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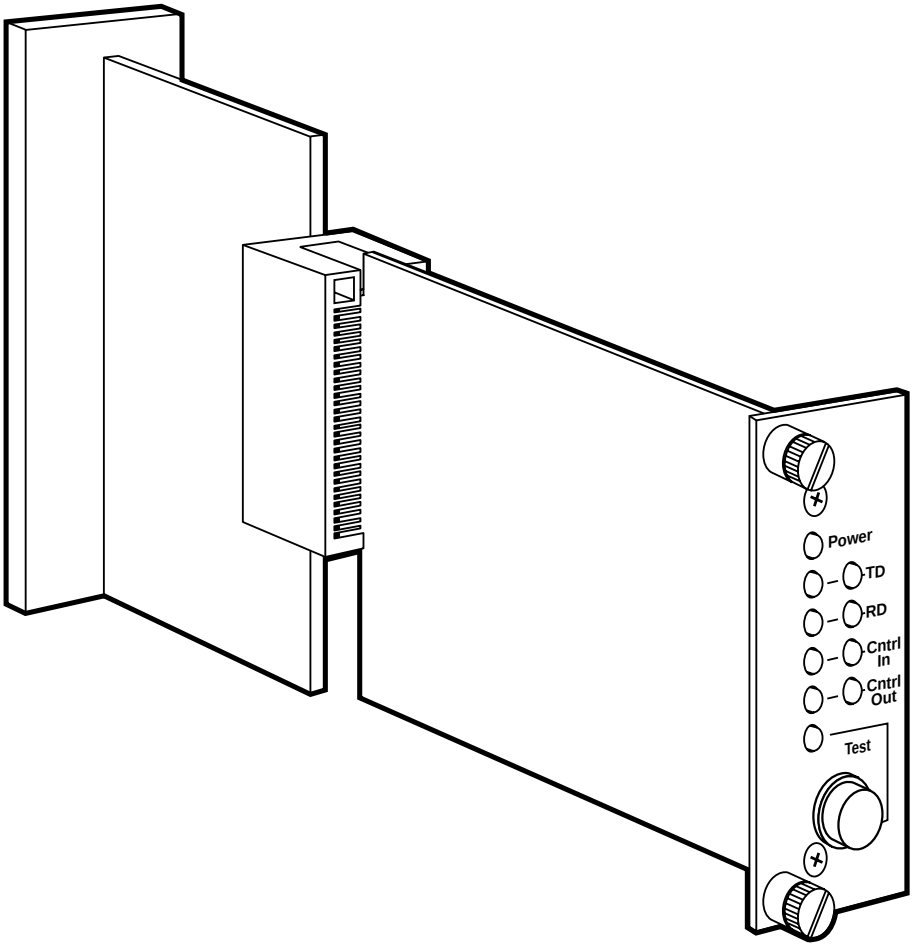
NETWORK SERVICES

**FEBRUARY 1999**
**ME930C-RJ11**

# Sync MP Line Driver Card

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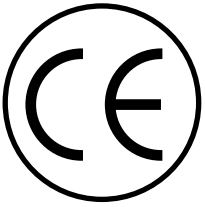
## DECLARATION OF CONFORMITY

This equipment complies with the Electromagnetic Compatibility (EMC) directive and the Low Volatge Directive (LVD) of the Euopean Union.



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# Contents

# 1. Specifications

**Compliance —** FCC Part 15 Subpart J Class A, IC Class/classe A

**Interfaces —** Local: EIA/TIA RS-232C/ITU-T V.24, V.28;
Line: Proprietary balanced 4-wire (see **Line Type** below)

**Protocol —** Synchronous

**Clock Source —** Internal or external (from DTE), user-selectable; with special cabling, can also use recovered receive clock

**Data Rate —** 19.2, 14.4, 9.6, 7.2, 4.8, 2.4, or 1.2 kbps (user-selectable)

**Flow Control —** RTS/CTS (hardware—RTS/CTS delay can be 0, 8, or 53 ms, user-selectable); can also pass through X-ON/X-OFF (software)

**Carrier Control —** Constantly on or controlled by RTS (user-selectable)

**Operation —** Point-to-point or multipoint

**Line Type —** 4-wire unconditioned twisted pair, 19 to 26 AWG, with 20 pF/ft. (65.6 pF/m) or better capacitance

**Optical Isolation —** 150 Vrms minimum

**User Controls —** Front-panel test pushbutton;
8-position DIP switch for various options mounted on front half-card;
(3) Jumpers for grounding options mounted on rear half-card

**Diagnostics —** Simultaneous local and remote analog loopback, controlled with front-panel pushbutton

**Indicators —** (10) Front-mounted LEDs:
(1) Power;
(1) Test;
(2) TD:
(1) for positive-state activity (green),
(1) for negative-state activity (red);

**Indicators (continued) —** (10) Front-mounted LEDs (continued):
(2) RD:
(1) for positive-state activity (green),
(1) for negative-state activity (red);
(2) Cntrl In:
(1) for RTS from local device ON (green);
(1) for RTS from local device OFF (red);
(2) Cntrl Out:
(1) for carrier and Carrier Detect ON (green);
(1) for carrier and Carrier Detect OFF (red)

