Digital Loopback (DL) (4-Wire Mode, Private Line only)

In the DL position, the received data is looped back into the transmitter and retransmitted to the remote end. The EIA-232 interface to the terminal is not active. See Figure 3-4.

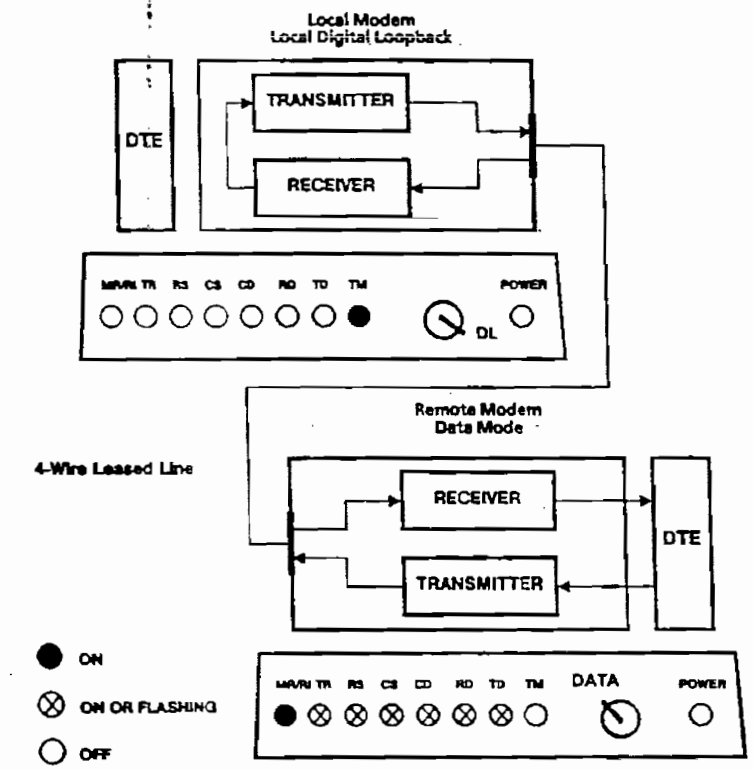


Figure 3-4
Digital Loopback Test

Chapter 4
Principles of Operation

GENERAL

The 202S/T is a 0 to 1200 bps serial asynchronous transmission modem. The modem accepts asynchronous data from the terminal, converts the data to an FM signal and transmits this signal out to the telephone line. The receiver accepts the FM signal, band limits the signal for noise rejection, recovers the data from the carrier, and presents the recovered data to the terminal.

The 202S/T-R is the 202S/T with the addition of a secondary channel plug-in board. The plug-in board can be configured for three modes of operation:

- 0 to 5 bps reverse channel
- 0 to 75 bps CCITT secondary channel
- 0 to 150 bps secondary channel.

PRIMARY CHANNEL MODEM

The 0 to 1200 bps primary channel for the 202S/T and 202S/T-R is implemented using an FSK modem chip. The transmit and receive filters are switched capacitor type, and are used to band limit the signal from and to the telephone line.

SECONDARY CHANNEL MODEM

The 202S/T-R is a 202S/T modem with a secondary plug-in modem card installed. The secondary channel is independent of the primary channel and has EIA-232C lines dedicated to the secondary channel. The 0 to 5 bps reverse channel is compatible with the Bell-type reverse channels which operate using a single 387 Hz tone. The 0 to 75 bps secondary channel is compatible with the CCITT secondary channel specifications. The 0 to 150 bps channel is not compatible with any standards. The frequencies are 390 Hz and 510 Hz for mark and space respectively.

SYNCHRONOUS OPERATION

The synchronous plug-in board adds 600 and 1200 baud synchronous operation capability to the 202S/T. The function of the synchronous board is to generate transmit and receive clocks.

AUTO ANSWER CIRCUITRY

The modem is designed primarily to operate on the switched telephone network. It will automatically answer (if the option is selected) an incoming call at the end of the ringing signal if DTR is on. When the modem goes off hook, the answer tone (2025 Hz) is transmitted for 2.5 seconds. At the end of the answer tone, DSR is turned on to the terminal. When DSR turns on, the terminal may turn on Request to Send to the modem. If the modem is strapped for private line operation, DSR is on continuously. If the modem is strapped for manual answer, the modem will not respond to the ringing signal.

CALL TERMINATION

The normal procedure for call termination (causing the modem to go on hook) is for the terminal to turn off the DTR signal. The 202S/T offers, as an option, a loss of line current disconnect. This circuit detects a loss of the line current from the central office due to a disconnect from the far end. The circuit then causes the modem to go on hook. The loss of current disconnect option is not recommended for disconnect of unattended devices except to supplement other means of disconnection (DTR turn-off). Not all telephone switching systems are equipped to provide interruption of line current in response to far-end disconnect.

