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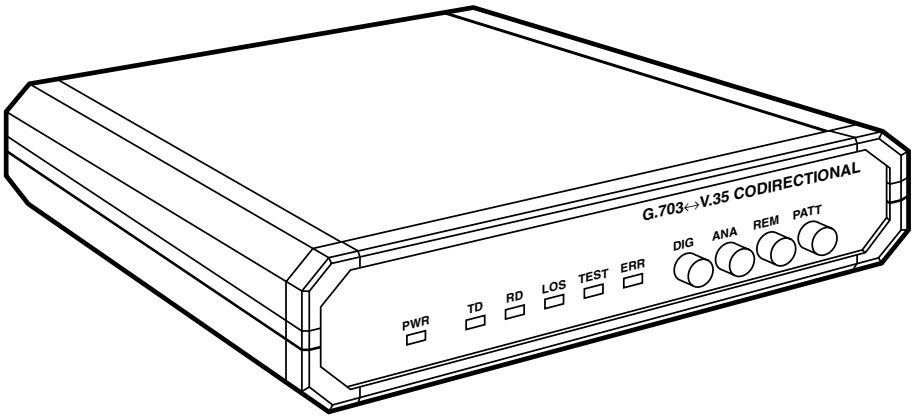
IC714A-X21-R2 IC714AE-X21-R2 IC714A-48-X21-R2

G.703 Codirectional Converter



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This equipment generates, uses, and can radiate radio-frequency energy, and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is 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 measures may be necessary to correct the interference.

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This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

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ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

    A: El cable de poder o el contacto ha sido dañado; u

    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

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SAFETY WARNING

Always observe standard safety precautions while installing, operating, or troubleshooting this product. To avoid the possibility of electrical shock, disconnect the unit's power cord from the power source before you remove the unit's cover.

TRADEMARKS USED IN THIS MANUAL

Any trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Contents

Contents (continued)

1. Specifications

1.1 G.703 Interface

Type — Codirectional 64-kbps

Line — 4-wire, 19- to 26-gauge

Range — Up to 800 meters (½ mile) over 24-gauge wire

Impedance — 120 ohms nominal

Balance — Greater than 45 dB (up to 256 kHz)
Greater than 35 dB (up to 384 kHz)

Return Loss — Less than 20 dB (up to 128 kHz)
Less than 14 dB (up to 384 kHz)

"Pulse" Amplitude — 1.0 V nominal

"Zero" Amplitude — 0 V ± 0.1 V max

Clock Frequency — 64 kHz

Frequency Tracking — ± 500 ppm

Connector — 5-screw terminal block

Jitter Performance — To G.823 requirements

1.2 Data Communications Interface

Type — Models with "-449" affix: EIA RS-530 adapted to EIA RS-449 (ITU-TSS V.11/V.36/EIA RS-422/423);
Models with "-530" affix: EIA RS-530;
Models with "-V35" affix: ITU-TSS V.35;
Models with "-X21" affix: ITU-TSS X.21/V.11

Data Rate — 64, 56, or 48 kbps, user-selectable

Spare Bandwidth — [at 56 or 48 kbps:] "1's" density bit stuffing as per ITU-TSS V.110; additional asynchronous channel at 1200 bps; or transfer of RTS to DCD control signal, end-to-end

Connector — Models with "-449" affix: DB25 female cabled to DB37 female;
Models with "-530" affix: DB25 female;
Models with "-V35" affix: 34-pin M-block female;
Models with "-X21" affix: DB15 female

1.3 Data-Communications Control Signals

Functional — *DCD, 64 kbps:* ON when Rx pair contains required violations, OFF when the Rx pair does not contain required violations;
DCD, 48 or 56 kbps: When the Rx pair contains the required violations, the DCD signal reflects the state of the remote RTS; DCD is always OFF when no violations are detected;
CTS output: ON after RTS ON, with delay; OFF when RTS OFF, or during Loss of Signal condition;
DSR output: ON (+V) when power is available

Clock Source — From G.703 Receive pair (LBT), from DCE (EXT), or from internal source (INT), user-selectable;
If LBT, three sub-options are user-selectable:
Unit is DCE and RC and TC signals are outputs from the unit to the local DTE (LBT-DTE);
RC signal is an output from the unit to the local DTE, but TC signal is an input from a tail-circuit DCE (LBT-DCE); or
X.21 only: Unit is DTE and RC and TC signals are both inputs to the unit from the local DCE (LBT-DCE21)

1.4 Other Physical Specifications

Compliance — EMI/RFI: FCC Part 15 Class A, DOC Class/MDC classe A
Safety: IEC 380

Standards — Diagnostics: ITU-TSS V.52 and V.54

Internal Memory — 32 bits of RAM divided into (2) independent 16-bit buffers

User Controls — (4) Front-mounted pushbuttons: Local Digital Loopback (DIG), Local Analog Loopback (ANA), Remote Digital Loopback (REM), and Test Pattern (PATT);
(5) Internal jumpers: Connect/disconnect grounds, clock source, LBT clock-signal derivation, data rate, and V.54 delay;
(1) Internal solder contact to connect grounds;
Loopback tests can also be triggered by interface signals from local DTE

Diagnostics — Local digital loopback; local analog loopback (V.54 Loop 3); remote digital loopback (V.54 Loop 2); 511-bit V.52 BERT; all user-initiated and user-terminated

Indicators — (6) Front-mounted LEDs: Power (PWR), Receive Data (RD), Transmit Data (TD), Loss of Signal (LOS), Test (TEST), and Error (ERR)

Power — IC714A models : Directly from outlet through detachable 6-ft. (1.8-m) power cord (included):
Optimal Input: 115 VAC, 60 Hz, 0.2 amps;
Input Ranges: 103.5 to 126.5 VAC, 47 to 63 Hz;
IC714AE models: Directly from outlet through detachable 6-ft. (1.8-m) power cord (included):
Optimal Input: 230 VAC, 50 Hz, 0.1 amps;
Input Ranges: 207 to 253 VAC, 47 to 63 Hz;

Power (cont'd) — IC714A-48 models: –48 VDC directly from source through detachable power cord (not included except for output-jack components);
All models: Consumption: 25 watts

Fuse — IC714A models: 0.2-amp;
IC714AE models: 0.1-amp;
IC714A-48 models: 250 V, 200 ma

Isolation Voltage — 1500 VAC between G.703 interface and each of these: data-communication interface, AC mains (transformer primary), and frame ground; also 1500 VAC betwen AC mains (transformer primary) and each of these: data-communication interface and frame ground
NOTE: This measurement was derived by testing for one minute.

Maximum Altitude — 8000 ft. (2348.4 m)

Temperature Tolerance — 32 to 122°F (0 to 50°C)

Humidity Tolerance — Up to 95% noncondensing

Enclosure — High-impact plastic

Size — 1.8"H x 7.6"W x 9.6"D (4.6 x 19.3 x 24.3 cm), but the unit's pushbuttons protrude up to 0.3" (66 mm) from the front panel and the connectors protrude up to 0.8" (1.9 cm) from the rear panel

Weight — Net: 3.7 lb (1.7 kg); Shipping: 6 lb. (2.7 kg)

2. Introduction

2.1 Functional Description

The G.703 Codirectional Converter converts the ITU-TSS (CCITT) G.703 codirectional (line) interface to standard data-communication interfaces. The Converter can perform two conversions:

- **Electrical Conversion —** from G.703 to ITU-TSS V.35, V.36/V.11 (EIA RS-449/422/423), X.21/V.11, or EIA RS-530.
- **Data-Rate Conversion —** from 64 kbps to 48 or 56 kbps, when required.

The electrical and rate conversions enable you to connect DCE devices to PCM transmission equipment.

Different models of the Converter have different interface connectors depending on which data-commu-nication interface they support:

- Models whose product codes in-clude "**-449**" support EIA RS-422/ 423/ITU-TSS V.11 signaling on the EIA RS-449/ITU-TSS V.36 physical interface. The interface connector mounted on these units is an RS-530 DB25 (see the next paragraph); an included adapter cable patches these to a 37-pin D-subminiature ("DB37") female interface connector.
- Models whose product codes include "**-530**" support the EIA RS-530 physical/electrical interface (with ITU-TSS V.11-compatible signal levels); they have a 25-pin D-subminiature ("DB25") female interface connector.
- Models whose product codes include "**-V35**" support the ITU-TSS V.35 physical/ electrical interface; they have a 34-pin M-block ("M/34") female interface connector.
- Models whose product codes include "**-X21**" support ITU-TSS V.11 signaling on the ITU-TSS X.21 physical interface; they have a 15-pin D-subminiature ("DB15") female interface connector.

Operating full-duplex at a transmission rate of 64 kbps, the Converter has a range of up to 800 meters (½ mile) from the PCM equipment. The unit's receive-timing source is the recovered clock from the CCITT G.703 receive pair. You can set a jumper to select any one of these transmit-timing sources:

- Recovered clock from the received pair;
- External timing from the data-communication (DTE) interface; or
- Internal timing (used only for testing and diagnostics).

Two internal 16-bit buffers accommodate the difference in clocking phase.

Figure 2-1 below shows a typical application of the G.703 Codirectional Converter.

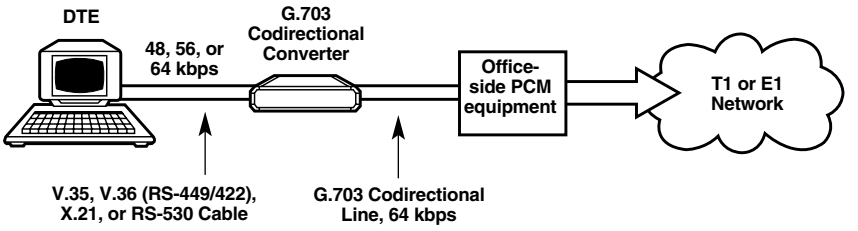


Figure 2-1. Typical G.703 Codirectional Converter application.

The Converter can act as a data-rate adapter, allowing you to connect DTEs running at 48 or 56 kbps to a 64-kbps G.703-interface line. At 48 or 56 kbps, depending on what you do or don't connect to the Converters' Request to Send and Carrier Detect leads, you can use the extra bandwidth in any of these ways:

- Nothing connected to Converter RTS (56 kbps only): To guarantee the satisfaction of the "ones density" requirement, by placing a "1" after every seven bits.
- Devices' RTS connected to Converters' RTS, and DCD to DCD: To pass a control signal (RTS/DCD) end-to-end.
- Async devices' Transmit Data to Converters' RTS, and Receive Data to CTS: As a 1200-bps asynchronous secondary channel for connecting additional DTE units over the same link.

You can use the Converter's front-panel LEDs to continuously monitor the main channel's activity and synchronization.

The Converter provides V.54 diagnostic capabilities with local digital and analog and remote digital loopbacks. All three loops can be activated by pressing front-panel pushbuttons; the latter two can be activated by raising the appropriate interface signal from the local DTE.

