



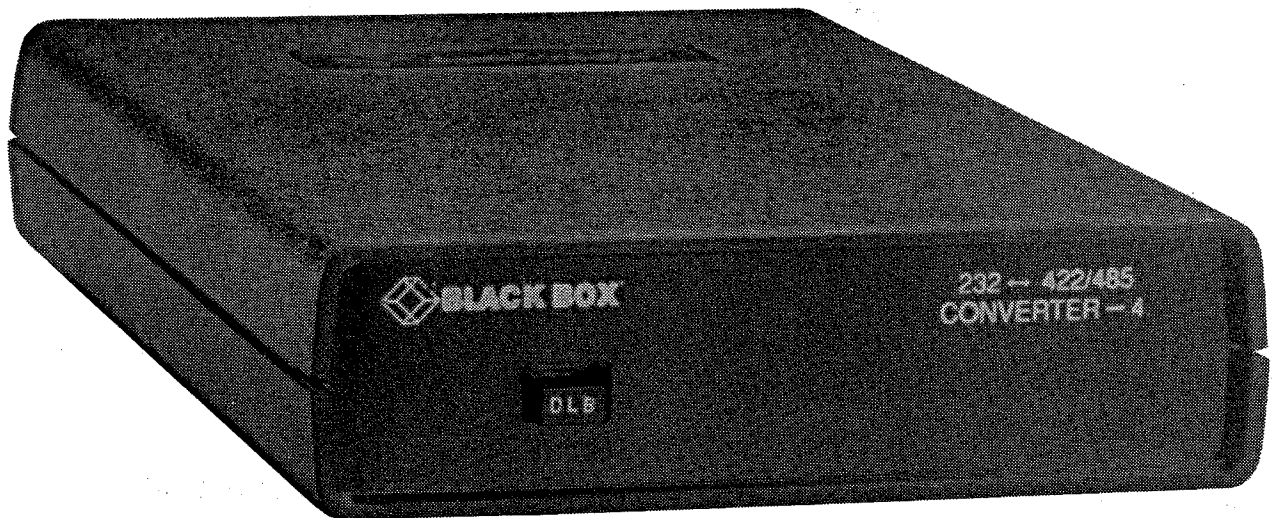
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DECEMBER 1989

IC007A

RS-232 <--> RS-422/485 Interface Converter



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SECTION 1
INTRODUCTION

1.1 SPECIFICATIONS

Interface: 1 asynchronous RS-422/485 port
1 asynchronous RS-232 port

Connectors: 1 DB25S (25 pin sub D female) - RS-232 port
1 four pin terminal block - RS-422/485 port

Pins Supported: RS-232 port - 1, 2, 3, 4, 5, 6, 7, 8, 20
RS-422/485 port - TXA, TXB, RXA, RXB

Data Rate: Up to 64K bps.

Indicators: 5 LEDs (TX, RX, RTS, CD and PWR)

Power: Wall mount transformer
115 VAC @ 70 mA
230 VAC @ 35 mA (European version)

Dimensions: Standalone Unit - 1.8"H x 5.5"W x 8.5"D
(4.5cm H x 13.9cm W x 21.5cm D)
Rackmount Card - 7.4" L x 4.7" H
(18.8 cm x 11.9 cm)

Weight: Standalone Unit - 1 lb. (454 g) unit only
0.5 lb. (227 g) power supply only
Rackmount Card - 0.5 lbs. (227 g)

Operating Temperature: 32 to 122 degrees F (0 to 50 degrees C)

Storage Temperature: -4 to 158 degrees F (-20 to 70 degrees C)

Humidity; 0% to 95% relative humidity, non-condensing

Mean Time Between Failure: Approximately 200,000 hours

Operation: Point to Point or Multipoint
Half or Full Duplex
Transparent to data
Selectable RTS to CTS delay
DTE or DCE configurable RS-232 port
Normal or loopback operation

1.2 GENERAL

The RS-232 <--> RS-422/485 Interface Converter (Data Only) is designed to convert signals from your RS-232 equipment in order to send them to your RS-422/485 device. The interace converter (product number IC007A) can work in point to point as well as multidrop network situations.

SECTION 2
INSTALLATION

2.1 GENERAL

The following paragraphs describe the set-up procedure for configuring the interface converter. See Figure 1 for the component locations. Set each of the six jumpers/switches as per your application, connect the devices together, and then apply power.

