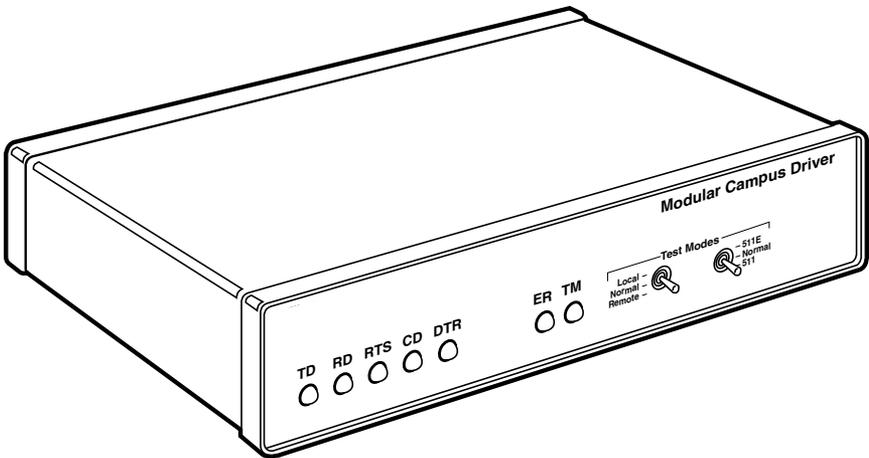




4-Wire Modular Campus Driver



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**FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS**

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

**NORMAS OFICIALES MEXICANAS (NOM)
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 conectado 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 física 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 líneas de energía.
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 objetos líquidos 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: Objetos 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.

TRADEMARKS USED IN THIS MANUAL

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

CE NOTICE

The CE symbol on your equipment indicates that it is in compliance with the Electromagnetic Compatibility (EMC) directive and the Low Voltage Directive (LVD) of the Union European (EU).

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1. Specifications

Transmission Format —	Synchronous
Transmission Line —	Unconditioned twisted pair, 19 to 26 AWG
Clocking —	Internal, external, or receive loopback
Distance —	Up to 11 miles (19 AWG @ 56 kbps)
Data Rates —	48, 56, 64, 72, 80, 112, 128, 144, and 160 kbps (switch-selectable)
Carrier Control —	Constantly on or Controlled by RTS
RTS/CTS Delay —	No delay, short delay (4 to 9 ms), long delay (33 to 71 ms)
Diagnostics —	V.52-compliant bit-error-rate pattern (511/511E pattern) generator and detector with error-injection mode; V.54 compliant—local analog loopback and remote digital loopback, activated by front-panel switch or via serial interface
LED Status Indicators —	TD, RD, RTS, CD, DTR, ER, and TM (test mode)
Isolation —	Minimum 3000V RMS via transformers
Surge Protection —	600W power dissipation at 1 ms
DCE/DTE Interface —	Field-replaceable interface cards
Twisted-Pair Interface —	8-position modular jack (RJ-45)
Power —	ME480A-R2: 100-240 VAC, 50/60 Hz (universal input option), 0.3 A max.; ME480A-D48: 48 VDC, 5 watts
Temperature Range —	32 to 95°F (0 to 35°C)
Altitude —	Up to 15,000 feet (4570 m)

Humidity —	5 to 95% noncondensing
Size —	7.3" x 6.6" x 1.6" (18.5 x 16.8 x 4.1 cm)
Weight —	2 lb. (1 kg)

2. Introduction

The 4-Wire Modular Campus Driver is designed for point-to-point, high-speed communication over 4 wires (two twisted pairs). Supporting switch-selectable data rates from 48 to 160 kbps, the Campus Driver is perfect for connecting two bridge/routers, or for similar campus applications at distances up to 11 miles (17.7 km). The Campus Driver incorporates built-in V.54 loopback tests, a V.52 BERT pattern generator, and seven front-panel LED indicators. Data integrity is enhanced by automatic equalization and gain control. The Campus Driver also incorporates transformer isolation and surge protection to guard data and connected equipment against the hazards of ground loops and transient surges. Clocking options are internal, external, and receive recover clock.