Another of the front-panel pushbuttons triggers an internal 511-bit pseudo-random V.52 test pattern for direct end-to-end integrity testing. The ERR LED flashes for each each error detected.

2.2 Timing Theory

2.2.1 CCITT G.703 Signaling

The CCITT G.703 codirectional signal is made up of two balanced signals: The **receive** and **transmit signals** carry timing and data information. The clock signal associated with each direction of transmission travels in the same direction as the data signal (see Figure 2-2 below).

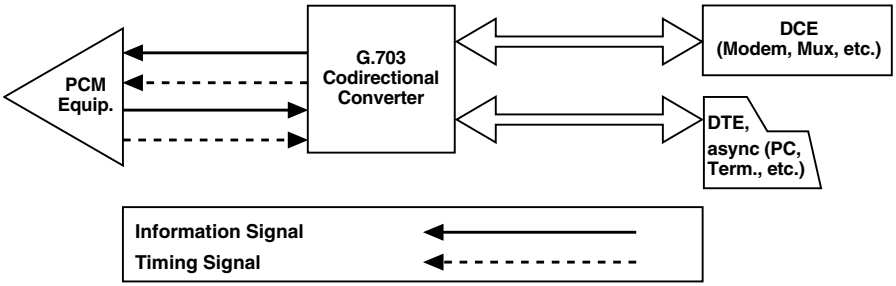


Figure 2-2. G.703 Codirectional Converter signaling.

2.2.2 G.703 Codirectional Timing

The G.703 Codirectional Converter can support virtually all timing options that you might need, as described and illustrated in this section.

G.703 Receive Timing Used for G.703 Transmit Timing
When G.703 receive timing is used for G.703 transmit timing, three timing options for the data-communication side, associated with the loopback timing (LBT) on the G.703 side, are available:

- Receive Clock and Transmit Clock are both outputs from the Converter, which serves as a DCE (see Figure 2-3 on the next page).
- X.21 interface only: Receive Clock and Transmit Clock are both inputs to the Converter, which serves as a DTE (see Figure 2-4 on the next page).
- Receive Clock is an output from the Converter, while Transmit Clock is an input to the Converter from an external DCE, for connection to a tail circuit (see Figure 2-5 on page 15).

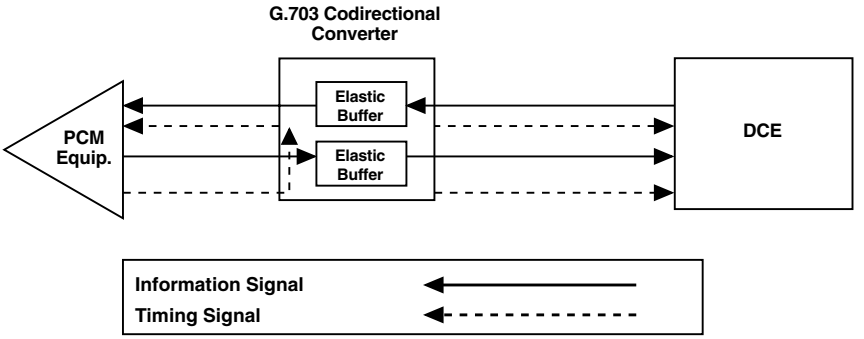


Figure 2-3. LBT-DTE Connection.

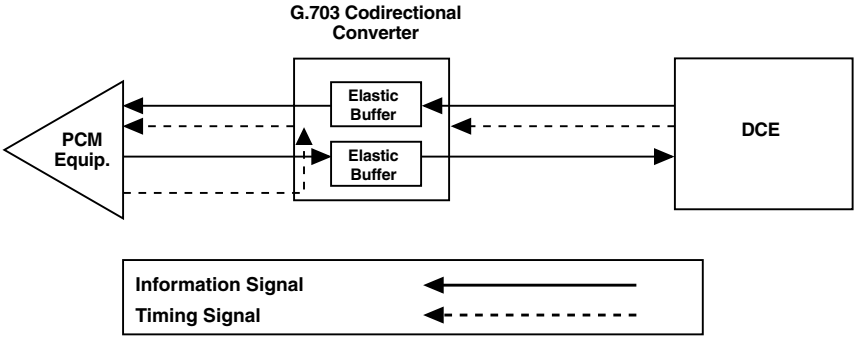


Figure 2-4. LBT-DCE21 Connection.

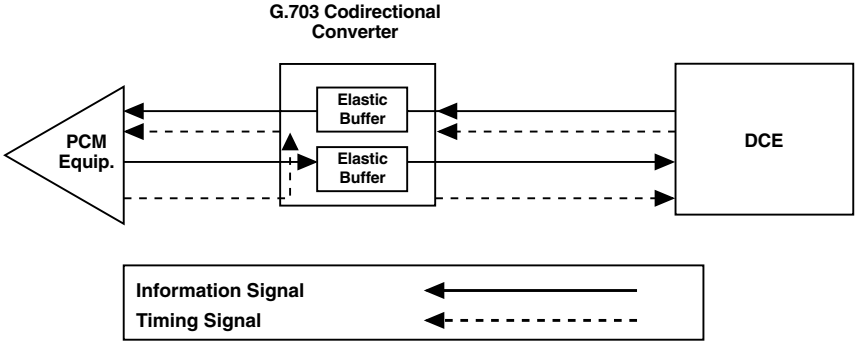


Figure 2-5. LBT-DCE Connection.

Transmit-Clock Timing Mode
When you use the external transmit clock on the data-communications side for G.703 transmit timing, there is complete independence, within the G.703 Codirectional Converter, between the receive and the transmit directions of transmission. Figure 2-6 on the next page shows this timing mode.

Internal-Clock Timing Mode
The Converter's internal oscillator is usually used as the source for G.703 transmit timing for testing purposes only, but can also be used with systems that do not have a clock source. Figure 2-7 on the next page shows this timing mode.

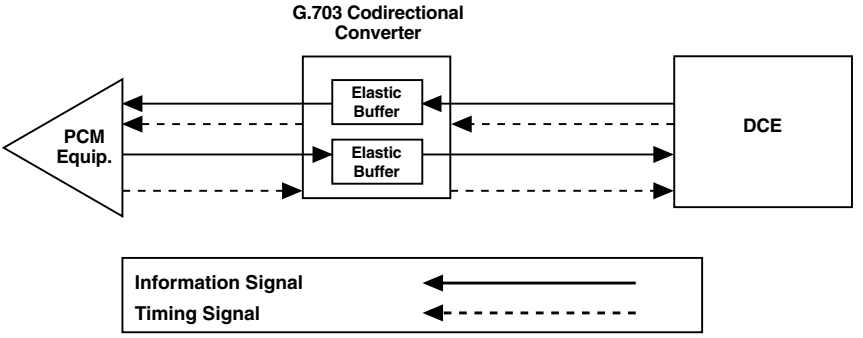


Figure 2-6. Transmit-Clock Timing Mode.

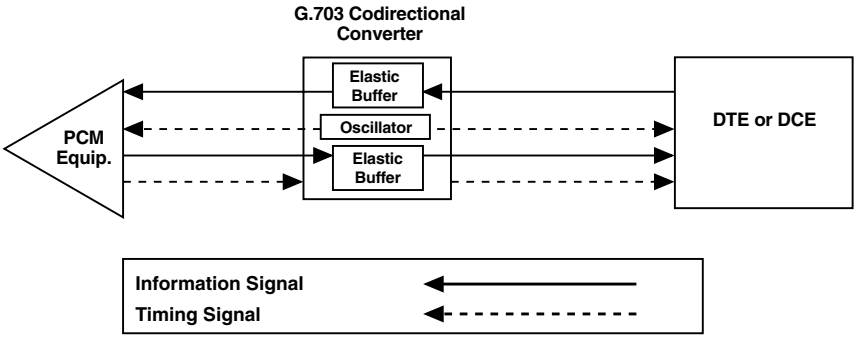


Figure 2-7. Internal-Clock Timing Mode.

2.2.3 Tail-End Clocking

Transmit clock from the external DCE source is provided for applications requiring the use of a modem in order to reach a remote DTE, as shown in Figure 2-8 on the next page (see Figures A-2, A-7, and A-10 in the **Appendix** for pinouts). Use the LBT-DCE-timing mode with the G.703 Codirectional Converter (see Figure 2-5 on page 15).

2.2.4 G.703 Codirectional Rules

G.703 codirectional signals, in each direction of transmission, are coded as follows: The composite timing/ data signal conveys the 64-KHz bit-timing information, the 8-KHz octet information (by introducing violations into the signal), and the 64-kbps data pattern.

- A binary one (64-kbps bit period) is coded as a block of the four bits "1100."
- A binary zero (64-kbps bit period) is coded as a block of the four bits "1010."

The binary signal is converted into a three-level signal by alternating the polarity of the blocks. The alternation of the polarity of the blocks is violated every eight blocks (see Figure 2-9 on the next page).

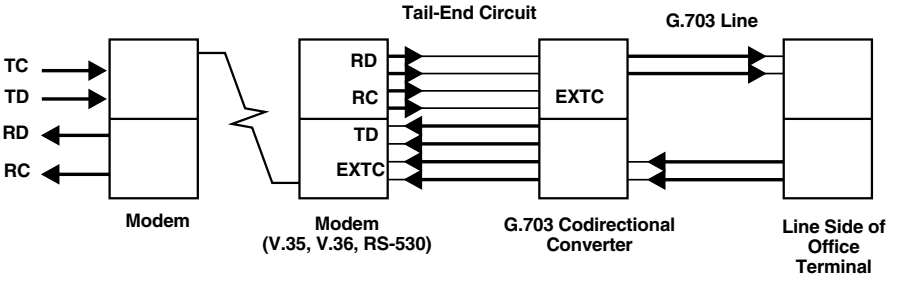


Figure 2-8. Tail-Circuit Application.

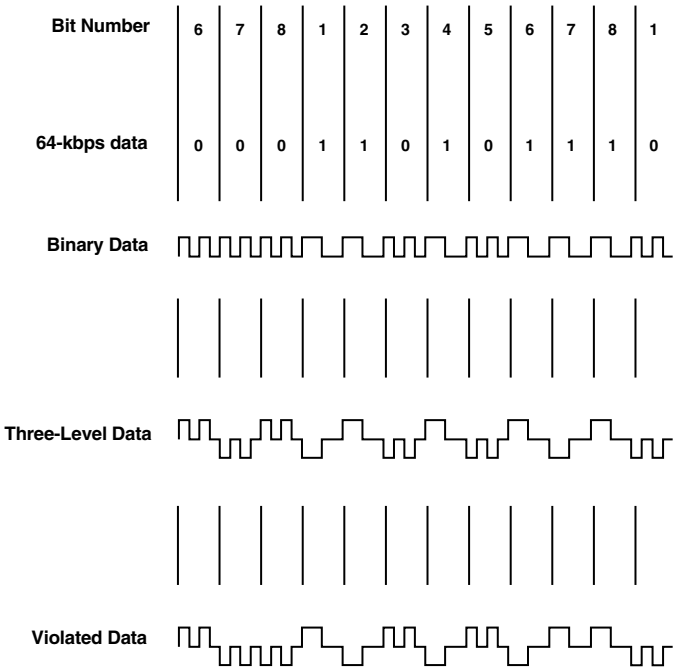


Figure 2-9. G.703 Code Conversion.