**Connectors —** (1) DB25 female for RS-232;
(1) Six-wire RJ-11 (RJ-12) for line;
(1) 50-pin card-edge on each half-card for mating interconnection and chassis attachment

**Surge Protection —** Silicon Avalanche Diodes capable of dissipating 600 watts rms within 1 millisecond (initial reponse time less than 1 picosecond)

**Power —** Input: 10-VAC from MicroRACK chassis (which has a switchable 120-VAC or 240-VAC power supply);
Consumption: 700 mW typical

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

**Humidity Tolerance —** 0 to 95% noncondensing

**Size —** Not incl. protruding connectors, screws, and controls:
Front half-card:
3.1"H x 1"W x 4.8"D (7.8 x 2.5 x 12.2 cm);
Rear half-card:
3.3"H x 1"W x 2.6"D (8.4 x 2.5 x 6.7 cm);
Front and rear half-cards mated:
3.3"H x 1"W x 7.2"D (8.4 x 2.5 x 18.3 cm)

**Weight —** Net total, both half-cards: 4 oz. (114 g, 0.3 lb., 0.1 kg)

# 2. Introduction

## 2.1 Features

- Supports data rates from 1200 to 19,200 bps, user-selectable
- Optical isolation
- High-speed surge protection
- Supports distances up to 10 miles (16 km)
- Designed to be mounted in our MicroRACK system
- Full set of LED indicators
- Point-to-point or multipoint
- Loopback test modes
- Internal or external clocking
- Can perform hardware (RTS/CTS) flow control or pass through software (X-ON/X-OFF) flow control
- Carrier can be constantly ON or controlled by RTS

## 2.2 Overview

The Sync MP Line Driver Card (our product code ME930C-RJ11) operates in full duplex over four-wire cable (two unconditioned twisted pairs). The Card supports data rates up to 19.2 Kbps and has a maximum range of 10 miles (at 1200 bps over 19-AWG wire). The Card also passes one control signal in each direction and features both optical isolation and Silicon Avalanche Diode surge protection on the data-line side. It can use its internal clock or the external clock from the attached DTE.

The Sync MP Line Driver Card is designed to be mounted in our MicroRACK system (product codes RM202 through RM216), a chassis that takes up 2U (3.5", 8.9 cm) of vertical space in a 19" rack. This chassis has a switchable 115/230-volt power supply and hosts cards with a midplane architecture: One “function” half-card slides into the front of the chassis and mates in the middle with a “connector” half-card that slides into the rear of the chassis.

The Sync MP Line Driver Card has two built-in diagnostic tools: local and remote loopback tests. Additionally, LEDs on the Card’s front panel allow you to visually monitor communication.

# 3. Configuration

This chapter describes the location and orientation of the Sync MP Line Driver Card's configuration switch, provides detailed instructions for setting each switch position, and describes jumper settings for the rear half-card.

As shown in **Figure 3-1** below, the Card's "function" front half has an eight-position DIP switch labeled "SW1" that you can use to configure the Card for any of a wide range of synchronous applications. This DIP switch is accessible when the Card is slid out of the rack chassis. Once configured, the Card is designed to operate transparently, without need for frequent reconfiguration: Just set it and forget it!

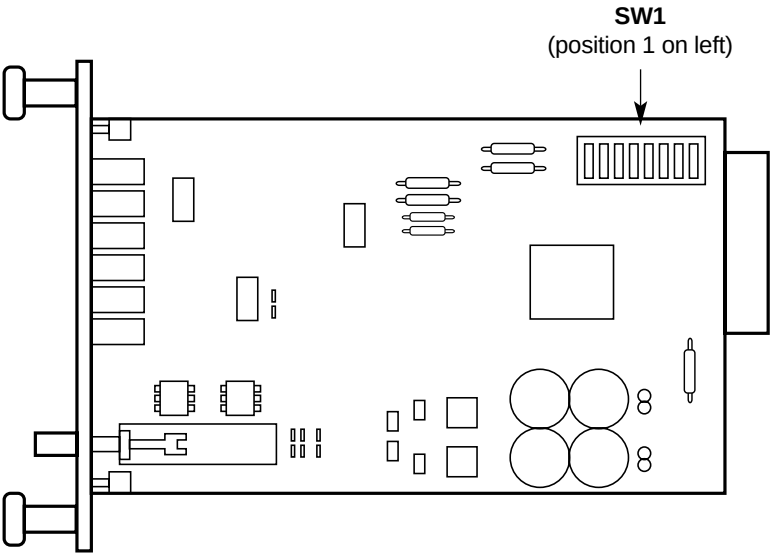



**Figure 3-1. The front half-card of the Sync MP Line Driver Card.**

## 3.1 The Orientation and Default Settings of the DIP Switch

The eight-position DIP switch on the Sync MP Line Driver Card allows you to specify the Card's data rate, clocking method, RTS/CTS delay, and carrier-control method. **Figure 3-2** below shows the orientation of the DIP switch with respect to the "ON" and "OFF" settings of its switch positions. Table 3-1 below summarizes the factory-default settings of these switch positions.