The Campus Driver features replaceable DCE-DTE interface modules. Several different modules are available. Line connection is made by RJ-45 jack. Internal AC power-supply options are 110-240 VAC (universal) or 48 VDC.

Some of the Campus Driver's features include:

- Synchronous data rates from 48 to 160 kbps.
- Frequency Shift Key (FSK) modulation.
- Full- or half-duplex operation over two twisted pair (4-wire).
- Point-to-point distances up to 11 miles (19 AWG @ 56 kbps).
- V.54 compliant local and remote loopback tests (DTE or front-panel activated).
- V.52 compliant Bit Error Rate (BER) test-pattern generator.
- Replaceable DTE-DCE interface modules.
- V.52 compliant BER test-pattern generator.
- Internal, external, or receive recovered clocking options.
- Automatic equalization.

3. Configuration

The 4-Wire Modular Campus Driver is equipped with one set of eight DIP switches, and one set of four DIP switches (all externally accessible). These DIP switches allow configuration of clock source, carrier control, loopback tests, and data rate. This section describes switch locations and explains all possible configurations.

External DIP-Switch Settings

The DIP switches are located on the underside of the unit (see Figure 3-1, below). Figure 3-2 shows the orientation of the switch set. All possible settings for the DIP switches are presented in the summary table and descriptions on the following pages. If you have additional questions regarding configuration, contact Technical Support at 724-746-5500.

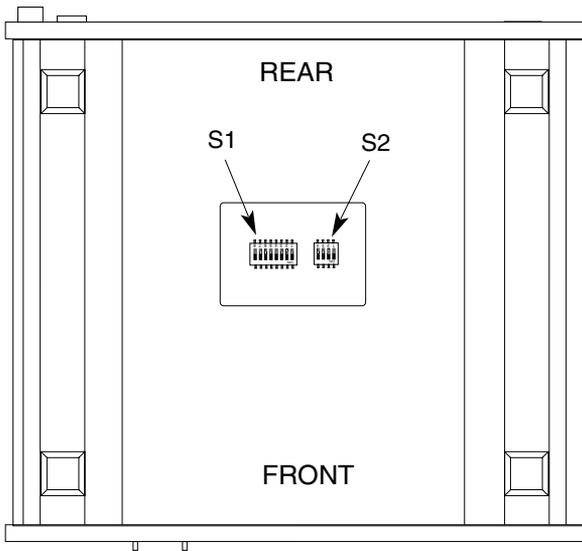


Figure 3-1. External DIP-Switch Locations.

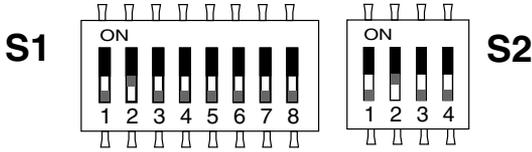


Figure 3-2. Close-Up of the Switches.

Table 3-1. Summary of DIP-Switch Default Settings for S1

S1 SUMMARY TABLE		
Position	Function	Factory Default
S1-1	Clock Source*	On
S1-2	Clock Source*	On
		} Internal
S1-3	RTS/CTS Delay	On Short Delay
S1-4	LDL Control	Off Disabled
S1-5	Carrier Control	Off Constant
S1-6	DTE Control of RDL	Off Disabled
S1-7	DTE Control of LAL	Off Disabled
S1-8	V.54 Enable/Disable	Off Enabled

*See Note in SWITCH SET S1 (next page) for X.21 Clock Sources

Switch Set S1

The configuration switches on S1 set clock source, RTS/CTS delay, carrier control, and loopback tests.

S1-1 and S1-2: Clock Source

Switches S1-1 and S1-2 are set in combination to determine the source of timing.

<u>S1-1</u>	<u>S1-2</u>	<u>Setting</u>
On	On	Internal
On	Off	Receive recover
Off	On	External transmit clock
Off	Off	Not a valid setting

NOTE

When an X.21 card is installed in one or both base units, one base unit *must* be configured for receive recover clock source. The particular application will dictate which unit must be configured for receive recover clock source.