1. DTE/DCE Jumper - A dip shunt is used to select DTE/DCE configuration. For the IC007 to appear as a DTE device, put the DIP shunt jumper in socket XW1B. For it to appear as a DCE device, put the DIP shunt jumper in socket XW1A.
2. Normal/Loopback Operation - The Normal/Loopback switch is a two-position push-button switch extending through the front panel. When this switch is in the normal mode, data is passed thru the IC007A from the RS-232 port to the RS-422/485 port and vice versa. When set to the loopback mode, any data received at the RS-422/485 port will be transmitted back out the RS-422/485 port and any data received at the RS-232 port will be transmitted back out the RS-232 port.

NOTE

When in the "Loopback" mode, if the RTS/CTS delay jumper is not in the "ON" position, RTS must be true (when unit is DCE) or CD must be true (when unit is DTE) before any data will be output from the RS-232 port.

3. Half/Full Duplex Operation - Jumper W8 selects half duplex or full duplex operation.
4. RTS/CTS Delay - When the IC007A is configured as a DCE device, jumper W9 selects the amount of delay from the time RTS is received true, until CTS is output true. Regardless of the delay selected, when RTS goes false, CTS will immediately go false. Jumper W9 also affects the RS-422/485 transmitter enable circuitry. The RS-422/485 transmit circuitry on the IC007A is constantly enabled when the RTS/CTS delay jumper (W9) is in the "ON" position. If the RTS/CTS jumper is in any position other than the "ON" position, the RS-422/485 transmit circuit will be enabled only when RTS is asserted true. When the transmit circuitry is

disabled, data cannot output from the RS-422/485 interface. When the IC007A is configured as DTE, jumper W9 only affects the RS-422/485 transmitter circuitry. When jumper W9 is in the "ON" position, the transmitter is constantly enabled. In any other position, the RS-422/485 transmitter is enabled only when CD is asserted true.

NOTE

When the RTS/CTS jumper is in the ON position, half duplex transmission cannot be performed.

5. Terminated or Unterminated - The RS-422/485 interface can be terminated with a resistor network at the receiver input pins (RXA and RXB) via switch S2. When S2 is placed in the "TERM" position, the resistor network is connected across the line. When S2 is placed in the "UNTERM" position, no connection to the resistor network is made and the line is not terminated.

For point to point applications, switch S2 should be in the "TERM" position. For multipoint applications, switch S2 should be in the "UNTERM" position on all the IC007A devices in the network except for the two units at the extreme opposite locations on the line. These two units should be set in the "TERM" position (see Figures 1 thru 5).

6. Frame Ground/Signal Ground - Jumper position W7 ties signal ground to frame ground. The position is normally left open at the factory. If signal ground is to be connected to frame ground, it is recommended that a 100 ohm, 1/2 watt resistor be soldered in location W7. A wire jumper may also be used; however, care must be taken to ensure that ground loop currents are limited to acceptable levels.