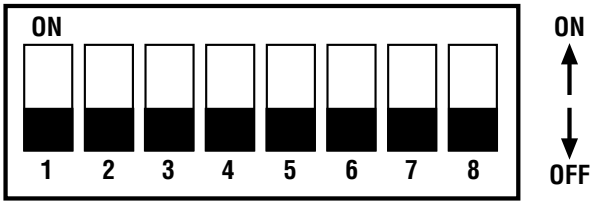



**Figure 3-2. DIP switch SW1.**

**Table 3-1. SW1's factory-default settings.**

| Position | Function | Factory-Default Setting |
|---|---|---|
| 1 | Data Rate | OFF |
| 2 | " | OFF (9600 bps) |
| 3 | " | ON |
| 4 | (Reserved for future use) | (N/A) |
| 5 | Transmit Clock | ON (Internal) |
| 6 | RTS/CTS Delay | ON |
| 7 | " | OFF (8 ms) |
| 8 | Carrier Control | OFF (Constant) |

## 3.2 Detailed Switch Settings

This section provides detailed information about the function of each DIP-switch position and lists all of their possible settings. Use this section as a configuration guide for applications where the Sync MP Line Driver Card's default settings would not provide correct results.

**1. Data Rate (Positions 1 through 3)**
Switch positions 1 through 3 are set in combination to allow the Card to be used at data rates from 1200 bps up to 19,200 bps.

| Pos. 1 | Pos. 2 | Pos. 3 | Data Rate in bps |
|---|---|---|---|
| ON | ON | ON | 1200 |
| OFF | ON | ON | 2400 |
| ON | OFF | ON | 4800 |
| ON | ON | OFF | 7200 |
| OFF | OFF | ON | 9600 (default) |
| OFF | ON | OFF | 14,400 |
| ON | OFF | OFF | 19,200 |
| OFF | OFF | OFF | 19,200 |

settings are identical

**2. Position 4 is reserved for future use. Do not change its setting.**

**3. Transmit Clock (Position 5)**
Switch position 5 is used to specify the Card's clocking method. The Card will provide an internal clock on DB25 Pin 15 if position 5 is set to OFF (the default), or receive an external clock from the attached DTE on DB25 Pin 24 if position 5 is set to ON.

Although the Card can't be directly set to use recovered receive clock from the remote Card, it always outputs that signal on DB25 Pin 17. So you can "trick" the local Card into using receive clock by setting it for external clock (position 5 ON) and attaching a special cable to its DB25 connector. This cable must not only pass Pin 17 on the Card to Pin 17 on the DTE (which must be set for receive clock) but must also loop Pin 17 on the Card back to Pin 24 (the external clock lead) on the Card. If you want such a cable, please call Black Box for technical support.

**4. RTS/CTS Delay (Positions 6 and 7)**
Switch positions 6 and 7 are used together to specify RTS/CTS delay. After request to send (RTS) is raised by the host terminal, the Card raises CTS after a slight delay in order to give the remote terminal time to receive an incoming signal. Depending on the type of environment, select either no delay or an 8- or 53-ms delay.

| Pos. 6 | Pos. 7 | Delay in milliseconds |
|---|---|---|
| ON | ON | Zero (no delay) |
| ON | OFF | Eight (default) |
| OFF | OFF | Fifty-three |

**5. Carrier Enable (Position 8)**
Switch position 8 is used to specify how the carrier signal is raised. In most point-to-point, full-duplex applications, the carrier signal can remain constantly "high," so you can leave this set to "constant carrier" (position 8 OFF, the default). But in multipoint environments, although each slave can be left set to "constant carrier," you *must* set the host to "controlled by RTS" (position 8 ON).

## 3.3 Configuring the Rear Half-Card

The rear "connector" half-card of the Sync MP Line Driver Card has one RS-232 interface (a DB25 female connector) and one balanced 4-wire interface (a six-wire RJ-11, sometimes called RJ-12, female connector). **Figure 3-3** below shows these interfaces.

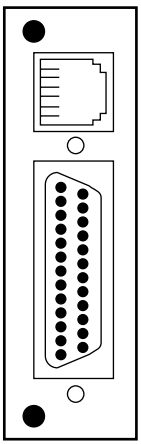


**Figure 3-3. The Card's RS-232 and 4-wire interfaces.**

Prior to installation, you will need to examine this half-card and be sure its jumpers are configured properly for your application. **Figure 3-4** below shows where the jumpers are. These jumpers determine various grounding characteristics for the RS-232 and twisted-pair lines.