S1-3: RTS/CTS Delay

Switch S1-3 determines the amount of delay between the time RTS is activated and the Campus Driver activates the CTS.

<u>S1-3</u>	<u>Function</u>
On	Short delay (4 to 9 msec)
Off	Long delay (33 to 71 msec)

S1-4: LDL Control

Switch S1-4 determines whether the front-panel switch can activate a Local Digital Loopback (LDL) diagnostic test.

<u>S1-4</u>	<u>Function</u>
On	LDL Control Enabled
Off	LDL Control Disabled

S1-5: Carrier Control

The setting for switch S1-5 determines whether the carrier is “constantly on” or “controlled by RTS.” This setting allows for operation in switched-carrier or hardware-handshaking applications.

<u>S1-5</u>	<u>Setting</u>
On	Controlled by RTS
Off	Constantly on

S1-6: DTE Control of RDL

The setting for switch S1-6 determines whether DTE control of the remote digital loopback test is enabled or disabled. If DTE control is disabled, the RDL test can only be initiated by the front-panel switch.

<u>S1-6</u>	<u>Setting</u>
On	DTE control enabled
Off	DTE control disabled

S1-7: DTE Control of LAL

The setting for switch S1-7 determines whether DTE control of the local analog loopback test is enabled or disabled. If DTE control is disabled, the LAL test can only be initiated by the front-panel switch.

<u>S1-7</u>	<u>Setting</u>
On	DTE control enabled
Off	DTE control disabled

S1-8: V.54 Enable / Disable

The setting for switch S1-8 determines whether the Campus Driver will respond when it receives the V.54 sequence. If you suspect the Campus Driver may be getting tricked into the loopback test by false detection of user data, you can try setting this to “Disable.”

<u>S1-8</u>	<u>Setting</u>
On	Disabled
Off	Enabled

Switch Set S2

The settings for DIP switches S2-1 through S2-4 determine the synchronous data rate of the Campus Driver. All possible settings (including the default) are shown below:

<u>S2-1</u>	<u>S2-2</u>	<u>S2-3</u>	<u>S2-4</u>	<u>Setting</u>
Off	Off	Off	On	48 kbps
Off	Off	On	Off	56 kbps
Off	Off	On	On	*64 kbps
Off	On	Off	Off	72 kbps
Off	On	Off	On	80 kbps
Off	On	On	Off	112 kbps
Off	On	On	On	128 kbps
On	Off	Off	Off	144 kbps
On	Off	Off	On	160 kbps

* Default Setting

4. Installation

Once the Campus Driver is properly configured, it is ready to connect to the twisted-pair interface, to the serial port, and to the power source.

4.1 Connection to the Twisted-Pair Interface

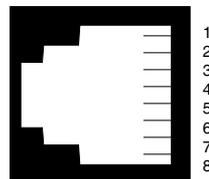
The Campus Driver supports communication between two terminal devices at distances to 11 miles and data rates to 160 kbps. There are two essential requirements for installing the Campus Driver:

1. These units work in pairs. Therefore, you must have one Campus Driver (or a compatible model) at each end of a two twisted-pair interface.
2. To function properly, the Campus Driver needs two twisted pairs of metallic wire. These twisted pairs must be unconditioned, dry, metallic wire, between 19 and 26 AWG (the higher-number gauges may limit distance somewhat). Standard dial-equalization equipment, or standard, flat modular telephone cable, is not acceptable.

TWISTED-PAIR CONNECTION USING RJ-45

The Campus Driver uses a modular RJ-45 jack for twisted-pair line connection. The signal/pin relationships are shown below:

RJ-45	SIGNAL
1	XMT+
2	XMT-
3	N/C
4	GND*
5	GND*
6	N/C
7	RCV+
8	RCV-



*Connection to ground is optional

When connecting two Campus Drivers, it is necessary to use a crossover cable. The diagram below shows how a crossover cable should be constructed.

