RFL Electronics Inc.

INSTRUCTION MANUAL

RFL 9660
Digital Switch

Publication Number MC 9660
Printed In U.S.A.
Revised April 24, 2007

RFL Electronics Inc.

WARRANTY

Except where noted, all RFL Electronics Inc. products come with a one-year warranty from date of delivery for replacement of any part which fails during normal operation. RFL will repair or, at its option, replace components that prove to be defective at no cost to the Customer. All equipment returned to RFL Electronics Inc. must have an RMA (Return Material Authorization) number, obtained by calling the Customer Service Department. A defective part should be returned to the factory, shipping charges prepaid, for repair or replacement FOB Boonton, N.J.

RFL Electronics Inc. is not responsible for warranty of peripherals, such as printers and external computers. The warranty for such devices is as stated by the original equipment manufacturer. If you have purchased peripheral equipment not manufactured by RFL, follow the written instructions supplied with that equipment for warranty information and how to obtain service.

WARRANTY STATEMENT

RFL Electronics Inc. products are warranted against defects in material and workmanship for one year from the date of shipment. During the warranty period, RFL will repair or, at its option, replace components that prove to be defective at no cost to the customer, except the one-way shipping cost of the failed assembly to the RFL Customer Service facility in Boonton, New Jersey.

This warranty does not apply if the equipment has been damaged by accident, neglect, misuse, or causes other than performed or authorized by RFL Electronics Inc.

This warranty specifically excludes damage incurred in shipment to or from RFL. In the event an item is received in damaged condition, the carrier should be notified immediately. All claims for such damage should be filed with the carrier.

NOTE

If you do not intend to use the product immediately, it is recommended that it be opened immediately after receiving and inspected for proper operation and signs of impact damage.

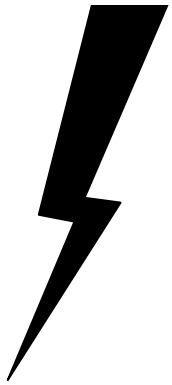
This warranty is in lieu of all other warranties, whether expressed, implied or statutory, including but not limited to implied warranties of merchantability and fitness for a particular purpose. In no event shall RFL be liable, whether in contract, in tort, or on any other basis, for any damages sustained by the customer or any other person arising from or related to loss of use, failure or interruption in the operation of any products, or delay in maintenance or for incidental, consequential, indirect, or special damages or liabilities, or for loss of revenue, loss of business, or other financial loss arising out of or in connection with the sale, lease, maintenance, use, performance, failure, or interruption of the products.

RFL Electronics Inc.
353 Powerville Road
Boonton Township, NJ 07005-9151

CAUTION

FOR YOUR SAFETY

THE INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONS.



WARNING:

The equipment described in this manual contains high voltage. Exercise due care during operation and servicing. Read the safety summary on the reverse of this page

SAFETY SUMMARY

The following safety precautions must be observed at all times during operation, service, and repair of this equipment. Failure to comply with these precautions, or with specific warnings elsewhere in this manual, violates safety standards of design, manufacture, and intended use of this product. RFL Electronics Inc. assumes no liability for failure to comply with these requirements.

GROUND THE CHASSIS

The chassis must be grounded to reduce shock hazard and allow the equipment to perform properly. Equipment supplied with three-wire ac power cables must be plugged into an approved three-contact electric outlet. All other equipment is provided with a rear-panel ground terminal, which must be connected to a proper electrical ground by suitable cabling. Refer to the wiring diagram for the chassis or cabinet for the location of the ground terminal.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE OR IN WET OR DAMP AREAS

Do not operate the product in the presence of flammable gases or fumes, or in any area that is wet or damp. Operating any electrical equipment under these conditions can result in a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel should never remove covers. Component replacement and internal adjustments must be done by qualified service personnel. Before attempting any work inside the product, disconnect it from the power source and discharge the circuit by temporarily grounding it. This will remove any dangerous voltages that may still be present after power is removed.

DO NOT SUBSTITUTE PARTS OR MODIFY EQUIPMENT

Because of the danger of introducing additional hazards, do not install substitute parts or make unauthorized modifications to the equipment. The product may be returned to RFL for service and repair, to ensure that all safety features are maintained.

READ THE MANUAL

Operators should read this manual before attempting to use the equipment, to learn how to use it properly and safely. Service personnel must be properly trained and have the proper tools and equipment before attempting to make adjustments or repairs.

Service personnel must recognize that whenever work is being done on the product, there is a potential electrical shock hazard and appropriate protection measures must be taken. Electrical shock can result in serious injury, because it can cause unconsciousness, cardiac arrest, and brain damage.

Throughout this manual, warnings appear before procedures that are potentially dangerous, and cautions appear before procedures that may result in equipment damage if not performed properly. The instructions contained in these warnings and cautions must be followed exactly.

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TRADEMARKS

"CrossTalk" is a registered trademark of Microstuf, Inc.
"DDP" and "D-Link" are registered trademarks of the General Electric Company.
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"WordStar" is a registered trademark of MicroPro International Corporation.

The trademark information listed above is, to the best of our knowledge, accurate and complete.

LIST OF EFFECTIVE PAGES

When revisions are made to the RFL 9660 Instruction Manual, the entire section where revisions were made is replaced. For the edition of this manual dated April 24, 2007 the sections are dated as follows:

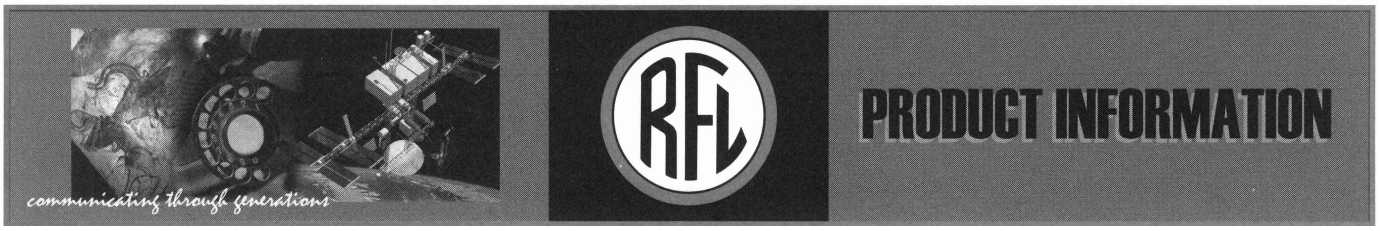
Front Matter	April 24, 2007
Section 1	Latest version of Product Information sheet
Section 2	April 24, 2007
Section 3	October 1, 1999
Section 4	April 24, 2007
Section 5	August 18, 1998
Section 6	August 18, 1998
Section 7	August 18, 1998
Section 8	April 24, 2007
Section 9	April 24, 2007
Section 10	August 18, 1998
Section 11	April 24, 2007
Section 12	August 18, 1998
Section 13	April 24, 2007
Section 14	April 24, 2007
Section 15	April 24, 2007
Section 16	October 1, 1999

REVISION RECORD

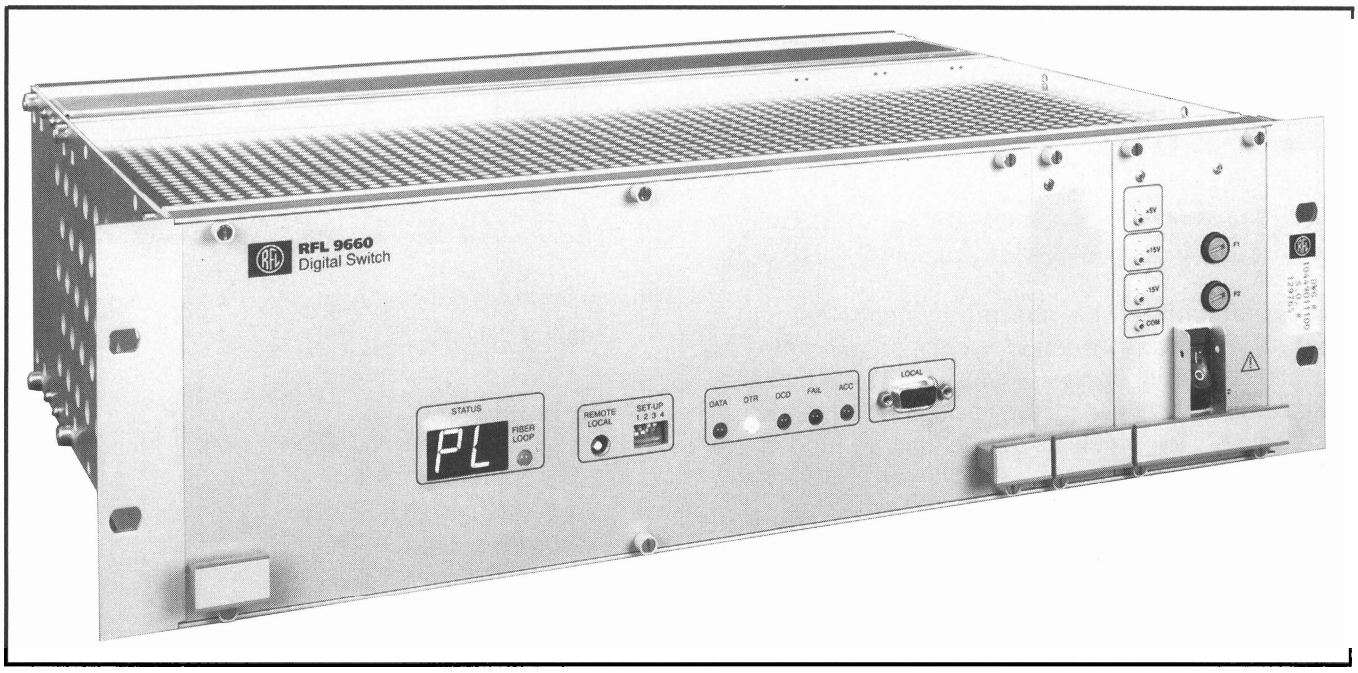
Rev	Description	Date	Approval
02-25-94	New Document Release		
10-24-94	Revised in accordance with ECO number(s) 9660-056, -058, -062, -068, and RFA number 2942		
02-15-95	Revised in accordance with ECO number 9660-072. Effected pages: i, v, xi, xii, xiii, Section 16		
10-18-96	Revised in accordance with ECO number 9660-076 and 077. Added 14.4 modem and new CPU		
04-16-97	Revised in accordance with ECO number 9660-084. Added new Product Information sheet.		
11-26-97	Revised in accordance with RFA number 5503, and ECO numbers 9660-085, 087, 088, 089, 090, 091. Replaced 14.4 modem with 28.8 modem, revised fiber optic master, power/alarm I/O, modem I/O, and updated product information sheet.		
04-30-98	Revised in accordance with RFA numbers 5085, 5636 and 5642 and ECO numbers 9660-093, 095 and 096. Added HyperTerminal setup, added Application notes 001A and 029		
08-18-98	Converted text from WordStar to Word, added paragraph numbers, upgraded HyperTerminal, deleted reference to RFL bulletin board.		
03-30-99	Revised in accordance with RFA numbers 6310 and 6359. Added Application note 030 and revised Application notes 001, 003, 005, 006, 009, 016, 022 and 025.		

REVISION RECORD - continued

Rev	Description	Date	Approval
10-01-99	Revised in accordance with RFA numbers 6191, 6198 and 6802. Revised in accordance with ECO number 9660-097. Added Application Notes 9660-030 and 9660-031.		
4-24-07	Manual revised to change to new modem. Section 2, 4, 8, 9, and 11 has minor changes, Section 13 and 14 is completely new. Modified for pdf production.	4-24-07	TG



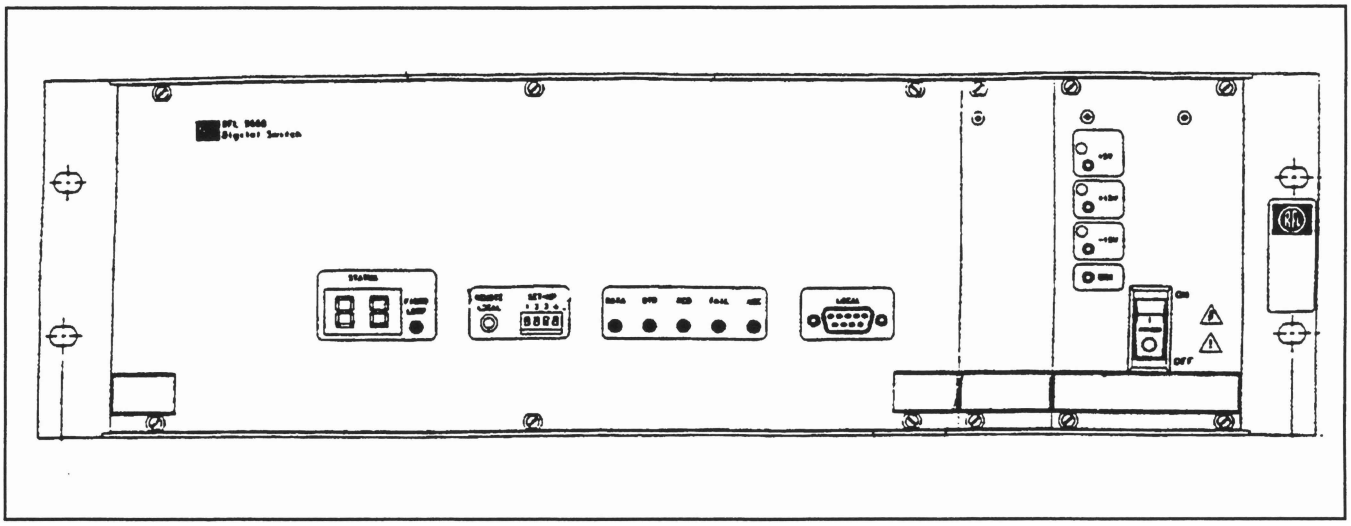
RFL 9660 Digital Switch



"One Phone Line Connects All Substation Devices"

The RFL 9660 Digital Switch provides a convenient way to connect intelligent relays, smart meters, sequence-of-event recorders, digital fault recorders (DFRs), or similar devices to a central intelligent digital switch. Through the use of third-party software packages, the RFL 9660 is able to communicate with Intelligent Electrical Devices (IED's). Once connected, the user can access and interrogate up to 32 individually programmable RS-232 ports. This allows maintenance personnel to instantly access substations from their desks, without having to make a field trip.

Only a single phone line is required to connect to the RFL 9660; this reduces the number of phone lines required for polling substation equipment. By replacing the internal modem with a direct digital interface, the RFL 9660 can also be connected to an existing substation digital network.



Front view, RFL 9660 Digital Switch

DEVICE MODEMS NOT REQUIRED

Regular telephone line sharing switches require a separate modem at each device. For example, an installation with eight devices would require eight modems. To eliminate expensive modem costs, the RFL 9660 has been designed to contain its own integrated modem. It's all that's needed to interface all your recorders, relays, solid-state meters, or similar equipment.

The RFL 9660 eliminates:

- Separate phone lines
- Individual telephone modems
  Expensive modem installation and maintenance costs.

SUBSTATION HARDENED

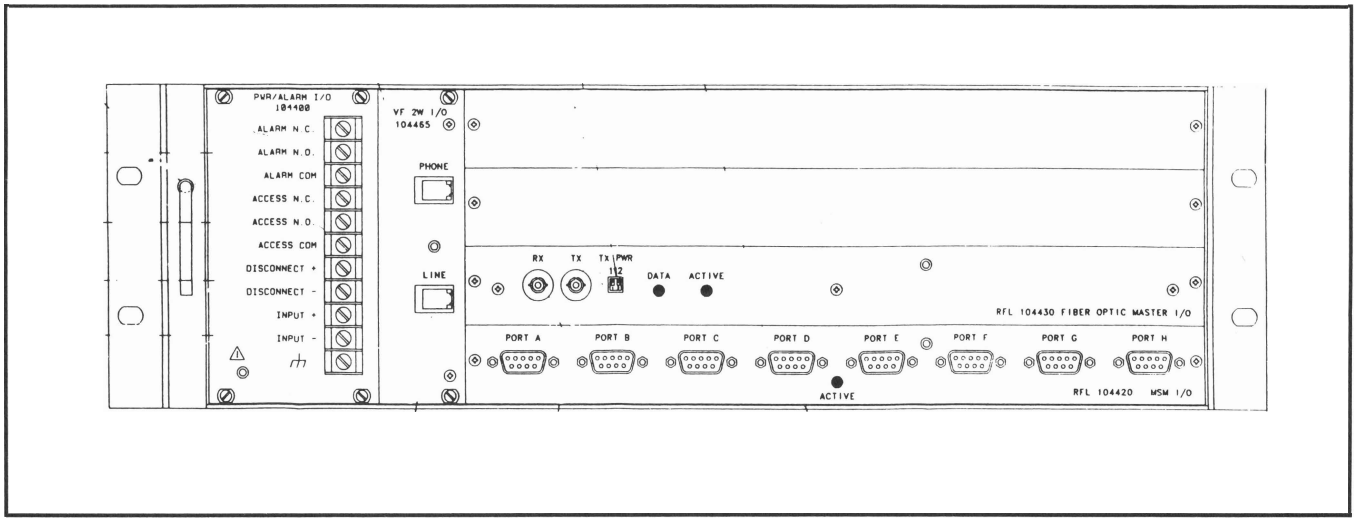
The RFL 9660's power supply, control inputs, and alarm relay outputs are designed to comply with the Surge Withstand and Fast Transient requirements of ANSI C.37.90.1 and C.37.90-1978. In addition, RFL 9660 operation is guaranteed at temperatures from -30°C to +60°C (-22°F to + 140°F).

APPLICATIONS FOR SUBSTATION DEVICES

RFL continues to develop Application Notes for a variety of substation devices:

ABB DPU Relay
ABB MDAR Relay (With PONI or MINT Module)
GEC Optimho Relay
General Electric DDP Relay
General Electric DLP Relay
Hathaway Fault Recorder
Mehta Tech Transcan Digital Recorder
Metrosonics Model RV-2 Recording Voltmeter
Metrosonics Model RV-3 Recording Voltmeter
Metrosonics Model SRV-3 Recording Voltmeter
NEI Duobias Fiber Modem
NEI Microphase Fiber Modem
RFL 6720P Checkback System
RFL 9001 Intelligent Multiplexer
RFL IMUX 2000 Intelligent Multiplexer
RFL 9300 Charge Comparison System (CCS)
RFL 9700 Digital Protection Channel
RFL 9720 Pilot Wire Interface
RFL 9745 Teleprotection Channel
Schlumberger Industries Quantum Meter
Schweitzer Engineering Series 100 Relay
Schweitzer Engineering Series 200 Relay
Schweitzer Engineering Series 300 Relay
Scientific Columbus JEM-2 Multifunction Meter

Note: *If you have a device that is not on this list, please contact the factory — an Application Note will be developed*

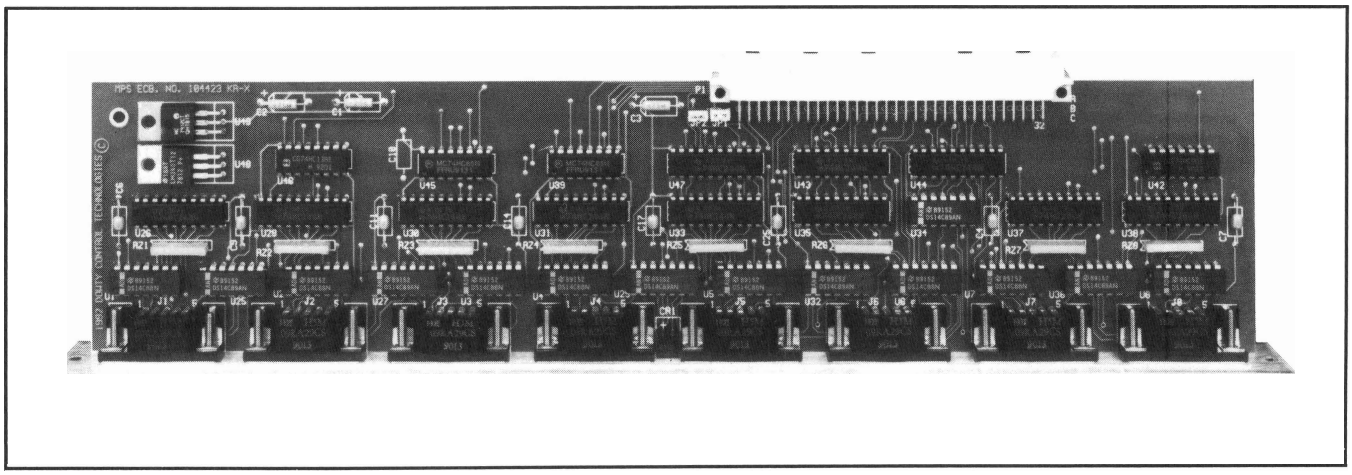


Rear view, RFL 9660 Digital Switch

DEVICE PORT MODULES

Two types of RFL 9660 device port modules are available: RS-232 and fiber ring. Each RS-232 device port module will accommodate up to eight individual devices, such as relays or meters. Up to four RS-232 device port modules can be installed in one RFL 9660 and can access up to 32 devices. A typical RS-232 device port module is shown below.

The fiber optic device port module allows up to 32 devices to be connected on to a fiber optic ring. An RFL 9660 can be equipped with both RS-232 and fiber optic device port modules. The total number of device connections cannot exceed 32.



RS-232 Device Port Module

SECURITY

In order to prevent unauthorized access, the RFL 9660 features three different levels of security and an access alarm output. In the first level of security, each device port can be protected with a password. The second level adds a log-on password that must be used when the switch is first called. The third level has a callback feature that causes the RFL 9660 to call the user back at a preset telephone location before access is allowed.

Passwords are assigned by a designated "super-user." Any time the RFL 9660 is accessed (either remotely or locally), an access alarm relay contact will close. These contact closures can be externally monitored or logged.

DEVICE PORT CONFIGURATION

Each device port on the RFL 9660 can be individually programmed to match the requirements of the device connected to it. Ports can be given physical names and functions such as baud rate, parity, number of data bits, and types of flow control can be individually programmed.

All port configuration is software-controlled and configuration parameters can be re-programmed locally or remotely. New values are stored in the RFL 9660's non-volatile memory so configurations will be retained even during loss of power.

FIBER OPTIC SYSTEM

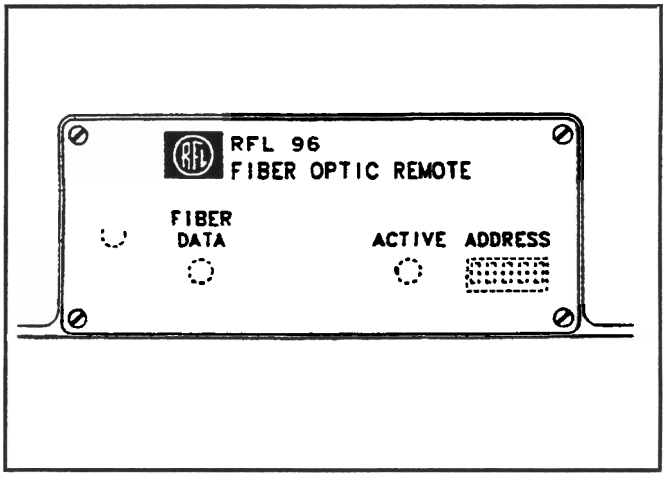
The RFL 9660 can communicate over a fiber optic loop when it is equipped with a fiber optic master I/O module. A separate fiber optic remote transceiver module connects each device to the fiber loop. Using multimode fiber and ST-type connectors, the loop operates at 850 nm.

The fiber optic loop option is particularly suited to any of the following applications:

- Any installation where isolation from ground potential rise is important.
- Any installation where ambient noise levels are high.
- Any installation where it is difficult to run RS-232 cables.
- Any installation where distances greater than those recommended by RS-232 must be covered.

REMOTE AND LOCAL ACCESS

The RFL 9660 is available with a built-in 28.8 bps modem that is Hayes-compatible and complies with CCITT V.34 bis and Bell 212A. By replacing this modem with a direct digital interface, an external modem can be used or connections can be made into an existing substation digital network, for data transfer rates up to 19.2 kbs.



Typical fiber optic remote transceiver module

When working at the substation, a local RS-232 port is available on the front of the RFL 9660. This allows you to configure the system or interrogate devices in the substation by connecting a terminal or portable PC directly to the RFL 9660. While the modem is in use, access to the RFL 9660 through the local RS-232 port is denied.

ACCESSING THE SWITCH

Remote users can access the RFL 9660 by using PC's with a 286 (or better) processor and a Hayes-compatible modem. A mouse is optional, but its presence will simplify use. The PC must be running DOS 3.1 (or better), with Microsoft Windows Version 3.1 (or better) installed. Microsoft Windows is recommended, because of its multi-tasking capabilities. The RFL 9660 also accommodates access by a dumb terminal or with most PC terminal emulation programs.

The RFL 9660 is compatible with the Microsoft Windows Terminal Emulation Program. This allows user-friendly access to all RFL 9660 functions. It also gives you the ability to conveniently run device-specific DOS-based programs once the RFL 9660 selects a port. By using the Windows terminal function keys, user-programmable events can be invoked with a mouse.

Once the switch is accessed, a simple ASCII command language is used to communicate with the RFL 9660. Typical display screens seen during access are shown on this page.

```
Esc          -Abort command
H            -Help
D            -Run diagnostics
I            -Port information
Q            -Quit session
Port #/Label -Port selection
P            -Program port
C            -Configure switch
S            -Save changes
R            -Reset port parameters
U            -Update hardware configuration
Modem        -Connect local port to modem port

Local> _
```

```
Port #2                3rd & Main St. Relay

Interface      -RS232  Call Out - Off
Baud Rate      -2400   Call Request - None
Data Bits      -8      Call Priority - O
Parity-None    Call String -
Stop Bits      -1      Remote String -
Port Flow Ctrl -None   Port String -
Local Port DTR -ON     Modem String-
Local Flow Ctrl -ON    Port Password-

To change type Y:_
a - Label port                 b - Call request
c - Call out                   d - Password
e - Call string                f - Modem string
g - Remote string              h - Port string
i - Port priority              j - Local port DTR
k - Local flow ctrl (xon/xoff) l - Port flow ctrl
m - Communications params      q - Quit

PORT 2> _
```

SELF-TEST AND DIAGNOSTICS

When the RFL 9660 is powered up, it conducts a full self-test routine. A built-in watchdog timer can trigger a system reset and communicate a failure alarm. The diagnostics can be run at any time, either from a terminal connected to the local port on the front of the RFL 9660, or from a remote terminal.

RJ-11 JACK

The RFL 9660 includes a redundant RJ-11 telephone jack. This allows the RFL 9660 to share an extension with a telephone.

EMERGENCY INTERRUPT SIGNALLING

The RFL 9660's emergency interrupt signalling can be used to interrupt a call into the RFL 9660 if the phone needs to be used in an emergency. In addition, interrupt signaling can give another user priority access to the RFL 9660.

MODEM RECONFIGURATION OR PORT SELECTION

The RFL 9660's internal or external modem may be reconfigured when a port is selected. The RFL 9660 can send a pre-programmed "AT" command string to the modem upon port selection. This command string can be used to turn flow control on or off, or to change any modem parameter to accommodate the device connected to that port.

INITIATING AN OUTGOING CALL

Each port can sense an active RTS (Request-To-Send) or DTR (Data-Terminal-Ready) signal on the RS-232 connector. This allows an end device to initiate a call out of the station to a pre-programmed location. One phone number can be stored for each port.

MODULAR CONSTRUCTION

Each RFL 9660 switch is housed in a chassis three rack units high (5.25 inches, or 13.3 cm). The RFL 9660's circuit board modules plug into the front of the chassis, and its I/O modules plug into the back. A mother board between the circuit board modules and the I/O modules, makes all interconnections between modules. External equipment connects to the RFL 9660 through the terminal blocks, telephone jacks, and RS-232 or fiber optic connectors on the rear panel.

DEVICE PORTS

Maximum Number: 8,16,24,32, asynchronous RS-232 data ports, depending on the number of device port modules installed.

Port Configuration: All device ports are configured as DCE's.

Connector Type: Male 9-pin D-subminiature (DE-9), EIA 574-compatible.

Port Configuration: Each port parameter is remotely or locally programmable.

Communications Parameters:
Data Rate: 300, 1200, 2400, 4800, 9660, or 19.200 bps.
Number of Data Bits: Seven or Eight
Parity: Odd, Even or None
Number of Stop Bits: One or Two

Flow Control: RTS/CTS, DTR/DSR, XON/XOFF, or None

Originate Call: Hayes AT-compatible command string, up to 40 characters long.

Port Name: Up to 30 ASCII characters.

Port Priority: Ten levels (0 through 9), with Level 9 given the highest priority.

Port Password: A different seven-character password can be stored for each port.

ASYNCHRONOUS LOCAL PORT

Connector Type: Female 9-pin D-Subminiature (DE-9), EIA 574-compatible. Mounted on front panel, configured as a DCE.

Programming: DIP switches set port for 1200, 2400, 4800, or 9600 bps, with Odd, Even, or No Parity.

Flow Control: XON/XOFF

Number of Data Bits: Eight

Number of Stop Bits: One or Two

MODEM

Type: Locally-programmable; fully-automatic auto-dial

FCC Registration: Modem module designed in accordance with FCC Part 68 rules.

FCC Registration Number: B46USA-30667-FA-E

Ringer Equivalence: 0.6B

Interface: EIA RS-232D/CCITT V.34

Data Format: Asynchronous Serial Binary

Number of Data Bits:
With Parity: Seven or Eight
Without Parity: Eight

Number of Stop Bits: One or Two.

Maximum Data Rate: CCITT V.34 bis: 28.8 kbps to DTE 115,200.

Data Compression: Automatic

Error Correction: Automatic

Command Set: Extended Hayes "AT" command set and responses.

Command Buffer: 40 characters.

Dialing Capability:
Tone Dialing: Digits 0 through 9, A,B,C,D, *, and #.
Pulse Dialing: 9.5 to 10.5 pulses per second (PPS)

Transmit Level: -10dBm

Receive Level: -43 to -10 dBm

I/O Module: Two-wire dial-up **

Direct Digital Interface (non-modem units):
Type: RS-232 data port configured as a DTE.
Connector Type: male 25-pin D-Subminiature (DB-25)

Port Configuration:
Data Rate: Switch-selectable to 300, 1200, 2400, 4800, 9600, 19,200 or 28,800 bps.
Parity: Odd, Even, or None
Number of Data Bits: Seven or Eight

Flow Control: XON/XOFF

ALARM RELAYS AND CONTROL INPUTS/OUTPUTS

Standards Compliance: Designed to meet the requirements of ANSI C37.90-1978 and ANSI C37.90.1

Switch Fail Alarm: Form "C" contact, rated for 100 mA at 142 Vdc

Access Alarm: Form "C" contact, rated for 100 mA at 142 Vdc

Remote Disconnect Input: Optically isolated, 48 to 142 Vdc operation

** For 4-wire applications the 2400 baud modem and 4W I/O must be used.

GENERAL

Power Supply: 25-Watt output, input voltage of 24 Vdc, 48 Vdc, 125 Vdc, 250 Vdc, 110 Vac, or 220 Vac. Each power supply meets the Surge Withstand and Fast Transient Protection requirements of ANSI C37.90-1978 and C37.90.1.

Current Draw: The RFL 9660 typically draws 350 mA from its power supply, plus an average of 15 mA for each device port module when the RFL 9660 is in the idle state. When a port is in use, an additional 15 mA will typically be drawn from the supply.

Operating Temperature: -30°C to +65°C
(-22°F to +149°F)

Relative Humidity: Up to 95 percent at +40°C, non-condensing

Dimensions:
- Height: 5.25 inches (13.3 cm)
- Depth: 13 inches (33.0 cm)
- Width: 19 inches (48.3 cm)

Weight: Approximately 15 lbs (6.2 kg).

Windows Application Requirements:
Computer: IBM PC or compatible, with a 286 processor (or better).
Operating System: DOS 3.1 or better, running Microsoft Windows Version 3.1 (or better).

FIBER OPTIC REMOTE TRANSCEIVERS

Device Port:
- Configuration: DCE. Each port parameter can be programmed through the RFL 9660.
- Connector Type: Male 9-pin D-Subminiature (DE-9), EIA 574-compatible.
- Data Rate: 300, 1200, 2400, 4800, 9600, or 19,200 bps.
- Number of Stop Bits: One or Two
- Flow Control: RTS/CTS, DTR/DSR, XON/XOFF, or None.

Fiber Optic Connector Type: ST

Fiber Type: 62.5-micron, 850-nm, multimode

Transmission Distance: Each fiber optic link can be up to 2 kilometers long (6,560 feet)

Optical Power Budget: 8 dB per link

Pulse Modulation Encoding Format: Manchester II.

Input Power: 9 Vdc, 48 Vdc, or 125 Vdc. The 48 Vdc and 125 Vdc inputs meets the Surge Withstand and Fast Transient Protection requirements of ANSI C37.90-1978 and ANSI C37.90.1

Current Draw: 350 mW typical

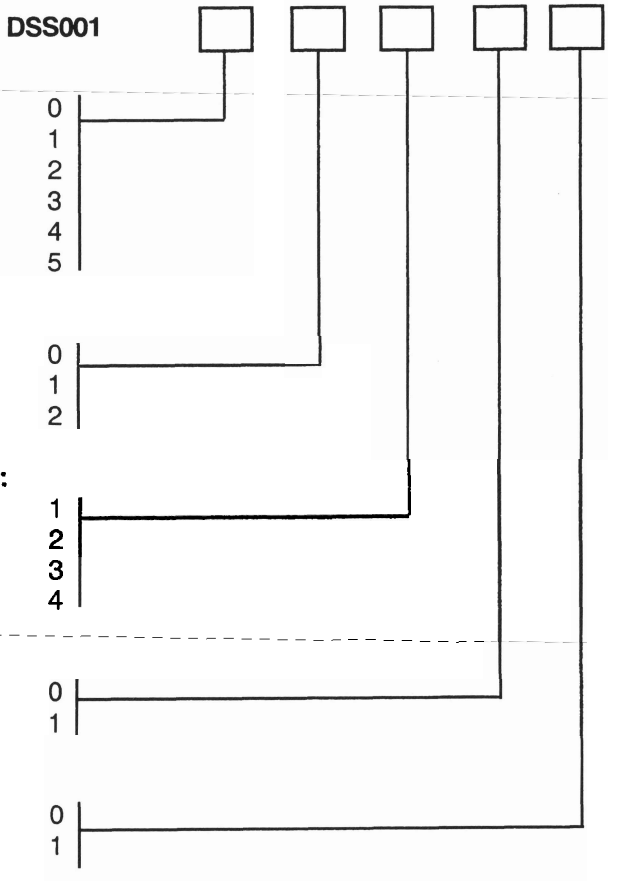
Operating Temperatures: -30°C to +70°C
(-22°F to 158°F)

Relative Humidity: Up to 95 percent at +40°C, noncondensing

Dimensions:
- Length: 6 inches (15.2 cm)
- Width: 4 inches (10.2 cm)
- Height: 2.0 inches (5.1 cm)

ORDERING INFORMATION

RFL 9660 Digital Switches are ordered by specifying the power supply input voltage, modem type, number of RS-232 device port modules required, whether a fiber optic device port module is required, and chassis type. The choices are specified by using the following part number scheme.



Power Supply Input:
24 Vdc 0
48 Vdc 1
125 Vdc 2
110 Vac 3
220 Vac 4
250 Vdc 5

Communciations
Direct Digital Interface 0
V.34 Modem & 2-Wire I/O 1
V.22 Modem & 4-Wire I/O 2

Number of RS-232 Device Port Modules:
1 (For up to 8 RS-232 devices) 1
2 (For up to 16 RS-232 devices) 2
3 (For up to 24 RS-232 devices) 3
4 (For up to 32 RS-232 devices) [1] 4

Fiber Optic Master: [1]
Not Installed 0
Installed 1

Chassis Mounting:
Flush Mount 0
Projection Mount 1

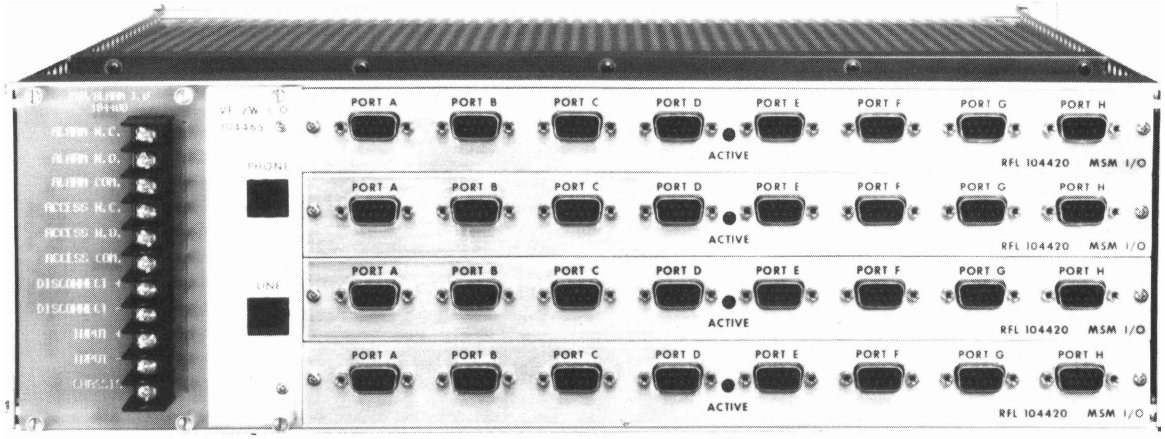
Fiber Optic Remote: [2]
Without Internal Power Supply: Order No. 104870-1 [3]
With Internal Power Supply:
48 Volt Input: Order No. 104870-2
125 Volt Input: Order No. 104870-3

Notes:

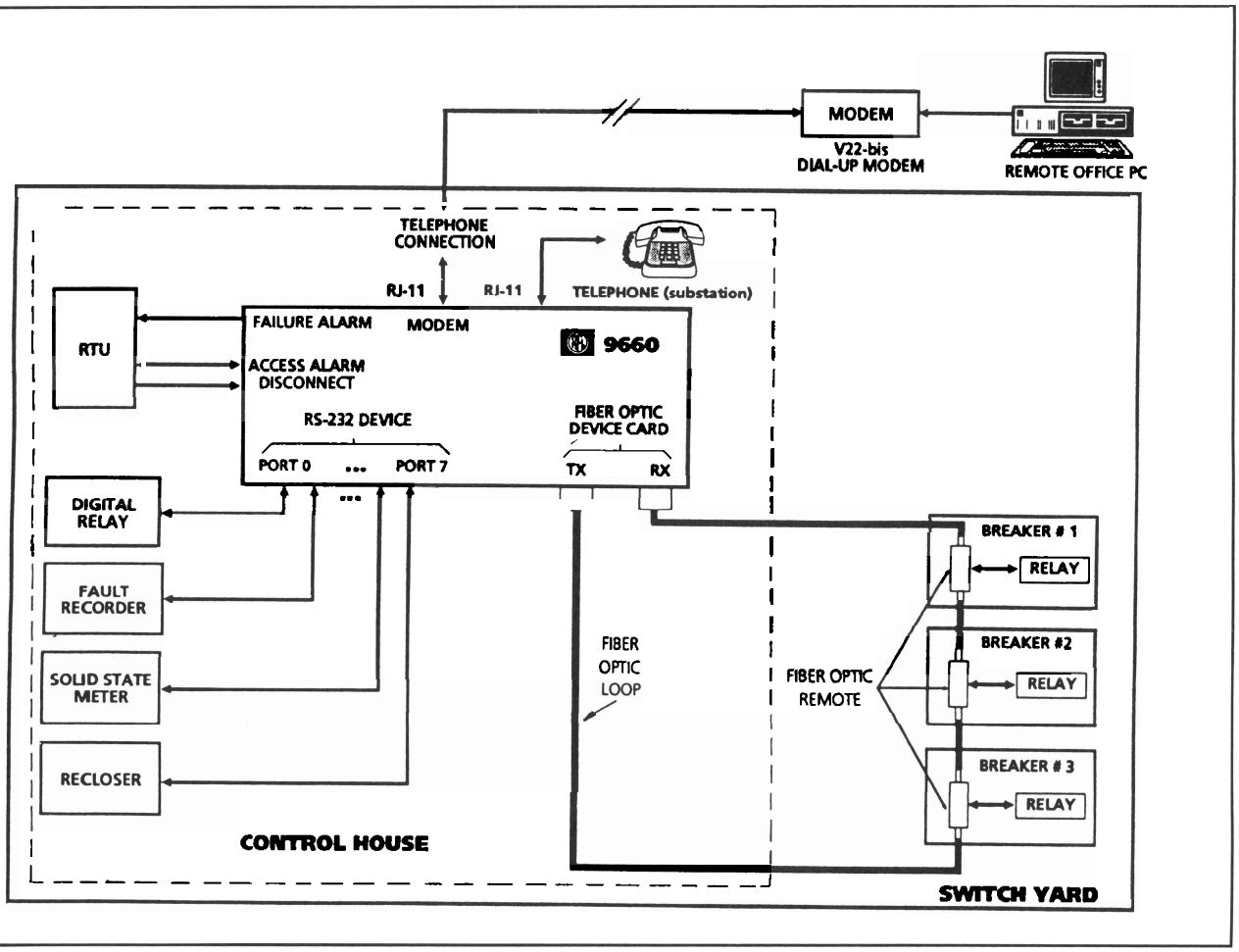
1 The fiber master occupies one horizontal device port slot in the rear of the RFL 9660. If a fiber optic master is installed, only three RS-232 Device Port Modules can be installed.

2 One fiber optic remote is required for each fiber optic device being interfaced to the RFL 9660. Up to 32 fiber optic remotes can be used. Fiber optic cabling between the RFL 9660 and the fiber optic remote is not normally supplied.

3 Up to two fiber optic remotes without power supplies may be powered from one with a power supply.



Rear view, RFL 9660 Digital Switch



Typical application, RFL 9660 Digital Switch

Section 2. INSTALLATION

WARNING

THE RFL 9660 MUST BE PROPERLY GROUNDED AS DESCRIBED IN THIS SECTION BEFORE ATTEMPTING TO PLACE THE SWITCH IN SERVICE. IMPROPER GROUNDING MAY RESULT IN SYSTEM MALFUNCTIONS, EQUIPMENT DAMAGE, OR ELECTRICAL SHOCK.

CAUTION

During normal operation, the switching of relay contacts can produce voltage spikes. These spikes can travel down the relay output leads and induce currents in other leads. These induced currents can result in corrupted data. To reduce this possibility, use shielded cable for all connections to the RFL 9660's PORT connectors. Shielded cable should also be used for the connections between the RFL 9660 and the local DTE when the direct digital interface is used. As an added precaution, do not bundle data, relay output, and power leads into the same harness - keep them as far apart as possible.

Before attempting to make power connections, make sure the power switch on the RFL 9125 power supply module is in the off (down) position. Also, make sure the power supply can operate at the available station battery voltage. This can be determined by checking the numbers next to the model designator on the module handle. If you connect the wrong voltage to the power supply, component damage will result.

2.1 INTRODUCTION

This section contains installation instructions for the RFL 9660, including unpacking, mounting, and wiring. Figure 2-7 at the end of this section summarizes the information in this section.

2.2 UNPACKING

Each RFL 9660 is packed in its own shipping carton:

1. Open each carton carefully to make sure the RFL 9660 is not damaged.

2. After removing the RFL 9660 from the carton, carefully examine all packing material to make sure no items of value are discarded.

3. Carefully remove any packing materials inserted into the RFL 9660 to hold circuit board modules in place during transit.

4. Make sure all front-panel modules are fully seated in the chassis. The quarter-turn fasteners securing each module in place should all be in the locked position (screwdriver slots vertical).

If you notice any signs of shipping damage, immediately notify RFL Customer Service at the phone number listed at the bottom of this page. Save all the packing material and the shipping carton, in case a damage claim needs to be filed with the shipping company that delivered the unit.

2.3 MOUNTING

After unpacking, the RFL 9660 must be securely mounted. The RFL 9660 chassis has two mounting ears (one on each side). Hole sizes and spacings conform with EIA standards, so the RFL 9660 can be mounted in any standard 19-inch rack or cabinet. Figure 2-2 provides complete mounting dimensions.

2.4 VENTILATION

The specified operating temperature range for RFL 9660 equipment is -30^{O}C to +65^{O}C (-22^{O}F to +149^{O}F). Operation at higher temperatures may affect system reliability and performance. Systems installed in enclosed cabinets should be ventilated to keep the temperature inside the cabinet within limits.

2.5 CONNECTIONS

Electrical connections are made to the RFL 9660 through the terminal blocks and connectors on its rear-panel I/O modules. (See Figure 2-1.) The following paragraphs provide basic descriptions of all the connections that must be made.

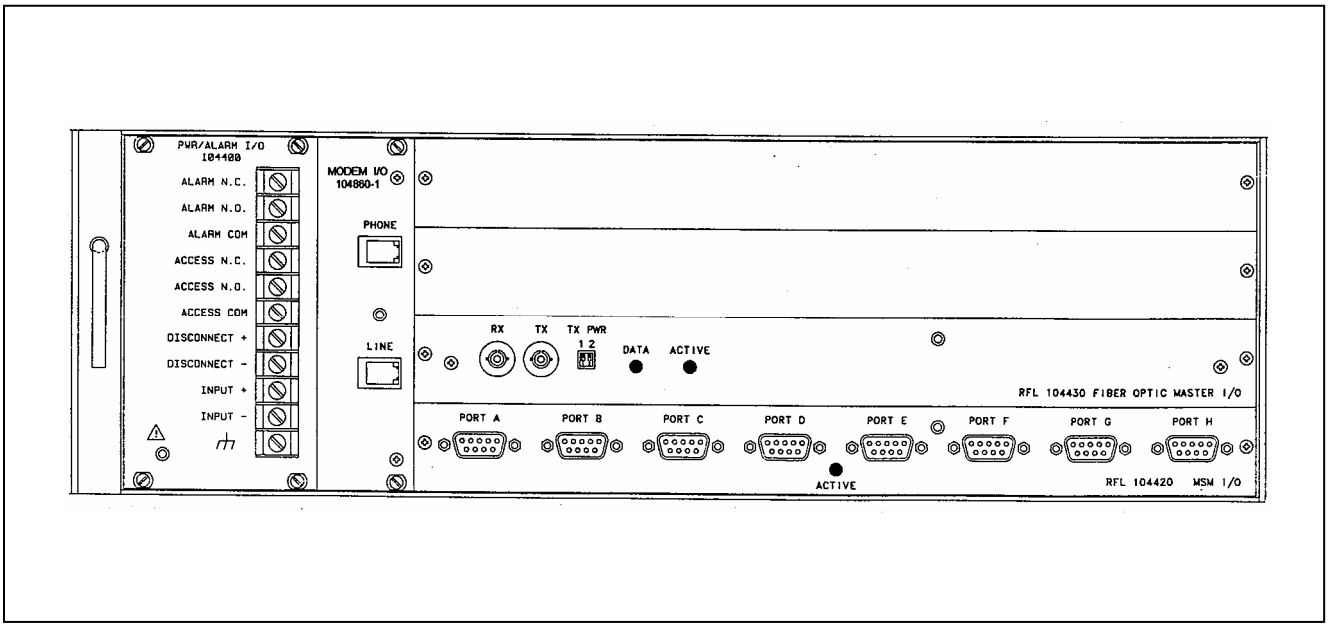
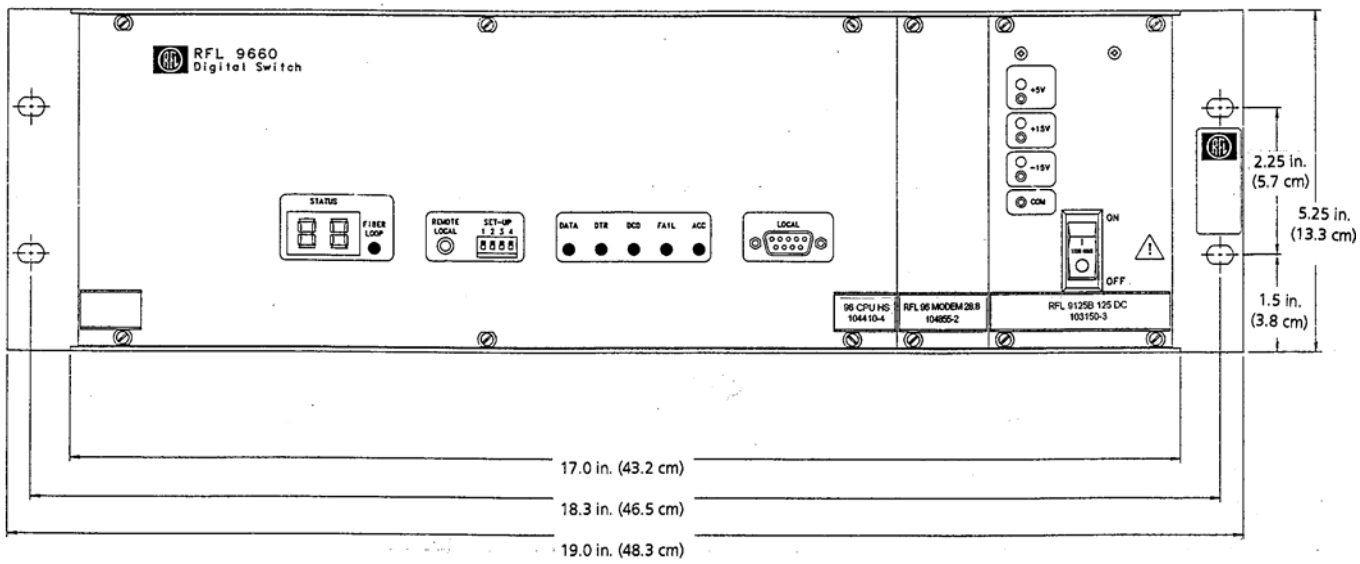


Figure 2-1. Rear view of typical RFL 9660 Digital Switch

2.5.1 MAKING CONNECTIONS TO TERMINAL BLOCKS

The terminal blocks on the RFL 9660's rear-panel I/O modules are conventional screw-type barrier blocks. Depending on local practice, you can either strip the wires you connect to them, or terminate the wires in spade lugs.



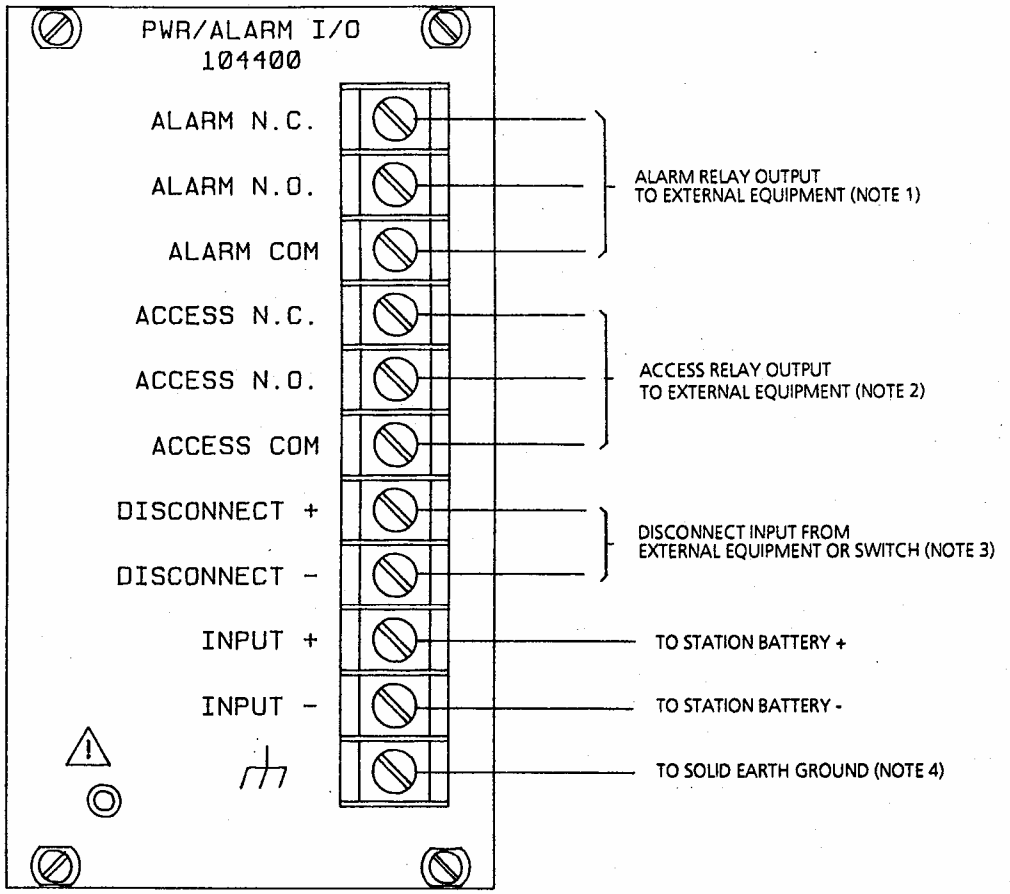
NOTE: RFL 9660 will extend 13.75 inches (35 cm) behind panel.

Figure 2-2. Mounting dimensions, RFL 9660 Digital Switch

To connect wires to the terminal block on the PWR/ALARM I/O (Part Number 104400) or AC/ALARM I/O (Part Number 104400-1), you will have to remove the protective cover from the terminal block by pulling it out of the standoffs holding it in place. After all connections have been made to the terminal block, reinstall the protective cover by lining up its mounting holes with the standoffs on the I/O module. Once the holes and standoffs are lined up, push down on the protective cover to secure it in place.

2.5.2 ALARM, REMOTE DISCONNECT, GROUND, AND POWER CONNECTIONS

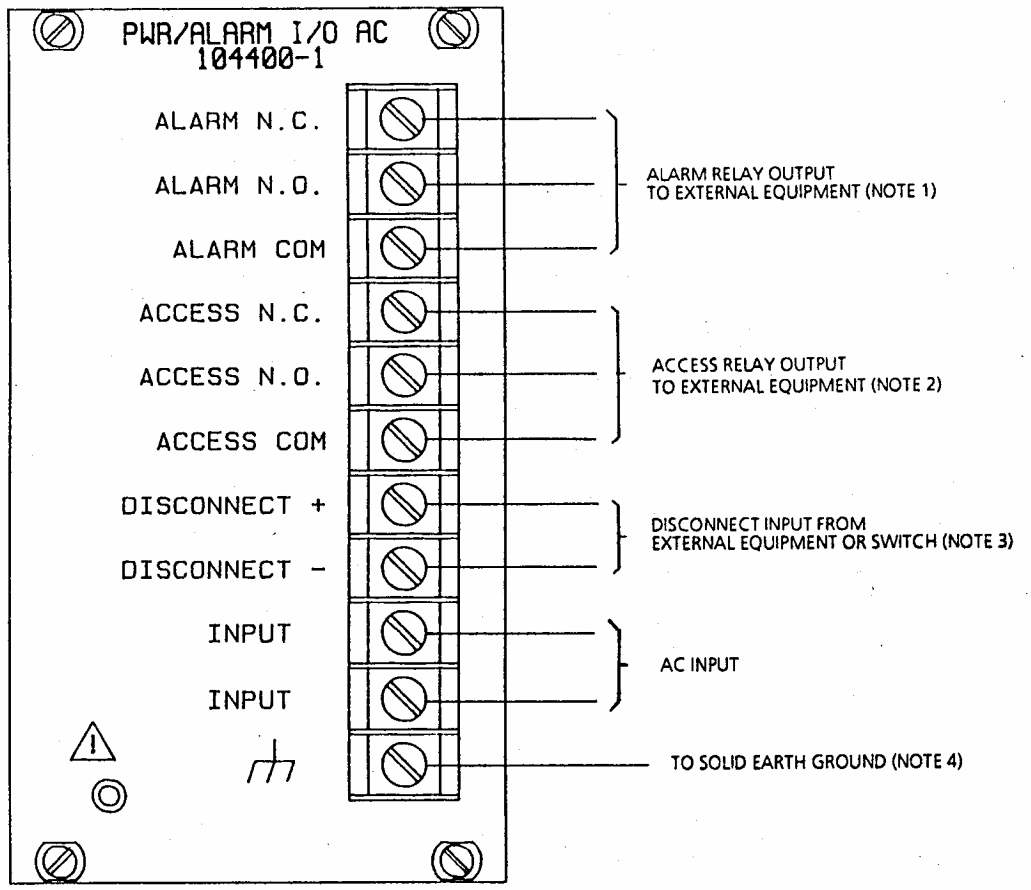
All alarm, remote disconnect, ground, and power connections are made to the RFL 9660 through terminal block TB1 on the PWR/ALARM I/O module. Figure 2-3 shows the connections that must be made on dc-powered units; Figure 2-4 shows the connections for ac-powered units.



NOTES:

1. The ALARM relay changes state when the RFL 9660 detects a loss of power,a CPU failure, or a fiber optic failure.
2. The ACCESS relay changes state whenever the RFL 9660 grants a user access to the switch.
3. When the remote disconnect input is active, the RFL 9660's modem will hang up and de-select the active port. Input voltages from 42 Vdc to 142 Vdc can be accepted.
4. The grounding wire should be kept as short and straight as possible, to keep its resistance and inductance to a minimum.

Figure 2-3. RFL 9660 alarm, remote disconnect, and power connections (dc-powered units)



NOTES:

1. The ALARM relay changes state when the RFL 9660 detects a loss of power,a CPU failure, or a fiber optic failure.
2. The ACCESS relay changes state whenever the RFL 9660 grants a user access to the switch.
3. When the remote disconnect input is active, the RFL 9660's modem will hang up and de-select the active port. Input voltages from 42 Vdc to 142 Vdc can be accepted.
4. The grounding wire should be kept as short and straight as possible, to keep its resistance and inductance to a minimum.

Figure 2-4. RFL 9660 alarm, remote disconnect, and power connections (ac-powered units)

2.5.3 TELEPHONE CONNECTIONS

The RFL 9660 is equipped with a two-wire I/O module. The substation phone will not be disabled once the RFL 9660 is connected to the telephone line; you will still be able to make outgoing calls.

The RFL 9660's modem will automatically answer after four rings (two rings on "double-ring" telephone systems). This number of rings is programmable up to 255; consult the factory if you wish to make a change.

2.5.3.1 Two-Wire Connections

RFL 9660 units equipped with VF 2W I/O Two-Wire Telephone Interface Modules (Part Number 104860-1) have two RJ-11 telephone jacks on the rear. Connect the incoming telephone line to the LINE jack. Connect a standard telephone deskset to the PHONE jack. (See Figure 2-5.) Telephone line cords are not provided with the RFL 9660. They can be purchased locally, or obtained from your local telephone company.

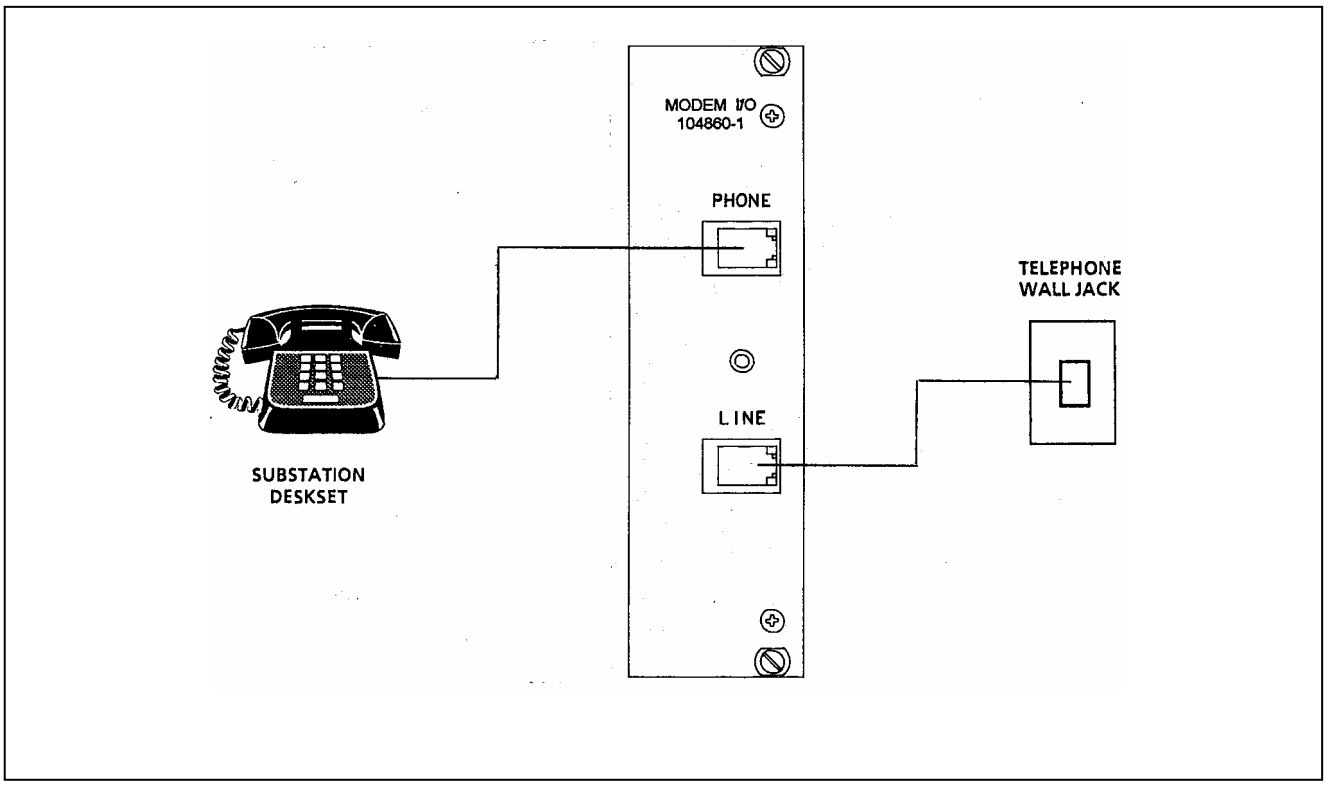


Figure 2-5. Two-wire telephone connections, RFL 9660 Digital Switch

2.5.4 RS-232 PORT CONNECTIONS

If your RFL 9660 is equipped with one or more RS-232 I/O modules (Part Number 104420), there will be a series of 9-pin D-subminiature (DB-9) male DCE connectors on the rear of the RFL 9660. Each of these connectors provides all connections for one RS-232 port. Port assignments are shown in Table 12-1 in Section 12. Space is also provided in the table for you to write in the name or description of the device connected to each port, along with its communications characteristics. You will need this information when you use the procedures in Section 3 to set the switch and port configuration.