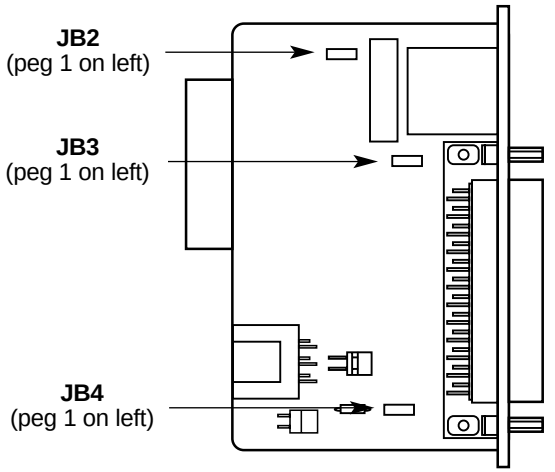



**Figure 3-4. The jumper locations.**

**Figure 3-5** below shows how the jumpers can be placed: either connecting pegs 1 and 2 or connecting pegs 2 and 3.

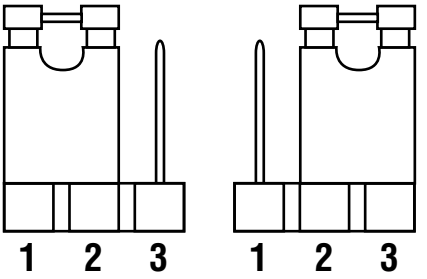



**Figure 3-5. Possible jumper placements.**

**Table 3-2** below summarizes the factory-default settings of the jumpers. Following this overview is a detailed description of each strap's function.

**Table 3-2. The factory-default settings of jumpers JB2, JB3, and JB4.**

| Jumper | Function | Factory-Default Setting |
|---|---|---|
| JB2 | Line Shield and Frame Ground | Jumper on positions 2 & 3 (grounds isolated) |
| JB3 | DTE Shield (Pin 1) and Frame Ground | Jumper on positions 2 & 3 (grounds isolated) |
| JB4 | Frame Ground and Signal Ground | Jumper on positions 2 & 3 (grounds isolated) |

**JB2: Line Shield and Frame Ground**
This jumper affects the grounding on the 4-wire line interface. With pegs 1 and 2 connected, this jumper links RJ-11 Pins 1 and 6 to the Card's frame ground. If you're using shielded twisted-pair cable, these pins can be used as connection points for the twisted-pair cable's shield (but the shield should be connected to one of the two Cards only—*never* to both!). With pegs 2 and 3 connected (the default setting), Pins 1 and 6 remain connected to each other, but are "lifted" (isolated) from the Card's frame ground.

Pegs 1 & 2 connected = Line shield tied to frame ground
Pegs 2 & 3 connected = Line shield isolated from frame ground (default)

**JB3: DTE Shield (DB25 Pin 1) and Frame Ground**
This jumper affects the grounding on the RS-232 interface to the DTE. With pegs 1 and 2 connected, this jumper links DB25 Pin 1 (the RS-232 "Shield" or "Protective Ground" lead) to the Card's frame ground. (If you are using shielded RS-232 cable with the shield connected to Pin 1, it should be connected at one end of the cable only—*never* at both ends!) With pegs 2 and 3 connected (the default setting), Pin 1 is "lifted" (isolated) from the Card's frame ground.

Pegs 1 & 2 connected = DTE shield (DB25 Pin 1) tied to frame ground
Pegs 2 & 3 connected = DTE shield isolated from frame ground (default)

**JB4: Signal Ground and Frame Ground**
This jumper also affects the grounding on the RS-232 interface—signal ground in this case. With pegs 1 and 2 connected, this jumper links DB25 Pin 7 (the RS-232 "Signal Ground" lead) to the Card's frame ground. With pegs 2 and 3 connected (the default setting), Pin 7 is "lifted" (isolated) from the Card's frame ground.

Pegs 1 & 2 connected = Signal ground (DB25 Pin 7) tied to frame ground
Pegs 2 & 3 connected = Signal ground isolated from frame ground (default)

# 4. Installation

This chapter describes the functions of the MicroRACK system, tells how to install the front and rear half-cards of the Sync MP Line Driver Card in its chassis, and provides diagrams for wiring the interface connections correctly.

## 4.1 The MicroRACK Chassis

The 16-Port MicroRACK chassis (our product code RM216), shown in **Figure 4-1** below, has slots for sixteen short-range modem cards, as well as its own power supply. Measuring only 3.5" (8.9 cm) high, the MicroRACK is designed to occupy only 2U of vertical space in a 19" rack. Sturdy front handles allow the MicroRACK to be extracted and transported conveniently.

If you short-range communication needs are more modest, we also offer 2-port (RM202), 4-port (RM204), and 8-port (RM208) versions of the MicroRACK chassis.