2.3 Rate-Conversion Rules

56-to-64-kbps conversion is performed by suppressing bit position number 8. This bit position coincides with the introduced violation (as shown in Figure 2-9), and thus suppressing it conforms to the requirements of ITU-TSS (CCITT) standard V.110 for 56- to 64-kbps rate conversion. The suppressed bit can be used for RTS-DCD end-to-end signalling or for a secondary async channel. North American T1 (1.544-Mbps) applications require that this bit position be set to a binary "1." You can do this easily by leaving the RTS pin open (not connected).

48-to-64-kbps conversion is performed by suppressing bit positions number 7 and 8. The suppressed bits are used in the same way as those suppressed for 56-to-64-kbps conversion.

2.4 Physical Description

The G.703 Codirectional Converter is a standalone unit. The unit is designed for installation on top of a bench or a shelf, but can also be mounted on a 19-inch rack with the proper adapter kit. One or two standalone units can be installed together.

3. Installation

This chapter shows you how to install the G.703 Codirectional Converter. After you complete the installation, refer to **Chapter 4** for operating information.

The AC-powered (IC714A and IC714AE) models of the G.703 Codirectional Converter are designed for placement on a shelf or bench, and come completely assembled. With a rackmount-adapter kit (not included—call for a quote), you can also install them in a 19-inch rack.

The DC-powered (IC714A-48) model of the G.703 Codirectional Converter is designed to operate from –48 VDC. With a rackmount adapter kit, these can also be installed in a 19-inch rack.

3.1 Unpacking

Unpack the equipment this way:

- Carefully take the G.703 Codirectional Converter out of the box it came in and place the Converter on a clean surface.
- Inspect the unit for damage. Immediately report any damage you find to your carrier and to Black Box.

3.2 Site Requirements

An AC-powered G.703 Codirectional Converter should be installed within 5 feet (1.5 m) of a grounded AC outlet capable of providing 230 or 115 volts. It must be situated within half a mile (800 m) of the PCM equipment.

A DC-powered G.703 Codirectional Converter should be installed near a grounded DC power source capable of providing –48 volts. It must be situated within half a mile (800 m) of the PCM equipment.

Make sure that there is at least 4 inches (10 cm) of clearance behind the G.703 Codirectional Converter for signal lines and interface cables.

3.3 Setting Jumpers

3.3.1 Overview

Prior to installing the G.703 Codirectional Converter, determine its configuration in the data system and set its jumpers accordingly. Refer to Table 3-1 on page 22. The diagrams in **Chapter 2** can help you identify the required jumper selection. Jumper locations on the printed circuit board are shown in Figure 3-1 on the next page. Read the instructions in **Section 3.3.2** before making any changes.

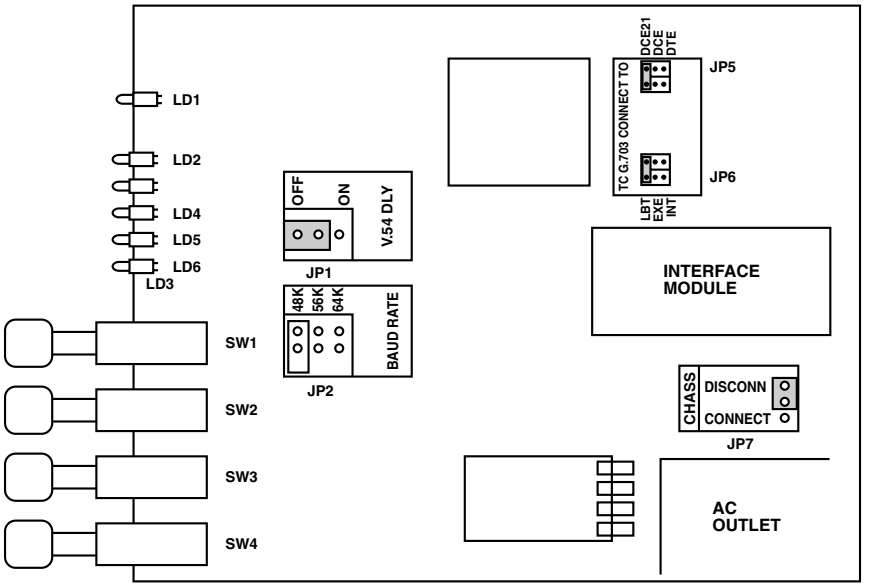


Figure 3-1. Board layout of the G.703 Codirectional Converter.

NOTES

Be aware that in the drawing above, the jumpers are exaggerated in size and other elements are minimized or deleted. For example, the JP1 jumper is in fact partially obscured by the interface module in the AC-powered models. Also, in both AC- and DC-powered models, the "JP1" label is partially or completely covered by material that helps secure the board to the rear panel.

There is also a second element labeled "JP1" on the interface module itself. Just like the other JP1, this element will also serve to connect chassis ground to signal ground, but it isn't a jumper. Rather, it is two contact points that can be soldered together to form a permanent connection. Be very certain that you will *always* want the grounds tied common before you solder these points together.

Table 3-1. Setting Jumpers

Jumper Identity	Factory Setting	Possible Position	Function
GND		Connect	Connect: Protective ground connected to signal ground.
	Disconn	Disconn	Disconn: Protective ground disconnected from signal ground.
TC G.703	LBT	LBT	The Tx-pair timing is the recovered clock from the CCITT G.703 Rx pair.
		EXT	The Tx-pair and transmit timing are from the RS-422/V.35 external source.
		INT	The Tx-pair and transmit timing are from the internal source.
LBT	DTE	DTE	Connection to DTE, with transmit and receive timing derived from the unit's recovered clock.
		DCE	Connection to DCE, while both the DCE and the unit operate with external transmit timing.
		DCE 21	Connection to X.21 DCE. The unit's transmit and receive timing are derived from the DCE.
BAUD RATE	64	64	Data rate is 64 kbps.
		56	Data rate is 56 kbps.
		48	Data rate is 48 kbps.
V.54 DLY	ON	ON	V.54 delay is active, preventing mutiple loopback on tail-end circuits.
		OFF	V.54 delay is not active.

3.3.2 The Jumper-Setting Procedure

CAUTION!

Disconnect the unit from the power line before removing it from its housing.

WARNING: HIGH VOLTAGE!

Any adjustment, mainten-ance, and repair of the open instrument under voltage should be avoided as much as possible, and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Capacitors inside the instrument may still be charged even after the instrument has been dis-connected from the power source.

To change the settings of any jumpers, perform the following steps:

- Disconnect the AC power cord from the AC mains outlet.
- Unscrew the two rear-panel screws until the rear panel becomes loose. This releases the unit's "drawer" mechanism; now you can pull the screws as if they were the knobs on a drawer and expose or remove the unit's circuit board.
- Identify the jumpers(s) (refer to Figure 3-1 on page 21).
- Move the jumper(s) to your desired position(s).
- Replace the circuit board and screw the rear-panel screws back in.

3.4 Installation in 19-inch Racks

3.4.1 Overview

The G.703 Codirectional Converter can be installed in 19-inch racks. It is 1U (1.75", 4.4 cm) high and is slightly less than half as wide as the available mounting area. Two rack-adapter kits are available: One kit provides the hardware necessary to install a single unit, and the other provides the hardware necessary to install two units side by side. **Sections 3.4.2** and **3.4.3** provide step-by-step instructions for installation of single or dual units.

CAUTION!

Disconnect the units from AC power while performing the following procedures.

3.4.2 Installing a Single Unit in a 19-inch Rack

The rack-adapter kit for single-unit installation includes one short bracket and one long bracket. The brackets are fastened with screws to the two side walls of the case, as shown in Figure 3-2 below.

To prepare the Converter for rack installation, attach the two brackets to the sides of the unit. Do this by inserting screws and flat washers into the two holes at the front of each side of the Converter (nuts are already in place inside the unit).

After attaching the brackets, install the unit in your 19-inch rack by fastening the brackets to the rack's side rails with four screws (not included in the kit), two on each side.

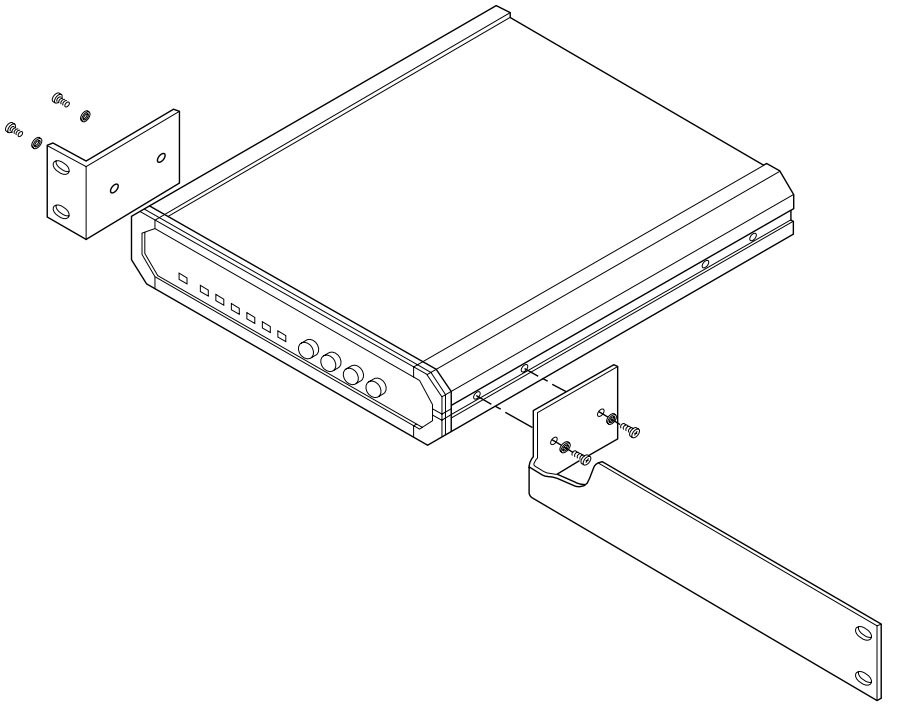


Figure 3-2. Installing a single unit in a 19-inch rack.

3.4.3 Installing Two Units in a 19-Inch Rack

The adapter kit includes two long side rails (one for each unit), which slide into each other to fasten the units together, and two short side brackets, which hold the two Converters side by side in a 19-inch rack. Refer to Figure 3-3 on the next page when you perform the following procedure:

1. Fasten one long side rail to each Converter—one rail on the right side of one unit, the other rail on the left side of the other unit—using the four included screws and flat washers. The rails must be attached so that they "oppose" each other: The narrow flange of the first rail must face the wide flange of the second rail.

