



User's Guide

for the

6410 with I.Q. / CSU-DSU

Digital Termination Unit



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The United States Government Federal Communications Commission has specified that the following notice be brought to the attention of users of this product:

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference with radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measure may be required to correct the interference. In order to ensure FCC compliance, only properly constructed, terminated, and shielded cabling should be used with this product.

NOTE:

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set forth in the radio interference regulations of the Canadian Department of Communications.

FCC REQUIRED INFORMATION

The following information is required for inclusion in this manual by the FCC:

This equipment complies with Part 68 of the FCC rules. On the bottom of the unit is a label that contains, among other information, the FCC registration number and ringer equivalence number (REN) for this equipment. If requested, this information must be provided to the telephone company.

This equipment uses the following USOC jack: **RJ48S**.

The REN is used to determine the quantity of devices, which may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total RENs contact the telephone company to determine the maximum REN for the calling area.

If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make the necessary modifications in order to maintain uninterrupted service.

If trouble is experienced with this equipment, please contact Raymar-Telenetics Labs at (800) 747-1522 for repair and (or) warranty information. If the trouble is causing harm to the telephone network, the telephone company may request that you remove the equipment from the network until the problem is resolved.

The following repairs can be done by the customer: none.

This equipment cannot be used on telephone company-provided coin service. Connection to Party Line Service is subject to state tariffs.

DOC CS-03
Requirements

NOTICE: The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, user should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

User should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: User should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

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ABOUT THIS MANUAL

This manual covers installation and operation of the 6410/CSU-DSU Digital Termination Unit (DTU). Designed for use in a Dataphone Digital Service (of DDS) network, this digital termination unit connects two remote locations together to form a wide area network. All DDS speeds are supported as well as speeds that may only appear in Limited Distance Modem (LDM) applications.

Conventions Used in This Manual

DTU Refers to a Digital Termination Unit. The DTU is the combination of a Channel Service Unit and a Data Service Unit in a single packaging.

CSU Refers to a Channel Service Unit.

DSU Refers to a Data Service Unit.

DDS Refers to a Dataphone Digital Service as originally created by AT&T. Many of the regional Bell operating companies and other common carriers have their own designation for DDS facilities.

UNIT Refers to the 6410 DTU.

DTE Refers to Data Terminal Equipment.

DCE Refers to Data Communications Equipment. A device that establishes, maintains, and terminates a data communications session and provides encoding or conversion if necessary.

TELCO Refers generically to any of the common carriers.

MARK A condition in which the TELCO line is transmitting or receiving an all ones signal.

SPACE A condition in which the TELCO line is transmitting or receiving an all zeros signal.

I.Q. Is an Raymar-Telenetics shorthand designation for Intelligent Quantitative Parametric Testing. I.Q. is also commonly used to connote a level of intelligence, implying that the 6410 is an intelligent CSU/DSU.

CHAPTER ONE – INTRODUCTION

The 6410 Multi-rate Line CSU-DSU is an advanced Channel Service Unit/Data Service Unit based on Digital Signal Processor technology. The 6410 is capable of operating in a point-to-point or multi-point environment on Dataphone Digital Service (DDS) as provided by the common carriers.

This manual provides all of the information needed to install, set-up, and operate a system of 6410 digital termination units. The 6410 is a multi-rate line digital termination unit that operates at all common speeds between 2,400bps and 64,000bps. The line speed and the DTE speed may be the same or may be different—speed matching. The 6410 supports asynchronous and synchronous operation.

Both V.35 and RS-232 line signaling and connectors are provided on the rear of the unit. Limited Distance Modem operation is also available on the 6410 with one unit configured with a master clock setting. At 56,000bps, depending upon wire gauge, the 6410 can operate error-free at up to a distance of ten miles.

The unit is also equipped with three touch pad switches, accessed from the front of the unit, to provide configuration, installation, and diagnostic assistance. An LCD display positioned adjacent to the touch pad switches provides a visual interface into the menu system of the 6410, as well as the operation of the unit.

A complete menu system is provided for the user to configure, test, and observe operation of the unit. The touch pad buttons—labeled Select, Advance, and Enter—allow for a simple manipulation of the 6410 through port and line settings, diagnostic testing, and selection of an operational display.

Among the operational displays are LED status simulations on the LCD front panel, as well as both port and line utilization statistics.

Speed matching is provided for all defined line speeds that have DTE port speeds that are less than or equal to the line speed for all common DTE speeds. One exception exists for 57,600bps asynchronous operation, which is supported on a 56,000bps DDS facility. In addition, synchronous as well as asynchronous character formats and timings are supported in both point-to-point and multi-point applications.

Electrical requirements are supplied by an external power transformer that accepts 117VAC and supplies 9VAC to the 6410. The electrical connection is therefore free from any dangerous voltages on the PC board itself. UL and CSA approvals exist for the power transformer separately from the unit. Alternatively, an LVDC (18 – 72 VDC) option or an HVDC (100 – 375 VDC) option is available.

When in actual operation, simulated LED indicators are provided on the LCD front panel display. From left to right they are In Service, Carrier Detect, Request to Send, Clear Send, Send Data, and Receive Data. In addition, two vertical columns of LEDs provide the same operational information whether or not the LCD display is currently displaying such information. A separate portion of the menu system provides access to diagnostic controls that include Self Test, digital Loop, Local Loop, Remote Loop, 2047 Pattern Generation and Receipt, and Line Analysis (also known as Intelligent Quantitative Parametric Testing).

Physical Description

The 6410 is a stand-alone unit that is used in a desktop configuration. The front panel is labeled appropriately so that the controls and indicators may be read from a normal viewing position. The unit is also available in a rack mount configuration—the 6410-R. This unit is identical to the desktop unit.

The case is powder coated aluminum and provides adequate electronic shielding from other nearby components. The front panel contains an LCD display, eight LED indicators, and three touch pad switches. The rear panel contains one DB-25 DTE connector for RS-232 devices (labeled Port 1), one M-34 DTE connector for V.35 devices (labeled V.35 Port 1), a power connection receptacle, and an RJ48S network connection receptacle.

Shipped with the unit are a straight through RJ48S male-male network interface connection cable, and a 9VAC, 1.5 amp power supply. The unit is a DCE device and only requires straight through cables for all DTE equipment. Cable diagrams are shown in **Appendix A**.

Physical Specifications

Regulatory Approvals: FCC Class A approved. UL, CSA approved. FCC Part 68 approved (1U5USA-74399-DE-N).

Connectors: One female M-34 Winchester for connection to V.35 DTE equipment, one female DB-25 for connection to RS-232 DTE equipment (only one may be used at a time), one female RJ48S for connection to the telephone network and one female power connector. All pinouts are given in **Appendix A**.