Terminal assignments for the device port connectors are shown in Figure 2-6. You do not have to make connections to all pins. Wiring will depend on the specific device being connected to the port. Refer to Section 16 for application notes for the specific device you are wiring, or refer to the manual supplied with the device.

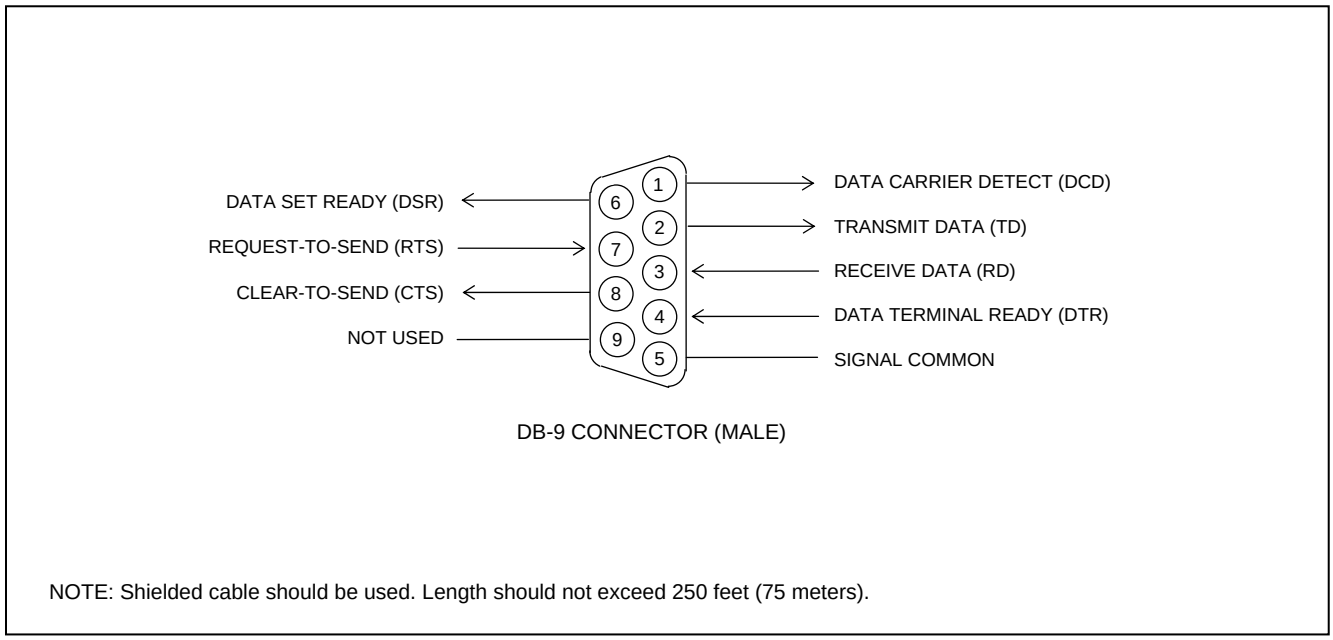


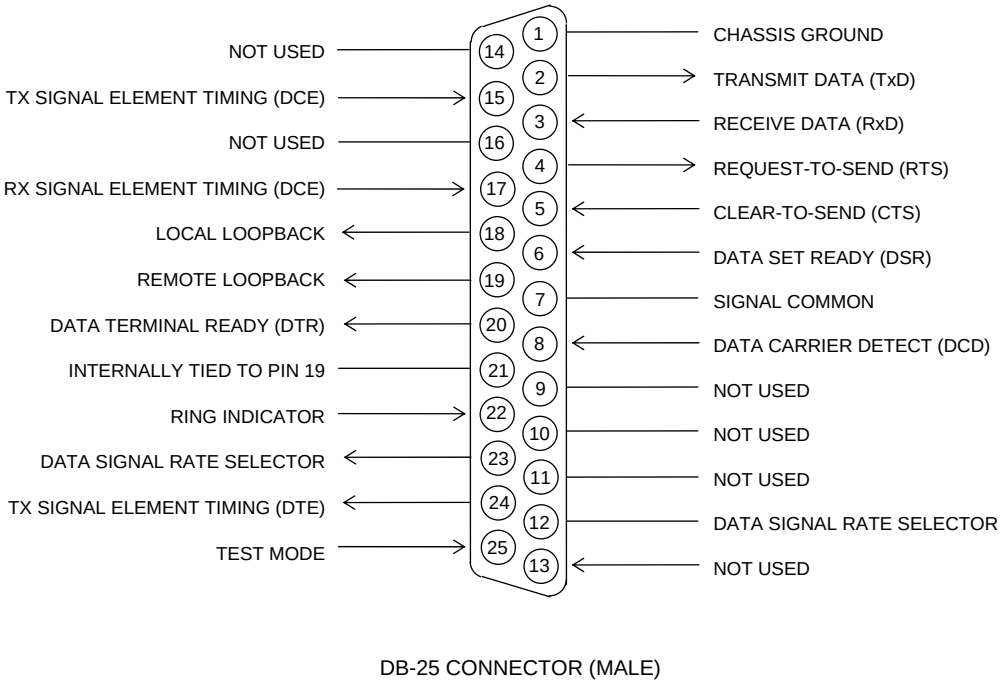
Figure 2-6. Terminal assignments for PORT connectors on RFL 9660 Digital Switch

2.5.5 CONNECTIONS TO DIRECT DIGITAL INTERFACE

If your RFL 9660 is equipped with a direct digital interface I/O module (Part Number 104455) instead of a modem module and telephone interface module, there will be a 25-pin D-subminiature connector (DB-25 male) on the rear panel. A cable must be connected between this connector and the local DTE. The DTE can be either an external modem or a communications network multiplexer. Pin assignments for this connector are shown in Figure 2-7.

NOTE

Unless specified at time of order, the direct digital interface port is set for 2400 baud, eight data bits, one stop bit, and no parity. If the DTE or modem you are connecting to requires a different setting, go to Section 8 and reset DIP switch S3 on the CPU module before attempting to use the RFL 9660.



DB-25 CONNECTOR (MALE)

NOTE: Shielded cable should be used. Length must not exceed 250 feet (75 meters).

Figure 2-7. Terminal assignments for direct digital connector on RFL 9660 Digital Switch

2.5.6 FIBER OPTIC REMOTE MOUNTING DIMENSIONS

The 9660 fiber optic remote outline drawing and mounting dimensions are shown in Figure 2-8.

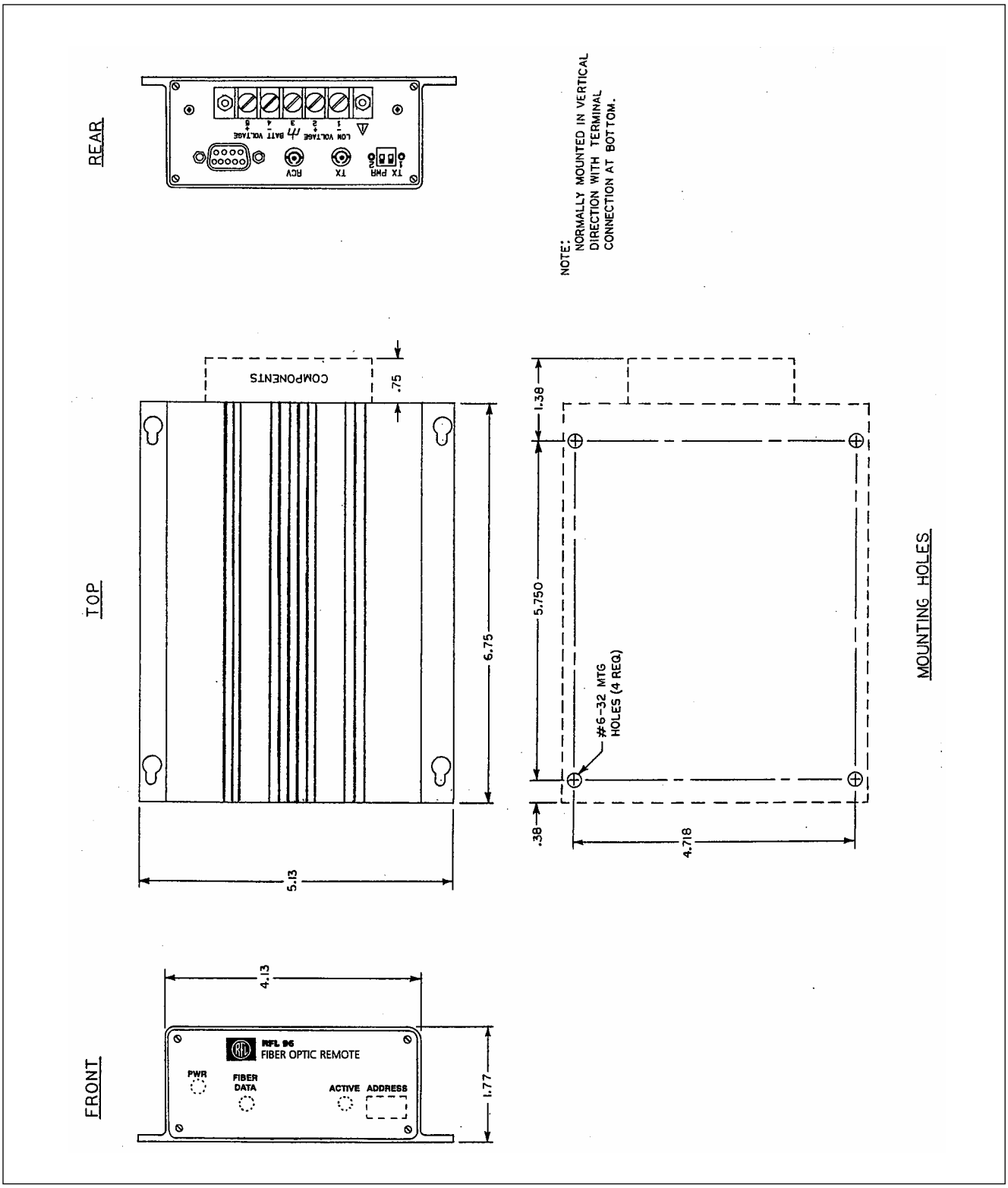


Figure 2-8. Fiber optic remote mounting dimensions

2.5.7 CONNECTIONS TO FIBER OPTIC MASTER AND REMOTES

If your RFL 9660 is equipped with a fiber optic master I/O module (Part Number 104430), you will have to connect fiber optic cables between it and the fiber optic remotes. This forms the fiber optic ring, as shown in Figure 2-9. Each fiber optic cable in the ring can be as long as 2000 meters (1.24 miles).

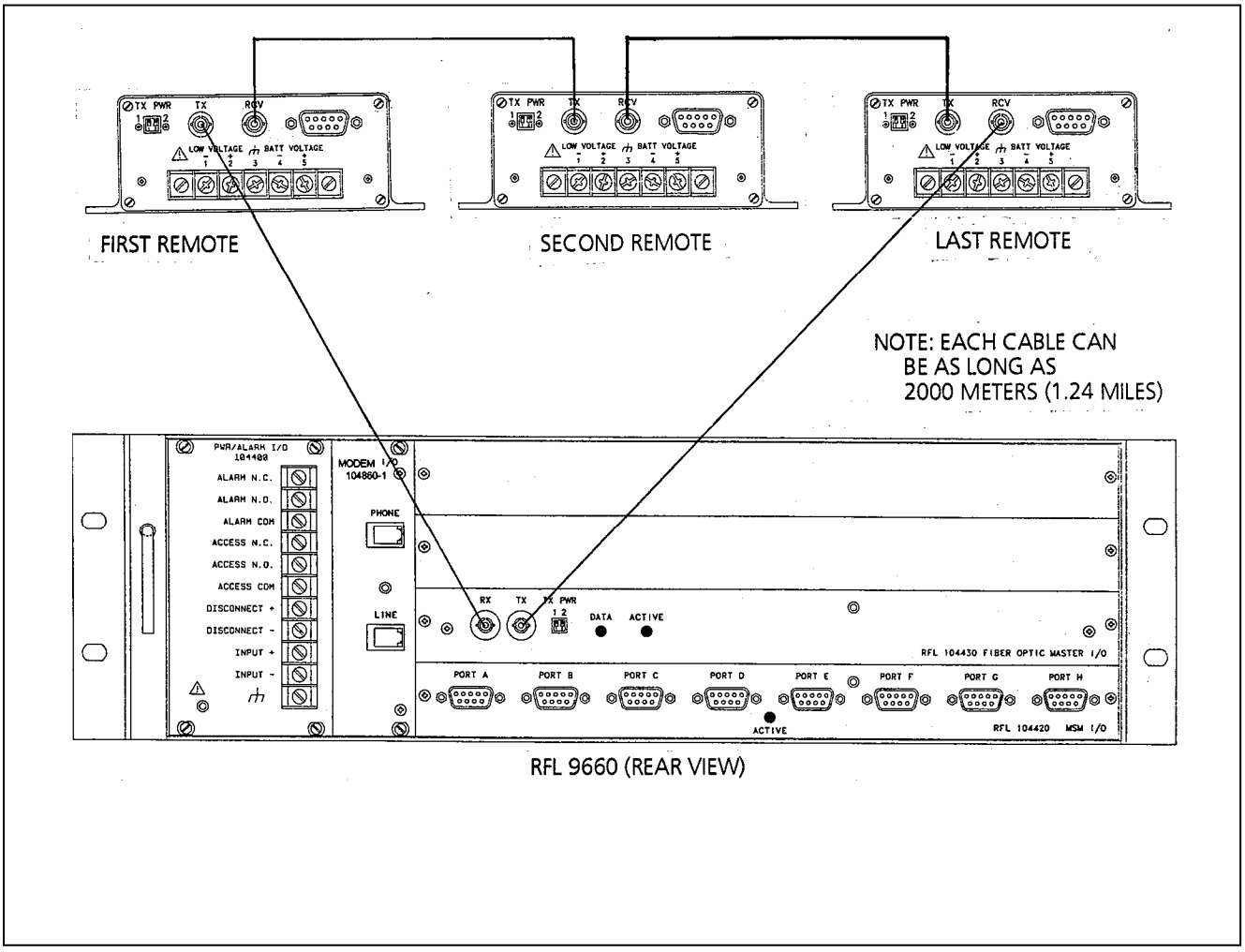


Figure 2-9. Fiber optic connections between master and remotes in fiber optic ring

At each fiber optic remote in the ring, power connections are made and cables are connected between the fiber optic remotes and the RS-232 devices that are being connected to the fiber optic ring. To make these connections, proceed as follows:

1. At the RFL 9660, connect the outgoing fiber optic cable to the TX fiber optic connector on the fiber optic master. Connect the incoming fiber optic cable to the RX fiber optic connector.

2. Make the following connections and DIP switch settings at each fiber optic remote:

   a. Connect the outgoing fiber optic cable to the TX fiber optic connector on the back of the fiber optic remote. Connect the incoming fiber optic cable to the RX fiber optic connector.

b. Connect station battery positive to terminal TB1-4 on the terminal block. Connect station battery negative to terminal TB1-3. Connect chassis common to the center terminal on TB1 (the one with the ground symbol beneath it).

If you have up to three fiber optic remotes at the same site, you can use the setup shown in Figure 2-10 to drive two 9-volt remotes from the power supply in one 48-volt or 125-volt remote. To avoid large voltage drops in the connecting wires, this method should only be used with fiber optic remotes that are near each other. Long wire runs would drop the supply voltage to a level that is too low for reliable remote operation.

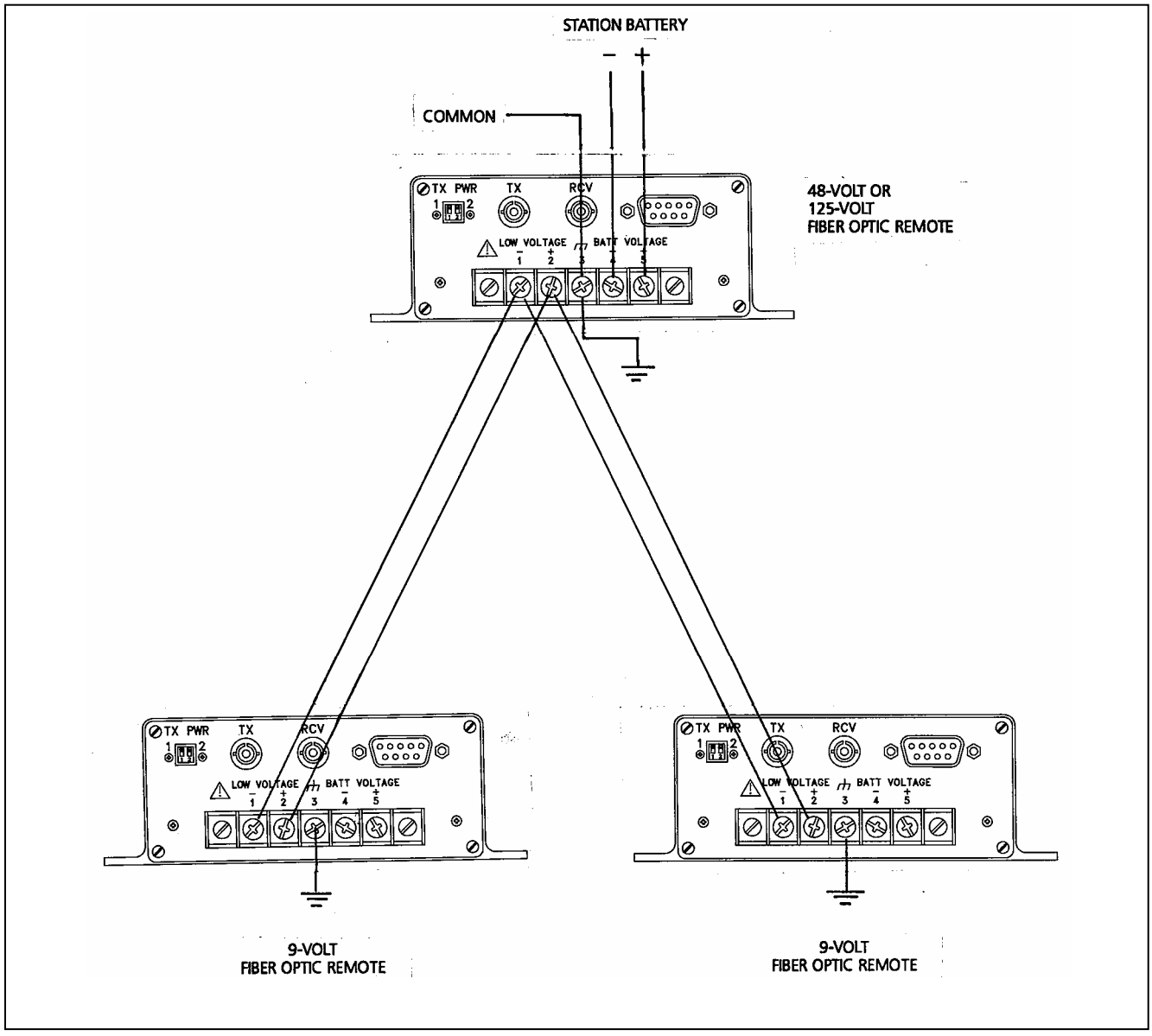


Figure 2-10. Power connections between three fiber optic remotes at the same site

c. Connect the RS-232 device to the 9-pin D-subminiature (DE-9) connector on the back of the fiber optic remote.

Terminal assignments for the device port connectors are the same as those shown in Figure 2-6 for the RFL 9660's rear panel PORT connectors.

You do not have to make connections to all pins. Wiring will depend on the specific device being connected to the port. Refer to Section 16 for application notes for the specific device you are wiring, or refer to the manual supplied with the device.

d. Set TX PWR switch S2 for the required optical output power.

S2 has four possible settings, producing four different power levels:

Output	S2-1	S2-2
-16 dBm	OFF	OFF
-13 dBm	ON	OFF
-11 dBm	OFF	ON
-10 dBm	ON	ON

When setting S2, remember that OFF is up, and ON is down.

e. Set ADDRESS switch S1 for remote module's address.

S1 sets up a binary number that represents the port number assigned to the device. (See Table 2-1 for the proper settings for each of the RFL 9660's 32 port numbers). When setting S1, remember that OFF is up, and ON is down.

f. Repeat steps 2a through 2e at all other fiber optic remotes.

2.6 SYSTEM EXPANSION

Your RFL 9660 was shipped with the correct number of device I/O modules for the number of device ports you ordered. Up to four device I/O modules can be installed in the RFL 9660, for a maximum capacity of 32 device ports.

When installing additional device I/O modules, the following rules apply:

1. The bottom I/O module slot must always be occupied.

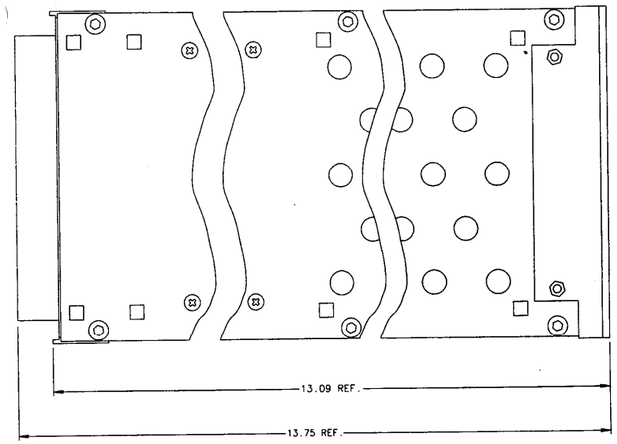
2. Additional device I/O modules must be installed from bottom to top; do not skip any I/O module slots.

3. An RFL 9660 may contain both RS-232 and fiber optic device I/O modules. If both types are to be installed, the RS-232 I/O modules must be at the bottom, with the fiber optic module on the top.

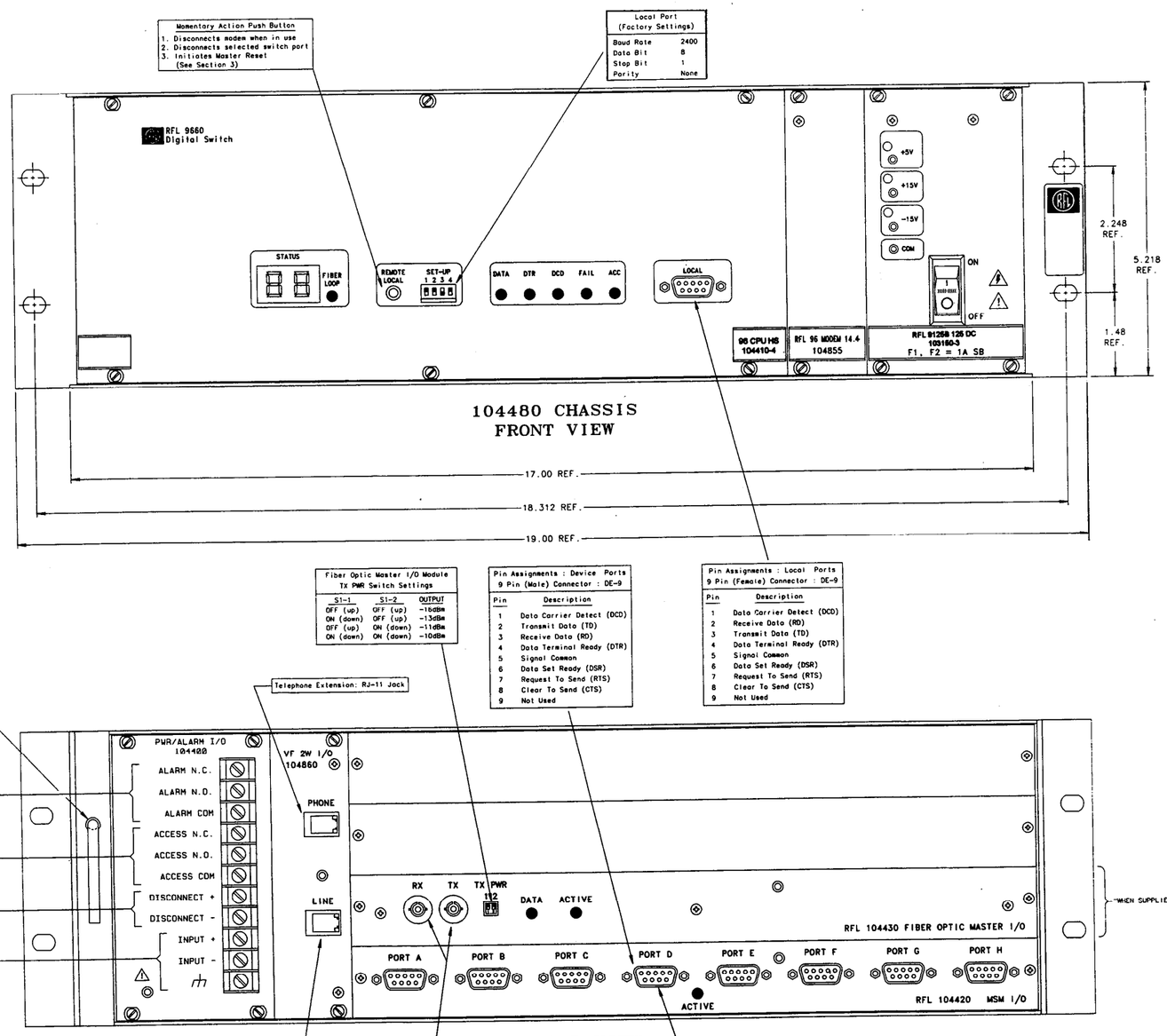
4. If you are adding an RS-232 I/O module to an RFL 9660 that already has a fiber optic I/O module, the fiber optic I/O module must be moved up one slot and the RS-232 I/O module installed below it. If the RFL 9660 has already been programmed for the devices connected to the fiber optic loop, it will have to be re-programmed, since the fiber optic devices have now been moved up eight port numbers. The address settings on the remote fiber optic modules must also be changed.

Table 2-1. DIP switch settings for fiber optic remote module addressing

Port Number	S1-1	S1-2	S1-3	S1-4	S1-5
1	OFF	OFF	OFF	OFF	OFF
2	ON	OFF	OFF	OFF	OFF
3	OFF	ON	OFF	OFF	OFF
4	ON	ON	OFF	OFF	OFF
5	OFF	OFF	ON	OFF	OFF
6	ON	OFF	ON	OFF	OFF
7	OFF	ON	ON	OFF	OFF
8	ON	ON	ON	OFF	OFF
9	OFF	OFF	OFF	ON	OFF
10	ON	OFF	OFF	ON	OFF
11	OFF	ON	OFF	ON	OFF
12	ON	ON	OFF	ON	OFF
13	OFF	OFF	ON	ON	OFF
14	ON	OFF	ON	ON	OFF
15	OFF	ON	ON	ON	OFF
16	ON	ON	ON	ON	OFF
17	OFF	OFF	OFF	OFF	ON
18	ON	OFF	OFF	OFF	ON
19	OFF	ON	OFF	OFF	ON
20	ON	ON	OFF	OFF	ON
21	OFF	OFF	ON	OFF	ON
22	ON	OFF	ON	OFF	ON
23	OFF	ON	ON	OFF	ON
24	ON	ON	ON	OFF	ON
25	OFF	OFF	OFF	ON	ON
26	ON	OFF	OFF	ON	ON
27	OFF	ON	OFF	ON	ON
28	ON	ON	OFF	ON	ON
29	OFF	OFF	ON	ON	ON
30	ON	OFF	ON	ON	ON
31	OFF	ON	ON	ON	ON
32	ON	ON	ON	ON	ON

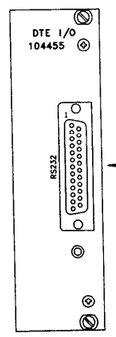


SIDE VIEW



REAR VIEW

(ALTERNATE TO VF 2W I/O)
DIRECT DIGITAL



Pin Assignments : Direct Digital
25 Pin (Female) Connector : DB25

Pin	Description
1	Chassis Ground
2	Transmit Data (TD)
3	Receive Data (RD)
4	Request To Send (RTS)
5	Clear To Send (CTS)
6	Data Set Ready (DSR)
7	Signal Ground
8	Data Carrier Detect (DCD)
9	+V Ref.
10	-V Ref.
11	Not Used
12	Data Signal Rate Select
13	Not Used
14	Not Used
15	Tx Timing (DCE)
16	Not Used
17	Rx Timing (DCE)
18	Local Loopback
19	Remote Loopback
20	Data Terminal Ready (DTR)
21	Not Used
22	Ring Indicator
23	Not Used
24	Tx Timing (DTE)
25	Test Mode

NOTE:

1. USE TOOL AT LEFT OF CHASSIS TO REMOVE CARDS.

Figure 2-11. General Installation and Interfacing Information, RFL 9660 Digital Switch (Drawing No. CD-37995)

Section 3. SWITCH AND PORT CONFIGURATION

3.1 INTRODUCTION

The procedures in this section will tell you how to configure the RFL 9660 and its ports to match your terminal and your substation equipment. These procedures can be used when first installing the RFL 9660, or any time the RFL 9660 configuration settings need to be changed or verified.

NOTE

When using the procedures in this section to change the RFL 9660's configuration settings, always keep a record of the changes you made. This record will be useful if it becomes necessary to re-program the RFL 9660.

3.2 CONTROLS AND INDICATORS

You will be using many of the RFL 9660's controls and indicators while setting its switch and port configuration. These controls and indicators are shown in Figure 3-1 and described in Table 3-1.

3.3 MAKING CONNECTIONS TO THE LOCAL TERMINAL

To configure the RFL 9660, you will have to connect a terminal to the LOCAL connector on the RFL 9660's front panel. This terminal can be a dumb RS-232 terminal, a PC, or a laptop computer with an RS-232 port running a terminal emulation program. For the rest of this section, the PC or terminal connected to the LOCAL connector will be called the "local terminal."

To connect the local terminal to the RFL 9660's local port, you will need a cable with a 9-pin D-subminiature (DB-9) male connector at one end. The other end of this cable will either have a 9-pin D-subminiature (DB-9) or a 25-pin D-subminiature (DB-25) connector, depending on what connector you have on your PC or terminal. A suitable ready-made cable can be purchased locally at any electronics or computer store, or you can make your own cable using Figure 3-2 as a guide.

Most dumb terminals have a single RS-232 connector, and this is where you would connect the cable. On many PC's or laptops, the cable will be connected to the COM1 port. If your PC has a mouse connected to COM1, connect the cable to the COM2 port. Refer to the manual supplied with your PC or terminal for more information.

Once the local terminal is connected to the LOCAL connector, it can be set to match the factory default settings for the RFL 9660's local port configuration (9600 baud, 8 data bits, 1 stop bit, no parity). Many dumb terminals have DIP switches you can use to set the configuration; refer to your terminal manual for more information. If you are using a PC with a terminal emulation program, set the configuration within the program; refer to the documentation supplied with the terminal emulation program for more information. If you would rather change the local port's configuration to match that of your PC or terminal, refer to Section 8 for information on how to set SET-UP switch S1 on the CPU module.

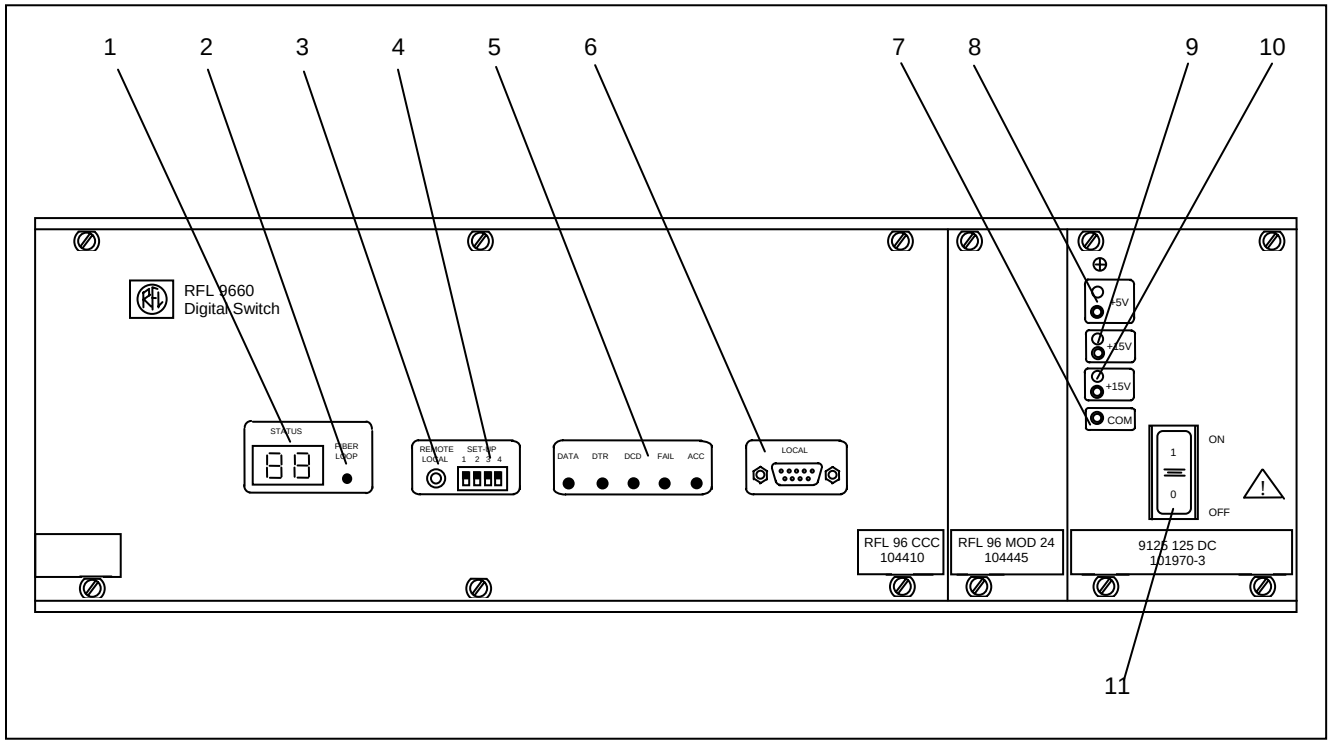
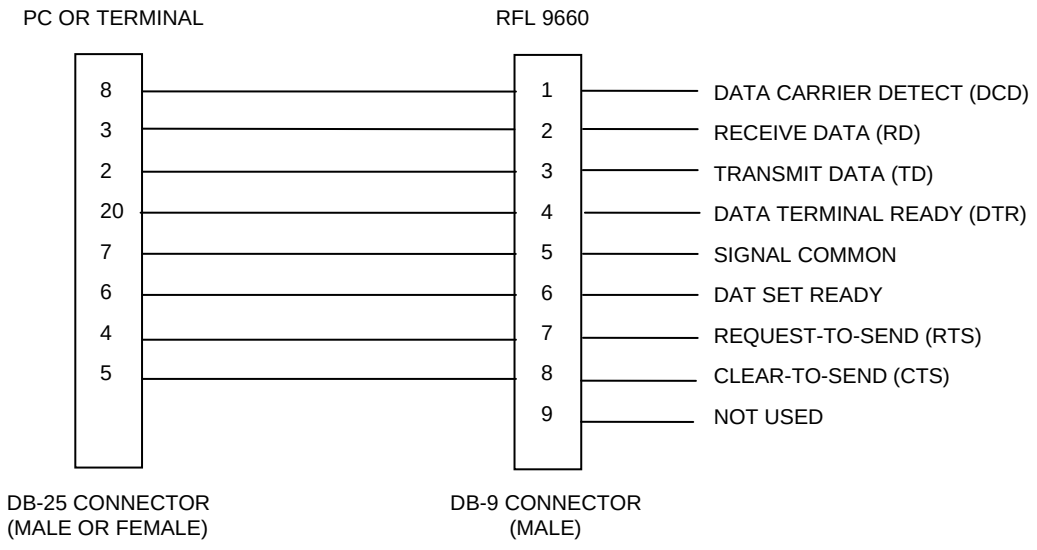


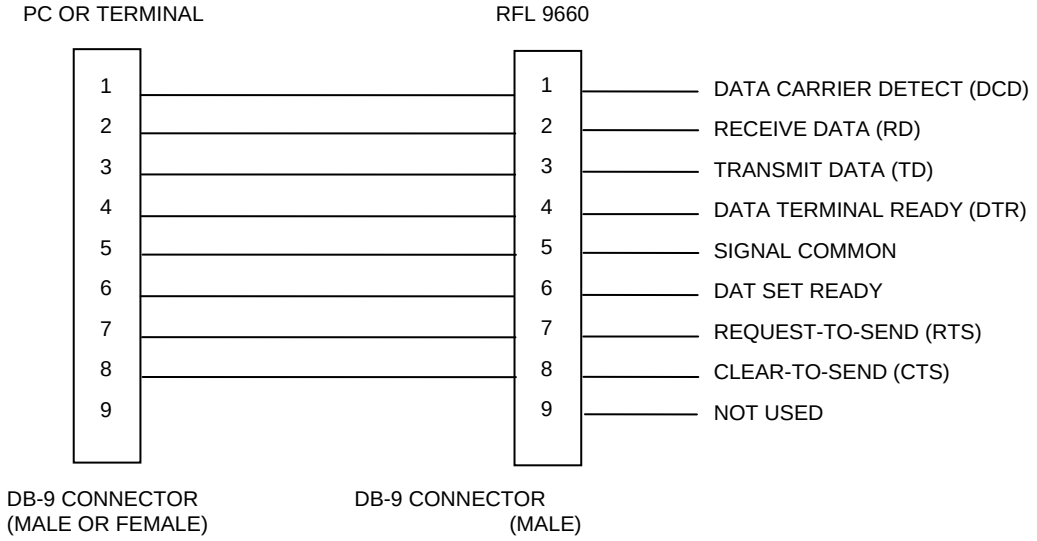
Figure 3-1. Controls and indicators, RFL 9660 Digital Switch

Table 3-1. Controls and indicators, RFL 9660 Digital Switch

Item	Description or Marking	Functional Description
1	STATUS display	Displays two-character status messages. (See Section 7 for a list of code displays.)
2	FIBER LOOP indicator	Lights green when the fiber optic loop is installed and functioning properly; lights red when the fiber optic loop is not functioning properly.
3	REMOTE LOCAL switch	1. Disconnects the modem when in use. 2. Disconnects the selected switch port. 3. Initiates a master reset. (See pagefor procedure.)
4	SET-UP DIP switch	Sets baud rate and parity for the local port. (See Sections 8 and 9.)
5	Switch status indicators	Indicate RFL 9660 status: DATA Lights green when RFL 9660 transmits and receives data. DTR Lights green when modem is ready. DCD Lights green when carrier is detected. FAIL Lights red when RFL 9660 detects a failure. ACC Lights green when the RFL 9660 is accessed.
6	LOCAL connector	Connection port for local terminal.
7	COM test point	Ground reference.
8	+5V test point and indicator	Measuring point and monitor for +5-volt supply.
9	+15V test point and indicator	Measuring point and monitor for +15-volt supply.
10	-15V test point and indicator	Measuring point and monitor for -15-volt supply.
11	Switch, rocker	Main power switch for RFL 9660.



a. For terminals with 25-pin RS-232 connectors.



b. For terminals with 9-pin RS-232 connectors.

Figure 3-2. Construction details for cable between local terminal and local connector on RFL 9660 Digital Switch

3.4 TURNING ON THE RFL 9660

To turn on the RFL 9660, simply place the rocker switch on the RFL 9125 power supply in the ON (up) position. It will initialize and run through a diagnostic routine; this will take about 90 seconds. When the letters "PL" appear in the STATUS display, the RFL 9660 is ready for use. "PL" means the RFL 9660 is polling its local and modem ports, looking for a connection.

3.5 MASTER RESET

The RFL 9660's master reset function returns all switch configuration settings (such as passwords, callback strings, delay times) to their factory-default values. This will erase any new configuration settings stored in the RFL 9660's memory, and return all switch configuration parameters to the settings they had when the RFL 9660 left the factory. The master reset can also be used to reset all port parameters (such as baud rate, flow control, port label) to their factory default settings.

If you need to initiate a master reset, use the following procedure:

1. Turn off the RFL 9660 by placing the power switch on the power supply in the off (down) position.

2. Press and hold in the REMOTE LOCAL switch on the front of the RFL 9660.

3. While holding in the REMOTE LOCAL switch, turn on the RFL 9660 by placing the power switch on the power supply in the on (up) position and look at the STATUS display.
   After about two seconds, the STATUS display will read "rC," meaning the switch passwords are about to be reset. The display will change to "00" once the passwords are reset.

4. If you only want to reset the passwords, release the REMOTE LOCAL switch when "00" appears on the STATUS display and go to step 5. If you also want to reset all the configuration parameters, keep holding the REMOTE LOCAL switch.
   After about eight more seconds, the STATUS display will read "rP," meaning the configuration parameters are about to be reset. The display will change to "00" once the configuration parameters are reset.

5. Watch the STATUS display.
   When the RFL 9660 has completed its reset routine and is ready for use, the STATUS display will read "PL." This means that the RFL 9660 is idle (not being accessed), but polling its local and modem ports for connection.

3.6 LOCALLY ACCESSING THE RFL 9660

Once you have connected the local terminal to the RFL 9660's local port and the RFL 9660 is turned on, you can access the RFL 9660 by pressing the **[ENTER]** key on the terminal keyboard. When you do, the following message will appear on your display:

Site ID.
Enter <CR> for access.

When you press the **[ENTER]** key, the following prompt appears:

LOCAL> _

Your local terminal is now accessing the RFL 9660. Each time you press a key on the local terminal's keyboard, the green DATA indicator on the RFL 9660's CPU module will light. This shows that the RFL 9660 is receiving data from the local terminal.

If the RFL 9660 does not respond, check the connections between the local terminal and the RFL 9660's local port. If the connections are good, make sure the terminal's configuration setting match that of the RFL 9660's local port (2400 baud, 8 data bits, 1 stop bit, no parity). If the connections are good and the configuration settings match, the RFL 9660 may require servicing. (See Section 12.)

If this is the first time you are using the RFL 9660 (or if passwords have not been enabled), you will be logged on as the "super-user." If you press the **[H]** and **[ENTER]** keys, a list of super-user commands will appear. (See Figure 3-3.) The relationships between these commands are shown in Figure 3-4.

```
Esc           -Abort command
H             -Help
D             -Run diagnostics
I             -Port Information
Q             -Quit session
Port #/Label  -Port selection
P             -Program port
C             -Configure switch
S             -Save changes
R             -Reset port parameters
U             -Update hardware
MODEM         -Connect Local port to Modem port.

LOCAL> _
```

Figure 3-3. List of super-user commands

If passwords have been set up and you did not use the super-user password, you will be logged on as a regular user; pressing the **[H]** and **[ENTER]** keys will display a list of general access commands, as described in Section 5. If this happens, terminate the session by pressing the **[Q]** and **[ENTER]** keys, and start another session by pressing the **[ENTER]** key again. When the prompt appears asking for a password, enter the super-user password. **You cannot perform the procedures in this section unless you are logged on as a super-user.**

NOTE

"Esc" and "Q" are universal commands. "Esc" will abort any command entry if it is pressed before you press the **[ENTER]** key. "Q" will terminate the session; it will also move you from the configuration modes back to the regular mode. The "S" command saves any changes you have made to the switch or port configuration settings. Always save your changes before you quit the session; otherwise, your changes will be erased.

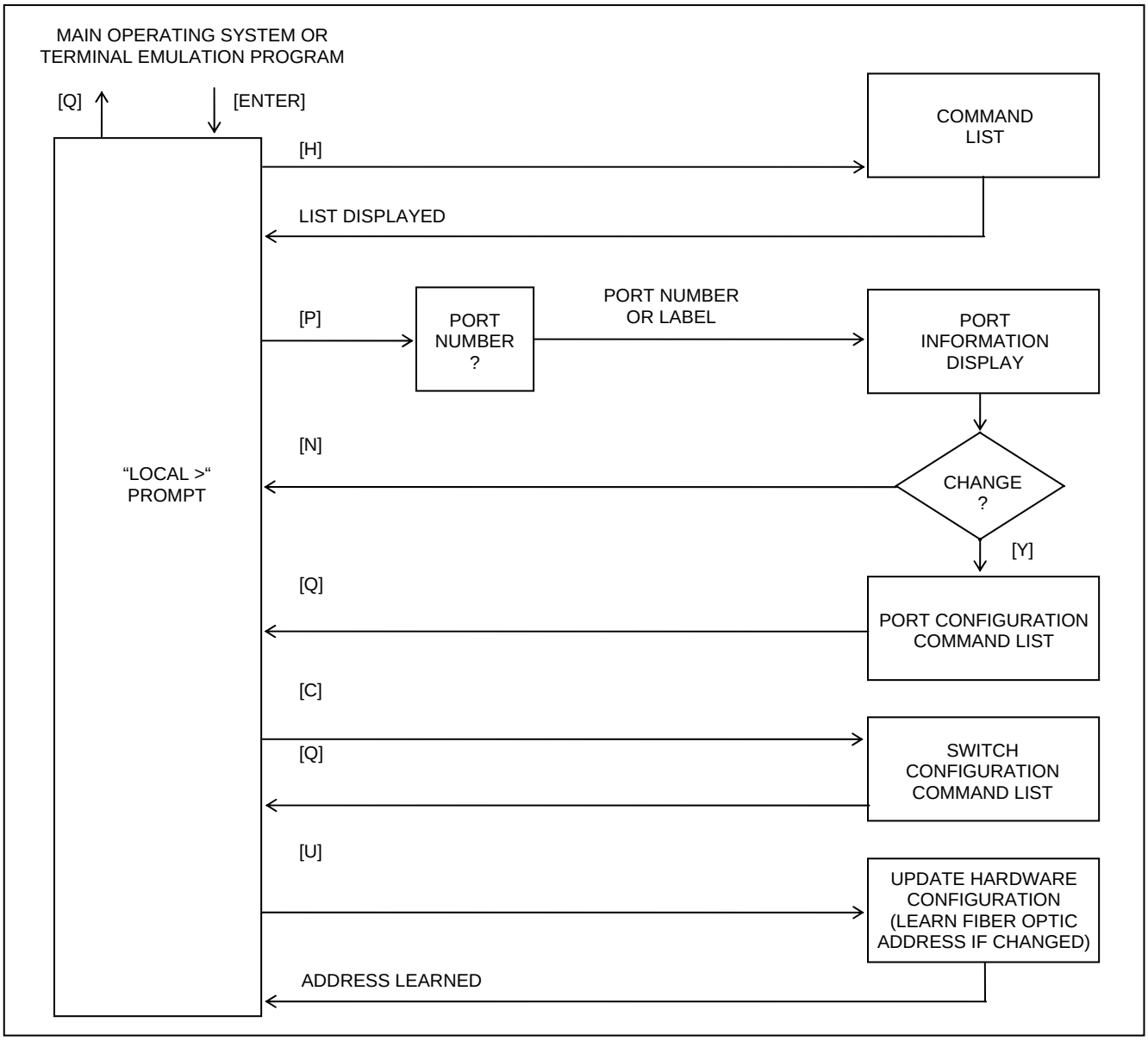


Figure 3-4. Relationship between commands used for switch and port configuration

3.7 SETTING THE SITE ID

Before you do anything else, the "site ID" should be entered into the RFL 9660's memory. The site ID is a name that is displayed each time the RFL 9660 is accessed. It is stored in the RFL 9660's memory as "Port 0." To set the site ID, use the following procedure:

1. Press the **[P]** and **[ENTER]** keys.
   The following prompt will appear:

   Port # _

2. Press the **[0]** (zero) and **[ENTER]** keys.
   The following prompt will appear:

   Site ID
   Old label was (old label)
   Please enter new label, up to 30 characters. _

3. Type in the desired site ID. It can be up to 30 characters long, including spaces (example: "Midtown Substation").

4. Press the **[ENTER]** key when you are finished entering the side ID.
   The "LOCAL" prompt will reappear.

5. Save the new site ID by pressing the **[S]** and **[ENTER]** keys.
   The RFL 9660 will send the following prompt to your terminal:

   Are you sure? (Y/N) _

6. Answer "yes" by pressing the upper case **[Y]** and **[ENTER]** keys.
   The following message will appear:

   Please wait.....

   Periods will be added to the line as the site ID is being stored. When storage is complete, the "LOCAL>" prompt will reappear.

3.8 SETTING PASSWORDS

Passwords can be used to control access to the RFL 9660. When passwords are used, nine regular users (and one super-user) will be able to use the RFL 9660. Each time someone calls into the RFL 9660, they will be asked to enter their password. They will have to enter it correctly to use the RFL 9660. In addition, the RFL 9660 keeps track of how many times each user calls in.

CAUTION

The super-user password (Password #3) must be entered before you enable passwords. If you enable passwords without a super-user password in the RFL 9660's memory, all future super-user access will be prohibited. A master reset will have to be performed to correct this condition; this will erase all switch and port configuration settings.

There are ten passwords, numbered 1 through 10. Password 3 is reserved for the super-user. All other passwords are for regular users. If passwords are not set up, all users will be able to access the RFL 9660 as super-users. This is not recommended, because super-users can make configuration and port changes.

Passwords are case-sensitive. Once you enter a password, it must be entered the same way each time it is used; otherwise, the RFL 9660 will not accept it.

To set and enable passwords, use the following procedure:

1. Press the **[C]** and **[ENTER]** keys.
   The "LOCAL>" prompt will change to a "CONFIG>" prompt. This shows that the RFL 9660 is in the configuration mode.

2. Press the **[H]** and **[ENTER]** keys.
   A list of configuration commands will appear on the terminal screen, as shown in Figure 3-5. Listed next to each command is its meaning, range limits, and default settings. You should not have to change most of these parameters, unless the equipment in your installation requires longer delay times. (Refer to Section 5 for more information on the configuration commands.)

```
nn          -represents digits.          xx-represents characters.
{0-99}      -represents allowed range.   [28]  -is default (if reset)
PP nn             - Period awaiting password {5-99} [28]
PA nn             - Silence before deselect code {1-99} [1]
PB nn             - Silence after deselect code {1-99} [1]
PT nnnn           - Inactive period, port selected {20-32000} [600]
PM nnnn           - Inactive period, menu mode {20-32000} [600]
CC xxx            - Port deselect code {0-3 characters} [BYE]
CR x...           - Modem reset code {2-30 characters} [\,+++\,ATZ0 O\n\,
CB n x...         - Call back string {1-10} of {1-40 characters}
PW n x...         - Password {1-10} of {2-7} characters [None]
CM x              - Message format {Long or Brief or None} [Long]
CT x              - Enable CCITT modem sequence {Y/N} [N]
CE x              - Password enable {Y/N} [N]
CS                - Store changes (use after alterations)
CA x              - Enable port selection by number {Y/N} [Y]
Q                 - Quit programming mode without saving changes
S                 - Show current selections
R                 - Reset to factory default
CONFIG> _
```

Figure 3-5. Typical configuration command list display

3. The super-user password must be set first. To do this, enter the following command:

   CONFIG> PW 3 *desired password* **[ENTER]**

   The password can be any character string (letters, numbers, or symbols) up to seven characters long. The password should not be something obvious, like a location name or a substation number; that would make it easier for unauthorized persons to access the switch.

4. Once the super-user password is set, set all the regular user passwords you need by entering the following command:

   CONFIG> PW *password number, space, desired password* **[ENTER]**

   Like the super-user password, user passwords can be any character string (letters, numbers, or symbols) up to seven characters long, and should not be something obvious. Only set up as many passwords as you need; unused passwords can be set up later if you need to add more users.

5. To view all the passwords you have set up, press the **[S]** and **[ENTER]** keys.
   A list of all current configuration settings will appear on your display, as shown in Figure 3-6. The passwords you entered are listed at the top. If any password needs to be changed, re-enter it by repeating step 4.

```
#       Password        Use     Callback String
.....................................................

1       GIANTS          0
2       BILLS   0
3       PATRIOT         0
4       EAGLES          0
5       STEELER         0
6       BROWNS          0
7       DOLPHIN         0
8       FALCONS         0
9       LIONS   0
10      REDSKIN         0
PP      28 sec
PA      1 sec
PB      1 sec
PT      600 sec
PM      600 sec
CR      \,+++\,ATZ0  0\n\,
CC      BYE
CM      Long    CE      N
CA      Y       CT      N

CONFIG> _
```

Figure 3-6. Typical list of current selections with passwords entered

6. If any password needs to be corrected, repeat step 4 to re-enter it. **Make sure the super-user password (#3) is present and entered correctly.** When all the passwords you need are entered correctly, enter the following command:

   CONFIG> CE Y [ENTER]

   The RFL 9660 will send the following prompt to your terminal:

   Are you sure? (Y/N) _

   Answer "yes" by pressing the **[Y]** and **[ENTER]** keys. The following message will appear:

   Please wait.....

   Periods will be added to the line as the passwords are enabled. When enabling is complete, the "CONFIG>" prompt will reappear.

7. Save the changes you have made by pressing the following command:

   CONFIG> CS [ENTER]

   The following message will appear:

   Please wait.....

   Periods will be added to the line as the changes are being stored. When storage is complete, the "CONFIG>" prompt will reappear.

8. Exit the configuration mode by pressing the **[Q]** and **[ENTER]** keys.
   The "CONFIG>" prompt will change back to the "LOCAL>" prompt. This shows that the RFL 9660 has left the configuration mode.

The passwords have now been set. To start using passwords, press the **[Q]** and **[ENTER]** keys to terminate the current session, and then press the **[ENTER]** key again to access the RFL 9660 and start another session. The RFL 9660 will ask you for your password; enter the super-user password you just entered (Password 3) and then press the **[ENTER]** key. The RFL 9660 will log you on as User 3 and return the "LOCAL>" prompt to your terminal.

Once passwords are set up and enabled, the RFL 9660 keeps track of how many times each password is used to access the RFL 9660. This information is displayed in the "Use" column of the list of current selections. (This is Figure 3-5, displayed by using the "S" command while in the configuration mode). The RFL 9660 will tally 65,536 uses for a password before it is reset to zero.

3.9 ADDING CALLBACK STRINGS TO PASSWORDS

"Callback strings" can be added to any or all RFL 9660 passwords. These strings will tell the RFL 9660 to hang up and call the user back at a certain preprogrammed phone number. This is an extra precaution that helps prevent unauthorized switch access.

The following control codes may be embedded in a callback string:

\H Hang up and pause 30 seconds.

\N Insert a carriage return.

\D Wait until carrier is detected or 60 seconds has passed, If carrier is detected, pause for another 5 seconds.

\, Pause 5 seconds.

\. Pause 60 seconds.

\X "X" is a number from 1 to 9. The callback string will be repeated this many times or until a carrier is detected. The the RFL 9660 will parse the remainder of the string.

A typical callback string is shown below:

\HATDT5551234\N\D\4

\H	This tells the RFL 9660 to hang up and wait 30 seconds.
ATDT5551234	This tells the RFL 9660 to tone-dial "555-1234."
\N	This tells the RFL 9660 to insert a carriage return.
\D	This tells the RFL 9660 to wait until carrier is detected or 60 seconds. If carrier is detected, the RFL 9660 will pause 5 more seconds.
\4	This tells the RFL 9660 to repeat the string up to 4 times if carrier is not detected within 60 seconds.
\N	This tells the RFL 9660 to insert another carriage return.

Spaces are not permitted in a callback string.

To enter a callback string for any of the active passwords, use the following procedure:

1. Press the **[C]** and **[ENTER]** keys.
   The "LOCAL>" prompt will change to a "CONFIG>" prompt. This shows that the RFL 9660 is in the configuration mode.

2. Set a callback string by entering the following command, followed by the **[ENTER]** key. Do not include any spaces in the callback string:

   CB *space, password number, space, desired callback string* **[ENTER]**

   For example, to have the RFL 9660 hang up and call the user at 555-1234 when Password #2 is entered, you would enter the following command:

   CB 2 \HATD5551234\N\D\4 [ENTER]

3. Repeat step 2 for any other passwords that require callback strings. You can always add more callback strings later if needed.

4. To view all the callback strings you have set up, press the **[S]** and **[ENTER]** keys.
   A list of all current configuration settings will appear on your display, as shown in Figure 3-7. The callback strings you entered are listed at the top, next to their passwords. If any callback string needs to be changed, re-enter it by repeating step 2.

5. When all the callback strings you need are entered correctly, save them by entering the following command:

   CONFIG> CS [ENTER]

   The RFL 9660 will send the following prompt to your terminal:

   Are you sure? (Y/N) _

```
#       Password        Use     Callback String
.....................................................
1       GIANTS          0       \HATDT5550101\N\D\4
2       BILLS           0       \HATDT5550202\N\D\4
3       PATRIOT         0       \HATDT5550303\N\D\4
4       EAGLES          0       \HATDT5550404\N\D\4
5       STEELER         0       \HATDT5550505\N\D\4
6       BROWNS          0       \HATDT5550606\N\D\4
7       DOLPHIN         0       \HATDT5550707\N\D\4
8       FALCONS         0       \HATDT5550808\N\D\4
9       LIONS           0       \HATDT5550909\N\D\4
10      REDSKIN         0       \HATDT5551010\N\D\4
PP      28 sec
PA      1 sec
PB      1 sec
PT      600 sec
PM      600 sec
CR      \,+++\,ATZ0  0\n\,
CC      BYE
CM      Long    CE      N
CA      Y       CT      N

CONFIG> _
```

Figure 3-7. Typical list of current selections with passwords and callback strings entered

6. Answer "yes" by pressing the **[Y]** and **[ENTER]** keys. The following message will appear:

   Please wait.....

   Periods will be added to the line as the callback strings are being stored. When storage is complete, the "CONFIG>" prompt will reappear.

7. Exit the configuration mode by pressing the **[Q]** and **[ENTER]** keys.
   The "CONFIG>" prompt will change back to the "LOCAL>" prompt. This shows that the RFL 9660 has left the configuration mode. At this point, the callback strings have now been set.

3.10 SETTING PORT CONFIGURATIONS

Each of the RFL 9660's device ports must be set to match the interface requirements of the device connected to it. During installation (Section 2), you listed these devices in the table in Section 12, next to the port to which they are connected. If you have not finished filling in this table, do it now. You will need this information during the following procedures. (Refer to the manufacturer's documentation for the device connected to each port or the application notes in Section 15 of this manual for the information you will need to complete the table in Section 12.)

3.10.1 ENTERING THE PORT CONFIGURATION MODE

To set port configuration, you most enter the port configuration mode. **To do this, you must be logged on to the RFL 9660 as a super-user, with the "LOCAL>" prompt on your terminal.** If the "CONFIG>" prompt is shown, you are still in the switch configuration mode; press the **[Q]** key to return to the "LOCAL>" prompt.

1. Press the **[P]** and **[ENTER]** keys.
   The RFL 9660 will send the following prompt to your terminal:

   LOCAL> Port # _

2. Enter the number of the port to be programmed, and then press the **[ENTER]** key.

   If you enter a number that is greater than the number of ports the RFL 9660 has, the following error message will appear:

   Cannot select port > than (maximum number of ports)

   If you enter a number between one and the maximum number of ports the RFL 9660 has (8, 16, 24, or 32), a port information display similar to the one shown in Figure 3-8 will appear.
   If you have a printer connected to your terminal, it would be helpful to print out this screen. You would then have a hard copy to refer to during the rest of this procedure.

```
                        Port # n (  )

Interface          -RS232 Call Out          -Off
Baud Rate          -2400  Call Request       -None
Data Bits          -8     Call Priority      -0
Parity             -None  Call String        -
Stop Bits          -1     Remote String      -
Port Flow Ctrl     -None  Port String        -
Local Port DTR     -On    Modem String       -
Local Flow Ctrl    -On    Port Password      -

To change type Y: _
```

Figure 3-8. Typical port information display, showing factory default values

3. To change any of the entries on the port information display, press the **[Y]** and **[ENTER]** keys.

The port information display will reappear, with a list of selections at the bottom. (See Figure 3-9.) Below the list of selections, the "LOCAL>" prompt will change to a "PORT n >" prompt, with "n" being the number of the port you selected during step 2. Each time you change one of the port configuration settings, this screen will be re-displayed with the change you made entered on it. To correct a change, simply make the change again.

If you don't want to change any of the settings, press the [N] and [ENTER] keys. The "LOCAL>" prompt will reappear and you will no longer be in the port configuration mode.

