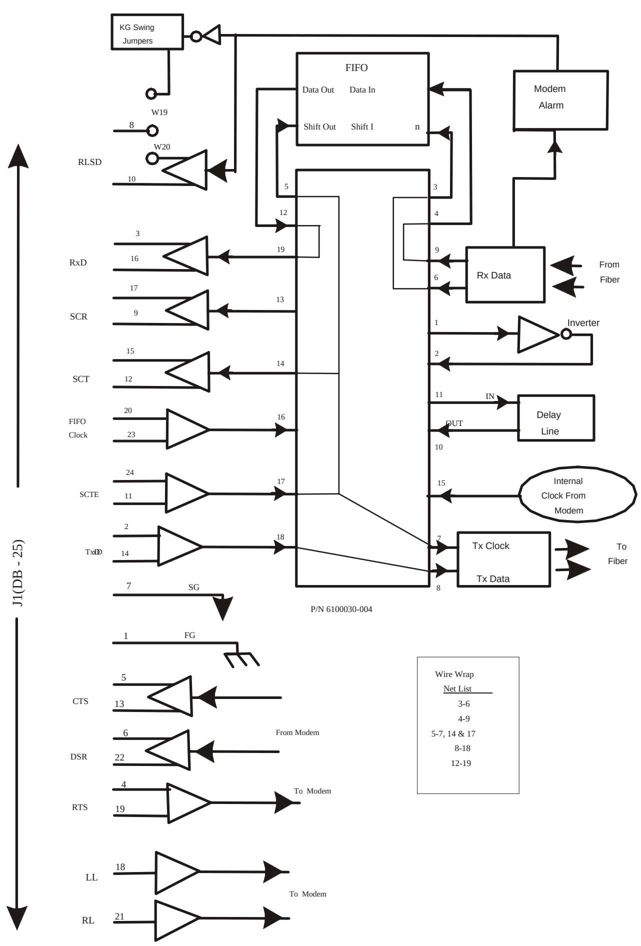


Figure 4-9.
Programmable
Buffered Interface,
Model P53,
External Station

4.9.4 Internal

The internal function is used when network equipment is set for Eternal Timing (see Figures 4-10 and 4-11). When connecting KG or KIV encryptors together on the Black side, you should install the internal strapped header in the J3 position. In this application, the modems are acting as the network timing source. In most cases, both modems should be set for internal master clock. The rate switches should be set to the appropriate speed for the circuit. This header is provided with the interface.

Typical Internal Clock Application

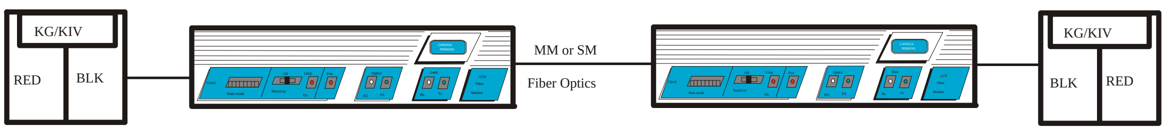


Figure 4-10. Internal Programmable Buffered Interface, Model P53, DCE RS-530

P/N 6100030-005

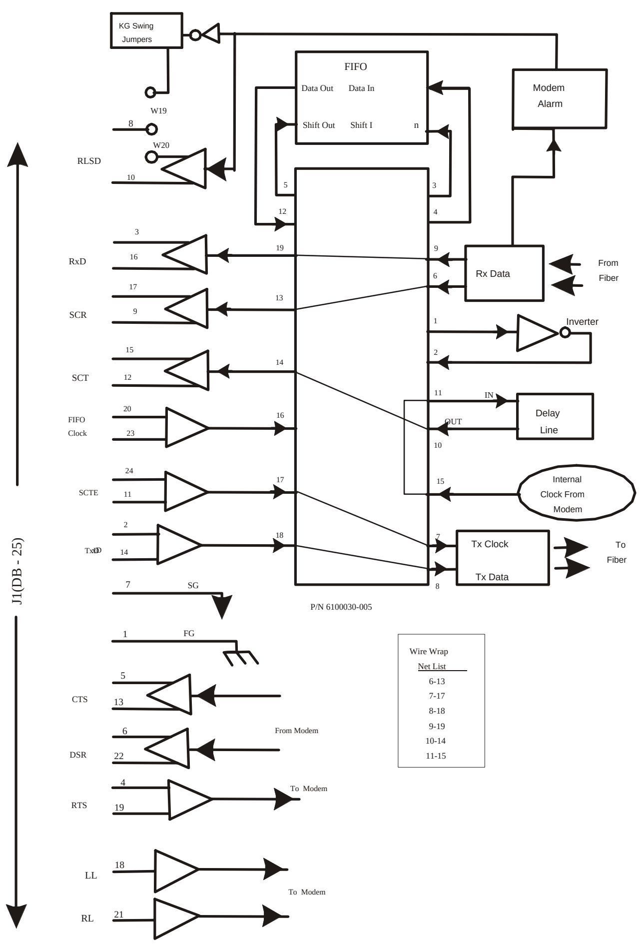


Figure 4-11. Internal Programmable Buffered Interface, Model P53

4.9.5 External

The External function is used when network equipment is set for Network or Internal Timing (see Figures 4-12 and 4-13). When connecting KG or KIV encryptors on the Red side to a DTE device, you should install the external strapped header in the J3 position. In this application, the modems are acting as an extension of the Red side cable in a true tail circuit. The modem at the Red end is set for external clock and the modem at the DTE end is set for slave clock. This header is provided with the interface.