Storage Temperature: 0 to +70 C

Operating Temperature: 0 to +40 C

Power Requirements: 117VAC, 47-63Hz—external transformer

Approximate Weight: Seven pounds

Operating Humidity: Up to 95% non-condensing

Operating Air Pressure: 10,000 feet (3050 m) maximum altitude

Dimensions: 8.6" (W) x 8.4" (D) x 1.8" (H)

DTE Data Rates: 1,200, 2,400, 4,800, 9,600, 19,200, 38,400, 56,000, 57,600bps and 64,000 bits per second

Line Data Rates: 2,400, 4,800, 9,600, 19,200, 38,400, 56,000, and 72,000 (64,000 bps Clear Channel) bits per second

Character Format: Synchronous and asynchronous (eight or nine bits per character – does not include start and stop bits)

Receiver Sensitivity: 0 to –60dB for 56,000bps and 64,000bps operation

CHAPTER TWO – INSTALLATION

Unpacking

All CSU/DSU series products are shipped in corrugated cardboard boxes. Suitable packing material is used to insure that the unit, along with its power transformer and network connection cable, is secure during transport. Unpacking consists of opening the carton and removing the equipment. It is recommended that the packing material be retained should it ever be necessary to re-transport the equipment. After unpacking, all equipment should be inspected for damage or deficiencies. Any damage or deficiency should be immediately reported to Raymar-Telenetics customer service.

Inspection

When the initial inspection has been completed, the equipment should be identified and verified against the accompanying shipping documents. Each item should be checked for the correct model and serial number as indicated on the shipping list. The bottom of the unit chassis bears a label on which the unit's model, serial number, and certifications are printed. Any discrepancies should be immediately reported to Raymar-Telenetics.

If the carton containing the unit is obviously damaged by the shipping carrier, file a claim immediately, and then contact Raymar-Telenetics customer service for additional instructions and quick-check procedures for the damaged equipment. This procedure may allow warranty provisions to remain in effect.

Location Determination

It is recommended that a grounded 117VAC, 47-63 Hertz power receptacle be used. The power transformer provides a six-foot, two-conductor cable with the appropriate power connector for the unit. Be sure that the DTE cable is long enough to reach to the rear of the unit. Position the unit within a convenient distance from the DTE equipment and communications network interface that enables any cable to be connected without stretching or binding. Prior to configuration of the unit, it is optional whether to attach any cables to the unit.

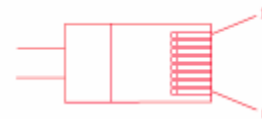
Primary Channel Connection

At the rear of the standard unit are one DB-25/RS-232 female connector and one M-34/V.35 female connector. **ONLY ONE OF THESE MAY BE USED AT A TIME!** Other options include RS232 & RS530, or a single RS232. These are for a DTE user connection to the unit. Each connector is configured as a DCE. Any DTE device connecting to a 6410 port should use a straight through cable. Cable lengths should be restricted to less than six feet for RS-232 connections and less than 50 feet for V.35 connections. Shielded cables should be used exclusively. Pin-outs for the various cables are shown in **Appendix A**.

RJ48S Network Connection

The communications Network Connection is a four-wire connection using an eight-wire connector—the RJ48S. This connector is designated by Bell Core as the proper termination for a DDS circuit. Typically, a common carrier will terminate the DDS circuit in a connector containing a female RJ48S receiver. Raymar-Telenetics supplies a straight through six-foot RJ48S cable with male connectors at each end. The network interface connection is made directly between the RJ48S female receiver on the rear of the unit and the female connector provided by the service provider. The female RJ48S connector, as viewed by looking directly at the rear of the unit, contains the pin designation number, 1 through 8, beginning with pin 1 at the left and ending with pin 8 at the right. With respect to the 6410 with I.Q., Pins 1 and 2 are the transmit pair. Pins 7 and 8 are the receive pair. Pins 3-6 are not used.

1 (Tip)	2 (Ring)	3	4	5	6	7 (Tip)	8 (Ring)
TX Pair		Not Used				RX Pair	



Dataphone Digital Service is tariffed in various geographical areas throughout the United States with slight variations. Inclusive of all geographical areas are speeds ranging from 2,400bps to 64,000bps. The 6410 supports all available speeds as tariffed by the various service providers. DDS is by definition a synchronous service. The 6410 provides both asynchronous and synchronous operation. Asynchronous DTE connections are converted to synchronous connections by the 6410, transmitted as synchronous data over the DDS link, and reconverted to asynchronous at the remote 6410 location.

Local loop lengths will vary depending upon proximity of the end user's location to the local service provider. The unit uses an automatic gain control system to compensate for various local loop lengths. The receiver range is 0 to -60dB at 56,000bps, which permits operation over long local loops (21,000 feet using 26-gauge wire). It should be noted that central office OCU's used by the service provider must also be capable of operation with this same receiver range in order for the unit to operate at this extended local loop distance.

Menu-Interface – LCD Display

The menu system is accessed through the LCD display using three pressure sensitive switches—Select, Advance, and Enter. The LCD display is a single line, 16-character position display.

Select

When depressed, this button places the unit in a non-operational mode at the top of the menu tree. The top of the menu tree is the Configuration option of the unit.

Advance

When depressed, this button displays the next option in a series of options. As an example, when in configuration mode, the Advance button displays the next line speed, port speed, async or sync, etc. When in operational mode, the next real-time operational mode is displayed (e.g. LED simulations, Line utilization statistics, and Port utilization statistics).

Enter

This switch accepts the option currently displayed in the LCD window and displays the next option in a series of options. The functionality is similar to the Advance button in that it displays an option, but differs in that the option is actually selected and used or executed (e.g. Enter immediately begins execution of a Digital Loop after being displayed by Advance).

CHAPTER THREE – OPERATION

Normal operational mode is achieved once the unit has been configured through its front panel LCD display, power is supplied by the external transformer, the network connection is made with the RJ48S cable, and the DTE device is attached via the M34/V.35 port or the DB25/RS-232 port. Normal operation is present when the front panel LCD display shows a simulated LED pattern with a solid In Svc “*”. This appears at the left most character position of the LCD display below the label **In Svc**.

LCD Front Panel Operation

The unit provides a front panel composed of a sixteen-character LCD display and three push buttons. Six simulated LEDs provide the operating status of the unit using a real-time update of an asterisk (*) character, which appears next to the IS, CD, RTS, CTS, SD, and RD indicators. Information provided by the LEDs is as follows:

IS	When on steady, indicates a correct (In Service) pattern from the TELCO is being received.
CD	When on, this indicates valid data is present on the DDS receive line pair. When off, it is either not In Service, the idle signal is being received, or no signal is present.
RTS	When on, this indicates RTS is present from the DTE or is being provided by the unit itself (RTS constant)
CTS	When on, this indicates that the unit is In Service and has a valid RTS signal from the remote DTE terminal.
SD	Flashes when DTE transmit data is present (a Space condition turns on LED).
RD	Flashes when DTE receive data is present (a Space condition turns on LED).