2. Using four included screws and flatwashers for each bracket, attach the two short brackets to the vacant sides of the Converters.

3. Slide the two Converters' side rails into each other, fastening the two units together.

4. Secure the included plastic caps to the ends of the rails, to protect the rail ends and prevent the units from moving.

5. You can now use four screws (*not* supplied with the kit), two on each side, to fasten the assembled units to the side rails of the 19-inch rack.

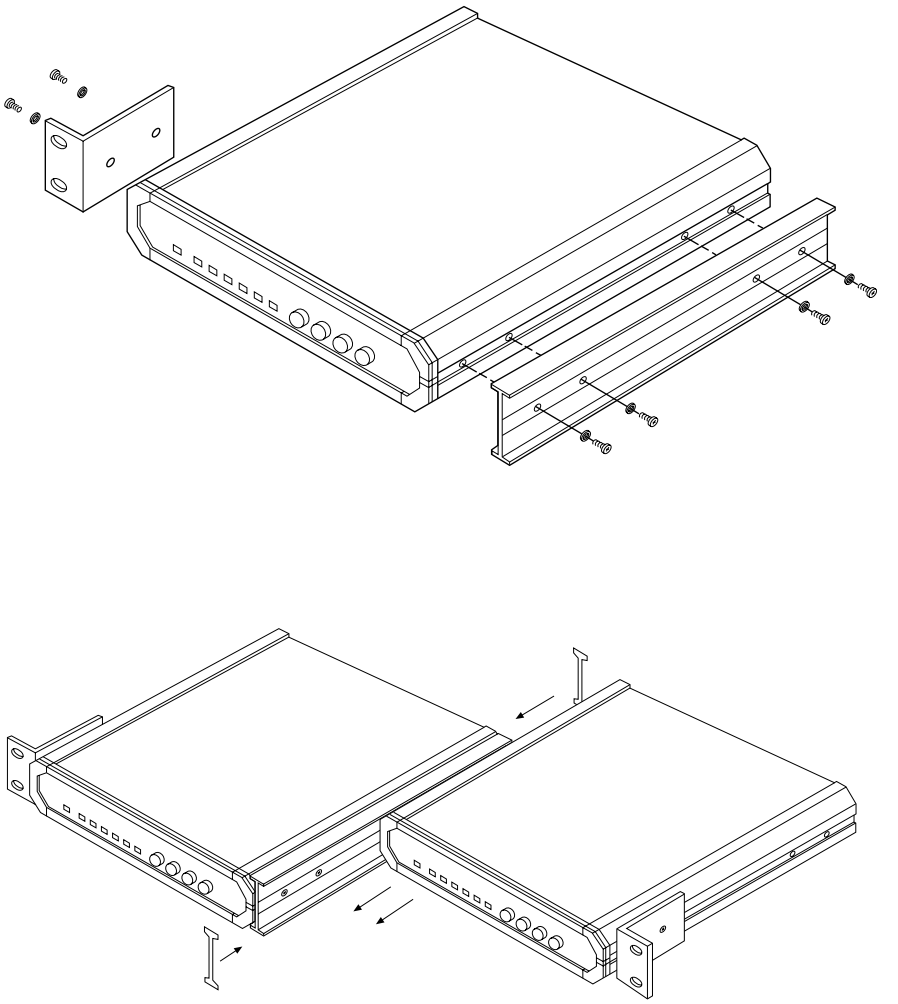


Figure 3-3. Installing two units in a 19-inch rack.

3.5 Connecting Power and Data Cables

After you set the G.703 Codirectional Converter's internal jumpers, the Converter is ready to be cabled for operation.

Its electrical connectors are located on its rear panel, as shown in Figures 3-4 and 3-5 below. These consist of a female interface connector labeled "DTE," a 5-screw terminal block," and a 3-prong AC or DC inlet. (The AC inlet also contains an integral fuse compartment.)

The interface connector (M/34, DB15, DB25, or DB25 cabled to DB37) carries input/output data, clock signals, and control signals between the Converter and the DCE (for more detailed information, refer to the **Appendix**).

The terminal block has five screws for connecting transmit and receive ITU-TSS (CCITT) G.703 lines—the transmit pair where XMT is indicated (for data output from the unit), the receive pair where RCV is indicated (for data input to the unit), and chassis ground where GND is indicated.

Connect power and data cables to the Converter as described in the following subsections.

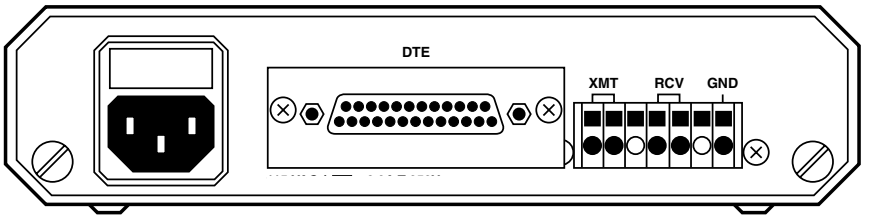


Figure 3-4. Rear panel of the 115-VAC (IC714A-530-R2) and 230-VAC (IC714AE-530-R2) RS-530 models of the Converter.

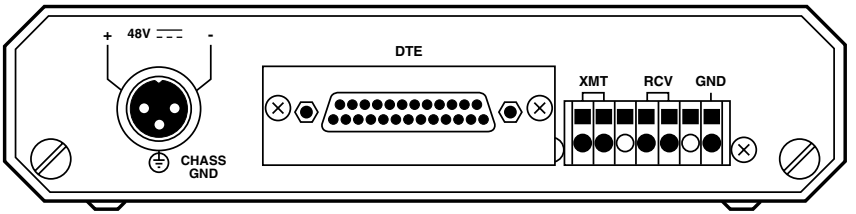


Figure 3-5. Rear panel of the –48-VDC RS-530 model of the G.703 Codirectional Converter (IC714A-48-530-R2).

3.5.1 Power Connection

The power connection provides AC or DC voltage to the Converter.

To make this connection on the 115-VAC (IC714A) models, first attach the IEC 320 female outlet of the included power cord to the IEC 320 male inlet on the Converter's rear panel.

To make this connection on the 230-VAC (IC714AE) models, first attach the IEC 320 female outlet of an appropriate power cord to the IEC 320 male inlet on the Converter's rear panel. (This power cord must have a plug on the other end that will fit the site's mains outlets.)

WARNING!

AC-POWERED MODELS: **BEFORE PLUGGING THIS UNIT INTO AN OUTLET OR OTHER LIVE POWER SOURCE, make sure its protective earth contact is connected to the protective conductor of the (mains) power cord. The mains plug must be inserted only in a socket outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective (grounding) conductor.**

If the Converter's fuse blows (opens), make sure that you replace it only with a fuse rated for the required amount of current. You must avoid using repaired fuses or short-circuiting the fuse holders. The fuse, and one replacement fuse, are located in the top part of the mains connector on the Converter's rear panel. The nominal current value of the fuse is 0.125 A for 230-VAC operation or 0.25 A for 115-VAC operation.

Whenever it is likely that the protection offered by the fuse has been impaired, the unit must be made inoperative and secured against any unintended operation.

To make this connection on the –48-VDC (IC714A-48) models, first attach the 3-pin DIN jack of an appropriate power cord to the 3-pin DIN plug on the Converter's rear panel. (Though an entire cord isn't included, we do include the components you'll need to assemble a 3-pin DIN jack that you can attach to a cord you build. For more information, consult standard reference works on cable assembly.)

After you have attached the power cord and have made sure that the cord is properly grounded, you can plug the power cord into a working mains outlet (AC models) or DC source (DC model).

CAUTION!

The unit has no power switch. It starts operating as soon as power of the proper type is applied to its POWER connector.

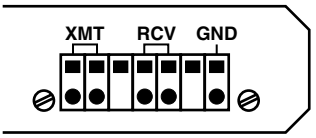
3.5.2 G.703 LINE Connection

The G.703 LINE connection provides an interface for the TX and RX signals between the Converter and G.703 line equipment. To make this connection, attach the wires from the line equipment to the terminal block on the Converter this way:

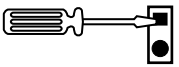
NOTE

There is no + or - XMT or RCV. The unit is auto-detecting and non-polarity sensitive.

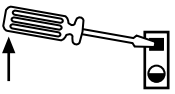
- XMT (line equipment) to RCV (Converter);
- XMT (line equipment) to RCV (Converter);
- RCV (line equipment) to XMT (Converter);
- RCV (line equipment) to XMT (Converter);
- Optional: Ground (line equipment) to ground (Converter—the rightmost terminal).



1) Insert screwdriver into square hole.



2) Raise inserted screwdriver, putting pressure on ramp inside square hole. Wire clamp in round hole will open.



3) Insert stripped end of wire and remove screwdriver.

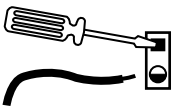


Figure 3-6. Wire-insertion details.

3.5.3 DTE Connection

The interface (DTE) connector pro-vides an interface for input/ output data, as well as clock and control signals, between the Converter and a DTE or DCE. For the most part, the different models have the type of connector appropriate for their designated interface: V.35 models have an M/34 female; RS-530 models have a DB25 female; and X.21 models have a DB15 female. On V.36/RS-449 models, the connector on the Converter is actually an RS-530 DB25 female, but you can attach the included adapter cable to patch this connector to a standard DB37 female. The pinouts of these connectors, of the RS-530-to-RS-449 adapter cable, and of cables you can run to DTE and DCEs, are listed in the **Appendix**.

To connect the Converter to a DTE or DCE, use an appropriate cable that is pinned correctly (straight-through for DTE, crossed for DCE—consult the **Appendix**). Run this cable from the other device to the Converter and attach it to the Converter's interface connector (or, on the V.36/RS-449 model, to the adapter cable's DB37 connector).

3.5.4 Async Secondary-Channel Connection

Non-X.21 models of the G.703 Codirectional Converter can support a 1200-bps async secondary channel when your main channel is operating at 56 or 48 kbps, but special T-cables are required. Call Black Box Technical Support for more information.

4. Operation and Troubleshooting

Besides giving operating instructions, this chapter describes the front-panel controls and LEDs and their functions, and tells you what to do if there is a problem with the unit.

4.1 Front-Panel Controls and LEDs

Six LEDs are visible through the front panel (see Figure 4-1 below). Each LED's function is described in Table 4-1 on the next page.

Four pushbuttons are available for activating diagnostic tests, as described in Table 4-1.

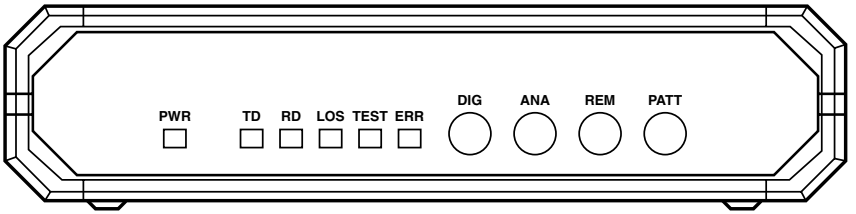


Figure 4-1. Front panel of the G.703 Codirectional Converter.