POWER SUPPLY

The power supply transformer, fuse and ON/OFF POWER switch are mounted to the modem housing. The power cord connects to the transformer after routing through the fuse and power switch. The transformer has a center tapped winding rated at 20 Vac and 150 mA and

a winding rated at 10 Vac and 225 mA. The transformer connects to the board through a 6-pin connector and cable.

REGISTERED PROTECTIVE CIRCUITRY

The registered protective circuitry consists of the input protection circuitry, ring current detector, loop current detector, off hook relay, coupling transformer, billing time circuit and output level select.

The telephone line is connected to the modem through the tip and ring leads (pins 4 and 5) of the TELCO jack. Tip and ring connect to the coupling transformer through the off hook relay contact and a diode bridge. An optical coupler is in series with the line to sense ringing current and loop current. The diode bridge makes the circuit insensitive to polarity changes on the telephone line. The optical coupler is coupled to the line and turns on when ringing current is detected and routed to the modem which outputs the indication on pin 22 of the EIA-232C connector. The ring current also sets a latch on the board which is used to enable the 2-second billing time circuit. If the off hook line from the modem is enabled after ring current stops, the off hook indication is given to the central office. The billing time circuit delays for 2 seconds and releases DSR to the DTE after Answer Tone transmission.

In a system which uses an exclusion key telephone, the telephone switch hook is connected to the board on the A and A1 leads (pins 3 and 6 of TELCO jack). When the telephone receiver is off hook, A and A1 are shorted together and the modem senses the SH indication and goes off hook if DTR is on.

Chapter 5
DTE Pin Functions

The 25-pin connector EIA-232C pin functions for the modem are as follows:

Pin	EIA-232C Circuit	CCITT V.24 Circuit	Function
1	AA	101	Frame Ground
2	BA	103	Transmitted Data
3	BB	104	Received Data
4	CA	105	Request to Send
5	CB	106	Clear to Send
6	CC	107	Data Set Ready
7	AB	102	Signal Ground
8	CF	109	Data Carrier Detect
9	--	--	+ 12 Volts Test Only
10	--	--	- 12 Volts Test Only
11	--	--	Unassigned
12	SCF	122	Sec. Data Carrier Detect
13	SCB	--	Sec. Clear to Send
14	SBA	118	Sec. Transmitted Data
15	DB	114	Transmitter Clock Output
16	SBB	119	Sec. Received Data
17	DD	115	Receiver Clock Output
18	--	--	Connected to Pin 25
19	SCA	120	Sec. Request to Send
20	CD	108/2	Data Terminal Ready
22	CE	125	Ring Indicator
24	DA	113	Transmitter Clock Input
25	--	--	Analog Loopback

Table 5-1
Pin Functions

NOTE
Unused pins have no electrical connection. The interface functions are defined below.

Pin 1

Frame Ground (AA). This pin is connected to the modem case and to the ground lead on the 3-wire ac power connection. It is not connected to signal common (pin 7), although it may be as an option by the user.

Pin 2

Transmitted Data (BA). Data to be transmitted is furnished on this lead to the modem from the terminal. Required voltage levels are:

Mark	– 3 to – 25V
Space	+ 3 to + 25V

Activity on the transmit data line (i.e., any space) is indicated by the TD LED on the front panel.

Pin 3

Received Data (BB). Data which is demodulated from the received phone line signal is presented to the terminal on pin 3. Output voltage levels into a greater than 3K ohm load are:

Mark	– 5 to – 15V
Space	+ 5 to + 15V

The data output is inhibited in a mark state when no valid carrier is present on the receive phone line as indicated by Carrier Detect (pin 8). Activity on the receive data line (i.e., any space) is indicated by the RD LED on the front panel.

Pin 4

Request to Send (CA). RTS is supplied by the business machine to the modem when it is required to transmit a message. Voltage levels required are:

RTS on	+ 3 to + 25V
RTS off ...	– 3 to – 25V

With RTS off, the modem carrier remains off. When RTS is turned on, the modem will immediately turn on the carrier. The modem data input will be inhibited so that constant mark is transmitted until the end of the CTS delay period (see the following section). At the end of the CTS delay, the input data inhibit is removed and the terminal may begin transmitting normal data.

When RTS is turned off at the end of the message, CTS will immediately turn off. The carrier will remain on long enough to ensure transmission of the last data bits and then turn off.

Pin 5

Clear to Send (CB). CTS is a function supplied to the terminal by the modem which indicates that it is permissible to begin the transmission of a message. CTS follows the off-to-on transition of RTS after a time delay chosen by strap option. The output levels into greater than 3K ohm load are:

CTS on	+ 5 to + 15V
CTS off ...	– 5 to – 15V

Pin 6

Data Set Ready (CC). DSR is a function supplied by the modem to the terminal to indicate that the modem has received DTR (pin 20) and is ready to transmit data. Output levels are:

DSR on ...	+ 5 to + 15V
DSR off ...	– 5 to – 15V

The absence of DSR may indicate:

- The modem power is off.
- The modem is in test mode.
- The modem has not connected to the phone line or is still generating Answer Back Tone (ABT).