Run-time Operational Displays

The unit has three operational displays that may be selected during normal operation. When the unit first becomes operational, a lead status simulation as described above is shown on the LCD display. The center of the display reads “Comm” to indicate the composite leads are being displayed. Single depression of the Advance button switches the display to a Line utilization statistics display. This display shows the word “Line” in the center and gives a real-time updated display of the transmit and receive utilization from the Telco as a function of total capacity. This is displayed as a percentage. A second depression of the Advance button shows a “Port” utilization display. This is identical to the “Line” presentation in format, but reports DTE activity. A third depression of the Advance button returns the unit to the original “Comm” display.

LED Operational Display

In addition to the LCD operational display, two vertical columns of four LEDs are positioned on the left side of the front panel. Six of eight of these LEDs are duplicates of the LCD asterisk simulations, except that they are always visible. The top two are from left to right – Send Data and Receive Data. The second pair from the top is Request to Send and Clear to Send. The third pair from the top is Carrier Detect and Error. The bottom pair from left to right is In Service and Test. The descriptions of send data, receive data, request to send, clear to send, carrier detect and in service are the same as described in the LCD front panel operation.

The error (Err) LED has special operational characteristics. During normal operation the Err LED should be off. ***If errors are detected on the network interface, the Err LED is illuminated giving an indication to the user of the line condition.*** Any time during normal operation the Err LED is illuminated, this is a strong indication that serious line errors are taking place and requires telephone company correction of the problem.

The test (Test) LED provides information to the user that the 6410 is not in a normal operational condition. The Test LED is illuminated any time the unit is in a test mode whether initiated by the user or initiated by the telephone company (CSU or DSU loop tests).

Self Test

Self Test is entered by depressing the Select button once, the Advance button twice, then the Enter button twice (see **Page 27**).

Self Test causes the unit to internally connect its transmitter to its receiver. An internal pattern generator then begins outputting a known pattern of data, which is checked for accuracy as it is received back internally. During this process, the LCD displays Self Test Pend. Once the pattern has been received correctly for five to fifteen seconds (this varies with the speed selected for the unit), the LCD displays the message Self Test Pass. The message condition continues for as long as the unit correctly received the test pattern. A depression of the Select button ends the Self Test and places the unit at the Configuration menu level. Self Test may be initiated without having any network connection. It is recommended that the first test performed to validate the unit's operation is the Self Test.

Digital Loop

Digital Loop is entered by depressing the Select button once, the Advance button twice, the Enter button once, the Advance button once, then the Enter button once (see **Page 27**).

Digital Loop performs a bi-directional loopback at the main processor of the unit. All data arriving from the network is reflected back to the network; all data received from the port is reflected back to the port. Both reflections are simultaneous and independent. These reflections will time out after 5

minutes. A single depression of the Select button ends the Digital Loop and returns the unit to the Configuration menu level.

Local Loop

Local Loop is entered by depressing the Select button once, the Advance button twice, the Enter button once, the Advance button twice, then the Enter button once (see **Page 27**).

Local Loop performs a bi-directional loopback at the network interface connection of the unit. All data arriving from the network is reflected back to the network; all data received from the port is reflected back to the port. Both reflections are simultaneous and independent. These reflections will time out after 5 minutes. A single depression of the Select button ends the Local Loop and returns the unit to the Configuration menu level.

2047 Pattern Generator/Receiver

2047 Pattern Generator/Receiver mode is entered by depressing the Select button once, the Advance button twice, the Enter button once, the Advance button four times, then the Enter button once (see **Page 27**).

The 6410 in this mode generates a standard 2047 pattern and sends it to the network interface. This is useful for testing a network that is experiencing errors. Any standard test set or BERT may be used at the other end of the circuit to receive the 2047 pattern and check for errors. In addition, the 6410 in this mode will look for a 2047 pattern on the receive side of the network interface. If present, the “RX” will appear at the extreme right side of the LCD display. The display also shows an error counter which counts errors up to a total of 99. The error counter may be cleared to zero by depressing the “Enter” key. Errors may be inserted in the transmit pattern by depressing the “Advance” key. A single depression and release of the “Advance” key generates one error.

To select the 2047 Pattern Generator/Receiver mode, it is necessary to configure the 6410 for synchronous operation and line speed equal to port speed. Failure to configure the 6410 in this manner prior to selecting 2047 Pattern Generator/Receiver mode causes an Option Error 2 message to be displayed.

To terminate the 2047 Pattern Generator/Receiver mode, a single depression of the Select button returns the unit to the Configuration menu level. There is no automatic time out for 2047 mode.

Remote Loop

Remote Loop is entered by depressing the Select button once, the Advance button twice, the Enter button once, the Advance button three times, then the Enter button once (see **Page 27**).

This test is extremely useful in initial installations on new DDS circuits that are not frame relay. **If the pair of units do not pass the Rmt/Loop test, they will not pass data correctly from the DTE sources.** Raymar-Telenetics Technical Support will always verify with an end user that the units do or do not pass the Remote Loop test before proceeding to other correctional activities. Often times a Remote Loop test initiated from one end will operate in one direction but not the other. Under these circumstances it is easy to identify which pair of DDS wires (Transmit or Receive) is functional and which is not.

This test can be performed only between two Raymar-Telenetics 6410-IQ series CSU/DSU units. The initiating unit begins outputting a data pattern on its transmit pair to a remote unit. The remote unit observes the test pattern for five to fifteen seconds to determine whether or not the pattern is accurate and valid. If so, the remote unit displays the LCD message Remote Loop Pend and begins transmitting the same test pattern back to the originator. The originator observes the incoming data for the presence of a special test pattern of data. Once received for five to fifteen seconds, the originating unit changes its initial LCD message, Remote Loop Pend, to Remote Loop Pass.

Once this test is in operation, any bit errors detected by the originator or the remote unit will cause the LCD message to revert back to a Remote Loop Pend condition. This will continue as long as bit errors are detected. When the pattern is again received accurately, the Remote Loop Pass message is again displayed. This display will time-out after 5 minutes.

To terminate the Remote Loop test, a single depression of the Select button returns the unit to the Configuration menu level.

Line Analysis – The I.Q. System

The Line Analysis or IQ. system mode is entered by depressing the Select button once, the Advance button twice, the Enter button once, the Advance button five times, then the Enter button once (see **Page 27**).

The 6410 contains a unique system of testing called “Line Analysis”. This mode provides Intelligent Quantitative Parametric Testing of the network interface providing the user information about the receive line signal. Specifically, the line characteristics examined include attenuation, background noise, and impulse noise. See Chapter Four for complete details regarding this powerful line analysis tool.

To terminate the Line Analysis mode, a single depression of the Select button returns the unit to the Configuration level.