Table 4-1. Functions of LEDs and Controls.

Indicator/Control	Function
PWR (Green LED) Power	Lights when the unit is receiving power.
TD (Yellow LED) Transmit Data	Flickers when data is present at transmit input and goes off when a steady mark is present.
RD (Yellow LED) Receive Data	Flickers when data is present at receive output and goes off when a steady mark is present.
LOS (Red LED) Loss of Signal	Lights when the RX pair does not contain the violations required.
TEST (Red LED) Test	Lights when a loopback is performed.
ERR (Red LED)	Lights when errors are detected in the test pattern. Active only after PATT button is pressed.
DIG (Pushbutton)	Activates local digital loopback.
ANA (Pushbutton)	Activates local analog loopback.
REM (Pushbutton)	Activates remote digital loopback.
PATT (Pushbutton)	Activates V.52-compliant pattern test.

4.2 Operating Instructions

The G.703 Codirectional Converter operates unattended once it has been installed and powered up. Intervention is only required when the Converter is set up for the first time, when it must be adapted to new operational requirements, or when diagnostic loops are necessary.

4.2.1 Turn-On Procedure

The Converter is turned on as soon as power is connected. When power is connected, the PWR LED comes on and remains lit as long as the unit receives power.

If the LOS LED is ON, check the line and make sure it is connected properly.

The TEST LED is ON while any front-panel pushbutton is depressed, or when one of the loopback pins of the interface (DTE) connector is active.

4.2.2 Activating Loops

When performing tests, remember:

- Activation of a test loop interrupts normal traffic flow.
- Only one test may be activated at a time.

4.2.3 Turn-Off Procedure

The Converter can be turned off only by disconnecting its power.

NOTE

Always disconnect the power cord from the AC outlet before you disconnect it from the Converter.

4.3 Diagnostics

The G.703 Codirectional Converter provides local loopback and remote digital loopback in compliance with the V.54 standard. These loopbacks can be activated manually from the unit's front panel. On any of the data-communications (DTE) interfaces that the Converter supports except X.21, these loopbacks can also be activated electronically through the DTE connection. (X.21 was developed before V.54 and does not include provisions for electronic loopback control.)

The loop test buttons (DIG, ANA, and REM) and LEDs built into the Converter allow you to rapidly check the unit, the attached cables, and the attached DTEs. Use the test procedures described in this section to verify normal system operation and to isolate faulty equipment if a failure occurs. (Before testing the operation of the system equipment and line circuits, make sure that all devices are turned on and are properly configured.)

The Converter is also capable of operating opposite any 511 BERT tester. When you use one Converter opposite another, either with one or both PATT buttons depressed (see Figure 4-2 below) or with an external BERT transmitting the same V.52 (511-bit) pattern, you can test the complete link. To activate the BERT, depress the PATT button. The ERR LED will light momentarily, just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).

NOTE

While PATT is depressed, the data-communications interface is functionally disconnected.

4.3.1 The Modem Self-Test

To verify that the G.703 Codirectional Converter itself is operating correctly, initiate the modem self-test by depressing the PATT and ANA buttons (refer to Figure 4-3 on the next page):

1. Press ANA to start local analog loopback. The TEST LED should light.
2. Press PATT to begin test-pattern transmission. Verify that the TEST LED is still lit and that the ERR LED lights briefly.
3. If the ERR stays lit or continues to flicker after the initial flash, the Converter is faulty; call Black Box to arrange for repair or replacement. Otherwise, the Converter passes the test; restore all of the buttons to their normal positions.

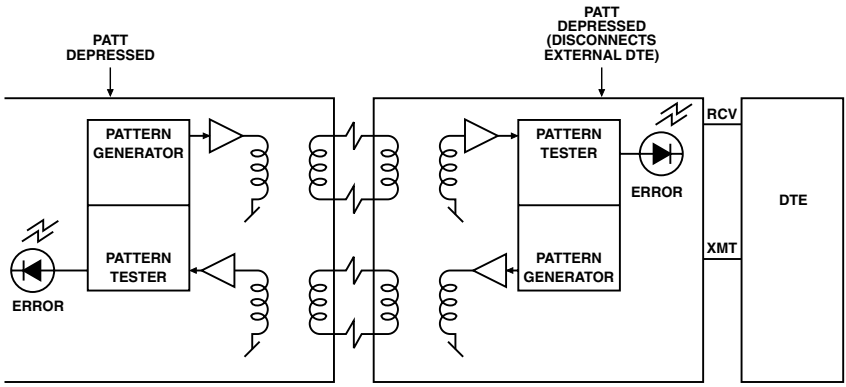


Figure 4-2. Two Converters doing end-to-end BERT.

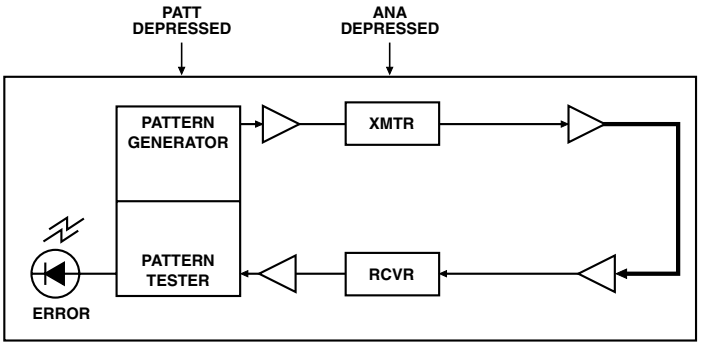


Figure 4-3. Modem self-test.

4.3.2 Local Analog Loopback

Activate the local analog loopback test by depressing the ANA button or by raising the level of the Local Loopback signal received by the Converter's DTE-side connector (on DB25 Pin 18 on the RS-530 models, M/34 Pin JJ on the V.35 models, or DB37 Pin 10 on the V.36/RS-449 models). This test checks the performance of the local Converter's modem, the local DTE, and the connections between them. Perform this test separately at the local and remote sites (refer to Figure 4-4 below):

1. Press ANA or raise Local Loopback to start local analog loopback. The TEST LED should light. The Converter's G.703 transmit output should be connected to its own receiver.

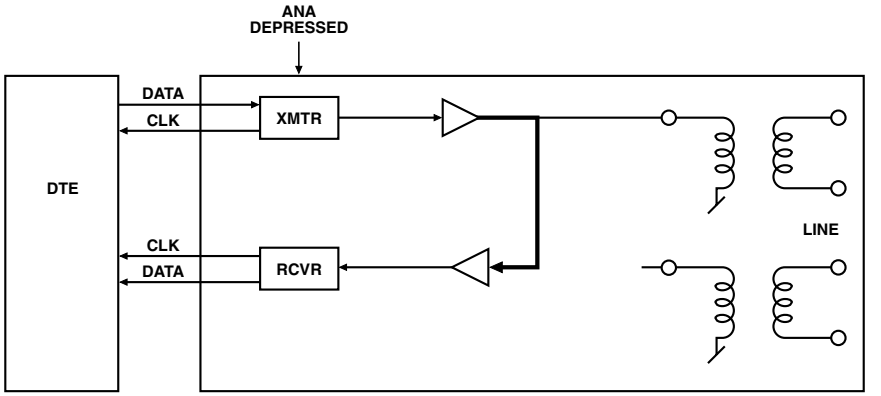


Figure 4-4. Local analog loopback.

2. Verify that the DTE is operating properly and can be used for a test.

3. Perform the test using one of these methods:

   - Send data from the DTE and check the echoed data stream.

   - Hook up an external Bit Error Rate Test (BERT) unit in place of the DTE.

   - Use the Converter's internal BERT. Press the PATT button.The ERR LED should light briefly just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).

4. Repeat Steps 1 through 3 at the remote site.

5. If the BERT tests show no errors, but the data echoed back to either DTE is bad, check the DTE and the cable connecting it to the Converter—one of them is faulty.

6. After the test is complete or the fault has been corrected, restore the ANA button to its normal position. Proceed with the digital loopback tests.

4.3.3 Remote Digital Loopback

Activate the remote digital loopback test by depressing the REM button or by raising the level of the Remote Loopback signal received by the Converter's DTE-side connector (on DB25 Pin 21 on the RS-530 models, M/34 Pin HH on the V.35 models, or DB37 Pin 14 on the V.36/RS-449 models). This test involves creating an outbound loopback at the remote Converter (see Figure 4-5 on the next page). The test checks the performance of the local and remote Converters and the lines between them:

1. Press REM or raise Remote Loopback; the local Converter will signal the remote unit to start remote digital loopback. The TEST LED should light on both units. The remote Converter's G.703 receive input should be connected to its own transmitter.

2. Perform a Bit Error Rate Test (BERT). Either:

   - Hook up an external Bit Error Rate Test (BERT) unit in place of the local DTE; or

   - Use the local Converter's internal BERT. Press the PATT button. The ERR LED should light briefly just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).

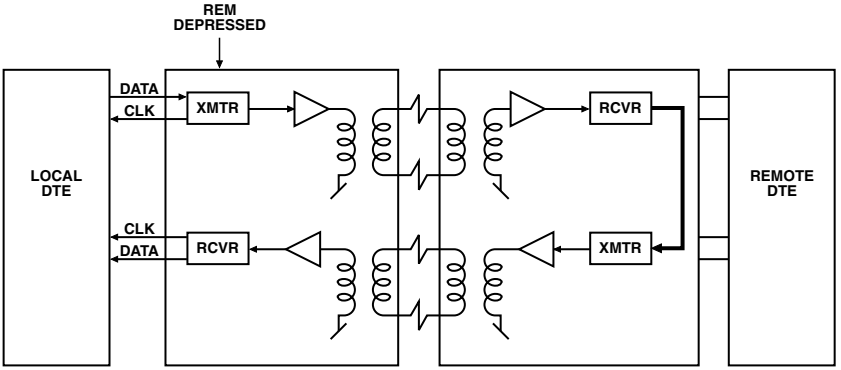


Figure 4-4. Remote digital loopback.

3. If the BERT test indicates a fault, but both Converters pass their modem self-tests (see **Section 4.3.1**), there is a problem somewhere in the communication line between the units.

4. After the test is complete or the fault has been corrected, restore the REM button to its normal position. Proceed with local digital loopback.

4.3.4 Local Digital Loopback

Activate the local digital loopback test by depressing the DIG button on the Converter's front panel. This test involves creating an outbound loopback at the local Converter (see Figure 4-5 on the next page). It works the same way as if the remote operator had initiated a remote digital loopback at the remote site. With this test, the remote operator can check the performance of the remote and local Converters and the lines between them:

1. Press DIG; the local Converter will signal the remote unit and will start local digital loopback. The TEST LED should light on both units. The local Converter's G.703 receive input should be connected to its own transmitter.