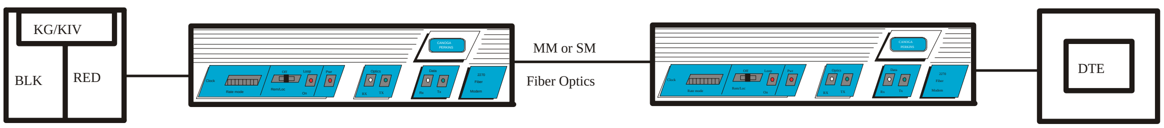


Figure 4-12. External Programmable Buffered Interface, Model P53, DCE RS-530

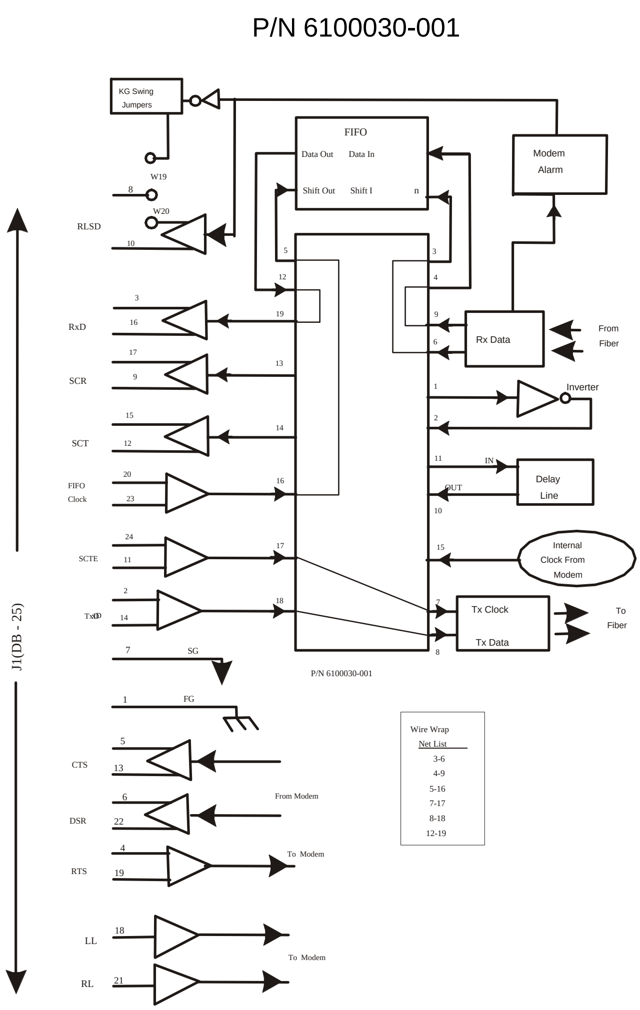
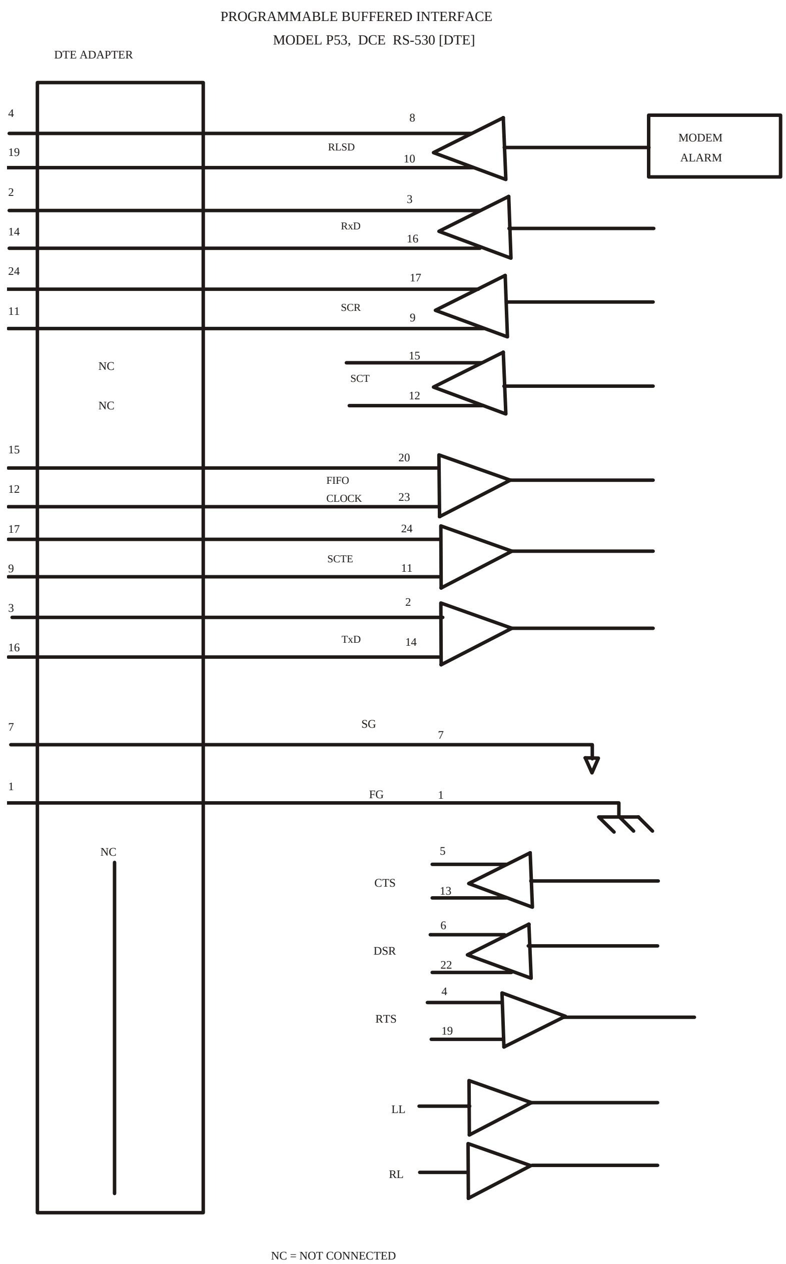


Figure 4-13. External Programmable Buffered Interface, Model P53

4.9.6 DTE Adapter

This adapter is supplied with the P53 interface and should be used when connecting to a DCE device. This allows the use of a straight-through RS-530 cable. Figure 4-14 illustrates the DCE to DTE pin assignments. The gender of this adapter on the user side is male.