RJ-45 Cable (4-Wire)

<u>SIGNAL</u>	<u>PIN#</u>	<u>PIN#</u>	<u>SIGNAL</u>
XMT+	1-----	7	RCV+
XMT-	2-----	8	RCV-
GND*	4-----	5	GND*
GND*	5-----	4	GND*
RCV+	7-----	1	XMT+
RCV-	8-----	2	XMT-

*Connection to ground is optional

4.2 Connection to the Serial Port

The serial port interface on the Campus Driver uses interchangeable Interface Cards. Each Card has a 50-pin card-edge connector on one side and a serial-port interface on the other. Figure 4-1 (below) shows how a Card plugs into the back of the Campus Driver.

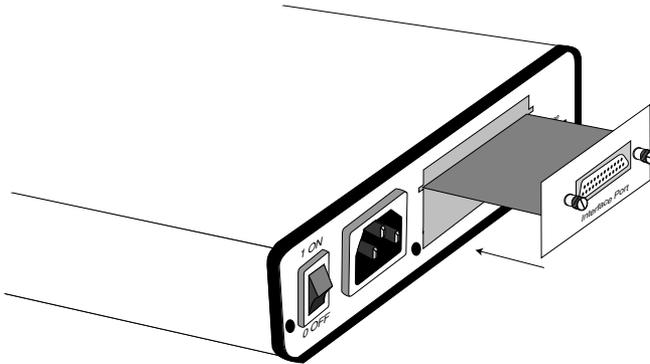


Figure 4-1. Installing the Interface Card.

4.2.1 CHANGING INTERFACE CARDS

Removing a Card

1. Turn the power switch off. Leave the power cord plugged into a grounded outlet to keep the unit grounded.
2. Loosen the two thumbscrews on the Card by turning them counterclockwise.
3. Grasp the two thumbscrews and gently pull the Card from the unit. Apply equal force to the thumbscrews to keep the Card straight during the removal process.

Installing a New Card

1. Make sure the power switch is off. Leave the power cord plugged into a grounded outlet to keep the unit grounded.
2. Hold the Card with the faceplate toward you and align the Card with the guide slots in the rear panel of the Campus Driver.
3. While keeping the Card's faceplate parallel with the Campus Driver's rear panel, slide the Card straight in—so that the card edge contacts line up with the socket inside the chassis.

NOTE

The card edge connector should meet the socket when it is almost all the way into the chassis. If you encounter a lot of resistance, remove the Card and repeat Steps 2 and 3.

4. With the card edge contacts aligned with the socket, firmly seat the Card by using your thumbs to apply pressure directly to the right and left edges of the Card's faceplate. Applying moderate and even pressure should be sufficient to seat the Card. You should hear it snap into place.
5. To secure the Card in place, push the thumbscrews into the chassis and turn the screws clockwise to tighten.

4.2.2 CONNECTION TO A DTE DEVICE

The serial port on the interface cards (all except the X.21 card) is hard-wired as a DCE. Therefore these cards “want” to plug into a DTE such as a terminal, PC, host, or printer. When making the connection to your DTE device, use a straight-through cable of the shortest possible length—we recommend 6 feet or less. When purchasing or constructing an interface cable, please refer to the pin diagrams in **Appendix C** as a guide.

4.2.3 CONNECTION TO A DCE DEVICE

If the Campus Driver’s interface card is hard-wired as a DCE (all except the X.21 card), you must use a null-modem cable when connecting to a modem, multiplexer, or other DCE device. This cable should be of the shortest possible length—we recommend 6 feet (1.8 m) or less. When purchasing or constructing a null-modem interface cable, use the pin diagrams in **Appendix C** as a guide.

NOTE

Pin-out requirements for null-modem applications vary widely between manufacturers. If you have any questions about a specific application, contact Technical Support.

4.2.4 RECONFIGURING THE X.21 INTERFACE CARD

The serial port on the X.21 card is default wired as a DCE, but may be switched to a DTE. This is done by reversing the orientation of the DCE/DTE strap, as described below:

To reverse DCE/DTE orientation, remove the card according to the instructions in **Section 4.2.1**. The DCE/DTE strap is located on the bottom side of the Card’s PC board. The arrows on the top of the strap indicate the configuration of the X.21 port (for example, if the DCE arrows are pointing toward the DB15 connector, the X.21 port is wired as a DCE). Reverse the DCE/DTE orientation by pulling the strap out of its socket, rotating it 180°, then plugging the strap back into the socket. You will see that the DCE/DTE arrows now point in the opposite directions, showing the new configuration of the X.21 port. Reinstall the card according to the instructions in **Section 4.2.1**.