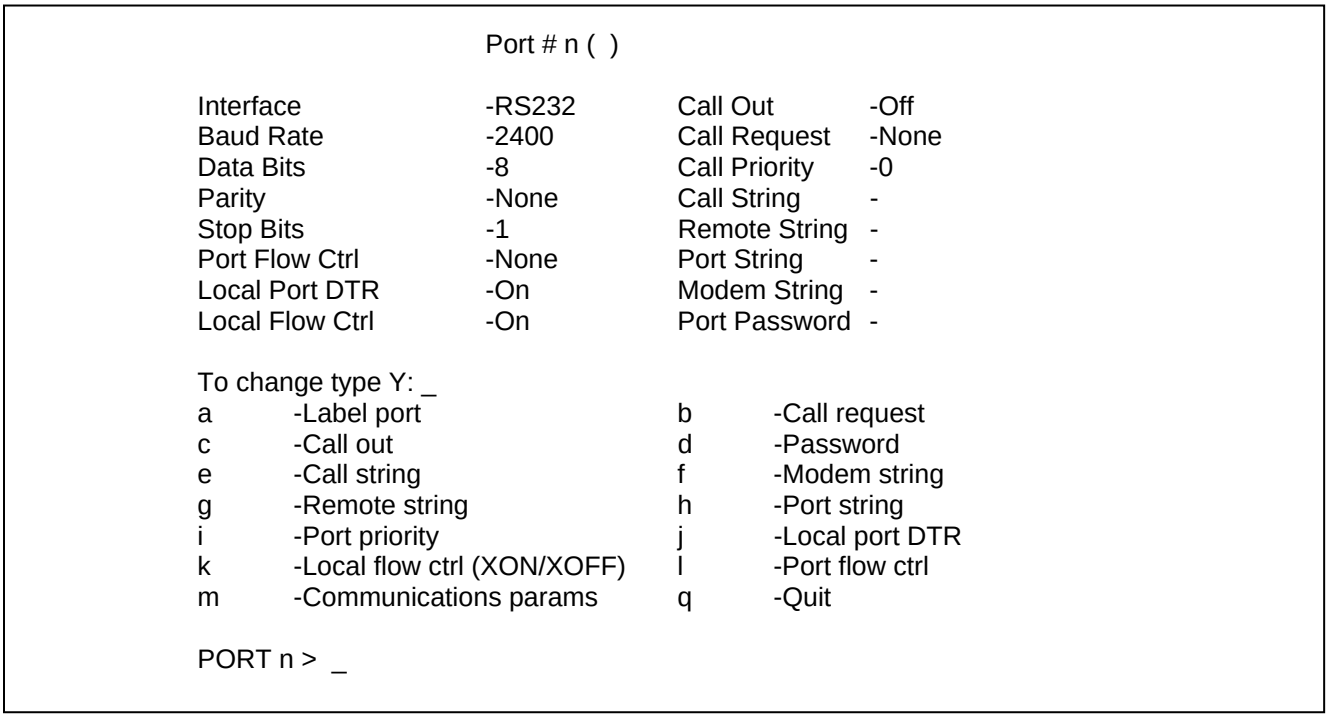


Figure 3-9. Typical port information display with list of selections for changing port information

3.10.2 SETTING THE PORT LABEL

The port label is a unique character string that can be used to identify the device attached to one of the RFL 9660's ports. Once set, the port label can be used to select the port you want to access. When you are granted access to the port, the port label will appear at the top of the port information display, next to the port number. Port labels are also listed on the port summary table when it is displayed. (See Section 4.)

To enter or change a port label, use the following procedure:

1. Press the **[A]** and **[ENTER]** keys. The following prompt will appear on your display:

   Old label was *old label - will be blank if there is no old label*
   Please enter new label, up to 30 characters. _

2. Enter the new port label, followed by the **[ENTER]** key.
   Port labels can be any combination of letters, numbers, symbols, and spaces that is 30 characters or less.

> **NOTE**
>
> **Like passwords, port labels are case-sensitive.** Once you enter a port label, all users must enter it the same way you did; otherwise, the RFL 9660 will not accept it.

3.10.3 SETTING THE COMMUNICATIONS PARAMETERS

The "M" selection lets you set the port's communication parameters to match those of the device connected to it. It is usually best to match the port's communication parameters to the device, rather than modifying the device's parameters to match the port. (Refer to the application notes in Section 15 or the manual supplied with the device for more information on the settings you will have to make. If you cannot find the information you need in either place, contact the device's manufacturer.)

To set the communication parameters, press the **[M]** and **[ENTER]** keys. The following prompt will appear on your display:

Baud: 0 = 300 1 = 1200 2 = 2400 3 = 4800 4 = 9600 5 = 19.2K: _

Enter the number that matches the baud rate of the device connected to the port, and then press the **[ENTER]** key. The following prompt will appear on your display:

Data bits: 7 or 8: _

Enter the number that matches the number of data bits for the device connected to the port, and then press the **[ENTER]** key. The following prompt will appear on your display:

Parity: 0=none, 1=even, 2=odd: _

Enter the number that matches the parity of the device connected to the port, and then press the **[ENTER]** key. The following prompt will appear on your display:

Stop bits: 1 or 2: _

Enter the number that matches the number of stop bits for the device connected to the port, and then press the **[ENTER]** key. The updated port information display and list of selections will be re-displayed, containing the new parameter settings.

3.10.4 SETTING THE PORT PASSWORD

The port password is a character string that must be entered before a user is allowed to access a device port. If a password is set for a device port, all users will be asked to enter the password each time they try to access the port. They will not be granted access unless they enter the password correctly.

To enter or change the password assigned to the selected device port, press the **[D]** and **[ENTER]** keys. The following prompt will appear on your display:

Enter new password: _

The port password can contain up to seven characters. Port passwords do not have to be unique; in fact, groups of devices can be assigned the same port password. For example, you may want to give all the relays at the substation the same password, so only the relay engineers can access them. Once you have entered the port password, press the **[ENTER]** key.

> **NOTE**
>
> **Port passwords are case-sensitive.** Once you enter a port password, all users must enter it the same way you did; otherwise, the RFL 9660 will not accept it.

3.10.5 SETTING PORT FLOW CONTROL

The "j," "k," and "l" selections allow you to set flow control for the port. "Flow control" governs the rate at which information passes between the RFL 9660 and the device connected to the port. Without flow control, data to and from the device might be corrupted. The flow control setting must be set to match the flow control requirements of the device connected to the port. (Refer to the manual supplied with the device or contact its manufacturer for more information.)

The RFL 9660 uses character-based flow control for "outbound" messages from the RFL 9660 to the device. Messages going from the device to the RFL 9660 ("inbound" messages) are fed to a 256-character buffer. The RFL 9660 will exercise its flow control for inbound messages after 128 characters are sent to the buffer. This gives the sending device 128 characters to start using its flow control. If the buffer fills up before the device halts its output in response to the RFL 9660's handshake, data corruption will occur.

To set flow control for the port, use the following procedure:

1. Press the **[L]** and **[ENTER]** keys.

   The following prompt will appear on your display:

   0 None
   1 RTS/CTS
   2 DSR/DTR
   3 XON/XOF

   _

   This selection lets you specify the flow control method the port will use.

2. Select the flow control method you want from the list on the screen, enter the number next to it, and then press the **[ENTER]** key.

3. Press the **[K]** and **[ENTER]** keys.

The following prompt will appear on your display:

Enable XON/XOFF at Modem & Local [Y]: _

This selection lets you determine whether the LOCAL and MODEM ports will use XON/XOFF flow control when communicating with this port. As shown in the prompt, this can be set to "Y" or "N," with "Y" being the default value.

4. Press the **[Y]** key to enable XON/XOFF flow control, or the **[N]** key to disable it. Once you have entered your choice, press the **[ENTER]** key.

Only set this selection to "N" (disable XON/XOFF flow control) if the device connected to the port uses the XON/XOFF characters for data, and not for flow control. If you are not sure about how to set this parameter, set it to "Y" (enable XON/XOFF flow control).

If you enter an "n," the following prompt will appear on your display above the list of selections:

Do NOT operate Modem/Local ports above 9600 baud (if the new modem is installed)

5. Press the **[J]** and **[ENTER]** keys.

The following prompt will appear on your display:

Monitor Local port DTR {Y/N} [Y]: _

This selection lets you determine whether the DTR line will be monitored at the LOCAL port. As shown in the prompt, this can be set to "Y" or "N," with "Y" being the default value.

6. Press the **[Y]** key to enable DTR line monitoring, or the **[N]** key to disable it.

If you enable local port DTR monitoring, the RFL 9660 will disconnect the user if the DTR line goes active. Set this selection to "N" (disable DTR monitoring) if the application software for the device connected to this port toggles the DTR line during communications sessions. Failure to do this will cause the RFL 9660 to disconnect while you are running the application program.

7. Once you have entered your choice, press the **[ENTER]** key.

3.10.6 SETTING CALLOUT FUNCTIONS

The callout functions will only have to be set if you want the device connected to the port to dial out through the RFL 9660. An example of this would be a digital fault recorder (DFR) that would dial up a specific phone number when a fault is detected. The callout functions include the following:

- o Call Out
- o Call Request
- o Call String
- o Call Priority

If the Application Note or device manual indicates that any of these functions should be reset, use the following procedure; otherwise, go on to the next procedure.

1. Press the **[C]** and **[ENTER]** keys.
   The following prompt will appear on your display:

   Request Enable (Y/N) _

   This selection lets you control whether the DTE connected to the port can call out through the RFL 9660.

2. Press the **[Y]** key to enable callout requests, or the **[N]** key to disable it. Once you have entered your choice, press the **[ENTER]** key.

3. Press the **[B]** and **[ENTER]** keys.
   The following prompt will appear on your display:

   0 None
   1 RTS+DTR
   2 DTR+RTS
   3 RTS
   4 DTR

   Enter Mode (0 - 4): _

   This selection lets you specify the call request method. This controls how the port device request lines will request connection to the RFL 9660.

4. Select the call request method you want from the list on the screen, enter the number next to it, and then press **[ENTER]**.

5. Press the **[E]** and **[ENTER]** keys.
   The following prompt will appear on your display:

   Enter new dialback string (<=40 chars.): _

   This selection lets you store a call string for the port. This is a character string containing a telephone number and modem commands that the port can use to dial out. The following control codes may be embedded in the callback string:

   \H Hang up and pause 30 seconds.

   \N Insert a carriage return.

\D Wait until carrier is detected or 60 seconds has passed, If carrier is detected, pause for another 5 seconds.

\, Pause 5 seconds.

\. Pause 60 seconds.

\X "X" is a number from 1 to 9. The callback string will be repeated this many times or until a carrier is detected. The the RFL 9660 will parse the remainder of the string.

A typical dialback string is shown below:

\HATDT5551234\N\D\4

\H This tells the RFL 9660 to hang up and wait 30 seconds.

ATDT5551234 This tells the RFL 9660 to tone-dial "555-1234."

\N This tells the RFL 9660 to insert a carriage return.

\D This tells the RFL 9660 to wait until carrier is detected or until 60 seconds has passed. If carrier is detected, the RFL 9660 will pause 5 more seconds.

\4 This tells the RFL 9660 to repeat the string up to 4 times if carrier is not detected within 60 seconds.

6. Once you have entered the new call string, press the **[ENTER]** key.

7. Press the **[I]** and **[ENTER]** keys.
   The following prompt will appear on your display:

   Port's priority {0 is lowest} (0 - 9): _

   This selection lets you assign a call priority level to each port.

8. Enter the priority level you want (a low number for low priority, a high number for top priority). Once you have entered the priority level, press the **[ENTER]** key.
   A high-priority call will not terminate a low-priority call that is already in progress. If a port with a high priority initiates a call at the same time as a port with a low priority, the higher priority call will go through first.

3.10.7 SETTING SPECIAL PORT CONFIGURATION FUNCTIONS

The following function settings normally do not have to be changed. The factory default settings should work with most substation devices. These special functions include the following:

- o Remote String (future enhancement)
- o Port String (future enhancement)
- o Modem String (for changing the internal modem's configuration upon output selection)

If the Application Note or device manual indicates that any of these functions should be reset, use the following procedure; otherwise, go on to the next procedure.

1. If you need to enter a modem string, press the **[F]** and **[ENTER]** keys. If you don't need to enter a modem string, go to step 4.

   The following prompt will appear on your display:

   Enter modem setup string (<=30 chars.): _

   This selection lets you store a modem string for the port. This is a character string that the port uses to send setup commands to the modem.

2. Enter the desired modem string. The following control codes may be embedded into the modem string:

   \N Insert a carriage return.

   \D Wait until carrier is detected or 60 seconds has passed, If carrier is detected, pause for another 5 seconds.

   \, Pause 5 seconds.

   \. Pause 60 seconds.

   \+ Pause five seconds, send the "+++" modem escape code, and then pause five more seconds. This control code is used to send the escape code through one modem to another. (If you inserted the "+++" escape code into the callback string, it would be intercepted by the first modem, placing it in the command mode.)

   \X "X" is a number from 1 to 9. The modem string will be repeated this many times or until a carrier is detected. The the RFL 9660 will parse the remainder of the string.

   A typical modem string is shown below:

   \+AT\X1 O\,

   \+ This tells the RFL 9660 to pause five seconds, send the "+++" modem escape code, and then pause five more seconds.

   AT\X1 This tells the modem to process XON and XOFF flow control characters, and pass then through to the local or remote system. (See Section 13 for more information on modem "AT" commands.)

O This tells the modem to enter the on-line state. (This command normally appears as "ATO," but the "AT" is not required in this string because it already appears as part of the previous command.)

\, This tells the RFL 9660 to wait 5 more seconds.

3. Once you have entered the modem string, press the **[ENTER]** key.

4. If you need to enter a remote string, press the **[G]** and **[ENTER]** keys. If you don't need to enter a remote string, go to step 6.

   The following prompt will appear on your display:

   Filename to be executed on inbound call: _

   This selection lets you store a remote string for the port. This string will specify a file to be executed on an inbound call, and is reserved for future use. The RFL 9660 will allow you to enter a remote string, but it will not be used.

5. Once you have entered the remote string, press the **[ENTER]** key.

6. If you need to enter a port string, press the **[H]** and **[ENTER]** keys. If you don't need to enter a modem string, go to the next procedure.

   The following prompt will appear on your display:

   Program to be executed on port originated call: _

   This selection lets you store a port string. This is the name of an executable program file to be run when a port originates a call, and is reserved for future use. The RFL 9660 will allow you to enter a port string, but it will not be used.

7. Once you have entered the program name, press the **[ENTER]** key.

3.10.8 SAVING YOUR PORT CONFIGURATION SETTINGS

Once you have finished making changes to the port parameters, they must be saved in the RFL 9660's memory. To do this, use the following procedure:

1. Press the **[Q]** key, followed by the **[ENTER]** key.
   The "LOCAL"> prompt will re-appear on your display, indicating that you have left the port configuration mode.

2. Save the changes you made by pressing the **[S]** and **[ENTER]** keys.
   The following message will appear on your display:

   Are you sure? (Y/N)

3. Press the upper case **[Y]** key to answer "yes," or the **[N]** key to answer "no," and then press **[ENTER]**.
   If you answer "no," the "LOCAL>" prompt will re-appear and none of your changes will be saved. Your changes will be in effect as long as the RFL 9660 is powered up, and they they will be lost the next time the RFL 9660 is powered down.

   If you answer "yes," the following message will appear:

   Please wait.....

   Periods will be added to the line as the changes are being stored. When storage is complete, the "LOCAL>" prompt will reappear.

The port configuration settings you just changed are now stored in the RFL 9660's memory. They will remain there until they are re-programmed or the port configuration is reset. (See Section 5.) To see a list of the new port configuration settings, do the following:

1. Press the **[P]** and **[ENTER]** keys.
   The RFL 9660 will send the following prompt to your terminal:

   Port # _

2. Enter the number of the port you just programmed, and then press the **[ENTER]** key.
   The port information display (Fig. 3-8) will re-appear, containing the new values you just entered.

To change any of the settings, press the **[Y]** key and repeat the procedure for the setting to be changed.

If your PC or terminal has a printer, press the **[PRINT SCREEN]** key on your keyboard to print out a copy of the port information display. If you don't have a printer, write down everything that appears on the port information display. Keep this hard copy in a safe place; you may have to refer to it later if there is a problem with the port configuration settings.

You will have to repeat all the port configuration procedures to program the RFL 9660's other device ports. Once you are finished programming save all changes by pressing the [S] and [ENTER] keys. Then enter the "Q" command to terminate the session and disconnect the cable from the LOCAL connector on the RFL 9660.

3.11 USING THE RFL 9660 AS A SUPER-USER

Once the basic switch and port configuration settings have been made, the RFL 9660 is ready for regular use. There may be cases where some of the configuration settings will have to be changed to make the RFL 9660 compatible with the equipment in your substation or your telephone system. If you need to make additional configuration setting changes, refer to Section 5 for more detailed information.

Once passwords are set up and enabled, people who access the RFL 9660 as regular users can only use the general access commands described in Section 5 of this manual. They will not be able to use any of the super-user commands, and will not be able to change any of the configuration settings.

NOTE

When you are finished using the RFL 9660, use the "Q" command to terminate the session and then disconnect the terminal and cable from the RFL 9660's LOCAL connector.

Section 4. USING THE SWITCH

4.1 INTRODUCTION

The commands in this section can be used by all RFL 9660 users to run diagnostic checks, access device ports, and display port information. If you are logged onto the RFL 9660 as the "super-user," you can also use the configuration commands described in Section 5 of this manual.

To use the general access commands, you must have a PC with a 286 (or better) processor and a Hayes-compatible modem. The PC must be equipped with either Microsoft Windows (Version 3.1.), or a terminal emulator program. A mouse is optional but its presence will simplify use, especially when running Windows. Windows is recommended because it contains a terminal emulator and has multi-tasking capabilities. However, some application software packages for substation equipment contain emulation programs, eliminating the need for a separate program.

4.2 SETTING UP THE MODEM

Before trying to access the RFL 9660 from a remote PC or terminal, you must have a Hayes-compatible modem. This can be a plug-in card inside your PC, or an external modem. The following settings must be changed on your modem to make it compatible with the RFL 9660. Refer to the manual furnished with your modem for more information on how to make these settings.

AUTO-ANSWER The modem's auto-answer function must be enabled. This will allow the RFL 9660 to call your modem if the RFL 9660's callback feature has been enabled. You can enable auto-answer by issuing an "ATS0=2" command; this will tell your modem to answer a call after two rings.

DTR You must set your modem to ignore its DTR (Data Terminal Ready) line. This will stop your modem from hanging up when you are switching between application programs. You can tell your modem to ignore the DTR line by issuing an "AT&D0" command.

ERROR DETECTION If your modem supports v.42 or MNP error detection, it should be enabled; this is what the RFL 9660 uses. If your modem uses any other form of error detection, it must be disabled.

4.3 USING MICROSOFT WINDOWS TO LOAD AND RUN APPLICATIONS

The following procedure will set up Microsoft Windows for use with the RFL 9660. Windows is optional, but it is recommended because of its multi-tasking capabilities. This will make it easy to switch from one application software package to another while you are accessing the RFL 9660.

If you want to use Windows to load and run your applications software and you don't have Windows installed on your PC yet, install it now. Refer to the documentation supplied with your Windows diskettes for instructions on how to do this.

The following procedure was written for users with some experience with Microsoft Windows. If you have never used Windows before, refer to the manuals supplied with Windows for information on running the Windows Tutorial. Make sure you are comfortable with the Windows Tutorial before trying to use Windows to access the RFL 9660.

1. Make sure Windows has been started. If it hasn't and the normal "C>" command prompt is displayed, type in the word "WIN" and press the **[ENTER]** key.
   This will start Microsoft Windows. When Windows is ready, the "Program Manager" window will appear on the screen.

2. Click on the "File" menu name, and then click on "New" in the menu that appears.
   A dialog box will appear, asking if you want to add a program group, or a program item.

3. Click on the spot next to "Program Group," and then click on the "OK" command button.
   The "Program Group Properties" window will appear, with a cursor flashing in the "Description" box.

4. Enter the words "Switch Applications" in the "Description" box.
   An empty window will appear, with "Switch Applications" in the title bar.

5. Open up the "Accessories" window by double-clicking on its icon at the bottom of the "Program Manager" window.
   The "Accessories" window will appear on top of the "Switch Applications" window.

6. Click on the "Window" menu name, and then click on "Tile" in the menu that appears.
   This will "tile" the open windows (display them next to each other, rather than on top of each other). This will allow you to move icons from one window to another.

7. Click on the "Terminal" icon in the "Accessories" window, and drag it over to the "Switch Applications" window. When it is in the "Switch Applications" window, release the mouse button.

8. Look for all the other switch application icons in the "Accessories" window. When you find one, click on its icon and drag it over to the "Switch Applications" window. When it is in the "Switch Applications" window, release the mouse button. Repeat this process for all switch application icons.

9. If you have some applications software programs that you haven't loaded into your PC yet, load them in now and place their icons in the "Switch Applications" window. Refer to the manuals supplied with your Windows diskettes for more information on how to do this.

Windows is now set to run with the RFL 9660. All the application software programs and the Windows Terminal Emulator have icons in the "Switch Applications" window. By opening this window through "Program Manager," you can easily move between programs.

4.4 USING THE MICROSOFT WINDOWS TERMINAL EMULATOR

The Terminal Emulator supplied with Windows can be used to communicate with the RFL 9660 through the modem. The following procedure was written for users with some experience with Microsoft Windows. If you have never used Windows before, refer to the manuals supplied with Windows for information on running the Windows Tutorial. Make sure you are comfortable with windows before trying to use the Windows Terminal Emulator.

1. Make sure Windows in running and the "Switch Applications" window is open. If not, run Windows and double-click on the "Switch Applications" icon to open the "Switch Applications" window.

2. Double-click on the "Terminal" icon in the "Switch Applications" window to call up the terminal emulator.
   The "Terminal Emulator" window will appear on the screen. (See Figure 4-1.)

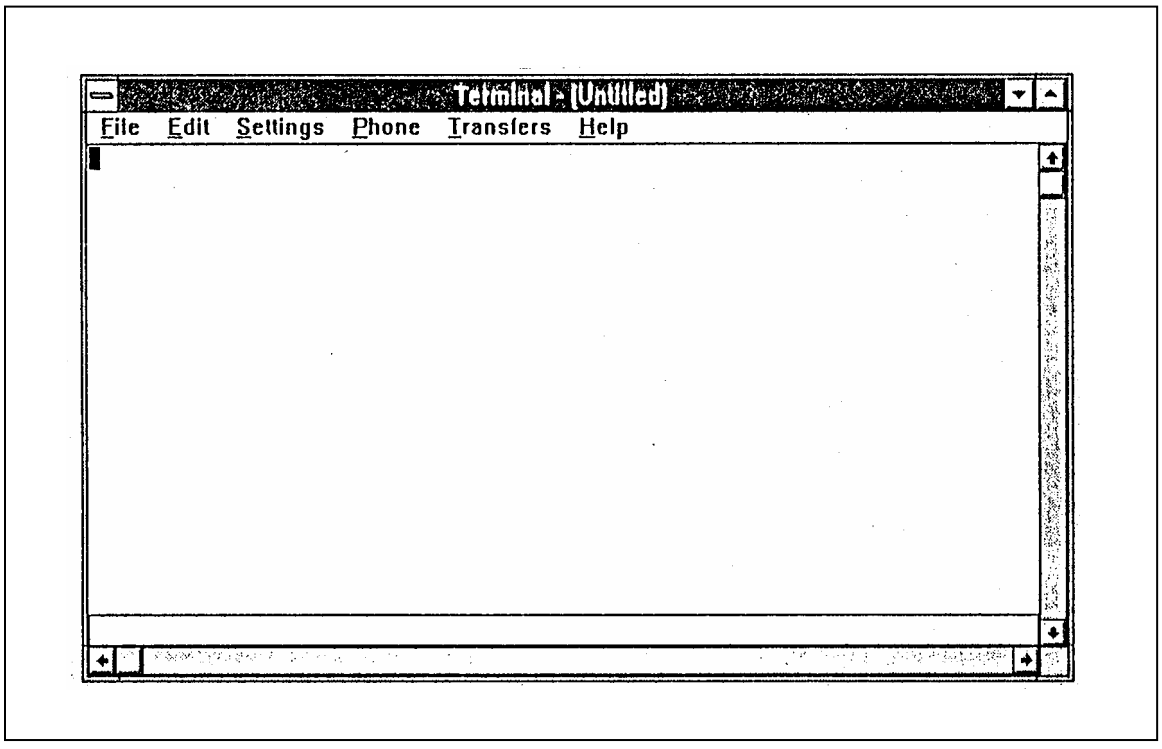


Figure 4-1. Microsoft Windows "Terminal Emulator" window

3. Click on the "Settings" menu name, and then click on "Terminal Emulation" in the menu that appears.
   The "Terminal Emulation" dialog box will appear. (See Figure 4-2.)

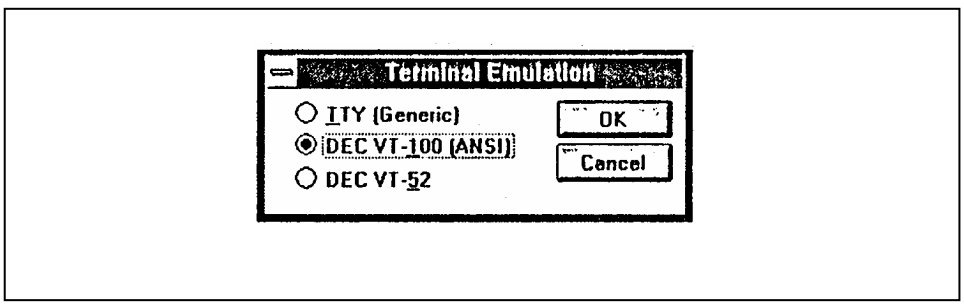


Figure 4-2. "Terminal Emulation" dialog box for Microsoft Windows Terminal Emulator

4. Click on the spot next to "DEC VT-100 [ANSI]," and then click on the "OK" command button.
The "Terminal Emulator" dialog box will disappear.

5. Click on the "Settings" menu name, and then click on "Terminal Preferences" in the menu that appears.
The "Terminal Preferences" dialog box will appear. (See Figure 4-3.)

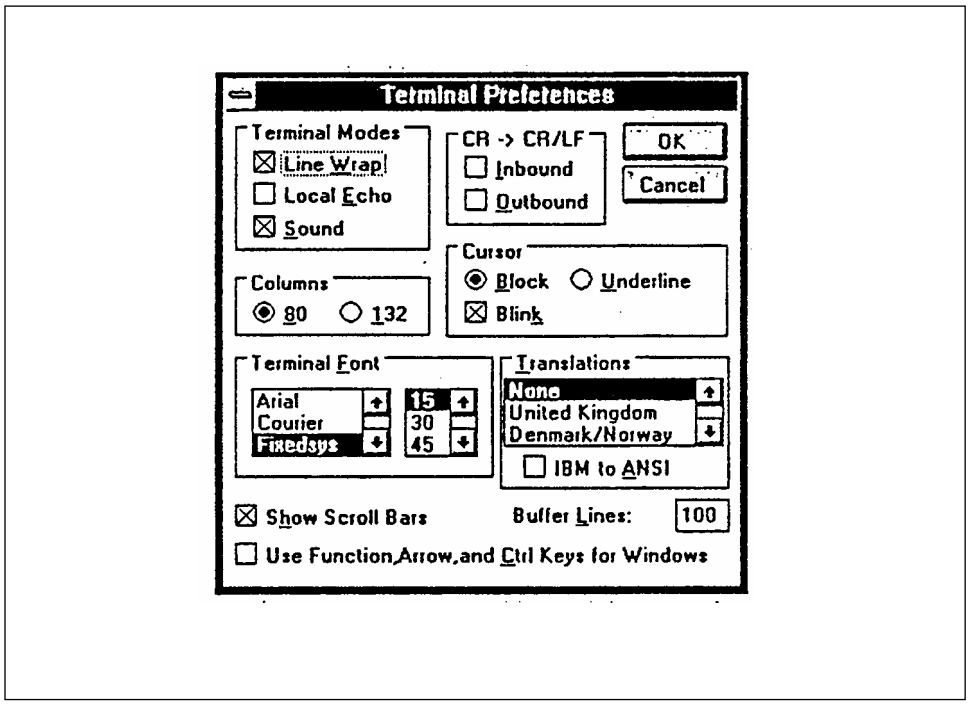


Figure 4-3. "Terminal Preferences" dialog box for Microsoft Windows Terminal Emulator

6. In the "Terminal Modes" box, make sure there is an "X" in the box next to "Line Wrap" and "Sound." If not, click on the box until an "X" appears.

7. In the "Columns" box, make sure there is a black dot in the circle next to "80." If not, click on the circle until a dot appears.

8. In the "Cursor" box, make sure there is a black dot in the circle next to "Block" if you want a block cursor, or in the circle next to "Underline" if you want an underline cursor. If you want the cursor to flash, make sure there is an "X" in the box next to "Blink." If not, click on the box until an "X" is not present.

9. In the "Terminal Font" box, make sure the font you want is highlighted. If not, scroll the window up or down until your choice is displayed, and then click on it. If your font selection has more than one size available, click on the size that you want.
If you're not sure about the font, leave it set to "Terminal 12."

10. The "Translations" box lets you adapt the terminal emulator to the character set your PC uses. For users in the United States and English-Speaking Canada, make sure "None" is highlighted; if it isn't, scroll the window up or down until "None" is displayed, and then click on it. Users in French-Speaking Canada or other countries should scroll the window up or down to find the translation they need, and then click on it.

11. Make sure there is an "X" in the boxes next to "Show Scroll Bars" and "Use Function, Arrow, and Ctrl Keys for Windows." If not, click on each box until an "X" appears.

12. Click on the "OK" command button.
The "Terminal Preferences" dialog box will disappear.

13. Click on the "Settings" menu name, and then click on "Text Transfer" in the menu that appears.
The "Text Transfer" dialog box will appear.

14. Click on the spot next to "Standard Flow Control," and then click on the "OK" command button.
The "Text Transfer" dialog box will disappear.

15. Click on the "Settings" menu name, and then click on "Binary Transfer" in the menu that appears.
The "Binary Transfer" dialog box will appear.

16. Click on the spot next to "XModem/CRC," and then click on the "OK" command button.
The "Binary Transfer" dialog box will disappear.

17. Click on the "Settings" menu name, and then click on "Communications" in the menu that appears.
The "Communications" dialog box will appear. (See Figure 4-4.)

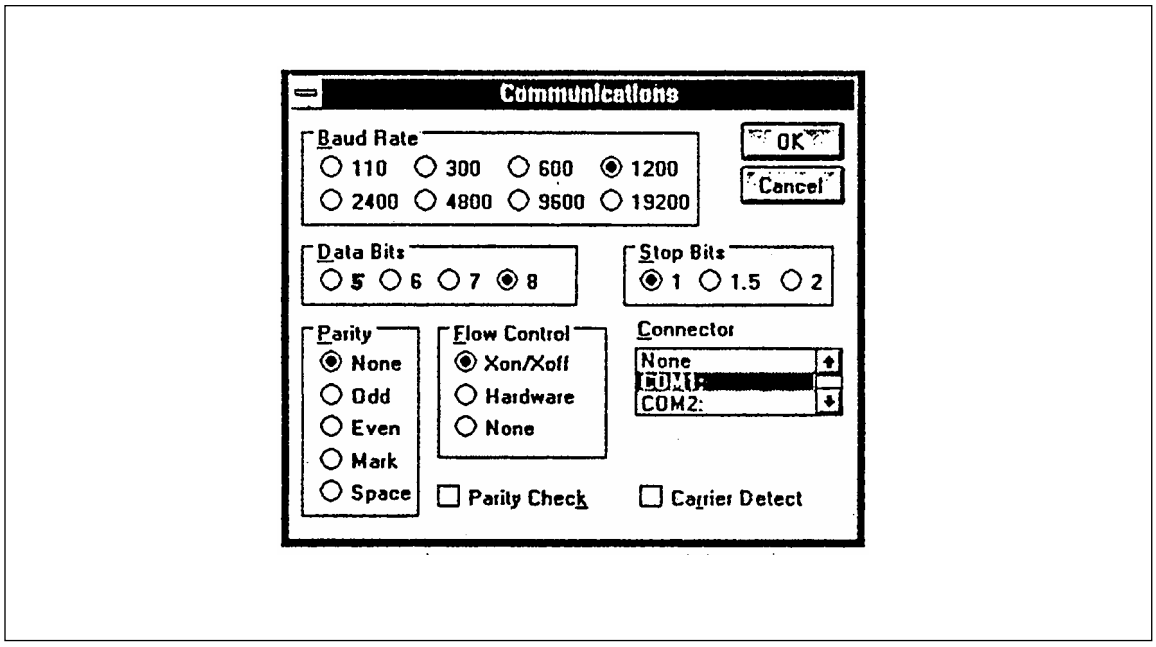


Figure 4-4. "Communications" dialog box for Microsoft Windows Terminal Emulator

18. Click on the spot next to "19200" in the "Baud Rate" box.

19. Click on the spot next to "8" in the "Data Bits" box.

20. Click on the spot next to "1" in the "Stop Bits" box.

21. Click on the spot next to "None" in the "Parity" box.

22. Click on the spot next to "Xon/Xoff" in the "Flow Control" box.

23. Choose the correct COM port.

24. Click on the "OK" command button.
The "Communications" dialog box will disappear.

25. Click on the "Settings" menu name, and then click on "Modem Commands" in the menu that appears.
The "Modem Commands" window will appear. (See Figure 4-5.)

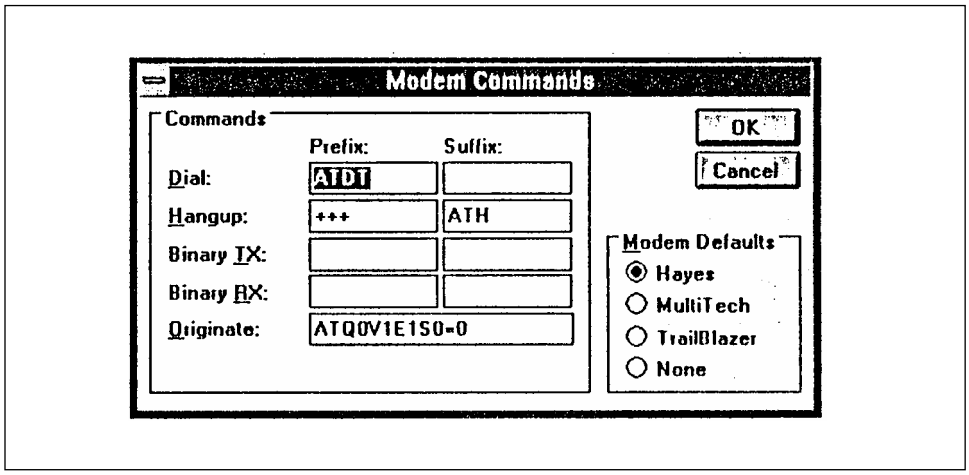


Figure 4-5. "Modem Commands" dialog box for Microsoft Windows Terminal Emulator

26. Click on the "Originate" box in the "Modem Commands" window, and type in the following modem command string:

AT&D0S0=2

27. In the "Modem Defaults" box, make sure there is a black dot in the circle next to "Hayes." If not, click on the box until a dot appears.

28. Click on the "OK" command button.
The "Modem Commands" window will disappear.

29. Click on the "Settings" menu name, and then click on "Phone Number" in the menu that appears.
The "Phone Number" dialog box will appear. (See Figure 4-6.)

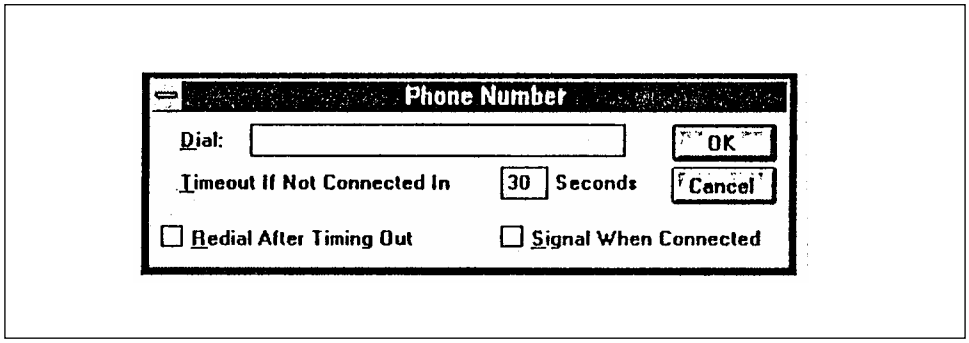


Figure 4-6. "Phone Number" dialog box for Microsoft Windows Terminal Emulator

30. Enter the RFL 9660's phone number in the "Dial" box.
You can type in parentheses and dashed, but they are not required. Type commas to provide any delays required before the number is processed by the telephone system. If you are using a Hayes-compatible modem with the default settings, each comma will add two seconds of delay. Other modem types may require another character for adding a delay, or the delay interval may be different.

The following dial string will dial a 9, pause for 4 seconds, and then dial 555-1234:

9,,555-1234

31. Change the number in the "Seconds" box from 30 to 45.

    This changes the terminal emulator's timeout value to 45 seconds. You will have to change this value to 45 seconds because the RFL 9660's modem answers incoming calls on the fourth ring (or the second ring on "double-ring" telephone systems). If you do not change this value, the modem in your PC will hang up before a connection can be established.

32. Click on the "OK" command button.

    The "Phone Number" dialog box will disappear.

33. Click on the "File" menu name, and then click on "Save" in the menu that appears.

    The "File Save As" window will appear, with the cursor flashing in the "File Name" box. "*.TRM" will appear in the "File Name" box.

34. Move the cursor to the beginning of the "File Name" box. Press the **[DELETE]** key on your keyboard to erase the "*," and then enter the word "SWITCH." When you are finished, click on the "OK" command button.

    The "File Save As" window will disappear, and the file name "SWITCH.TRM" will now be displayed at the top of the "Terminal Emulator" window.

The terminal emulator settings required by the RFL 9660 are now stored as SWITCH.TRM. From now on, if you want to access the RFL 9660, you will open up the Windows Terminal Emulator, and then open the SWITCH.TRM file to use the settings you just stored.

4.5 WINDOWS 95 HYPERTERMINAL SETUP FOR USE WITH THE RFL 9660 DIGITAL SWITCH

BASIC SETUP:

1. From the Windows 95 Main window, click on the “START” button.

2. Move the cursor to “Programs”, then over to “Accessories” and then over to “HyperTerminal”. Then click on “HyperTerminal”. This will bring you to the HyperTerminal Window as shown in Figure 4-7.

3. Double click on the Hypertrm icon. This will bring you to the Connection Description window as shown in Figure 4-8.

Figure 4-7. HyperTerminal window

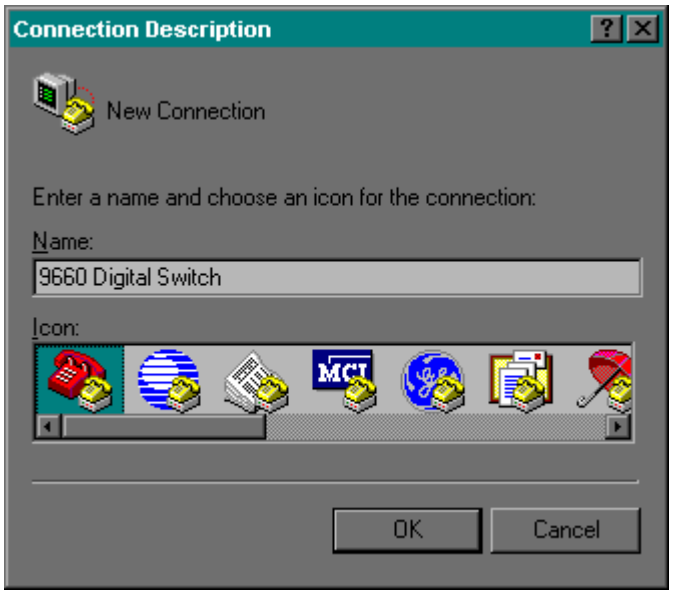


Figure 4-8. Connection Description Window.

4. You will be prompted to enter a name for your HyperTerminal connection. You must enter a name. For example you can enter: 9660 Digital Switch. Then choose an icon for the connection, and then click on OK. This will bring you to the Phone Number window as shown in Figure 4-9.

Figure 4-9. Phone Number window

5. Enter the area code and phone number of the line to which your RFL 9660 Digital Switch is connected. In the “Connect using” box, enter the complete name of the modem you will be using, for example: US Robotics Sportster 14,400. Then click on OK. This will bring you to the Connect window as shown in Figure 4-10.

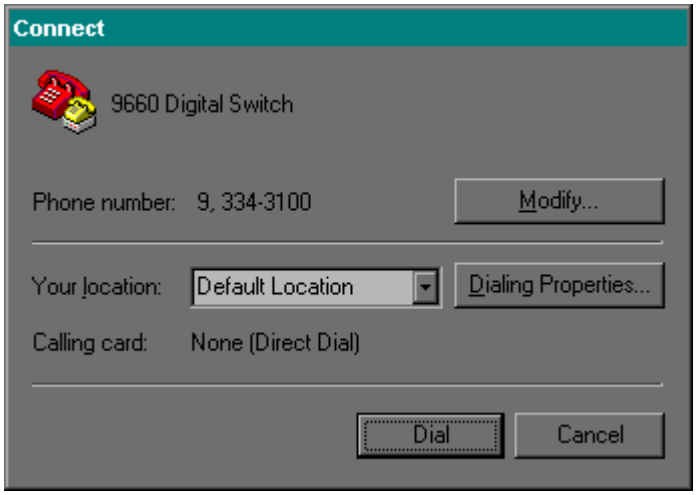


Figure 4-10. Connect window

6. Enter your location. For example: “Substation 49”, then click on Modify. This will bring you to the 9660 Digital Switch “properties/phone number” window as shown in Figure 4-11.

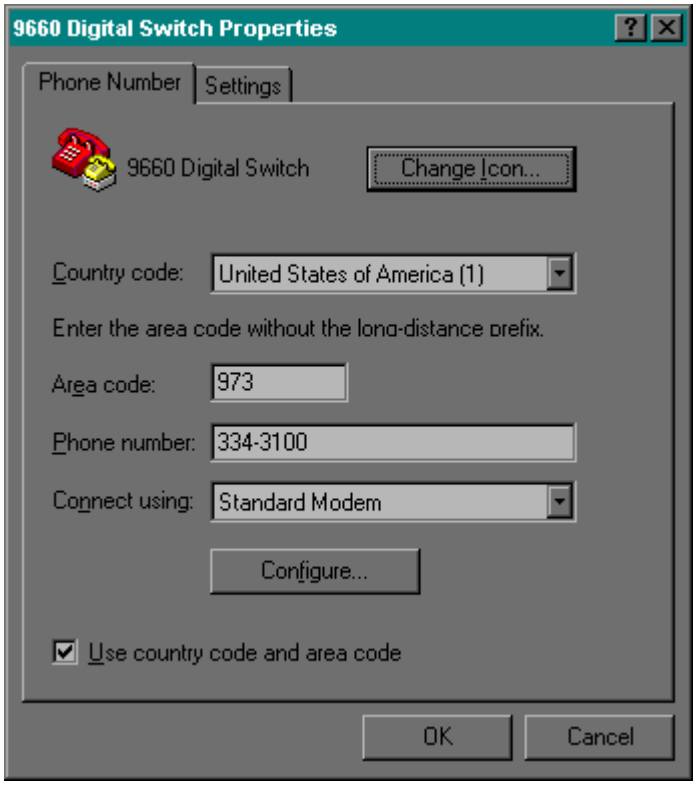


Figure 4-11. Properties/ Phone Number window

7. Click on Configure. This will bring you to the “Modem Properties/General” window as shown in Figure 4-12. Select the communications port number that your modem will be using and confirm that the maximum baud rate is set to 19200.

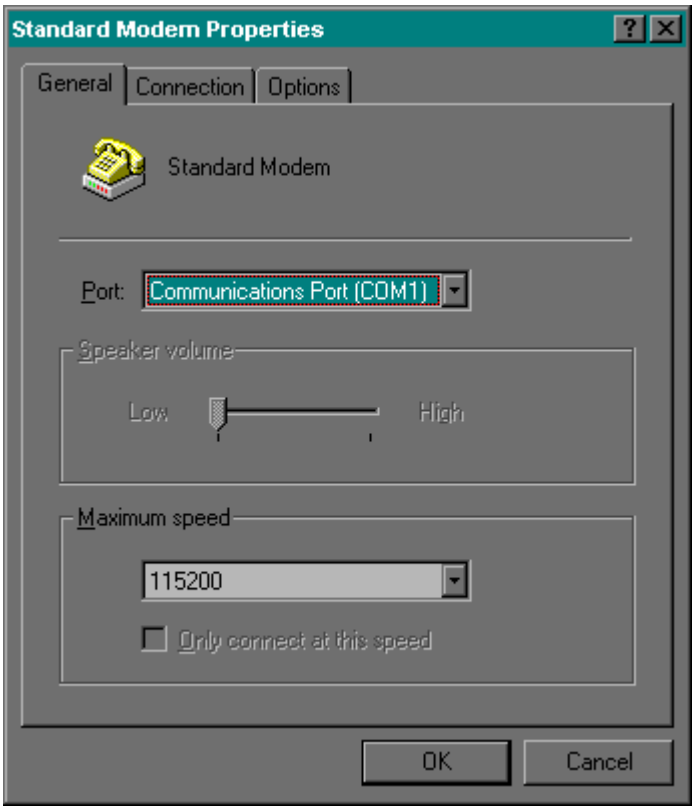


Figure 4-12. Modem Properties/General window

8. Click on Connection. This will bring you to the “Modem Properties/Connection” window as shown in Figure 4-13. Setup your window with the same parameters as those shown in Figure 4-13.

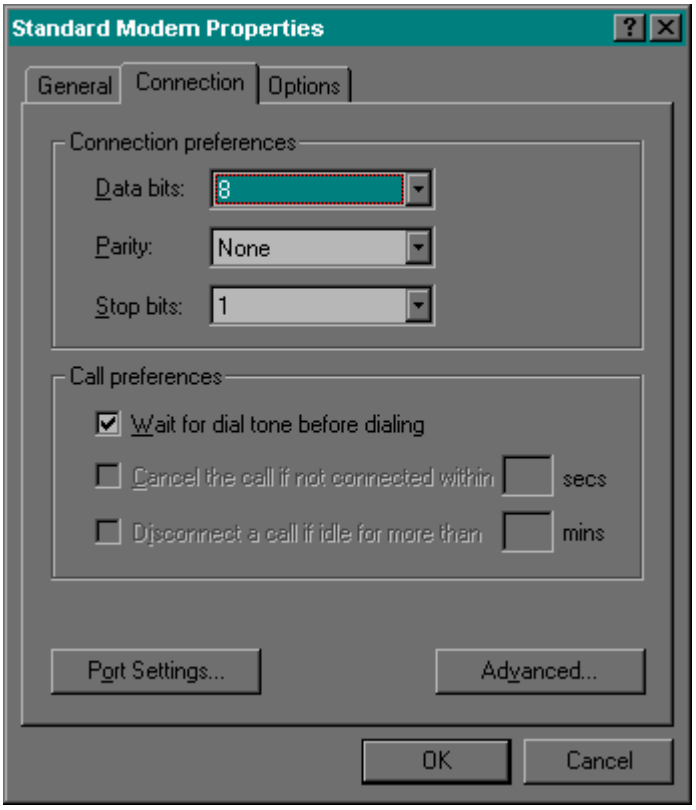


Figure 4-13. Modem Properties/Connection window

9. Click on Port Settings. This will bring you to the Advanced Port Settings window as shown in Figure 4-14. Setup your window with the same parameters as those shown in Figure 4-14.

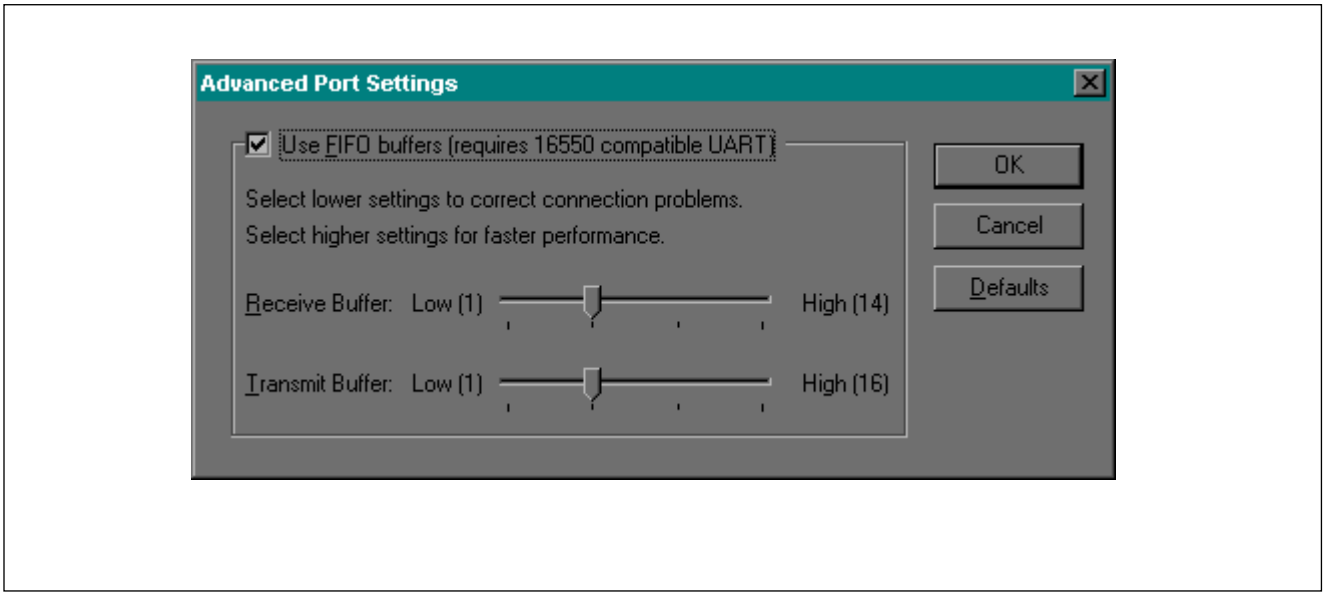


Figure 4-14. Advanced Port Settings window

10. Click on OK and then click on Advanced. This will bring you to the Advanced Connection Settings window as shown in Figure 4-15. Setup your window with the same parameters as those shown in Figure 4-15.

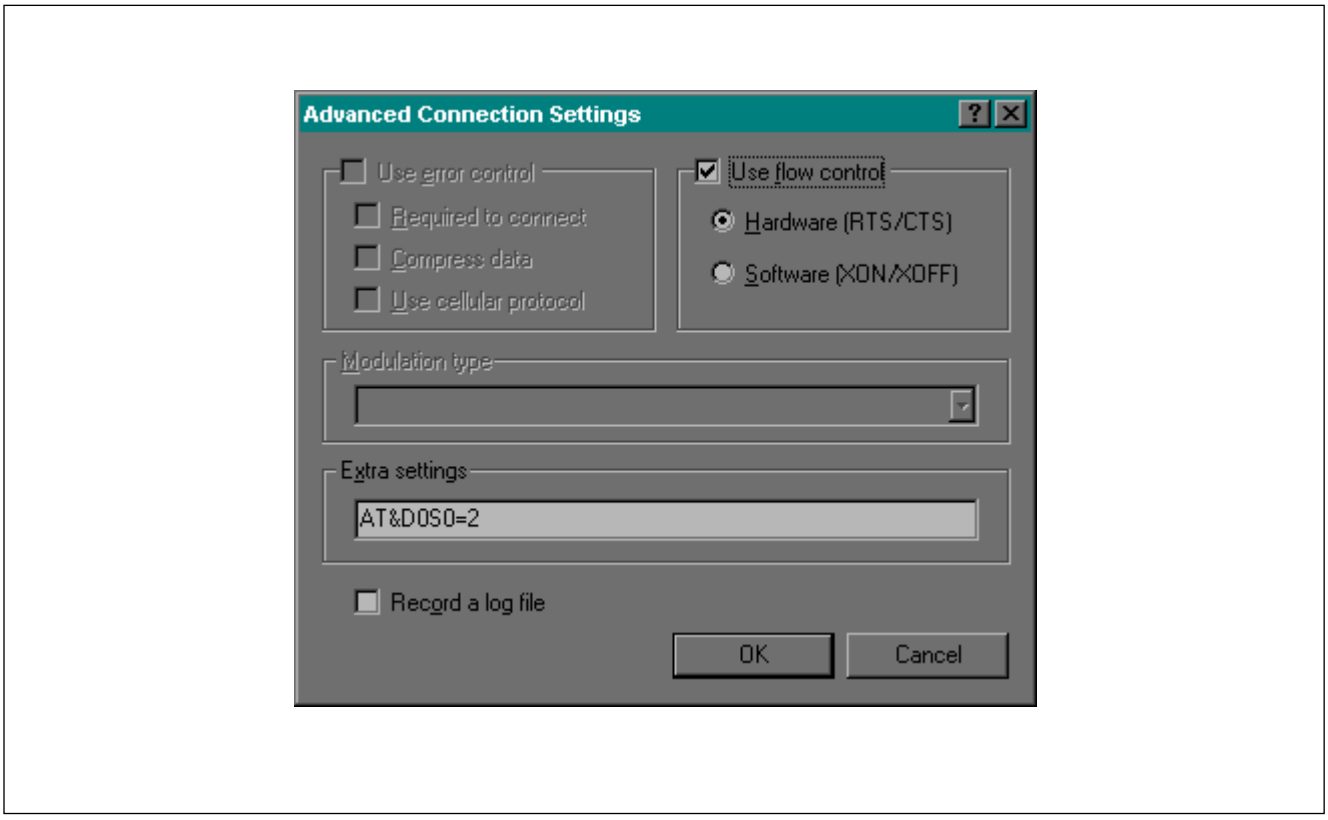


Figure 4-15. Advanced Connection Settings window

11. Click on OK and then click on Options. This will bring you to the Modem Properties/Options window as shown in Figure 4-16. Setup your window with the same parameters as those shown in Figure 4-16.

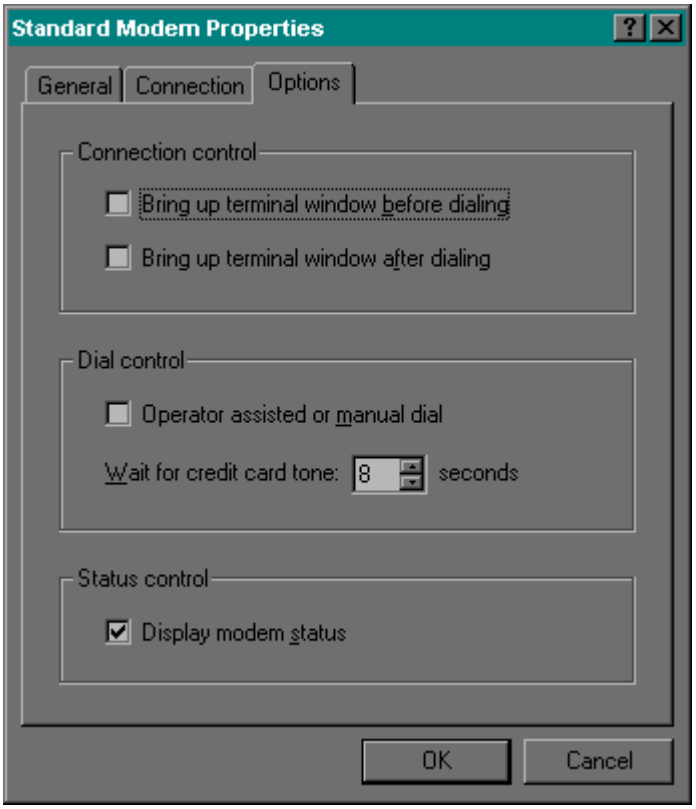


Figure 4-16. Modem Properties/Options window

12. Click on OK and then click on Settings. This will bring you to the Properties/Settings window as shown in Figure 4-17. Setup your window with the same parameters as those shown in Figure 4-17.

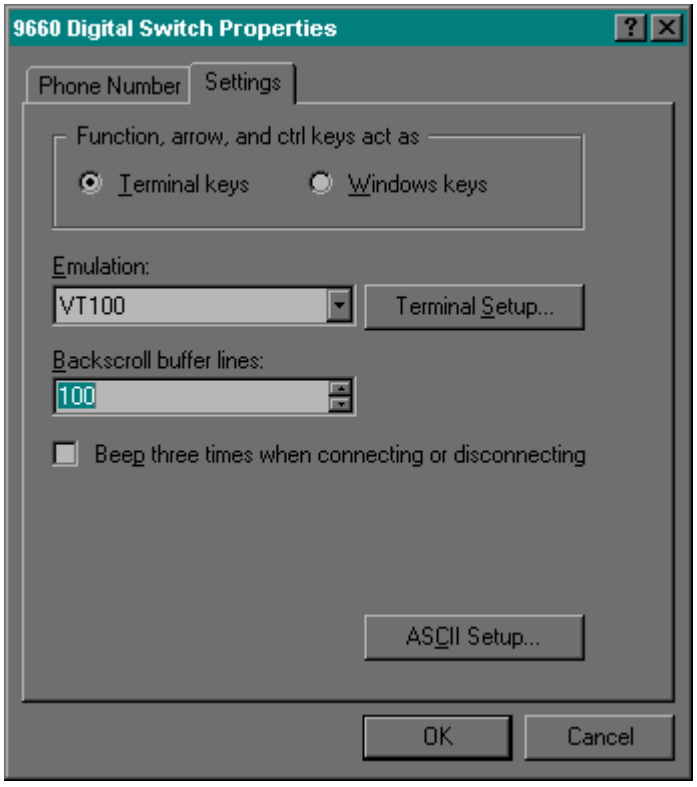


Figure 4-17. Properties/Settings window

13. Click on Terminal Setup. This will bring you to the Terminal Settings window as shown in Figure 4-18. Setup your window with the same parameters as those shown in Figure 4-18.

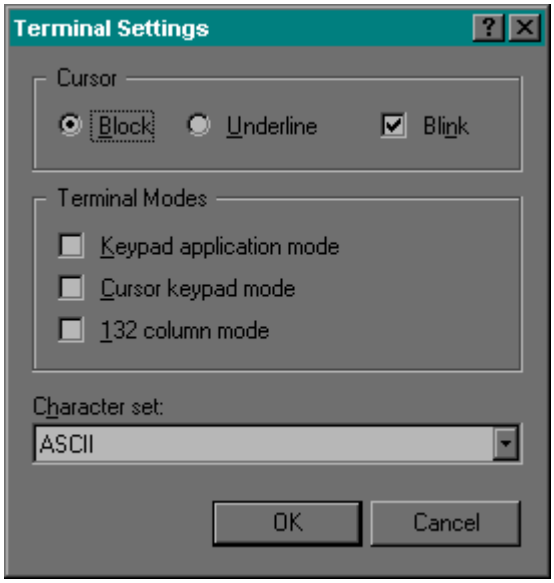


Figure 4-18. Terminal Settings window

14. Click on OK and then click on ASCII Setup. This will bring you to the ASCII Setup window as shown in Figure 4-19. Setup your window with the same parameters as those shown in Figure 4-19.

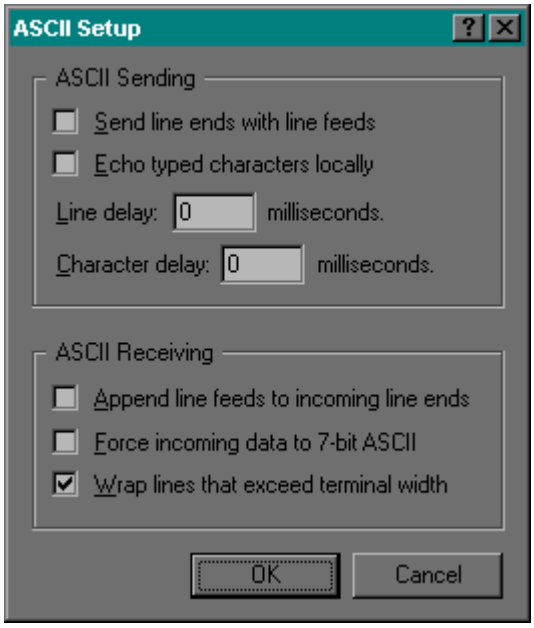


Figure 4-19. ASCII Setup window

15. Click on OK and then click on OK again. This will bring you to the Connect window as shown in Figure 4-20.

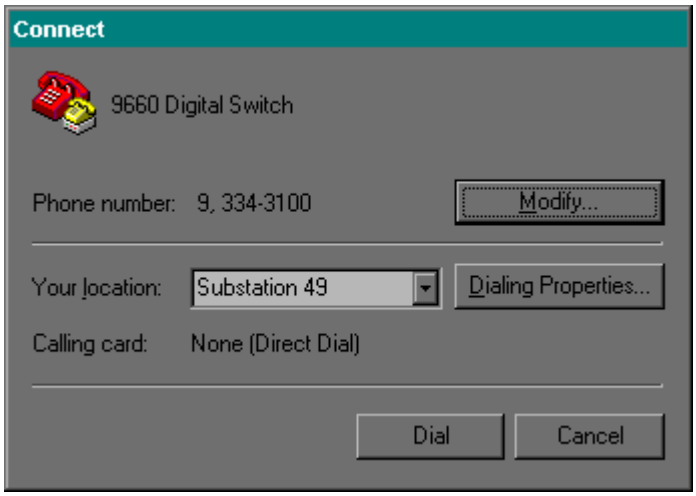


Figure 4-20. Connect window

16. This completes the HyperTerminal setup. You can now dial by clicking on the Dial button.

4.6 ACCESSING THE RFL 9660

There are three basic methods you can use to access the RFL 9660, remotely using the Windows Terminal Emulator, remotely using a non-Windows terminal emulator program, and locally through direct connection to the RFL 9660's LOCAL connector.

4.6.1 REMOTE ACCESS USING THE MICROSOFT WINDOWS TERMINAL EMULATOR

To remotely access the RFL 9660 using the Microsoft Windows Terminal Emulator, use the following procedure:

1. Make sure Microsoft Windows is running on your PC. If it isn't, either call it up from the DOS Shell or type in "win" at the "C>" prompt and press the **[ENTER]** key.
   This will start Microsoft Windows. When Windows is ready, the "Program Manager" window will appear on the screen.

2. Double-click on the "Switch Applications" icon in the "Program Manager" window to open the "Switch Applications" window.
   The "Switch Applications" window will appear on the screen.

3. Double-click on the "Terminal" icon in the "Switch Applications" window to call up the terminal emulator.
   The "Terminal Emulator" window will appear on the screen.

4. Click on the "File" menu name, and then click on "Open" in the menu that appears.
   The "File Open" dialog box will appear, with the cursor flashing in the "File Name" box. "*.TRM" will appear in the "File Name" box, and a list of ".TRM" files will appear directly below it.