Pin 7

Signal Ground (AB). Common return lead for all signals at the modem interface.

Pin 8

Data Carrier Detect (CF). CF is furnished by the modem to the terminal to indicate that a valid carrier is being received. This indication implies both sufficient amplitude and in-band frequencies of the received carrier. This signal must also persist above the CD threshold for a minimum of 6 ms for a constant Space.

When CD is off (– 5 to – 15V), Received Data (pin 3) is clamped to a mark condition (– 5 to – 15V).

Pins 9 & 10

Resistively protected supply voltages for testing only, at + 12V and – 12V respectively.

Pin 12

Secondary Data Carrier Detect (SCD). SCD provides a status indication of the Secondary Channel received data. Out-of-band detection is not provided for as described above for the primary channel but sufficient amplitude persisting for a minimum time is necessary.

Pin 13

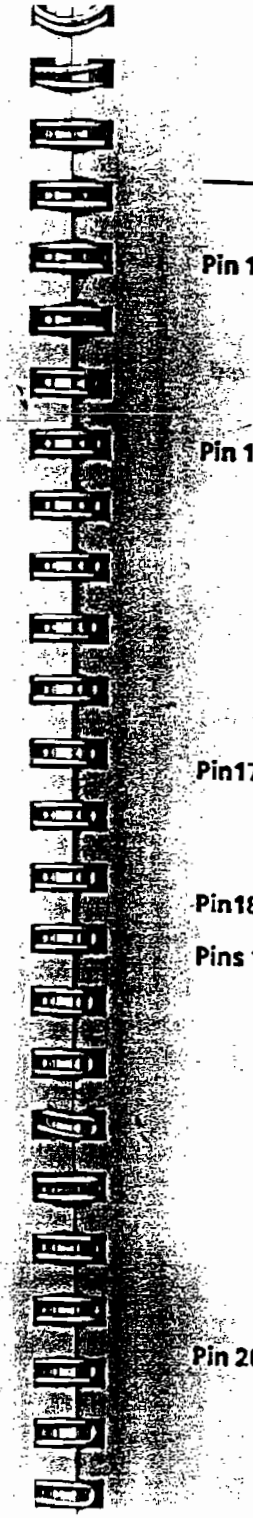
Secondary Clear to Send (SCB). SCTS is supplied to the terminal by the modem as an indication that the secondary channel is ready to transmit data. Data to the modem transmitter is clamped to a mark state prior to the set's transition from off to on.

SCTS on ...	+ 5 to + 15V
SCTS off ..	– 5 to – 15V

Pin 14

Secondary Transmitted Data (SBA). Secondary data to be transmitted is furnished on this lead to the modem from the terminal. Transmitted data is inhibited until Secondary Clear to Send transition from off to on.

Mark	– 3 to – 5V
Space	+ 3 to + 25V



Pin 15

Pin 16

Pin17

Pin18

Pins 19 & 11

Pin 20

Transmitter Clock Output (DB). Transmitter clock is a 600 Hz or 1200 Hz (switch selected) square wave supplied to the terminal by the modem for use by the terminal in clocking the transmitter data from the terminal in synchronous mode.

Secondary Received Data (SBB). Data which is demodulated from the received phone line signal by the secondary receiver is presented to the terminal by the modem on this lead. The data output is clamped to a mark state when no valid secondary carrier is present on the receive phone line as indicated by Secondary Data Carrier Detect (pin 12).

Mark	– 5 to – 15V
Space	+ 5 to + 15V

Receiver Clock Output (DD). A 600 Hz or 1200 Hz signal supplied by the modem to the terminal. Receiver clock is derived from the received signal.

Connected to pin 25.

Secondary Request to Send (SCA). SRTS is supplied by the terminal to the modem when it is required to transmit a message. With SRTS off, the modem carrier remains Off. When SRTS is turned on, the modem responds immediately with the transmission of a mark frequency. Secondary Transmitted Data (pin 14) is inhibited until the termination of the Secondary Clear to Send delay (213 ms), at which time normal transmission may begin. This delay ensures that echoes have diminished in the case of 2-wire operation and also allows sufficient time for Secondary Carrier Detect to turn on at the remote site prior to data transmission.

Data Terminal Ready (CD). A signal from the terminal to the modem to indicate that the

terminal is ready to send or receive. DTR must be on to allow Data Set Ready (pin 6) to come on.

Pin 22 Ring Indicator (CE). A signal from the modem indicating that a ringing signal is being received on the communications channel.