Figure 4-14.
Programmable
Buffered Interface,
Model P53 [DTE]



4.9.7 Legacy Adapter

This adapter is provided with the P53 interface and should be used if preexisting cabling was installed for use with Model P2 interface cards (see Figure 4-15). This adapter converts the standard RS-530 pin assignment on the P53 back to the original P2 pin assignments.

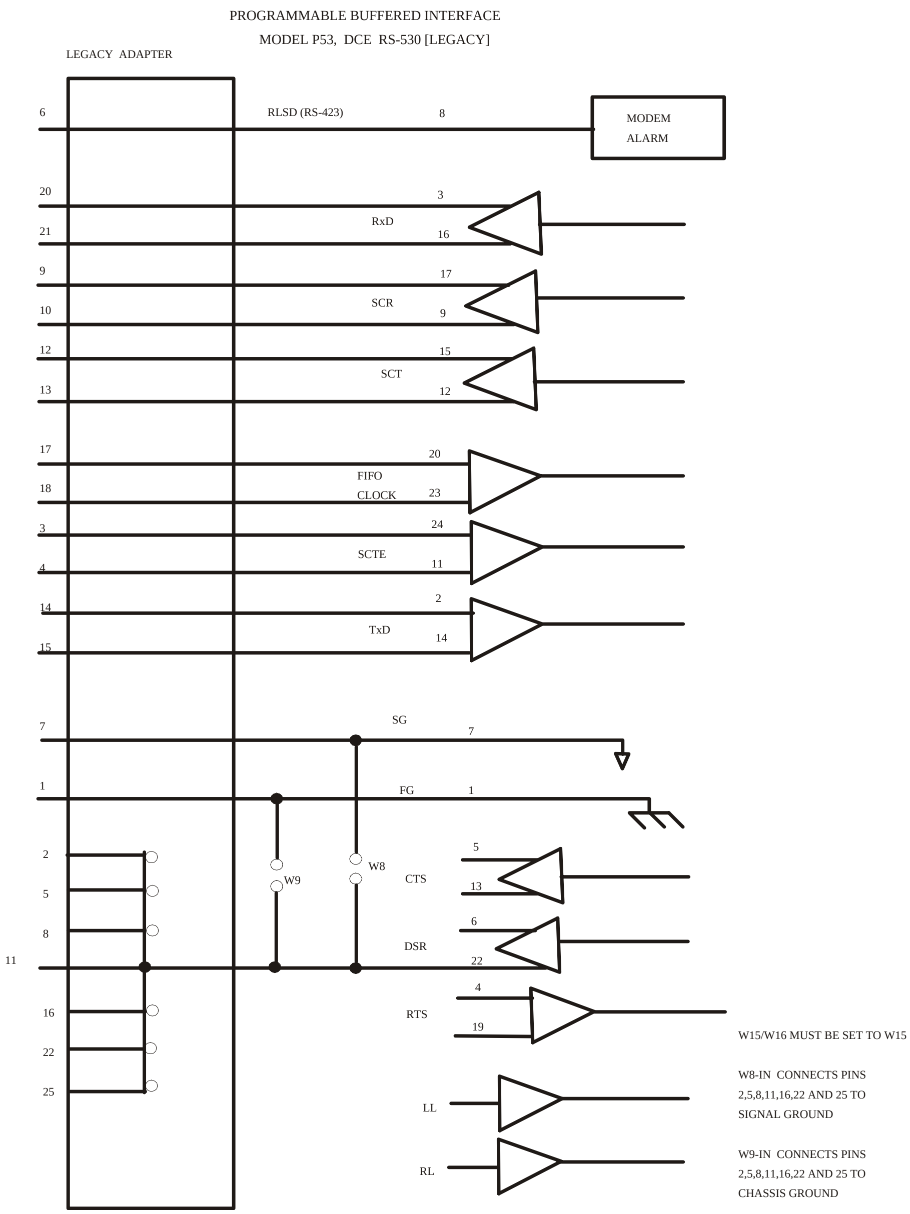


Figure 4-15. Programmable Buffered Interface, Model P53 [Legacy Adapter]

4.10 High-Speed RS-422 / Mil-Std 188-114C Interfaces

There are three High-Speed RS-422 interface models (TW, T22 and D22) and three High-Speed Mil-Std 188-114C interface models (TW8, T88 and D88) available.

All can operate up to 20 Mbps (2240 limited to 2.048 Mbps). All support only clock and data signals as shown in Table 4-R. Both the RS-422A and Mil-Std 188-114C are balanced differential electrical signals.

Table 4-S. TwinAx Supported Signals

Signal	Full Name	Direction
TxD	Transmit Data	To Modem
RxD	Receive Data	From Modem
SCR	Serial Clock Receive	From Modem
SCT	Serial Clock Transmit	From Modem
SCTE	External Clock Transmit	To Modem

The RS-422A operates between +1 and +4 volts whereas the Mil-Std 188-114C swings between +/-3 volts. The termination impedances vary slightly as illustrated in Table 4-T. The two interface types will communicate with each other but center tap ground jumpers E2 and E3 must be removed from a Mil-Std 188-114C interface (refer to Table 4-U).