5. Move the cursor to the file name SWITCH.TRM, and click on it, then click on the "OK" command button.
   This will open the SWITCH.TRM file. All the settings you previously placed in this file will be used to set the Windows Terminal Emulator to communicate with the RFL 9660. The "File Open" dialog box will disappear, and the "SWITCH.TRM" file name will appear at the top of the "Terminal Emulator" window.

6. Click on the "Phone" menu name, and then click on "Dial" in the menu that appears.
   A window will appear, stating that the modem is calling the number you stored for the RFL 9660. You should be able to hear your modem start to operate.

   The Terminal Emulator program gives your modem 30 seconds to make a connection with the RFL 9660. If a connection is made, the dialing window will disappear.

   If the super-user has enabled password protection, go to step 7. If passwords are not being used, go to step 9.

7. Press the **[ENTER]** key on your keyboard a few times.

   The following prompt will appear on your display:

   Please enter password

   When you see this prompt, enter the password on your keyboard. For each letter of the password you enter, the RFL 9660 will echo back an asterisk (*).

> **NOTE**
>
> **Passwords are case-sensitive.** If the super-user stored the password as all capitals, you must enter it as all capitals. Otherwise, the RFL 9660 will reject it.

8. When you finish entering the password, press the **[ENTER]** key.

   If the RFL 9660 accepts the password, go to step 9. If it does not accept your password, repeat steps 7 and 8.

9. Wait for the RFL 9660 to log you onto the system.

   If the RFL 9660 is not using password protection, the following message will appear on your display:

   Please wait .....(site identification message)

   REMOTE> _

   If the RFL 9660 is using password protection, the following message will appear on your display:

   Logged on as # (user password number)
   Please wait .....(site identification message)

   REMOTE> _

   Your PC is now accessing the RFL 9660. Each time you press a key on the PC's keyboard, the RFL 9660 will respond by sending another "REMOTE>" prompt to your PC.

   If the RFL 9660 does not respond, check the connections between your PC, the modem, and the telephone line. If they are all good, repeat the TERMINAL EMULATOR SETUP procedure starting on pageof this manual, and then try to call up the RFL 9660 again. If you still cannot access the RFL 9660, contact the super-user.

10. If you are receiving "REMOTE>" prompts and you would like to see a list of all the commands available to you, press the **[H]** and **[ENTER]** keys.

    A list of general access commands will appear on your display, with the "REMOTE>" prompt beneath it. (See Figure 4-21). If you are logged on as the "super-user, the list will also contain the configuration commands described in Section 5 of this manual.

```
Esc             -Abort command
H               -Help
D               -Run diagnostics
I               -Port Information
Q               -Quit session
Port #/Label    -Port selection
REMOTE> _
```

Figure 4-21. Typical general access command list display

11. If you are receiving "REMOTE>" prompts and you know the port number or label for the device you want to connect to, enter it and then press the **[ENTER]** key. The RFL 9660 will connect you to that device.

> **NOTE**
>
> If a port password has been stored for that port, you will have to enter it before the RFL 9660 will grant you access. Remember that **passwords are case-sensitive.** If the password was entered as all CAPITALS, you will have to enter it that way for the RFL 9660 to accept it.

12. If you do not know the port number or label for the device you want to connect to, you can view a list of the RFL 9660's device ports by pressing the **[I]** and **[ENTER]** keys.

    A list of devices connected to the RFL 9660 will appear on your display, with the "REMOTE>" prompt beneath it. (See Figure 4-22). Find the device you want on the list, and enter its number or label next to the prompt.

```
(site ID)
#       TYPE        LABEL                MODE   DTR   RTS   CallBack
.....................................................................

1       RS232       SEL 221F - Line 21   0      0     0     N
2       RS232       OPTIMHO - Line 15    0      0     0     N
3       RS232       DLP - Line 17        0      0     0     N
4       RS232       DFR 3                4      0     0     Y
5       RS232       QUANTUM              0      0     0     N
6       RS232                            0      0     0     N
7       RS232                            0      0     0     N
8       RS232                            0      0     0     N
REMOTE> _
```

Figure 4-22. Typical port summary table

13. Once the RFL 9660 has connected you to the device you want, double-click on the "Switch Application" icon at the bottom of the "Program Manager" window.

    The "Switch Applications" window will appear on the screen, on top of the "Terminal Emulator" window. (Because the "Terminal Emulator" window is still displayed, the terminal emulator is still active and the phone connection has not been broken.)

14. Click on the icon for the application program you want to run with the device you are connected to.

    The application program will start running. (Refer to the documentation supplied with the application program for information on how to use it.)

15. When you are finished, exit the application program.

    Refer to the documentation supplied with the program for information on how to do this.

16. Click on the "Minimize" button at the top right of the "Switch Applications" window.

    The "Switch Applications" window will disappear, and its icon will reappear at the bottom of the "Program Manager" window.

17. Type in the port deselect code ("BYE") to terminate the connection to the device.

    Do not press the [ENTER] key. The RFL 9660 will return a "REMOTE>" prompt to your display when the device port is deselected.

18. Repeat steps 11 through 17 if you want to connect to another device. If you are finished, you can terminate the session by pressing the **[Q]** and **[ENTER]** keys, or by clicking on the "Phone" menu name, and then clicking on "Hang Up" in the menu that appears.

    The RFL 9660 will disconnect your terminal and end the session. The following message will appear on your display:

    User terminated this session!

    The RFL 9660 will begin its hang-up sequence. When it is finished, the RFL 9660 will be ready to start another session.

4.6.2 REMOTE ACCESS USING A DOS-BASED TERMINAL EMULATOR

To remotely access the RFL 9660 using a DOS-based terminal emulator (such as CrossTalk or Procomm Plus), use the following procedure:

1. Make sure DOS is running on your PC. If it isn't, either return to DOS from the program you are running, or re-boot the PC.
   When DOS is ready, the DOS prompt will appear on the screen. FOr most PC's, this will be "C>"

2. Start your terminal emulation program.
   Refer to the documentation supplied with your terminal emulation program for information on how to do this.

3. Set your terminal emulation program to match the RFL 9660's modem port configurations setting (2400 baud, 8 data bits, 1 stop bit, no parity).
   Refer to the documentation supplied with your terminal emulation program for information on how to do this.

4. Dial up the RFL 9660 by calling its telephone number.
   For information on how to dial out from your PC, refer to the documentation supplied with your communications software.

   If the super-user has enabled password protection, go to step 5. If passwords are not being used, go to step 7.

5. Press the **[ENTER]** key on your keyboard a few times.
   The following prompt will appear on your display:

   Please enter password

   When you see this prompt, enter the password on your keyboard. For each letter of the password you enter, the RFL 9660 will echo back an asterisk (*).

> **NOTE**
>
> **Passwords are case-sensitive.** If the super-user stored the password as all CAPITALS, you must enter it that way. Otherwise, the RFL 9660 will reject it.

6. When you finish entering the password, press the **[ENTER]** key.
   If the RFL 9660 accepts the password, go to step 7. If it does not accept your password, repeat steps 5 and 6.

7. Wait for the RFL 9660 to log you onto the system.
   If the RFL 9660 is not using password protection, the following message will appear on your display:

   Please wait .....(site identification message)

   REMOTE> _

If the RFL 9660 is using password protection, the following message will appear on your display:

Logged on as # (user password number)
Please wait .....(site identification message)

REMOTE> _

Your PC is now accessing the RFL 9660. Each time you press a key on the PC's keyboard, the RFL 9660 will respond by sending another "REMOTE>" prompt to your PC.

If the RFL 9660 does not respond, check the connections between your PC, the modem, and the telephone line. If they are all good, repeat the TERMINAL EMULATOR SETUP procedure starting on pageof this manual, and then try to call up the RFL 9660 again. If you still cannot access the RFL 9660, contact the super-user.

8. If you are receiving "REMOTE>" prompts and you would like to see a list of all the commands available to you, press the **[H]** and **[ENTER]** keys.

   A list of general access commands will appear on your display, with the "REMOTE>" prompt beneath it. (See Figure 4-23). If you are logged on as the "super-user," the list will also contain the configuration commands described in Section 5 of this manual.

```
Esc             -Abort command
H               -Help
D               -Run diagnostics
I               -Port Information
Q               -Quit session
Port #/Label    -Port selection
REMOTE> _
```

Figure 4-23. Typical general access command list display

9. If you are receiving "REMOTE>" prompts and you know the port number or label for the device you want to connect to, enter it and then press the **[ENTER]** key. The RFL 9660 will connect you to that device.

NOTE

If a port password has been stored for that port, you will have to enter it before the RFL 9660 will grant you access. Remember that **passwords are case-sensitive.** If the password was entered as all CAPITALS, you will have to enter it that way for the RFL 9660 to accept it.

10. If you do not know the port number or label for the device you want to connect to, you can view a list of the RFL 9660's device ports by pressing the **[I]** and **[ENTER]** keys.

    A list of devices connected to the RFL 9660 will appear on your display, with the "REMOTE>" prompt beneath it. (See Figure 4-24). Find the device you want on the list, and enter its number or label next to the prompt.

(site ID)

#	TYPE	LABEL	MODE	DTR	RTS	CallBack
1	RS232	SEL 221F - Line 21	0	0	0	N
2	RS232	OPTIMHO - Line 15	0	0	0	N
3	RS232	DLP - Line 17	0	0	0	N
4	RS232	DFR 3	4	0	0	Y
5	RS232	QUANTUM	0	0	0	N
6	RS232		0	0	0	N
7	RS232		0	0	0	N
8	RS232		0	0	0	N

REMOTE> _

Figure 4-24. Typical port summary table

11. Once the RFL 9660 has connected you to the device you want, run its application software program to test or poll the device.

    Refer to the documentation supplied with the software for information on how to do this.

12. When you are finished, exit the application software program.

    Refer to the documentation supplied with the software for information on how to do this.

13. Type in the port deselect code ("BYE") to terminate the connection to the device.

    The RFL 9660 will return a "REMOTE>" prompt to your display when the device port is deselected.

14. Repeat steps 8 through 13 if you want to connect to another device. If you are finished, terminate the session by pressing the **[Q]** and **[ENTER]** keys.

    The RFL 9660 will disconnect your terminal and end the session. The following message will appear on your display:

    User terminated this session!

    The RFL 9660 will begin its hang-up sequence. When it is finished, the RFL 9660 will be ready to start another session.

4.6.3 LOCALLY ACCESSING THE RFL 9660

If you are at the substation, you can access the RFL 9660 locally by connecting a terminal to the LOCAL connector on the RFL 9660's front panel. This terminal can be a dumb RS-232 terminal, a PC, or a laptop computer with an RS-232 port running a terminal emulation program.

To access the RFL 9660 locally, use the following procedure:

1. Connect the local terminal to the RFL 9660's LOCAL port.

   For this connection, you will need a cable with a 9-pin D-subminiature (DE-9) male connector at one end. This cable will either have a 9-pin D-subminiature (DE-9) or a 25-pin D-subminiature (DB-25) connector, depending on what kind of mating connector you have on your PC or terminal. A suitable ready-made cable can be purchased locally at any electronics or computer store, or you can make your own cable using Figure 3-2 in Section 3 as a guide.

   Most dumb terminals have a single RS-232 connector, and this is where you would connect the cable. On many PC's or laptops, the cable will be connected to the COM1 port. If your PC has a mouse connected to COM1, connect the cable to the COM2 port. Refer to the manual supplied with your PC or terminal for more information.

2. Set the local terminal set to match the RFL 9660's local port configurations setting (2400 baud, 8 data bits, 1 stop bit, no parity).

   Many dumb terminals have DIP switches you can use to set the configuration; refer to your terminal manual for more information. If you are using a PC with a terminal emulation program, set the configuration within the program; refer to the documentation supplied with the terminal emulation program for more information.

3. Make sure the RFL 9660 is turned on and ready for access.

   If the RFL 9660 is turned on and no other user is accessing it, the STATUS display will read "PL." This means the RFL 9660 is idle and polling all its ports, looking for a connect request. (Refer to Section 3 for more information about turning on the RFL 9660.

4. Press the **[ENTER]** key on your keyboard a few times.

   If the super-user has enabled password protection, go to step 5. If passwords are not being used, go to step 7.

5. The following prompt will appear on your display:

   Please enter password

   When you see this prompt, enter the password on your keyboard.

   For each letter of the password you enter, the RFL 9660 will echo back an asterisk (*).

> **NOTE**
>
> **Passwords are case-sensitive.** If the super-user stored the password as all CAPITALS, you must enter it that way. Otherwise, the RFL 9660 will reject it.

6. When you finish entering the password, press the **[ENTER]** key.

If the RFL 9660 accepts the password, go to step 7. If it does not accept your password, repeat steps 5 and 6.

7. Wait for the RFL 9660 to log you onto the system.

If the RFL 9660 is not using password protection, the following message will appear on your display:

Please wait .....(site identification message)

LOCAL> _

If the RFL 9660 is using password protection, the following message will appear on your display:

Logged on as # (user password number)
Please wait .....(site identification message)

LOCAL> _

Your local terminal is now accessing the RFL 9660. Each time you press a key on the local terminal's keyboard, the green DATA indicator on the RFL 9660's CPU module will light. This shows that the RFL 9660 is receiving data from the local terminal.

If the RFL 9660 does not respond, check the connections between the local terminal and the RFL 9660's local port. If the connections are good, make sure the terminal's configuration setting match that of the RFL 9660's local port (2400 baud, 8 data bits, 1 stop bit, no parity). If the connections are good and the configuration settings match, the RFL 9660 may require servicing. (See Section 11.)

8. If you are receiving "LOCAL>" prompts and you would like to see a list of all the commands available to you, press the **[H]** and **[ENTER]** keys.

A list of general access commands will appear on your display, with the "LOCAL>" prompt beneath it. (See Figure 4-25.) If you are logged on as the "super-user, the list will also contain the configuration commands described in Section 5 of this manual.

```
Esc             -Abort command
H               -Help
D               -Run diagnostics
I               -Port Information
Q               -Quit session
Port #/Label    -Port selection
MODEM           -Connect local port to modem port

LOCAL> _
```

Figure 4-25. Typical general access command list display

9. If you are receiving "LOCAL>" prompts and you know the port number or label for the device you want to connect to, enter it and then press the **[ENTER]** key. The RFL 9660 will connect you to that device.

> **NOTE**
>
> If a port password has been stored for that port, you will have to enter it before the RFL 9660 will grant you access. Remember that **passwords are case-sensitive.** If the password was entered as all CAPITALS, you will have to enter it that way for the RFL 9660 to accept it.

10. If you do not know the port number or label for the device you want to connect to, you can view a list of the RFL 9660's device ports by pressing the **[I]** and **[ENTER]** keys.

    A list of devices connected to the RFL 9660 will appear on your display, with the "LOCAL>" prompt beneath it. (See Figure 4-26.) Find the device you want on the list, and enter its number or label next to the prompt.

(site ID)

#	TYPE	LABEL	MODE	DTR	RTS	CallBack
1	RS232	SEL 221F - Line 21	0	0	0	N
2	RS232	OPTIMHO - Line 15	0	0	0	N
3	RS232	DLP - Line 17	0	0	0	N
4	RS232	DFR 3	4	0	0	Y
5	RS232	QUANTUM	0	0	0	N
6	RS232		0	0	0	N
7	RS232		0	0	0	N
8	RS232		0	0	0	N

LOCAL> _

Figure 4-26. Typical port summary table

10. Once the RFL 9660 has connected you to the device you want, run its application software program to t est or poll the device.

    Refer to the documentation supplied with the software for information on how to do this.

11. When you are finished, exit the application software program.

    Refer to the documentation supplied with the software for information on how to do this.

12. Type in the port deselect code ("BYE") to terminate the connection to the device.

    The RFL 9660 will return a "LOCAL>" prompt to your display when the device port is deselected.

13. Repeat steps 8 through 12 if you want to connect to another device. If you are finished, terminate the session by pressing the **[Q]** and **[ENTER]** keys.

    The RFL 9660 will disconnect your terminal and end the session. The following message will appear on your display:

    User terminated this session!

    The RFL 9660 will begin its hang-up sequence. When it is finished, the RFL 9660 will be ready to start another session.

4.7 GENERAL ACCESS COMMANDS

Once you have accessed the RFL 9660, you can use its general access commands to view port information, connect your PC to a device at the substation, or run a diagnostic test. To view a list of these commands, press the **[H]** and **[ENTER]** keys.

REMOTE> H [ENTER]

This tells the RFL 9660 to send a list of all general access commands to your PC. A typical command list appears in Figure 4-27. The system "super-user" can display a similar list, but it has additional super-user commands on it. (See Section 5.) Figure 4-28 shows the relationship between the general access commands.

NOTE

"Esc" and "Q" are universal commands. "Esc" will abort any command entry if it is pressed before you press the **[ENTER]** key. "Q" will terminate the session; it will also move you from the configuration modes back to the regular mode.

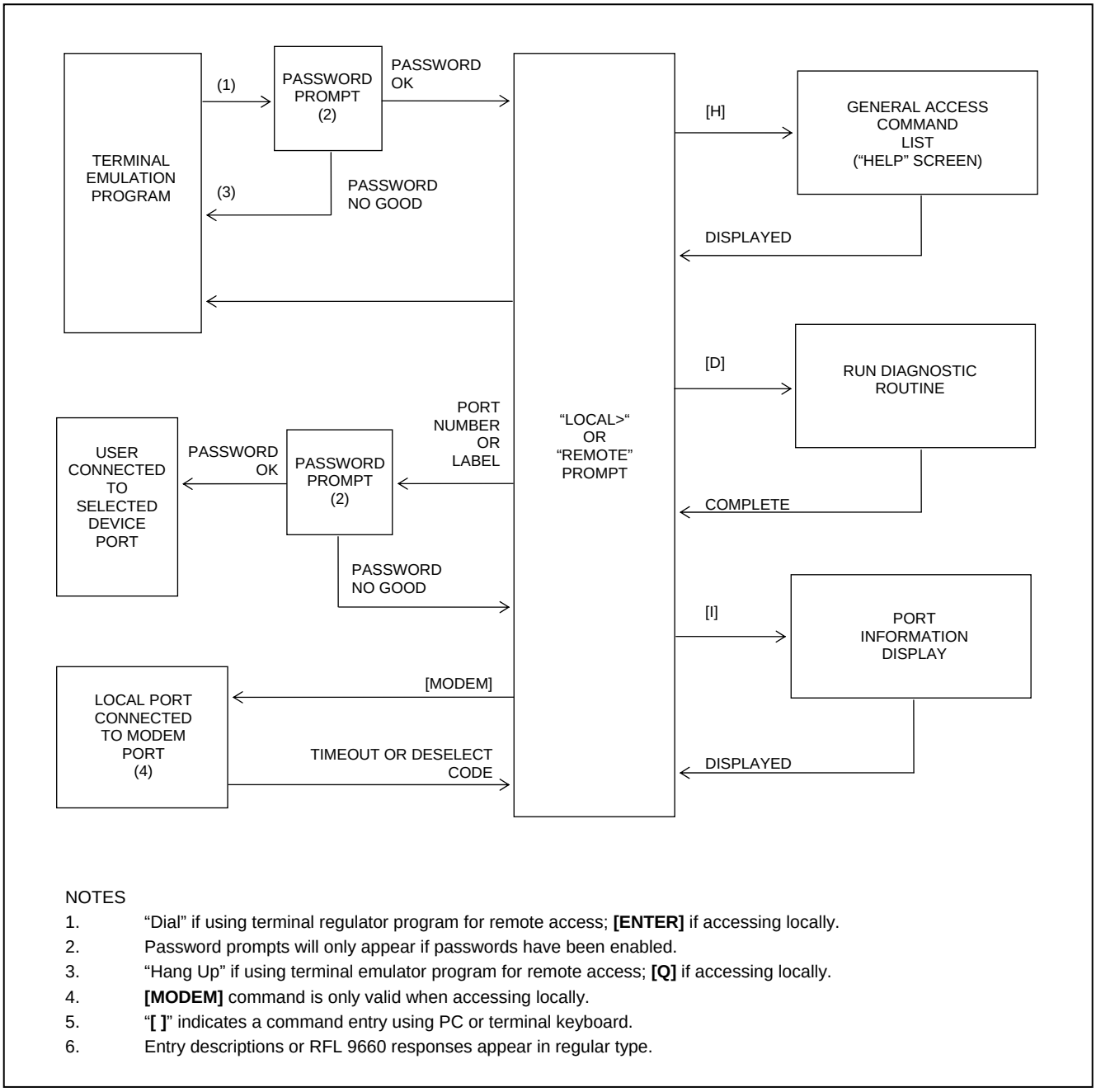
```
Esc              -Abort command
H                -Help
D                -Run diagnostics
I                -Port Information
Q                -Quit session
Port #/Label     -Port selection
MODEM            -Connect local port to modem port

REMOTE> _
```

Figure 4-27. Typical general access command list display

For more information on each user operating command, refer to the page number listed below next to the command.

Command	Meaning	Page
Esc	Abort command	4-30
H	Help	4-30
D	Run diagnostics	4-30
I	Port information	4-30
Q	Quit session	4-32
Port #/Label	Port selection	4-32
MODEM	Connect local and modem ports	4-34

The "MODEM" command only appears if you are logged on as a regular user with your PC directly connected to the RFL 9660's front-panel LOCAL connector. (See page 4-34 for more information.)



NOTES

1. "Dial" if using terminal regulator program for remote access; **[ENTER]** if accessing locally.
2. Password prompts will only appear if passwords have been enabled.
3. "Hang Up" if using terminal emulator program for remote access; **[Q]** if accessing locally.
4. **[MODEM]** command is only valid when accessing locally.
5. "**[ ]**" indicates a command entry using PC or terminal keyboard.
6. Entry descriptions or RFL 9660 responses appear in regular type.

Figure 4-28. Relationship between general access commands

Esc - ABORT COMMAND

If you start entering a user command and change your mind, press the **[ESC]** key instead of the **[ENTER]** key to abort the command.

Format: REMOTE> ESC (no **[ENTER]**)

For example, if you enter a "D" (Run diagnostics) and then press the **[ESC]** key, the following message will appear on your display:

REMOTE> D -Command Cancelled-

Error
REMOTE>

You can also abort a command by pressing **[CTRL][H]** before pressing the **[ENTER]** key. This will backspace over the command, erasing it.

H - DISPLAY COMMAND LIST

Whenever you are accessing the RFL 9660, you can view a list of the commands available to you by using the "H" (help) command.

Format: REMOTE> H [ENTER]

The "H" command tells the RFL 9660 to send a list of all user commands to your terminal. A typical command list appears in Figure 4-27. The system "super-user" can display a similar list, but it has additional configuration commands on it. (See Section 5.)

D - RUN DIAGNOSTICS

Any time you want to make sure the RFL 9660 is working properly, you can use the "D" command to run the RFL 9660's internal diagnostic program. For more information of the diagnostic routine, refer to Section 10 of this manual.

I- PORT INFORMATION

The "I" command tells the RFL 9660 to generate the port information summary; this is a table listing all available ports.

Format: REMOTE> I [ENTER]

A typical port summary table appears in Figure 4-29. The CPU automatically updates this table as new ports (RS-232 or fiber) are added to the system.

(site ID)

#	TYPE	LABEL	MODE	DTR	RTS	CallBack
1	RS232	SEL 221F - Line 21	0	0	0	N
2	RS232	OPTIMHO - Line 15	0	0	0	N
3	RS232	DLP - Line 17	0	0	0	N
4	RS232	DFR 3	4	0	0	Y
5	RS232	QUANTUM	0	0	0	N
6	RS232		0	0	0	N
7	RS232		0	0	0	N
8	RS232		0	0	0	N

REMOTE> _

Figure 4-29. Typical port summary table

The following information appears in the port summary table:

Port number (1 to 32). As more device port modules are added to the RFL 9660, more lines will appear on this table, one for each installed port.

TYPE Type of connection ("RS232" for RS-232, or "FO" for fiber optic).

LABEL The name assigned to the port by the super-user. This is an optional field that may contain up to 30 ASCII characters.

NOTE

Port labels are case-sensitive. If the port label was entered as all CAPITALS, you will have to enter it that way for the RFL 9660 to accept it.

MODE Request connect method assigned to this port:

0 Port Callout not enabled.

1 RTS + DTR

2 DTR + RTS

3 RTS

4 DTR

9 Disabled by the switch. This means that a device timeout occurred and the RFL 9660 disabled the callout feature for that port. When this happens, the super-user will have to use the "P" command to manually reset the port callout feature. (See Section 5.)

DTR This is an activity indicator; it will be "0" if DTR is not active, and "1" if it is active.

RTS This is an activity indicator; it will be "0" if RTS is not active, and "1" if it is active.

CallBack This is an enable indicator; it will be "Y" if callback is enabled, and "N" if it is not.

Q - QUIT SESSION

To disconnect your terminal from the RFL 9660 and end the session, use the "Q" command.

Format: REMOTE> Q [ENTER]

If you are using the Microsoft Windows Terminal Emulator, you can also disconnect your PC from the RFL 9660 by clicking on "Phone" in the menu line, and then clicking on "Hang Up" in the menu that appears. This will make your modem go on-hook.

Whichever method you use, the following message will appear on your display:

User terminates the session

The RFL 9660's STATUS display will read "hu," meaning that the RFL 9660 has begun its hang-up sequence. When it is completed, the STATUS display will read "0" for a few seconds, and then "PL." The RFL 9660 is then ready to start another session.

Port #/Label - PORT SELECTION

To connect your PC or terminal to one of the device ports on the back of the RFL 9660, enter the port number or its label, and then press the **[ENTER]** key.

Format: REMOTE> *port number or label* **[ENTER]**

If you enter a number that is greater than the number of ports the RFL 9660 has, the following error message will appear:

Cannot select port > than (maximum number of ports)

If you enter a number between one and the maximum number of ports the RFL 9660 has (8, 16, 24, or 32), the RFL 9660 will connect your terminal to that port.

If the super-user has enabled passwords, the following prompt will appear on your terminal:

Please enter password:

Enter the password on the keyboard, one letter at a time. For each letter of the password you enter, the RFL 9660 will echo back an asterisk (*).

NOTE

Passwords are case-sensitive. If the super-user stored the password as all CAPITALS, you must enter it that way. Otherwise, the RFL 9660 will reject it.

When you finish entering the password, press the **[ENTER]** key. If the RFL 9660 accepts the password, your terminal will be connected to the device port. If it does not accept your password, you will have to re-enter it.

Once your terminal is connected to the device port, the RFL 9660 is transparent to the system and will only respond to the deselect code sequence ("BYE"). If this code interferes with any of the application programs, notify the super-user. Only the super-user can change this code. (See Section 5.)

4.8 DESELECTING A PORT

When you are finished using the device port, type in the deselect code, without pressing the **[ENTER]** key. (The deselect code is usually "BYE," unless the super-user has stored another code in the RFL 9660's memory.)

Format: **BYE** (no **[ENTER]**)

When the RFL 9660 receives the deselect code, it will disconnect you from the port (after a delay period that can be changed by the super-user). Your normal prompt will appear again, and will be able to select another port, or use any of the other general access commands. Also, other users will be able to use the device port you were using.

If you forget to enter the deselect code and simply stop using your terminal, a timer inside the RFL 9660 starts keeping track of the time. This timer is set at the factory for 10 minutes; it can only be reset by the super-user. Once this timer times out, the RFL 9660 will disconnect your terminal from the device port. The RFL 9660 does this to prevent one user from tying up a device and keeping other users from accessing it.

NOTE

The RFL 9660 will not respond if CTS/RTS or DTR/DSR flow control is involved and there is no device connected to the selected port. You will have to wait for the timeout period to pass before the port will be de-selected.

4.9 CONNECTING THE LOCAL AND MODEM PORTS

The "MODEM" command only appears if your PC is connected to the RFL 9660's front-panel LOCAL connector. It allows you to connect the local port to the modem port for calling out to another substation. This also allows you to change the factory-set configuration of the RFL 9660's modem (for example, the number of rings before auto-answer).

To connect the local and modem ports, type in the word "MODEM," and then press the **[ENTER]** key.

Format: **LOCAL> MODEM [ENTER]**

The following prompt will appear on your display:

Local port connected to Modem port!
To alter type (deselect code)

When you are finished dialing out, type in the deselect code ("BYE"). The RFL 9660 will hang up and disconnect the local port from the modem port. While it is doing this, the following message appears on your display:

Please wait...

When the RFL 9660 is ready for normal operation again, your normal prompt will reappear.

Section 5. CONFIGURATION COMMANDS

5.1 INTRODUCTION

In many installations, the person responsible for the RFL 9660 Digital Switch will want to control how the RFL 9660 is configured and how users may gain access to it. This person (or some other authorized person) would use the configuration commands in this section to control these functions. Since the people that normally access the RFL 9660 are called "users," the person that uses the commands in this section is called the "super-user."

The configuration commands described in this section are only available to the system super-user. You may wish to remove this section from the users' manuals. This would help prevent unauthorized modifications to the system configuration.

> **NOTE**
>
> The super-user's password is always Password #3. If you do not enable password protection, all users will be able to use the configuration commands described in this section. Since this is not recommended, set up and enable passwords. (See Section 3.)

5.2 ACCESSING THE RFL 9660 AS A SUPER-USER

As a super-user, you can access the RFL 9660 either locally or remotely. To access it locally, follow the instructions in Section 3 of this manual. To access it remotely with a PC and dial-up modem, refer to Section 4.

5.3 SUPER-USER COMMANDS

Besides the general access commands described in Section 4 of this manual, the RFL 9660 has configuration commands that can only be used when you are logged on as a super-user. To view a list of these commands, press the **[H]** and **[ENTER]** keys. This will tell the RFL 9660 to send a list of all super-user commands to your terminal.

A typical super-user command list appears in Figure 5-1. This is similar to the user command list shown in Figure 4-7, but it contains more commands. Figure 5-2 on shows the relationships between all super-user commands.

For more information on each super-user command, refer to the page number listed below. Commands on the super-user command list that are not listed below are described in Section 4 of this manual.

Command	Meaning	Page
H	Help	5-2
P	Program port	5-2
C	Configure switch	5-12
S	Save changes	5-21
R	Reset port parameters	5-21
U	Update hardware configuration	5-22

```
Esc             -Abort command
H               -Help
D               -Run diagnostics
I               -Port information
Q               -Quit session
Port#/Label     -Port selection
P               -Program port
C               -Configure switch
S               -Save changes
R               -Reset port parameters
U               -Update hardware configuration
MODEM           -Connect local port to modem port

LOCAL>_
```

Figure 5-1. Typical super-user command list display

H - HELP

The "H" command lets you view a list of all the commands you can use when you are logged on as a super-user. These include the general access commands described in Section 5, and the commands described in this section.

Format: LOCAL> H [ENTER]

This command tells the RFL 9660 to send a list of all super-user commands to your terminal. A typical super-user command list appears in Figure 5-1. This is similar to the general access command list described in Section 4, but it contains more commands.

P - PROGRAM PORT

You can view detailed information about any of the RFL 9660's I/O ports by using the "P" command.

Format: LOCAL> P [ENTER]

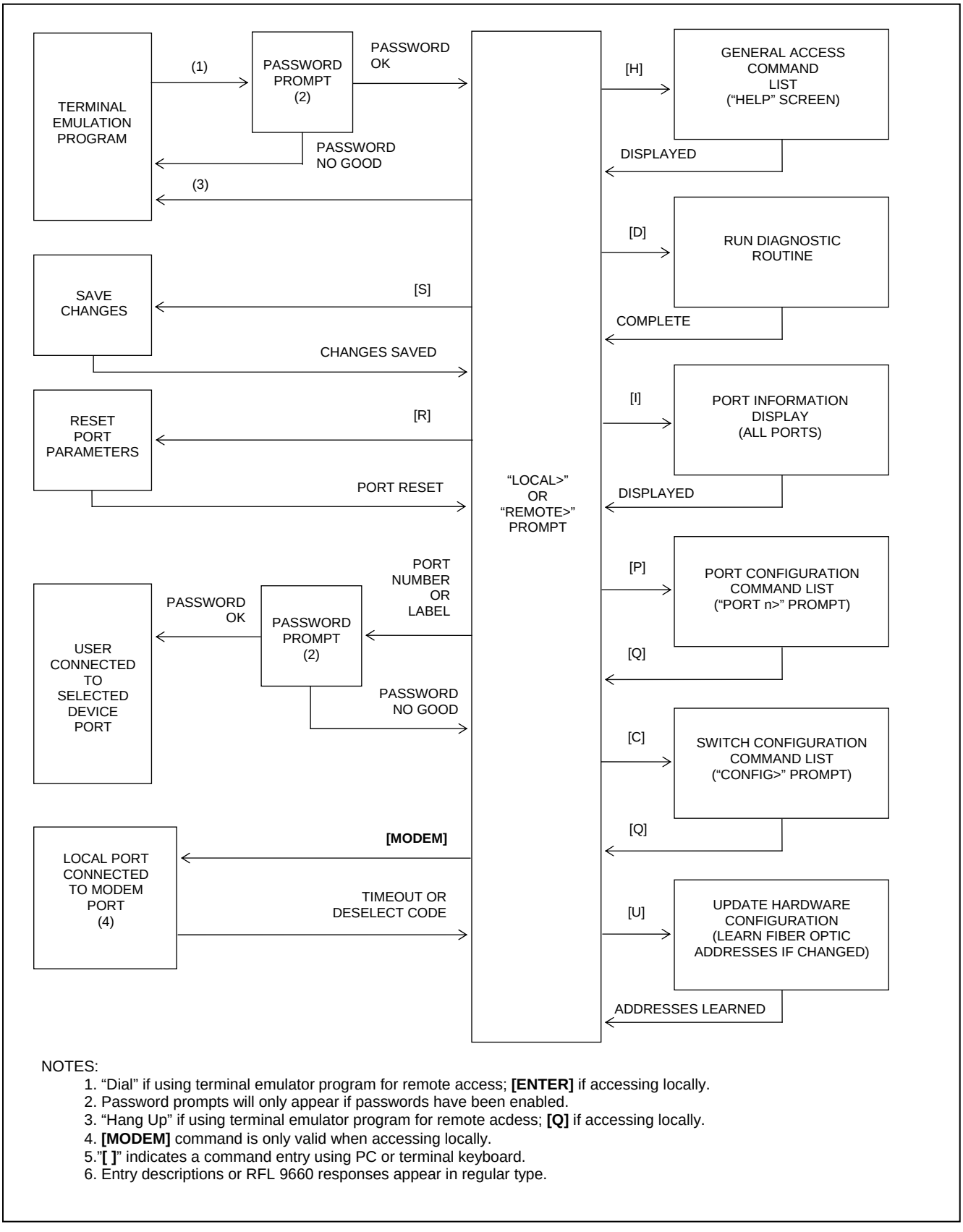
The RFL 9660 will return a prompt asking you for the port number.

Port #

If you enter a zero for the port number, the RFL 9660 will allow you to set the site ID. The following prompt will appear:

Site ID
Old label was *old label*
Please enter new label, up to 30 characters. _

Type in the desired site ID, and press the **[ENTER]** key when you are finished. Your regular prompt will return.



NOTES:

1. "Dial" if using terminal emulator program for remote access; **[ENTER]** if accessing locally.
2. Password prompts will only appear if passwords have been enabled.
3. "Hang Up" if using terminal emulator program for remote acdess; **[Q]** if accessing locally.
4. **[MODEM]** command is only valid when accessing locally.
5. "**[ ]**" indicates a command entry using PC or terminal keyboard.
6. Entry descriptions or RFL 9660 responses appear in regular type.

Figure 5-2. Relationships between super-user commands

If you enter a number that is greater than the number of ports the RFL 9660 has, the following error message will appear:

Cannot select port > than *maximum number of ports*

If you enter a number between one and the maximum number of ports the RFL 9660 has (8, 16, 24, or 32), a port information display similar to the one shown in Figure 5-3 will appear.

```
                          Port # n (  )

Interface          -RS232      Call Out          -Off
Baud Rate          -2400       Call Request      -None
Data Bits          -8          Call Priority     -0
Parity             -None       Call String       -
Stop Bits          -1          Remote String     -
Port Flow Ctrl     -None       Port String       -
Local Port DTR     -On         Modem String      -
Local Flow Ctrl    -On         Port Password     -

To change type Y: _
```

Figure 5-3. Typical port information display, showing factory default values

If you want to change any of the entries on the port information display, press the **[Y]** and **[ENTER]** keys. The port information display will reappear, with a list of selections at the bottom. (See Figure 5-4.) Below the list of selections, your regular prompt will change to a "PORT n >" prompt, with "n" being the port number you entered.

If you don't want to change any of the settings, press the **[N]** and **[ENTER]** keys. Your regular prompt ("LOCAL>" or "REMOTE>") will reappear.

Each time you make a selection from this list, prompts will appear guiding you through the change. The selections are listed below, in the order they appear on the list.

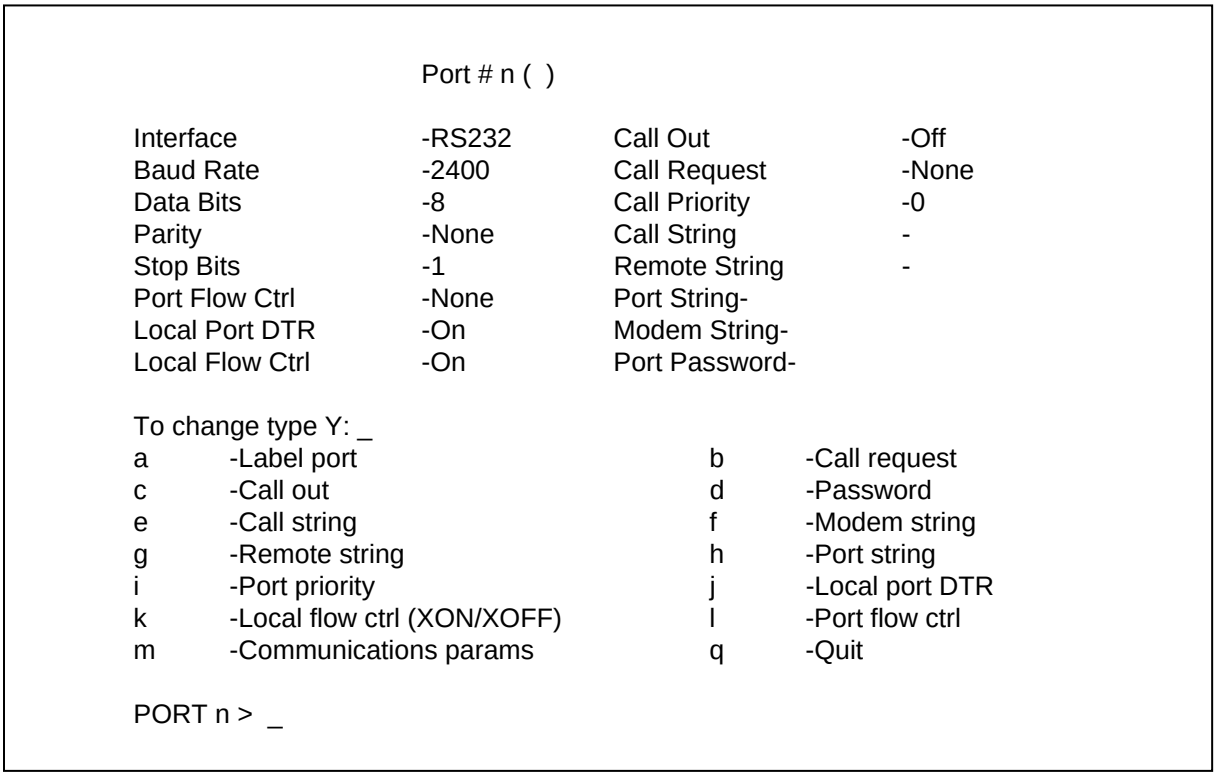


Figure 5-4. Typical port information display with list of selections for changing port information

a - Label Port

The "a" selection allows you to enter or change the label stored for the port. The port label is a unique character string that can be used to identify one of the RFL 9660's device ports. Once set, the port label can be used to select the port you want to access. When you are granted access to the port, the port label will appear at the top of the port information display, next to the port number. Port labels are also listed on the port summary table when it is displayed. (See Section 4.)

Format: PORT n> A [ENTER]

To change the port label, press the **[A]** key. The following prompt will appear on your display:

Old label was (old label)
Please enter new label, up to 30 characters. _

Port labels can be any combination of letters, numbers, symbols, and spaces that is 30 characters or less.

NOTE

Port labels are case-sensitive. Once you enter a port label, all users must enter it the same way you did; otherwise, the RFL 9660 will not accept it.

Enter the new label, and then press the **[ENTER]** key.

b - Call Request

The "b" selection lets you specify the call request method. This controls how the port device request lines will request connection to the RFL 9660.

Format: PORT n> B [ENTER]

The following prompt will appear on your display:

0 None
1 RTS+DTR
2 DTR+RTS
3 RTS
4 DTR

Enter Mode (0 - 4): _

Select the method you want, enter the number next to it, and then press the **[ENTER]** key.

c - Call Out

This selection lets you control whether the DTE connected to the port can call out through the RFL 9660.

Format: PORT n> C [ENTER]

The following prompt will appear on your display:

Request Enable (Y/N) _

Press the **[Y]** key for "yes" or the **[N]** key for "no," and then press the **[ENTER]** key.

d - Password

This selection lets you enter or change the password assigned to the port. The port password is a character string that must be entered before a user is allowed to access a device port. If a password has been set for a device port, users will be asked to enter the password each time they try to access a port; they will not be granted access unless they enter the password correctly.

Format: PORT n> D [ENTER]

The following prompt will appear on your display:

Enter new password: _

Enter the desired password, which can contain up to seven characters.

NOTE

Port passwords are case-sensitive. Once you enter a port password, all users must enter it the same way you did; otherwise, the RFL 9660 will not accept it.

Port passwords do not have to be unique; in fact, groups of devices can be assigned the same port password. For example, you may want to give all the relays at the substation the same password, so only the relay engineers can access them.

Once you have entered the new password, press the **[ENTER]** key.

e - Call String

This selection lets you store a call string for the port. This is a character string containing a telephone number and modem commands that the port can use to dial out.

Format: PORT n> E [ENTER]

The following prompt will appear on your display:

Enter new dialback string (<=40 chars.): _

The following control codes may be embedded in a callback string:

\H Hang up and pause 30 seconds.

\N Insert a carriage return.

\D Wait until carrier is detected or 60 seconds has passed, If carrier is detected, pause for another 5 seconds.

\, Pause 5 seconds.

\. Pause 60 seconds.

\X "X" is a number from 1 to 9. The callback string will be repeated this many times or until a carrier is detected. The the RFL 9660 will parse the remainder of the string.

A typical dialback string is shown below:

\HATDT5551234\N\D\4

\H	This tells the RFL 9660 to hang up and wait 30 seconds.
ATDT5551234	This tells the RFL 9660 to tone-dial 555-1234.
\N	This tells the RFL 9660 to insert a carriage return.
\D	This tells the RFL 9660 to wait until carrier is detected or until 60 seconds has passed. If carrier is detected, the RFL 9660 will pause 5 more seconds.
\4	This tells the RFL 9660 to repeat the string up to 4 times if carrier is not detected within 60 seconds.

Once you have entered the new call string, press the **[ENTER]** key.

f - Modem String

This selection lets you store a modem string for the port. This is a character string that the port uses to send setup commands to the modem.

Format: **PORT n> F [ENTER]**

The following prompt will appear on your display:

Enter modem setup string (<=30 chars.): _

The following control codes may be embedded into the modem string:

\N Insert a carriage return.

\D Wait until carrier is detected or 60 seconds has passed, If carrier is detected, pause for another 5 seconds.

\, Pause 5 seconds.

\. Pause 60 seconds.

\+ Pause five seconds, send the "+++" modem escape code, and then pause five more seconds. This control code is used to send the escape code through one modem to another. (If you inserted the "+++" escape code into the modem string, it would be intercepted by the first modem, placing it in the command mode.)

\X "X" is a number from 1 to 9. The modem string will be repeated this many times or until a carrier is detected. The the RFL 9660 will parse the remainder of the string.

A typical modem string is shown below:

\+AT\X1 O\,

\+ This tells the RFL 9660 to pause five seconds, send the "+++" modem escape code, and then pause five more seconds.

AT\X1 This tells the modem to process XON and XOFF flow control characters, and pass then through to the local or remote system. (See Section 13 for more information on modem "AT" commands.)

O This tells the modem to enter the on-line state. (This command normally appears as "ATO," but the "AT" is not required in this string because it already appears as part of the previous command.)

\, This tells the RFL 9660 to wait 5 more seconds.

Once you have entered the modem string, press the **[ENTER]** key.

g - Remote String

This selection lets you store a remote string for the port. This string will specify a file to be executed on an inbound call, and is reserved for future use. The RFL 9660 will allow you to enter a remote string, but it will not be used.

Format: PORT n> G [ENTER]

The following prompt will appear on your display:

Filename to be executed on inbound call: _

Once you have entered the remote string, press the **[ENTER]** key.

h - Port String

This selection lets you store a port string. This is the name of an executable program file to be run when a port originates a call, and is reserved for future use. The RFL 9660 will allow you to enter a port string, but it will not be used.

Format: PORT n> H [ENTER]

The following prompt will appear on your display:

Program to be executed on port originated call: _

Once you have entered the program name, press the **[ENTER]** key.

i - Port Priority

This selection lets you assign a call priority level to each port.

Format: PORT n> I [ENTER]

The following prompt will appear on your display:

Port's priority {0 is lowest} (0 - 9): _

Once you have entered the priority level you want, press the **[ENTER]** key.

NOTE

A high-priority call will not terminate a low-priority call that is already in progress. If a port with a high priority initiates a call at the same time as a port with a low priority, the higher priority call will go through first.

j - Local Port DTR

This selection lets you determine whether the DTR line will be monitored at the LOCAL port.

Format: PORT n> J [ENTER]

The following prompt will appear on your display:

Monitor Local port DTR {Y/N} [Y]: _

As shown in the prompt, this can be set to "Y" or "N," with "Y" being the default value. Once you have entered your choice, press the **[ENTER]** key.

k - Local Flow Control (XON/XOFF)

This selection lets you determine whether the LOCAL and MODEM ports will use XON/XOFF flow control when communicating with this port.

Format: PORT n> K [ENTER]

The following prompt will appear on your display:

Enable XON/XOFF at Modem & Local [Y]: _

As shown in the prompt, this can be set to "Y" or "N," with "Y" being the default value. Once you have entered your choice, press the **[ENTER]** key.

If you set the "k" selection to "N," the following prompt will appear on your display above the list of selections if the 2400 baud modem (Part No. 104445) is installed:

Do NOT operate Modem/Local ports above 2400 baud

If you set the "k" selection to "N," the following prompt will appear on your display above the list of selections if the 14.4Kbps modem (Part No. 104855) is installed:

Do NOT operate Modem/Local ports above 9600 baud

l - Port Flow Control

This selection lets you specify the flow control method for the port.

Format: PORT n> L [ENTER]

The following prompt will appear on your display:

0 None
1 RTS/CTS
2 DSR/DTR
3 XON/XOF
_

Select the method you want, enter the number next to it, and then press the **[ENTER]** key.

"Flow control" governs the rate at which information passes between the RFL 9660 and the device. Without flow control, data to and from the device might be corrupted. The flow control setting must be set to match the flow control requirements of the device connected to the port. (Refer to the manual supplied with the device or contact its manufacturer for more information).

The RFL 9660 uses character-based flow control for "outbound" messages from the RFL 9660 to the device. Messages going from the device to the RFL 9660 ("inbound" messages) are fed to a 256-character buffer. The RFL 9660 will exercise its flow control for inbound messages after 32 characters are sent to the buffer. This gives the sending device 224 characters to start using its flow control. If the buffer fills up before the device halts its output in response to the RFL 9660's handshake, data corruption will occur.

m - Communications Parameters

This selection lets you set the port's communication parameters to match those of the device connected to it. It is usually best to match the port's communication parameters to the device, rather than modifying the device's parameters to match the port. (Refer to the manual supplied with the device or contact its manufacturer for more information.)

Format: PORT n> M [ENTER]

The following prompt will appear on your display:

Baud: 0 = 300 1 = 1200 2 = 2400 3 = 4800 4 = 9600 5 = 19.2K: _

Find the baud rate that matches the device baud rate. Enter the number next to it, and then press the **[ENTER]** key. The following prompt will appear on your display:

Data bits: 7 or 8: _

Enter the number that matches the number of data bits for the device connected to the port, and then press the **[ENTER]** key. The following prompt will appear on your display:

Parity: 0=none, 1=even, 2=odd: _

Find the parity setting that matches the device parity. Enter the number next to it, and then press the **[ENTER]** key. The following prompt will appear on your display:

Stop bits: 1 or 2: _

Enter the number that matches the number of stop bits for the device connected to the port, and then press the **[ENTER]** key.

q - Quit

This selection lets you leave the port configuration mode and return to your normal prompt.

Format: PORT n> Q [ENTER]

If you want to save the changes you have made, use the "S" command described on page 5-21 of this section. If you do not save the changes, they will be lost the next time the RFL 9660 is powered down.

Once you have changed the port parameters, make a hard copy of the new settings. Use the "P" command described on page 5-2 of this section to view the port information display; this will show the new settings. If your PC or terminal has a printer, press the **[PRINT SCREEN]** key on your keyboard to print out a copy of the port information display. If you don't have a printer, write down everything that appears on the port information display.

Keep the hard copy in a safe place. You may have to refer to it later if there is a problem with the port configuration settings.

C - CONFIGURE THE SWITCH

The "C" command will switch you to the configuration command level. When this happens, your normal prompt will be replaced with the following:

CONFIG>

To view a list of the commands you can use at the configuration command level, use the "H" (help) command. This tells the RFL 9660 to send a list of all configuration commands to your terminal. A typical configuration command list is shown in Figure 5-5.

```
nn      -represents digits.              xx-represents characters.
{0-99}  -represents allowed range.       [28]   -is default (if reset)
PP nn           - Period awaiting password {5-99} [28]
PA nn           - Silence before deselect code {1-99} [1]
PB nn           - Silence after deselect code {1-99} [1]
PT nnnn         - Inactive period, port selected {20-32000} [600]
PM nnnn         - Inactive period, menu mode {20-32000} [600]
CC xxx          - Port deselect code {0-3 characters} [BYE]
CR x...         - Modem reset code {2-30 characters} [\,+++\,ATZ0 O\n\,]
CB n x...       - Call back string {1-10} of {1-40 characters}
PW n x...       - Password {1-10} of {2-7} characters [None]
CM x            - Message format {Long or Brief or None} [Long]
CT x            - Enable CCITT modem sequence {Y/N} [N]
CE x            - Password enable {Y/N} [N]
CS              - Store changes (use after alterations)
CA x            - Enable port selection by number {Y/N} [Y]
Q               - Quit programming mode without saving changes
S               - Show current selections
R               - Reset to factory default
CONFIG> _
```

Figure 5-5. Typical configuration command list display for the 14.4Kbps modem

The configuration commands are listed below, in the order they appear on the configuration command list. They are also listed in Table 5-1, along with their meaning, setting range, and default setting. Space is provided in Table 5-1 for you to write in the value you want to assign to each configuration command. If you do this before you start calling up configuration commands, it will simplify programming.

NOTE

Many of the configuration commands listed in Table 5-1 have factory default settings. These settings should be satisfactory for most applications. Under normal circumstances, you should only have to change these settings if your application requires longer or shorter delay periods.

Table 5-1. Configuration setting worksheet, RFL 9660 Digital Switch

Command	Meaning	Setting Range	Default Setting	Actual Setting
PP nn	Period awaiting password	5 to 99 seconds	28 seconds	
PA nn	Silence before deselect code	1 to 99 seconds	1 second	
PB nn	Silence after deselect code	1 to 99 seconds	1 second	
PT nnnn	Inactive period, port selected	20 to 32000 seconds	600 seconds	
PM nnnn	Inactive period, menu mode	20 to 32000 seconds	600 seconds	
CC xxx	Port deselect code	Up to 3 characters	BYE	
CR x...	Modem reset code	2 to 30 characters	. . .	
CB n x...	Call back string	1 to 40 characters	. . .	
PW 1 x...	Front-end password #1	2 to 7 characters	. . .	
PW 2 x...	Front-end password #2	2 to 7 characters	. . .	
PW 3 x...	Front-end password #3 (reserved for super-user)	2 to 7 characters	. . .	
PW 4 x...	Front-end password #4	2 to 7 characters	. . .	
PW 5 x...	Front-end password #5	2 to 7 characters	. . .	
PW 6 x...	Front-end password #6	2 to 7 characters	. . .	
PW 7 x...	Front-end password #7	2 to 7 characters	. . .	
PW 8 x...	Front-end password #8	2 to 7 characters	. . .	
PW 9 x...	Front-end password #9	2 to 7 characters	. . .	
PW 10 x...	Front-end password #10	2 to 7 characters	. . .	
CM x	Message format	LONG, BRIEF, or NONE	LONG	
EC x	Enable CCITT modem sequence	Y (yes) or N (no)	N	
PE x	Password enable	Y (yes) or N (no	N	
EP x	Enable port selection by number	Y (yes) or N (no)	Y	

PP nn - Period Awaiting Password

This command sets the amount of time the RFL 9660 will wait for a password when password protection is enabled. The default setting is 28 seconds, but it can be set anywhere from 5 seconds to 99 seconds (1 minute, 39 seconds).

Format: **CONFIG> PP** *space, desired value* **[ENTER]**

Example: **CONFIG> PP 10 [ENTER]**

The example above tells the RFL 9660 to hang up if there is no data activity for ten seconds after the "Please enter password" prompt appears.

PA nn - Silence Before Deselect Code

This command sets the silence period before the deselect code may be entered. The deselect code is used to disconnect the RFL 9660 from a port. This value is used with the PB and CC values to make up the deselect sequence. The default setting is one second, but it can be set anywhere from 1 to 99 seconds.

Format: **CONFIG> PA** *space, desired value* **[ENTER]**

Example: **CONFIG> PA 5 [ENTER]**

The example above tells the RFL 9660 to monitor the incoming data for a five-second pause period. Once this pause period is detected, the RFL 9660 looks for the deselect code. If the deselect code is not received after the deselect silence period has elapsed, any data received by the RFL 9660 is passed on to the DTE.

PB nn - Silence After Deselect Code

This command sets the silence period after the deselect code. The deselect code is used to disconnect the RFL 9660 from a port. This value is used with the PA and CC values to make up the deselect sequence. The default setting is one second, but it can be set anywhere from 1 to 99 seconds.

Format: **CONFIG> PB** *space, desired value* **[ENTER]**

Example: **CONFIG> PB 5 [ENTER]**

The example above tells the RFL 9660 to monitor the incoming data for the deselect sequence. After the deselect code is accepted, data will need to be paused again. If this does not happen, the data is still passed on to the DTE, and the deselect command is canceled.

PT nnnn - Inactive Period, Port Selected

This command sets the inactive period timer for port selection. If the RFL 9660 connects to a port and this period passes with no data going through the port, the RFL 9660 disconnects from the port. The default setting is 600 seconds (ten minutes), but it can be set anywhere from 20 seconds to 32,000 seconds (8 hours, 53 minutes, 20 seconds).

Format: **CONFIG> PT** *space, desired value* **[ENTER]**

Example: **CONFIG> PT 600 [ENTER]**

The example above sets the timer to 600 seconds, or ten minutes. This timer prevents the RFL 9660 from remaining connected to one port when it is not being used. This would prevent access to other devices. The timeout setting is the same for all ports.

PM nnnn - Inactive period, menu mode

This command sets the inactive period timer for line connection. If the RFL 9660 connects to either a local or remote terminal and this period passes with no commands being received, the RFL 9660 disconnects from the terminal. The default setting is 600 seconds (ten minutes), but it can be set anywhere from 20 seconds to 32,000 seconds (8 hours, 53 minutes, 20 seconds).

Format: **CONFIG> PM** *space, desired value* **[ENTER]**

Example: **CONFIG> PM 600 [ENTER]**

The example above sets the timer to 600 seconds, or ten minutes. This timer is also triggered after the PT timer has timed out. For example, if the RFL 9660 is connected to a port and no data passes through the port during the port inactive period, the port will be deselected. Then, if no commands pass during the terminal connection menu inactive period, the RFL 9660 will disconnect.

This feature prevents the RFL 9660 from remaining connected inadvertently and preventing access to other equipment requesting service, or other remote terminals.

CC xxx - Port Deselect Code

This command sets the deselect character string. This string, the time set by the "PA" command, and the time set by the "PB" command make up the port deselect sequence. The default setting is "BYE."

Format: **CONFIG> PD** *space, desired deselect code* **[ENTER]**

Example: **CONFIG> PD BYE**

The example above sets the deselect code to "BYE." The deselect code can contain any ASCII characters, and can be up to three characters long. Spaces count as characters. The timeout setting is the same for all ports.

CAUTION

Do not use a deselect code that starts with the letter "A" (upper or lower case). "A" is the first character for Hayes "AT" modem commands. Using it as the first character of the deselect code will send false commands to the modem and lock up the system. If this happens, the only way to clear the system is to power down the RFL 9660, wait a few seconds, and then power it up again.

CB n x... - Callback String

This command can set a callback string for each of the RFL 9660's front-end passwords. When password protection is enabled, and one of the passwords with a callback string is used, the RFL 9660 will hang up and use the callback string to call the user back at a pre-programmed telephone number. (See the "CE" and "PW" commands for more information).

Format: **CONFIG> CB** *space, password number, space, callback string* **[ENTER]**

Example: **CONFIG> CB 1 \HATDT5554321\N\D\4 [ENTER]**

The callback string can be up to 40 characters long. The following control codes may be embedded in the callback string:

\H Hang up and pause 30 seconds.

\N Insert a carriage return.

\D Wait until carrier is detected or 60 seconds has passed, If carrier is detected, pause for another 5 seconds.

\, Pause 5 seconds.

\. Pause 60 seconds.

\X "X" is a number from 1 to 9. The callback string will be repeated this many times or until a carrier is detected. The the RFL 9660 will parse the remainder of the string.

The example above sets a callback string for Password #1. This string tells the RFL 9660 that when Password #1 is entered and passwords are enabled, it is to hang up the phone connection, and then call the user back (using tone dialing) at 555-4321. "\n" inserts a carriage return. "\d" tells the RFL 9660 to wait until carrier is detected or 60 seconds, and then pause 5 more seconds after carrier is detected. "\4" tells the RFL 9660 to repeat the string up to four times if carrier is not detected within 60 seconds.

Refer to Section 13 for more information on modem "AT" commands.

PW n x... - Password

This command is used to enter the ten front-end passwords. When you have password protection enabled, the RFL 9660 checks its memory for these passwords. Once the RFL 9660 identifies a good password, it will see if a callback string is saved for that password; if not, connection will be made. If a callback string is saved for that password, the modem will be instructed to hang up and the callback string for that password will be executed.

Format: **CONFIG> PW** *space, password number, space, password* **[ENTER]**

Example: **CONFIG> PW 1 RFL [ENTER]**

The example above sets Password #1 to "RFL."

NOTE

Remember that Password #3 is always reserved as the super-user password, and that passwords are case-sensitive. Once you enter a password, it must be entered the same way each time it is used; otherwise, the RFL 9660 will not accept it.

CM x - Message Format

This command sets the RFL 9660's default mode of communications. Three settings are possible: Long (verbose responses), Brief (response codes), and None (no responses). The default setting is "Long."

Format: **CONFIG> CM** *space, desired setting* **[ENTER]**

Example: **CONFIG> CM LONG [ENTER]**

The example above selects the long message format. In most applications, the long setting should be used. Only set the format to "Brief" or "None" if that is what your application requires. Section 8 of this manual contains tables that cross-reference each long-form message to its short-form equivalent.

CT x - Enable CCITT Modem Sequence

This command sets the modem command set to comply with CCITT recommendations. Two settings are possible: Y (yes) and N (no). The default setting is "N."

Format: **CONFIG> CT *setting* [ENTER]**

Example: **CONFIG> CT N [ENTER]**

The example above sets this command to "no," which is the required setting in North America. Check with your communications service provider to see if you have to set this to "yes."

CE x -Password Enable

This command enables and disables front-end password protection. Two settings are possible: Y (yes) and N (no). The default setting is "N."

Format: **CONFIG> CE *setting* [ENTER]**

Example: **CONFIG> CE Y [ENTER]**

The example above will enable password protection. Once this command is entered, the following message will appear:

Are you sure? (Y/N)

Press the **[Y]** key to answer "yes," or the **[N]** key to answer "no," and then press the **[ENTER]** key. The configuration prompt ("CONFIG>") will re-appear once passwords are enabled.

When passwords are not enabled, super-user access to the RFL 9660 is permitted to anyone who establishes communications with its modem or local ports. When enabled, a user will have to enter one of the ten possible passwords before gaining access. Remember that Password #3 is reserved for the super-user.

CS - Store Changes

This command stores any changes you made to any of the above parameter settings in the RFL 9660's non-volatile memory.

Format: **CONFIG> CS [ENTER]**

The following message will appear:

Are you sure? (Y/N)

Press the **[Y]** key to answer "yes," or the **[N]** key to answer "no," and then press the **[ENTER]** key. The configuration prompt (">") will re-appear once the changes are saved.

If you made changes and then use the "Q" command below to exit the configuration command mode without saving the changes first, the changes you made are active but not saved. If you turn off the RFL 9660 and then turned back on, it will default to the previous parameter settings.

CA x - Enable Port Selection By Number

This command allows port selection by port number. Two settings are possible: Y (yes) and N (no). The default setting is "Y."

Format: **CONFIG> CA *setting* [ENTER]**

Example: **CONFIG> CA Y [ENTER]**

The example above sets this command to "yes." This will allow ports to be selected by port number or port label. If it is set to "no," ports can only be selected by label.

Q - Quit programming mode without saving changes

Use this command to exit the configuration command mode and return to your regular prompt.

Format: **CONFIG> Q [ENTER]**

If you made changes to the program and wish to save them, use the "CS" command on page 5-18 before quitting. If you made changes and are not sure if you want to save them, use the "S" command described below to view the current settings.