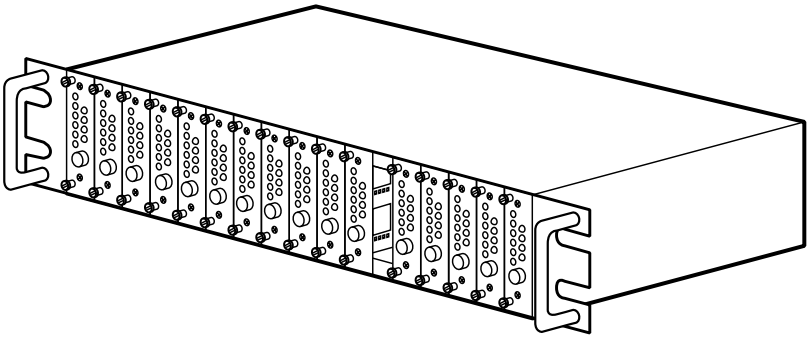


**Figure 4-1. The MicroRACK chassis.**

## 4.2 The MicroRACK's Power Supply

The power supply preinstalled in the MicroRACK uses the same mid-plane architecture as the modem cards. The front half-card of the power supply slides in from the front, and the rear half-card slides in from the rear. They plug into one another in the middle of the rack. The front half-card is then secured with spring-loaded thumbscrews and the rear half-card with conventional metal screws.

The power supply's on/off switch is located on its front panel. When the power supply is plugged in and switched on, a red LED on the supply's front panel will glow. Since the MicroRACK is a "hot-swappable" rack, it is not necessary for you to install the Sync MP Line Driver Card (or any other compatible cards) before switching on the power supply, and you can switch off the power supply at any time without harming the installed cards.

If you should ever need to replace the power supply's fuse or switch the power supply from 115 to 230 VAC, please refer to the MicroRACK's manual.

## 4.3 Installing the Sync MP Line Driver Card

As described earlier, the Sync MP Line Driver Card is made up of a front "function" half-card and a rear "connector" half-card. The two half-cards meet inside the rack chassis and plug into each other with mating 50-pin card-edge connectors. Use the following steps as a guideline for installing each Sync MP Line Driver Card in the MicroRACK chassis. (Note that the MicroRACK supports "hot-swapping," so you don't have to turn it off before installing or removing cards.)

1. Slide the rear "connector" half-card into the back of the chassis along the chassis' metal rails.
2. Secure the rear half-card using the included metal screws.
3. Slide the "function" half-card into the front of the chassis. It should meet the rear half-card when it's almost all the way inside the chassis.
4. Push the front half-card gently into the card-edge receptacle of the rear half-card. It should click into place.
5. Secure the front half-card using its spring-loaded thumbscrews.

## 4.4 Connecting Cables to the Card

As mentioned earlier, the rear "connector" half-card of the Sync MP Line Driver Card has one RS-232 port (a DB25 female connector) for local connections and one 4-wire twisted-pair port (a six-wire RJ-11 female) for connections between line drivers.

### 4.4.1 Making the RS-232 Connection

**NOTE**

**If you want the Card to use receive clock, the RS-232 cable must be specially pinned; see** Section 3.2**.**

The RS-232 port is pinned out as DCE (Data Communications Equipment) according to the EIA/TIA RS-232C and ITU-T V.24 interface standards, as shown in Figure 4-2 below. It can be connected to other RS-232 equipment in these ways:

- To DTEs (Data Terminal Equipment) with DB25 RS-232 connectors, such as those on sync terminals or the second COM port on many PCs: Use straight-through-pinned shielded cable such as our product code EDN25C.
- To DTEs with DB9 male RS-232 connectors, such as the first COM port on many PCs: Use shielded AT modem cable such as our product code EVMBMC.
- To other DCEs with DB25 female connectors, such as modems or muxes: Use shielded synchronous RS-232 tail-circuit cable such as our product code EYN255C.

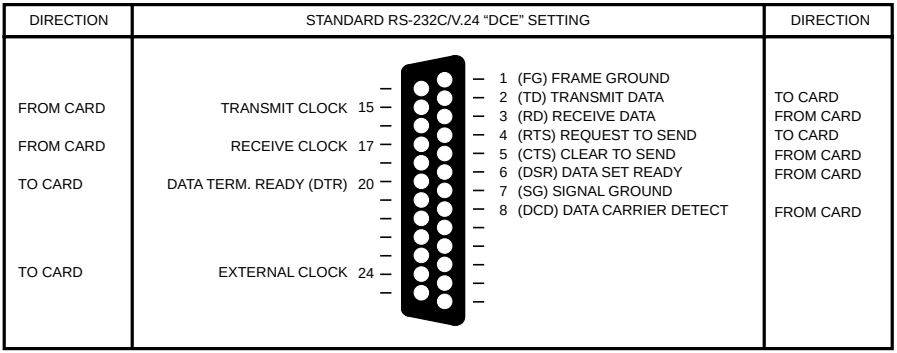



**Figure 4-2. The Card's RS-232 pinout.**

#### 4.4.2 Making the Twisted-Pair Connection

The Sync MP Line Driver Card operates full duplex over two twisted pairs. In all applications, the twisted-pair wire must be 26 AWG or thicker, unconditioned, dry metallic wire. (See **Appendix A** for a table of wire grades, distances, and data rates.)