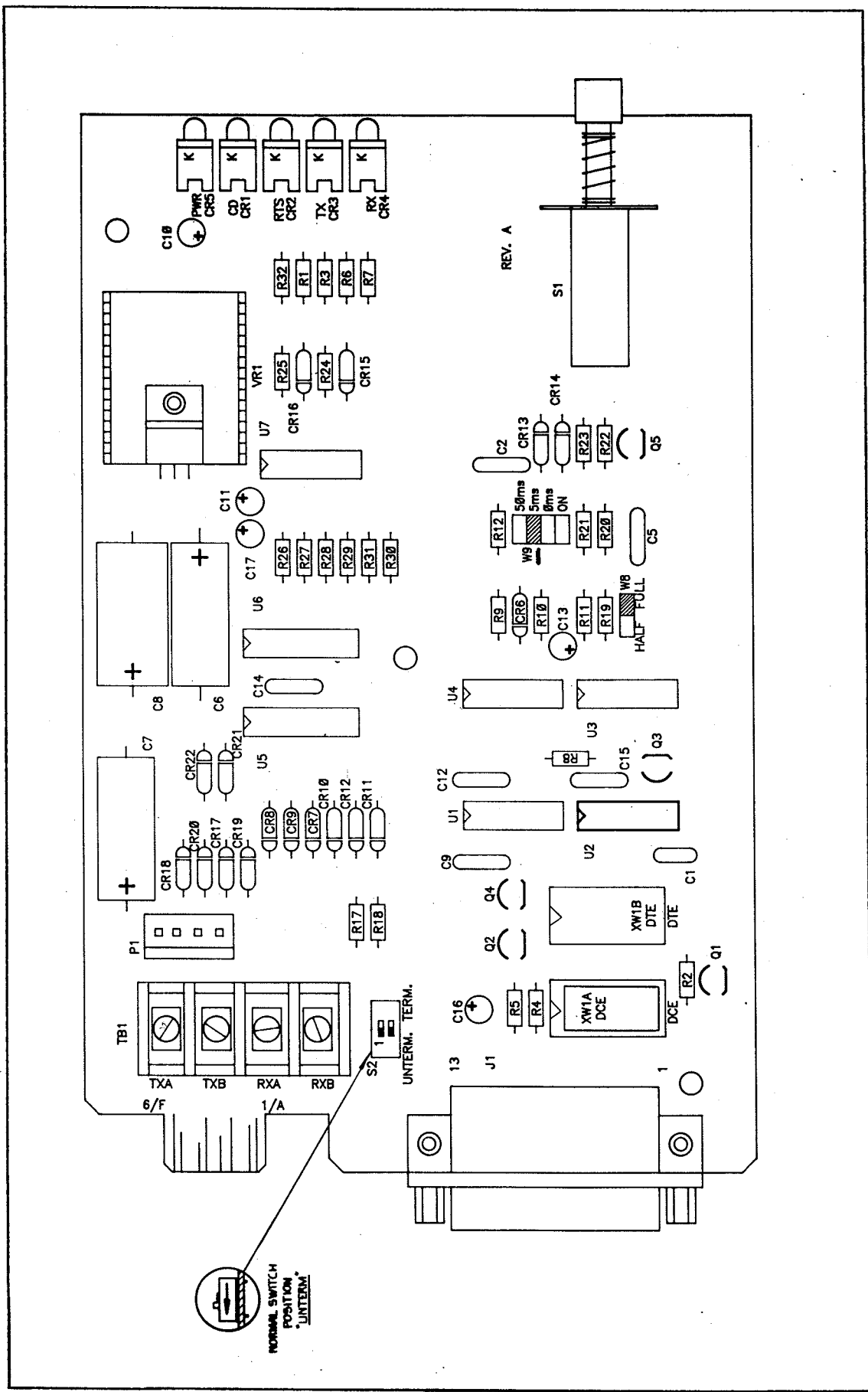


Figure 1. PCB Layout

2.2 TYPICAL APPLICATIONS

Figures 2 thru 5 illustrate typical applications using the interface converter. The connections shown are for the RS-422/485 port. A resistor shown in the circuit indicates that the termination resistor has been selected via switch S2. Please note that although Figures 4 and 5 show only two IC007A devices networked together, up to 64 units can be connected in the manner shown in Figure 4, and up to 32 units as shown in Figure 5.

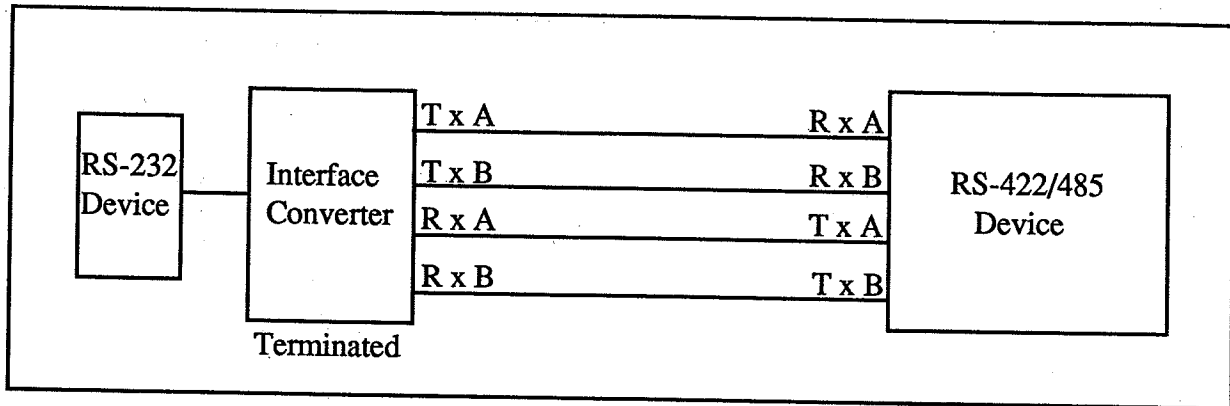


Figure 2. Point to Point 4 Wire (Full or Half Duplex)