All command settings are accepted and implemented when entered. However, they are not written to non-volatile memory unless you use the "S" command. If you make changes and don't save them, the values in non-volatile memory are used as the default settings the next time the RFL 9660 is powered up.

Once you have left the configuration command mode, the configuration command prompt (**"CONFIG>"**) will be replaced by your normal prompt ("REMOTE>" or "LOCAL>").

S - Show Current Selections

This command displays a list of the current active super-user command selections.

Format: **CONFIG> S [ENTER]**

A list similar to the one in Figure 5-6 will appear. Only the command code is shown with the current value next to it, so it will be helpful to have this manual available when displaying the list.

Password Use Callback String

```
1       GIANTS          0
2       BILLS   0
3       PATRIOT         0
4       EAGLES          0
5       STEELER         0
6       BROWNS          0
7       DOLPHIN         0
8       FALCONS         0
9       LIONS   0
10      REDSKIN         0
PP      28 sec
PA      1 sec
PB      1 sec
PT      600 sec
PM      600 sec
CR      \,+++\,ATZ0 0\n\,
CC      BYE
CM      Long    CE      N
CA      Y       CT      N

CONFIG> _
```

Figure 5-6. Typical list of current selections for the 14.4 Kbps modem

The list of current selections shows the **active** states of these settings. This list does **not** show the settings stored in non-volatile memory that are used as the default settings on power-up. You should make a hard copy of the settings list each time you make changes to these settings. The hard copy could then be used as reference if system had to be re-configured. If you are using a PC equipped with a printer as your terminal, you can obtain a hard copy by pressing the **[PRINT SCREEN]** key on your computer keyboard.

R - Reset To Factory Default

This command will reset all RFL 9660 configuration command parameters to their original default settings. The default settings are listed on the super-user configuration command list display in brackets, as shown below:

PP nn - Period awaiting password {5-99} [28]

To reset the RFL 9660 to its original default settings, use the "R" command.

Format:CONFIG> R [ENTER]

The following message will appear:

Are you sure? (Y/N)

Press the **[Y]** key to answer "yes," or the **[N]** key to answer "no," and then press the **[ENTER]** key. If you answered "no," your normal prompt will re-appear. If you answer "yes," the following message will appear:

Please wait.....

Periods will be added to the line as the parameters are being reset. When they are all reset, your normal prompt will reappear. Invoking this command will erase all the changes you (and any other super-users) have already made. Because of this, only use the "R" command as a last resort.

S - SAVE CHANGES

The "S" command stores any changes made to any of the port parameters settings in the RFL 9660's non-volatile memory.

Format:LOCAL> S [ENTER]

The following message will appear:

Are you sure? (Y/N)

Press the **[Y]** key to answer "yes," or the **[N]** key to answer "no," and then press the **[ENTER]** key. If you answered "no," your normal prompt will re-appear. If you answer "yes," the following message will appear:

Please wait.....

Periods will be added to the line as the changes are being stored. When storage is complete, your normal prompt will reappear.

R - RESET ALL PORT PARAMETERS TO DEFAULT

The "R" command will reset all port parameters to their original default settings.

Format:LOCAL> R [ENTER]

The following message will appear:

Are you sure? (Y/N)

Press the **[Y]** key to answer "yes," or the **[N]** key to answer "no," and then press the **[ENTER]** key. If you answered "no," your normal prompt will re-appear. If you answer "yes," the following message will appear:

Please wait.....

Periods will be added to the line as the ports are being reset. When all the ports are reset, your normal prompt will reappear.

Invoking this command will erase **all** the port configuration changes that have been made. Because of this, the "R" command should only be used as a last resort.

U - UPDATE HARDWARE CONFIGURATION

The "U" command tells the RFL 9660 to update the hardware configuration information in its memory. This command is automatically run every time the RFL 9660 is turned on. You will have to execute the "U" command any time fiber optic remotes are added to the fiber optic ring with the RFL 9660 turned on.

Format:LOCAL> U [ENTER]

The following message will appear while the RFL 9660's memory is being updated:

FOM detected
Please wait...

When the RFL 9660's memory has been updated, the port configuration will be displayed. A typical port configuration display appears in Figure 5-7.

```
1       RS232  2       RS232  3       RS232  4       RS232
5       RS232  6       RS232  7       RS232  8       RS232
9       RS232  10      RS232  11      RS232  12      RS232
13      RS232  14      RS232  15      RS232  16      RS232
17      Fiber  18      Fiber  19      Fiber  20      Fiber
21      Fiber  22      Fiber  23      Fiber  24      Fiber
25      None   26      None   27      None   28      None
29      None   30      None   31      None   32      None
LOCAL> _
```

Figure 5-7. Typical port configuration display

Section 6. STATUS AND ERROR CODES

This section lists the status and error codes that may appear on the RFL 9660's front panel STATUS display. Some of these codes are transient and may only appear for a split second. If a problem persists, these transient codes will remain on display. If the RFL 9660 appears to be "locked-up", refer to Section 10 (Maintenance).

0	The RFL 9660 has completed its hang-up sequence, and is going off-hook.
00	The port or configuration structure has been reset to factory-default values, and stored in non-volatilememory.
1 to 32	The logged-on user (or super-user) is accessing the indicated device port. The numbers "8", "16", "24", or "32" will also flash during power-up. This indicates the total number of devices that can be accessed by the RFL 9660 (RS-232 or fiber).
8.8.	This is an initial display at power-up that checks all display segments.
5A	A diagnostic test is in progress.
Ac	The RFL 9660 has been accessed. It is idle in menu mode, and is polling its ports for a service request.
C1	8253 CTC Channel 1 has failed.
C2	8253 CTC Channel 2 has failed.
C3	8253 CTC Channel 3 has failed.
cA	DSR (Data Set Ready) was lost during the call answer phase.
cd	A carrier has been detected.
co	Program global parameters (super-user only).
cS	Call starting (DSR from modem).
ct	Off-hook, waiting for DCD.
dc	Awaiting DTE to establish Carrier Detect through modem.
dn	Parsing answerback string.
ee	EEPROM is exhausted; no more writes may be possible.
Er	ERROR - too many bad passwords.

F9	Timeout on TD from DTE. This is a transient display - only for a short while.
FA	Initialization failure; this is a transient display - only for a short while.
FL	General diagnostic test failure.
Fo	Fiber optic master (if present) being addressed.
hu	Hang-up sequence (30 seconds of no DTR).
ig	Port set to “ignore” (Mode 9) if no TD in 30 seconds.
no	Local port connected to modem port.
PA	Diagnostic test successfully completed; this is a transient display - only for a short while.
Pd	Awaiting correct password entry.
PE	An error was made when entering a password.
PL	RFL 9660 is idle; not being accessed, but polling ports for possible connection.
rC	RFL 9660 is about to reset the configuration structure.
rd	Remote Disconnect activated.
ri	Ring indicate pin at modem active. “PL” appears after ring.
rP	RFL 9660 is about to reset the port structure.
Sr	A service request has been received from a port.
td	Awaiting TD from DTE (30 seconds).
to	Timeout on no DTE established DCD.
u1	UART #1 has failed.
u2	UART #2 has failed.

Section 7. COMMAND LANGUAGE

CAUTION

The "B" and "F" commands described in this section will affect the way responses appear on your PC terminal. Do not invoke either of these commands unless your application requires it; you could inadvertently change something that might affect system performance, and not know about it.

If you accidently invoke the "B" command, simply invoke the "F" command. This will cancel out the "B" command, and return the RFL 9660 to the long-form response format.

This section describes two additional commands that do not appear on the RFL 9660's "help" screens. These commands control the language the RFL 9660 uses to send responses to a user's screen.

B - SHORT FORM RESPONSE

The "B" command selects the "short form" language that sends two-character ASCII codes. This is a high-level command language used with some programs. It also can be used for automation programs written by the user.

Format: B [ENTER]

Table 7-1 is an alphabetical list of all the short-form responses and their long-form equivalents.

F - VERBOSE ASCII

The "F" command selects the "long-form" language, or verbose ASCII (meaningful words and phrases).

Format: F [ENTER]

The long form is used in most applications and is the factory default setting. Unless you are using a program that requires the short form, use the long form. The Windows program will automatically switch the RFL 9660 to the short form, so you don't have to do it manually.

Table 7-2 is an alphabetical list of all long-form responses and their short-form equivalents.

Table 7-1. Short-form responses and long-form equivalents

Short-Form Response ("B" Command) [1]	Verbose ASCII ("F" Command) [2]
#P	Number of ports [number of ports]
BF	Brief response format
BP	Invalid password
C#	Checking port number [port number]
CC	Command cancelled
DP	Parameters are [parameters]
DS	Current port deselect code is [deselect code]
ER	ERROR
ES	EEPROM checksum
F#	Failed at port number [port number]
FA	*****FAILED*****
FD	Diagnostics
FL	The fiber optic loop is operating
FM	Fiber optic master absent
H*	"LOCAL>" or "MODEM>" prompt
LD	DCD lost while in menu
LP	Please enter new label, up to [number of characters]
LR	Long response format
MP	Connected to port # [number of selected port]
NF	EEPROM failure
NV	EEPROM size is [number of bytes]
OL	Old label was [old label]
P#	Logged on as number [user number]
P#	Port number [number of selected port]
P>	Cannot select port > than {highest port number; 8, 16, 24, or 32]
PA	Passed
PE	Port number must be 1 - [highest port number; 8, 16, 24, or 32]
PR	Local disconnect button pressed
PW	Please enter password
R#	ROM IS [ ]
RD	Remote disconnect active
RM	Reset in progress ...

Table 7-1. Short-form responses and long-form equivalents - continued.

Short-Form Response ("B" Command) [1]	Verbose ASCII ("F" Command) [2]
RS	ROM checksum
SN	Site ID [site identification
SR	Static RAM
SS	Static RAM size is [number of bytes]
SU	Are you sure (Y/N) ?
TL	**** TOO LONG ****
UR	Request for service from port
VA	Software version 1.1.7

NOTES:

1. A number sign ("#") in a short-form response indicates a wild-card character; it can be replaced with any number.
2. Information within brackets describes the information that will appear as part of the long-form response.

Table 7-2 Long-form responses and short-form equivalents

Verbose ASCII ("F" Command) [1]	Short-Form Response ("B" Command) [2]
"LOCAL>" or "MODEM>" prompt	H*
**** TOO LONG ****	TL
***** FAILED *****	FA
Are you sure (Y/N) ?	SU
Brief response format	BF
Cannot select port > than [highest port number; 8, 16, 24, or 32]	P>
Checking port number [port number]	C#
Command canceled	CC
Connected to port # [number of selected port]	MP
Current port deselect code is [deselect code]	DS
DCD lost while in menu	LD
Diagnostics	FD
EEPROM checksum	ES
EEPROM failure	NF
EEPROM size is [number of bytes]	NV
ERROR	ER
Failed at port number [port number]	F#

Table 7-2 Long-form responses and short-form equivalents - continued.

Verbose ASCII ("F" Command) [1]	Short-Form Response ("B" Command) [2]
Fiber optic master absent	FM
Invalid password	BP
Local disconnect button pressed	PR
Logged on as number [user number]	P#
Long response format	LR
Number of ports [number of ports]	#P
Old label was [old label]	OL
Parameters are [parameters]	DP
Passed	PA
Please enter new label, up to [number of characters]	LP
Please enter password	PW
Port number [number of selected port]	P#
Port number must be 1 - [highest port number; 8, 16, 24, or 32]	PE
Remote disconnect active	RD
Request for service from port	UR
Reset in progress ...	RM
ROM checksum	RS
ROM IS [ ]	R#
Site ID [site identification]	SN
Software version 1.1.7	VA
Static RAM	SR
Static RAM size is [number of bytes]	SS
The fiber optic loop is operating	FL

NOTES:

1. Information within brackets describes the information that will appear as part of the long-form response.
2. A number sign ("#") in a short-form response indicates a wild-card character; it can be replaced with any number.

Section 8. SPECIAL JUMPER AND DIP SWITCH SETTINGS

8.1 INTRODUCTION

Some RFL 9660 circuit card modules and assemblies are equipped with programmable jumpers and DIP switches. These jumpers and DIP switches are set at the factory to a configuration that should work in most applications. Under normal circumstances, they will only have to be reset in the field if the factory settings are not compatible with your equipment. The information in this section allows you to set these jumpers and DIP switches to match the equipment requirements of your specific installation.

8.2 CPU MODULE

The CPU module has three programmable jumpers (J2 through J5) and two programmable DIP switches (S1 and S3).

Figure 8-1 shows the location of these jumpers and switches. S1 can be accessed through the front panel. S3 and jumpers J2 through J5 can only be accessed when the CPU is removed from the RFL 9660 chassis.

J2 - J5 Jumpers J2 through J5 are set at the factory according to the memory devices installed on the circuit board. These jumpers should not be changed in the field.

S1-1 thru S1-4 Four-section SET-UP switch S1 sets the baud rate and parity for the RFL 9660's LOCAL port; the number of data bits is fixed at eight.

Switch settings for S1 are given in Table 8-1. When viewed from the front of the RFL 9660, ON is down and OFF is up.

S3-1 thru S3-7 S3-1 through S3-7 set the communications parameters for the RFL 9660 modem or direct digital port. S3-1 through S3-3 set the baud rate, S3-4 and S3-5 set the parity, S3-6 sets the word length, and S3-7 sets the number of stop bits.

Table 8-2 lists the valid switch settings for S3-1 through S3-7 when the RFL 9660 is equipped with a modem; if the RFL 9660 has a direct digital I/O module, the switch settings are given in Table 8-3. To use these tables, look up the baud rate you wish to set the port to, and then find the parity, word length, and stop bit settings that you need. When you find the row in the table that matches your requirements, set S3-1 through S3-7 as shown on that row.

NOTE

The setting combinations listed in Table 8-2 are the only ones that are valid when the RFL 9660 is equipped with a modem. Any other combination setting may result in modem misoperation.

S3-8 S3-8 controls the RFL 9660's internal diagnostic loop. Place S3-8 in the ON position to disable the diagnostic loop; to enable the diagnostic loop, place S3-8 in the OFF position.

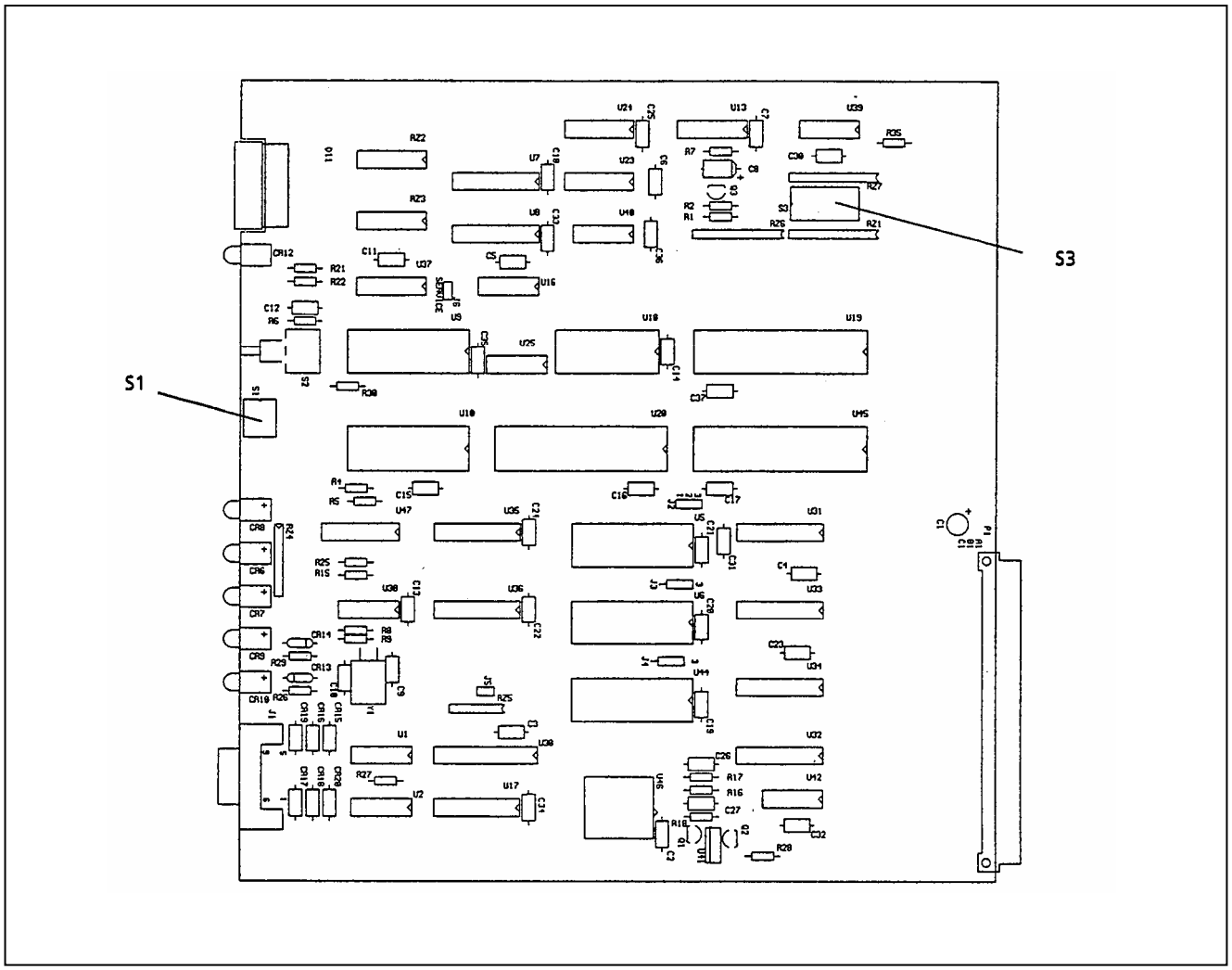


Figure 8-1. Programmable jumpers and DIP switches, CPU module

Table 8-1. DIP switch settings for local port setup

Speed	Data Bits And Parity	S1-1	S1-2	S1-3	S1-4
1200	Eight Bits Odd	OFF (up)	ON (down)	ON (down)	ON (down)
	Eight Bits Even	OFF (up)	ON (down)	OFF (up)	ON (down)
	Eight Bits None	OFF (up)	ON (down)	X	OFF (up)
2400	Eight Bits Odd	ON (down)	ON (down)	ON (down)	ON (down)
	Eight Bits Even	ON (down)	ON (down)	OFF (up)	ON (down)
	Eight Bits None	ON (down)	ON (down)	X	OFF (up)
4800	Eight Bits Odd	ON (down)	OFF (up)	ON (down)	ON (down)
	Eight Bits Even	ON (down)	OFF (up)	OFF (up)	ON (down)
	Eight Bits None	ON (down)	OFF (up)	X	OFF (up)
9600	Eight Bits Odd	OFF (up)	OFF (up)	ON (down)	ON (down)
	Eight Bits Even	OFF (up)	OFF (up)	OFF (up)	ON (down)
	Eight Bits None	OFF (up)	OFF (up)	X	OFF (up)

X = Don't care

Table 8-2. DIP switch settings for modem port setup.

Speed	Parity	Word Length	No. Of Stop Bits	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7
19,200	None	8 bits	1	ON	ON	OFF	ON	ON	ON	ON

Table 8-3. DIP switch settings for direct digital port setup

Speed	Parity	Word Length	No. Of Stop Bits	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7
300	Odd	7 bits	1	OFF	ON	OFF	OFF	ON	OFF	ON
			2	OFF	ON	OFF	OFF	ON	OFF	OFF
		8 bits	1	OFF	ON	OFF	OFF	ON	ON	ON
			2	OFF	ON	OFF	OFF	ON	ON	OFF
	Even	7 bits	1	OFF	ON	OFF	OFF	OFF	OFF	ON
			2	OFF	ON	OFF	OFF	OFF	OFF	OFF
		8 bits	1	OFF	ON	OFF	OFF	OFF	ON	ON
			2	OFF	ON	OFF	OFF	OFF	ON	OFF
	None	7 bits	1	OFF	ON	OFF	ON	ON	OFF	ON
			2	OFF	ON	OFF	ON	ON	OFF	OFF
		8 bits	1	OFF	ON	OFF	ON	ON	ON	ON
			2	OFF	ON	OFF	ON	ON	ON	OFF
1200	Odd	7 bits	1	OFF	ON	ON	OFF	ON	OFF	ON
			2	OFF	ON	ON	OFF	ON	OFF	OFF
		8 bits	1	OFF	ON	ON	OFF	ON	ON	ON
			2	OFF	ON	ON	OFF	ON	ON	OFF
	Even	7 bits	1	OFF	ON	ON	OFF	OFF	OFF	ON
			2	OFF	ON	ON	OFF	OFF	OFF	OFF
		8 bits	1	OFF	ON	ON	OFF	OFF	ON	ON
			2	OFF	ON	ON	OFF	OFF	ON	OFF
	None	7 bits	1	OFF	ON	ON	ON	ON	OFF	ON
			2	OFF	ON	ON	ON	ON	OFF	OFF
		8 bits	1	OFF	ON	ON	ON	ON	ON	ON
			2	OFF	ON	ON	ON	ON	ON	OFF
2400	Odd	7 bits	1	ON	ON	ON	OFF	ON	OFF	ON
			2	ON	ON	ON	OFF	ON	OFF	OFF
		8 bits	1	ON	ON	ON	OFF	ON	ON	ON
			2	ON	ON	ON	OFF	ON	ON	OFF
	Even	7 bits	1	ON	ON	ON	OFF	OFF	OFF	ON
			2	ON	ON	ON	OFF	OFF	OFF	OFF
		8 bits	1	ON	ON	ON	OFF	OFF	ON	ON
			2	ON	ON	ON	OFF	OFF	ON	OFF
	None	7 bits	1	ON	ON	ON	ON	ON	OFF	ON
			2	ON	ON	ON	ON	ON	OFF	OFF
		8 bits	1	ON	ON	ON	ON	ON	ON	ON
			2	ON	ON	ON	ON	ON	ON	OFF

<< table continues on next page >>

Table 8-3. DIP switch settings for direct digital port setup - continued.

Speed	Parity	Word Length	No. Of Stop Bits	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7
4800	Odd	7 bits	1	ON	OFF	ON	OFF	ON	OFF	ON
			2	ON	OFF	ON	OFF	ON	OFF	OFF
		8 bits	1	ON	OFF	ON	OFF	ON	ON	ON
			2	ON	OFF	ON	OFF	ON	ON	OFF
	Even	7 bits	1	ON	OFF	ON	OFF	OFF	OFF	ON
			2	ON	OFF	ON	OFF	OFF	OFF	OFF
		8 bits	1	ON	OFF	ON	OFF	OFF	ON	ON
			2	ON	OFF	ON	OFF	OFF	ON	OFF
	None	7 bits	1	ON	OFF	ON	ON	ON	OFF	ON
			2	ON	OFF	ON	ON	ON	OFF	OFF
		8 bits	1	ON	OFF	ON	ON	ON	ON	ON
			2	ON	OFF	ON	ON	ON	ON	OFF
9600	Odd	7 bits	1	OFF	OFF	ON	OFF	ON	OFF	ON
			2	OFF	OFF	ON	OFF	ON	OFF	OFF
		8 bits	1	OFF	OFF	ON	OFF	ON	ON	ON
			2	OFF	OFF	ON	OFF	ON	ON	OFF
	Even	7 bits	1	OFF	OFF	ON	OFF	OFF	OFF	ON
			2	OFF	OFF	ON	OFF	OFF	OFF	OFF
		8 bits	1	OFF	OFF	ON	OFF	OFF	ON	ON
			2	OFF	OFF	ON	OFF	OFF	ON	OFF
	None	7 bits	1	OFF	OFF	ON	ON	ON	OFF	ON
			2	OFF	OFF	ON	ON	ON	OFF	OFF
		8 bits	1	OFF	OFF	ON	ON	ON	ON	ON
			2	OFF	OFF	ON	ON	ON	ON	OFF
19,200	Odd	7 bits	1	ON	ON	OFF	OFF	ON	OFF	ON
			2	ON	ON	OFF	OFF	ON	OFF	OFF
		8 bits	1	ON	ON	OFF	OFF	ON	ON	ON
			2	ON	ON	OFF	OFF	ON	ON	OFF
	Even	7 bits	1	ON	ON	OFF	OFF	OFF	OFF	ON
			2	ON	ON	OFF	OFF	OFF	OFF	OFF
		8 bits	1	ON	ON	OFF	OFF	OFF	ON	ON
			2	ON	ON	OFF	OFF	OFF	ON	OFF
	None	7 bits	1	ON	ON	OFF	ON	ON	OFF	ON
			2	ON	ON	OFF	ON	ON	OFF	OFF
		8 bits	1	ON	ON	OFF	ON	ON	ON	ON
			2	ON	ON	OFF	ON	ON	ON	OFF

8.3 MODEM MODULE

The RFL 9660 modem module has a single programmable jumper (J4). Figure 8-2 shows the location of this jumper which can be accessed only when the module is removed from the RFL 9660 chassis.

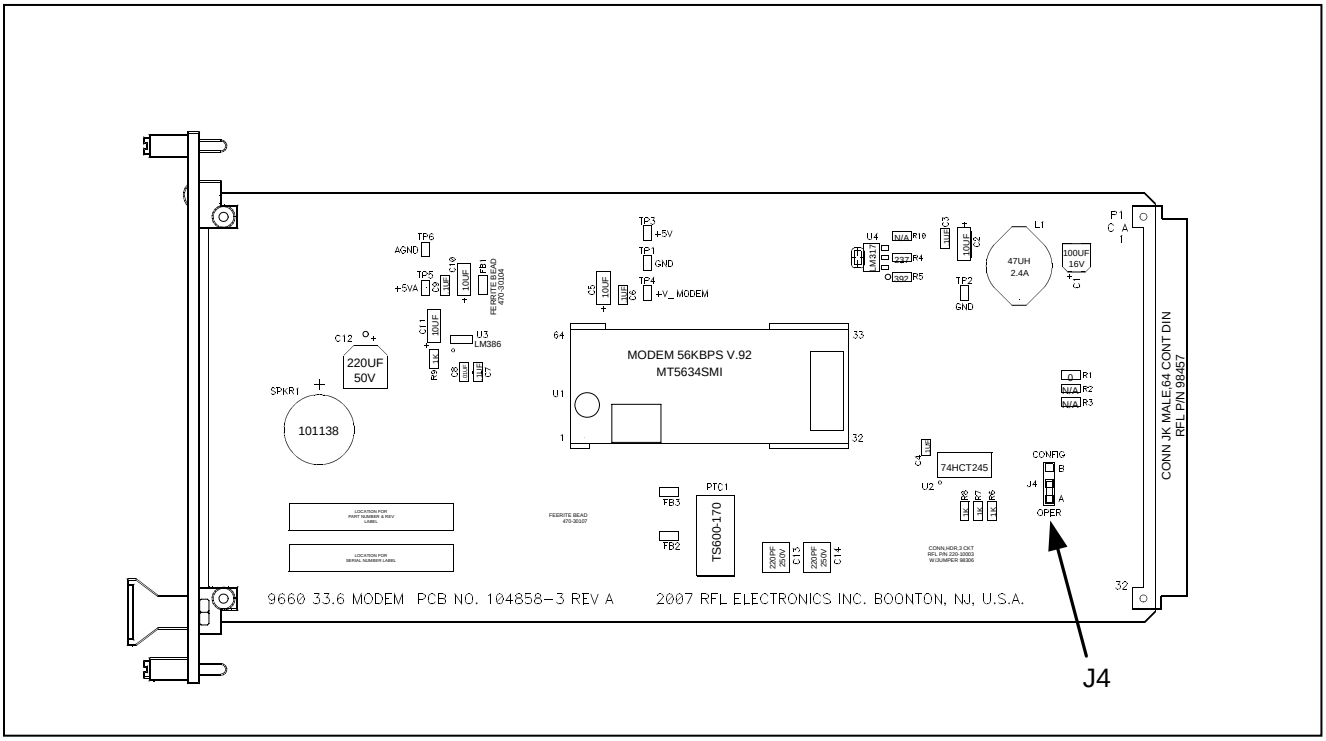


Figure 8-2. Programmable jumper location, RFL 9660 33.6 Kbps modem module.

J4 Modem parameters are configured in the factory before shipment. For modem re-configuration in the field, place J4 in position “B”. For normal operation J4 should be placed in position “A”.

8.4 RS-232 DEVICE PORT MODULE

The RS232 device port module has two programmable jumpers, JP1 and JP2. Figure 8-3 shows the location of these jumpers. These jumpers are set at the factory; do not change the settings of these jumpers.

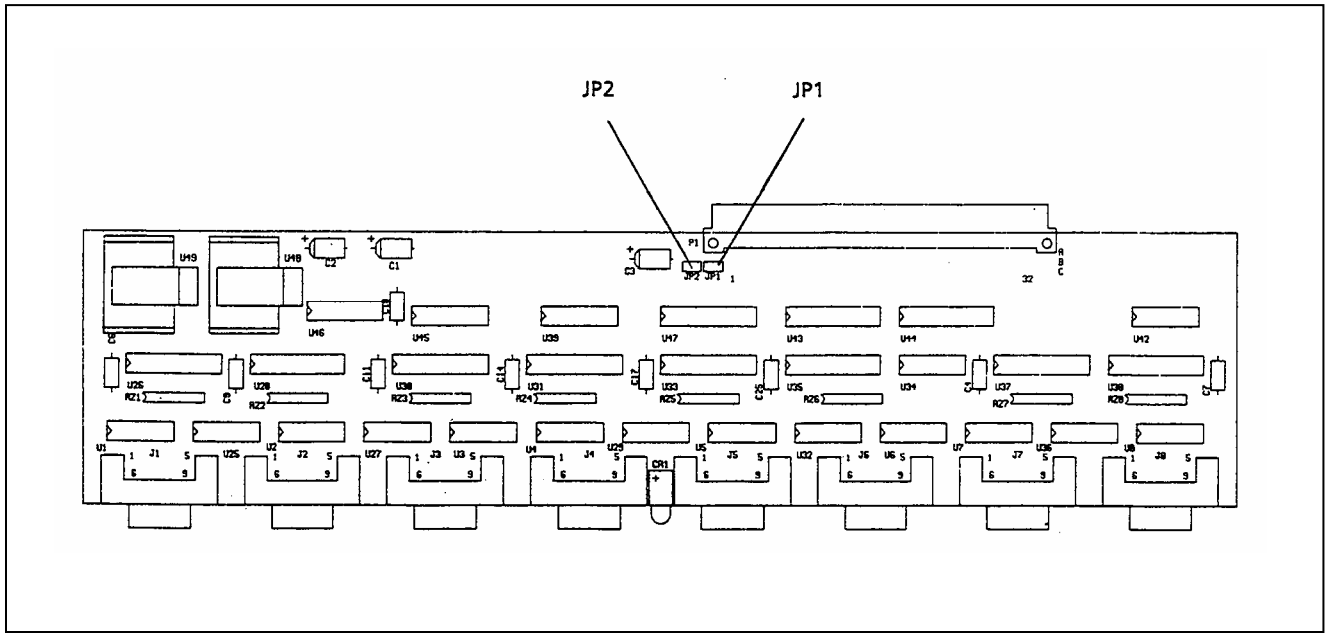


Figure 8-3. Programmable jumpers, RS232 device port module

8.5 DIRECT DIGITAL I/O MODULE

The Direct Digital I/O Module has three programmable jumpers: J2, J3 and J4. Figure 8-4 shows the location of these jumpers. These jumpers are used to enable or disable RS-232 handshaking. When all jumpers are in position A, RS-232 handshaking is disabled. When all jumpers are in position B, RS-232 handshaking is enabled. The jumpers are set at the factory in position B (enabled).

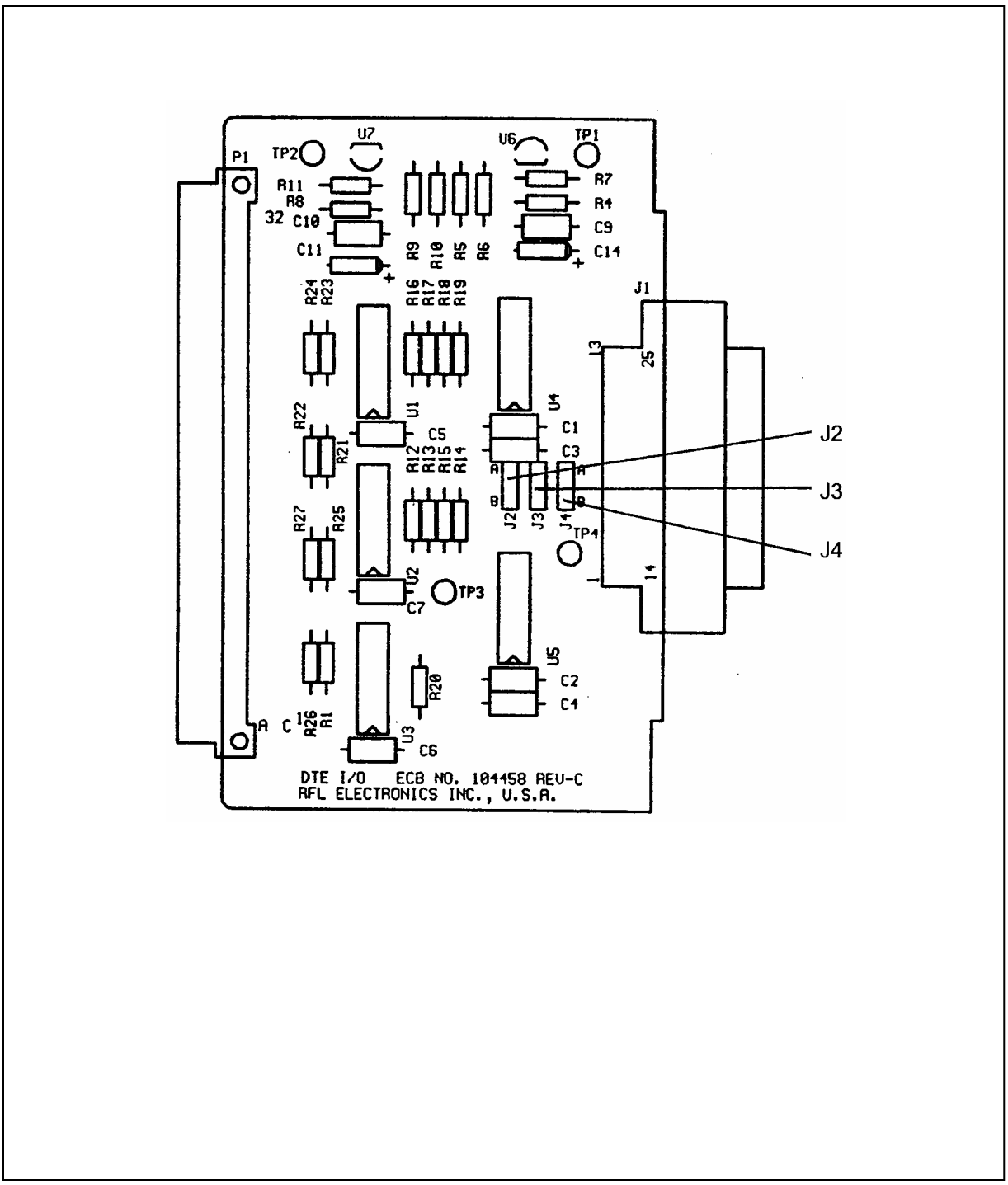


Figure 8-4. Programmable jumpers, Direct Digital I/O module.

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Section 9. FIBER OPTIC SET-UP INFORMATION

9.1 INTRODUCTION

The RFL 9660 Digital Switch can be equipped with an optional fiber optic master I/O module (Part Number 104430). This provides the RFL 9660 with a time-division multiplex (TDM) fiber optic ring. Up to 32 asynchronous serial data channels can be multiplexed onto the fiber optic ring. The ring is periodically polled by sending a specially coded message that checks the ring's integrity.

The fiber optic master I/O module is installed in one of the horizontal I/O slots at the rear of the RFL 9660. When installing a fiber optic I/O module, the following rules apply:

1. The bottom I/O module slot must always be occupied.

2. Additional device I/O modules must be installed from bottom to top; do not skip any I/O module slots.

3. An RFL 9660 may contain both RS-232 and fiber optic device I/O modules. If both types are to be installed, the RS-232 I/O modules must be at the bottom, with the fiber optic module on the top.

4. If you are adding an RS-232 I/O module to an RFL 9660 that already has a fiber optic I/O module, the fiber optic I/O module must be moved up one slot and the RS-232 I/O module installed below it. If the RFL 9660 has already been programmed for the devices connected to the fiber optic loop, it will have to be re-programmed, since the fiber optic devices have now been moved up eight port numbers. The address of the fiber optic remotes must be changed to reflect programming.

Each device being interfaced to the fiber optic ring must be equipped with a fiber optic remote module (Part Number 104460). Each fiber optic remote module is mounted in a compact housing that can be fastened near or on the device being connected to it. A 9-pin D-subminiature connector (DE-9) is provided for connections between the fiber optic remote module and the device. A terminal strip accepts the available dc input voltage (9, 48, or 125 Vdc).

Connections between the fiber optic master I/O and the fiber optic remote modules are made using 850-nm multimode fiber with ST connectors. Loop lengths up to 2000 feet (610 meters) can be accommodated by the RFL 9660's optical power budget of 8 dB (6.5 dB worst-case). Switch-controlled attenuators on both the master I/O and the fiber optic remote modules vary the optical power from -16 dBm to -10 dBm. Each fiber optic port is configured by using the same super-user port configuration commands as RS-232 ports. (See Sections 3 and 5 for more information.)

9.2 FIBER OPTIC MASTER I/O MODULE

The fiber optic master I/O module has one two-position programmable DIP switch labeled "S1," two LED indicators labeled "DATA" and "ACTIVE," and two fiber optic connectors labeled "TX and "RX." Figure 9-1 shows the location of these items.

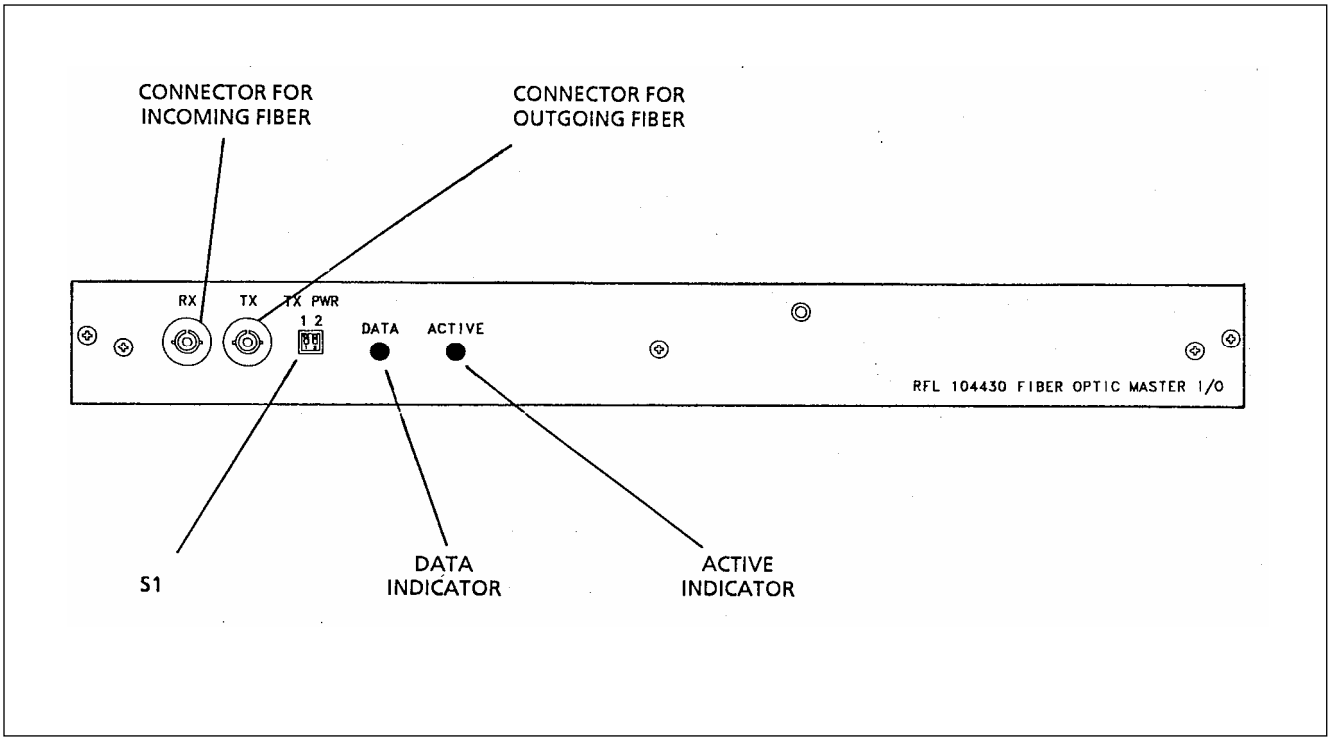

Figure 9-1. Programmable DIP switches and indicators, fiber optic master I/O module

DATA The DATA indicator lights when the fiber optic loop is running and the data being sent is valid.

ACTIVE The ACTIVE indicator lights whenever a fiber optic port is being accessed.

RX The incoming fiber optic cable is connected to the RX connector.

TX The outgoing fiber optic cable is connected to the TX connector.

S1 TX PWR switch S1 controls the master I/O module's optical output power:

Output	**S1-1**	**S1-2**
-42 dBm	OFF (up)	OFF (up)
-38 dBm	ON (down)	OFF (up)
-34 dBm	OFF (up)	ON (down)
-33 dBm	ON (down)	ON (down)

NOTE

These are typical power output levels when jumper J5 is in position 'A' (run mode), on Fiber Optic Master I/O Module (Assembly No. 104430) as shown in the schematic of Figure 14-23 on page 14-55. Position 'B' (test mode) is for factory use only.

9.3 FIBER OPTIC REMOTE MODULE

Each fiber optic remote module has two programmable DIP switches, three LED indicators, two fiber optic cable connectors, a 9-pin RS-232 connector, and a five-position terminal block. Figure 9-2 shows the location of these items.

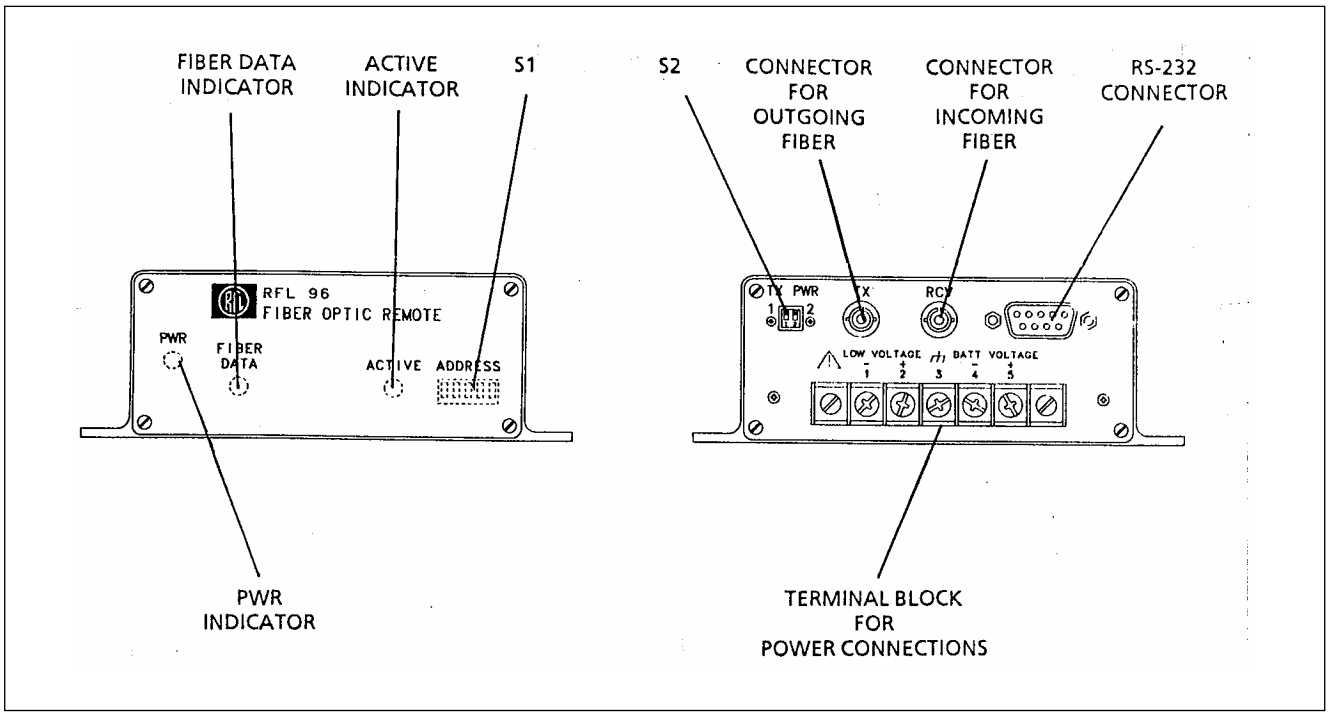

Figure 9-2. Programmable DIP switches and indicators, fiber optic remote module

ACTIVE The ACTIVE indicator lights when the device connected to the RS-232 connector is being accessed by the RFL 9660.

FIBER DATA The FIBER DATA indicator lights when loop integrity is good at the remote module and the data being received is valid.

PWR The PWR indicator lights when dc input power is being applied to the remote module.

S1 ADDRESS switch S1 sets the remote module's address. It sets up a binary number that represents the port number assigned to the device. (See Table 9-1.)

S2 TX PWR switch S2 controls the remote module's optical output power:

Output	S2-1	S2-2
-42 dBm	OFF (up)	OFF (up)
-38 dBm	ON (down)	OFF (up)
-34 dBm	OFF (up)	ON (down)
-33 dBm	ON (down)	ON (down)

NOTE

These are typical power output levels when jumper J1 is in position 'A' (run mode), on Fiber Optic Remote Module (Assembly No. 104460) as shown in the schematic of Figure 14-27 on page 14-65. Position 'B' (test mode) is for factory use only.

Table 9-1. DIP switch settings for fiber optic remote module addressing

Port Number	S1-1	S1-2	S1-3	S1-4	S1-5
1	OFF	OFF	OFF	OFF	OFF
2	ON	OFF	OFF	OFF	OFF
3	OFF	ON	OFF	OFF	OFF
4	ON	ON	OFF	OFF	OFF
5	OFF	OFF	ON	OFF	OFF
6	ON	OFF	ON	OFF	OFF
7	OFF	ON	ON	OFF	OFF
8	ON	ON	ON	OFF	OFF
9	OFF	OFF	OFF	ON	OFF
10	ON	OFF	OFF	ON	OFF
11	OFF	ON	OFF	ON	OFF
12	ON	ON	OFF	ON	OFF
13	OFF	OFF	ON	ON	OFF
14	ON	OFF	ON	ON	OFF
15	OFF	ON	ON	ON	OFF
16	ON	ON	ON	ON	OFF
17	OFF	OFF	OFF	OFF	ON
18	ON	OFF	OFF	OFF	ON
19	OFF	ON	OFF	OFF	ON
20	ON	ON	OFF	OFF	ON
21	OFF	OFF	ON	OFF	ON
22	ON	OFF	ON	OFF	ON
23	OFF	ON	ON	OFF	ON
24	ON	ON	ON	OFF	ON
25	OFF	OFF	OFF	ON	ON
26	ON	OFF	OFF	ON	ON
27	OFF	ON	OFF	ON	ON
28	ON	ON	OFF	ON	ON
29	OFF	OFF	ON	ON	ON
30	ON	OFF	ON	ON	ON
31	OFF	ON	ON	ON	ON
32	ON	ON	ON	ON	ON

Section 10. MAINTENANCE

10.1 INTRODUCTION

This section provides maintenance information for the RFL 9660 Digital Switch. Customer maintenance is limited to power supply fuse replacement; all other maintenance must be performed by qualified service personnel. Information is also provided in this section on how to arrange for service.

10.2 FUSE REPLACEMENT

Three different fuse replacement procedures are given in this section: one for the RFL 9660's power supply, one for the power/alarm I/O module used in ac-powered RFL 9660s, and one for the RFL 9660's fiber optic remote module.

10.2.1 POWER SUPPLY FUSE REPLACEMENT

An RFL 9125 25-Watt Power Supply Module furnishes input power for the RFL 9660. Several different models are available, for a wide range of input voltages. Some models have their fuses on the main circuit board; the module will have to be removed from the chassis to gain access to the fuses. On other models, the fuses are located in fuseholders on the front of the module; these fuses can be changed without removing the power supply from the chassis.

To check the power supply fuses, proceed as follows:

1. Place the POWER switch on the RFL 9125 in the OFF position.

2. If the power supply does not have front-panel fuseholders, remove the fuses as follows:

    a. Using a flat-blade screwdriver, loosen the four quarter-turn fasteners securing the power supply module in place.

    b. Pull on the module handle until the module is out of the chassis.

    c. Using a fuse puller or a flat-blade screwdriver, remove fuses F1 and F2 from the fuse clips near the rear of the input converter board.

3. If the power supply does have front-panel fuseholders, remove the fuses as follows:

    a. Push in on one of the fuseholder caps with a flat-blade screwdriver.

    b. Turn the cap counter clockwise about 1/4 turn.
    The cap will pop out of position.

    c. Remove the fuse from the fuseholder cap.

    d. Repeat steps 3a through 3c to remove the other fuse.

4. Inspect each fuse for damage.

   If the fuse is bad, it must be replaced. If the fuse is good, check for presence of input voltage at TB1-9 and TB1-10 on the PWR/ALARM I/O module. If voltage is present and the RFL 9125 does not function, the power supply module is defective and must be replaced.

5. If the power supply does not have front-panel fuseholders, replace the fuses as follows:

   a. Insert a fuse with the proper voltage and current ratings into each set of fuseholder clips on the input converter board, and push it in until the fuse is firmly seated.

      For continued safe operation, always replace a fuse with one having the same voltage and current ratings. Refer to Table 10-1 for proper fuse values.

   b. Line the edges of the input converter board up with the card guides in the chassis. Once they are lined up, push the module in to the chassis until its front panel is flush with the other modules on the front of the chassis.

   c. Using a flat-blade screwdriver, turn the four quarter-turn fasteners on the front panel one quarter-turn to secure the power supply module in place.

6. If the power supply does have front-panel fuseholders, replace the fuses as follows:

   a. Insert a fuse with the proper voltage and current ratings into the fuseholder cap and push it in until the fuse is firmly seated.

      For continued safe operation, always replace a fuse with one having the same voltage and current ratings. Refer to Table 10-1 for proper fuse values.

   b. Insert the fuse and fuseholder cap into the fuseholder. Using a flat-blade screwdriver, push in on the cap and turn clockwise about one quarter-turn.

      This will secure the fuse in place.

   c. Repeat steps 2 through 5 for the other fuse.

Table 10-1. Fuse replacement data, RFL 9660 power supply modules

Model	Assy. No.	Fuse Rating	Manufacturer's Type	Part Number
9125B 24DCPS	103150-1	3AG slow-blow, 250V, 3A	Littelfuse 313 004 or equiv.	91935
9125B 48DCPS	103150-2	3AG slow-blow, 250V, 2A	Littelfuse 313 002 or equiv.	7549
9125B 125DCPS	103150-3	3AG slow-blow, 250V, 1A	Littelfuse 313 001 or equiv.	6645
9125 250DCPS	101970-4	3AG slow-blow, 250V, 1A	Littelfuse 313 001 or equiv.	6645
9125 110ACPS	101975-1	3AG slow-blow, 250V, 1A	Littelfuse 313 001 or equiv.	6645
9125 220ACPS	101975-2	Type T slow-blow, 250V, 1A	Littelfuse 213 001 or equiv.	30457

7. Place the power switch in the ON position.

   If all the indicators on the front of the power supply module light, the power supply is working properly. If all five indicators do not light or if one or both fuses blow again, the RFL 9125 is defective and should be replaced.

10.2.2 I/O MODULE FUSE REPLACEMENT

If your RFL 9660 is equipped with an ac-input power supply, it will also contain an RFL 96 AC/ALARM I/O Ac-Input Power/Alarm I/O Module (Assembly No. 104400-1). This I/O module will have two fuses mounted to a daughterboard that plugs onto its main circuit board. To check these fuses, proceed as follows:

1. Place the POWER switch on the power supply module in the OFF position.

2. Using a flat-blade screwdriver, loosen the four quarter-turn fasteners securing the power/alarm I/O module in place.

3. Using the terminal block as a handle, rock the I/O module back and forth until it disconnects from its mating connector on the chassis motherboard. Once it disconnects, Pull on the terminal block until the I/O module is out of the chassis.

4. Using a fuse puller or a flat-blade screwdriver, remove fuses F1 and F2 from the fuse clips on the daughterboard.

5. Inspect each fuse for damage.

   If the fuse is bad, it must be replaced. If the fuse is good, check for presence of input voltage at TB1-9 and TB1-10 on the rear-panel terminal block. If voltage is present and the power supply does not function, the power supply module itself is defective and must be replaced.

6. Insert a fuse with the proper voltage and current ratings into each set of fuseholder clips on the daughterboard, and push it in until the fuse is firmly seated.

   The fuses installed on the daughterboard are 3AG slow-blow types, rated for 1 ampere @250 Vac (Littelfuse 313001 or equivalent, RFL P/N 6645). For continued safe operation, always replace a fuse with one having the same voltage and current ratings.

7. Line the edges of the I/O module up with the card guides in the chassis. Once they are lined up, push the I/O module in to the chassis until its panel is flush with the other I/O modules on the rear of the chassis.

8. Using a flat-blade screwdriver, turn the four quarter-turn fasteners on the panel one quarter-turn to secure the I/O module in place

9. Place the power switch in the ON position.

   If all the indicators on the front of the power supply module light, the power supply is working properly. If all five indicators do not light or if one or both fuses blow again, the power supply module is defective and should be replaced.

10.2.3 FIBER OPTIC REMOTE MODULE FUSE REPLACEMENT

Each RFL 96 FO Fiber Optic Remote Module contains a power supply board that provides all the power required by the fiber optic transceiver circuits in the fiber optic remote module. 48-volt and 129-volt units are protected by fuses that are located on the board itself; 9-volt power supply boards are not equipped with fuses.

To determine if a fuse needs to be replaced, proceed as follows:

1. Look at the indicators on the front of the fiber optic remote module.

   If the PWR and FIBER DATA indicators are lit, the fiber optic remote module is working properly. Do not perform the rest of this procedure.

   If the PWR indicator is not lit, check for the presence of station battery voltage at terminal blocks TB1-5 (positive) and TB1-4 (negative) on the rear panel. If station battery voltage is not present, troubleshoot the station wit\ring to determine the cause and fix it. If the PWR and FIBER DATA indicators light once station battery voltage is restored, do not perform the rest of this rocedure.

   If station battery voltage is present on the terminal block and the PWR and FIBER DATA indicators are not lit, go on to step 2.

2. Using a Phillips screwdriver, remove the four screws securing the rear panel to the case.

3. Using terminal block TB1 as a handle, pull on the rear panel until the circuit boards are out of the case.

4. Using a fuse puller or a flat-blade screwdriver, remove fuse F1 from its clips on the circuit board and inspect it for damage.

   If the fuse is bad, it must be replaced. If the fuse is good, check for presence of input voltage across TB1-4 and TB1-5 on 48-volt and 129-volt units, or TB1-1 and TB1-2 on 9-volt units. If input voltage is present and the fiber optic remote module does not function, it is defective and must be replaced.

5. Insert a fuse with the proper voltage and current ratings into the clips and push it in until it is firmly seated.

   For continued safe operation, always replace a fuse with one having the same voltage and current ratings. Refer to Table 10-2 for proper fuse values.

Table 10-2. Fuse replacement data, RFL 9660 fiber optic remote modules

Input Voltage	Assy. No.	Fuse Rating	Manufacturer's Type	Part Number
9 Vdc	104495-1	No fuse in this model	. . .	. . .
48 Vdc	104495-2	3AG slow-blow, 250V, 1/2A	Littelfuse 313.500 or equiv.	6723
129 Vdc	104495-3	3AG slow-blow, 250V, 0.15A	Littelfuse 313.150 or equiv.	14392

6. There are five card guide grooves that run the length of the case on the inside. Align the circuit boards so the power supply board lines up with the second groove from the bottom, and the fiber optic transceiver board lines up with the second groove from the top.

7. Once the boards are lined up, push them into the case until the rear panel is against the end of the case.

8. Using a Phillips screwdriver, install and tighten four screws in the corners of the rear panel to secure it to the case.

9. Look at the PWR indicator on the front of the fiber optic remote module.

   If the PWR indicator is lit, the fiber optic remote module is working properly.

   If the PWR indicator does not light, check for the presence of station battery voltage at terminal blocks TB1-5 (positive) and TB1-4 (negative) on the rear panel. If voltage is present, the fiber optic remote module is defective and should be replaced. If voltage is not present, determine the cause.

10.3 USING THE MODULE REMOVAL TOOL

A module removal tool is provided with each RFL 9660 to simplify removal and replacement of rear-panel I/O modules. The tool is stored next to the PWR/ALARM I/O module.

To use the module removal tool to remove and replace an I/O module, proceed as follows:

1. Disconnect all wiring from the I/O module to be removed.
   Tag all wires before removal. This will simplify rewiring once the I/O module is replaced.

2. Pull the module removal tool out of its storage space.

3. One end of the module removal tool is threaded. Insert this end into the threaded hole on the I/O module to be removed, and turn the tool clockwise until tight.

4. The PWR/ALARM I/O and communication I/O modules (VF 2W, VF 4W, or DTE I/O) are held in place by quarter-turn fasteners. If removing one of these I/O modules, use a flat blade screwdriver to turn each fastener one quarter-turn, until it is loose.

   The MSM I/O and FIBER OPTIC MASTER I/O modules are held in place by two flat head slotted screws (one on each end). If removing one of these I/O modules, use a flat blade screwdriver to remove these screws.

5. Using the module removal tool as a handle, pull the I/O module out of the chassis.

6. Disconnect the module removal tool from the I/O module.

To replace an I/O module, proceed as follows:

1. Push the I/O module into the chassis until its edge connector engages its mating connector on the chassis motherboard.

2. If a PWR/ALARM I/O or communication I/O module (VF 2W, VF 4W, or DTE I/O) is being replaced, use a flat blade screwdriver to push in and turn each fastener one quarter-turn, until it is tight.

   If an MSM I/O or FIBER OPTIC MASTER I/O module is being replaced, use a flat blade screwdriver to install and tighten one screw at each end.

3. Insert the threaded end of the module removal tool into its storage space, and push the tool in until is its firmly seated.

4. Reconnect all wiring to the I/O module.
   Use the tags placed on the wires during removal as a reference.

10.4 DIAGNOSTICS

Any time you want to make sure the RFL 9660 is working properly, you can use the "D" command to run the RFL 9660's internal diagnostic program. This is the same program the RFL 9660 runs every time it is powered up. To run the internal diagnostics program, press the following keys:

Format: **D [ENTER]**

Status messages appear on the display during the diagnostic test. At the end of the test, the display will look like the typical display shown in Figure 10-1.

```
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RFL Electronics Inc. 9660 Switch. Version 3.2
Modem type is 6
Modem
Settings are:  19,200 baud, 8 Data bits,  1 stop bit(s), None parity
Local
Settings are:  2400 baud, 8 Data bits,  1 stop bit(s), None parity
uP
Settings are:  9600 baud, 8 Data bits,  1 stop bit(s), ODD  parity
Current port deselect code is  42,59,45 (hexadecimal)
ROM Checksum .....(ce)  Passed
0
Please wait.....
# of EEPROM updates 65532 & 23.
EEPROM checksum of config=7h & port_info=9dH
No. of ports 24
Oct 22 1992 ROM is 27512
Static RAM size (bytes)  is 7fffH
Static RAM Passed
8253 Passed
8251 #1 Passed
8251 #2 Passed
CPU RAM size : 127
8255A  Passed
8255B  Passed
FOM detected
Please wait...
1   RS232    2   RS232    3   RS232    4   RS232
5   RS232    6   RS232    7   RS232    8   RS232
9   RS232    10  RS232    11  RS232    12  RS232
13  RS232    14  RS232    15  RS232    16  RS232
17  Fiber    18  Fiber    19  Fiber    20  Fiber
21  Fiber    22  Fiber    23  Fiber    24  Fiber
25  None     26  None     27  None     28  None
29  None     30  None     31  None     32  None
The Fiber Optic Loop is operating

REMOTE> _
```

Figure 10-1. Typical diagnostic test display for an RFL 9660 equipped with a 14.4 Kbit modem

10.5 HOW TO ARRANGE FOR SERVICE

The RFL 9660 Digital Switch is designed for years of trouble-free service. If a malfunction occurs involving the RFL 9660, use standard troubleshooting techniques to determine if the problem is in the RFL 9660, or in some other connected equipment. If the problem lies within the RFL 9660, it must be returned for repair. Contact our Customer Service Department using the telephone number listed at the bottom of this page. You will be given an authorization number and shipping instructions.

Section 11. GOVERNMENT REGULATIONS

FCC (United States)

As of the date of manufacture, the RFL 9660's modem is compatible with the telephone company communications facilities with which it was intended to operate. However, if the telephone company changes its communications facilities, equipment, operations, or procedures such that this equipment is no longer compatible, RFL Electronics Inc. is not responsible for the cost of modification or replacement of the modem.

Before installation, the telephone company must be notified of the intended installation. You also must provide the telephone company with the modem FCC registration number (AU7USA-25814-M5-E) and ringer equivalence number (0.3B). A Universal Service Order Code (USOC) number for the RJ-11 telephone service jack must be specified for installation by the telephone company.

The FCC does not allow the RFL 9660's modem to be connected to party lines or coin lines.

If there are problems with the modem or you suspect a malfunction, immediately disconnect the modem from the communications facility. Do not reconnect the modem to the communications facility until the malfunction is corrected or you can determine that the modem is operating properly. The telephone company can, at its option, discontinue service to a malfunctioning modem if the modem is causing harm to the telephone network. Once this malfunction is corrected, service can be restored.