The basic differences between the models is the type of physical connectors used for the interface. Table 4-T lists the six interface models with the corresponding source and termination impedances and physical connectors. Table 4-U shows the jumper options available and the factory default settings for the jumpers.

4.10.1 Model TW

The signaling used on this interface is RS-422A. Four TwinAx connectors (BJ-77, 3-lug) are used for the physical connection (see Figure 4-16).

A switch is provided to select whether the fourth TwinAx (SCT / SCTE) is to be used as an output (SCT) or as an input (SCTE). By setting the switch to the SCT position, the port becomes an output providing the clock to the connected device. When set for SCTE, the port becomes an input and will accept a clock from the connected device.

Model	Electrical Interface Type	Physical Interface Type	Physical Interface Figure / Table	Driver Impedance	Termination Impedance
TW	RS-422A	4 TwinAx	Figure 4-16	<100 Ohms	100 Ohms ±10%
TW8	Mil-Std 118-114C	4 TwinAx	Figure 4-16	<100 Ohms	78 Ohms ±10%
T22	RS-422A	5 TwinAx	Figure 4-17	<100 Ohms	100 Ohms ±10%
T88	Mil-Std 188-114C	5 TwinAx	Figure 4-17	<100 Ohms	78 Ohms ±10%
D22	RS-422A	DC-37	Table 4-V	<100 Ohms	100 Ohms ±10%
D88	Mil-Std 188-114C	DC-37	Table 4-V	<100 Ohms	124 Ohms ±10%

Table 4-T. Model Characteristics

SCT should be selected if the modem is set for Internal or Slave Clock mode.
SCTE should be selected if the modem is set for External Clock mode.

NOTE: The SCT output cannot be returned on the SCTE leads to eliminate propagation delay problems with this interface.

Table 4-U.
Jumper Strap
Options

JUMPER ID	DESCRIPTION	FACTORY CONFIGURATION TW	TW8	T22	T88	D22	D88
W3 / W4*	W3 = VCO disabled W4 = VCO enabled	W4	W4	W4	W4	W4	W4
W5 / W6**	W6 = Normal SCT W5 = Inverted SCT	W6	W6	W6	W6	W6	W6
W5 / W6	W7 = Shield connected to chassis ground W8 = Shield connected to signal ground	W7	W7	W7	W7	W7	W7
W9 / W10	W9 = Chassis ground connected to signal ground W10 = Not connected	W10	W10	W10	W10	W10	W10
E2	TxD RCV termination resistor	N/A	IN	N/A	IN	N/A	IN
E3	SCTE RCV termination resistor center tap to shield ground	N/A	IN	N/A	IN	N/A	IN

* W3 / W4 jumper option may not exist on some older versions. It is only required when performing Local loopbacks. The W4 position corrects the duty cycle of External Clock above 9 Mbps.

** The W5 / W6 jumper option serves the same function as the SCT Normal / Invert Jumper on the main 2240 board. Either one may be used to invert SCT. Refer to Section 2.2.5 for details.

4.10.2 Model TW8

The signaling used on this interface is Mil-Std 188-114C. Four TwinAx connectors (BJ-77, 3-lug) are used for the physical connection (see Figure 4-16).

A switch is provided to select whether the fourth TwinAx (SCT / SCTE) is to be used as an output (SCT) or as an input (SCTE). By setting the switch to the SCT position, the port becomes an output providing the clock to the connected device. When set for SCTE, the port becomes an input and will accept a clock from the connected device.

SCT should be selected if the modem is set for Internal or Slave Clock mode. SCTE should be selected if the modem is set for External Clock mode.

NOTE: The SCT output cannot be returned on the SCTE leads to eliminate propagation delay problems with this interface.

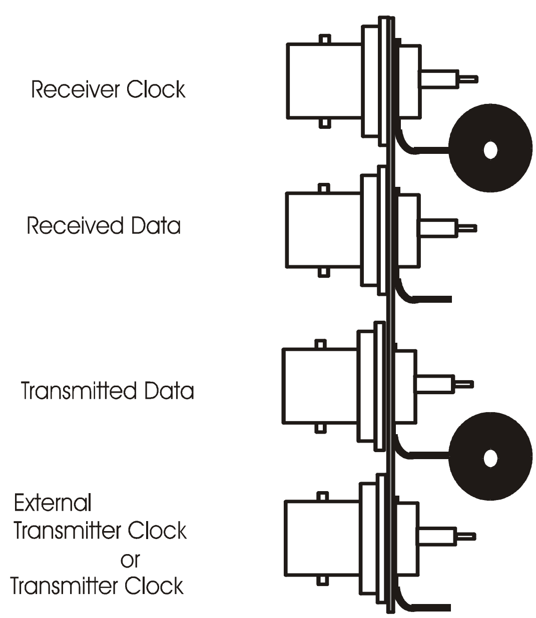


Figure 4-16.
Four TwinAx
Connectors
(BJ-77, 3-Lug)

4.10.3 Model T22

The signaling used on this interface is RS-422A. Five TwinAx connectors (BJ-77, 3-lug) are used for the physical connection (see Figure 4-17).

4.10.4 Model T88

The signaling used on this interface is Mil-Std 188-114C. Five TwinAx connectors (BJ-77, 3-lug) are used for the physical connection (see Figure 4-17).

4.10.5 Model D22

The signaling used on this interface is RS-422A. A standard 37-position, D-type female connector (DC-37) is used as the physical connection (refer to Table 4-V).

4.10.6 Model D88

The signaling used on this interface is Mil-Std 188-114C. A standard 37-position, D-type female connector (DC-37) is used as the physical connection (refer to Table 4-V).