## CAUTION!

**The Card can only communicate in a closed data circuit with another Sync MP Line Driver Card. Trying to connect two of these Cards across a dialup analog circuit, such as those used by telephones and standard analog modems, will not work and might damage both the Cards and the phone line.**

*4.4.2.A Point-to-Point Twisted Pair Connections*

The 4-wire port is prewired for a standard telco wiring environment. Establishing a 4-wire twisted-pair circuit between two or more Sync MP Line Driver Cards requires a shielded or unshielded crossover cable, as shown in **Table 4-1** and **Figure 4-3** below. (You can build such cables from bulk CAT5 cable such as our product code EVNSL70A.) Note that (a) although positive and negative are shown here, the Card is not actually sensitive to polarity; (b) you can connect the cable shield to Pin 1 or 6 at one end (do *not* connect the shield at both ends!); and (c) the color codes listed are standard for this type of wiring, but the colors of your wires might be different.

**Table 4-1. Pinouts for RJ-11 to RJ-11 Cabling**

| Local RJ-11 | | | | Remote RJ-11 | |
|---|---|---|---|---|---|
| **Signal Abbrev.** | **Wire Color** | **Pin No.** | **Pin No.** | **Wire Color** | **Signal Abbrev.** |
| GND | Blue | 1 | 6 | White | GND |
| RCV– | Yellow | 2 | 4 | Red | XMT+ |
| XMT+ | Green | 3 | 5 | Black | RCV– |
| XMT– | Red | 4 | 2 | Yellow | RCV– |
| RCV+ | Black | 5 | 3 | Green | XMT+ |
| GND | White | 6 | 1 | Blue | GND |

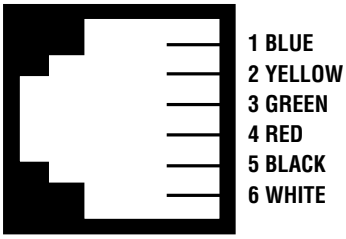



**Figure 4-3. The Card's RJ-11 socket.**

*4.4.2.B Multipoint Twisted-Pair Connections*

The Sync MP Line Driver Card supports multipoint applications using a star topology. You just have to be sure that carrier control, determined by the setting of position 8 of DIP switch SW1, is set correctly for each of your Cards (see **Section 3.2**). Maximum distance between the units will vary based on the number of drops, data rate, wire gauge, etc. Refer to **Appendix A** for general guidelines; for help determining the distance you can run in your particular application, call Black Box Technical Support.

Figure 4-4 below shows how to properly wire the Cards' two-pair cabling for a multipoint star topology. Note that no ground connection is needed.

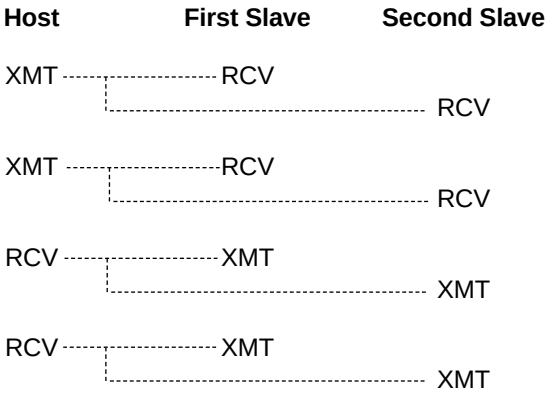



**Figure 4-4. Multipoint star wiring.**

# 5. Operation

Once you have configured each Sync MP Line Driver Card and connected the cables to them, you are ready to operate them. This chapter describes the Card's LED status monitors, the power-up procedure, and the use of the Card's built-in loopback test modes.

## 5.1 LED Status Monitors

The Sync MP Line Driver Card has ten front-panel status LEDs that indicate the condition of the Card-toCard and Card-to-local-device links. **Figure 5-**1 below shows the relative front-panel positions of the LEDs, and below that are descriptions of each LED's function.

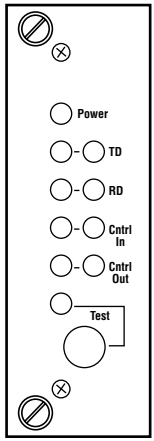



**Figure 5-1. The Card's LEDs and controls.**

- The green "PWR" LED glows when power is being applied to the Card through its midplane chassis connection.
- The green "TD" and "RD" indicators blink to show positive-state data activity. The red "TD" and "RD" indicators blink to show negative-state data activity. Solid red indicates a connection in an idle state.
- The *green* "Cntrl In" and "Cntrl Out" indicators glow solid to show that the in-band control signal is ON, while the *red* "Control In" and "Control Out" indicators glow solid to show that the control signal is OFF. Here's how this works (assuming that both DTEs are set for hardware flow control):
  If the local DTE needs the remote DTE to *start* sending data, it should raise RTS (the signal that comes into the Card on DB25 Pin 4). This causes the local Card to put its transmit leads in a low-impedance (positive/negative) state and

simultaneously light its green Cntrl In LED. The remote Card senses the low impedance on the transmit lines, raises CD (the signal that goes out to the remote DTE on the Card's DB25 Pin 8), and lights its green Cntrl Out LED. When the remote DTE senses that CD is ON, it will begin transmitting.