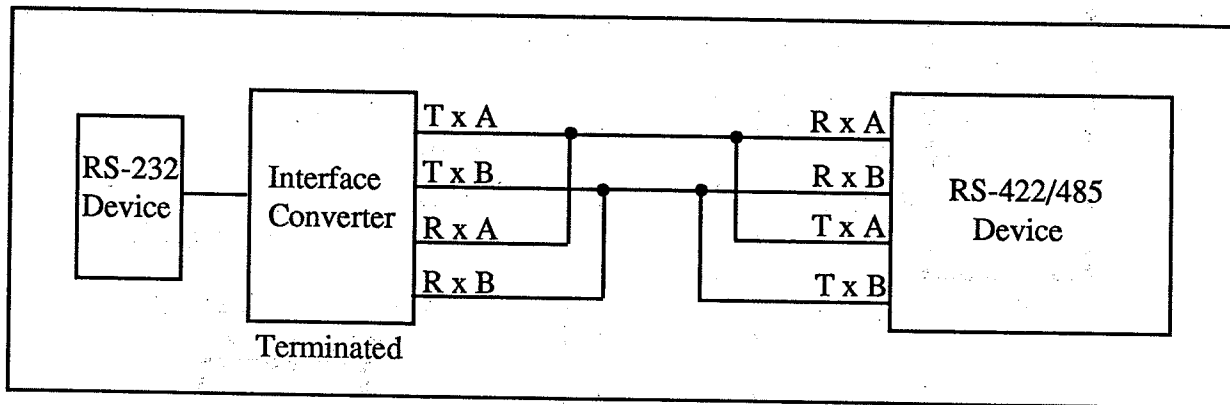


Figure 3. Point to Point 2 Wire (Half Duplex)

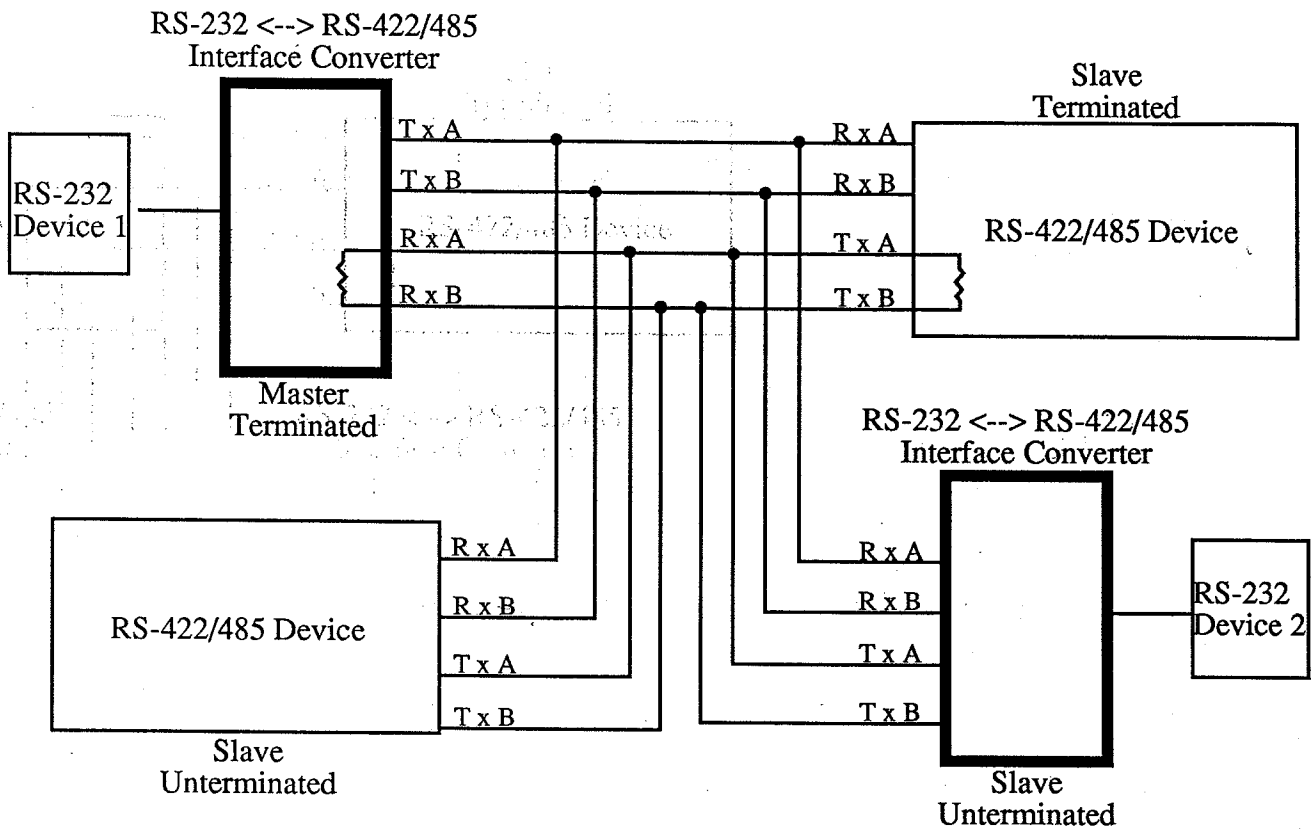


Figure 4. Multipoint 4 Wire (Half or Full Duplex)