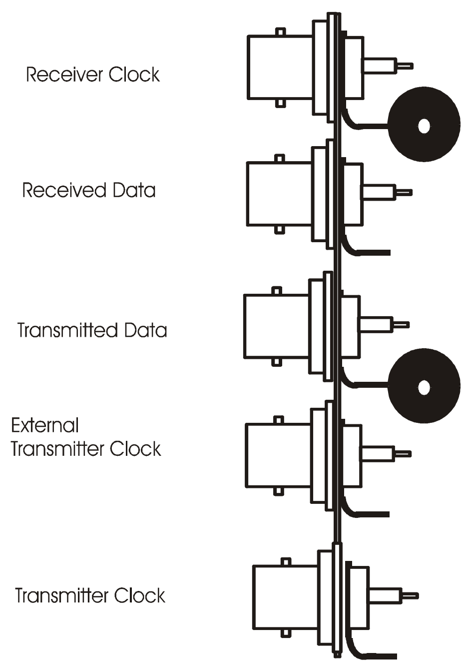


Figure 4-17.
Five TwinAx
Connectors
(BJ-77, 3-Lug)

SIGNAL	DC-37 PIN NUMBERS *
SCR (A)	17
SCR (B)	35
RXD (A)	15
RXD (B)	33
TXD (A)	9
TXD (B)	27
SCTE (A)	5
SCTE (B)	23
SCT (A)	3
SCT (B)	21
SIGNAL GROUND	19
FRAME GROUND	1

*NOTE: These pin assignments do not correspond to RS-449

Table 4-V. Models D22 and D88 Connector Pin Assignments

4.11 Interface Reconfiguration

Figure 4-18 illustrates how the interface circuit board fits into the larger main modem board opening.

A header-type connector is provided to connect the two circuit boards together. The interface board may be removed by loosening the two retaining screws and nuts, then pulling the board outward from its connector.

Once a replacement board is in position, the two flanged lock nuts and screws are secured with built-in flat washers above and below the board junctures.

It may be desirable to select a new data rate at this time using the front panel switches as outlined in Chapter 3 of this manual.

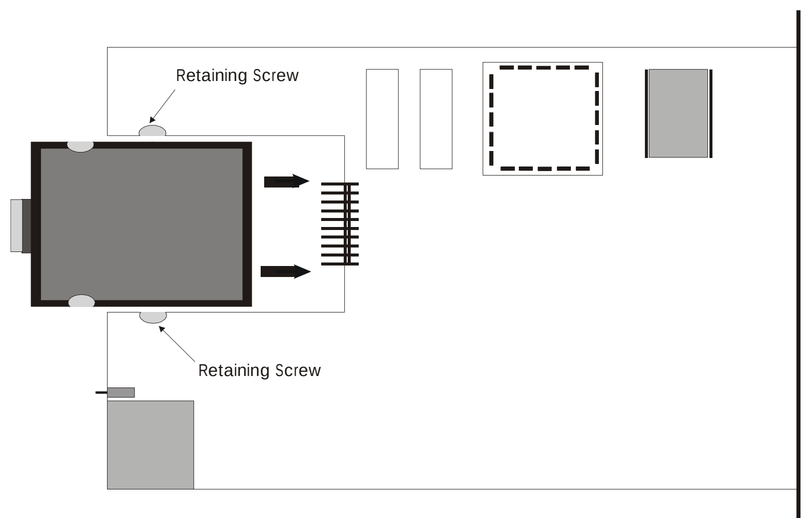


Figure 4-18.
Interface Card
Installation

4.12 Standalone Reconfiguration

To access the circuit board on a standalone unit, the enclosure cover must first be removed by loosening the six screws on the sides of the unit. Next, unplug the power supply connector from the PC board, and remove the two screws holding the rear panel in place.

The entire circuit board may now be removed by loosening the eight mounting screws. The interface board may now be changed as outlined in Section 4.11, "Interface Reconfiguration."

The rear panel supplied with the new interface must also be exchanged with the original rear panel. The unit may then be assembled in the reverse order of the disassembly.

5. Troubleshooting

5.1 Diagnostic Procedures

The following procedures are intended for use in the event of a system failure, not during the initial installation of a 2240 optical link. For initial installation checkout, refer to Section 1.7 of this manual. Also, refer to Section 6 for detailed diagnostics.

5.2 Local and Remote Loopback

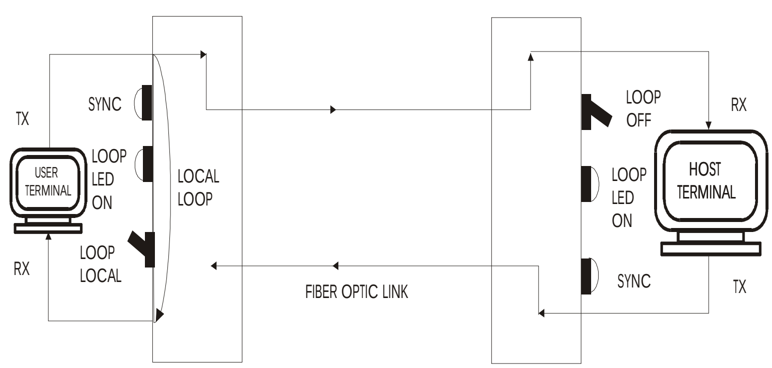
5.2.1 Loopback Tests

All 2240s have built-in Local and Remote Loopback. These tests can be used to verify the basic operation of a 2240 system.

The test modes can be activated by setting the Loopback switch on the front panel or by turning on the Local Loopback or Remote Loopback control leads in the electrical interface (supported interfaces only). See Section 4 for more information.