When the local DTE wants the remote DTE to *stop* sending data, it should drop RTS. This causes the local Card to put its transmit leads in a high-impedance (zero) state and simultaneously light its red Cntrl In LED. The remote Card senses the high impedance on the transmit lines, drops CD to the remote DTE, and lights its red Cntrl Out LED. When the remote DTE senses that CD is OFF, it will interpret this as loss of carrier and cease transmitting until CD comes back ON again.

- The green "TEST" LED will glow when the loopback test modes are activated.

## 5.2 Power-Up

There is no power switch on the Sync MP Line Driver Card: Power is automatically applied to the Card when its card-edge connector makes contact with the MicroRACK chassis' midplane socket (as long as the chassis' power supply is turned on). Note once again that the Card is "hot-swappable"—it will not be damaged by plugging it in or removing it while the MicroRACK is powered up.

When the local and remote Cards are both powered up and are passing data normally, the LEDs should look like this:

- PWR = green
- TD & RD = flashing red and green
- Control In & Control Out = green
- TEST = off

## 5.3 Test Modes

The Sync MP Line Driver Card performs two diagnostic loops: local analog loopback and remote analog loopback. These test modes are activated *simultaneously* by pressing the "Test" button on the Card's front panel so that it latches in the "in" position. Contrast normal operation as shown in **Figure 5-2** on the next page with the loopback testing described below and shown in **Figure 5-3** on the next page.

### 5.3.1 Local Analog Loopback

When you press "Test" on the local Card, local analog loopback causes any data sent to the local Card by the local RS-232 device to be echoed back to that RS-232 device. For example, characters typed on the keyboard of a terminal will appear on the terminal screen. If characters are not echoed back, check the connection between the local RS-232 device and the local Card. All Cards in the system should be tested in this manner.

### 5.3.2 Remote Analog Loopback

When you press "Test" on the local Card, remote analog loopback causes any characters sent from the remote Card to the local Card to be returned to the remote Card. (Because of this, make sure that only *one* of the Cards is in test mode at any given time—if they both are, neither of them will be sending any data to the other, and the test will not work.) If no characters are echoed back, check the wiring between the two Cards. Make sure that the cabling between the units is wired as described in **Section 4.4.2**.

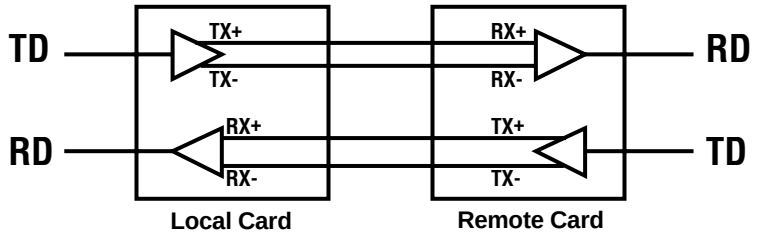



**Figure 5-2. The flow of data during normal operation.**

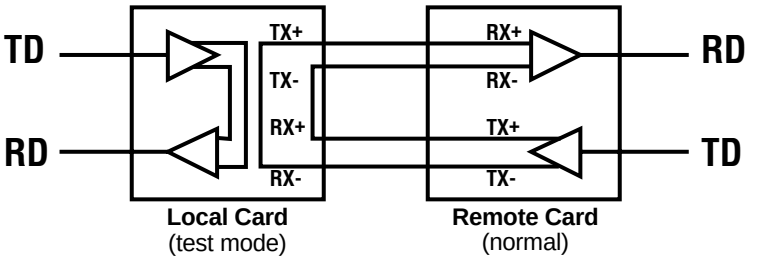



**Figure 5-3. The flow of data when the local Card is in test mode.**

# 6. Troubleshooting

If the Sync MP Line Driver Card doesn't seem to be operating properly, first make sure it is properly seated in the MicroRACK and that the cables attached to it are attached securely. If the problem persists, activate test mode (see **Section 5.3**) on the local Card and try sending data to the Card from both sides; if that doesn't show where the problem is, stop test mode on the local Card, activate test mode on the remote Card, and send data to *it*. If this still doesn't help solve the problem, call Black Box for technical support as directed below.

## 6.1 Calling Black Box

If you determine that your Sync MP Line Driver Card 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.

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.
- the results of any testing you've already done.

## 6.2 Shipping and Packaging

If you need to transport or ship your Sync MP Line Driver Card:

- Package it carefully. We recommend that you use the original container.
- Before you ship the unit back to Black Box for repair or return, contact us to get a Return Authorization (RA) number.