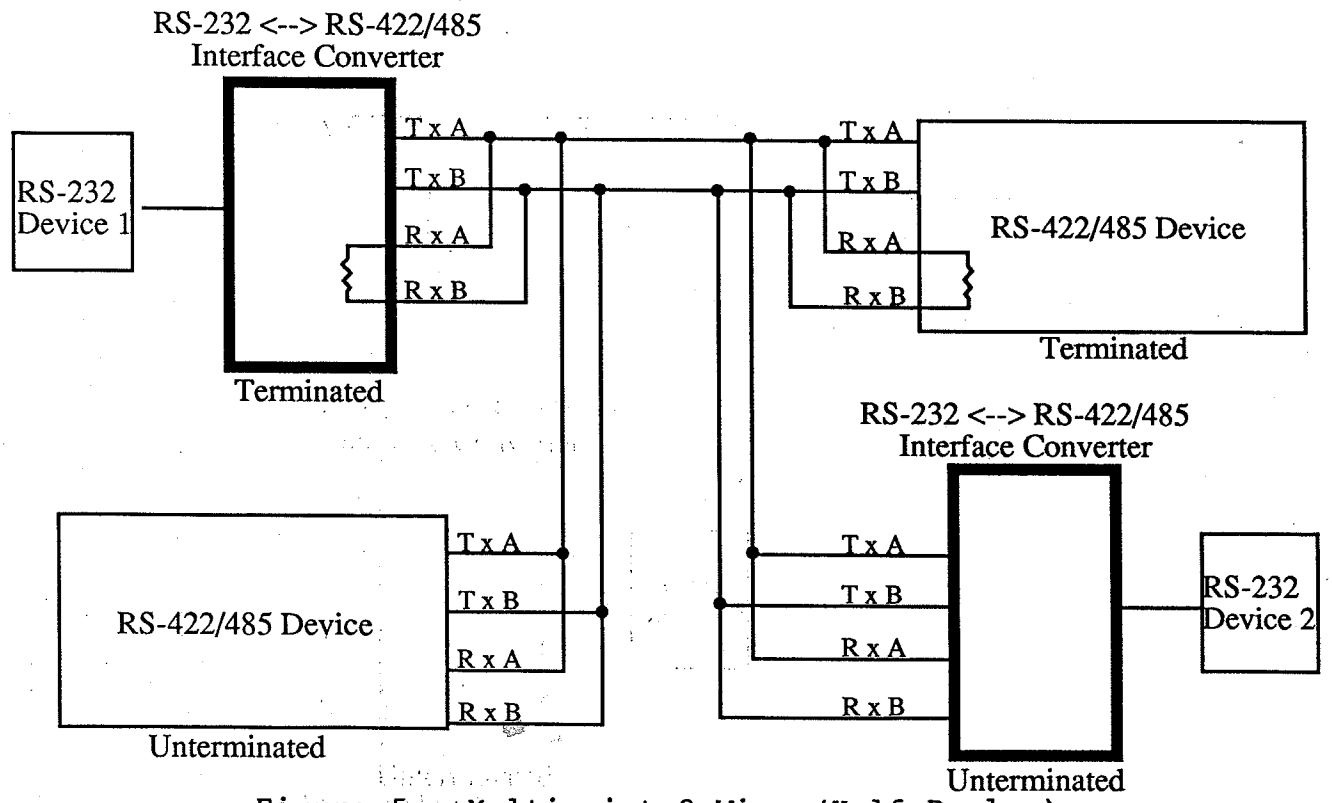


Figure 5. Multipoint 2 Wire (Half Duplex)

SECTION 3

BASIC OPERATION

3.1 SIGNAL FLOW

Figures 6 and 7 show the signal flow for an IC007A set for "NORMAL" (not "Loopback") mode of operation and set for full duplex. The signal flow is indicated by the arrows. Also shown are the locations of the indicator LEDs.