Whenever either modem has a Loopback selected, the Loop On indicators on both modems will be on and the DSR signal on the interface may be negated (check strapping of interface). Figure 5-1 shows a local loopback configuration.

Figure 5-1.
Local Loopback
from User-End
of Fiber Link



NOTE: Interface control of the loopback tests is only supported on the following modular interfaces: RS-423 / RS-232C, RS-449, RS-530 and V.35.

When activated, the Local Loopback test will cause all data transmission from the near end (local) user device to be looped back toward the receive of that same device. The data from the remote user device will not loop back (it will continue receiving data from the local device), but the Loop On indicator at the far end turns on.

The loopback point is set at the electrical interface of the local modem (see Figure 5-1).

NOTE: If the local loopback modem is operating in Mode 5 (slave clock mode), the remote device will receive garbled data because of the overall timing configuration. The local loopback will function correctly.

5.2.2 Remote Loopback Test

When activated, the Remote Loopback test will cause all data transmission from the near end (local) user device to be looped back after the optical sections of the remote device.

The data from the remote user device also loops back locally at the electrical interface. See Figure 5-2.

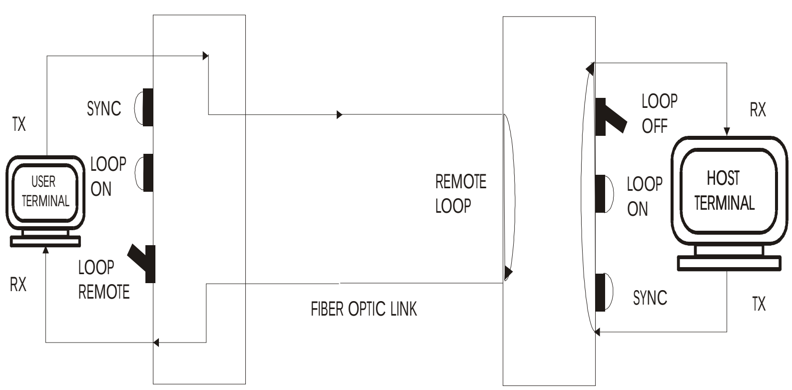


Figure 5-2.
Remote Loopback
from User-End
of Fiber Link

6. Diagnostic Procedures

6.1 2240 / 2201 Diagnostic Procedures

The following diagnostic procedures should be followed to test the 2240 system, troubleshoot a defective link or detect a defective fiber optic cable, connector, modem or power supply.

NOTE: Refer to the 2201 Rack Chassis / 2200R Redundant Modem Card User Manual for diagnostic procedures for the 2201 Rack Chassis and power supplies.

6.1.1 Required Equipment

1) Multimeter - for AC voltage, resistance and continuity tests
2) Fiber Optic Power Meter - should be calibrated atthe correct optical wave length with the appropriate optical connectors
3) A short (one meter or less) fiber optic jumper cable consistent with the modem optics under test, terminated with the appropriate connectors
4) A Bit Error Rate Tester (BERT) with the appropriate electrical interface and cable

Step	Symptom	Possible Cause(s)	Action
1	No power indicator on front panel(s)	No AC power	Check AC power source
2	No power indicator on front panel(s)	Defective modem	Replace Modem
	NOTE: Once any power system problems have been corrected, continue the system checkout after the Loopback Diagnostic Procedure.		

6.2 Loopback Test Diagnostic Procedure

Step	Symptom	Possible Cause(s)	Action
1	No Sync Indication.	Defective fiber optic modem(s), cable(s) or connectors. If the modems are configured for a tail circuit (one is externally locked and the other is slave), verify that the externally locked 2240 has a clock on its TT (or equivalent) leads that matches its rate switch.	Continue to the to the next step.
2	Verify the optical cable loss. Remove the Tx fiber from the modem. Use the optical power meter and fiber optic jumper cable to determine the optical launch power for this modem. Reconnect the Tx fiber to the modem. Remove the Rx fiber from the modem and determine the optical receive power into this modem. Reconnect the Rx fiber to the modem. Repeat the above step for the modem at the other end and record both optical power levels. Perform the following optical loss calculation: Near-end Receiver level *minus* far-end Transmit level = Near-end link loss figure. Far-end Receiver level *minus* near-end Transmit level = Far-end link loss figure. If the optical cable loss figure exceeds the optical link loss budget specified for the modem, set the optical launch power for the modem(s) to the high power setting and repeat the power measurements (refer to the "Specifications" section for appropriate loss budget figures). If the actual cable loss still exceeds the loss budget for the modem, go to Step 3. If the cable loss is within the specified loss budget for the modem, go to Step 5.		

Step	Symptom	Possible Cause(s)	Action
3	Cable loss exceeds modem loss budget.	Defective F/O cable	Repair or replace defective cable
4	Cable loss exceeds modem loss budget.	Defective Fiber Optic Connectors	Repolish or replace defective connector
5	Set the Remote Loopback switch on the near-end modem. Set up BERT tester for the proper clocking, data rate and format as used with the circuit. Use the existing interface cables if possible. Connect the BERT tester in place of the near-end user device. Run the BERT test and go to the next step.		
6	Loopback test passes but modems will not pass data.	Modem not configured properly	Verify / correct switch and strap settings on modem and devices
7	Loopback test passes but modems will not pass data.	Interface cables damaged or mis-wired.	Repair damaged or miswired cables
8	Optically loopback each modem and repeat BERT test as detailed in Step 5 of this procedure. Modem fails BERT test when optically looped back to itself.	Defective modem or electrical interface	Replace defective modem
9	Set the Local Loop-back switch on the near-end modem. Modem fails BERT when looped locally	Defective modem or electrical interface	Replace defective modem

6.3 Fiber Optic Diagnostic Procedure

If the Loopback Test is successful, and the modems still do not function, check the fiber optic parameters as outlined below. There also may be a data rate incompatibility. If this check out of the electrical and optical links provides no indication as to the problem, contact Canoga Perkins Installation and Repair Department for assistance.