4.3 Connection to the Power Source

The Campus Driver is available with two power-supply options:

The **Universal Interface** power-supply option (ME480A-R2) operates in environments ranging from 110 to 240 VAC, with no reconfiguration necessary.

The **DC** power-supply option (ME480A-D48) operates in 48-VDC environments and is equipped with a 3-pin terminal block with spring-type contacts. The DC power source used with this product must be a Selv source of supply.

The **AC** power-supply option (Universal) is equipped with a male IEC-320 power connection. A North American power-supply cord is supplied for use with a 115-volt outlet. For a 230-volt outlet, use a cord with a plug that fits outlets in your area. To connect the universal power supply, follow these steps:

1. Attach the power cord (supplied) to the shrouded male IEC-320 connector on the rear of the Campus Driver.
2. Plug the power cord into a nearby AC power outlet.
3. Turn the rear power switch ON.

WARNING! There are no user-serviceable parts in the power-supply section of the Campus Driver. Voltage-setting changes and fuse replacement should only be performed by qualified service personnel. Any questions may be answered by contacting Technical Support at 724-746-5500.

5. Operation

Once the Campus Driver is properly configured and installed, it should operate transparently. This section describes power-up, reading the LED status monitors, and using the built-in loopback test modes.

5.1 Power-Up

Before applying power to the Campus Driver, first be sure that you have read **Section 4.3**, and that the your power source matches the power rating shown on the bottom label of the Campus Driver. Failure to do so could result in damage to the unit and connected equipment, and may constitute a fire hazard. If your Campus Driver is AC powered, plug the AC power cord into both the Campus Driver and the AC outlet. Then power up the unit using the rear power switch. If your Campus Driver is DC powered, and has been connected to the DC power source according to the instructions in **Section 4.3**, turn on the DC power supply and then power up the unit using the rear power switch.

5.2 LED Status Monitors

The Campus Driver features seven front-panel LEDs that monitor transmit data, receive data, request to send, carrier detect, data terminal ready, test modes, and error conditions. Figure 5-1 shows the front-panel location of each LED. Following Figure 5-1 is a description of each LED's function.

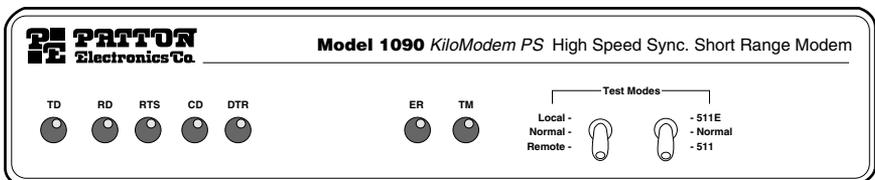


Figure 5-1. Front Panel.

4-WIRE MODULAR CAMPUS DRIVER

TD and RD	Will glow red to indicate an idle condition of Binary 1 data on the respective terminal interface signals. Green indicates Binary 0 data.
RTS	Will glow green to indicate that the Request to Send signal from the terminal is active.
CD	Will glow red if no carrier signal is being received from the remote modem. Green indicates that the remote modem's carrier is being received.
DTR	Will glow green to indicate that the Data Terminal Ready signal from the terminal is active.
ER	Will glow red to indicate the likelihood of a Bit Error in the received signal. During the 511 or 511/E test, ER will flash to indicate that the Test Pattern Detector has detected a bit error.
TM	Will glow green to indicate that the Campus Driver has been placed in Test Mode. The unit can be placed in test mode by the local user or by the remote user.

5.3 Diagnostics

The Campus Driver is equipped with three sets of diagnostics to evaluate the condition of the local and remote units, as well as the twisted-pair link between them: local analog loopback (LAL) and remote digital loopback (RDL) according to the CCITT V.54 Standard, and bit-error-rate (BER) test according to the CCITT V.52 Standard.