Front Panel Lock

To ensure that an operational condition is not accidentally interrupted, the 6410 has the facility to lock and unlock its front panel push buttons. This is accomplished by simultaneously depressing the Advance and Enter buttons while in operational mode and holding them for a period of five seconds.

At this point, the LCD display will show a “....Locked....” message. The unlock function is accomplished in exactly the same fashion; by depressing the Advance and Enter buttons for five seconds.

Factory Configuration

The Raymar-Telenetics 6410-IQ/CSU-DSU is shipped with a factory configuration of 56,000bps line, 56,000bps port, synchronous, slave clock, and RTS constant. At any time, this configuration may again be selected by simultaneously depressing all three push buttons while applying power to the unit.

Telco Central Office Loopbacks

The unit is constructed to perform the mandatory telephone company initiated loopbacks—CSU Loop and DSU Loop.

Telco CSU Loopback

The Telco CSU Loopback condition is initiated by the telephone company by performing a sealing current reversal on the DDS circuit. The unit senses this condition and initiates a uni-directional loopback at the network interface. While in this mode of operation, any data sent by the telephone company will be reflected back at the network interface. The unit displays the message Telco CSU Loop on the LCD front panel.

Telco DSU Loopback

The Telco DSU Loopback is initiated by the telephone company by performing a specific bi-polar code violation on the DDS circuit. The unit senses this condition and initiates a uni-directional loopback at the processor interface. While in this mode of operation, any data sent by the telephone company will be reflected back. The unit displays the message Telco DSU Loop on the LCD front panel.

Five Minute Timer

The unit employs an internal five-minute timer that monitors any user initiated test condition. After five minutes of being in a non-operational state other than the Telco CSU and DSU Loopbacks, 2047 Pattern Generator/Receiver, and Line Analysis, the unit automatically returns to a normal operating condition. This prevents the unit from accidentally being left in a test condition.

Flow Control

The unit supports several methods of flow control through the DDS network. Since the unit provides clear channel operation with absolute character transparency on all channels, all of the software flow controls defined for asynchronous operation are supported. The software flow control systems include but are not limited to XON/XOF, ENQ/ACK, ENQ/Anything, plus others.

Hardware flow control is also supported. This has been implemented through two common leads appearing on most synchronous and asynchronous systems—Request To Send (RTS) and Data Carrier Detect (DCD). When the unit is presented with an external RTS lead that is high, the remote unit raises its DCD lead. This also is true in reverse. For DTE systems requiring flow control, this is sufficient for normal operation.

Multi-Point Operation and Anti-Streaming

Multi-point environments are operational with this same technique described above – RTS raises the remote unit's DCD lead and vice-versa. The 6410 will operate in all defined multi-point environments including port speed equals line speed, rate adaptive, asynchronous and synchronous data formats. Note that 64k Clear Channel operation is not defined as a multi-point environment.

The 6410 supports, at the user option, an anti-streaming feature. Streaming is defined as an environment in which the DTE device raises its RTS lead and fails to lower it in a short amount of time. Such conditions result in a streaming condition in which the entire multi-point circuit ceases to operate. The 6410 may be configured to set a timer whenever RTS is raised by the DTE. If the timer expires before the DTE lowers its RTS lead, the 6410 automatically shuts the DTE down and resumes IDLE on the network allowing other DTE units in the multi-point to continue operation. In addition, for malfunctioning DTEs that persist in streaming, an anti-streaming count may also be selected by the user. If the count of streaming conditions equals or is greater than the selected count established by the user, the 6410 will take the failing DTE off line. Manual intervention is then required after the DTE is repaired to continue operation of the failing DTE location. This is done by re-initializing the 6410 or accomplishing a power cycle of the 6410.

Parameters for the anti-streaming timer include Off, 0.5, 1.0, and 6.5 seconds. Parameters for the anti-streaming occurrence counter include Off, 1, 10, and 50. Anti-streaming is only presented on the menu system if "RTS External" is selected, otherwise it is in an Off condition.

Limited Distance Modem Operation

The 6410 CSU/DSU units operate extremely well as Limited Distance Modems or LDMs. The connecting copper wire may be provided as private end user cabling or as un-loaded cabling from the local telephone company.

The distance that the unit may traverse depends on the wire gauge used along with the number of splice points that the wire may have, as well as the speed at which the units must operate. The following table is provided as reference information for an end user's decision as to the appropriateness for the unit to function properly in a given limited distance modem environment.

<i>NI Speed</i>	<i>24 Gauge Max Feet db Loss</i>	<i>Max Noise Feet and db Loss</i>
72,000bps	28K' (-61db)	20K' (-43db)
56,000bps	30K' (-62db)	22K' (-45db)
25,600bps	32K' (-55db)	24K' (-41db)
19,200bps	35K' (-55db)	26K' (-41db)
12,800bps	36K' (-49db)	29K' (-40db)
9,600bps	36K' (-44db)	31K' (-38db)
6,400bps	38K' (-40db)	35K' (-36db)
4,800bps	46K' (-42db)	42K' (-38db)
3,200bps	60K' (-46db)	45K' (-34db)
2,400bps	78K' (-52db)	52K' (-34db)

All measurements are taken with respect to 24-gauge wire. With 20-gauge wire, the above distances are approximately two times longer. With 26-gauge wire, the above distances are approximately 70% of the stated length. A network interface speed of 72,000bps corresponds to a Clear Channel 64,000bps circuit or a 56,000bps DDS II circuit. Where non-standard Network Interface speeds are shown above, these correspond to DDS II speeds. The "Max Feet" column indicates the maximum distance achieved by a Raymar-Telenetics 6410 with no noise present with its corresponding db attenuation loss. The "Max Noise Feet" column indicates the maximum distance achieved by a 6410 with the maximum allowable background and impulse noise present with its corresponding db attenuation loss.

Clock settings for LDM operation are unique. For normal DDS operation, the units are set to "Slave Clock." Timing is thus derived from the DDS network. For LDM operation, clock timing must be available from the units. This is accomplished by setting one of the two units to "Master Clock" and the other unit to "Slave Clock."

Error Messages

An error screen appears to indicate that the user has requested an option that is not available under the current configuration or needs some action taken before the selected option will become available. The screen appears as follows:

Option error #

The pound sign (#) is replaced with a number indicating the reason this screen was displayed and can be one of the following:

1. An attempt was made to run the 2047 Pattern Generator/Receiver while in async or rate adaptive mode.
2. The user has executed a sequence of events making it necessary to recalculate the gain setting before the requested option can be used. The gain is calculated each time the unit powers up or Enter is pressed from the Normal Mode menu screen.
3. An attempt was made to establish a link with the port speed set to a value greater than the link speed.

Normal Mode Initialization Display

After power is applied or when the Normal Mode menu screen option is selected, the unit begins testing the network interface signal to determine how much front-end gain is necessary. While this is being calculated, the LCD screen displays “Initializing...”