All signal levels from the modem are as follows:

Off ..... – 15V – 3V
on ..... + 15V + 3V

Pin 24 Transmitter Clock Input (DA). A square wave at 600 Hz or 1200 Hz that may be supplied by the terminal as a reference for the modem in synchronous mode.

Pin 25 Analog Loopback. The modem goes into analog loopback test mode when pin 25 is active. Signals received on pin 18 are shunted to pin 25.

Chapter 6
Maintenance

WARNING
Disconnect ac power before performing maintenance. Although dangerous voltage levels are not exposed, disconnecting power ensures an electric shock hazard is not present.

GENERAL

The modem provides maintenance-free service. Periodically it is necessary to remove dust from internal electrical components with low pressure air, or a vacuum, and a soft bristle brush.

FUSE

If a fuse fails, replace it with one of equal rating. Repeated failure indicates a more serious problem. If this happens, refer to Maintenance.

MAINTENANCE

The test procedures will identify the faulty component in a bad communications link. Assistance is available from the UDS Field Service Department at 1-800-221-4380. If the modem is faulty, it should be returned to UDS for repair. Do not return the modem without prior instructions.

The modem contains no components that can be serviced or replaced by the user. Repairs should not be attempted by the user.

Appendix A
Specifications

FCC	Registration number: AK396F-72226-DM-N REN: 0.3B		
UDS 202S/T PRIMARY CHANNEL			
Operation	2-wire half-duplex PTSN or 4-wire full-duplex leased line operation.		
Data Rate	0-1200 bps asynchronous 600 and 1200 bps with synchronous option		
Operating Mode	Manual/auto answer on PTSN. Point-to-point or multidrop on leased lines.		
Modulation	Frequency Shift Keyed (FSK), asynchronous.		
Carrier Frequencies	202 mode	Mark	= 1200 Hz ± 0.2%
		Space	= 2200 Hz ± 0.2%
		Answer tone	= 2025 Hz ± 0.2%
		SCTO	= 900 Hz ± 0.2%
	V.23 mode	Mark	= 1300 Hz ± 0.2%
		Space	= 2100 Hz ± 0.2%
		Answer tone	= 2100 Hz ± 0.2%
		SCTO	= 900 Hz ± 0.2%
Line Impedance	600 ohms ± 10%		
Transmit Output Level	0, – 2, – 4, – 6, – 8, – 9 dBm, programmable (external by resistor)		
Clear to Send Delay	8, 30, 60, 180 ms		
Carrier Detect Delay	6 or 23 ms		
Receiver Squelch	Local copy squelch and turnaround squelch of 8 or 150 ms		

Controls

Front panel switch

TALK	Connects telephone to line.
DATA	Allows modem to be connected to line on incoming ring signal or transition from TALK to DATA if DTR is on.
AL	Puts modem in analog loopback mode.
DL	Puts modem in digital loopback mode.
ST	Puts modem in self test mode.
TTP	Causes modem to transmit a test pattern when off hook condition occurs due to incoming ring signal or leased line operation.

Indicators

Nine LEDs

POWER	On when power is applied to modem.
MR/RI	On when modem is in data mode. Flashes when ring signal is incoming.
TD	On when EIA-232C TD line is on.
RD	On when EIA-232C RD line is on.
CD	On when a valid carrier is received.
DTR	On when EIA-232C DTR line is on.
RS	On when EIA-232C RTS line is on.
CS	On when EIA-232C CTS line is on.
TM	On when the modem is in any test mode. Flashes off when errors are detected in self test mode.