5.3.1 LOCAL ANALOG LOOPBACK (LAL)

The Local Analog Loopback (LAL) test checks the operation of the local Campus Driver. Any data sent to the local Campus Driver in this test mode will be echoed (returned) back to the user device. For example, characters typed on the keyboard of a terminal will appear on the terminal screen (see Figure 5-2, below).

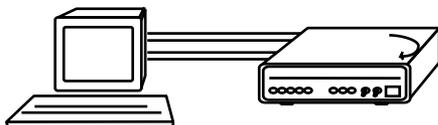


Figure 5-2. LAL.

To perform an Analog Loopback test, follow these steps:

- A. Activate Local Analog Loopback. This may be done in one of two ways: first, by moving the front panel toggle switch UP to Local, or second, by raising signal LL on the terminal interface (for pin numbers, see **Appendix C**). Once LAL is activated, the Campus Driver's transmit output is connected to its own receiver. The TM LED should be lit.
- B. Verify that the data terminal equipment is operating properly and can be used for a test. If a fault is indicated, call a technician or replace the unit.
- C. Perform a BER (bit error rate) test on each unit using a separate BER tester. If the BER test equipment indicates no faults but the data terminal indicates a fault, follow the manufacturer's checkout procedures for the data terminal. Also, check the interface cable between the terminal and the Campus Driver.

5.3.2 REMOTE DIGITAL LOOPBACK (RDL)

The Remote Digital Loopback (RDL) test checks the performance of both the local and remote Campus Drivers, and the communication link between them. Any characters sent to the remote Campus Driver in this test mode will be returned back to the originating device.

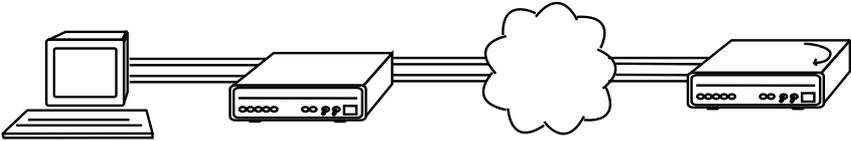


Figure 5-3. RDL.

To perform an RDL test, follow these steps:

- A. Activate RDL. This may be done in one of two ways: First, by moving the front-panel toggle switch DOWN to “Remote.” Or, second, by raising the RL signal on the terminal interface (for pin numbers, see **Appendix C**).
- B. Perform a BER (bit error rate) test on the system, using BER testers on both ends.
- C. If the BER test equipment indicates a fault and the Local Analog Loopback test was successful for both Campus Drivers, you may have a problem with the line between the Campus Drivers. You should inspect the line for proper connections.

5.3.3 LOCAL DIGITAL LOOPBACK (LDL)

The Local Digital Loopback (LDL) test checks the local and remote Campus Drivers and all communication paths. In LDL, the TX/RX circuit of the local Campus Driver closes, thereby allowing characters sent from BOTH the local terminal and remote terminal to loop back (echo) to themselves (see **Figure 5-4**). To accurately perform LDL diagnostics, technicians must send characters (or BER diagnostics) from each end. To perform an LDL, follow the instructions below.

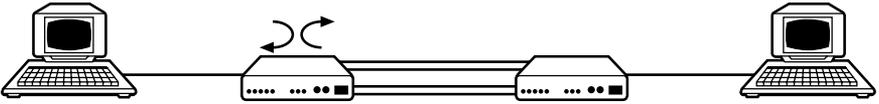


Figure 5-4. LDL.

- A. On the bottom of the Campus Driver, turn S1-4 to the ON position.
- B. Enable LDL by moving the front panel toggle switch up to “Local,” or, by raising the signal LL on the terminal interface (for pin numbers, see **Appendix C**).
- C. Now you may do a BER (bit error rate) test on the system by using either the 511 or 511/E toggle switch or a BER tester connected to the DTE interface.
- D. If the BER test equipment indicates a fault and the Local Analog Loopback test was successful for both Campus Drivers, you may have a problem with the line between the Campus Drivers. Inspect the line for proper connections.