Once a normal “Com” asterisk display appears, the operation of the 6410 is commencing. A few more seconds are required for internal digital signal processing calculations to complete. If the “Select” key is depressed, the message “Please wait” is displayed. The entire time for all of this to occur is approximately 5-8 seconds.

Version Number Display

At the top level of the menu, “Configuration” is displayed. On the same level are various options including “Normal Mode”, “Diagnostics”, “Master/Slave Clock”, and finally “Version Number”. The Version Number is the current software revision level of code operating within the 6410. Customer Support personnel may request this version number while diagnosing a problem with the unit.

CHAPTER FOUR – LINE ANALYSIS

The 6410 is the first standard commercial CSU/DSU to be equipped with a diagnostic subsystem capable of doing a complete line analysis of the network interface. This function is termed Intelligent Quantitative Parametric Testing or **I.Q.** for short. I.Q. utilizes the Digital Signal Processing (DSP) power of the on-board DSP processor to perform measurements of line attenuation, noise, bi-polar violations, and actually provides a comparison of the signal quality as compared to the AT&T and RBOC line specifications. The end result is that a line is determined to be “in specification” or “out of specification”. If a DDS line is determined out of specification due to attenuation, background noise, or impulse noise, a simple LCD display provides easy to understand English messages indicating the problem.

6410 Line Analysis Setup

In order for the Line Analysis subsystem to perform properly, a signal must be present on the DDS circuit. Line Analysis was calibrated using a standard 2047 pattern and is required for I.Q. testing. The source for a 2047 pattern at the other end of a circuit may be the telephone company central office test board or another 6410 located at the other end of the circuit. If two 6410 units are placed at opposite ends of the same circuit, one can be placed in 2047 pattern generation mode to perform the testing. Optionally, the telephone company central office can generate the required 2047 pattern. Optionally, an external BERT may be used at the other end of the DDS circuit being tested.

Line Analysis Initiation

To initiate Line Analysis testing, the 6410 should be brought to a normal operating condition on the DDS circuit first. This is done by plugging the line into the RJ48S female connector on the rear of the unit and optionally pressing “Select” followed by “Advance” followed by “Enter”. Depending upon whether the DDS circuit is properly provisioned, the circuit may appear to operate correctly at this time. CSU and DSU central office loopbacks may be initiated as required for testing.

From a normal operating condition, to place the 6410 into Line Analysis mode, perform the following front panel button depressions: Select, Advance two times, Enter, Advance five times, Enter.

Step 1 – Network Interface Rate Calculation

Displayed on the front panel of the 6410 is the following message – “NI Rate Calc: XX”. The process of determining the rate or frequency of the network interface may take from as little as a few seconds to as much as one minute. There are ten possible DDS frequencies inclusive of both DDS I and DDS II speeds. The “XX” is a seconds counter indicating to the user that the rate calculation is actively under way. When complete, Line Analysis will present one of the following messages:

NI: DDS II 72.0K

NI: DDS I 56.0K

NI: DDS II 25.6K

NI: DDS I 19.2K

NI: DDS II 12.8K

NI: DDS I 9.6K

NI: DDS II 6.4K

NI: DDS I 4.8K

NI: DDS II 3.2K

NI: DDS I 2.4K

Note #1: Line Analysis cannot detect whether 64.0K Clear Channel DDS II is in use verses 56.0K DDS II. Both have the same network interface rate of 72.0K.

Note #2: Customer Service personnel have often spent days trying to determine why a specific DDS circuit does not work properly. Occasionally, the telephone company providing the service places an Office Channel Unit in service at the wrong speed or with/without a secondary channel (DDS I vs. DDS II). This can be detected and corrected at this time.

Step 2 – Attenuation Calculation

To view the attenuation calculation for the network interface press the “Advance” key. The 6410 Line Analysis subsystem now provides a calculation of attenuation of the network interface signal in db units. This calculation is accurate to within 0.5 db and is expressed as a negative value.

The 6410 displays the following signal attenuation message:

Sig: -XX.XXdb

Where XX.XX is a numeric value of the signal attenuation.

Note #3: Bellcore Specification TR 62310 indicates that the maximum attenuation for any DDS circuit should not be greater than -38.00db (72K through 9.6K) or -34.00db (6.4K through 2.4K) depending upon NI frequency. In practice, most Regional Bell Operating Companies (RBOCs) have selected a more stringent standard of -34.00db for all network interface frequencies. Line Analysis will provide attenuation readings in the range of 0.00db to approximately -60.00db .

Step 3 – Line Status Display

Press the “Advance” key to view the Line Status Display. The next step of Line Analysis is to declare a DDS circuit “In” or “out” of specification. This is shown in the following display:

Line: OK

Line: Bad Err:ABI

where –

A – Attenuation out of specification

B – Background noise out of specification

I – Impulse noise out of specification

If a line is in specification, the “OK” message is given. If out of specification, one or more of the letters “A”, “B”, or “I” will be present. The letter(s) present indicate the condition(s) which is causing the DDS line to be declared “Out Of Specification”. Again, the “Enter” key will reset the conditions causing a new calculation to be performed and displayed. The Step 3 display works in conjunction with Steps 4, 5, and 6.

Step 4 – Background Noise Display

To view the background noise display for the network interface, press the “Advance” key. In addition, the “Enter” key may be depressed to clear the 6410 of previous background noise calculations. Line Analysis provides a continuous calculation of noise that is present – both background and impulse. The maximum noise value is retained unless cleared by pressing the “Enter” key. One of the following displays will be shown:

Bkg: S/N Small

Bkg: S/N Large

Bkg: >>-XX.XXdBm

Bkg: <<-XX.XXdBm

Background noise is any combination of White Noise, Near-end Cross Talk, and Power Noise. A comparison of maximum background noise specifications given by Bellcore TR 62310 is presented as the XX.XX value. The XX.XX value varies depending upon the network interface frequency. The dynamic noise measurement taken from the line signal is either greater than or less than the specification value from 62310. If greater than the specification value, the line will be shown to be out of specification in Step 3. It is best to allow several minutes of calculation to allow the 6410 Line Analysis subsystem to detect the maximum background noise that is present on the network interface.

For very small attenuation circuits (0 to -10db), the signal to noise ratio is so strong in favor of the signal that even if a large amount of background noise were present, it would not affect operation on the DDS circuit. For such conditions the “S/N Large” message is displayed. In addition, for large attenuation circuits (>39.00db), the DDS circuit is already “Out Of Specification” and the measurement of background noise that is present may be of interest but of no value. When the noise measurement of highly attenuated circuits becomes too large, the “S/N Small” message is displayed.