2. Perform a Bit Error Rate Test (BERT). Either:

   - Hook up an external BERT unit in place of the remote DTE; or

   - Use the remote Converter's internal BERT. Press the PATT button. The ERR LED should light briefly just to confirm that the LED is working, and then the test will proceed. If errors are detected, the ERR LED will be continuously lit (if the errors are continuous) or will blink (for intermittent errors).

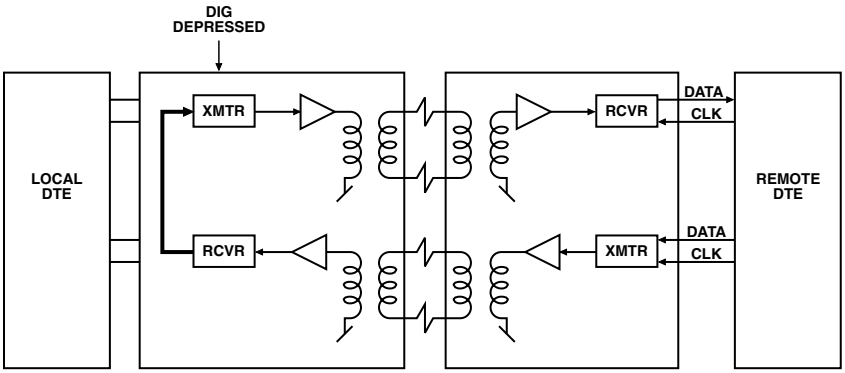


Figure 4-5. Local digital loopback.

3. If the BERT test indicates a fault, but both Converters pass their modem self-tests (see **Section 4.3.1**), there is a problem somewhere in the communication line between the units.

4. After the test is complete or the fault has been corrected, restore the DIG button to its normal position.

4.4 Calling Black Box

If you determine that your G.703 Codirectional Converter is malfunctioning, *do not attempt to alter or repair the unit.* It contains no user-serviceable parts. Contact Black Box Technical Support at (724) 746-5500; the problem might be solvable over the phone.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem.
- when the problem occurs.
- the components involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

4.5 Shipping and Packaging

If you need to transport or ship your G.703 Codirectional Converter:

- Package it carefully. We recommend that you use the original container.
- If you are shipping the Converter for repair, make sure you include its power cord and (for V.36/RS-449 models) the adapter cable you're using with it. If you are returning the Converter, make sure you include its manual as well. Before you ship, contact Black Box to get a Return Authorization (RA) number.

Appendix: Pinouts

Table A-1 lists the signals and leads supported by the four Converter DTE interfaces. Signals in different interfaces that are next to each other in this table are analogous (that is, they perform roughly the same functions). This means that the pinout of the RS-530-to-RS-449 adapter included with the RS-449 models is also shown in this table; the adapter cable connects the RS-530 leads/signals to the V.36/RS-449 leads/signals listed beside them.

Figures A-1 through A-8 show how cables connecting different equipment to the Converter's interface connector should be pinned.

Table A-1. Interface-Connector Pinouts

Signal Names		ITU-TSS Circuit	V.35 Pin	RS-530 Pin	V.36/ RS-449 Pin(s)	X.21 Pin	Description
Shield, Frame Ground (FGND), Protective Ground (PGND)		101	A	1	1	1	Chassis ground. Can be isolated from Signal Ground or tied to it.
Signal Ground (SGND, SG); V.36/RS-449 only: also Send Common (SC) and Receive Common (RC)		102	B	7	19, 20, 37	8	Common ground for signaling and for the DC power supply. Can be isolated from Shield or tied to it.
Send Data (SD), Transmitted Data (TD), Transmit (T)	A	103	P	2	4	2	Serial digital data from the DTE. The data transitions must occur on the rising edge of the transmit clock.
	B		S	14	22	9	
Receive(d) Data (RD), Receive (R)	A	104	R	3	6	4	Serial digital data sent to the DTE. The data transitions occur on the rising edge of the clock.
	B		T	16	24	11	
Request to Send (RTS, RS), Control (C)	A	105	C	4	7	3	The DTE raises this signal when it wants to send data through the Converter.
	B			19	25	10	

Table A-1 (continued). Interface-Connector Pinouts

Signal Names		ITU-TSS Circuit	V.35 Pin	RS-530 Pin	V.36/ RS-449 Pin(s)	X.21 Pin	Description
Clear to Send (CTS, CS)	A	106	D	5	9	—	Assuming it is ready to receive, the Converter raises this signal a few moments after sensing RTS.
	B			13	27	—	
Data Set Ready (DSR), DCE Ready (DCER), Data Mode (DM)	A	107	E	6	11	—	The Converter holds this signal high while the Converter is ON and is not in local or remote digital loopback.
	B			22	29	—	
Received Line Signal Detector (RLSD), Receiver Ready (RR), Indication (I); a.k.a. Data Carrier Detect (DCD)	A	109	F	8	13	5	The Converter holds this signal high, lowering it only if carrier is lost or DSRgoes low.
	B			10	31	12	
Serial Clock Transmit Ext. (SCTE), Terminal Timing (TT), T'mitter Signal Element Timing [DTE] (TSETT); a.k.a. External Clock (EXTC)	A	113	U	24	17	6*	An serial data-rate clock input to the Converter from a data source. Positive clock transitions must correspond to data transitions.
	B		W	11	35	13*	
Serial Clock T'mit (SCT), Send Timing (ST), T'mitter Signal Element Timing [DCE] (TSETC), Signal Elem. Timing (S); a.k.a. Transmit Clock (TC)	A	114	Y	15	5	6	A serial data-rate clock output from the Converter to a data source. Positive clock transitions correspond to data transitions.
	B		AA	12	23	13	

Table A-1 (continued). Interface-Connector Pinouts

Signal Names		ITU-TSS Circuit	V.35 Pin	RS-530 Pin	V.36/ RS-449 Pin(s)	X.21 Pin	Description
Serial Clock Rcv. (SCR), Rcv. Timing (RT), Rec'ver Signal Element Timing [DCE] (RSET); a.k.a. Rcv. Clock (TC)	A	115	V	17	8	—	A serial data-rate clock output from the Converter to a data sink. Positive clock transitions correspond to data transitions.
	B		X	9	26	—	
Local Analog Loopback (LL)		141	JJ	18	10	—	The DTE can raise this signal to the Converter to force it into local analog loopback (see **Section 4.3.2**).
Remote Digital Loopback (RL)		140	HH	21	14	—	The DTE can raise this signal to the Converter to force it into remote digital loopback (see **Section 4.3.3**).
Test Mode (TM)		142	KK	25	18	—	The Converter raises this signal to the DTE during any test mode.

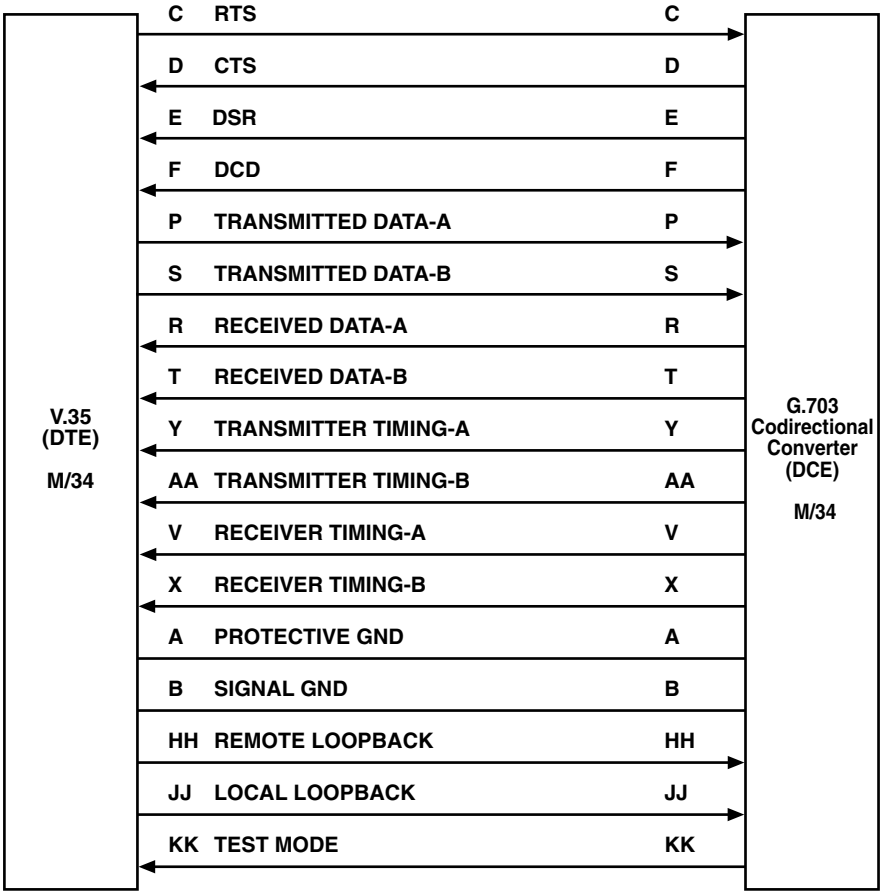


Figure A-1. Connecting a V.35 DTE to a V.35 Converter.

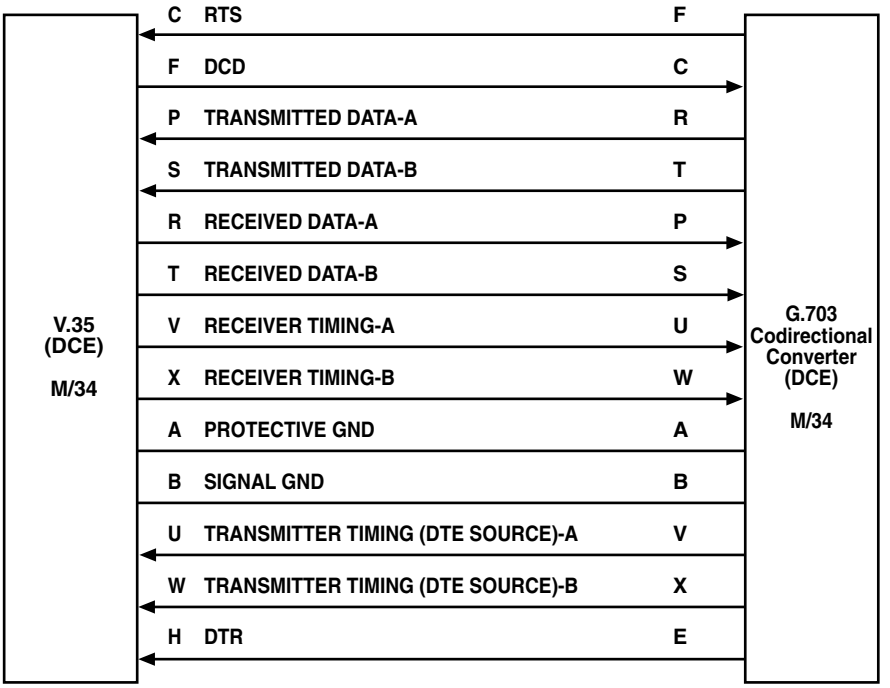


Figure A-2. Connecting a V.35 DCE to a V.35 Converter.