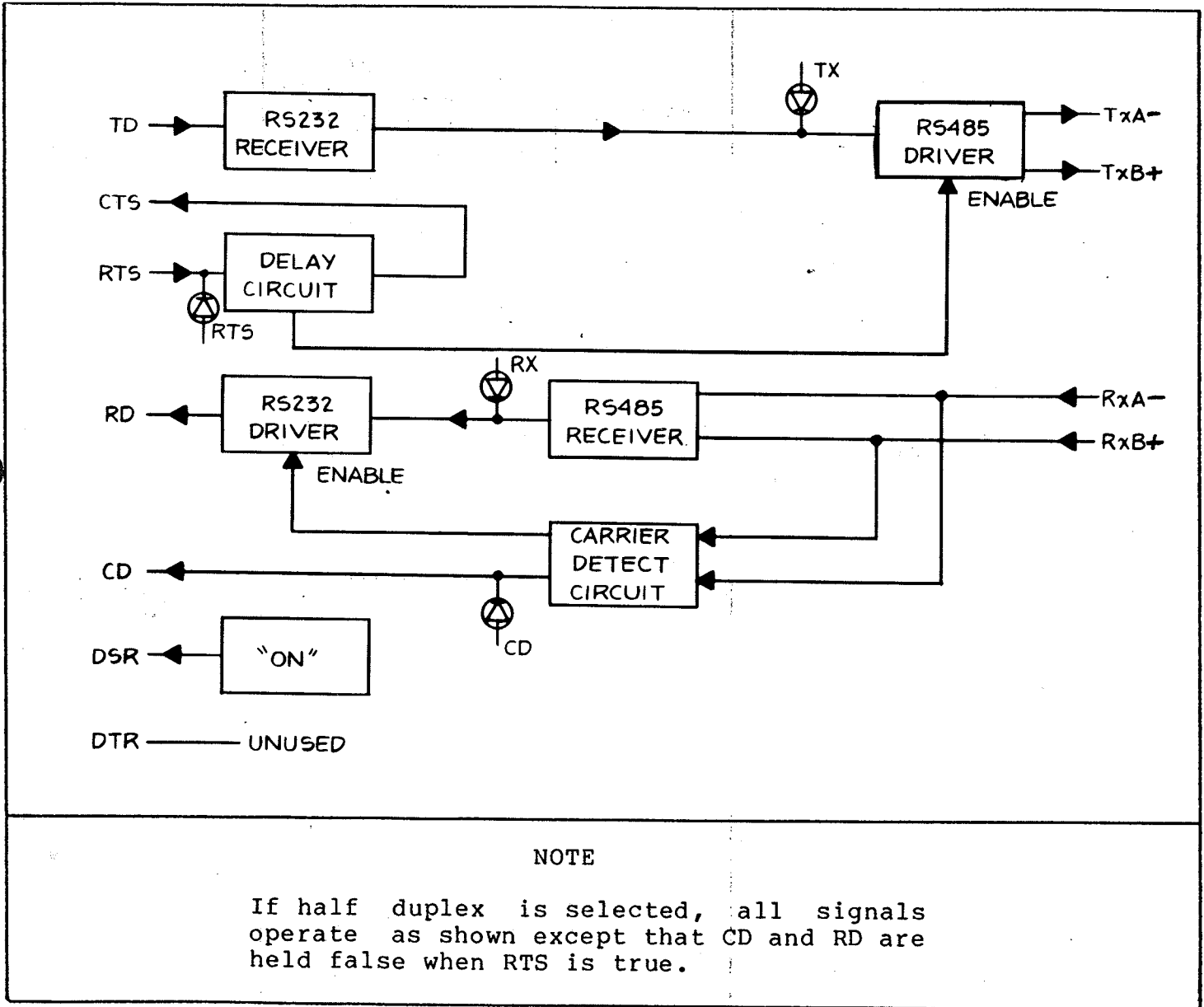
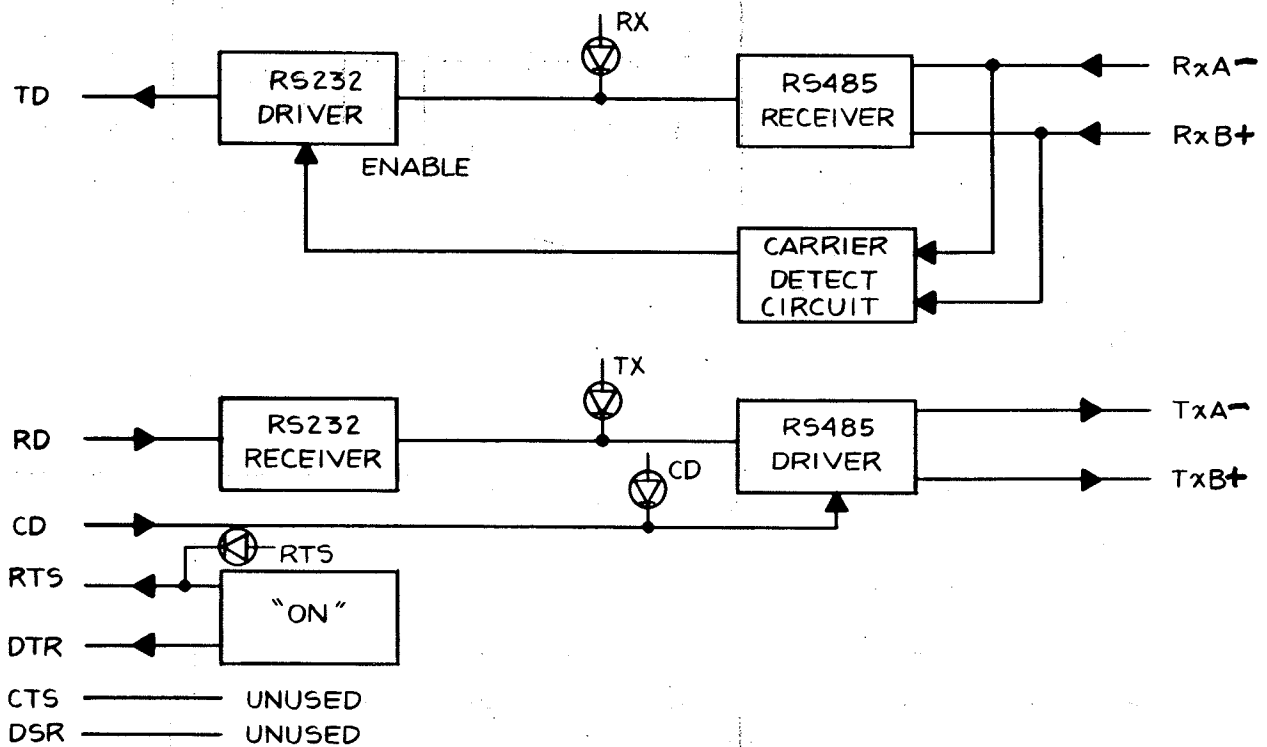