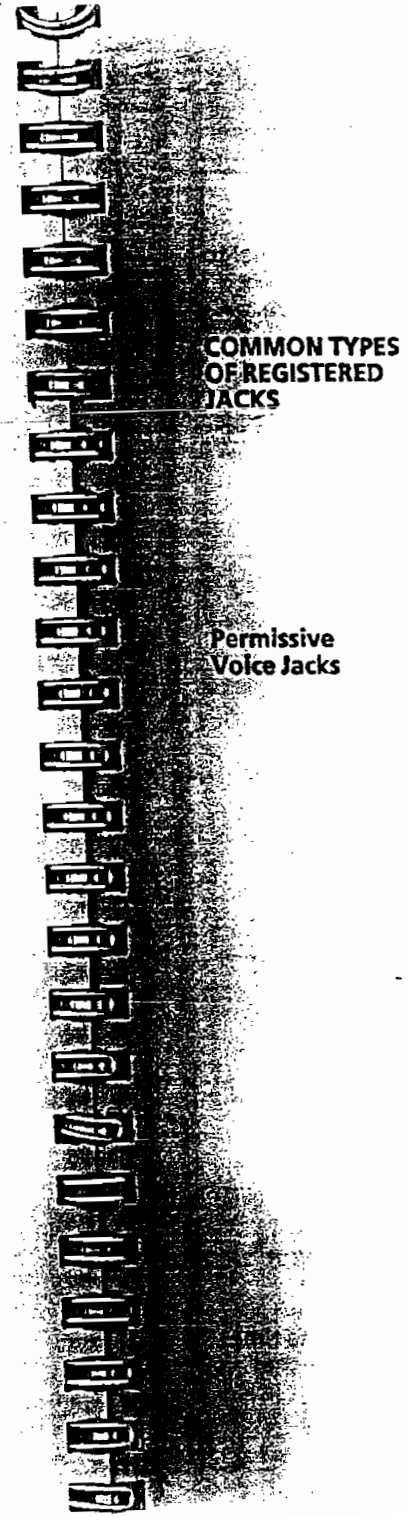
UDS 2025/T-R SECONDARY CHANNEL

Operation	2-wire half-duplex PTSN or 4-wire full-duplex leased line operation.
Data Rates	0 to 5 bps 0 to 75 bps 0 to 150 bps
Modulation	Frequency Shift Keyed (FSK) (single tone for 0 to 5 bps operation)
Audio Tone Frequencies	0 to 5 bps: Single frequency = 390 Hz ± 1% 0 to 75 bps: Mark = 390 Hz ± 1% Space = 450 Hz ± % 0 to 150 bps: Mark = 390 Hz ± 1% Space = 510 Hz ± 1%
Transmit Output Level	– 3 dBm and – 6 dBm (referenced to primary channel output level)
Receiver Input Level	– 45 dBm ± 3 dBm
Carrier Detect Delay	50 ms ± 20 ms turn on 50 ms ± 5 ms turn off
RTS/CTS Delay	213 ms ± 20 ms
Turnaround Squelch	110 ms ± 10 ms
Local Copy Squelch	Squelch receiver when SRTS is on (option)

pecifications

HYSICAL

Dimension and Weight	Width: 7.00 inches (17.8 cm) Height: 2.25 inches (5.7 cm) Length: 9.60 inches (24.4 cm) Weight: 24 oz. (.68 kg)
Environmental Conditions	Temperature Operating: 0 to + 50 ° C Storage: – 40 to + 85 ° C Humidity: 95% relative, non-condensing
Primary Power	115 Vac ± 10%; 50/60 Hz or 230 Vac ± 10%; 50/60 Hz for applicable models.
Interface	The interface to the modem is as follows: • DTE Connector — EIA-232C • TELCO Jack — Standard RJ45S, RJ41S, or RJ11C data jack • TELSET Jack — Standard model 500 telephone set



COMMON TYPES OF REGISTERED JACKS

Permissive Voice Jacks

Appendix B
Telephone Line Connections

FCC Part 68 Universal Service Order Code (USOC) specifies jack arrangements for use on the Public Switched Telephone Network (PSTN). Wiring configurations and modes of operation are also specified in the USOC. When installing a modem, the user may use existing jacks or order special jacks from the telephone company. Understanding the types of jacks, their operation, and connection will make jack selection easier.

Allow a fixed signal level output no greater than –9 dBm. It does not guarantee that same signal level will reach the Central Office (CO). The optimum CO signal level is –12 dBm. Telephone line loss between the customer and the CO is 3 to 6 dB, causing the level received at the CO to be –12 to –15 dBm. This signal is sufficient for voice communication and most modem applications.

RJ11C is the most common permissive arrangement. (See Figure B-1). It is a 6-pin modular jack for single line bridged tip and ring connection. The RJ11C has only two wires connected. Other 6-pin permissive modular jacks may use the same housing. RJ12C and RJ13C are special permissive arrangements that are associated with multi-line key telephones. If connecting a modem to these arrangements, a transfer key, installed by the telephone company, allows selection between data and voice transmissions.

The RJ16X is a special permissive jack that permits the use of an exclusion key phone.

If you experience problems with telephone line characteristics such as attenuation distortion,

envelope delay distortion, line loss, and signal to noise ratio, you may have to replace the voice jack with a data jack to correct the problem.