NOTE: Each range limit has a +1dB margin at the transition point.

The following are some additional checkpoints to consider:

- **Fiber optics.**
  - **Are you using a fiber optic link of less than the High Power Loss Budget? (refer to Table 6-A)**

  Set the optical power switch to LO.
  - **Are you using a fiber optic link of more than the Low Power Loss Budget?(refer to Table 6-A)**

  Set the optical power switch to HI.
  - **Are the fiber optic cables marked correctly?**

  Connect Tx cable to Tx connector, Rx to the Rx connector.

  If Local and Remote Sync indicators do not come on, try swapping cables at one end of link.
  - **Is the data rate set correctly?**
  - **Are you using the correct clock mode (internal/external) for synchronous transmission or are you using asynchronous transmission?**

Model	Link Loss Range	
	HI Power	LO Power
850 nm Standard	>6 dB to Max	<6 dB
1310 nm HP Laser	>6 dB to Max	<6 dB
1550 nm HP Laser	>6 dB to Max	<6 dB
1310 nm LP Laser	–	–

Table 6-A.
Link Loss Range

NOTE: The 1310 nm LP Laser does not have a HI/LO power switch.

7. Specifications

7.1 Optical Interface

Composite Error Rate:	1 in 10^{10} or better
Fiber Optic Cable Compatibility:	50 and 62.5 micron Multimode or 8 to 10 micron Single Mode fiber
Transmitter:	LED (850nm) Laser diode (1310nm or 1550nm)
HI / LO Optical Power Switch:	Reduces transmit power to accommodate a zero loss link
Wavelength:	850, 1310 or 1550 nanometers
Fiber Optic Connector:	ST or FC type
Fiber Optic Receiver:	
850nm standard	PIN diode
1310nm Laser	PIN (InGaAs)
1550nm Laser	PIN (InGaAs)
Transmission Code	Biphase multiplexed
Typical Fiber Optic Link Loss Budget:	
850nm LED	15 dB with 62.5/125 mm fiber
1310nm LP Laser	13 dB with 8 or 10/125 sm fiber or 62.5/125 mm fiber
1310nm HP Laser	25 dB with 8 or 10/125 sm fiber or 62.5/125 mm fiber
1550nm HP Laser	25 dB with 8 or 10/125 sm fiber or 62.5/125 mm fiber

TYPICAL LAUNCH POWER AND Rx SENSITIVITY			
	LAUNCH POWER (dBm)		
OPTIC TYPE	HI	LO	Rx SENS. (dBm)
850 LED	-15±2	-20±4	-32
1310 LP LASER	-15±2	-15±2	-32
1310 / 1550 HP LASER	-5±1	-14±2	-32

Table 7-A.
Launch Power and
Rx Sensitivity

7.2 System Electrical

Interface Connector:

Interface	**Connector Type**
RS-232C / 423 / 530	female DB-25
Programmable RS-530 (P53)	female DB-25
RS-422 (422)	female DC-37
CCITT V.35 (V.36)	female 34-pin Winchester
TTL / BNC	four female BNC coaxial
RS-422, Mil-Std 188-114C	four or five female Twinaxial connectors, BJ-77 (3-lug)

Transparent T1 / E1 — female DA-15, two female BNCs or Terminal strip

Interfaces Supported:

RS-232D / RS-423
RS-449
CCITT V.35
TTL / BNC
Programmable RS-422 (P)
TwinAx 422
TwinAx MIL-STD-188-114C
DC-37 MIL-STD-188-114
Transparent T1 / E1
CCITT V.35 / RS-423 (MC2), RS-449 / 423 (MC1)
RS-530

Power Requirement:

Standalone	115 VAC +10% @ 0.22 Amps 115/230 VAC + 10% switchable @ 0.11 Amps ,47 to 63 Hz -48VDC; 0.5 Amps (max)
Rack Mount PC Card	18 VAC +10% @ 1.1 Amps per board 50 to 64 Hz

7.3 Indicators and Controls

Indicators (6):	Tx/Rx Data Activity; Local / Remote Sync; Loopback Active; Power On; Power Alarms (2201 Rack Only)
Controls (10):	Local / Remote Loopback Slide Switch; Operating Mode DIP Switch; Data Rate DIP Switch; Hi / Low Optic Power DIP Switch

7.4 Physical / Environmental:

Dimensions:	
2240-S Standalone	12.8" L x 8.5" W x 2.5" H
PC Card	12.5" L x 7.8" W x 1.06" H
Unit Weights [shipping]:	
2240-S Standalone	3.63 lbs
PC Card	0.9 lbs
Operating Environment:	
Temperature	0 to 50 ^{0}C
Humidity	0 to 95% (non-condensing)

7.5 2240 Fiber Optic Modem Configurations

2240-S-XXX-XX-XX-X S = STANDALONE
2240-R-XXX-XX-XX-0 R = RACKMOUNT

POWER OPTIONS

0 -	N/A
1 -	115V-AC WALL PLUG
2 -	115/230V IN-LINE
3 -	48VDC (Call Canoga Perkins for additional DC options)

CRYSTAL OPTIONS

00 -	NO CRYSTAL

The 2240 Fiber Optic Modem provides most standard clock rates with built in oscillators. If a non-standard internal clock rate is required, refer to Section 3.3, or call Canoga Perkins and ask for Applications Support.