Figure 6. Simplified Functional Block Diagram (DCE operation)



NOTE

If the RTS/CTS delay jumper is placed in the "ON" position, the RS-422/485 driver will always be enabled, rather than being activated by CD as shown. When configured DTE, half duplex operation cannot be performed using hardware handshake.

Figure 7. Simplified Functional Block Diagram (DTE Operation)

3.2 RS-232 CIRCUITRY

The RS-232 section of the interface converter is composed of the RS-232 drivers and receivers, the delay circuitry, and other circuitry necessary to operate the RS-232 control lines in the proper manner.

When the IC007A is configured as DCE, data received on pin 2 (TD) will be transmitted out TXA and TXB on the RS-422/485 port. For this to occur, RTS must be asserted true or the RTS/CTS delay jumper must be in the "ON" position. In other words, before you can send any data through the IC007A, you must either first ask (assert RTS true), then be given permission (receive CTS true) before sending data, or the interface converter must be set in the mode where it is constantly enabled (RTS/CTS jumper in the ON position).

When the IC007A is jumpered for DTE operation, pin 8 (CD) performs the same function as RTS described above i.e., you must first have something to send (CD asserted true) before any data will be output from the RS-422/485 port. Again, it is possible to place the interface converter in the constantly enabled mode by setting the RTS/CTS delay jumper in the "ON" position.

Data received on the RXA and RXB pins of the RS-422/485 port will be transmitted out pin 3 (RXD) when the unit is configured as DCE and out pin 2 (TXD) when the unit is configured as DTE.

In the half duplex mode, the device connected to the RS-232 port has priority over data received at the RS-422/485 port. If RTS is asserted true when the IC007A is configured as DCE, or if CD is asserted true when configured as DTE, the IC007A ignores any data received at the RS-422/485 port. The data output pin at the RS-232 port is also forced in the marking condition. Note that to operate in the half duplex mode over a single pair of wires, the RTS/CTS jumper must be in a position other than the "ON" position. Otherwise, the unit will not operate.

3.3 RS-422/485 CIRCUITRY

The RS-422/485 section of the interface converter is comprised of the driver, receiver and line termination networks. Switch S2 has been provided to allow the user to either select the termination network for the receiver to be connected to the line (terminated), or left unconnected (unterminated). Having the line terminated will reduce distortion and improve the overall signal quality in most applications. For point to point systems where only two devices are connected to the line, each device should usually have the termination network connected to the line. In multipoint applications, only the two devices at the extreme ends of the line should have the termination network connected to the line. If any of the other IC007A's were configured as "terminated", the amount of distortion would increase - possibly causing errors to occur in the data being transmitted.

3.4 CARRIER DETECT CIRCUITRY

The carrier detect circuitry's purpose is to indicate whether or not any IC007A connected to the line is enabled and ready to transmit data. In a 4-wire point-to-point system, each of the drivers on the two interface converter's may always be enabled without any adverse affects. In a 2-wire system or in multipoint applications, only one driver may be enabled at any one time. If more than one driver is turned ON, a situation known as "contention" occurs and the data from one driver interferes with the data from the other driver. This results in garbled data.