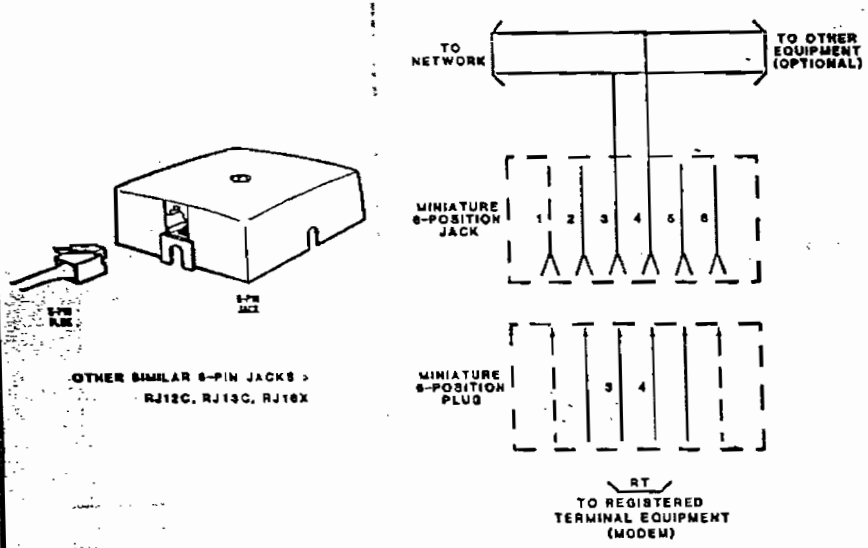


Figure B-1
RJ11C Permissive Jack

Programmable Data Jacks

Data jacks provide a means to adjust the signal level that is received by the CO. There are two methods to adjust the signal level:

- Programmable
- Fixed loss loop

In programmable (PROG), the modem output level is adjusted by a programming resistor located inside the data jack. The telephone company measures the local loop loss at the time of installation, then selects a resistor value that

allows the transmitted signal to reach the CO at the optimum signal power level of – 12 dBm. A table of resistor values for implementing the automatic control of signal power output is provided in FCC Part 68, allowing the telephone company to correct for the optimum level without having the modem connected.

In fixed loss loop (FLL), the modem output level is fixed at a signal level of – 4 dBm by an adjustable attenuator. The attenuator is installed and adjusted by the telephone company during installation. The attenuator is located in the data jack and compensates for local loop loss on the telephone line. It is adjusted for an optimum power level of – 12 dBm at the CO.

UDS modems are not designed to work in a fixed loss loop arrangement.

Bell companies have stricter parameters for local loop characteristics when a data jack is installed instead of a voice jack and will respond more quickly to correct signal problems.

There are two categories of data jack configurations.

- Universal RJ41S (see Figure B-2)
- Programmed RJ45S (see Figure B-3)

The RJ41S has a programming resistor for PROG transmit signal level plus an attenuator for FLL transmit signal level.

The RJ45S has only a programming resistor for PROG transmit signal level.

UDS modems are designed to operate with the RJ45S and RJ41S. When using the RJ41S, the switch must be in the PROG position. If the

switch is placed in the FLL position, both the received and transmit signals are attenuated, causing a higher than normal error rate.

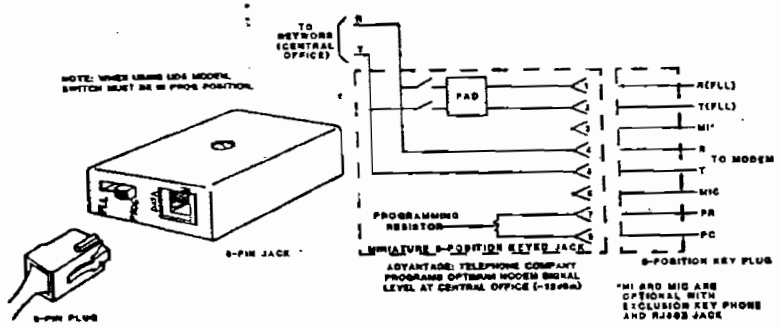


Figure B-2
RJ41S Jack

Typical Modem Connection

To connect the modem to a permissive RJ11C jack (see Figure B-4), an 8-pin to 6-pin modular jack cable* is used between the 8-pin TELCO jack on the modem and the 6-pin RJ11C jack on the wall. A standard rotary or pushbutton telephone is connected to the TELSET jack on the rear of the modem. The cable supplied with the telephone is used for this connection. A talk/data switch on the modem front panel is used to connect the telephone line to the modem or the telephone. This switch is placed in the data position to allow the modem to answer calls.