FIBER OPTIONS MULTIMODE (STANDARD)

01 -	850nm LED ST
11 -	1310nm LASER ST
13 -	1310nm LASER FC
16 -	1310nm LP LASER ST
17 -	1310nm LP LASER FC

SINGLE MODE (STANDARD)

11 -	1310nm LASER ST
13 -	1310nm LASER FC
16 -	1310nm LP LASER ST
17 -	1310nm LP LASER FC
21 -	1550nm HP LASER ST
23 -	1550nm HP LASER FC

INTERFACE OPTIONS

	432	EIA 423 / EIA 232 / DB-25 w/ Control
	422	EIA 422 / DC-37 w/ Control
	430	EIA 530 / DB-25
	435	V.35 / MRC-34 w/ Control (Special Situations Only)
	436	V.35 / MRC-34 w/ Control
	4B1	1.544 / 2.048 T1 / E1 DA-15
	4B2	1.544 / 2.048 T1 / E1 / TERM STRIP
	4B3	1.544 / 2.048 T1 / E1 / BNC
	-BN	TTL / BNC
	-TW	422 / TWIN AX
	TW8	MIL 118-114A / TWIN AX
	T22	422 / 5 Conn TWIN AX
	T88	MIL 188-114A / 5 Conn TWIN AX
	D88	MIL 188-114A / DC-37
*	MC1	Multi-channel; (1) EIA 449 (DC-37), EIA 423 (DB-25)
*	MC2	Multi-channel; (1) V.35 (MRC-34), EIA 423 (DB-25)
* *	P53	Programmable 8 Bit Buffered Interface, EIA 530 / DB-25
	4PB	REDUNDANT PADDLE BOARD
	000	NO INTERFACE

* Includes Adapter, EIA 423 to EIA 366 ACE, Male to Female, DB-25 and Adapter, EIA 423 to EIA 366 DTE, Male to Female, DB-25.
* * Consult Factory Before Ordering to Confirm Configuration.

Note: RS prefix designations have been changed to EIA.
The EIA 232 and RS-232 are the same Part Number.

Appendix A

Limited Warranty

A.1 Products

Canoga Perkins warrants that, at the time of sale, its products will be free from defects in material and workmanship, and if properly installed and used will substantially conform to Canoga Perkins' published specifications. Subject to the conditions and limitations set forth below, Canoga Perkins will, at its opinion, either repair or replace any part of its product(s) that prove defective by use of improper worksmanship or materials. This warranty does not cover any damage to products that have been subjected to lightning damage or other Acts of Nature, misuse, neglect, accident, damage, improper installation or maintenance, or alteration or repair by anyone other thanCanoga Perkins or its authorized representative. Customer must notify Canoga Perkins promptly in writing of any claim based on warranty. Canoga Perkins is not liable for, and does not cover under warranty, any costs associated with service and/or the installation of its products of for any inspection, packig or labor costs in connection withreturn of goods. In the event Canoga Perkins breaches its obligation of warranty, customer sole and exclusive remedy is limited to replacement, repair, or credit of the purchase price, at Canoga Perkins' option.

A.2 Duration of Warranty

Three-year Warranty: This product is covered by this warranty for a period of three (3) years from the date of shipment.

A.3 Limitations

Canoga Perkins may at its sole discretion modify its Limited Warranty at any time and from time to time.

Other than those expressly stated herein, THERE ARE NO OTHER WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, AND SPECIFICALLY EXCLUDED BUT NOT BY WAY OF LIMITATION, ARE THE IMPLIED WARRANTIES FOR FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY. IT IS UNDERSTOOD AND AGREED CANOGA PERKINS' LIABILITY WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, IN NEGLIGENCE OR OTHERWISE SHALL NOT EXCEED THE AMOUNT OF THE PURCHASE PRICE PAID BY THE PURCHASER AND UNDER NO CIRCUMSTANCES SHALL CANOGA PERKINS BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES. THE PRICE STATED FOR THE EQUIPMENT IS A CONSIDERATION IN LIMITING CANOGA PERKINS' LIABILITY. NO ACTION, REGARDLESS OF FORM, ARISING OUT OF THE TRANSACTIONS OF THIS AGREEMENT MAY BE BROUGHT BY PURCHASER MORE THAN ONE YEAR AFTER THE CAUSE OF THE ACTION HAS ACCRUED. CANOGA

PERKINS' MAXIMUM LIABILITY SHALL NOT EXCEED AND CUSTOMER'S REMEDY IS LIMITED TO EITHER (i) REPAIR OR REPLACEMENT OF THE DEFECTIVE PART OF PRODUCT, OR AT CANOGA PERKINS' OPTION (ii) RETURN OF THE PRODUCT AND REFUND OF THE PURCHASE PRICE, AND SUCH REMEDY SHALL BE CUSTOMER'S ENTIRE AND EXCLUSIVE REMEDY.

A.4 Customer Service Department Repair Warranty

Repairs performed by the Canoga Perkins Customer Service Department will be free from defects in material and workmanship for a period of ninety (90) DAYS from the date the repaired product is shipped, or until the expiration of the original factory warranty, whichever is longer.

Shipping charges to Canoga Perkins will be at customer's expense. Units will be returned to the customer FOB origin. Repaired units will be returned to the customer by standard ground shipment unless otherwise specified, with any additional costs for customer specified expedited delivery at the customer’s expense.

A.5 Return Policy

Customer must obtain an RMA (Return Material Authorization) number from the Canoga Perkins Customer Service Department (818) 718-6300 prior to returning a product for service or repair.

If the product's warranty has expired, customer must provide the Canoga Perkins Customer Service Representative with a Purchase Order to authorize the repair.

Whenever possible, products should be returned in the original shipping carton or packaging with a description of the failure and results of any diagnostic testing included.