Note #4: Due to the capability of many commercial CSU/DSUs including the 6410, many times a circuit **CAN** be out of specification and still operate error free. This is both a plus and a minus. The plus is that a circuit that is out of specification often operates without errors on some manufacturer’s CSU/DSU. The minus is that the telephone companies often declare a circuit in specification by merely operating a commercial CSU/DSU on the line before it is turned over to the user. **This is NOT a valid test of a circuit being in specification.**

Note #5: Bellcore Specification TR 62310 indicates that the maximum background noise allowable, that may be presented, varies by frequency of the network interface. An independent specification also exists for impulse noise. If both are present at the same time, background noise may encompass the impulse noise that may be present, or they may tend to be additive. With the additive condition, both background and impulse noise may be in specification but the combination of the two may show that one or both of the background/impulse noise limits are exceeded. Under such circumstances, the DDS line will be declared “Out Of Specification” in Step 3. A limitation of Bellcore TR 62310 is that it assumes that only one type of noise may be present on any given DDS circuit.

Step 5 – Impulse Noise Display

Press the “Advance” key to view the impulse noise display. By pressing the “Enter” key, previous noise calculations are discarded and new readings taken. Line analysis provides a constant calculation of noise that is present – both background and impulse. The maximum noise value is retained unless cleared by pressing the “Enter” key. One of the following displays will be shown:

Imp: S/N Small

Imp: S/N Large

Imp: >>-XX.XXdBm

Imp: <<-XX.XXdBm

Impulse noise is any noise event which occurs, disappears, and then reappears. For the purposes of Line Analysis, calibration was done with a pseudo random impulse noise source which on the average appeared every 200 millisecs and had a duration of 80 microsecs. The Bellcore TR 62310 specification indicates that no noise event will re-occur after it is present for 200 millisecs.

However, event timing may be as much as several minutes apart. For this reason, it is necessary to allow impulse noise calculations to continue for a number of minutes if a true reading of signal impulse noise is to be obtained. The 6410-IQ Line Analysis subsystem is intended to be operated for minutes up to a duration of hours or days, if necessary. Results are not cleared until the “Enter” key is depressed. If it is desirable on a problem circuit to allow overnight operation to detect noise, the 6410-IQ accommodates this environment. A comparison of maximum impulse noise specifications given by Bellcore TR 62310 is presented as the XX.XX value. The XX.XX value varies depending upon the network interface frequency. The dynamic noise measurement taken from the line signal is either greater than or less than the specification value. If greater than the specification value, the line will be shown to be out of specification in Step 3. As stated above, it is best to allow several minutes of calculation to allow the 6410-IQ Line Analysis subsystem to detect the maximum impulse noise that is present on the network interface.

For very small attenuation circuits (0 to -10.0db), the signal to noise ratio is so strong in favor of the signal that even if a large amount of impulse noise were present, it would not affect operation on the DDS circuit. For such conditions the “S/N Large” message is displayed. In addition, for large attenuation circuits (>-38.00db), the DDS circuit is already “Out Of Specification” and the measurement of impulse noise that is present may be of interest but of no value. When the noise measurement of highly attenuated circuits becomes too large, the “S/N Small” message is displayed.

Step 6 – Bi-Polar Violations Display

Press the “Advance” key to view the Bi-Polar Violations display. Bi-Polar violations that may be present are shown on the following display:

Vs: Z S D F C I E

where –

Z – Zero Violation

S – Out of Service Violation

D – DSU Loop Violation

F – Out of Frame Violation

C – CSU Loop Violation

I – Idle Violation

E – Error Violation

Although this dynamic display is cryptic in its information, it is extremely valuable in detecting errors which may be occurring on the received DDS signal. Depending upon the pattern of data which may be in use, there may be no violations present. If, however, the 2047 pseudo random pattern is present, a Zero violation is expected and should be present. Any of the violations may be present under normal circumstances with the exception of the Error Violation. Violation sequences sent to the 6410 Line Analysis subsystem that are not valid are declared an Error Violation. If errors are occurring on the received line signal, this display becomes “alive” with any or all violations occurring at the same time. The display updates every $\frac{1}{4}$ seconds and reflects violations that have occurred in the past $\frac{1}{4}$ second.

Step 7 – Loop Status Display

Press the “Advance” key to view the Loop Status Display. This final display in the Line Analysis series gives the Status of central office initiated CSU and DSU loops which may be present. The display appears as follows:

Loop Status: --

Loop Status: CSU

Loop Status: DSU

If no loop is present, the “—” message is shown. If a seal current reversal is present, the “CSU” message is shown. If a “DSU” loop is present, the “DSU” message is shown.

Note #6: In new DDS circuit installations, it is often useful to detect loops which may have been left in an “ON” condition by the Telco central office. In addition, if wiring is completed where transmit and receive are reversed, the “CSU” message will be displayed when it is not expected.

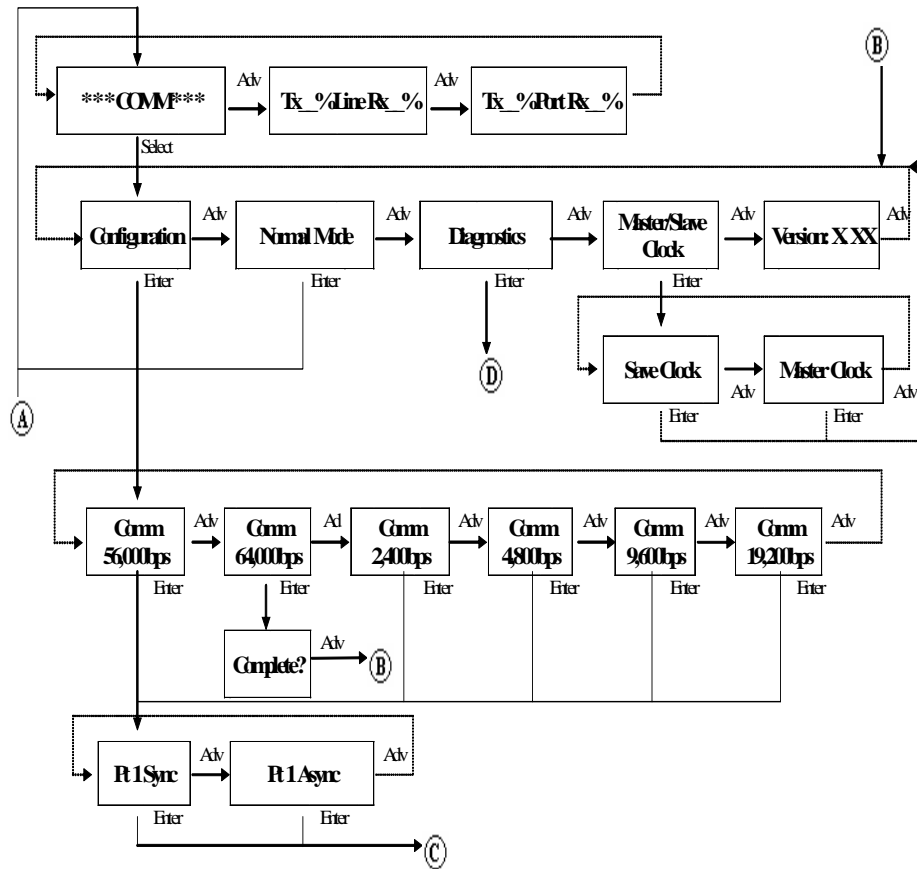
Note #7: A final comment. The 6410-IQ Line Analysis subsystem is always in a state of line loopback. Anything being received on the 6410-IQ receive pair will be reflected on the transmit pair. During Line Analysis, the Port of the 6410-IQ is **NOT ACTIVE**. No data is received or transmitted on the DTE connection.