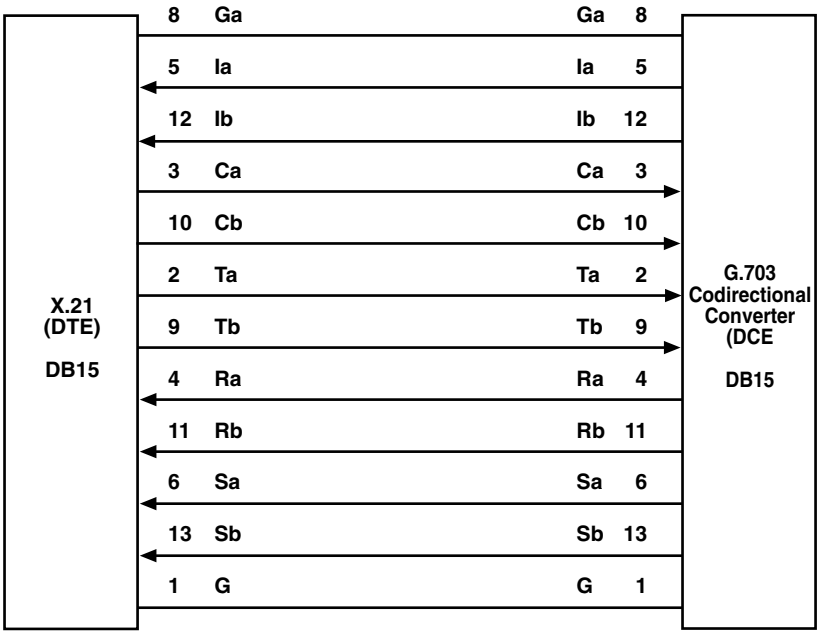


Figure A-3. Connecting an X.21 DTE to an X.21 Converter.

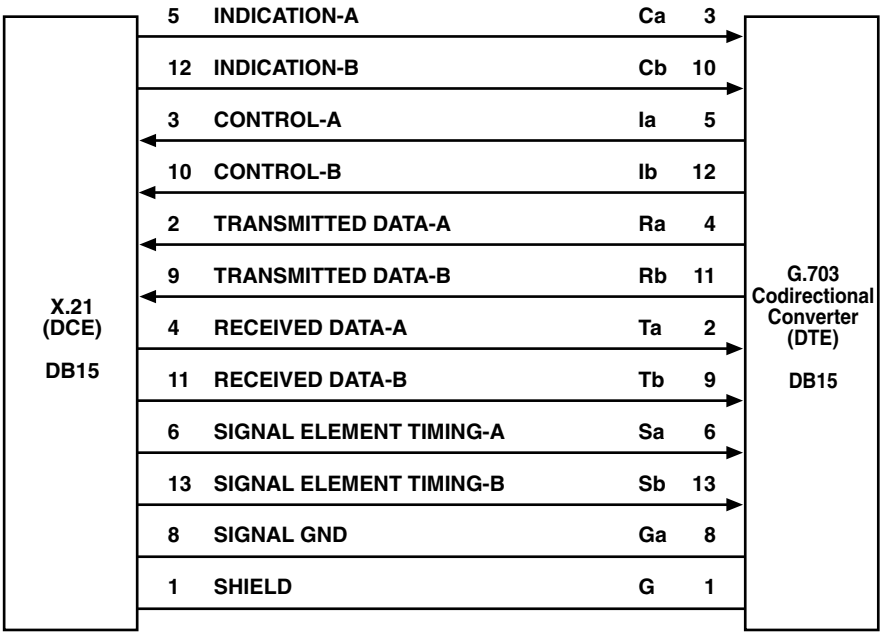


Figure A-4. Connecting an X.21 DCE to an X.21 Converter.

NOTE

The unit's timing jumpers must be set to LBT-DCE21 (see Sections 2.2.2 and 3.3) for this type of connection to work.

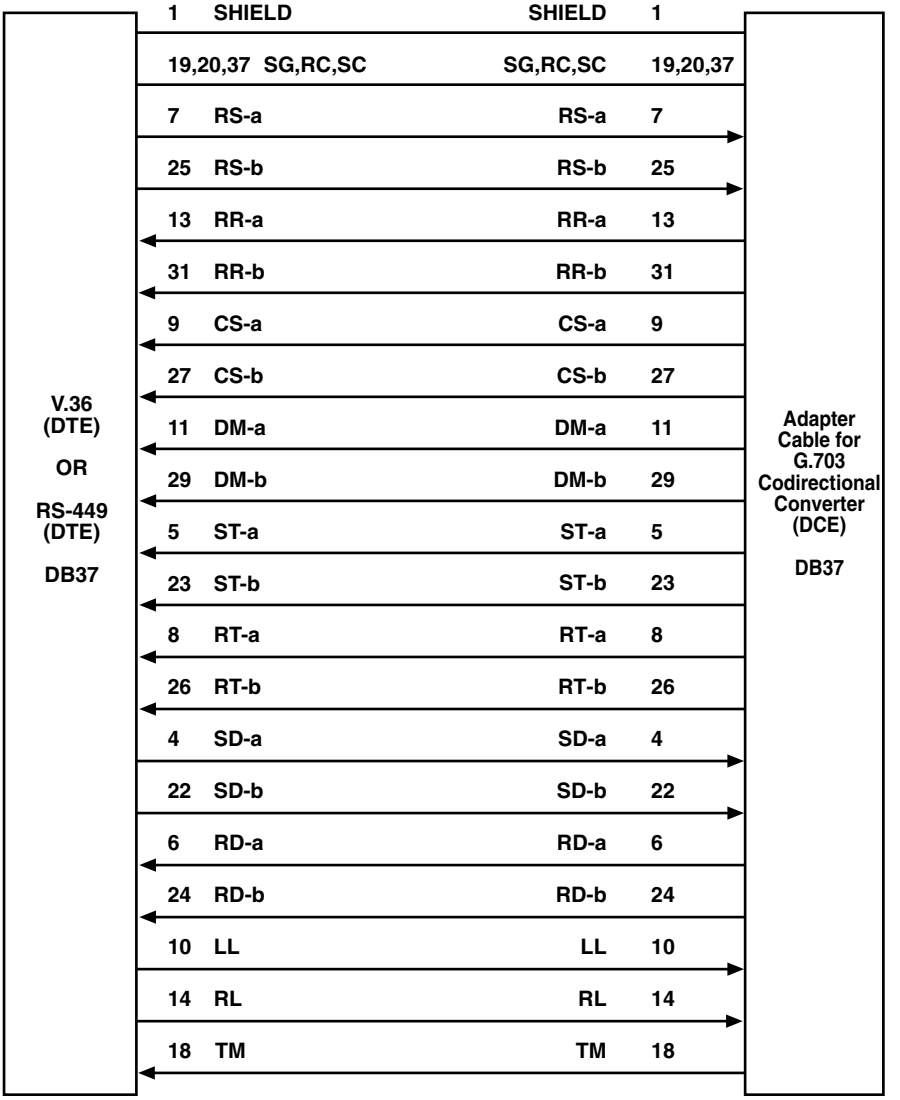


Figure A-5. Indirectly connecting a V.36/RS-449 DTE to a V.36/RS-449 Converter through the included adapter cable.

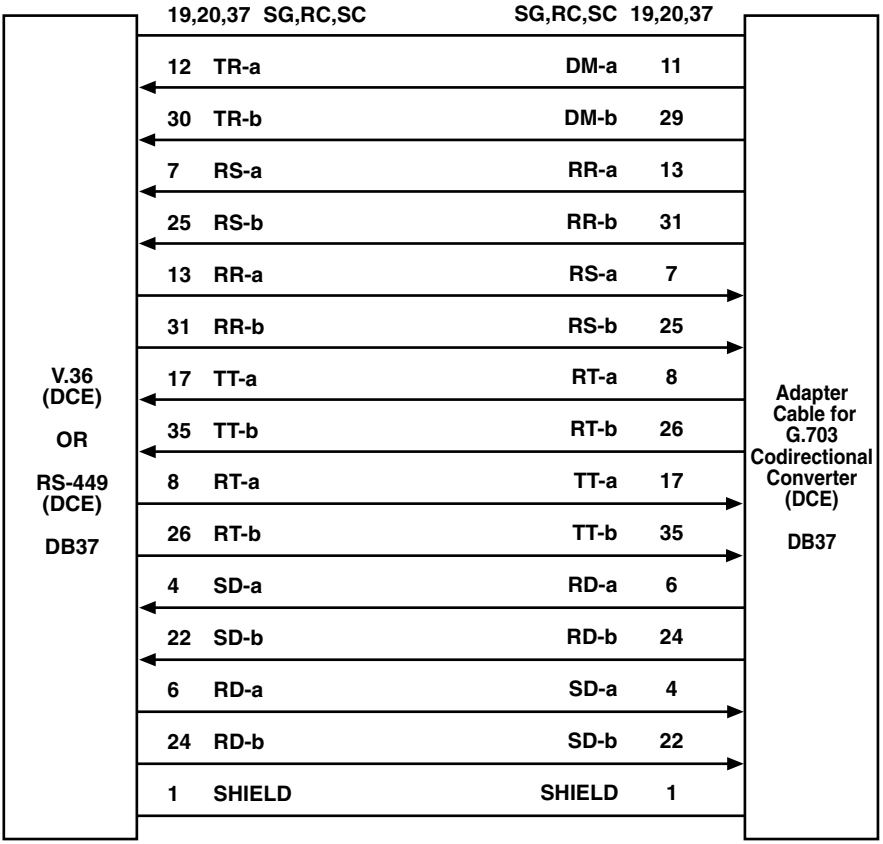


Figure A-6. Indirectly connecting a V.36/RS-449 DCE to a V.36/RS-449 Converter through the included adapter cable.