The RFL 9660's modem can be repaired only by RFL Electronics Inc. or one of its authorized agents.

DOC (Canada)

The RFL 9660 modem meets all of the requirements of the Canadian Department Of Communications.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment also must be installed using an acceptable method of connection. If necessary, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by RFL Electronics Inc. Any repairs or alterations made by the user to the equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas. **Users should not attempt to make such connections themselves, but should contact the appropriate electrical inspection authority, or an electrician, as appropriate.**

The Ringer Equivalence Number (REN) of the RFL 9660 modem is as follows: 0.3B. Note that if several devices are connected to the same line, the RENs must not add up to more than 5.0 (A or B). This REN figure is important to your telephone company.

Section 12. PORT ASSIGNMENTS

Each device you connect to the RFL 9660 has its own communication parameter settings. These parameters include baud rate (speed), number of data bits (word length), number of stop bits, and parity (odd, even, or none). You will need to know what the proper settings are for each device before you can use the configuration procedures in Section 3.

The total number of device ports and their port numbers are determined by the I/O modules installed at the rear of the RFL 9660. (See Table 12-1).

NOTE

I/O modules must be installed in the RFL 9660 from bottom to top. If the RFL 9660 is equipped with one or more RS-232 I/O modules and a fiber optic master I/O module, the fiber optic master I/O module must be installed on top.

Table 12-1. Device port totals and port numbers, RFL 9660 Digital Switch

Number Of RS-232 I/O Modules	Number Of Fiber Optic Master I/O Modules	RS-232 Device Port Numbers	Fiber Optic Device Port Numbers
0	1	. . .	1 to 32
1	0	1 to 8	. . .
	1	1 to 8	9 to 32
2	0	1 to 16	. . .
	1	1 to 16	17 to 32
3	0	1 to 24	. . .
	1	1 to 24	25 to 32
4	0	1 to 24	. . .

As you connect each device to the RFL 9660, write its make and model in the column in table 12-2 for its port. When you have all the devices connected, refer to their manuals for the information needed to fill in the other lines in the table.

Table 12-2. Device port assignments, RFL 9660 Digital Substation Switch

Port Number	1	2	3	4	5	6	7	8
Interface								
Baud Rate								
Data Bits								
Parity								
Stop Bits								
Port Flow Control								
Local Port DTR								
Local Flow Ctrl								
Call Out								
Call Request								
Call Priority (0 - 9)								
Call String								
Remote String								
Port String								
Modem String								
Port Password								

Table 12-2. Device port assignments, RFL 9660 Digital Substation Switch - continued.

Port Number	9	10	11	12	13	14	15	16
Interface								
Baud Rate								
Data Bits								
Parity								
Stop Bits								
Port Flow Control								
Local Port DTR								
Local Flow Ctrl								
Call Out								
Call Request								
Call Priority (0 - 9)								
Call String								
Remote String								
Port String								
Modem String								
Port Password								

Table 12-2. Device port assignments, RFL 9660 Digital Substation Switch - continued.

Port Number	17	18	19	20	21	22	23	24
Interface								
Baud Rate								
Data Bits								
Parity								
Stop Bits								
Port Flow Control								
Local Port DTR								
Local Flow Ctrl								
Call Out								
Call Request								
Call Priority (0 - 9)								
Call String								
Remote String								
Port String								
Modem String								
Port Password								

Table 12-2. Device port assignments, RFL 9660 Digital Substation Switch - continued.

Port Number	25	26	27	28	29	30	31	32
Interface								
Baud Rate								
Data Bits								
Parity								
Stop Bits								
Port Flow Control								
Local Port DTR								
Local Flow Ctrl								
Call Out								
Call Request								
Call Priority (0 - 9)								
Call String								
Remote String								
Port String								
Modem String								
Port Password								

Section 13. MODEM "AT" COMMANDS AND "S" REGISTERS

NOTE

The command and register descriptions in this section are provided for informational purposes only, since the RFL 9660 modem is set up at the factory.

13.1 INTRODUCTION

This section describes the "AT" commands that are used to control the RFL 9660 modem module. The "S" registers that store values used by many of the "AT" commands are also described in this section.

The AT Command Set is used by the RFL 9660 local port to communicate with modems. A typical command string begins with the ASCII “A” and “T” or “a” and “t”. The modem uses these first two characters to determine the data rate, number of bits, and type of parity which the RFL 9660 is employing in its communication. The modem then buffers the command string in its RAM until a carriage return [CR] or [ENTER] is transmitted. Once the [CR] is received, the modem begins to execute in order, all of the commands in the string. The number of characters in this string should not exceed 40. If the modem encounters an illegal command, a command that cannot be executed, or more than 40 characters, it immediately aborts the execution of the command string and issues an ERROR message to the RFL 9660. If the command string is proper, the modem will execute all commands and send an OK message to the RFL 9660.

The modem has one factory default profile and one additional user profile that can be programmed into its non-volatile memory. To configure the modem to one of these profiles, issue the command:

AT&F0[CR] for the factory default profile; or
ATZ0[CR] for the user profile

To store or recall a user profile, use the following commands: Zn, &Wn, or &V, (These commands are discussed in detail later in this section). In each of the the following command descriptions, the default setting for the factory profile is indicated where applicable.

Modems are always in one of two modes of operation. The modem enters into Data Mode once a connection has been established with a remote modem. In Data Mode, any data transmitted from the RFL 9660 to the remote modem is first modulated and then transmitted to the remote modem; and similarly, any data that the remote modem transmits to the RFL 9660 has been received from the remote modem and is then demodulated. The modem can be in Data Mode only when the modem has established a communications link with a remote modem (The only exception to this is during diagnostic tests - See &Tn commands). At all other times, the modem is in Command Mode. When in Command Mode, the modem will respond to AT commands issued from the RFL 9660 local port.

While in Data Mode, if it is necessary to issue commands to the modem without severing the communications link to the remote modem, an escape sequence may be issued to the modem.

Refer to Section 13.2.2 for more information.

13.2 “AT” COMMANDS

13.2.1 “AT” Command Format

A command line is a string of characters sent from a DTE to the modem (DCE) while the modem is in a command state. A command line has a prefix, a body, and a terminator. Each command line (with the exception of the A/command) must begin with the character sequence AT and must be terminated by a carriage return. Commands entered in upper case or lower case are accepted, but both the A and T must be of the same case, i.e., “AT” = ASCII 065, 084 or “at” = ASCII 097, 116. The body is a string of commands restricted to printable ASCII characters (032-126). Space characters (ASCII 032) and control characters other than CR (ASCII 013) and BS (ASCII 010) in the command string are ignored. The default terminator is the ASCII <CR> character. Characters that precede the AT prefix are ignored. The command line interpretation begins upon receipt of the carriage return character.

Characters within the command line are parsed as commands with associated parameter values. The basic commands consist of single ASCII characters, or single characters preceded by a prefix character (e.g., “&”), followed by a decimal parameter. Missing decimal parameters are evaluated as 0.

The modem supports the editing of command lines by recognizing a backspace character. When modem echo is enabled, the modem responds to receipt of a backspace or delete by echoing a backspace character, a space character, and another backspace. The hex value to be used for the backspace character is programmable through register S5. Values equal to 0 or greater than 127, or the value which corresponds to the carriage return character, cannot be used for the backspace character. This editing is not applicable to the AT header of a command. A command line may be aborted at any time by entering <cntrl-x> (18h).

The AT sequence may be followed by any number of commands in sequence, except for commands such as Z, D, or A. Commands following commands Z, D, or A on the same command line will be ignored. The maximum number of characters on any command line is 39 (including “A” and “I”). If a syntax error is found anywhere in a command line command, the remainder of the line will be ignored and the ERROR result code will be returned.

Most commands entered with parameters out of range will not be accepted and the ERROR response will be returned to the DTE.

Commands will only be accepted by the modem once the previous command has been fully executed, which is normally indicated by the return of an appropriate result code. Execution of commands D and A, either as a result of a direct command or a re-execute command, will be aborted if another character is entered before completion of the handshake.

13.2.2 Escape Code Sequence

When the modem has established a connection and has entered on-line data mode, it is possible to break into a data transmission in order to issue further commands to the modem in an on-line command mode. This is achieved by the 9660 sending the following sequence to the modem:

+++AT [CR].

The first three characters of the sequence is determined by the value of register S2. The default value of register F2 is 43 (+). The modem can be returned to the data mode by entering ATO [CR].

To disable the local escape sequence, enter the command ATS2=128.

The remote modem can also break into the data transmission to issue commands to the 9660 modem. This is achieved by the remote modem sending the following sequence:

%%%ATMTSMODEM [CR].

The first three characters of the sequence are specified by register S9. The default value of register S9 is 37 (%). The modem can be returned to the data modem by entering ATO [CR]. To disable the remote escape code sequence, enter the command ATS9=0.

13.2.3 "AT" Command Summary

Organization of AT Commands on the following pages: 1st, by the initial command character (&, +, %) 2nd, alphabetized by the second command character (Except for listing of **AT**).

Command	Description
AT	Attention Code
A	Answer
A/	Repeat Last Command
B*n*	Communication Standard Setting
D*s*	Dial
DS=*y*	Dial Stored Telephone Number
E*n*	Echo Command Mode Characters
F*n*	Echo Online Data Characters
H*n*	Hook Control
I*n*	Information Request
M*n*	Monitor Speaker Mode
N*n*	Modulation Handshake
O*n*	Return Online to Data Mode
P	Pulse Dialing
Q*n*	Result Codes Enable/Disable
S*r*=*n*	Set Register Value
S*r*?	Read Register Value
T	Tone Dialing
V*n*	Result Code Format
W*n*	Result Code Options
X*n*	Result Code Selection
Z*n*	Modem Reset
&C*n*	Data Carrier Detect (DCD) Control
&D*n*	Data Terminal Ready (DTR) Control
&E*n*	XON/XOFF Pass-Through
&F*n*	Load Factory Settings
&G*n*	V.22bis Guard Tone Control
&K*n*	Flow Control Selection
&L*n*	Leased Line Operation
&P*n*	Pulse Dial Make-to-Break Ratio Selection
&Q*n*	Asynchronous Communications Mode
&S*n*	Data Set Ready (DSR) Control
&T*n*	Loopback Test (V.54 Test) Commands
&V	Display Current Settings
&W*n*	Store Current Configuration
&Zy=*x*	Store Dialing Command
\A*n*	Select Maximum MNP Block Size
\B*n*	Transmit Break
\K*n*	Break Control
\N*n*	Error Correction Mode Selection
\Q*n*	Flow Control Selection
\T*n*	Inactivity Timer
\V*n*	Protocol Result Code
-C*n*	Data Calling Tone
%A	Adaptive Answer Result Code Enable
%B	View Numbers in Blacklist
%C*n*	Data Compression Control
%DC*n*	AT Command Control
%E*n*	Fallback and Fall Forward Control
%H*n*	Direct Connect Enable
%R*n*	Cisco Configuration
%S*n*	Command Speed Response
$EB*n*	Asynchronous Word Length

Command	Description
$D*n*	DTR Dialing
$MB*n*	Online BPS Speed
$SB*n*	Serial Port Baud Rate
#CBA*n*	Callback Attempts
#CBD*n*	Callback Delay
# CBF?	Callback Failed Attempts Display
# CBFR	Callback Failed Attempts Reset
# CBI*n*	Local Callback Inactivity Timer
# CBN*y*=*n*	Store Callback Password
# CBP*n*	Callback Parity
# CBR*y*	Callback Security Reset
# CBS*n*	Callback Enable/Disable
#P*n*	Set 11-bit Parity
#S*x*	Enter Setup Password
#S=*x*	Store Setup Password
+VDR=*x, y*	Distinctive Ring Report
+++AT<CR>	Escape Sequence
%%%ATMTSMODEM<CR>	Remote Configuration Escape Sequence
V.92 Commands	

13.2.4 "AT" Commands

Command: AT **Attention Code**
Values: N/A
Description: The attention code precedes all command lines except **A/**, **A:** and escape sequences.

Command: **ENTER Key**
Values: N/A
Description: Press the ENTER (RETURN) key to execute most commands.

Command: A **Answer**
Values: N/A
Description: Answer call before final ring.

Command: A/ **Repeat Last Command**
Values: N/A
Description: Repeat the last command string. Do not precede this command with AT. Do not press ENTER to execute.

Command: B*n* **Communication Standard Setting**
Values: *n* = 0–3, 15, 16
Default: 0 and 15
Description:

B0	Select ITU-T V.22 mode when modem is at 1200 bps.
B1	Select Bell 212A when modem is at 1200 bps.
B2	Deselect V.23 reverse channel (same as **B3**).
B3	Deselect V.23 reverse channel (same as **B2**).
B15	Select V.21 when the modem is at 300 bps.
B16	Select Bell 103J when the modem is at 300 bps.

Command: Ds Dial

Values: *s* = dial string (phone number and dial modifiers)

Default: none

Description: Dial telephone number *s*, where *s* may up to 40 characters long and include the 0–9, *, #, , B, C, and D characters, and the L, P, T, V, W, S, comma (,), semicolon (;), !, @, ^ and $ dial string modifiers.

Dial string modifiers:

L Redial last number. (Must be placed immediately after **ATD**.)

P Pulse-dial following numbers in command.

T Tone-dial following numbers in command (default).

V Switch to speakerphone mode and dial the following number. Use **ATH** command to hang up.

W Wait for a new dial tone before continuing to dial.(**X2**, **X4**, **X5**, **X6**, or **X7** must be selected.)

, Pause during dialing for time set in register S8.

; Return to command mode after dialing. (Place at end of dial string.)

! Hook flash. Causes the modem to go on-hook for one-half second, then off-hook again.

@ Wait for quiet answer. Causes modem to wait for a ringback, then 5 seconds of silence, before processing next part of command. If silence is not detected, the modem returns a NO ANSWER code.

^ Disable data calling tone transmission.

$ Detect AT&T call card “bong” tone. The character should follow the phone number and precede the user’s call card number:
ATDT10288061278535O0$123456789

Command: DS=*y* Dial Stored Telephone Number

Values: *n* = 0–2 (0–1 for SMI-Parallel {internal})

Default: none

Description: Dial a number previously stored in directory number *y* by the **&Zy=x** command.
Example: **ATDS=2**

Command: E*n* Echo Command Mode Characters

Values: *n* = 0 or 1

Default: 1

Description:
E0 Do not echo keyboard input to the terminal.
E1 Do echo keyboard input to the terminal.

Command: F*n* Echo Online Data Characters

Values: *n* = 1

Default: 1

F0 Enable online data character echo. (Not supported.)

F1 Disable online data character echo (included for backward compatibility with some software).

Command: H*n* Hook Control

Values: *n* = 0 or 1
Default: 0
Description:
H0 Go on-hook (hang up).
H1 Go off-hook (make the phone line busy).

Command: I*n* Information Request

Values: *n* = 0–5, 9, 11
Default: None
Description:
I0 Display default speed and controller firmware version.
I1 Calculate and display ROM checksum (e.g., *12AB*).
I2 Check ROM and verify the checksum, displaying *OK* or *ERROR*.
I3 Display default speed and controller firmware version.
I4 Display firmware version for data pump (e.g., 94).
I5 Display the board ID: software version, hardware version, and country ID
I9 Display the country code (e.g., *NA Ver. 1*).
I11 Display diagnostic information for the last modem connection, such as DSP and firmware version, link type, line speed, serial speed, type of error correction/data compression, number of past retrains, etc.

Command: M*n* Monitor Speaker Mode

Values: *n* = 0, 1, 2, or 3
Default: 1
Description:
M0 Speaker always off.
M1 Speaker on until carrier signal detected.
M2 Speaker always on when modem is off-hook.
M3 Speaker on until carrier is detected, except while dialing.

Command: N*n* Modulation Handshake

Values: *n* = 0 or 1
Default: 1
Description:
N0 Modem performs handshake only at communication standard specified by S37 and the B command.
N1 Modem begins handshake at communication standard specified by S37 and the B command. During handshake, fallback to a lower speed can occur.

Command: O*n* Return Online to Data Mode

Values: 0, 1, 3
Default: None
Description:
O0 Exit online command mode and return to data mode (see *+++AT<CR>* escape sequence).
O1 Issue a retrain and return to online data mode.
O3 Issue a rate renegotiations and return to data mode.

Command: **P** **Pulse Dialing**

Values: P, T

Default: T

Description: Configures the modem for pulse (non-touch-tone) dialing. Dialed digits are pulsed until a **T** command or dial modifier is received.

Command: **Q*n*** **Result Codes Enable/Disable**

Values: *n* = 0 or 1

Default: 0

Description:
Q0 Enable result codes.
Q1 Disable result codes.
Q2 Returns an *OK* for backward compatibility with some software.

Command: **Sr=*n*** **Set Register Value**

Values: *r* = S-register number; *n* varies

Default: None

Description: Set value of register S*r* to value of *n*, where *n* is entered in decimal format (e.g., S0=1).

Command: **Sr?** **Read Register Value**

Values: *r* = S-register number

Default: None

Description: Read value of register **S*r*** and display it in 3-digit decimal form (e.g., **S2?** gives the response *043)*.

Command: **T** **Tone Dialing**

Values: P, T

Default: T

Description: Configures the modem for DTMF (touch-tone) dialing. Dialed digits are tone dialed until a **P** command or dial modifier is received.

Command: **V*n*** **Result Code Format**

Values: *n* = 0 or 1

Default: 1

Description:
V0 Displays result codes as digits (terse response).
V1 Displays result codes as words (verbose response).

Command: **W*n*** **Result Code Options**

Values: *n* = 0, 1, or 2

Default: 2

Description:
W0 CONNECT result code reports serial port speed, disables protocol result codes.
W1 CONNECT result code reports serial port speed, enables protocol result codes.
W2 CONNECT result code reports line speed, enables protocol result codes.

Command: ***Xn*** **Result Code Selection**

Values: *n* = 0–7

Default: 4

Description:

X0 Basic result codes (*CONNECT*); does not look for dial tone or busy signal.

X1 Extended result codes (*CONNECT 46000 V42bis*); does not look for dial tone or busy signal.

X2 Extended result codes with *NO DIALTONE*; does not look for busy signal.

X3 Extended result codes with *BUSY*; does not look for dial tone.

X4 Extended result codes with *NO DIALTONE* and *BUSY*.

X5 Extended result codes with *NO DIALTONE* and *BUSY*.

X6 Extended result codes with *NO DIALTONE* and *BUSY*.

X7 Basic result codes with *NO DIALTONE* and *BUSY*.

Command: ***Zn*** **Modem Reset**

Values: *n* = 0 or 1

Default: None

Description:

Z0 Reset modem to profile saved by the last **&W** command.

Z1 Same as **Z0**.

Command: ***&Cn*** **Data Carrier Detect (DCD) Control**

Values: *n* = 0, 1, 2

Default: 1

Description

&C0 Forces the DCD circuit to be always ON.

&C1 DCD goes ON when the remote modem's carrier signal is detected, and goes OFF when the carrier signal is not detected.

&C2 DCD turns OFF upon disconnect for time set by S18. It then goes high again (for some PBX phone systems).

Command: ***&Dn*** **Data Terminal Ready (DTR) Control**

Values: *n* = 0, 1, 2, or 3

Default: 2

Description

&D0 Modem ignores true status of DTR signal and responds as if it is always on.

&D1 If DTR drops while in online data mode, the modem enters command mode, issues an *OK*, and remains connected.

&D2 If DTR drops while in online data mode, the modem hangs up. If the signal is not present, the modem will not answer or dial.

&D3 If DTR drops, modem hangs up and resets as if **ATZ** command were issued.

Command: ***&En*** **XON/XOFF Pacing Control**

Values: *n* = 12 or 13

Default: 12

Description

&E12 Disables XON/XOFF pacing.

&E13 Enables XON/XOFF pacing.

Command: ***&Fn*** **Load Factory Settings**

Values: *n* = 0

Default: None

Description: &F0 Load factory settings as active configuration.

Note: See also the **Z** command.

Command: ***&Gn*** **V.22bis Guard Tone Control**

Values: *n* = 0, 1, or 2

Default: 0

Description:
&G0 Disable guard tone.
&G1 Set guard tone to 550 Hz.
&G2 Set guard tone to 1800 Hz.

Note: The **&G** command is not used in North America.

Command: ***&Kn*** **Flow Control Selection**

Values: *n* = 0, 3, or 4

Defaults: 3

Description:
&K0 Disable flow control.
&K3 Enable CTS/RTS hardware flow control.
&K4 Enable XON/XOFF software flow control.

Command: ***&Ln*** **Leased Line Operation**

Values: *n* = 0, 1, or 2

Defaults: 0

Description:
&L0 The modem is set for standard dial-up operation.
&L1 The modem is set for leased line operation in originate mode.
&L2 The modem is set for leased line operation in answer mode.

Note: For **&L1** and **&L2**, there is a 30-second window between power up and the starting of the leased line handshake. During this time, you can turn off the command, if desired.

Command: ***&Pn*** **Pulse Dial Make-to-Break Ratio Selection**

Values: *n* = 0, 1, or 2

Default: 0

Description:
&P0 60/40 make-to-break ratio
&P1 67/33 make-to-break ratio
&P2 20 pulses per second

Note: The **&P2** command is available only if the country code is set to Japan.

Command: ***&Qn*** **Asynchronous Communications Mode**

Values: *n* = 0, 5, 6, 8, or 9

Default: 5

Description

&Q0 Asynchronous with data buffering. Same as **\N0**.

&Q5 Error control with data buffering. Same as **\N3**.

&Q6 Asynchronous with data buffering. Same as **\N0**.

&Q8 MNP error control mode. If MNP error control is not established, the modem falls back according to the setting in **S36**.

&Q9 V.42 or MNP error control mode. If neither error control is established, the modem falls back according to the setting in **S36**.

Command: ***&Sn*** **Data Set Ready (DSR) Control**

Values: *n* = 0 or 1

Default: 0

Description

&S0 DSR is always ON.

&S1 DSR goes ON only during a connection.

Command: ***&Tn*** **Loopback Test (V.54 Test) Commands** Values: *n* = 0, 1, 3, 6

Default: None

Description

The modem can perform selected test and diagnostic functions. A test can be run only when the modem is operating in non-error-correction mode (normal or direct mode). For tests 3 and 6, a connection between the two modems must be established. To terminate a test in progress, the escape sequence (**+++AT**) must be entered.

&T0 Stops any test in progress.

&T1 Starts a local analog loopback, V.54 Loop 3, test. If a connection exists when this command is issued, the modem hangs up. When the test starts, a *CONNECT* message is displayed.

&T3 Starts local digital loopback, V.54 Loop 2, test. If no connection exists, *ERROR* is returned.

&T6 Initiates a remote digital loopback, V.54 Loop 2, test without self-test. If no connection exists, *ERROR* is returned.

Command: ***&V*** **Display Current Settings**

Values: N/A

Description: Displays the active modem settings.

Command: ***&Wn*** **Store Current Configuration**

Values: *n* = 0 or 1

Default: 1

Description:

&W0 Stores current modem settings in non-volatile memory and causes them to be loaded at power-on or following the **ATZ** command instead of the factory defaults. See **&F** command.

&W1 Clears user default settings from non-volatile memory and causes the factory defaults to be loaded at power-on or following the **ATZ** command.

Command: **&Zy=*x*** **Store Dialing Command**

Values: *y* = 0–2 (0–1SMI-Parallel {internal})
x = Dialing command

Default: None

Description: Stores dialing command *x* in memory location *y*. Dial the stored number using the command **ATDS=y**. See Also the #CBS command, a callback security command.

Command: **\A*n*** **Select Maximum MNP Block Size**

Values: *n* = 0, 1, 2, or 3

Default: 3

Description:
\A0 64-character maximum
\A1 128-character maximum
\A2 192-character maximum
\A3 256-character maximum

Command: **\B*n*** **Transmit Break**

Values: *n* = 0–9 in 100 ms units

Default: 3

Description: In non-error-correction mode only, sends a break signal of the specified length to a
remote modem. Works in conjunction with the ***\K*** command.

Command: **\K*n*** **Break Control**

Values: *n* = 0–5

Default: 5

Description: Controls the modem's response to a break received from: computer, remote modem, or **\B** command. Response is different for each of three different states.

Data mode. Modem receives the break from the computer:
\K0 Enter online command mode, no break sent to the remote modem.
\K1 Clear data buffers and send break to the remote modem.
\K2 Same as **\K0**.
\K3 Send break immediately to the remote modem.
\K4 Same as **\K0**.
\K5 Send break to the remote modem in sequence with the transmitted data.

Data mode. Modem receives the break from the remote modem:
\K0 Clear data buffers and send break to the computer.
\K1 Same as **\K0**.
\K2 Send break immediately to the compute.
\K3 Same as **\K2**.
\K4 Send break to the computer in sequence with the received data.
\K5 Same as **\K4**.

Online command mode. Modem receives a \Bn command from the computer:
\K0 Clear data buffers and send break to the remote modem.
\K1 Same as **\K0**.
\K2 Send break immediately to the remote modem.
\K3 Same as **\K2**.
\K4 Send break to the remote modem in sequence with the transmitted data.
\K5 Same as **\K4**.

Command: **\N*n*** **Error Correction Mode Selection**

Values: *n* = 0–5, or 7

Default: 3

Description:

\N0 Non-error correction mode with data buffering (buffer mode; same as **&Q6**).

\N1 Direct mode. \N2 MNP reliable mode. If the modem cannot make an MNP connection, it disconnects.

\N2 MNP reliable mode. If the modem cannot make an MNP connection, it disconnects.

\N3 V.42/MNP auto-reliable mode. The modem attempts first to connect in V.42 error correction mode, then in MNP mode, and finally in non-error correction (buffer) mode with continued operation.

\N4 V.42 reliable mode. If the modem cannot make a V.42 connection, it disconnects.

\N5 V.42, MNP, or non-error correction (same as **\ N3**).

\N7 V.42, MNP, or non-error correction (same as **\ N3**).

Command: **\Q*n*** **Flow Control Selection**

Values: n = 0, 1, or 3

Default: 3

Description:

\Q0 Disable flow control (same as **&K0**).

\Q1 XON/XOFF software flow control (same as **&K4**).

\Q2 CTS-only flow control. Not supported.

\Q3 RTS/CTS hardware flow control (same as **&K3**)

Command: **\Tn** **Inactivity Timer**

Values: n = 0, 1–255

Default: 0

Description: Sets the time (in minutes) after the last character is sent or received that the modem waits before disconnecting. A value of zero disables the timer. Applies only in buffer mode.

Note: You can also set the inactivity timer by changing the value of **S30**.

Command: **\Vn** **Protocol Result Code**

Values: n = 0, 1, or 2

Default: 1

Description:

\V0 Disables the appending of the protocol result code to the DCE speed.

\V1 Enables the appending of the protocol result code to the DCE speed.

\V2 Same as **\V1**.

Command: **\X*n*** **XON/XOFF Pass-Through**

Values: *n* = 0 or 1

Default: 0

Description:

\X0 Modem responds to and discards XON/XOFF characters.

\X1 Modem responds to and passes XON/XOFF characters.

Note: This is also controlled via **&E6** and **&E7.**

Command: **-C*n*** **Data Calling Tone**

Values: *n* = 0 or 1

Defaults: 1

Description:

-C0 Disable V.25 data calling tone to deny remote data/fax/voice discrimination.

-C1 Enable V.25 data calling tone to allow remote data/fax/voice discrimination.

Command: **%A** **Adaptive Answer Result Code Enable**

Values: *n* = 0 or 1

Default: 0

Description: The %A command controls whether the DATA or FAX result codes will be sent by the modem. The modem must be in fax mode for this command to work. Also, the modem must be set to **+FAA=1**, which enables the modem to distinguish between a fax and a data call. When these commands are enabled, the modem sends DATA to the computer when it detects data tones and FAX when it detects fax tones. These strings are used by some servers to select the appropriate communication program.

%A0 Disables adaptive answer result codes.

%A1 Enables adaptive answer result codes.

Command: **%B** **View Numbers in Blacklist**

Values: N/A

Description: If blacklisting is in effect, **AT%B** displays the numbers for which the last call attempted in the previous two hours failed. In countries that do not require blacklisting, the *ERROR* result code appears.

Command: **%C*n*** **Data Compression Control**

Values: *n* = 0 or 1

Default: 1

Description: %C0 Disable V.42bis/MNP 5 data compression.

%C1 Enable V.42bis/MNP 5 data compression.

Command: **%DC*n*** **AT Command Control**

Values: *n* = 0 or 1

Default: 0

Description: %DC0 The modem responds to AT commands.

%DC1 The modem ignores AT commands.

Note: The modem will respond to **AT%DC** for 10 seconds after power-up.

Command: **%E*n*** **Fallback and Fall Forward Control**

Values: *n* = 0, 1, or 2

Default: 2

Description: %E0 Disable fallback and fall forward.

%E1 Enable fallback, disable fall forward.

%E2 Enable fallback and fall forward.

Command: **%H*n*** **Direct Connect Enable**

Values: *n* = 0, 1

Default: 0

Description: %H0 Sets callback security to normal operation.

%H1 All callback security calls will be direct connect regardless of whether the password or phone number has the **-** character.

Command: **%R*n*** **Cisco Configuration**

Values: *n* = 0, 1

Default: 0

Description: %R0 Disables Cisco configuration.

%R1 Sets **E0**, **Q1**, **&D0**, **\N0**, **$SB9600**, and **%S1** for operation with a Cisco router.

Command: **%S*n*** **Command Speed Response**

Values: *n* = 0, 1

Default: 0

Description:

%S0 Sets modem to respond to AT commands at all normal speeds.

%S1 AT commands accepted at 115200 bps only. Commands at other speeds are ignored.

Command: **$D*n*** **DTR Dialing**

Values: *n* = 0 or 1

Default: 0

Description:

$D0 Disables DTR dialing.

$D1 Dials the number in memory location 0 when DTR goes high.

Command: **$EB*n*** **Asynchronous Word Length**

Values: *n* = 0 or 1

Default: 0

Description:

$EB0 Enables 10-bit mode.

$EB1 Enables 11-bit mode.

Command: **$MB*n*** **Online BPS Speed**

Values: *n* = speed in bits per second

Default: 28,800

Description:

$MB75 Selects CCITT V.23 mode

$MB300 Selects 300 bps on-line

$MB1200 Selects 1200 bps on-line

$MB2400 Selects 2400 bps on-line

$MB4800 Selects 4800 bps on-line

$MB9600 Selects 9600 bps on-line

$MB14400 Selects 14400 bps on-line

$MB19200 Selects 19200 bps on-line

$MB28800 Selects 28800 bps on-line

$MB33600 Selects 33600 bps on-line

Command: **$RP*n*** **Ring Priority vs. AT Command Priority**

Values: *n* = 0 or 1

Default: 1

Description:

$RP0 The AT command will have priority over the ring. S1 will be reset to 0 if an AT command is received. This command is storable to memory.

$RP1 The ring will have priority over the AT command. S1 will increment even if an AT command and ring are received together and the incoming call will be answered when S1 is equal to S0.

Note: SocketModems do not detect ring cadence of TelTone telephone line simulators as a valid ring.

Command: **$SB*n*** **Serial Port Baud Rate**

Values: *n*= speed in bits per second

Default: 57600

Description:

$SB300 Sets serial port to 300 bps
$SB1200 Sets serial port to 1200 bps
$SB2400 Sets serial port to 2400 bps
$SB4800 Sets serial port to 4800 bps
$SB9600 Sets serial port to 9600 bps
$SB19200 Sets serial port to 19200 bps
$SB38400 Sets serial port to 38400 bps
$SB57600 Sets serial port to 57600 bps
$SB115200 Sets serial port to 115200 bps
$SB230400 Sets serial port to 230400 bps

Command: **+VDR= x, y** **Distinctive Ring Report**

Values: x = 0, 1 Distinctive Ring report control. See description.
y = 0–255 Minimum ring interval in 100 ms units. See description.

Default: 0, 0

Description: Enables reporting of ring cadence information to the DTE and specifies the minimum ring cadence that will be reported.

The report format is one line per silence period and one line per ring period. The length of the silence period is in the form DROF=number in units of 100 ms<CR><LF>, and the length of the ring is in the form DRON=number in units of 100 ms<CR> <LF>. The modem may produce a Ring event code after the DRON message if enabled by the y parameter. The y parameter must be set to a value equal to or smaller than the expected ring cadence in order to pass the report to the DTE.

+VDR=0, N/A Disables Distinctive Ring cadence reporting.
+VDR=1, 0 Enables Distinctive Ring cadence reporting. Other call progress result codes (including RING) are reported as normal.
+VDR=1, >0 Enables Distinctive Ring cadence reporting. The RING result code is reported after the falling edge of the ring pulse (i.e., after the DRON report).
+VDR=? Displays the allowed values.
+VDR? Displays the current value.

Command: **#CBAn** **Callback Attempts**

Values: n = 1–255

Default: 4

Description: Sets the number of callback attempts that are allowed after passwords have been exchanged between modems.

Command: **#CBDn** **Callback Delay**

Values: n = 0–255

Default: 15

Description: Sets the length of time (in seconds) that the modem waits before calling back the remote modem.

Command: **#CBF?** **Callback Failed Attempts Display**

Values: N/A

Default: N/A

Description: Requests the number of failed callback passwords since reset or power-up. This number can be stored to nonvolatile memory using the **&W** command.

Command: **#CBFR** **Callback Failed Attempts Reset**

Values: N/A

Default: N/A

Description: Resets the number of failed callback passwords to 0. This does not reset the number stored in nonvolatile memory.

Command: **#CBIn** **Local Callback Inactivity Timer**

Values: n = 1–255

Default: 20

Description: Sets the time (in minutes) that the modem waits for a command before forcing the user to enter the setup password again.

Command: **#CBNy =x** **Store Callback Password**

Values: y = 0–29

Default: x = password

Description: None

Sets the callback security password for the y memory location. The password must have 6 to 10 characters, and cannot include the + or - characters.

Command: **#CBPn** **Callback Parity**

Values: n = 0, 1, or 2

Default: 0

Description: Sets parity for the callback security messages.

#CBP0 No parity.

#CBP1 Odd parity.

#CBP2 Even parity.

Command: **#CBRy** **Callback Security Reset**

Values: y = 0–29

Default: None

Description: Clears the password and phone number in the **y** memory location.

Command: **#CBSn** **Callback Enable/Disable**

Values: n = 0, 1, 2, or 3

Default: 0

Description:
#CBS0 Disables callback security.
#CBS1 Enables local and remote callback security.
#CBS2 Enables remote callback security only.
#CBS3 Disables callback security until local hang-up or reset.

Command: **#Pn** **Set 11-bit Parity**

Values: n = 0, 1 or 2

Default: 2

Description:
#P0 No parity.
#P1 Odd parity.
#P2 Even parity.

Command: **#S*x*** **Enter Setup Password**

Values: *x*= password (1–8 characters, case sensitive)

Default: MTSMODEM

Description: Enters the remote configuration setup password.

Command: **#S=*x*** **Store Setup Password**

Values: *x*= password (1–8 characters, case sensitive)

Default: MTSMODEM

Description: Stores a new remote configuration setup password.

13.2.5 Escape “AT” Commands

Command: +++AT<CR> — **Escape Sequence**

Values: N/A

Description: Puts the modem in command mode (and optionally issues a command) while remaining online. Type **+++AT** and up to six optional command characters; then press ENTER. Used mostly to issue the hang-up command: **+++ATH<CR>**.

Command: %%%ATMTSMODEM<CR> — **Remote Configuration Escape Sequence**

Values: N/A

Description: Initiates remote configuration mode while online with remote modem. The remote configuration escape character (%) is defined in register **S13**.

13.3 V.92 Commands

Command: +MS= Modulation Selection

Values: See description.

Defaults: See description.

Description: This extended-format command selects modulation, enables or disables automode, and specifies the highest downstream and upstream connection rates using one to four subparameters.

The command syntax is
+MS=[mod][,[automode][,[0][,[max_rate][,[0][,[max_rx_rate]]]]]]<CR>
Subparameters that are not entered retain their current value. Commas separate optional subparameters, and must be inserted to skip a subparameter. Example: +MS=,0<CR> disables automode and keeps all other settings at their current values.

+MS=? Reports supported options in the format (list of supported mod values),(list of supported automode values),(0),(list of supported max_rate values),(0),(list of supported max_rx_rate values). Example: +MS: (BELL103, V21, BELL212A, V22, V22B, V23C, V32, V32B, V34, V90, V92), (0, 1), (0), (0-33600), (0), (0-56000)

+MS? Reports current options in the format mod, automode, 0, max_rate, 0, max_rx_rate. Example: +MS: V92, 1, 0, 31200, 0, 56000.

Subparameters

mod Specifies the preferred modulation (automode enabled) or the modulation to use in originating or answering a connection (automode disabled). The default is V92.

mod	**Modulation**	**Possible rates (bps)[1]**
V92[2]	V92	56000, 54666, 53333, 52000, 50666, 49333, 48000, 46666, 45333, 44000, 42666, 41333. 40000, 38666, 37333, 36000, 34666, 33333, 32000, 30666, 29333, or 28000
V903	V.90	56000, 54666, 53333, 52000, 50666, 49333, 48000, 46666, 45333, 44000, 42666, 41333. 40000, 38666, 37333, 36000, 34666, 33333, 32000, 30666, 29333, or 28000
V34	V.34	33600, 31200, 28800, 26400, 24000, 21600,19200, 16800, 14400, 12000, 9600, 7200, 4800, or 2400
V32B	V.32bis	14400, 12000, 9600, 7200, or 4800
V32	V.32	9600 or 4800
V22B	V.22bis	2400 or 1200
V22	V.22	1200
V23C	V.23	1200
V21	V.21	300
Bell212A	Bell 212A	1200
Bell103	Bell 103	300

Notes: 1. See optional <*automode*>, <*max_rate*>, and <*max_RX_rate*> subparameters. 2. Selects V.92 modulation as first priority. If a V.92 connection cannot be established, the modem attempts V.90, V.34, V.32bis, etc. 3. Selects V.90 modulation as first priority. If a V.90 connection cannot be established, the modem attempts V.34, V.32bis, etc.

automode An optional numeric value that enables or disables automatic modulation negotiation using V.8 bis/V.8 or V.32 bis Annex A. Automode is disabled if values are specified for the max_rate and max_rx_rate parameters. The options are:

0 Disable automode
1 Enable automode (default)

max_rate An optional number that specifies the highest rate at which the modem may establish an upstream (transmit) connection. The value is decimal coded in units of bps, for example, 33600 specifies the highest rate to be 33600 bps.

0 Maximum rate determined by the modulation selected in mod (default).

300–33600 Maximum rate value limited by the modulation selected in mod. For valid max_rate values for each mod value, see the following table.

***mod* value**	**Valid *max_rate* values (bps)**
V92, V90, V34	31200, 28800, 26400, 24000, 21600,19200, 16800, 14400, 12000, 9600, 7200, 4800, 2400
V32B	19200, 16800, 14400, 12000, 9600, 7200, 4800
V32	14400, 12000, 9600, 7200, 4800
V22B	2400
V22, V23C, Bell212A	1200
V21, Bell103	300

max_rx_rate An optional number that specifies the highest rate at which the modem may establish a downstream (receive) connection. The value is decimal coded in units of bps, e.g., 28800 specifies the highest rate to be 28800 bps.

0 Maximum rate determined by the modulation selected in mod (default).

300–56000 Maximum rate value limited by the modulation selected in *mod*. See “Possible rates” in the *mod* table.

Command: +PCW=n Call Waiting Enable
Values: n = 0, 1, or 2
Default: 2
Description: Controls the action to be taken upon detection of a call waiting tone in V.92 mode. Values specified by this command are not modified when an **AT&F** command is issued.
+PCW=0 Toggles V.24 Circuit 125 and collects Caller ID if enabled by +VCID
+PCW=1 Hangs up
+PCW=2 Ignores V.92 call waiting
+PCW=? Displays the allowed values
+PCW? Displays the current value

Command: +PIG=n PCM Upstream Ignore
Values: n = 0 or 1
Default: 1
Description: Controls the use of PCM upstream during V.92 operation. PCM upstream allows faster upload speeds to a V.92 server.
+PIG=0 Disables PCM upstream
+PIG=1 Enables PCM upstream
+PIG=? Displays the allowed values
+PIG? Displays the current value

Command: **+PMH=n** **Modem on Hold Enable**

Values: n = 0 or 1

Default: 1

Description: Controls if modem on hold procedures are enabled during V.92 operation. Normally controlled by a modem on hold program. Values specified by this command are not modified when an **AT&F** command is issued.

+PMH=0 Enables V.92 modem on hold
+PMH=1 Disables V.92 modem on hold
+PMH=? Displays the allowed values
+PMH? Displays the current value

Command: **+PMHF** **V.92 Modem Hook Flash**

Values: N/A

Default: N/A

Description: Causes the DCE to go on-hook for a specified period of time, and then return off-hook for at least a specified period of time. The specified period of time is normally one-half second, but may be governed by national regulations. “ERROR” is returned if MOH is not enabled.

Command: **+PMHR=n** **Modem on Hold Initiate**

Values: n = 0–13

Default: 0

Description: +PMHR is an action command that causes the modem to initiate MOH with the central site modem. It returns the following values to indicate what has been negotiated. Valid only if MOH is enabled and the modem is off-hook or in data mode. Otherwise, ERROR will be returned.

+PMHR=0 Deny MOH request
+PMHR=1 Grant MOH request with 10 second timeout
+PMHR=2 Grant MOH request with 20 second timeout
+PMHR=3 Grant MOH request with 30 second timeout
+PMHR=4 Grant MOH request with 40 second timeout
+PMHR=5 Grant MOH request with 1 minute timeout
+PMHR=6 Grant MOH request with 2 minute timeout
+PMHR=7 Grant MOH request with 3 minute timeout
+PMHR=8 Grant MOH request with 4 minute timeout
+PMHR=9 Grant MOH request with 6 minute timeout
+PMHR=10 Grant MOH request with 8 minute timeout
+PMHR=11 Grant MOH request with 12 minute timeout
+PMHR=12 Grant MOH request with 16 minute timeout
+PMHR=13 Grant MOH request with indefinite timeout
+PMHR=? Displays the allowed values
+PMHR? Displays the current value

Command: **+PMHT=n** **Modem on Hold Timer**

Values: *n* = 0–13

Default: 0

Description: Determines if the modem will accept a V.92 Modem on Hold (MOH) request and will set the MoH timeout.

+PMHT=0 Deny MOH request
+PMHT=1 Grant MOH request with 10 second timeout
+PMHT=2 Grant MOH request with 20 second timeout
+PMHT=3 Grant MOH request with 30 second timeout
+PMHT=4 Grant MOH request with 40 second timeout
+PMHT=5 Grant MOH request with 1 minute timeout
+PMHT=6 Grant MOH request with 2 minute timeout
+PMHT=7 Grant MOH request with 3 minute timeout
+PMHT=8 Grant MOH request with 4 minute timeout
+PMHT=9 Grant MOH request with 6 minute timeout
+PMHT=10 Grant MOH request with 8 minute timeout
+PMHT=11 Grant MOH request with 12 minute timeout
+PMHT=12 Grant MOH request with 16 minute timeout
+PMHT=13 Grant MOH request with indefinite timeout
+PMHT=? Displays the allowed values
+PMHT? Displays the current value

Command: **+PQC=n** **Quick Connect Control**

Values: n = 0, 1, 2, or 3

Default: 3

Description: Controls V.92 shortened Phase 1 and Phase 2 startup procedures (Quick Connect). When line conditions are stable, quick connect results in shortened connect times; however, significant fluctuation in line conditions from call to call can cause longer connect times; thus, it may be advisable to disable quick connect.

+PQC=0 Enables Short Phase 1 and Short Phase 2 (Quick Connect)
+PQC=1 Enables Short Phase 1
+PQC=2 Enables Short Phase 2
+PQC=3 Disables Short Phase 1 and Short Phase 2
+PQC=? Displays the allowed values
+PQC? Displays the current value

Command: +VCID=n **Caller ID Selection**

Values: n = 0, 1, or 2

Default: 0

Description: Enables Caller ID detection and configures the reporting and presentation of the Caller ID data that is detected after the first ring. The reported data includes the date and time of the call, the caller's name and number, and a message. Set S0=2.

+VCID=0 Disables Caller ID

+VCID=1 Enables Caller ID with formatted data

+VCID=2 Enables Caller ID with unformatted data

+VCID=? Displays the allowed values

+VCID? Displays the current value

Command: +VDR=x, y **Distinctive Ring Report**

Values: x = 0, 1 Distinctive Ring report control. See description.

y = 0–255 Minimum ring interval in 100 ms units. See description.

Default: 0, 0

Description: Enables reporting of ring cadence information to the DTE and specifies the minimum ring cadence that will be reported.

Report format is one line per silence period and one line per ring period. The length of the silence period is in the form DROF=number in units of 100 ms<CR><LF>, and the length of the ring is in the form DRON=number in units of 100 ms<CR> <LF>. The modem may produce a Ring event code after the DRON message if enabled by the y parameter. The *y* parameter must be set to a value equal to or smaller than the expected ring cadence in order to pass the report to the DTE.

+VDR=0,N/A	Disables Distinctive Ring cadence reporting.
+VDR=1, 0	Enables Distinctive Ring cadence reporting. Other call progress result codes (including RING) are reported as normal.
+VDR=1, >0	Enables Distinctive Ring cadence reporting. RING result code is reported after falling edge of the ring pulse (after the DRON report).
+VDR=?	Displays the allowed values.
+VDR?	Displays the current value.

Command: #CBAn **Callback Attempts**

Values: n = 1–255

Default: 4

Description: Sets the number of callback attempts that are allowed after passwords have been exchanged between modems.

Command: #CBDn **Callback Delay**

Values: n = 0–255

Default: 15

Description: Sets the length of time (in seconds) that the modem waits before calling back the remote modem.

Command: **#CBF?** **Callback Failed Attempts Display**

Values: N/A

Default: N/A -

Description: Requests the number of failed callback passwords since reset or power-up. This number can be stored to nonvolatile memory using the &W command.

Command: **#CBFR** **Callback Failed Attempts Reset**

Values: N/A

Default: N/A

Description: Resets the number of failed callback passwords to 0. This does not reset the number stored in nonvolatile memory.

Command: **#CBIn** **Local Callback Inactivity Timer**

Values: n = 1–255

Default: 20

Description: Sets the time (in minutes) that the modem waits for a command before forcing the user to enter the setup password again.

Command: **#CBNy=x** **Store Callback Password**

Values: y = 0–29
x = password

Defaults: None

Description: Sets the callback security password for the y memory location. The password must have 6 to 10 characters, and cannot include the + or - characters.

Command: **#CBPn** **Callback Parity**

Values: n = 0, 1, or 2

Default: 0

Description: Sets parity for the callback security messages.
#CBP0 No parity.
#CBP1 Odd parity.
#CBP2 Even parity.

Command: **#CBRy** **Callback Security Reset**

Values: y = 0–29

Default: None

Description: Clears the password and phone number in the y memory location.

Command: **#CBSn** **Callback Enable/Disable**

Values: n = 0, 1, 2, or 3

Default: 0

Description: #CBS0 Disables callback security.
#CBS1 Enables local and remote callback security.
#CBS2 Enables remote callback security only.
#CBS3 Disables callback security until local hang-up or reset.

Command: **#Pn** **Set 11-bit Parity**

Values: n = 0 or 1

Default: 2

Description: #P0 No parity.
#P1 Odd parity.
#P2 Even parity.

Command: **#Sx** **Enter Setup Password**

Values: x= password (1–8 characters, case sensitive)

Default: MTSMODEM

Description: Enters the callback security setup password.

Command: **#S=x** **Store Setup Password**

Values: x= password (1–8 characters, case sensitive)

Default: MTSMODEM

Description: Stores a new callback security and remote configuration setup password.

13.4 S-REGISTERS

Certain modem values, or parameters, are stored in memory locations called S-Registers. Use the **S** command to read or to alter the contents of S-Registers (see previous section).

Register	Unit	Range	Default	Description
S0	1 ring	0, 1–255	1	Sets the number of rings until the modem answers. ATS0=0 disables auto answer completely.
S1	1 ring	0–255	0	Counts the rings that have occurred.
S2	decimal	0–127	43 (+)	Sets ASCII code for the escape sequence character.
		128–255		Values greater than 127 disable escape.
S3	decimal	0–127	13 (^M)	Sets the ASCII code for the carriage return character.
S4	decimal	0–127	10 (^J)	Sets the ASCII code for the line feed character.
S5	decimal	0–32	8 (^H)	Sets the ASCII code for the backspace character.
		33–127		Values greater than 32 disable backspace.
S6	seconds	2–65*	2*	Sets the time the modem waits after it goes off-hook before it begins to dial the telephone number.
S7	seconds	35-65*	50*	Sets the time the modem waits for a carrier signal before aborting a call. Also sets the wait for silence time for the @ dial modifier.
S8	seconds	0–65	2	Sets the length of a pause caused by a comma character in a dialing command.
S9	decimal	0, 1–127	37 (%)	Sets ASCII code for remote configuration escape character. **S9=0** disables remote configuration.
S10	100 ms	1–254	20	Sets how long a carrier signal must be lost before the modem disconnects.
S11	1 ms	50–150*	95*	Sets spacing and duration of dialing tones.
S28	decimal	0, 1–255	1	0 disables, 1–255 enables V.34 modulation.
S30	1 minute	0, 1–255	0	Sets the length of time that the modem waits before disconnecting when no data is sent or received. A value of zero disables the timer. See also the **\T** command
S35	decimal	0–1	1	0 disables, 1 enables the V.25 calling tone, which allows remote data/fax/voice discrimination.
S36	decimal	0–7	7	Specifies the action to take in the event of a negotiation failure when error control is selected. (See **S48**).

Register	Unit	Range	Default	Description
S37	decimal	0–19	0	Sets the maximum V.34 “upstream” speed at which the modem attempts to connect. 0 = maximum speed 1 = reserved 2 = 1200/75 bps 3 = 300 bps 4 = reserved 5 = 1200 bps 6 = 2400 bps 7 = 4800 bps 8 = 7200 bps 9 = 9600 bps 10 = 12000 bps 11 = 14400 bps 12 = 16800 bps 13 = 19200 bps 14 = 21600 bps 15 = 24000 bps 16 = 26400 bps 17 = 28800 bps 18 = 31200 bps 19 = 33600 bps
S38	decimal	0–23	1	Sets “downstream” data rate where V.90 provides rates of 28,000 to 56,000 bps in increments of 1,333 bps. 0 = V.90 disabled 1 = V.90 auto rate 2 = 28,000 bps 3 = 29,333 bps 4 = 30,666 bps 5 = 32,000 bps 6 = 33,333 bps 7 = 34,666 bps 8 = 36,000 bps 9 = 37,333 bps 10 = 38,666 bps 11 = 40,000 bps 12 = 41,333 bps 13 = 42,666 bps 14 = 44,000 bps 15 = 45,333 bps 16 = 46,666 bps 17 = 48,000 bps 18 = 49,333 bps 19 = 50,666 bps 20 = 52,000 bps 21 = 53,333 bps 22 = 54,666 bps 23 = 56,000 bps **Upstream data rates:** Upstream V.90 data rates are 4800 to 33,600 bps in 2400 bps increments.

Register	Unit	Range	Default	Description
S43	decimal	0–1	1	For testing and debugging only. Enables/disables V.32bis start-up auto mode operation. 0 = disable; 1 = enable.
S48	decimal	7 or 128	7	Enables (7) or disables (128) LAPM negotiation. The following table lists the **S36** and **S48** configuration settings for certain types of connections.

	S48=7	**S48=128**
S36=0, 2	LAPM or hang up	Do not use
S36=1, 3	LAPM or async	Async
S36=4, 6	LAPM, MNP, or hang up	MNP or hang up
S36=5, 7	LAPM, MNP, or async	MNP or async

S89	seconds	0, 5–255	10	Sets the length of time in the off-line command mode before the modem goes into standby mode or “sleep mode”. A value of zero prevents standby mode; a value of 1–4 sets the value to 5. Standby mode (sleep mode or low power mode) is controlled by **S89**. It programs the number of seconds of inactivity before the modem will go to sleep. The default value is 0. A value of 0 disables standby mode. The modem will wake on an incoming ring or an AT command.
S108	decimal	0–3, 6, 7	6	Selects the 56K digital loss if using the modem through a PBX line. The default value is -6 dB loss, the value used when calling from a typical POTS line long distance. 0 = -0 dB digital loss, no robbed-bit signaling 1 = -3 dB PBX digital loss 2 = -2 dB digital loss 3 = -3 dB digital loss 6 = -6 dB digital loss 7 = -0 dB digital loss with robbed-bit signaling

13.5 RESULT CODES

In command mode your modem can send responses called **Result Codes** to your computer. Result codes are used by communications programs and can also appear on your monitor.

Terse	Verbose	Description
0	OK	Command executed
1	CONNECT	Modem connected to line
2	RING	Ring signal detected
3	NO CARRIER	Carrier signal lost or not detected
4	ERROR	Invalid command
5 *	CONNECT 1200	Connected at 1200 bps
6	NO DIALTONE	No dial tone detected
7	BUSY	Busy signal detected
8	NO ANSWER	No answer at remote end
9	CONNECT 75	Connected at 75 bps
10*	CONNECT 2400	Connected at 2400 bps
11*	CONNECT 4800	Connected at 4800 bps
12*	CONNECT 9600	Connected at 9600 bps
13*	CONNECT 14400	Connected at 14400 bps
14*	CONNECT 19200	Connected at 19200 bps
18	CONNECT 57600	Connected at 57600 bps
24*	CONNECT 7200	Connected at 7200 bps
25*	CONNECT 12000	Connected at 12000 bps
28	CONNECT 38400	Connected at 38400 bps
40*	CONNECT 300	Connected at 300 bps
55*	CONNECT 21600	Connected at 21600 bps
56*	CONNECT 24000	Connected at 24000 bps
57*	CONNECT 26400	Connected at 26400 bps
58*	CONNECT 28800	Connected at 28800 bps
59*	CONNECT 31200	Connected at 31200 bps
60*	CONNECT 33600	Connected at 33600 bps
70	CONNECT 32000	Connected at 32000 bps
71	CONNECT 34000	Connected at 34000 bps
72	CONNECT 36000	Connected at 36000 bps
73	CONNECT 38000	Connected at 38000 bps
74	CONNECT 40000	Connected at 40000 bps
75	CONNECT 42000	Connected at 42000 bps
76	CONNECT 44000	Connected at 44000 bps
77	CONNECT 46000	Connected at 46000 bps
78	CONNECT 48000	Connected at 48000 bps
79	CONNECT 50000	Connected at 50000 bps
80	CONNECT 52000	Connected at 52000 bps
81	CONNECT 54000	Connected at 54000 bps
82	CONNECT 56000	Connected at 56000 bps
83	CONNECT 58000	Connected at 58000 bps
84	CONNECT 60000	Connected at 60000 bps
86	CONNECT 16800	Connected at 16800 bps
87	CONNECT 115200	Connected at 115200 bps
88	DELAYED	Delay is in effect for the dialed number
89	BLACKLISTED	Dialed number is blacklisted
90	BLACKLIST FULL	Blacklist is full
91	CONNECT 230400	Connected at 230400 bps
100	CONNECT 28000	Connected at 28000 bps
101	CONNECT 29333	Connected at 29333 bps
102	CONNECT 30666	Connected at 30666 bps
103	CONNECT 33333	Connected at 33333 bps
104	CONNECT 34666	Connected at 34666 bps
105	CONNECT 37333	Connected at 37333 bps
106	CONNECT 38666	Connected at 38666 bps
107	CONNECT 41333	Connected at 41333 bps
108	CONNECT 42666	Connected at 42666 bps

Terse	Verbose	Description
109	CONNECT 45333	Connected at 45333 bps
110	CONNECT 46666	Connected at 46666 bps
111	CONNECT 49333	Connected at 49333 bps
112	CONNECT 50666	Connected at 50666 bps
113	CONNECT 53333	Connected at 53333 bps
114	CONNECT 54666	Connected at 54666 bps
115	CONNECT 25333	Connected at 25333 bps
116	CONNECT 26666	Connected at 26666 bps

* EC is added to these result codes when the extended result codes configuration option is enabled. EC is replaced by one of the following codes, depending on the type of error control connection:

V42bis – V.42 error control (LAP-M) and V.42bis data compression
V42 – V.42 error control (LAP-M) only
MNP5 – MNP 4 error control and MNP 5 data compression
MNP4 – MNP 4 error control only
NoEC – No error control protocol.

Section 14. PARTS LISTS AND SCHEMATICS

This section contains parts lists, component locator drawings, and schematics for all RFL 9660 modules and I/O modules.

Table 14-1. Replaceable parts, RFL 96 CPU Central Processor (CPU) Module Assembly No. 104410-4

Circuit Symbol (Figs. 14-1 & 14-2)	Description	Part Number
	CAPACITORS	
C1	Capacitor,electrolytic,47μF,+50-10%,25V,Panasonic ECEA1EV470S or equiv.	1007 1578
C2-7,12-25,30-37	Capacitor,X7R ceramic,0.1μF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C8	Capacitor,tantalum,4.7μF,20%,20V,Kemet T322B475M020AS or equiv.	1007 711
C9,10	Capacitor,ceramic,33pF,10%,100V,AVX SA101A330KAA or equiv.	0125 13301
C11	Capacitor,ceramic,0.001μF,5%,100V,AVX SA201A102JAA or equiv.	0125 11025
C26-29	Not used.	
	RESISTORS	
R1,30,35	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R2,6,9,25,27	Resistor,metal film,3.32KΩ,1%,1/4W, Type RN1/4	0410 1338
R3,16-20,23,24, 28,31-34	Not used.	
R4,5	Resistor,metal film,2.74KΩ,1%,1/4W, Type RN1/4	0410 1330
R7	Resistor,metal film,22.1KΩ,1%,1/4W, Type RN1/4	0410 1417
R8	Resistor,metal film,1.0MΩ,1%,1/4W, Type RN1/4	0410 1576
R10-14	Resistor,metal film,681Ω,1%,1/4W, Type RN1/4	0410 1272
R15	Resistor,metal film,8.25KΩ,1%,1/4W, Type RN1/4	0410 1376
R21,22	Resistor,metal film,182Ω,1%,1/4W, Type RN1/4	0410 1217
R26,29	Resistor,metal film,150Ω,1%,1/4W, Type RN1/4	0410 1209
RZ1,6,7	Resistor network,nine 10KΩ 2% resistors,1.25W total,10-pin SIP, Bourns 4310R-101-103 or equiv.	32622
RZ2,3	Resistor network,eight 330Ω 2% resistors,1.75W total,16-pin DIP, CTS of Berne 761-3-R330 or equiv.	44532
RZ4	Resistor network,seven 680Ω 2% resistors,1W total,8-pin SIP, Bourns 4308R-101-681 or equiv.	98448
RZ5	Resistor network,five 4.7KΩ 2% resistors,0.75W total,6-pin SIP, Bourns 4306R-101-472 or equiv.	30554
	SEMICONDUCTORS	
CR1-5,11	Not used.	32567
CR6-8,10	Light-emitting diode,green,right-angle PC mount,Industrial Devices 5300H5 or equiv.	99294
CR9	Light-emitting diode,red,right-angle PC mount,extended length, Industrial Devices 5300H1 or equiv.	102801
CR12	Light-emitting diode,red/green,high-intensity,PC-mount,Dialight 550-3006 or equiv.	29755
CR13,14	Diode,Zener,12V,5%,1W,1N4742A	100572
CR15-20	Transient suppressor,bidirectional,15.2 to 16.8-volt breakdown, General Semiconductor P6KE16CA or equiv.	101117
D1-10	Not used.	
D11	Display,seven-segment,2-digit numeric,high-performance,0.560-inch orange, General Instrument MAN6610 or equiv.	

Table 14-1. Replaceable parts, RFL 96 CPU Central Processor (CPU) Module - continued.

Circuit Symbol (Figs. 14-1 & 14-2)	Description	Part Number
	SEMICONDUCTORS - continued.	
Q1,2	Not used.	
Q3	Transistor,NPN,plastic package,2N2222A	37445
U1	MOS quad line driver,14-pin DIP,National Semiconductor DS14C88N or equiv.	0615 302
U2	MOS quad line receiver,14-pin DIP,National Semiconductor DS14C89N or equiv.	0615 303
U3,4,11,12,14,15, 21,22,26-39,31, 32,34,40,41,43,46	Not used.	
U5	EPROM, 64K x 8,programmed at factory	Contact factory
U6	RAM,32K x 8,120-ns access time,28-pin DIP,Hitachi HM65256LPI-12 or equiv.	0630 59
U7,8	MOS tri-state octal D-type flip-flop,20-pin DIP, National Semiconductor MM74HC374N or equiv.	0615 178
U9,10	Programmable communication interface (PCI),28-pin DIP,Intel 8251A/32657	0635 9
U13	MOS monostable multivibrator,16-pin DIP, National Semiconductor MM74HC221AN or equiv.	0615 397
U16,42	MOS dual D-type flip-flop w/preset and clear,14-pin DIP, National Semiconductor MM74HC74N or equiv.	0615 166
U17	MOS octal D-type latch,20-pin DIP,National Semiconductor MM74HC373N or equiv.	0615 283
U18	Programmable interval timer,10-MHz,24-pin DIP,Intel TP82C54-2 or equiv.	0635 35
U19,45	Programmable peripheral interface,40-pin DIP,Harris IP82C55A or equiv.	0635 21
U20	Microcontroller,40-pin DIP, Dallas DS80C320-MNG or equiv.	0640 36
U23,24	MOS decoder,3-line to 8-line,16-pin DIP,National Semiconductor MM74HC138N or equiv.	0615 168
U25	MOS dual 4-bit binary counter,14-pin DIP,National Semiconductor MM74HC393N or equiv.	0615 192
U30	Custom Exclusive-OR PAL (Programmable Array - Logic), programmed at factory	Contact factory
U33,36	MOS tri-state octal buffer,20-pin DIP,National Semiconductor MM74HC244N or equiv.	0615 176
U35	MOS tri-state octal transceiver 20-pin DIP,National Semiconductor MM74HC245N or equiv.	0615 177
U37	Microprocessor supervisor,16-pin DIP,Maxim MAX691EPE or equiv.	0635 31
U38	MOS hex inverter,unbuffered,high-speed,14-pin DIP,RCA CD74HCU04E or equiv.	0615 304
U39	MOS 8-input NAND gate,14-pin DIP,National Semiconductor MM74HC30N or equiv.	0615 164
U44	Memory elect,eraseable,8K x 8,150-ns,28-pin DIP,Atmel AT28C64-15DI or equiv.	0630 62
U47	Transistor array,Darlington,high-voltage,high-current,18-pin DIP, Sprague ULN2803A or equiv.	0720 7
U48	MOS quad 2-input NAND gate,14-pin DIP,National Semiconductor MM74HC00N or equiv.	0615 159

Table 14-1. Replaceable parts, RFL 96 CPU Central Processor (CPU) Module - continued.