*UDS part number 61020202

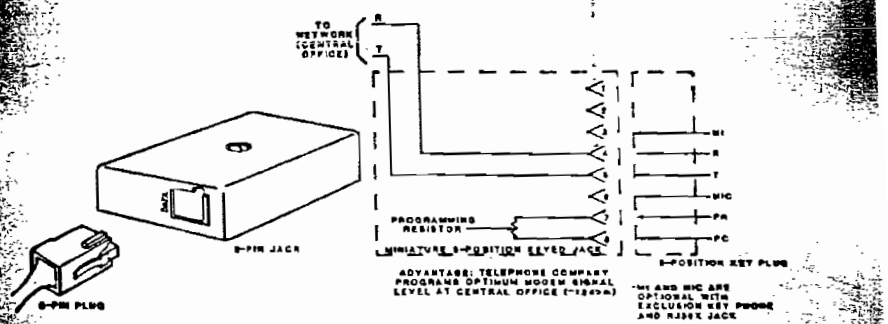


Figure B-3
RJ45S Jack

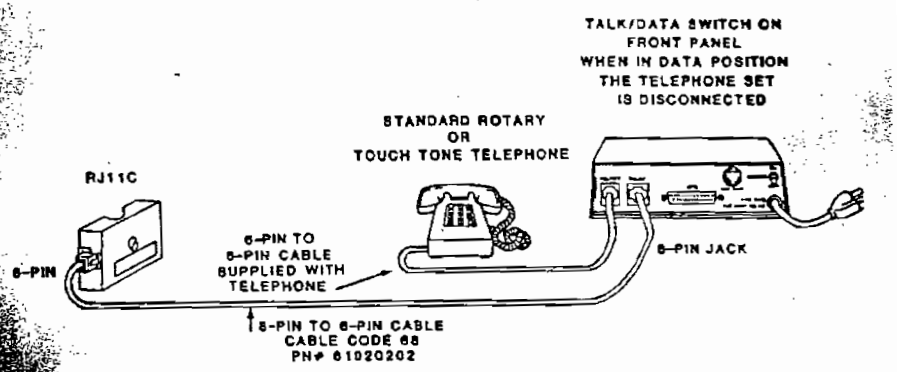


Figure B-4
Modem Connection with RJ11C

To connect the modem to an RJ41S or RJ45S data jack (see Figures B-5 and B-6), an 8-pin to 8-pin modular jack cable* between the TELCO jack, and the wall jack is used. If the RJ41S jack is used, place the switch in the PROG position.

A standard rotary or pushbutton telephone is connected to the 6-pin TELSET jack on the rear of the modem. The telephone supplied cable is used for this connection. A talk/data switch on the front panel is used to connect the telephone line to the modem or the telephone. This switch is placed in the data position to allow the modem to answer calls.

*UDS part number 61020192

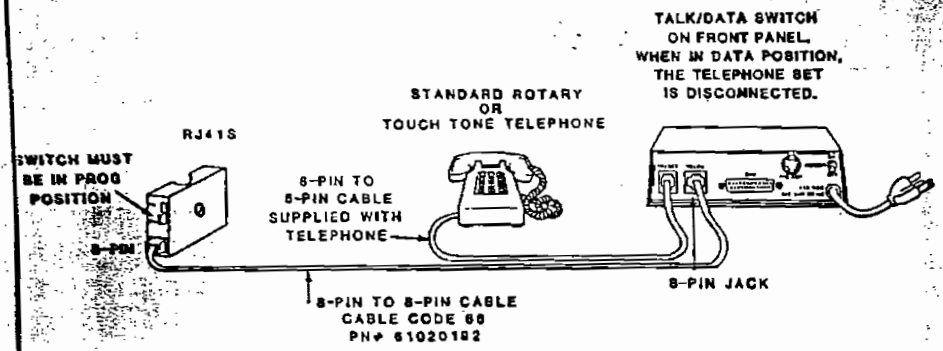


Figure B-5
Modem Connection with RJ41S

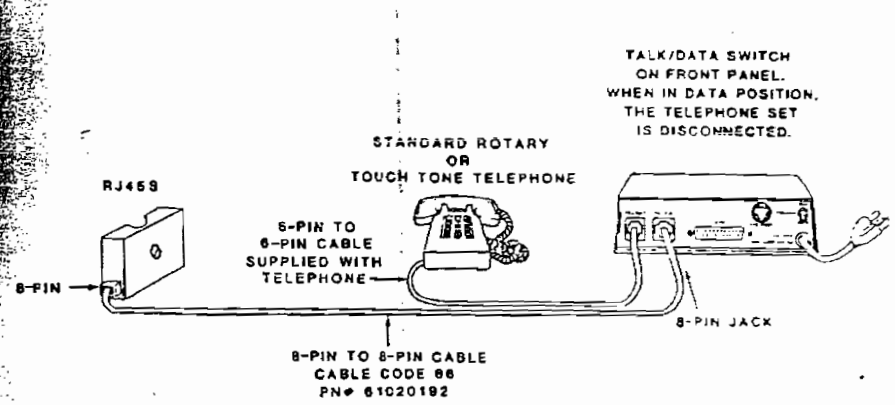


Figure B-6
Modem Connection with RJ45S

Special Modem Connection for Use with Exclusion Key Telephones

UDS standalone modems will operate with an exclusion key telephone. An exclusion key telephone has a special switch hook button on the left hand side. Special control leads called mode indication (MI/A) and mode indication common (MIC/A1) are connected to the switch. There are two types of exclusion key telephone configurations:

- Data set controls the telephone line
- Telephone set controls the telephone line

Data Set Control

Data set control is most common. This configuration has three positions.