# Appendix A: Cable Recommendations

The Sync MP Line Driver Card operates at frequencies of 20 kHz or less and has been performance-tested using twisted-pair cable with the following characteristics:

| Wire Gauge | Capacitance | Resistance |
|---|---|---|
| 19 AWG | 83 nF/mi or 15.7 pF/ft. (51.6 nF/km or 49.9 pF/m) | 16.3 mΩ/ft. (53.5 mΩ/m) |
| 22 AWG | 83 nF/mi or 15.7 pF/ft. (51.6 nF/km or 49.9 pF/m) | 32.6 mΩ/ft. (107 mΩ/m) |
| 24 AWG | 83 nF/mi or 15.7 pF/ft. (51.6 nF/km or 49.9 pF/m) | 51.7 mΩ/ft. (169.5 mΩ/m) |

Using or simulating cable with the above characteristics, the following data rate/distance results were obtained during bench tests:

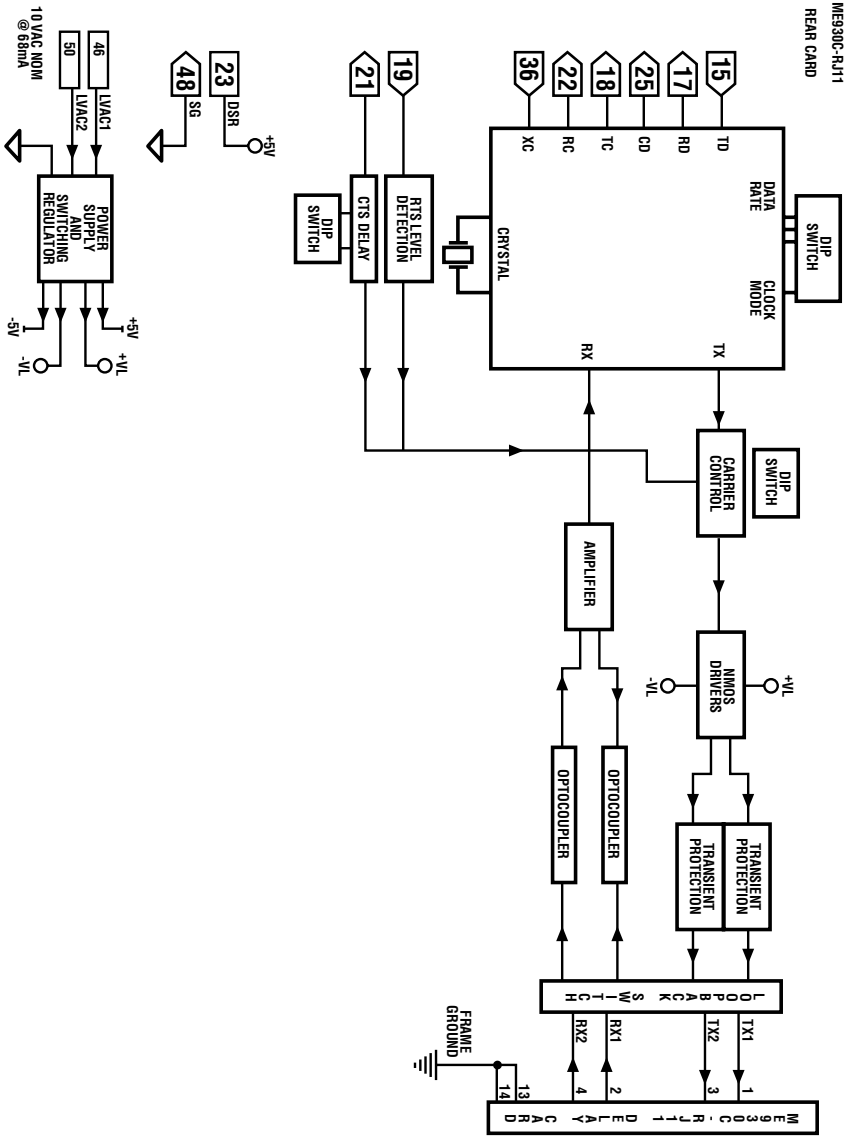
| Data Rate in bps | Distance in miles (km) | | |
|---|---|---|---|
| | 19 AWG | 22 AWG | 24 AWG |
| 19,200 | 2.5 (4) | 2.1 (3.4) | 1.3 (2.1) |
| 9,600 | 3.7 (6) | 2.3 (3.7) | 1.7 (2.7) |
| 4,800 | 4.9 (7.9) | 4.9 (7.9) | 2.5 (4) |
| 2,400 | 8.2 (13.2) | 5.8 (9.3) | 4.6 (7.4) |
| 1,200 | 10 (16.1) | 8.3 (13.4) | 6.8 (10.9) |

To get optimum performance from the Card, keep these guidelines in mind:

- Always use twisted-pair wire—this is *not* an option.
- Use twisted-pair wire with a capacitance of 20 pF/ft or less.
- Avoid twisted-pair wire thinner than 26 AWG (that is, avoid higher AWG numbers than 26).
- Using twisted-pair cable with a resistance greater than that specified above might reduce the maximum distance you can run, but the function of the Card shouldn't be affected otherwise.
- Environmental factors too numerous to mention can affect the maximum distances obtainable at a particular site. Use the above data rate/distance table as a general guideline only.

# Appendix B: Block Diagram

The pin numbers referred to on the left- and right-hand sides of the diagram are those of the 50-pin card-edge connector between the Sync MP Line-Driver Cards' half-cards and the MicroRACK.



# NOTES