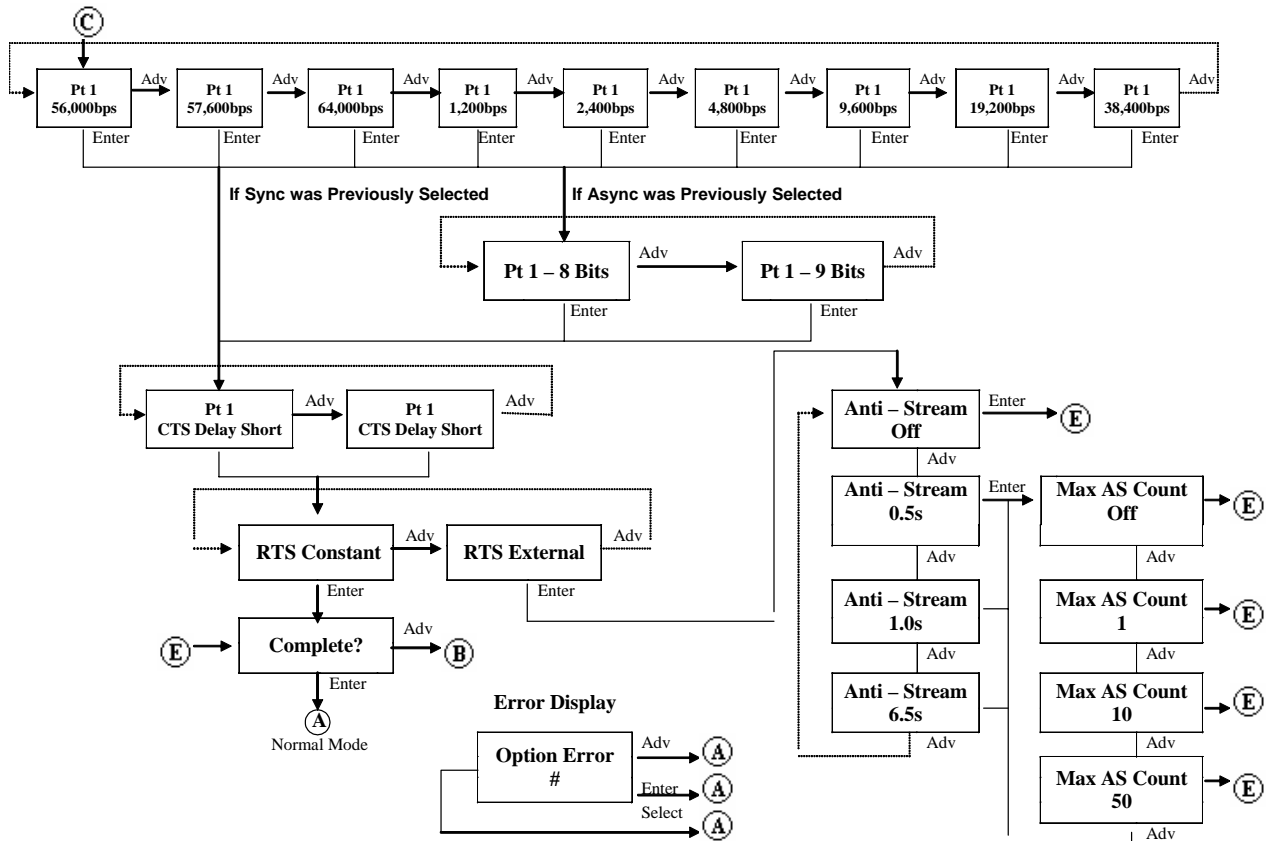
APPENDIX A – CABLE DIAGRAMS

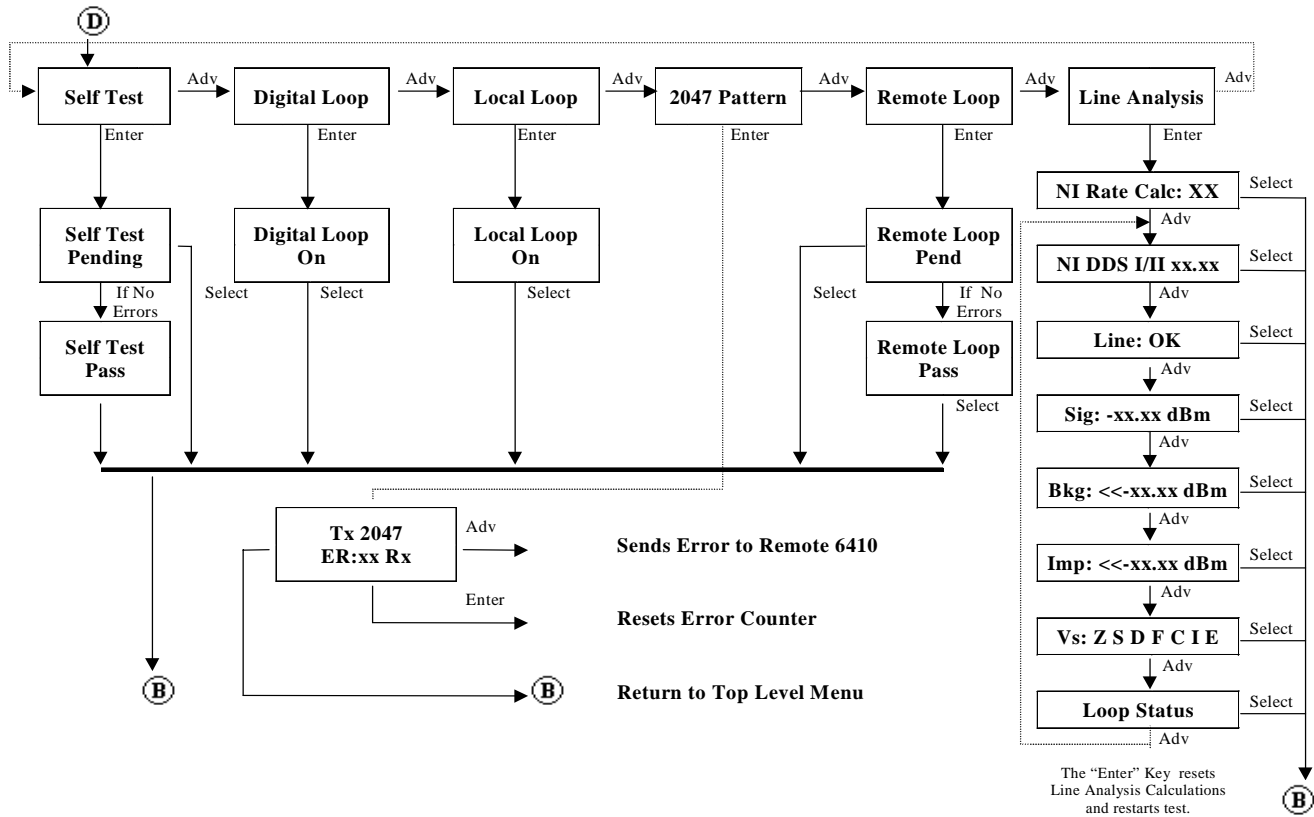
The DTE interface cable may be purchased from Raymar-Telenetics configured for V.35 or RS-232 signaling. In either case, special cables are required to make the connection between the primary channel of the unit and the data terminal equipment. These cables are wired as indicated in the two diagrams that follow.