NOTE

LDL will only work when S1-4 is ON.

5.3.4 V.52 BER TEST GENERATOR

The Campus Driver has a built-in test-pattern generator and detector. It can be invoked at both ends of a link simultaneously, or it can be used with the Local Analog or Remote Digital Loopbacks. The following example requires two operators: one to initiate and monitor the test at the local Campus Driver, and one at the remote Campus Driver. To use the V.52 BER test by itself, both operators should simultaneously follow these steps.

- A. Locate the 511/511E toggle switch on the front panel of the Campus Driver and move it DOWN. This activates the V.52 BER test mode and transmits a 511 pseudorandom test pattern to the other unit. If any errors are received, the receiving Campus Driver's red ER LED will blink sporadically.

NOTE

For this test to function, the 511 switch on both Campus Drivers must be on.

- B. If the test indicates no errors are present, move the V.52 toggle switch UP, activating the 511/E test. The 511/E test transmits the 511 pseudorandom test pattern and injects intentional errors about once per second. If the test is working properly, the receiving Campus Driver's red ER LED will blink regularly.

A successful 511/E test will confirm that the link is in place, and that the Campus Driver's built-in 511 generator and detector are working properly.

- C. This test can be done by one operator by first activating the local analog loop or remote digital loop.

Appendix A. Replacing the Fuse

WARNING! Only Service Personnel are to access the area inside the plastic shield marked with the electric shock symbol.



Service Personnel are defined as persons who have the appropriate technical training and experience necessary to (a) perform tasks in the SERVICE ACCESS AREA of the equipment, and (b) be aware of hazards to which they are exposed in performing a task, and of measures to minimize the danger to themselves or other persons.

This section describes the procedures for replacing the fuse.

- A. Switch the unit OFF.
- B. Remove the power plug from the AC wall outlet.
- C. Remove the power plug out of the rear of the unit.
- D. Switch the unit ON and verify that none of the front-panel status indicators are lit. Switch the unit OFF.
- E. Remove the metal screws on the bottom left and bottom right of the rear panel. *Do not discard the screws.* Gently slide the PC board and rear panel out from the metal enclosure.
- F. Remove the nylon screws that hold the clear plastic shield in place. Lift off the plastic shield. *Do not discard the screws or the plastic shield.*
- G. With a flat-blade screwdriver, gently pry off the fuse cover. *Do not discard this cover!* Pull out the fuse. Replace the fuse and reinstall the fuse cover.

WARNING! Replace the fuse only with one that has the correct voltage and current rating for the voltage setting of the unit (the proper fuse ratings is marked on the board near the fuse holder). Replacing the fuse with one having an incorrect rating can result in a fire!

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- H. *Before connecting the power cord, verify that the line voltage is within the voltage range specified for the unit. This rating is stated on the label on the bottom of the unit. An improper line-voltage connection may result in damage, improper functioning, or both.* Install the circuit power cord according to the instructions in **Section 4.3**.
- I. Reinstall the plastic shield so that all of the holes line up with the stand-offs. Reinstall the nylon screws. *Do not overtighten the nylon screws.*
- J. Line up the PC board with the two slots located on the rear-panel bottom left and bottom right. Gently slide the PC board/rear-panel assembly back into the enclosure. It is properly installed when the all of the indicators and switches are aligned at the front-panel and the rear-panel bezel is fully mated into the enclosure. Do not force the unit into the enclosure. If it sticks, it's usually because the PC board was not inserted into the two slots properly.
- K. Reinstall the two metal screws that were removed as instructed in Step E.
- L. Reinstall the power cord according to the instructions in **Section 4.3**.

Replacement Fuses

ME480A-R2.....Fuse 5x20mm, 200mA, 250V, Time-lag

ME480A-D48.....Fuse 5x20mm, 200mA, 250V, Time-lag

Appendix B. Cable Recommendations

The Campus Driver operates at frequencies of 160 kHz or less and has been performance-tested using twisted-pair cable with the following characteristics:

<u>Wire Gauge</u>	<u>Capacitance</u>	<u>Resistance</u>
19 AWG	83nF/mi or 15.72 pF/ft.	0.0163 ohms/ft.
22 AWG	83nF/mi or 15.72 pF/ft.	0.0326 ohms/ft.
24 AWG	83nF/mi or 15.72 pF/ft.	0.05165 ohms/ft.
26 AWG	83nF/mi or 15.72 pF/ft.	0.08347 ohms/ft.