Circuit Symbol (Figs. 14-1 & 14-2)	Description	Part Number
	MISCELLANEOUS COMPONENTS	
J1	Not field-replaceable.	
J2-J4	Shorting bar,single,Molex 90059-0009 or equiv.	98306
S1	Switch array,four SPST piano switches,8-pin DIP,AMP 1-435802-5 or equiv.	101122
S2	Switch,SPDT,momentary snap-action pushbutton,	49583
	C & K Components 8125A (Termination Option A) or equiv.	
S3	Switch array,8-position,16-pin DIP,AMP 5-435166-3 or equiv.	38933
Y1	Crystal,quartz,11.0592 MHz	99215 10
. . .	Shorting bar,single,Molex 90059-0009 or equiv.	98306

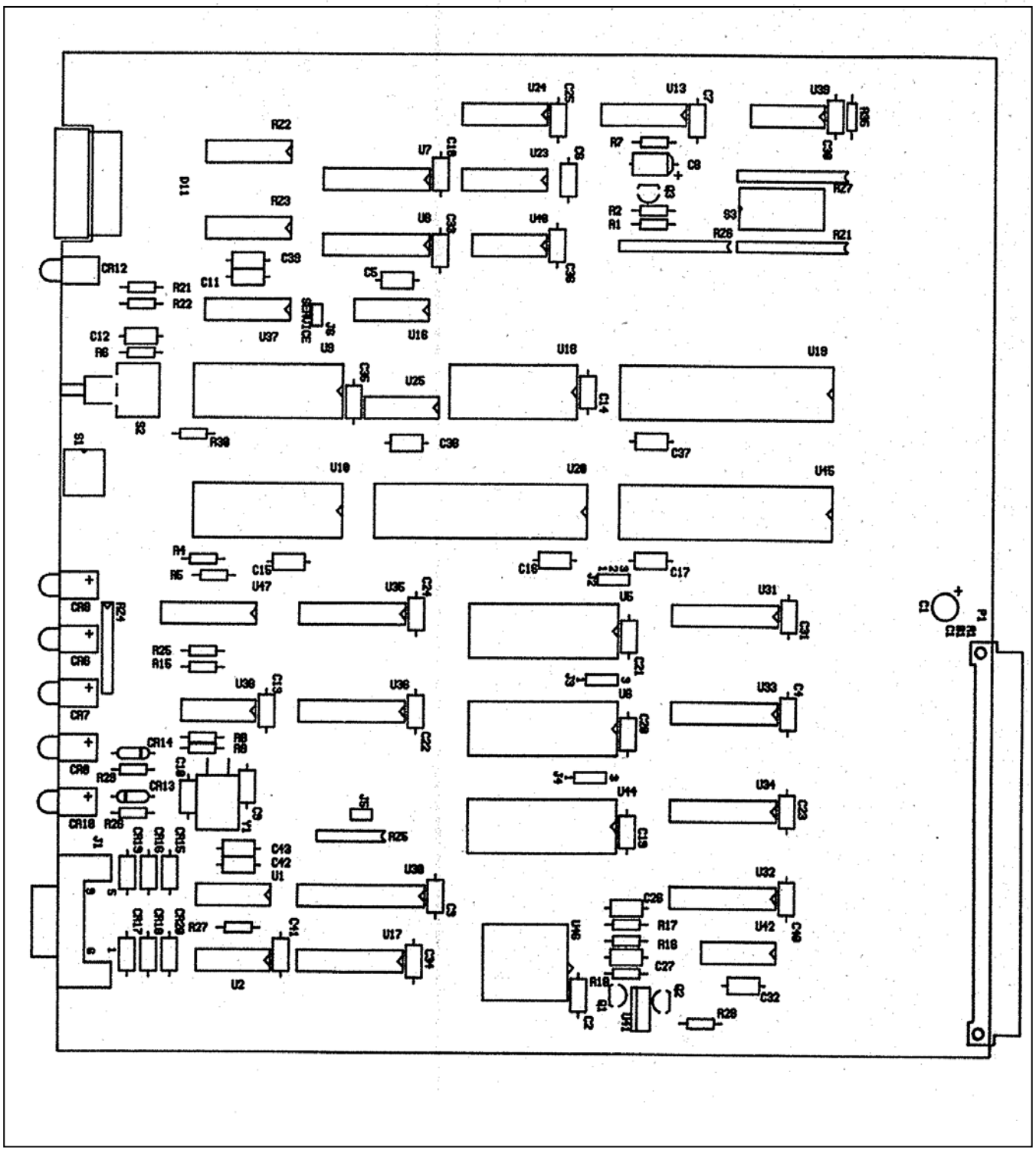

Figure 14-1. Component locator drawing, RFL 96 CPU Central Processor (CPU) Module (Assembly No. 104410-4; Drawing No. D-104413-1)

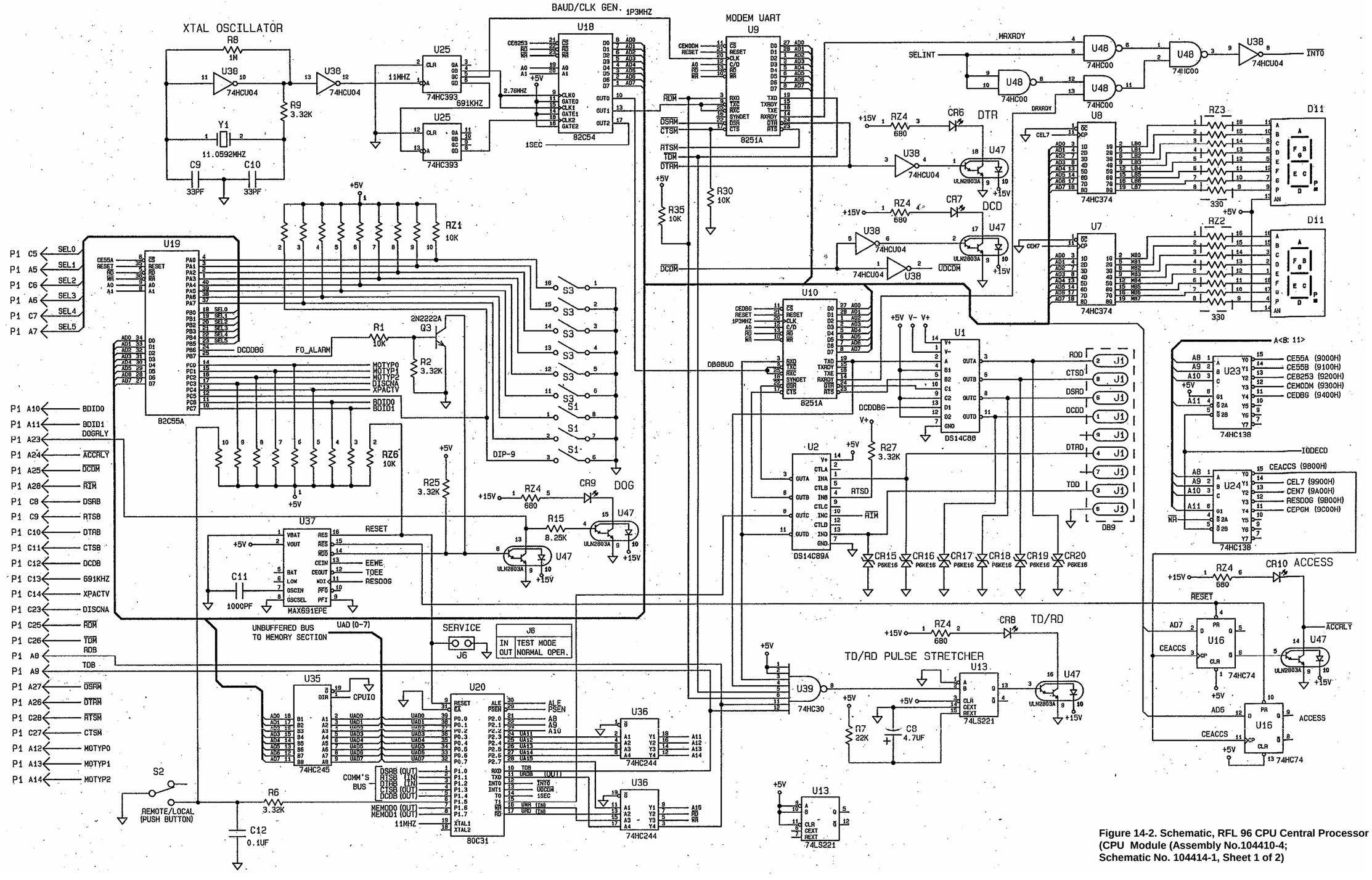

Figure 14-2. Schematic, RFL 96 CPU Central Processor (CPU Module (Assembly No.104410-4; Schematic No. 104414-1, Sheet 1 of 2)

CONFIGURATION TABLE

	J2	J3	J5	U5	U44	U46
W/O EEPROM	1-2	1-2	OUT	27C512	2864	OMIT
W/ EEPROM	2-3	2-3	IN	27C64	OMIT	28F010

J4 JUMPER	
1-2	16K/32 X 8 SRAM
2-3	8K X 8 SRAM

	FOSTA0	FOSTA1
RED	1	0
GREEN	0	1
OFF	0	0

ONLY ADD COMPONENTS WITHIN DOTTTED LINE IF EXTERNAL I/O CARDS ARE USED

ONLY LOAD COMPONENTS IN DASHED BOX IF EEPROM

SEE CONFIG. TABLE

Figure 14-2. Schematic, RFL 96 CPU Central Processor (CPU Module (Assembly No.104410-4; Schematic No. 104414-1, Sheet 2 of 2)

Table 14-2. Replaceable parts, RFL 9660 33.6 Modem
Assembly No. 104855-3

Circuit Symbol (Figs. 14-3 & 14-4)	Description	Part Number
	CAPACITORS	
C3, 4, 6, 7, 9	Capacitor, ceramic, 0.1μF, 20%, 50V	151-10104040603
C12	Capacitor, electrolytic, 220μF, 20%, 50V	150-10221070109
C8	Capacitor, ceramic, 0.1μF, 10%, 100V	151-10103040603
C1	Capacitor, electrolytic, 100μF, 20%, 16V	150-05101040104
C2, 5, 10, 11	Capacitor, tantalum, 100μF, 20%, 16V	153-106080105
C13, 14	Capacitor, ceramic , 220pF, 10%, 250VAC	151-10221500620
	RESISTORS	
R6, 7, 8, 9	Resistor, metal film, precision, 1K, 1%, 1/8W	700-15100134
R4	Resistor, metal film, precision, 237, 1%, 1/8W	700-15237034
R5	Resistor, metal film, precision, 392, 1%, 1/8W	700-15397034
	SEMICONDUCTORS	
U1	Modem Module, 33.6Kbps	104801
U2	IC, MOS, tri-state, octal XCVR	500-174
U3	IC, linear LV, audio power amp	510-203
U4	IC, Voltage Regulator	510-140
	MISCELLANEOUS COMPONENTS	
L1	Inductor, 47uH	470-15104
R1	Resistor, metal film, zero ohm, 1/8W	700-15000034
J4	Connector, jumper	98306
SPKR1	Transducer, buzzer, 3-12VDC	101138
PTC1	Fuse, PTC, resettable	450-15504
FB1	Ferrite bead	470-30104
FB2, 3	Ferrite bead	47030107

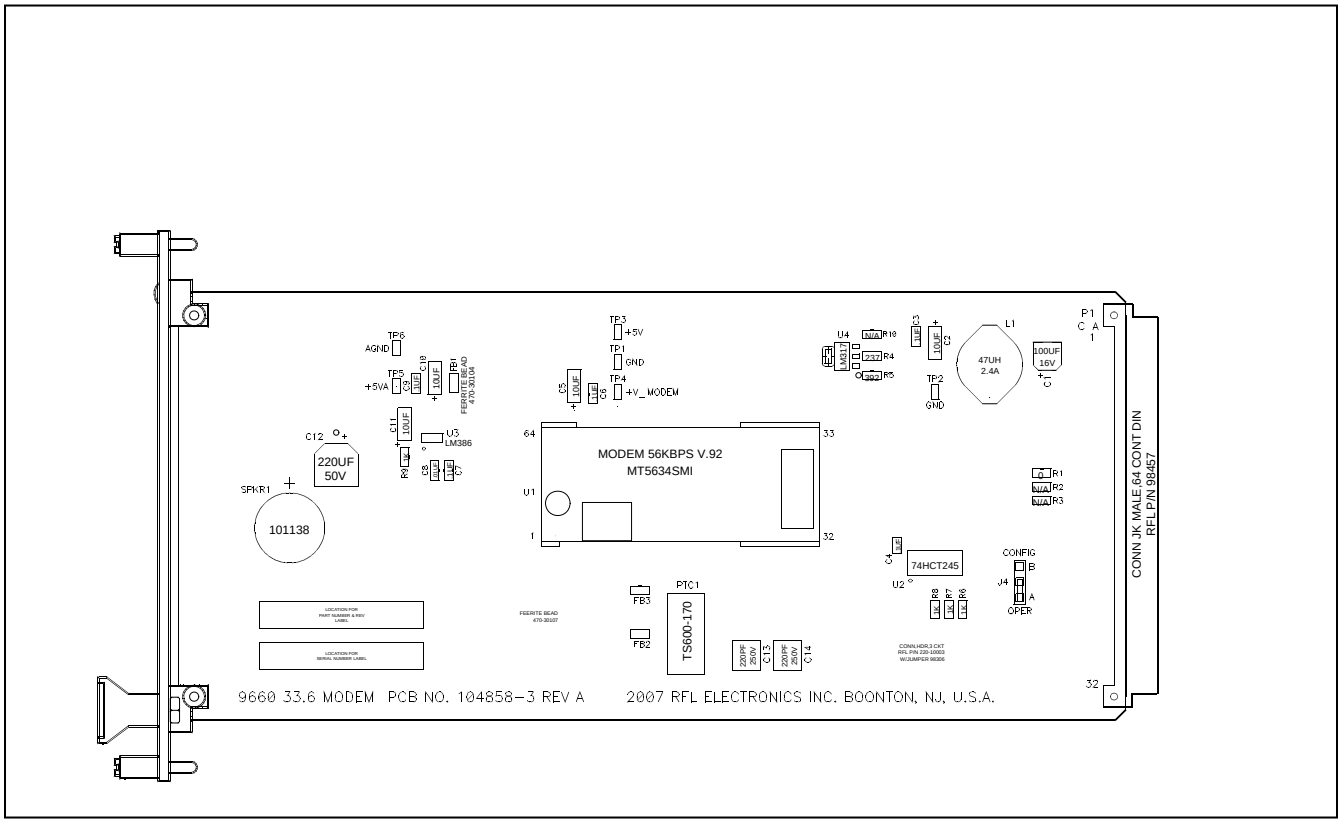

Figure 14-3. Component locator drawing, RFL 9660 33.6 Modem (Assembly No. 104855-3; Schematic No. 104858-3)

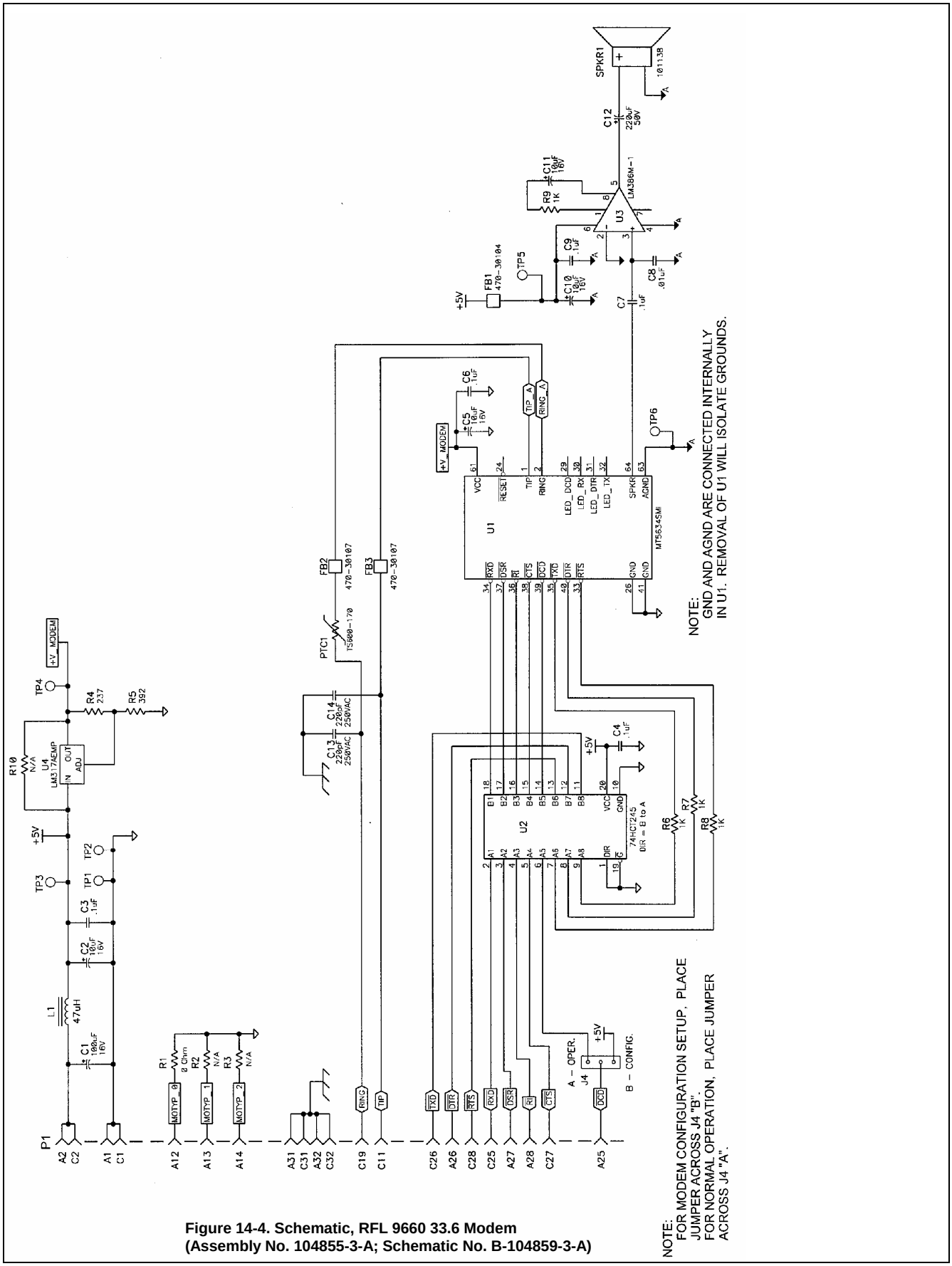

Figure 14-4. Schematic, RFL 9660 33.6 Modem (Assembly No. 104855-3-A; Schematic No. B-104859-3-A)

Table 14-3. Replaceable parts, RFL 9660 Modem I/O Module
Assembly No. 104860-1

Circuit Symbol (Figs. 14-5 & 14-6)	Description	Part Number
CR1	Diode, Surmetic, Rectifier, 1N4001	38876
J1, 2	Connector, jack, telephone 6 CKT	30088 6
K1	Relay, DPDT, 5Vdc, Coil form “D”	101136
P1	Connector, plug, fem, 64CONT, DIN	99134
Q1	Transistor, Silicon, NPN, 2N2222A	37445
Q2	Transistor, VMOS, FET, VN10KM	0715 13
R1, 2	Resistor, Metal film, Precision, 1KΩ,1%,1/4W	0410 1288

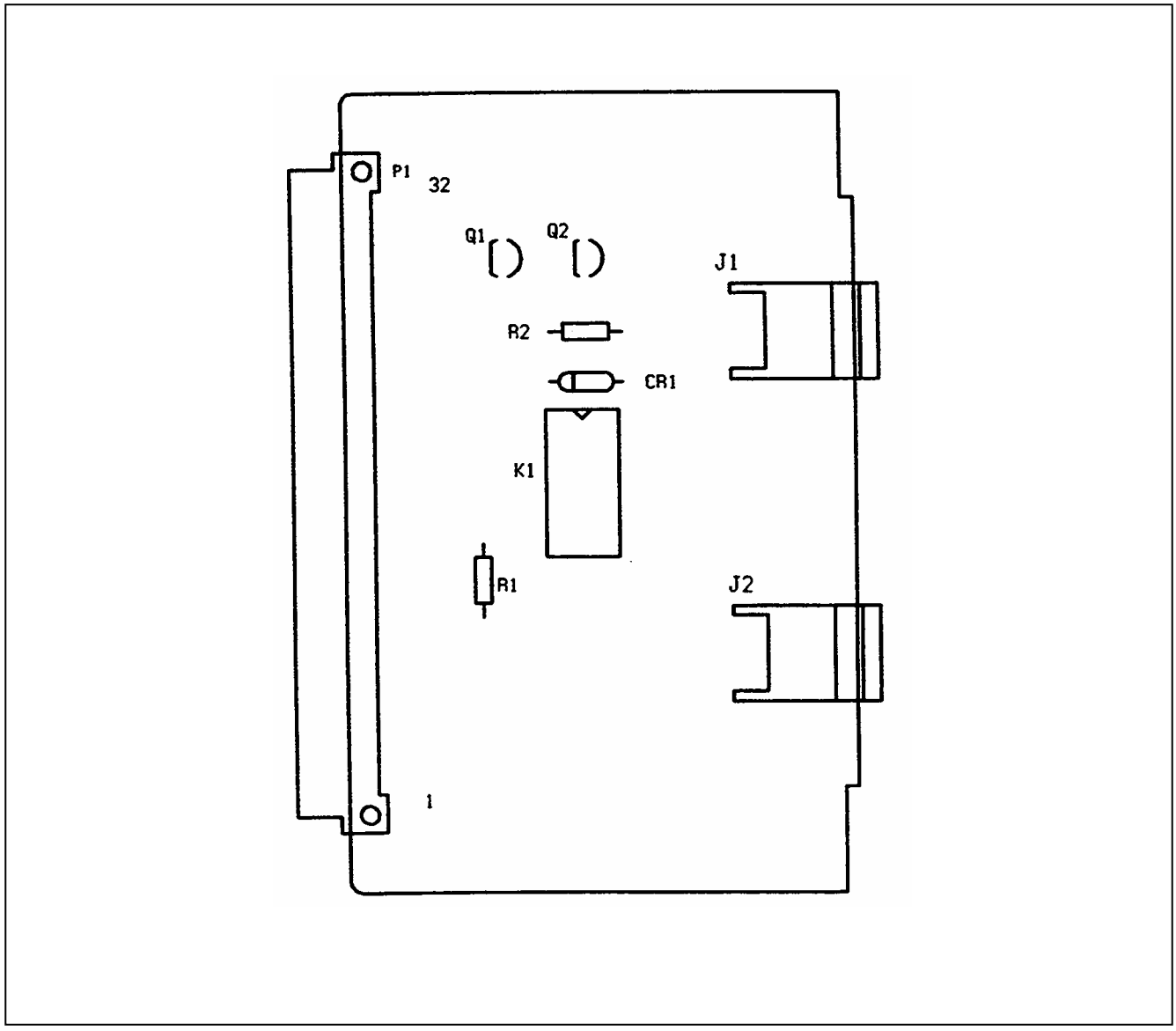

Figure 14-5. Component locator drawing, RFL 9660 Modem I/O Module
(Assembly No. 104860-1; Drawing No. C-104860-1, Rev. B)

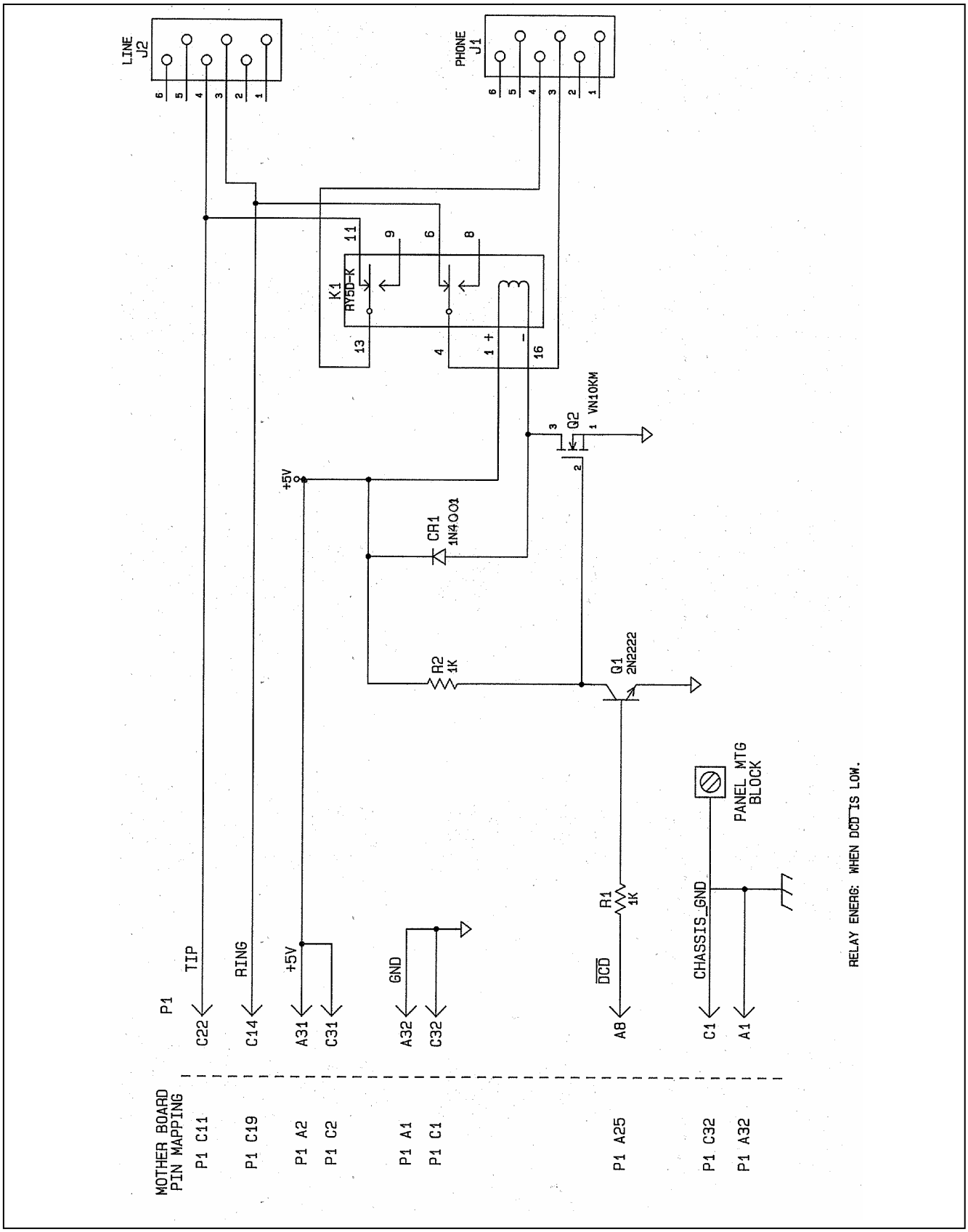

Figure 14-6. Schematic, RFL 9660 Modem I/O (Assembly No. 104860-1; Schematic No. C-104864-1, Rev. B)

Table 14-5. Replaceable parts, RFL 96 DTE I/O Direct Digital I/O Module Assembly No. 104455

Circuit Symbol (Figs. 14-9 & 14-10)	Description	Part Number
C1-7,9,10	Capacitor,X7R ceramic,0.1μF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C11,14	Capacitor,tantalum,1μF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C8,12,13	Not used.	
R1,5,9	Resistor,metal film,4.99KΩ,1%,1/4W, Type RN1/4	0410 1355
R2,3	Not used.	
R4,8,21-27	Resistor,metal film,10KΩ,1%,1/4W, Type RN1/4	0410 1384
R6,7,10,11	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R12-20	Resistor,metal film,6.98KΩ,1%,1/4W, Type RN1/4	0410 1369
U1-3	MOS quad line receiver,14-pin DIP,National Semiconductor DS14C89N or equiv.	0615 303
U4,5	MOS quad line driver,14-pin DIP,National Semiconductor DS14C88N or equiv.	0615 302
U6,7	MOS dual-port RAM,1K x 16/2K x 8, 68-lead chip carrier, VSLI Technology VT16DP8-70QC or equiv.	0620 320

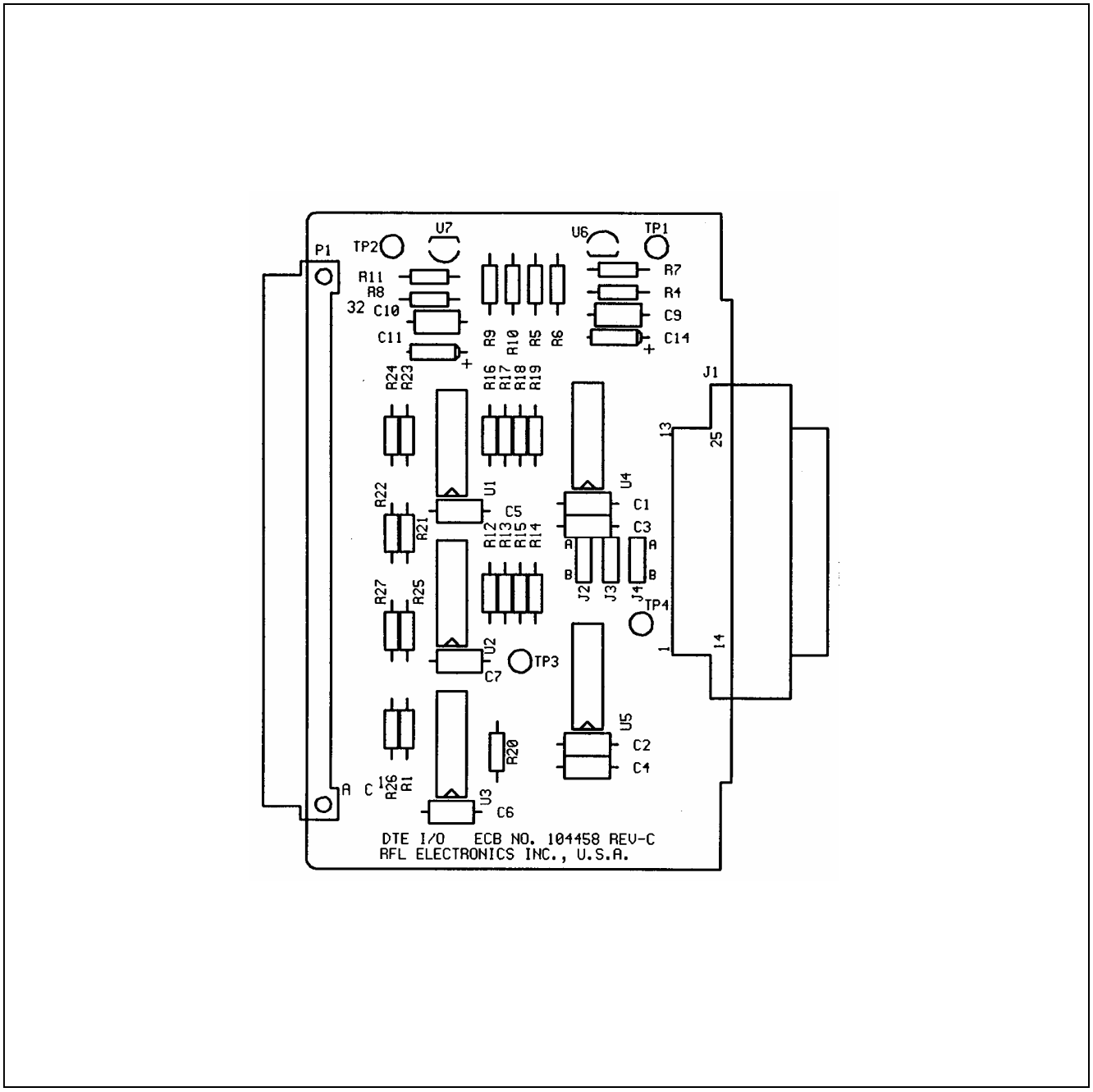

Figure 14-7. Component locator drawing, RFL 96 DTE I/O Direct Digital Module (Assembly No. 104455; Drawing No. C-104458, Rev. C)

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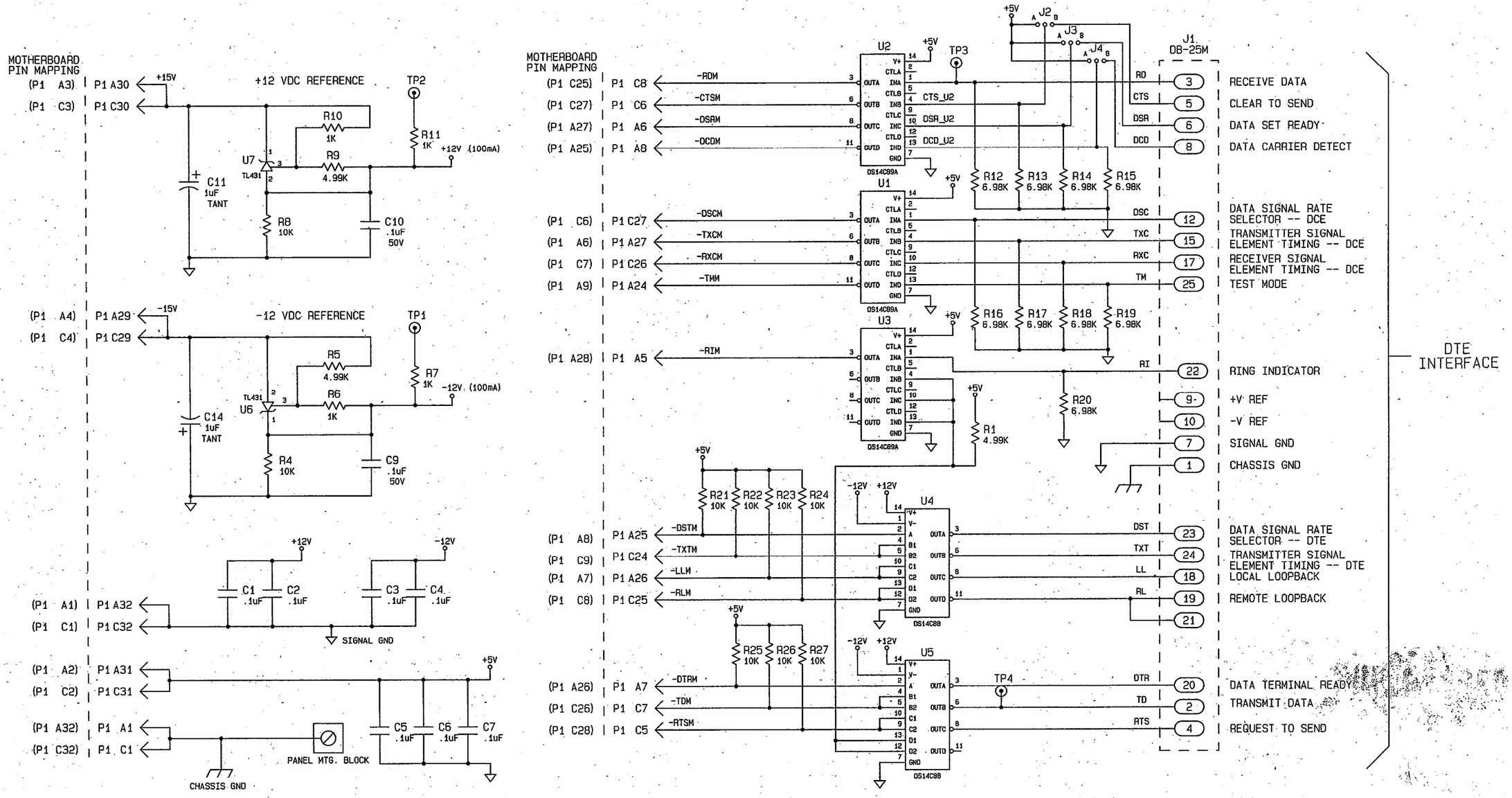


Figure 14-8. Schematic, RFL 96 DTE I/O Direct Digital I/O Module (Assembly No. 104455; Schematic No. D-104459, Rev B)

Table 14-6. Replaceable parts, dc-input power supply modules for RFL 9660 Digital Switch
RFL 9125B 24DCPS (24-Vdc Input) - Assembly No. 103150-1
RFL 9125B 48DCPS (48-Vdc Input) - Assembly No. 103150-2
RFL 9125B 125DCPS (125-Vdc Input) - Assembly No. 103150-3

Circuit Symbol (Figs. 14-11 thru 14-13)	Description	Part Number
	CAPACITORS	
C1,2	Capacitor,ceramic disc,0.005μF,20%,3kV,Centralab DD30-502 or equiv.	1007 1264
C3,5,7	Capacitor,metallized polypropylene,0.47μF,10%,250V,radial leads, Illinois Capacitor 474MPR250K or equiv.	1007 1693
C4,6	Capacitor,electrolytic,radial leads, value dependent upon model:	
	RFL 9125B 24DCPS: 220μF,20%,50V,Illinois Capacitor 227RMR050M or equiv.	1007 1718
	RFL 9125B 48DCPS: 33μF,20%,250V,Illinois Capacitor 336RMR250M or equiv.	1007 1716
	RFL 9125B 125DCPS: 100μF,20%,100V,Illinois Capacitor 107RMR100M or equiv.	1007 1717
C8	Capacitor,electrolytic,radial leads, value dependent upon model:	
	RFL 9125B 24DCPS: 470μF,20%,50V,Illinois Capacitor 477RMR050M or equiv.	1007 1721
	RFL 9125B 48DCPS: 220μF,20%,100V,Illinois Capacitor 227RMR100M or equiv.	1007 1720
	RFL 9125B 125DCPS: 22μF,20%,250V,Illinois Capacitor 226RMR250M or equiv.	1007 1726
C9	Capacitor,metallized polypropylene,0.033μF,10%,400V,radial leads, Illinois Capacitor 333MPR400K or equiv.	1007 1694
C10	Capacitor,ceramic,0.0022μF,5%,100V,AVX SA301A222JAA or equiv.	0125 12225
C11,14,31,39,45	Capacitor,X7R ceramic,0.1μF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C12	Capacitor,tantalum,4.7μF,10%,35V,Kemet T322C475K035AS or equiv.	1007 1623
C13	Capacitor,polyester,0.012μF,2%,100V,Wesco 32P or equiv.	5115 39
C15	Capacitor,tantalum,15μF,20%,20V,Kemet T322D156M020AS or equiv.	1007 716
C16	Capacitor,metallized polycarbonate,0.047μF,2%,200V,Wesco 32MPC or equiv.	1007 1196
C17	Capacitor,X7R ceramic,0.01μF,10%,50V,AVX SA105C103KAA or equiv.	0130 51031
C18,38	Capacitor,tantalum,1μF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C19	Capacitor,polypropylene,0.0049μF,2%,100V,F-Dyne PPA-11-.0049-100-2 or equiv.	0105 69
C20-29	Not used.	
C30,36,42,48	Capacitor,electrolytic,470μF,20%,35V,radial leads, Illinois Capacitor 477RZS035M or equiv.	1007 1722
C32,40,46	Capacitor,tantalum,2.2μF,20%,25V,Kemet T322B225M025AS or equiv.	1007 645
C33,41,47	Capacitor,X7R ceramic,0.022μF,10%,50V,AVX SA105C223KAA or equiv.	0130 52231
C34	Capacitor,electrolytic,1000μF,20%,16V,radial leads, Illinois Capacitor 108RZS016M or equiv.	1007 1723
C35	Capacitor,tantalum,220μF,20%,10V,Kemet T350L227M010AS or equiv.	1007 1684
C37	Capacitor,tantalum,4.7μF,10%,50V,axial leads,Kemet T322D475K050AS or equiv.	1007 1727
C43,49	Capacitor,tantalum,47μF,10%,20V,radial leads,Kemet T353K476K020AS or equiv.	1007 1715
C44	Capacitor,electrolytic,100μF,20%,63V,radial leads, Illinois Capacitor 107RZS063M or equiv.	1007 1696

Table 14-6. Replaceable parts, dc-input power supply modules for RFL 9660 Digital Switch - continued.

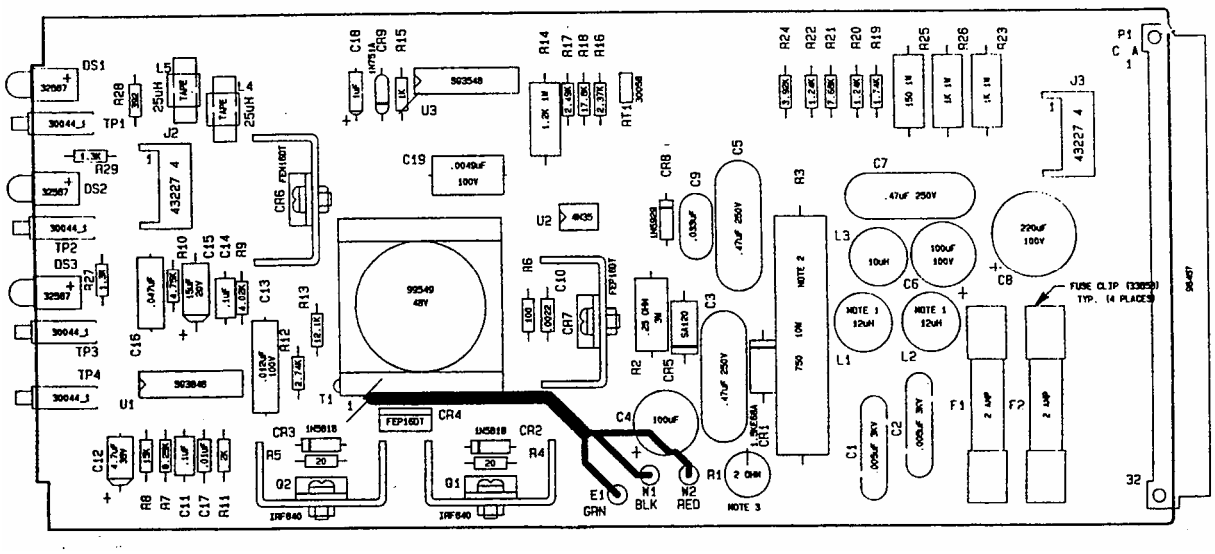
Circuit Symbol (Figs. 14-11 thru 14-13)	Description	Part Number
	RESISTORS	
R1	Resistor,wirewound,value and power rating dependent upon model:	
	RFL 9125B 24DCPS: 0.5Ω,10%,5W,Clarostat Type VC5E or equiv.	1100 808
	RFL 9125B 48DCPS: 2Ω,5%,5W,Clarostat Type VC5E or equiv.	1100 809
	RFL 9125B 125DCPS: 0.5Ω,10%,3W,Clarostat Type VC3D or equiv.	1100 807
R2	Resistor,wirewound,value and power rating dependent upon model:	
	RFL 9125B 24DCPS: 0.13Ω,10%,3W,Clarostat Type VC3D or equiv.	1100 805
	RFL 9125B 48DCPS: Same as R48.	
	RFL 9125B 125DCPS: 3KΩ,5%,10W,Ohmite 4835 Style 995-10A or equiv.	1100 410
R3	Resistor,wirewound,value and power rating dependent upon model:	
	RFL 9125B 24DCPS: 100Ω,5%,10W,Clarostat Type VC10F or equiv.	1100 811
	RFL 9125B 48DCPS: 750Ω,5%,10W,Clarostat Type VC10F or equiv.	1100 812
	RFL 9125B 125DCPS: 4Ω,5%,5W,Clarostat Type VC5E or equiv.	1100 810
R4,5	Resistor,metal film,20Ω,1%,1/4W,Type RN60D	1510 1016
R6,41,49,55,60,63,68	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192
R7,58,66	Resistor,metal film,8.25KΩ,1%,1/4W, Type RN1/4	0410 1376
R8	Resistor,metal film,15KΩ,1%,1/4W, Type RN1/4	0410 1401
R9	Resistor,metal film,4.02KΩ,1%,1/4W, Type RN1/4	0410 1346
R10,53	Resistor,metal film,4.75KΩ,1%,1/4W, Type RN1/4	0410 1353
R11,40,62	Resistor,metal film,2KΩ,1%,1/4W, Type RN1/4	0410 1317
R12	Resistor,metal film,2.74KΩ,1%,1/4W, Type RN1/4	0410 1330
R13	Resistor,metal film,12.1KΩ,1%,1/4W, Type RN1/4	0410 1392
R14	Resistor,composition,1.2KΩ,5%,1W, Allen-Bradley GB Series or equiv.	1009 64
R15	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R16	Resistor,metal film,2.37KΩ,1%,1/4W, Type RN1/4	0410 1324
R17	Resistor,metal film,2.49KΩ,1%,1/4W, Type RN1/4	0410 1326
R18	Resistor,metal film,17.8KΩ,1%,1/4W, Type RN1/4	0410 1408
R19	Resistor,metal film,1.74KΩ,1%,1/4W, Type RN1/4	0410 1311
R20,22	Resistor,metal film,1.24KΩ,1%,1/4W, Type RN1/4	0410 1297
R21	Resistor,metal film,7.68KΩ,1%,1/4W, Type RN1/4	0410 1373
R23,26	Resistor,composition,1KΩ,5%,1W, Allen-Bradley GB Series or equiv.	1009 6
R24,51,52	Resistor,metal film,3.92KΩ,1%,1/4W, Type RN1/4	0410 1345
R25	Resistor,composition,150Ω,5%,1W, Allen-Bradley GB Series or equiv.	1009 183
R27,29	Resistor,metal film,1.3KΩ,1%,1/4W, Type RN1/4	0410 1299
R28	Resistor,metal film,392Ω,1%,1/4W, Type RN1/4	0410 1249
R30-39	Not used.	
R42	Resistor,metal film,2.94KΩ,1%,1/4W, Type RN1/4	0410 1333
R43,57,65	Resistor,metal film,2.21KΩ,1%,1/4W, Type RN1/4	0410 1321
R44	Resistor,metal film,3.01KΩ,1%,1/4W, Type RN1/4	0410 1334
R45,59,67	Resistor,metal film,475Ω,1%,1/4W, Type RN1/4	0410 1257
R46	Resistor,metal film,47.5Ω,1%,1/4W, Type RN1/4	0410 1161
R47	Resistor,metal film,56.2KΩ,1%,1/4W, Type RN1/4	0410 1456

Table 14-6. Replaceable parts, dc-input power supply modules for RFL 9660 Digital Switch - continued.

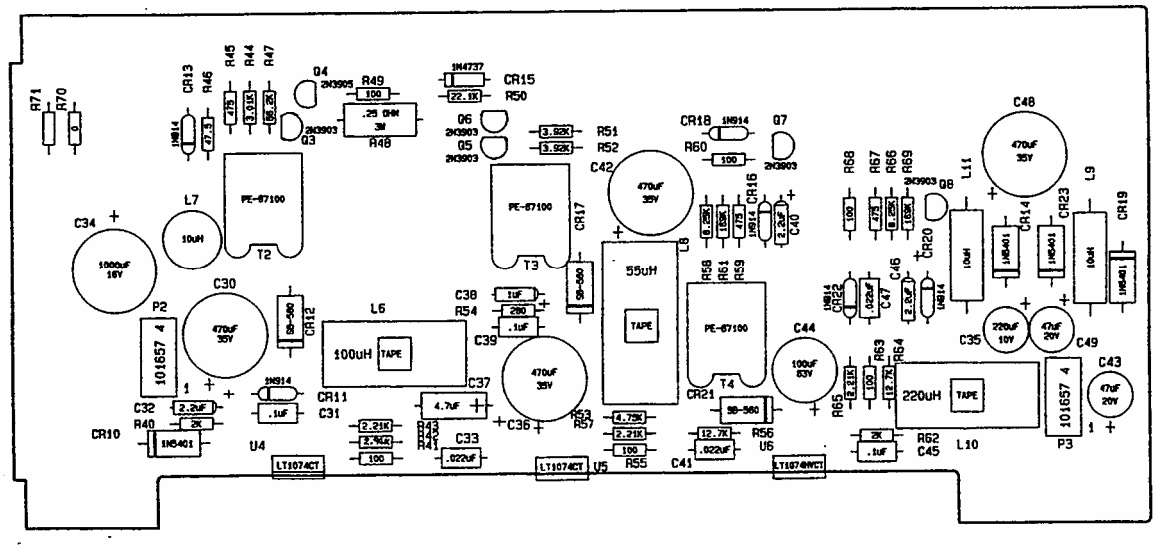
Circuit Symbol (Figs. 14-11 thru 14-13)	Description	Part Number
	RESISTORS - continued.	
R48	Resistor,wirewound,0.25Ω,10%,3W,Clarostat Type VC3D or equiv.	1100 806
R50	Resistor,metal film,22.1KΩ,1%,1/4W, Type RN1/4	0410 1417
R54	Resistor,metal film,280Ω,1%,1/4W, Type RN1/4	0410 1235
R56,64	Resistor,metal film,12.7KΩ,1%,1/4W, Type RN1/4	0410 1394
R61,69	Resistor,metal film,169KΩ,1%,1/4W, Type RN1/4	0410 1502
R70	Resistor,zero-ohm,1/4-watt size,Corning OMA07 or equiv.	1510 2217
RT1	Thermistor,25K @ 25deg C,10%,Keystone RL 1007-13.8-120-D1 or equiv.	30058
	SEMICONDUCTORS	
CR1	Transient voltage suppressor,breakdown voltage dependent upon model: RFL 9125B 24DCPS: 31.4- to 34.7-volt breakdown, General Semiconductor 1.5KE33A or equiv. RFL 9125B 48DCPS: 64.6- to 71.4-volt breakdown, General Semiconductor 1.5KE68A or equiv. RFL 9125B 125DCPS: 190- to 210-volt breakdown, General Semiconductor 1.5KE200A or equiv.	30447 30448 30449
CR2,3	Diode,Schottky,1A,30V,1N5818	30073
CR4	Rectifier,comon-cathode,type dependent upon model: RFL 9125B 125DCPS: 2-diode,500V,16A,50-ns TRR, 3-terminal TO-220 case, General Instrument FEP16HT or equiv. All Others: Same as CR7.	30460
CR5	Transient voltage suppressor,breakdown voltage dependent upon model: RFL 9125B 24DCPS: 66.7V,4.7A,500W for 1 ms,Motorola SA60 or equiv. RFL 9125B 48DCPS: 133V,2.3A,500W for 1 ms,Motorola SA120 or equiv. RFL 9125B 125DCPS: 189V,1.6A,500W for 1 ms,Motorola SA170 or equiv.	30078 30079 30083
CR6	Rectifier,common-anode,2-diode,200V,16A,35-ns TRR, 3-terminal TO-220 case,General Instrument FEN16DT or equiv.	30489
CR7	Rectifier,common-cathode,2-diode,200V,16A,35-ns TRR, 3-terminal TO-220 case,General Instrument FEP16DT or equiv.	30490
CR8	Diode,Zener,15V,5%,1.5W,1N5929A	30053
CR9	Diode,Zener,5.1V,5%,400mW,1N751A	37497
CR10,14,19,23	Diode,silicon,100V,3A,1N5401	94287
CR11,13,16,18,20,22	Diode,silicon,1N914B or 1N4448	26482
CR12,17,21	Diode,Schottky high-current barrier,5A,60V,DO-201AD package, General Instrument SB560 or equiv.	100513
CR15	Diode,Zener,7.5V,5%,1W,DO-41 case,1N4737A	34410
DS1-3	Light-emitting diode,green,right-angle PC mount,Industrial Devices 5300H5 or equiv.	32567
Q1,2	Transistor,type dependent upon model: RFL 9125B 24DCPS: N-channel MOSFET,100V,27A, TO-220AB plastic case,International Rectifier IRF540 or equiv. RFL 9125B 48DCPS: N-channel FET,200V,18A,TO-220AB plastic case, International Rectifier IRF640 or equiv. RFL 9125B 125DCPS: N-channel FET,400V,10A,TO-220AB plastic case, International Rectifier IRF740 or equiv.	0715 26 0716 27 0715 28

Table 14-6. Replaceable parts, dc-input power supply modules for RFL 9660 Digital Switch - continued.

Circuit Symbol (Figs. 14-11 thru 14-13)	Description	Part Number
	SEMICONDUCTORS - continued.	
Q3,5-8	Transistor,NPN,TO-92 case,2N3903	21562
Q4	Transistor,PNP,TO-92 case,2N3905	21564
U1	Linear mode RWM controller,16-pin DIP,Silicon General SG3846N or equiv.	0620 326
U2	Photo-coupled isolator,6-pin DIP,General Electric 4N35 or equiv.	47104
U3	Linear quad fault monitor, 16-pin DIP,Silicon General SG3548N or equiv.	0620 325
	Linear switching regulator,5-pin TO-220 package,	
U4,5	Linear Technology LT1074CT or equiv.	0620 328
	Linear switching regulator,64V/5A,5-terminal TO-220 package,	
U6	Linear Technology LT1074HVCT or equiv.	0620 337
	MISCELLANEOUS COMPONENTS	
F1	Fuse,3AG slow-blow,250V,current rating dependent upon model:	
	RFL 9125B 24DCPS: 3A,Littelfuse 313003 or equiv.	6607
	RFL 9125B 48DCPS: 2A,Littelfuse 313002 or equiv.	7549
	RFL 9125B 125DCPS: 1A,Littelfuse 313001 or equiv.	6645
L1,2	Choke,high-current,12mH,4.5A,10%,40 MHz series resonant frequency,	30436
	Caddell-Burns 6860-02 or equiv.	
L3,7	Inductor,powerline,10mH,Renco RL-1283-10 or equiv.	30063
L4,5	Inductor,powerline,25mH,Pulse Engineering 92100 or equiv.	30064
L6	Choke,swingductor,100mH,5A,radial leads,Renco RL-1386-1-100 or equiv.	30061
L8	Inductor,powerline,55mH,Pulse Engineering 92116 or equiv.	30068
L9,11	Inductor,powerline,10mH,Renco RL-1284-10 or equiv.	30059
L10	Choke,swingductor,220mH,4.5A,radial leads,Renco RL-1386-1-220 or equiv.	30062
SW1	Switch,rocker,SPST,marked,high inrush current	30441 1
T1	Transformer,input,voltage dependent upon model:	
	RFL 9125B 24DCPS: 24V	99548
	RFL 9125B 48DCPS: 48V	99549
	RFL 9125B 125DCPS: 125V	99551
T2-4	Transformer,current-sense,one-turn primary,100-turn secondary,	101653
	Pulse Engineering 67100 or equiv.	



a. Input converter board (Drawing No. D-103253, Rev A).



b. Output converter board (Drawing No. D-103258, Rev A).

NOTE: COMPONENT VALUES SHOWN ABOVE ARE FOR 48-VOLT SUPPLY; VALUES MAY BE DIFFERENT ON 24-VOLT OR 125-VOLT SUPPLIES.