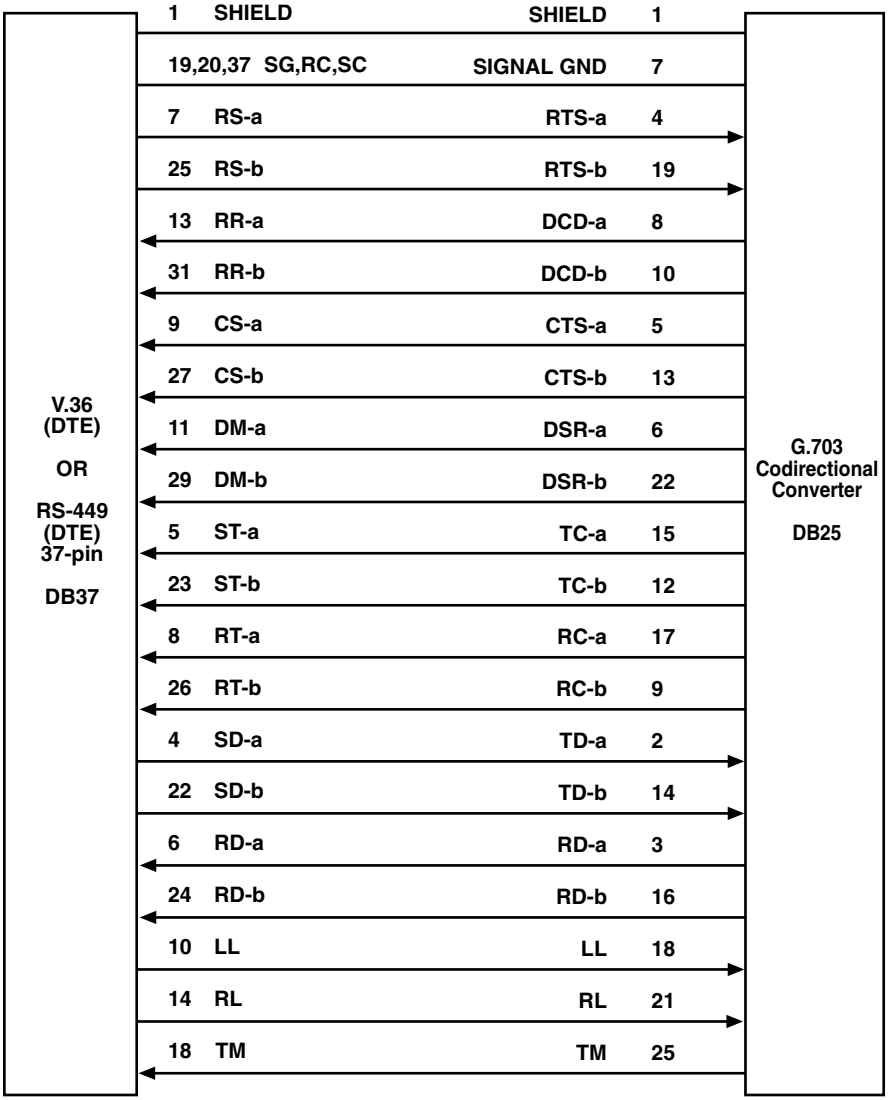


Figure A-7. Directly connecting a V.36/RS-449 DTE to a V.36/RS-449 Converter (RS-530 interface connector).

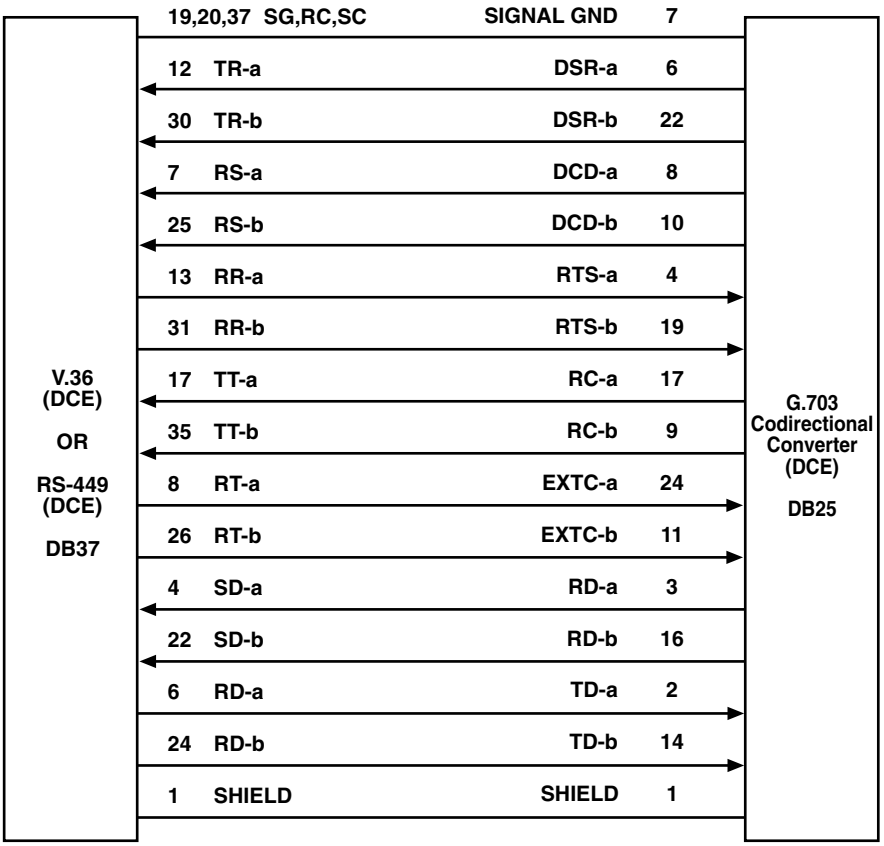


Figure A-8. Directly connecting a V.36/RS-449 DCE to a V.36/RS-449 Converter (RS-530 interface connector).

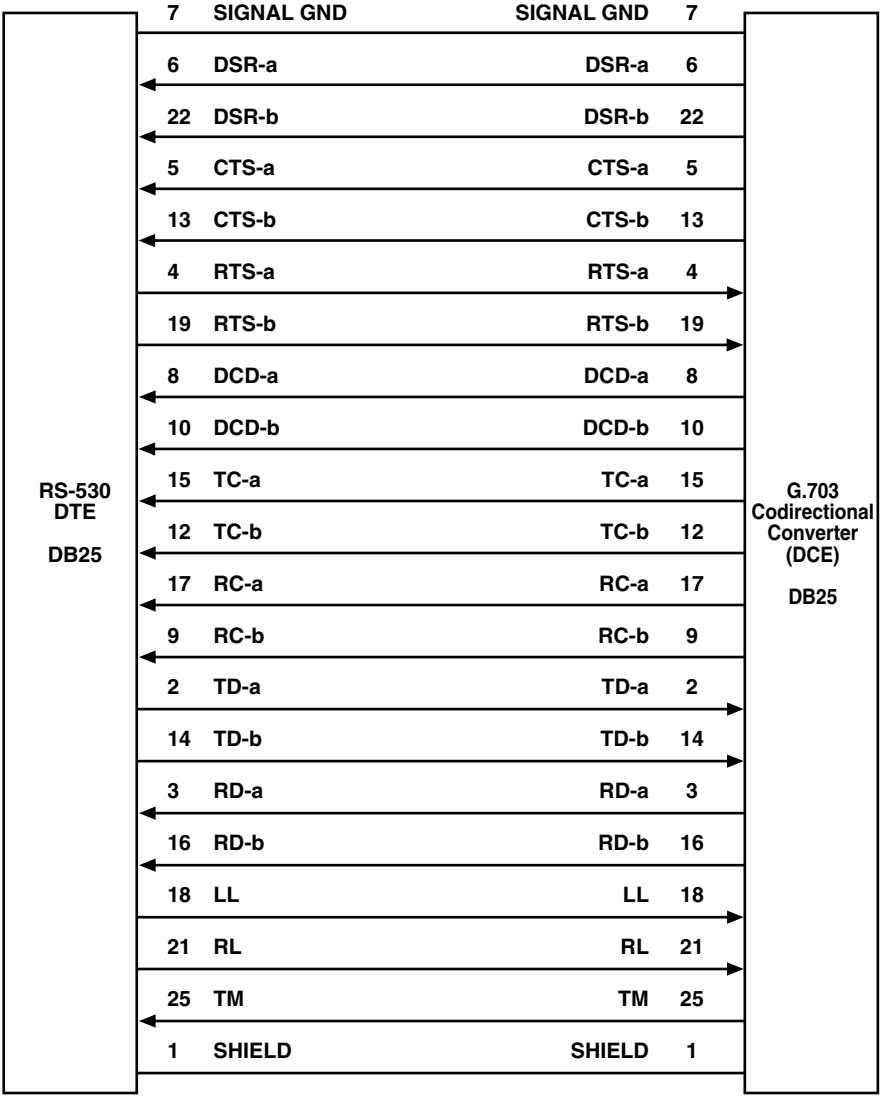


Figure A-9. Connecting an RS-530 DTE to an RS-530 Converter.

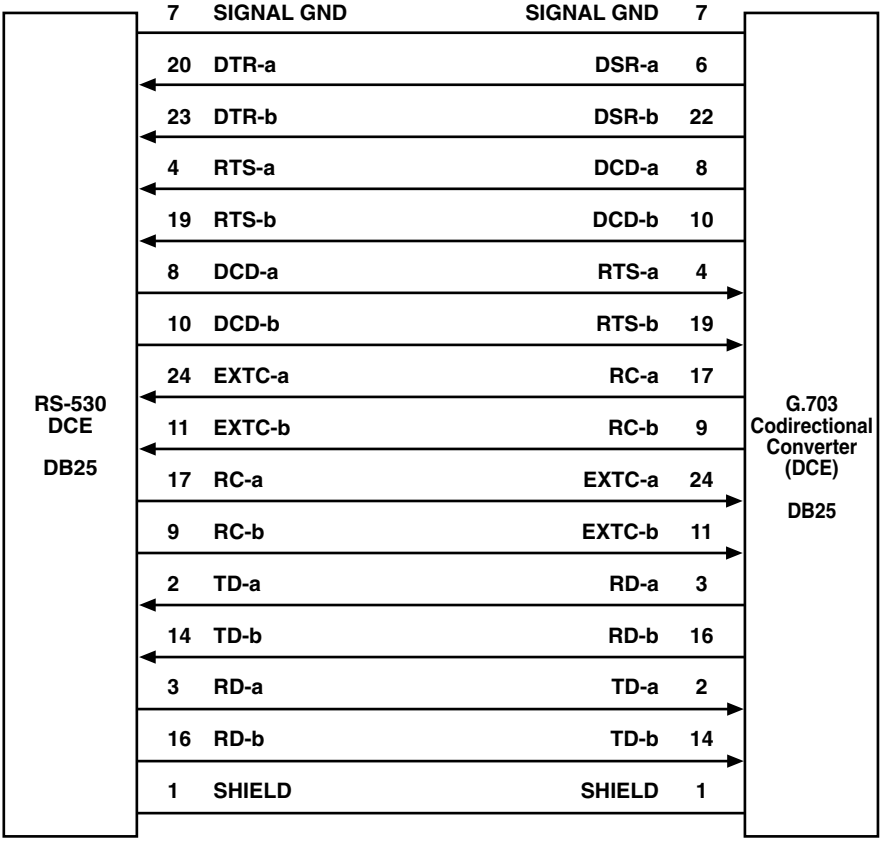


Figure A-10. Connecting an RS-530 DCE to an RS-530 Converter.

NOTES

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