Pin Definitions V.35	Designation	Source
B	Signal Ground	Both
A	Chassis Ground	N/C
C	Request to Send (RTS)	DTE
E	Data Set Ready (DSR)	6410
H	Data Terminal Ready (DTR)	N/C
D	Clear To Send (CTS)	6410
F	Data Carrier Detect (DCD)	6410
P	Transmit Data (A)	DTE
S	Transmit Data (B)	DTE
R	Receive Data (A)	6410
T	Receive Data (B)	6410
Y	Transmit Timing (A)	6410
AA	Transmit Timing (B)	6410
V	Receive Timing (A)	DTE
X	Receive Timing (B)	DTE

Pin Definitions RS-232	Description	Source
2	Transmit Data	DTE
3	Receive Data	6410
4	Request To Sent (RTS)	DTE
5	Clear To Send (CTS)	6410
6	Data Set Ready (DSR)	6410
7	Signal Ground	Both
8	Data Carrier Detect (DCD)	6410
15	Transmit Clock (Sync Only)	6410
17	Receive Clock (Sync Only)	6410
20	Data Terminal Ready (DTR)	DTE







Raymar Information Technology, Inc. Limited Warranty

One Year Limited Hardware Warranty

Raymar Information Technology, Inc., dba Raymar-Telenetics, warrants their products against defects in hardware, material and workmanship under normal use for one (1) year from the date of purchase. Raymar will, at no charge, either repair the product (with new or reconditioned parts), or replace it (with a new or reconditioned product). Repaired replacement products are warranted for either 90 days or the remainder of the original warranty period, whichever is longer. This warranty extends to the original end-user only.

What This Warranty Does Not Cover

This warranty does not cover: (a) software; (b) installation or service of the product; (c) conditions resulting from consumer damage such as improper maintenance or misuse, abuse, accident or alteration; (d) all plastic surfaces (including display screens) and all other exposed parts that are scratched or damaged due to normal use; (e) operation of our products with equipment not supplied by Raymar (f) products which have had the serial number removed or made illegible; or (g) products rented to others. This warranty applies only to hardware products manufactured by or for Raymar Information Technology, Inc. and identified by the Raymar-Telenetics trademark, trade name or product identification logo affixed to them. Refer to the Service and Support section of the User's Guide for service after the warranty expires. No warranty is made as to coverage availability or grade of service provided by the carrier.

General Provisions

This warranty sets forth Raymar's entire hardware responsibilities regarding this product. Repair, replacement or refund of the purchase price is at Raymar's discretion. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER EXPRESS WARRANTIES, IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ARE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY. IN NO EVENT SHALL RAYMAR BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS, OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THIS RAYMAR PRODUCT, TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW. WITHOUT LIMITING THE FOREGOING, RAYMAR SHALL HAVE NO LIABILITY FOR ANY DATA STORED IN OR USED WITH THE PRODUCT, INCLUDING THE RECOVERY COSTS OF SUCH DATA OR PROGRAMS.

State Law Rights

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS. THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU. This warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

Provincial Law Rights

SOME PROVINCIAL LAWS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF IMPLIED WARRANTIES, THE EXCLUSION OR LIMITATION OF WARRANTY COVERAGE IN CERTAIN SITUATIONS. SOME OF THE ABOVE LIMITATIONS OR EXCLUSIONS CONTAINED IN THIS LIMITED WARRANTY MAY NOT APPLY TO YOU. This warranty gives you specific rights, and you may have other rights which vary from province to province.

How To Use Raymar's Limited Warranty Service

To take advantage of this warranty, you must do the following:

- If you are having trouble with your product, contact Raymar service using the appropriate number from the Service and Support section of the User's Guide. If it is determined that your product requires service, you will be issued a Return Materials Authorization (RMA) form.
- Pack the defective product securely for shipping. Include only the units pre-approved by service on your RMA form.
- This warranty is void if the product is damaged in transit, you must insure your shipment.
- Ship the defective product, proof of date of purchase, and the RMA form to the address specified.
- Display your RMA number prominently on the outside of the shipping box. Customer is responsible for freight in, door to door. Raymar is responsible for return shipping costs.
- To ensure prompt service, please write on the RMA form a brief description of the problem you are experiencing with the product.

Raymar Information Technology, Inc.

7325 Roseville Road

Sacramento, CA 95842

Service Hotline (800) 747-1522

<http://support.telenetics.com> or e-mail to techsupport@raymarinc.com

Raymar Information Technology, Inc. Return Merchandise Authorization (RMA) Procedure

Before returning any Raymar-Telenetics product, an RMA number must be obtained.

The most convenient way to obtain an RMA number for a product purchased from Raymar-Telenetics is to call **1-800-747-1522**. When doing so, please have the following information ready:

- Company name
- Full billing address, as well as the address for the location where the product should be returned once repaired or replaced
- Telephone & Fax numbers
- Email address
- Product model number and serial number

For each item being returned, please include the product model number, the serial number, a description of the problem being encountered, and the cause of the problem (if known).

Please note that prior to authorizing a return, a product support specialist may call to verify that the product is properly installed or may ask you to perform tests to insure that the product has actually failed.

The product must be properly packed and returned to:

**Raymar-Telenetics
7325 Roseville Road
Sacramento, CA 95842**

The RMA number must be legibly displayed on the shipping carton. Raymar-Telenetics will not be responsible for any product returned without an RMA number.

If the product is out of warranty, estimates for repair rates and any applicable shipping costs will be communicated by a customer service representative. Currently, Raymar-Telenetics accepts purchase orders or credit cards as payment methods.

Repairs currently require 5 – 10 business days and are returned via UPS Ground.