For optimum performance, keep the following guidelines in mind:

- *Always use twisted-pair wire—this is not an option.*
- Use twisted-pair wire with a capacitance of 20pF/ft. or less.
- Avoid twisted-pair wire thinner than 26 AWG (avoid higher AWG numbers than 26).
- Use of twisted pair with a resistance greater than the above specifications above may cause a reduction in maximum distance obtainable. Functionality should not be affected.
- Many environmental factors can affect the maximum distances obtainable at a particular site. Use the data rate/distance table (below) as a general guideline only.

Distance Table (in miles)

Data Rate (kbps)	Wire Gauge			
	19G (0.9 mm)	22G (0.64 mm)	24G (0.5 mm)	26G (0.4 mm)
160	8.14	5.87	4.07	3.03
144	8.52	6.06	4.36	3.13
128	9.00	6.16	4.64	3.22
112	9.19	6.25	4.83	3.22
80	9.19	6.44	5.21	3.22
72	10.80	6.63	5.49	3.41
64	10.98	6.82	5.49	3.41
56	11.08	6.82	5.49	3.41
48	10.80	6.63	5.40	3.31

Appendix C. Pinouts

DB25F Connector—DCE (ME481C-232, ME481C-422)

<u>Pin #</u>	<u>Signal</u>
1	FG (Frame Ground)
2	TD (Transmit Data)
3	RD (Receive Data)
4	RTS (Request to Send)
5	CTS (Clear to Send)
6	DSR (Data Set Ready)
7	SGND (Signal Ground)
8	CD (Carrier Detect)
9	RC/ (Receive Timing-B)
10	CD/ (Carrier Detect-B)
11	XTC/ (External Transmit Clock-B)
12	TC/ (Test Control-B)
13	CTS/ (Clear to Send-B)
14	TD/ (Transmit Data-B)
15	TC (Test Control-A)
16	RD (Receive Data)
17	RC (Receive Timing)
18	LLB (Local Line Loop)
19	RTS/ (Request to Send-B)
20	DTR (Data Transfer Rate)
21	RDL (Remote Digital Loop)
22	DSR/ (Data Set Ready-B)
23	DTR/ (Data Transfer Rate-B)
24	XTC (External Transmit Clock)
25	TM (Test Mode)

**M/34F Connector—DCE
(V.35 Interface)
(ME481C-35)**

Pin #	Signal
B	SGND (Signal Ground)
C	RTS (Request to Send)
D	CTS (Clear to Send)
E	DSR (Data Set Ready)
F	CD (Carrier Detect)
H	DTR (Data Transfer Ready)
L	LLB (Local Line Loop)
M	TM (Test Mode)
N	RDL (Remote Digital Loop)
P	TD (Transmit Data)
R	RD (Receive Data)
S	TD/ (Transmit Data-B)
T	RD/ (Receive Data-B)
U	XTC (External Transmit Clock)
V	RC (Receive Timing)
W	XTC/ (External Transmit Clock-B)
X	RC/ (Receive Timing-B)
Y	TC (Test Control-A)
AA	TC/ (Test Control-B)

DB15F Connector—DCE Setting (X.21 Interface) (ME481C-X21)

<u>Pin #</u>	<u>Signal</u>
1	Frame Ground
2	T (Transmit Data-A)
3	C (Control-A)
4	R (Receive Data-A)
5	I (Indication-A)
6	S (Signal Element Timing-A)
7	BT (Byte Timing-A)
8	SGND (Signal Ground)
9	T/ (Transmit Data-B)
10	C/ (Control-B)
11	R/ (Receive Data-B)
12	I/ (Indication-B)
13	S/ (Signal Element Timing-B)
14	BT/ (Byte Timing-B)

Note: X.21 uses balanced data and control signals.



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