- Handset in the cradle
- Handset lifted, exclusion key intermediate
- Handset lifted, exclusion key up

With the handset in the cradle, tip and ring leads pass through the telephone to the modem. MI

and MIC are open. This allows an incoming call to be routed directly to the modem.

With the handset lifted and exclusion key intermediate, tip and ring leads are bridged through a capacitor to the handset earpiece. This allows monitoring of the modem analog signal for troubleshooting purposes.

NOTE

The handset must have the aural monitoring option for this feature.

With the handset lifted and exclusion key up, tip and ring leads are connected to the handset. This allows calls to be manually placed or answered. When the exclusion key is up, the MI and MIC leads are shorted. This tells the modem the telephone is in voice mode.

After manual use of the exclusion key telephone, the handset is placed in the cradle.

To connect the modem to a permissive RJ16X jack through an exclusion key telephone (see Figure B-7), an 8-pin to 6-pin modular jack cable* is used between the 8-pin TELCO jack and the 6-pin RJ16X jack on the wall. The TELSET jack on the rear of the modem is not used. The exclusion key telephone is connected to an 8-pin RJ36X jack. This cable is provided by the telephone company. The RJ36X and RJ16X jacks are connected together by the telephone company. The modem talk/data switch on the front panel must be in the data position when originating or answering calls.

*UDS part number 61020418

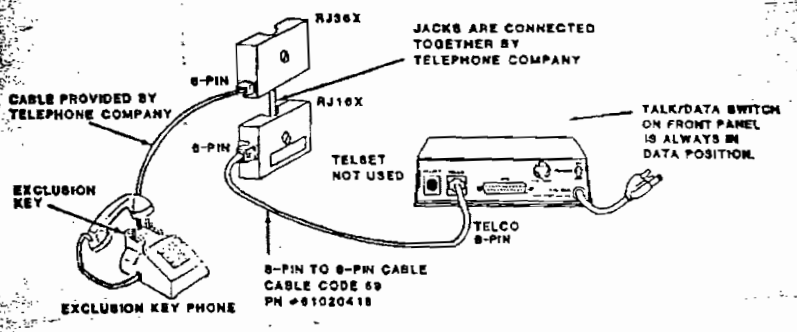


Figure B-7
Modem/Exclusion Key Telephone Connection with RJ16X

To connect the modem to an RJ41S or RJ45S data jack (see Figure B-8), an 8-pin to 8-pin modular jack cable* is used between the 8-pin TELCO jack and the 8-pin RJ41S or RJ45S jack on the wall. If the RJ41S jack is used, ensure the switch is placed in the PROG position. The TELSET jack on the rear of the modem is not used. The exclusion key telephone is connected to an 8-pin RJ36X jack. This cable is provided by the telephone company. The RJ36X and either the RJ41S or RJ45S jack are connected together by the telephone company. The modem talk/data switch on the front panel must be in the data position when originating or answering calls.

*UDS part number 61020192

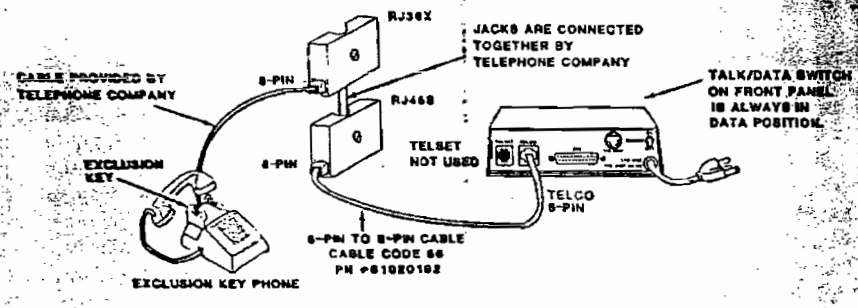


Figure B-8
Modem/Exclusion Key Telephone Connection with RJ41S or RJ45S

Telephone Set Control

The telephone set control is seldom used. This configuration has three positions

- Handset in the cradle
- Handset lifted, exclusion key intermediate
- Handset lifted, exclusion key up

The difference between data set or telephone set control is effected by wiring changes in the phone. In the first two positions the telephone is electrically isolated from the modem and functions as a regular phone.

With the handset in the cradle, tip and ring leads are connected to the telephone, MI and MIC are open.

With the handset lifted and exclusion key intermediate, tip and ring leads are connected to the telephone handset, and the MI and MIC leads are shorted. In this position the telephone

is in voice mode and calls may be manually placed or answered.

With the handset lifted and the exclusion key pulled up, tip and ring leads are passed through the modem, and the MI and MIC leads are open. Pulling the exclusion key to the up position causes the MI and MIC to go from a shorted to open condition. It is this transition that causes the modem to go off hook and connect to the telephone line. The drawback of this feature is the handset must be off hook for data transmission.