When the IC007A is configured as DCE, the carrier detect circuit detects the absence or presence of any active driver on the line and relays this information to the RS-232 device connected to it via pin 8 (CD). When the IC007A is configured as a DTE device, the absence of an active line driver connected to the line can't be indicated. This is because the RS-232 interface does not provide any pin for this purpose.

The carrier detect circuitry also forces data out on the RS-232 port (TD when DTE, and RD when DCE) to the marking state when no active driver is present on the line. This technique prevents random noise on the RS-422/485 side from being passed thru to the RS-232 side.

3.5 Typical Multipoint Application

In this example application, a personal computer is used to gather information from several remote data logging stations. A system protocol has been defined such that all the remote data logging stations receive the information sent by the personal computer, but only the remote station specifically addressed will respond.

In this example, the P.C. and all the remote stations are DTE devices. Therefore, all of the interface converters will be set for DCE operation and a "straight thru" cable will be used to connect the RS-232 port on each IC007A to the RS-232 port on each of the remote stations and the P.C. All the interface converters will be set for "NORMAL" (not LOOPBACK) operation. After a remote station has been addressed, two way data transmission can occur between it and the P.C. until the P.C. sends a "CLEAR" command. This command causes the remote station to resume data logging while waiting to be addressed again. With this being the case, we will set each IC007A for full duplex operation and use two twisted pairs to connect the units together as shown in Figure 3. Note from the figure which units are terminated and which remain unterminated. Since all the remote stations must be inactive until addressed, the RTS/CTS delay jumper for their IC007A's must be set to a position other than "ON". Since the remote stations are fairly far from the P.C. in our example, we'll set the delay for 5 msec. to allow the line to settle after a remote station becomes active but before it starts to

transmit. The interface converter at the P.C., however, can be jumpered for enter "ON", or for any of the delay settings. We'll set it in the "ON" position in this example because we want to allow the P.C. to be able to transmit to the remote stations at any time without having to wait for any delay period. This completes the configuration procedure, and the system can now be activated.

TABLE I. PINNING CHART

RS-232 Pin Number	Name	Description
1	Frame Ground	Connects frame ground of IC007A to frame ground of the RS-232 device.
2	TD	When the IC007A is DCE, data is received on TD. The TX LED lights when TD is a "space". When the IC007A is DTE, data is output on TD. The RX LED lights when TD is a "Space".
3	RD	When the IC007A is DCE, data is output on RD. The RX LED lights when RD is a "Space". When the IC007A is DTE, data is received on RD. The TX LED lights when RD is a "space".
4	RTS	When the IC007A is DCE, RTS is an input which turns on the RS-422/485 driver when RTS is true. Note that the "ON" position of the RTS/CTS delay jumper will force the RS-422/485 driver always ON. When the IC007A is DTE, RTS is asserted true. The RTS LED indicates when the RTS pin is true for both DTE and DCE operation.

TABLE I. PINNING CHART (continued)

RS-232 Pin Number	Name	Description
5	CTS	When the IC007A is configured DCE, CTS is an output that follows the RTS input. CTS can be set for always ON (true), or for any one of three delay settings. When the IC007A is configured DTE, CTS is unused.
6	DSR	When the IC007A is configured DCE, DSR is asserted true. When the IC007A is configured DTE, DSR is unused.
7	Signal Ground	Connects the circuit ground of the IC007A to the circuit ground of the RS-232 device.
8	CD	When the IC007A is configured DCE, CD goes true to indicate when data being output on RD (pin 3) of the RS-232 port is valid data. When the IC007A is configured DTE, the RS-422/485 line driver will be enabled and data can be sent when CD is asserted true. When CD is false, the RS-422/485 line driver is disabled. Note that if the RTS/CTS delay jumper is in the "ON" position, the RS-422/485 line driver will be constantly enabled. The CD LED indicates the state of the CD pin for both DCE and DTE operation.
20	DTR	When the IC007A is configured DCE, the DTR pin is unused. When the IC007A is configured DTE, the DTR pin is asserted true.

TABLE I. PINNING CHART (continued)

RS-422/485 PIN NAME	DESCRIPTION
TXA and TXB	Data received by the IC007A at the RS-232 port is transmitted out of the unit over twisted pair wires via these two outputs. The "TX" LED indicates the state of these two leads. When the TXA lead is positive with respect to the TXB lead (a "zero is being transmitted), the "TX" LED is lit.
RXA and RXB	These are the received data inputs for the RS-422/485 port. The status of these leads is monitored by the "RX" LED. When the RXA lead is positive with respect to the RXB lead (a "zero" is being received), the "RX" LED is lit.