Figure 14-9 Component locator drawing, dc-input power supply modules for RFL 9660 Digital Switch

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* FACTORY SELECTED PARTS

SYMBOL	24V	48V	125V
C4	220uF	100uF	22uF
C6	220uF	100uF	22uF
C8	470uF	220uF	33uF
R2	.13 OHM	.25 OHM	.5 OHM
R1	.5 OHM	2 OHM	4 OHM
CR4	FEP16DT	FEP16DT	FEP16HT
CR1	1.5KE33A	1.5KE68A	1.5KE200A
CR5	SA60	SA120	SA170
Q1	IRF540	IRF640	IRF740
Q2	IRF540	IRF640	IRF740
F1	3A	2A	1A
F2	3A	2A	1A
R3	100 OHM	750 OHM	3K
T1	24V	48V	125V

Figure 14-10. Schematic input board, dc input power supply, modules for RFL 9660 Digital Switch (Schematic No. D-103254, Rev A, Sheet 1 of 2)

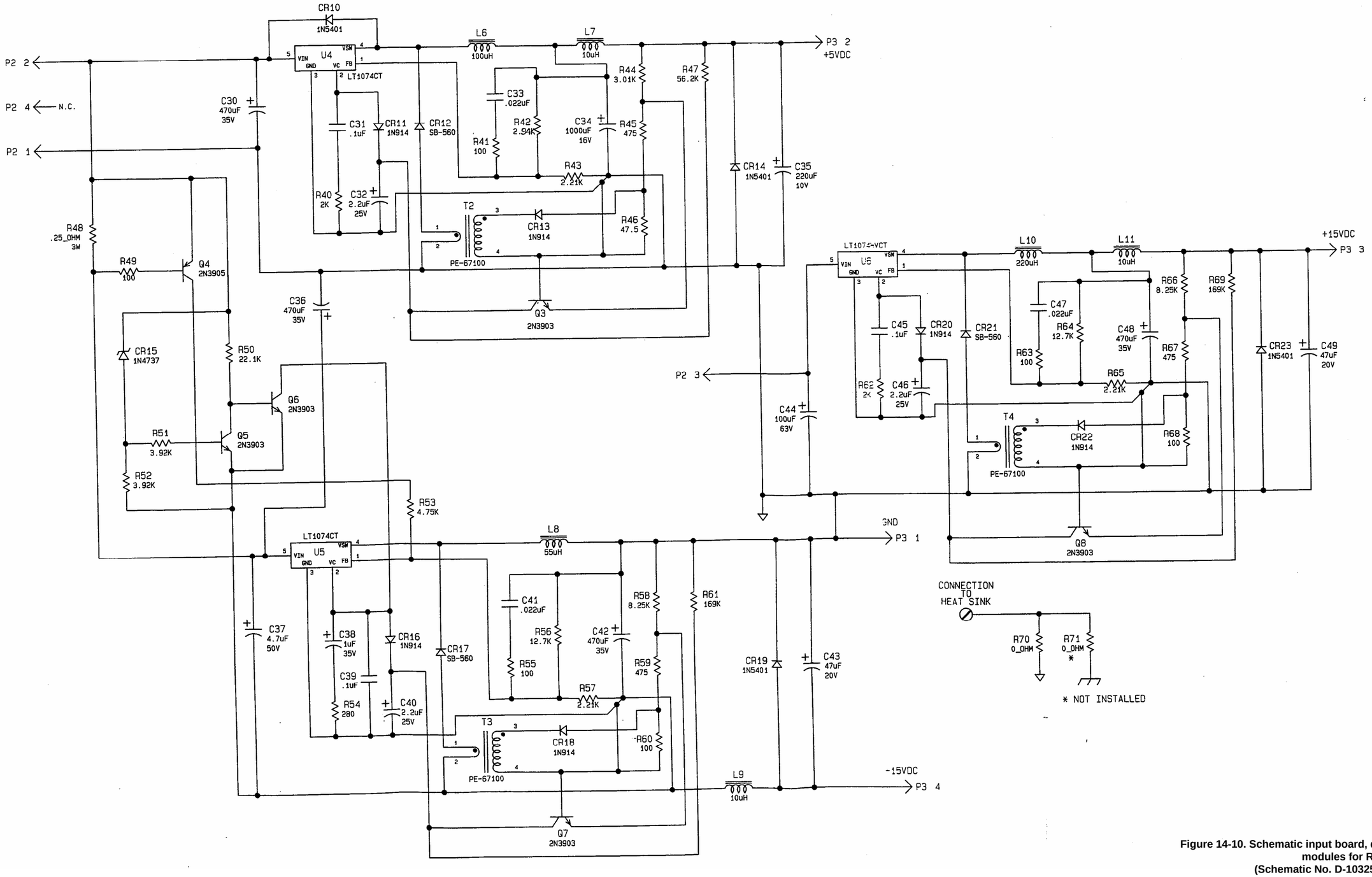


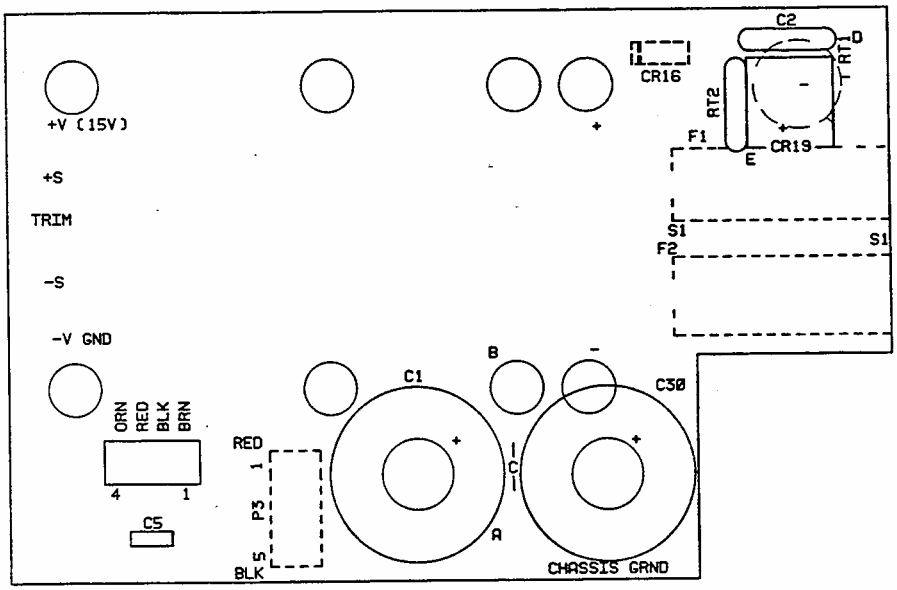
Figure 14-10. Schematic input board, dc input power supply, modules for RFL 9660 Digital Switch (Schematic No. D-103254, Rev A, Sheet 2 of 2)

Table 14-7. Replaceable parts, ac-input power supply module for RFL 9660 Digital Switch
RFL 9125A 110ACPS (110-Vac Input) - Assembly No. 101975-1

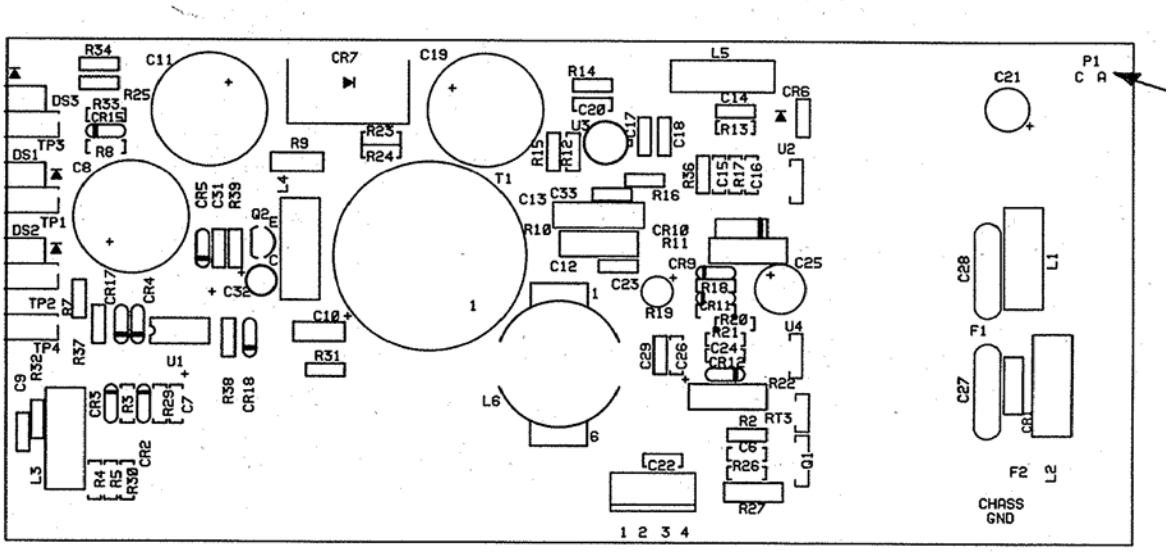
Circuit Symbol (Figs. 14-14 & 14-15)	Description	Part Number
	CAPACITORS	
C1,30	Capacitor,electrolytic,220μF,+30/-10%,200V,Sprague 80D221P200KA5 or equiv.	1007 1676
C2,27,28	Capacitor,ceramic disc,0.005μF,20%,3kV,Centralab DD30-502 or equiv.	1007 1264
C3,4,18	Not used.	
C5,9,15,22,24	Capacitor,Z5U ceramic,0.33μF,+80/-20%,50V,Murata RPA3025U334Z50V or equiv.	0135 53348
C6,8,20,29,33	Capacitor,X7R ceramic,0.1mF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C7,31	Capacitor,tantalum,1μF,20%,35V,Kemet T322B105M035AS or equiv.	1007 496
C8,11	Capacitor,electrolytic,2700μF,+30/-10%,25V,Sprague 80D272P025HA5 or equiv.	1007 1678
C10	Capacitor,tantalum,15μF,20%,20V,Kemet T322D156M020AS or equiv.	1007 716
C12	Capacitor,ceramic,0.0018μF,5%,100V,AVX SA301A182JAA or equiv.	0125 11825
C13	Capacitor,metallized polycarbonate,0.285μF,2%,100V,	1007 1423
	Wesco 32MPC or equiv.	
C14,16	Capacitor,X7R ceramic,0.01μF,10%,50V,AVX SA105C103KAA or equiv.	0130 51031
C17	Capacitor,ceramic,220pF,5%,100V,AVX SA101A221JAA or equiv.	0125 12215
C19	Capacitor,electrolytic,5600μF,+30/-10%,10V,Sprague 80D562P010HA5 or equiv.	1007 1679
C21	Capacitor,tantalum,220μF,20%,10V,Kemet T350L227M010AS or equiv.	1007 1684
C23	Capacitor,tantalum,1μF,10%,35V,Kemet T362A105K035AS or equiv.	1007 1566
C25	Capacitor,electrolytic,100μF,20%,50V,Nichicon ULB1H101M or equiv.	1007 1513
C26	Capacitor,tantalum,4.7μF,20%,20V,Kemet T322B475M020AS or equiv.	1007 711
C32	Capacitor,ceramic,0.1μF,GMV,50V,Centralab CY20C104P or equiv.	1007 1563
	RESISTORS	
R1,6,28,31,35,36	Not used.	
R2,31	Resistor,metal film,100Ω,1%,1/4W, Type RN1/4	0410 1192
R3,14,15	Resistor,metal film,4.99KΩ,1%,1/4W, Type RN1/4	0410 1355
R4	Resistor,metal film,200Ω,1%,1/4W, Type RN1/4	0410 1221
R5	Resistor,metal film,845Ω,1%,1/4W, Type RN1/4	0410 1281
R7,13,20,21,24,32-34	Resistor,metal film,1KΩ,1%,1/4W, Type RN1/4	0410 1288
R8,25	Resistor,metal film,221Ω,1%,1/4W, Type RN1/4	0410 1225
R9	Resistor,metal film,1KΩ,1%,1/2W, Type RN1/2	0410 2288
R10,22	Resistor,composition,470Ω,10%,1W,Allen-Bradley GB Series or equiv.	1009 662
R11	Resistor,wirewound,500Ω,5%,3.25W,Ohmite 4411 Style 995-3A or equiv.	1100 308
R12,16	Resistor,metal film,1.18KΩ,1%,1/4W, Type RN1/4	0410 1295
R17	Resistor,metal film,681Ω,1%,1/4W, Type RN1/4	0410 1272
R18,26,39	Resistor,metal film,49.9Ω,1%,1/4W, Type RN1/4	0410 1163
R19	Resistor,metal film,11KΩ,1%,1/4W, Type RN1/4	0410 1388
R23	Resistor,metal film,866Ω,1%,1/4W, Type RN1/4	0410 1282

Table 14-7. Replaceable parts, ac-input power supply module for RFL 9660 Digital Switch - continued.

Circuit Symbol (Figs. 14-14 & 14-15)	Description	Part Number
	RESISTORS -continued.	
R27	Resistor,composition,1W,5%,1/2W, Allen-Bradley EB Series or equiv.	1009 978
R29,36	Resistor,metal film,100KW,1%,1/4W, Type RN1/4	0410 1480
R30	Resistor,metal film,1.37KW,1%,1/4W, Type RN1/4	0410 1301
R37	Resistor,metal film,309KW,1%,1/4W, Type RN1/4	0410 1527
R38	Resistor,metal film,1.24KW,1%,1/4W, Type RN1/4	0410 1297
RT1,2	Thermistor,5W @ +25deg C,6A steady-state current, Keystone CL-40 or equiv.	30438
RT3	Keystone RL2006-100-100-30PTI or equiv.	30439
	SEMICONDUCTORS	
CR1,8,13,14,16	Not used.	
CR2-4,11,17	Diode,silicon,1N914B or 1N4448	26482
CR5	Diode,silicon,200 PIV,1N4003	30769
CR6,7	Diode,Schottky,45V,7A,TO-220 case,Motorola MBR745 or equiv.	30435
CR9,12	Diode,Schottky,60V,1A,DO-41 case,International Rectifier 11DQ06 or equiv.	96365
CR10	Diode,rectifier,200V,3A,Motorola MR502 or equiv.	90912
CR15	Diode,Zener,10V,5%,400mW,1N961B	34874
CR18	Bridge rectifier,400V,6A,Varo VH448 or equiv.	48731
CR19	Diode,Zener,18V,5%,1W,1N4746A	29757
DS1-3	Light-emitting diode,green,right-angle panel mount,Schroff 69004.122 or equiv.	30472
Q1	Diode,rectifier,50V,8A,TO-220AB case,General Electric C122F or equiv.	41073
Q2	Transistor,NPN,TO-92 case,2N3903	21562
U1	Linear overvoltage sensing circuit,8-pin ceramic DIP,Motorola MC3523V or equiv.	0620 310
U2,4	Linear switching regulator,+65-volt output @ 2.5 amperes, 5-pin TO-220 plastic package,Linear Technology LT1071CT or equiv.	0620 318
U3	Linear operational amplifier,8-pin TO-5 case,National Semiconductor LM208H or equiv.	0620 146
	MISCELLANEOUS COMPONENTS	
A1	Dc-dc converter module,150-volt input,+15-volt output,50W, Vicor VI-252-IY or equiv.	30595
F1,2	Fuse,3AG slow-blow,1A,250V,Littelfuse 313001 or equiv.	6645
L1-5	Choke,high-current,12mH,4.5A,10%,40 MHz series resonant frequency, Caddell-Burns 6860-02 or equiv.	30436
L6	Inductor,high-power/high-frequency	101983
SW1	Switch,rocker,SPST,marked,high inrush current	30441 1
T1	Transformer,flyback	101979 2



a. Input converter board (Drawing No. D-103998, Rev C).



b. Output converter board (Drawing No. D-101973, Rev H).

Figure 14-11 Component locator drawing, dc-input power supply modules for RFL 9660 Digital Switch

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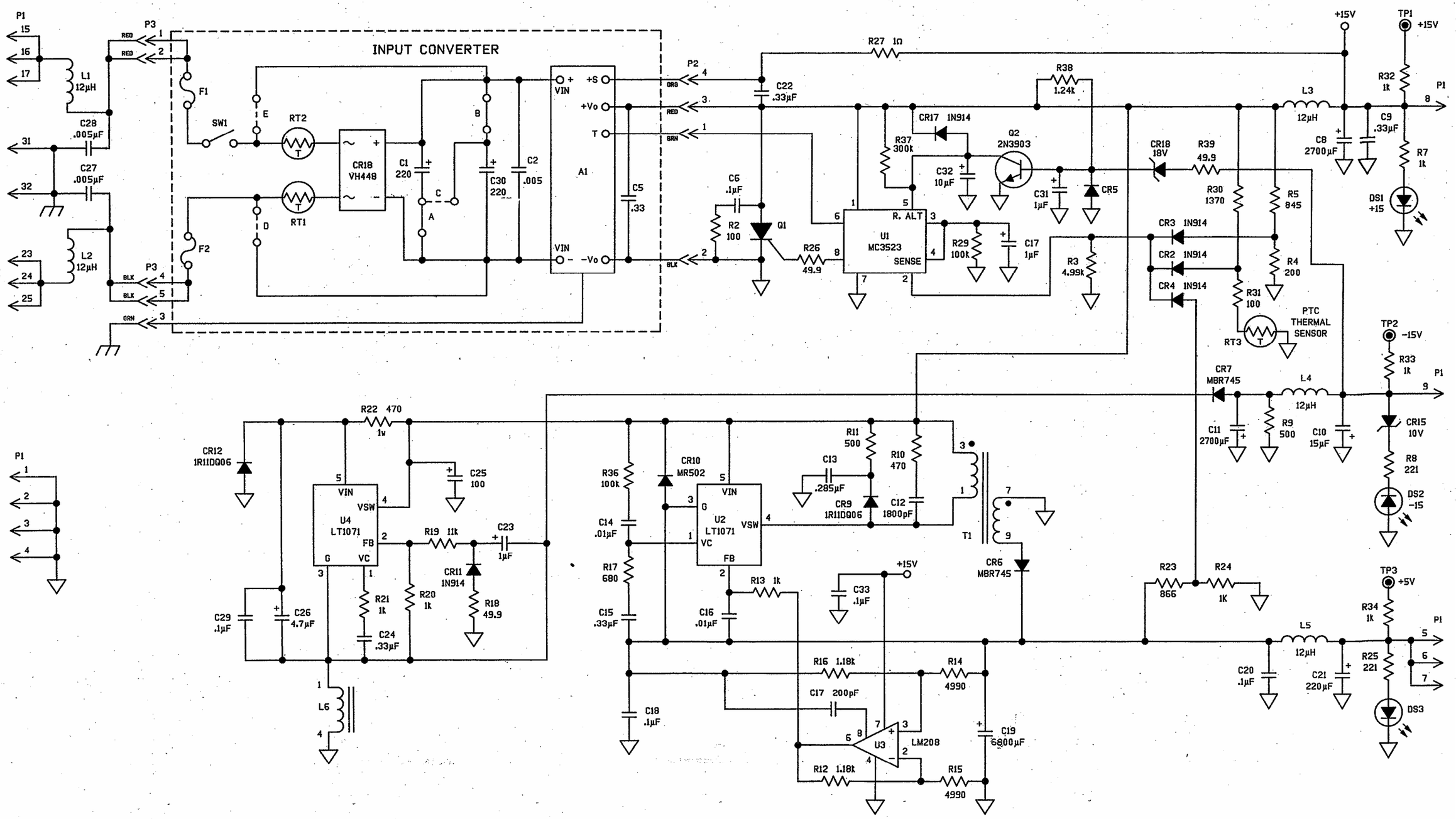


Figure 14-12. Schematic ac-input power supply modules, For RFL 9660 Digital Switch (Assembly No. 101975-1; (Schematic No. D-101974-3, Rev B,

Table 14-8. Replaceable parts, RFL 96 PWR/ALARM I/O Dc-Input Power/Alarm I/O Module
RFL 96 PWR/ALARM I/O (48Vdc/125Vdc) - Assembly No. 104400
RFL 96 PWR/ALARM I/O (220Vac) - Assembly No. 104400-2
RFL 96 PWR/ALARM I/O (24Vdc) - Assembly No. 104400-3
RFL 96 PWR/ALARM I/O (250Vdc) - Assembly No. 104400-4

Circuit Symbol (Figs. 14-16 & 14-17)	Description	Part Number
C1-4,7-10	Capacitor,ceramic disc,0.01uF,20%,3KV,Sprague 30GAS10KJ or equiv.	1007 1811
C5	Capacitor,electrolytic,220uF,20%,35V,Panasonic ECEA1VV221S or equiv.	1007 1480
C6	Capacitor,ceramic,0.1uF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
CR1,2	Diode,silicon,rectifier,1 Amp,1N4003	30769
CR3	Suppressor,transient,voltage,General Instrument 1.5KE350CA or equiv.	
	104400: 1N4003	101722
	104400-2 not used	not used
	104400-3: 1N4003	101722
	104400-4: 1N4003	101722
CR4	Diode,silicon,rectifier,1 Amp,1N4003	
	104400: not used	not used
	104400-2: not used	not used
	104400-3: 1N4003	30769
	104400-4: 1N4003	30769
K1,2	Relay,SPDT,12VDC, PCB MTG	
	104400: American Zettler AZ8-1CH-12DE or equiv.	101178
	104400-2: American Zettler AZ8-1CH-12DE or equiv.	101178
	104400-3: American Zettler AZ8-1CH-12DE or equiv.	101178
	104400-4: Potter & Brumfield RKA-5DG-12 or equiv.	101236
K3	Optical input module,3- to 32-Vdc input A 18 mA, 5-volt logic output @ 50 mA, Grayhill 70M-IDC5 or equiv.	98098
L1-6	Inductor,10uH,5%,1.5A max,J.W. Miller 4622 or equiv.	30285
L7,8	Inductor,12uH,4.5A,10%,Caddell-Burns 6880-2 or equiv.	30436
R1,2	Resistor,wirewound	
	104400: 5K,5%,3.25W,Ohmite 4442 style 995-3A or equiv.	1100 460
	104400-2: 5K,5%,3.25W,Ohmite 4442 style 995-3A or equiv.	1100 460
	104400-3: 1.2K,5%,3.25W,Ohmite 4442 style 995-3A or equiv.	1100 411
	104400-4: 9K,5%,5W, Clarostat VC5E9K or equiv.	1100 431
VR1	Suppressor, varistor	
	104400: not used	not used
	104400-2 275VRMS	101171
	104400-3: not used	not used
	104400-4: not used	not used
F1, 2	Fuse	
	104400: not used	not used
	104400-2 1 Amp, 3AG, 250V, SLO-BLO	6645
	104400-3: not used	not used
	104400-4: not used	not used

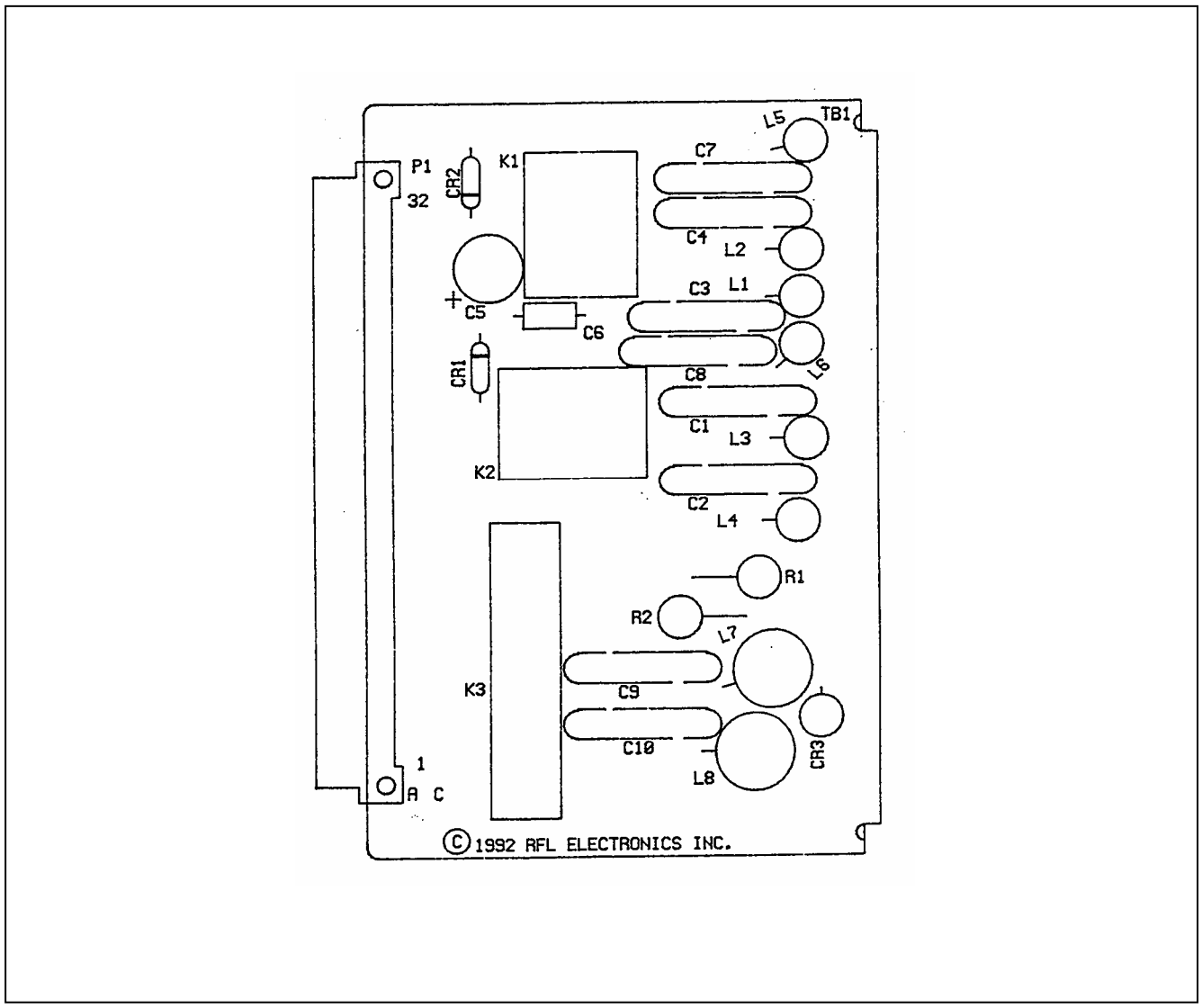
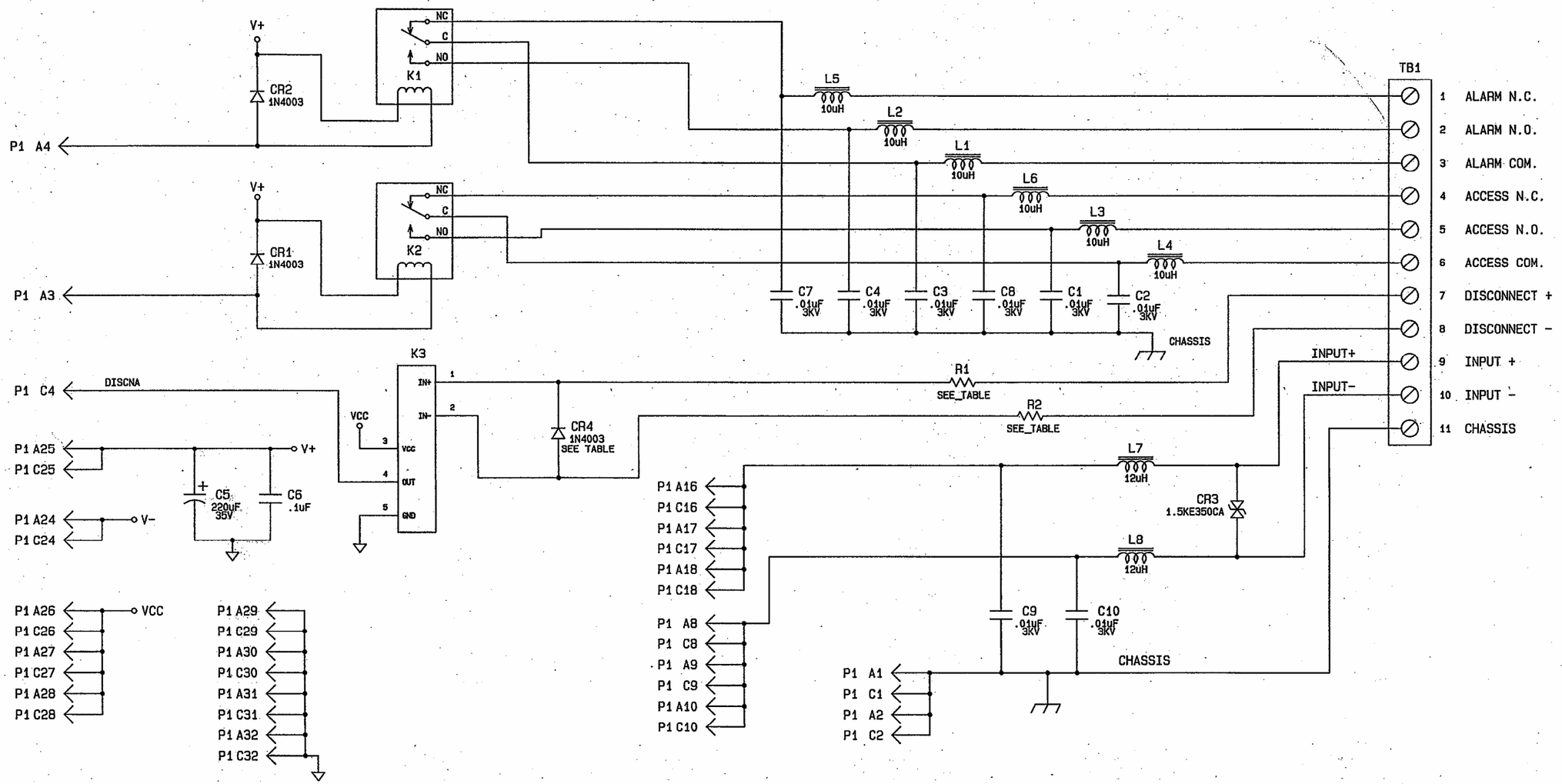


Figure 14-13. Component locator drawing, RFL 96 PWR/ALARM I/O Dc-Input Power/Alarm I/O Module (Assembly No. 104400; Drawing No. C-104403, Rev. G)



DESCRIPTION	INPUT VOLTS	R1	R2	CR4
104400	48/125VDC	5K 3.25W	5K 3.25W	NA
104400-3	24VDC	1.2K 3.25W	1.2K 3.25W	1N4003
104400-4	250VDC	9K 5W	9K 5W	1N4003

Figure 14-17. Schematic RFL 96 PWR/ALARM I/O, Dc-input Power/Alarm I/O Module (Assembly No. 104400, 104400-3 and 104400-4; Schematic No. D-104404, Rev E)

Table 14-9. Replaceable parts, RFL 96 AC/ALARM I/O Ac-Input Power/Alarm I/O Module
RFL 96 AC/ALARM I/O (110Vac) - Assembly No. 104400-1

Circuit Symbol (Figs. 14-18 & 14-19)	Description	Part Number
C1-4,7-10	Capacitor,ceramic disc,0.01uF,20%,3KV,Sprague 30GAS10KJ or equiv.	1007 1811
C5	Capacitor,electrolytic,220uF,20%,35V,Panasonic ECEA1VV221S or equiv.	1007 1480
C6	Capacitor,ceramic,0.1uF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
CR1,2	Diode,silicon,rectifier,1 Amp,1N4003	30769
F1,2	Fuse,3AG,slow-blow,1A,250V,Littlefuse 313001 or equiv.	6645
K1,2	Relay,SPDT,12VDC,PCB MTG	101722
K3	Optical input module,3- to 32-Vdc input A 18 mA, 5-volt logic output @50 mA,Grayhill 70M-IDC5 or equiv.	98098
L1-6	Inductor,10uH,1.5A,5%,J.W.Miller 4622 or equiv.	30285
L7,8	Inductor,12uH,4.5A,10%,Caddell-Burns 6880-2 or equiv.	30436
R1,2	Resistor,wirewound,5KΩ,5%,3.25W,Ohmite 4442 Style 995-3A or equiv.	1100 460
VR1	Suppressor,Varistor,metal-oxide,140 Vrms/180 Vdc,Siemens S10K140 or equiv.	101170

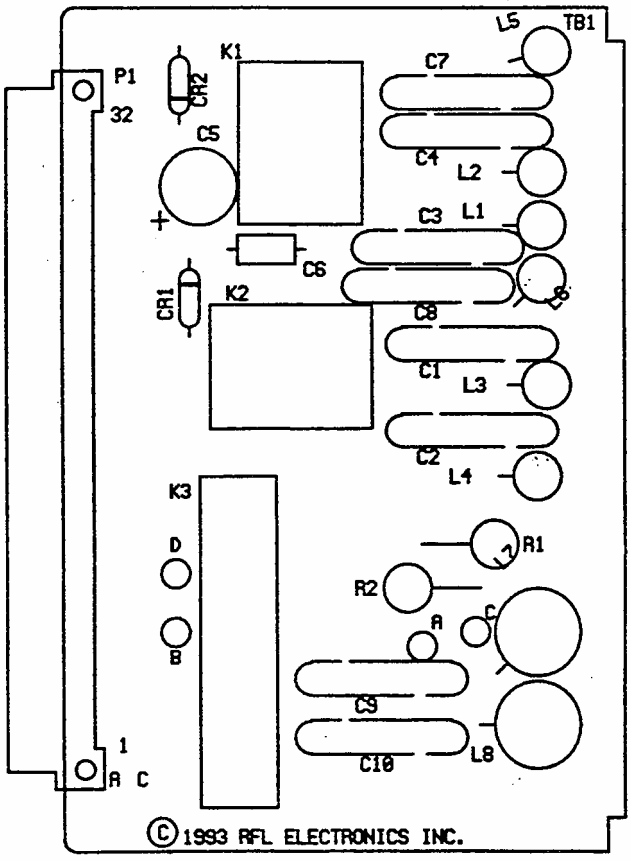
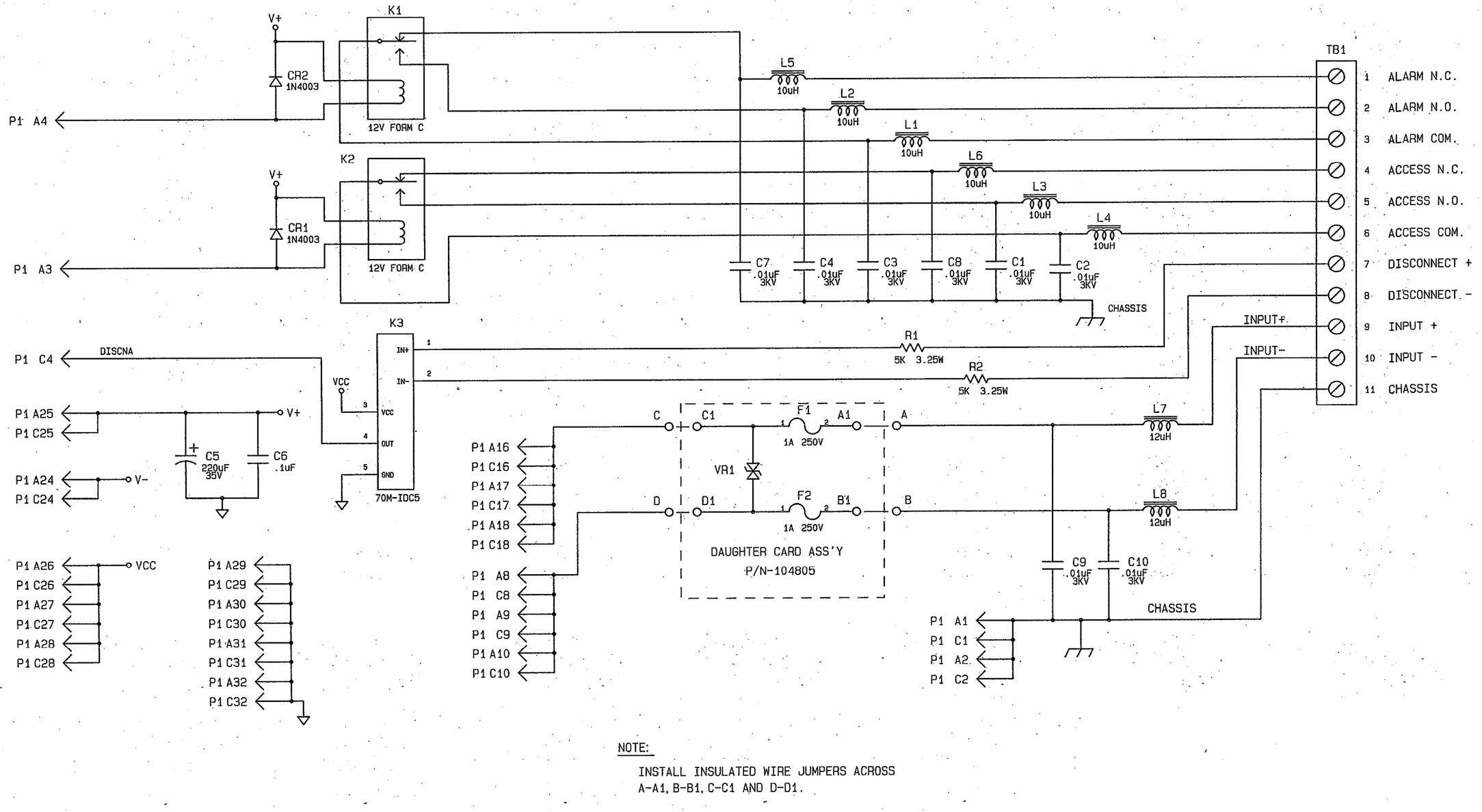


Figure 14-18. Component locator drawing, RFL 96 AC/ALARM I/O (110Vac and 220Vac)Ac-Input Power/Alarm I/O Module (Assembly No. 104400-1 and 104400-2; Drawing No. C-104403-1, Rev. C)



NOTE:

INSTALL INSULATED WIRE JUMPERS ACROSS A-A1, B-B1, C-C1 AND D-D1.

Figure 14-19. Schematic RFL 96 AC/ALARM I/O, Ac-input Power/Alarm I/O Module (Assembly No. 104400-1; Schematic No. D-104404-1, Rev C)

Table 14-10. Replaceable parts, RFL 96 MSM I/O RS-232 Device Port Module Assembly No. 104420

Circuit Symbol (Figs. 14-20 & 14-21)	Description	Part Number
C1-3	Capacitor,tantalum,4.7mF,20%,20V,Kemet T322B475M020AS or equiv.	1007 711
C4,6,7,9-11,14,17,25	Capacitor,X7R ceramic,0.1mF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C5,8,12,13,15,16, 18-24	Not used.	
CR1	Light-emitting diode,red,Dialight 550-0102 or equiv.	39568
JP1,2	Shorting bar,single,Molex 90059-0009 or equiv.	98306
RZ1-8	Resistor network,five 4.7KW 2% resistors,0.75W total,6-pin SIP, Bourns 4306R-101-472 or equiv.	30554
U1-8	MOS quad line driver,14-pin DIP,National Semiconductor DS14C88N or equiv.	0615 302
U9-24,40,41	Not used.	
U25,27,29,32,34,36	MOS quad line receiver,14-pin DIP,National Semiconductor DS14C89N or equiv.	0615 303
U26,28,30,31,33,35, 37,38,43,44,47	MOS tri-state octal buffer,20-pin DIP,National Semiconductor MM74HC244N or equiv.	0615 176
U39,45	MOS 4-bit magnitude comparator,16-pin DIP, National Semiconductor MM74HC85N or equiv.	0615 167
U42	MOS quad 2-input NAND gate,14-pin DIP, National Semiconductor MM74HC00N or equiv.	0615 159
U46	MOS decoder,3-line to 8-line,16-pin DIP, National Semiconductor MM74HC138N or equiv.	0615 168
U48	Linear voltage regulator,+12-volt,3-terminal TO-220 case, National Semiconductor LM340T-12 or equiv.	0620 69
U49	Linear voltage regulator,-12-volt,3-terminal plastic package, National Semiconductor LM320T-12 or equiv.	0620 121

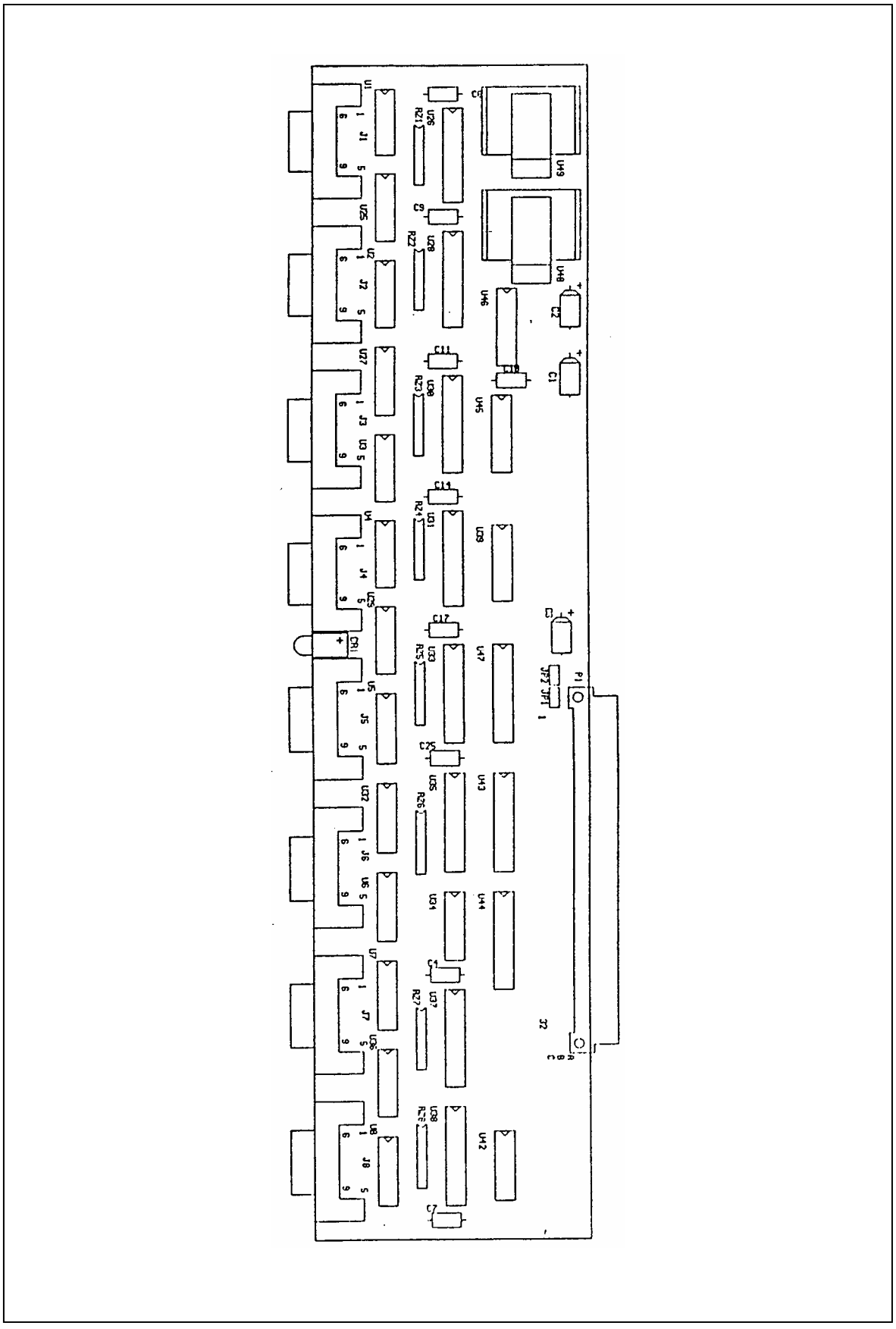


Figure 14-20. Component locator drawing, RFL 96 MSM I/O RS-232 Device Port Module (Assembly No. 104420; Drawing No. D-104423, Rev. D)

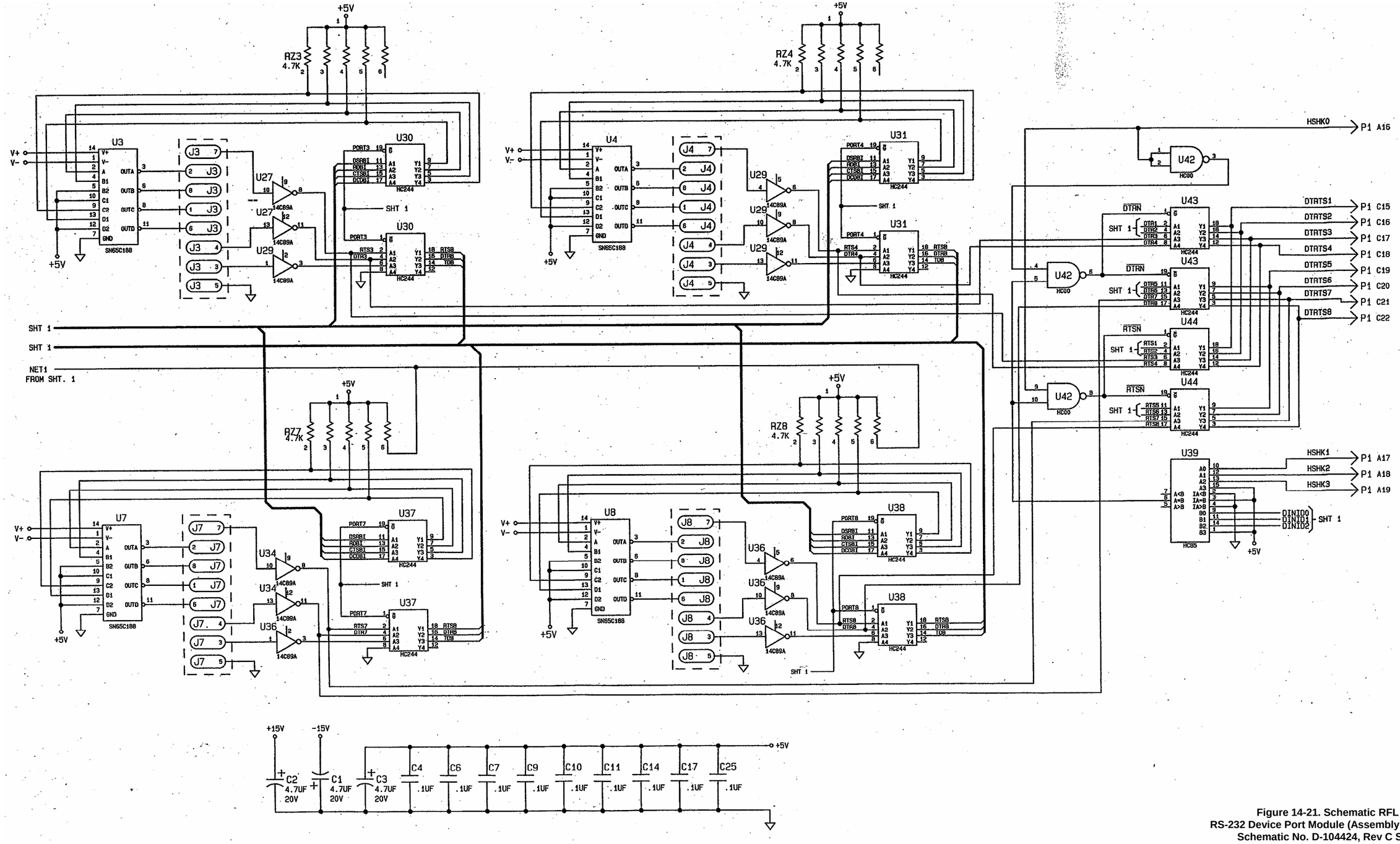


Figure 14-21. Schematic RFL 96 MSM I/O RS-232 Device Port Module (Assembly No.104420; Schematic No. D-104424, Rev C Sheet 1 of 2)

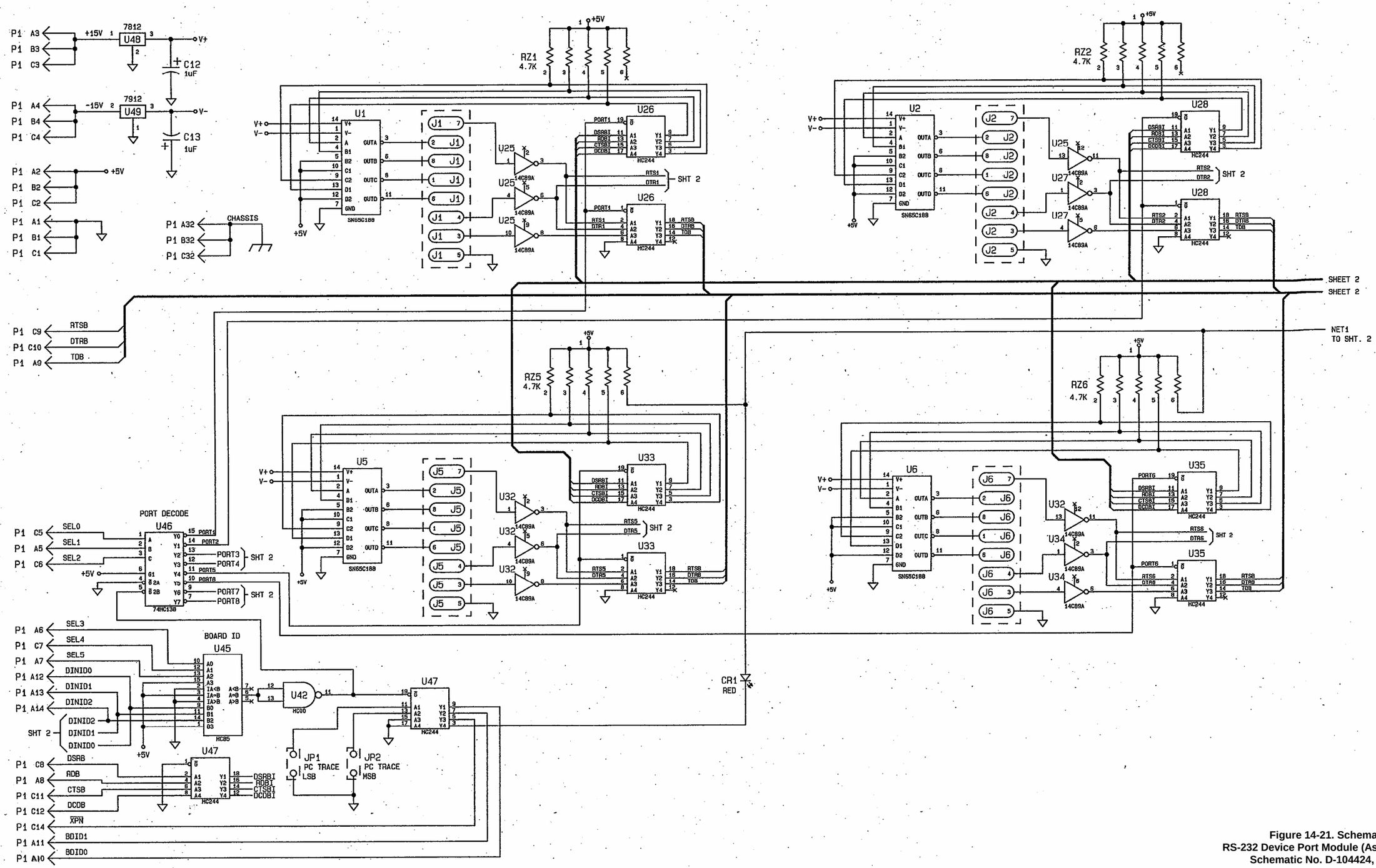


Figure 14-21. Schematic RFL 96 MSM I/O RS-232 Device Port Module (Assembly No.104420; Schematic No. D-104424, Rev C Sheet 2 of 2)

Table 14-11. Replaceable parts, fiber optic master I/O module for RFL 9660 Digital Switch Assembly No. 104430

Circuit Symbol (Figs. 14-22 & 14-23)	Description	Part Number
	CAPACITORS	
C1	Capacitor,ceramic,33pF,5%,100V,AVX SA101A330JAA or equiv.	0125 13305
C2,3,6,7	Capacitor,ceramic,27pF,5%,100V,AVX SA101A270JAA or equiv.	0125 12705
C4,8,9,12-24,28-38	Capacitor,X7R ceramic,0.1mF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C5	Capacitor,tantalum,4.7mF,20%,20V,Kemet T322B475M020AS or equiv.	1007 711
C10,11	Not used.	
C25,39,40	Capacitor,ceramic,0.001mF,5%,100V,AVX SA201A102JAA or equiv.	0125 11025
C26,27	Capacitor,electrolytic,100mF,20%,10V,Illinois Capacitor 107RMR010M or equiv.	1007 1740
	RESISTORS	
R1	Resistor,composition,8.2W,5%,1/4W, Allen-Bradley CB Series or equiv.	1009 971
R2	Resistor,metal film,2.49KW,1%,1/4W, Type RN1/4	0410 1326
R3	Resistor,metal film,1KW,1%,1/4W, Type RN1/4	0410 1288
R4	Resistor,metal film,562W,1%,1/4W, Type RN1/4	0410 1264
R5	Resistor,metal film,15.0MW,1%,1/4W, Type RN1/4	0410 1689
R6	Resistor,metal film,100KW,1%,1/4W, Type RN1/4	0410 1480
RZ1	Resistor network,five 330W 2% resistors,1.0W total,6-pin SIP, Allen-Bradley 406A-331 or equiv.	96381
RZ2	Resistor network,five 3.6KW 2% resistors,1W total,6-pin SIP, Bourns 4306R-101-332 or equiv.	101161
RZ3	Resistor network,five 150W 2% resistors,1W total,6-pin SIP, Bourns 4306R-101-151 or equiv.	101156
RZ4	Resistor network,five 560W 2% resistors,1W total,6-pin SIP, Bourns 4306R-101-561 or equiv.	101158
	SEMICONDUCTORS	
DS1,2	Light-emitting diode,green,right-angle PC mount,Industrial Devices 5300H5 or equiv.	32567
U1	TTL quad 2-input NAND drivers,gate,14-pin DIP, Texas Instruments SN74AS1000AN or equiv.	0610 151
U2	MOS Manchester,medium,20-pin DIP,Harris HDI-6409-9 or equiv.	0615 396
U3	MOS shift register,8-bit,parallel in/serial out,14-pin DIP, National Semiconductor MM74HC165N or equiv.	0615 174
U4	MOS 14-stage binary counter,16-pin DIP,Texas Instruments SN74HC4020N or equiv.	0615 404
U5	MOS synchronous binary counter w/asynchronous clear,16-pin DIP, National Semiconductor MM74HC161N or equiv.	0615 172
U6	MOS quad 2-input NOR gate,14-pin DIP, National Semiconductor MM74HC02N or equiv.	0615 160
U7	MOS hex inverter,14-pin DIP,National Semiconductor MM74HC04N or equiv.	0615 185
U8,10	MOS dual D-type flip-flop w/preset and clear,14-pin DIP, National Semiconductor MM74HC74N or equiv.	0615 166

Table 14-11. Replaceable parts, fiber optic master I/O module for RFL 9660 Digital Switch - continued.

Circuit Symbol (Figs. 14-22 & 14-23)	Description	Part Number
	SEMICONDUCTORS - continued.	
U9	MOS shift register,8-input,tri-state outputs,16-pin DIP, Motorola MC74HC595N or equiv.	0615 373
U11,23	MOS dual 4-bit binary counter,14-pin DIP, National Semiconductor MM74HC393N or equiv.	0615 192
U12,21	Custom PAL (Programmable Array - Logic),factory-programmed	Contact factory
U13	Not used.	
U14	Microcontroller,40-pin DIP,Signetics SC80C31BA0N40 or equiv.	0640 36
U15	MOS static RAM,8K x 8,100-ns access time,28-pin DIP,Sharp LH5168H-10L or equiv.	0615 398
U16	Programmable peripheral interface,40-pin DIP,Harris IP82C55A or equiv.	0635 21
U17	EPROM,3332K x 8,factory-programmed	Contact factory
U18	MOS tri-state octal buffer,20-pin DIP,National Semiconductor MM74HC244N or equiv.	0615 176
U19	MOS octal D-type latch,20-pin DIP,National Semiconductor MM74HC373N or equiv.	0615 283
U20	MOS dual precision monostable multivibrator,16-pin DIP, Motorola MC74HC4538N or equiv.	0615 301
U22	Microprocessor supervisor,16-pin DIP,Maxim MAX691EPE or equiv.	0635 31
U24	MOS tri-state octal D-type flip-flop,20-pin DIP, National Semiconductor MM74HC374N or equiv.	0615 178
U25	MOS 1 to 64-bit shift register,16-pin DIP,Motorola MC14557BCP or equiv.	0615 403
U26	Fiber optic receiver,ST connector,pc-mount right-angle, Hewlett-Packard HFBR-2412 (ST) or equiv.	101111
U27	Fiber optic transmitter,ST connector,pc-mount right-angle, Hewlett-Packard HFBR-1414 (ST) or equiv.	101112
U28	Linear voltage regulator,+5-volt,3-terminal plastic package, Motorola MC7805CP or equiv.	0620 77
	MISCELLANEOUS COMPONENTS	
S1	Switch array,two SPST piano switches,4-pin DIP,AMP 1-435802-3 or equiv.	101157
Y1	Crystal,quartz,16 Mhz	99215 9
Y2	Crystal,quartz,11.0592 MHz	99215 10
. . .	Shorting bar,single,Molex 90059-0009 or equiv.	98306

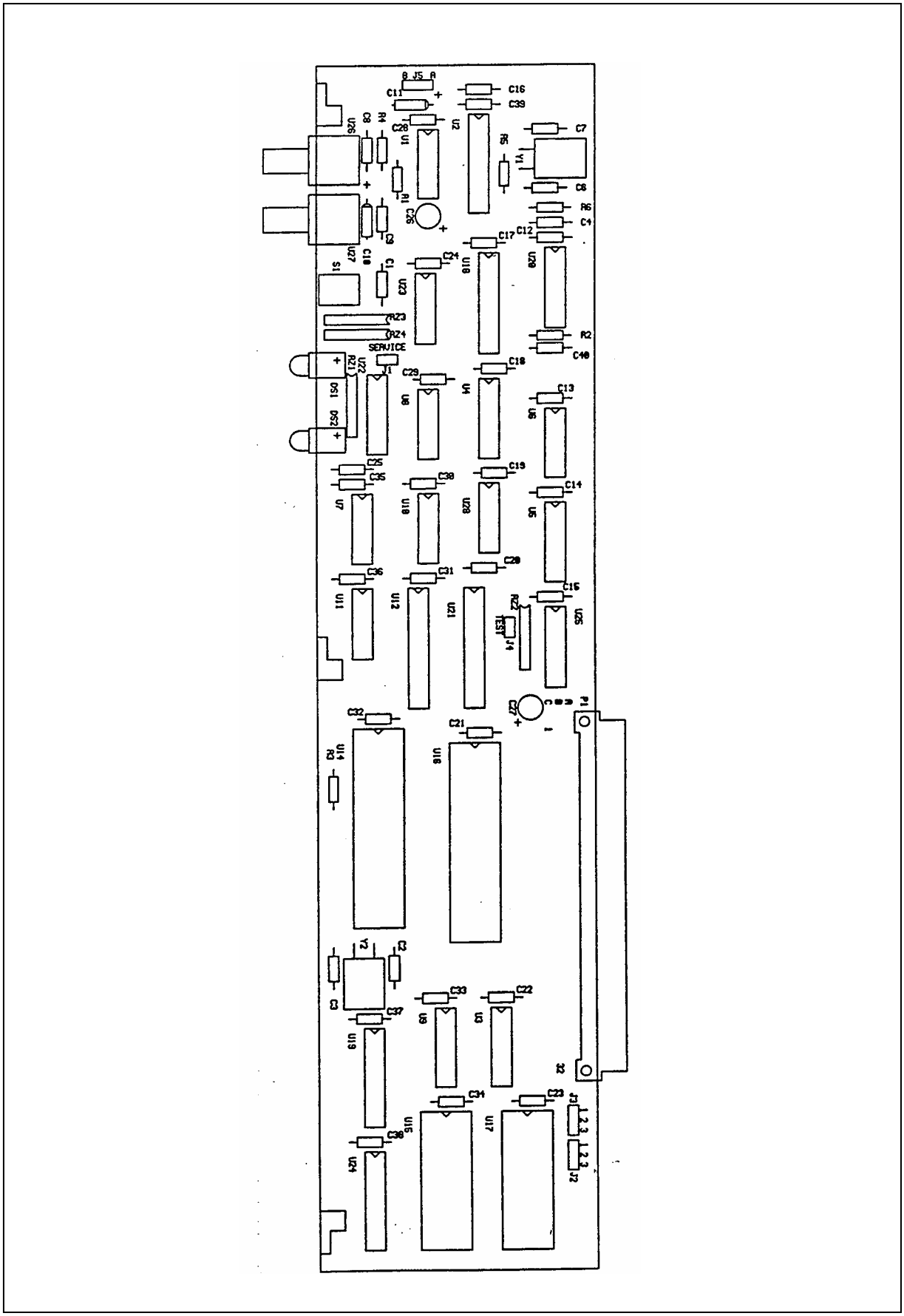


Figure 14-22. Component locator drawing, fiber optic master I/O Module for RFL 9660 Digital Switch (Assembly No. 104430; Drawing No. D-104433, Rev. B)

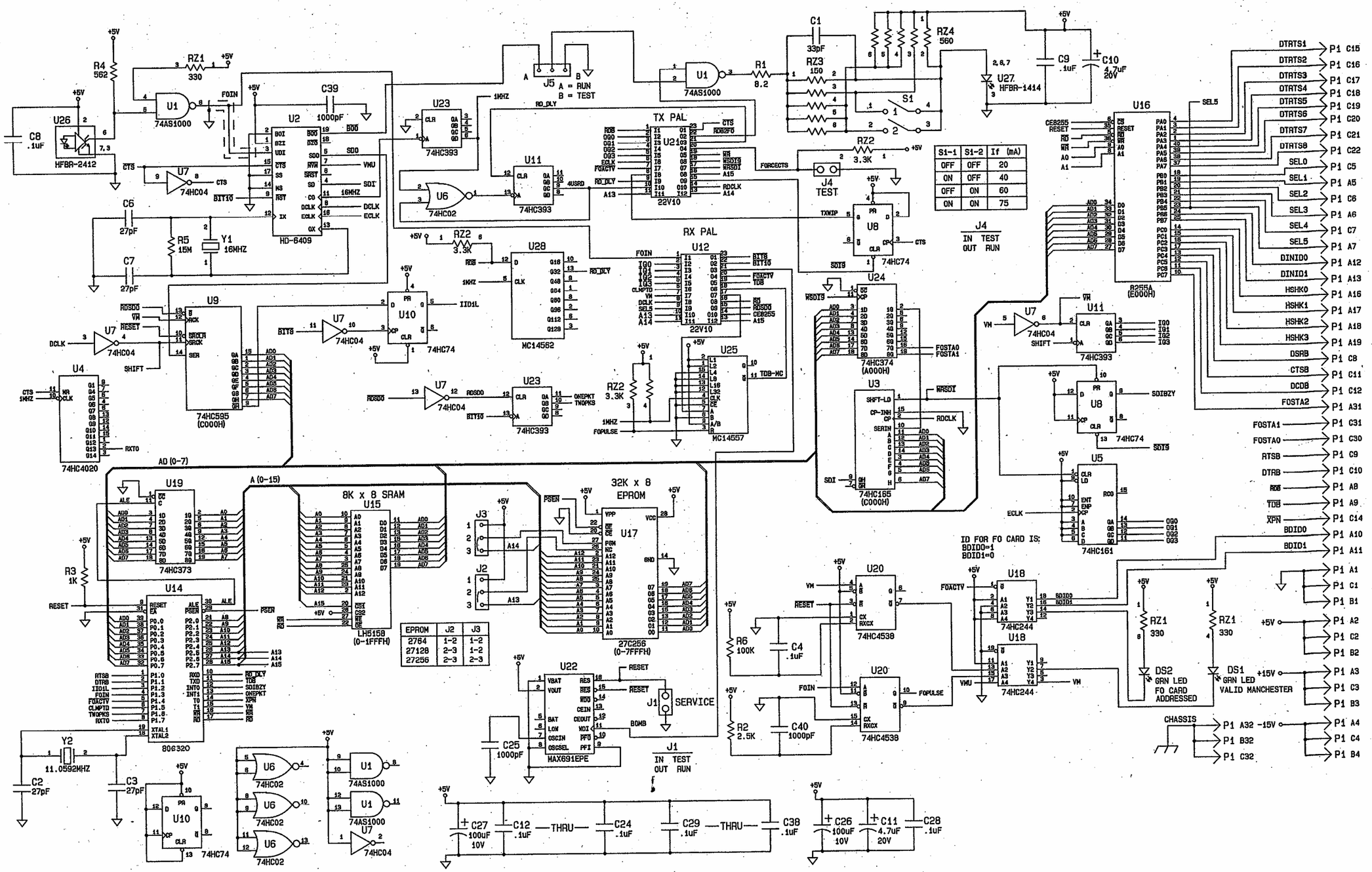


Figure 14-23. Schematic, fiber optic master I/O module for RFL 9660 Digital Switch (Assembly No. 104430; Schematic No. D-104434, Rev B)

Table 14-12. Replaceable parts, motherboard for RFL 9660 Digital Switch Assembly No. 104470

Circuit Symbol (Figs. 14-24 & 14-25)	Description	Part Number
C1-3	Capacitor,ceramic disc,0.01mF,20%,3000V,Sprague 30GA-S10 or equiv.	1007 1442

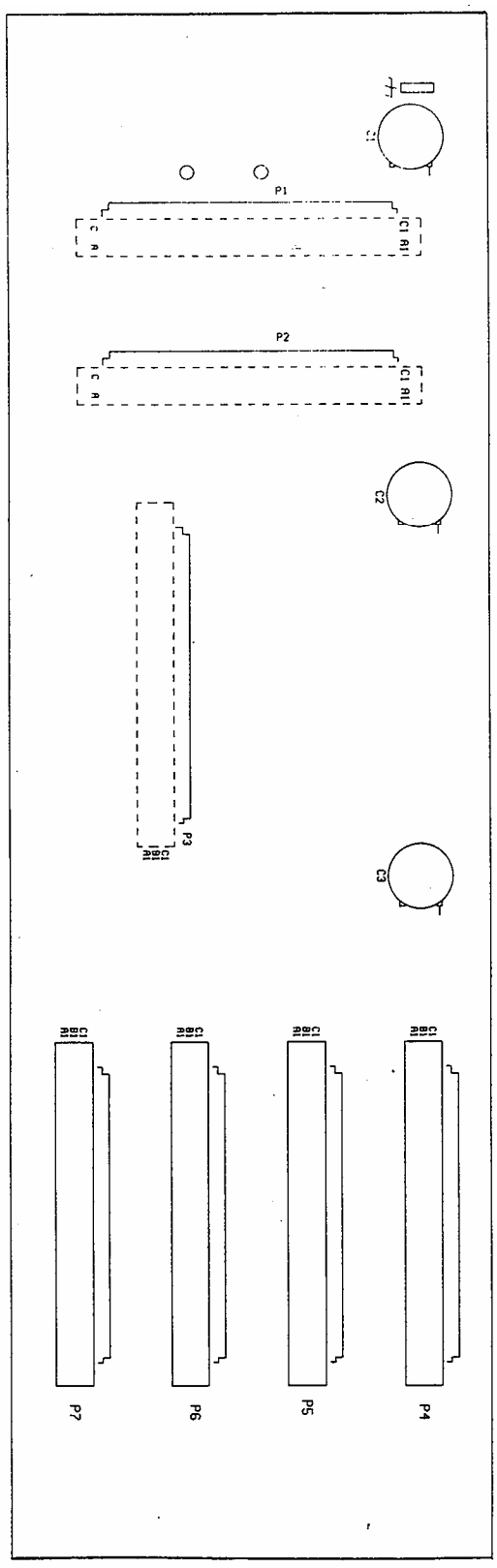


Figure 14-24. Component locator drawing, motherboard for RFL 9660 Digital Switch (Assembly No. 104470; Drawing No. D-104473, Rev. B)

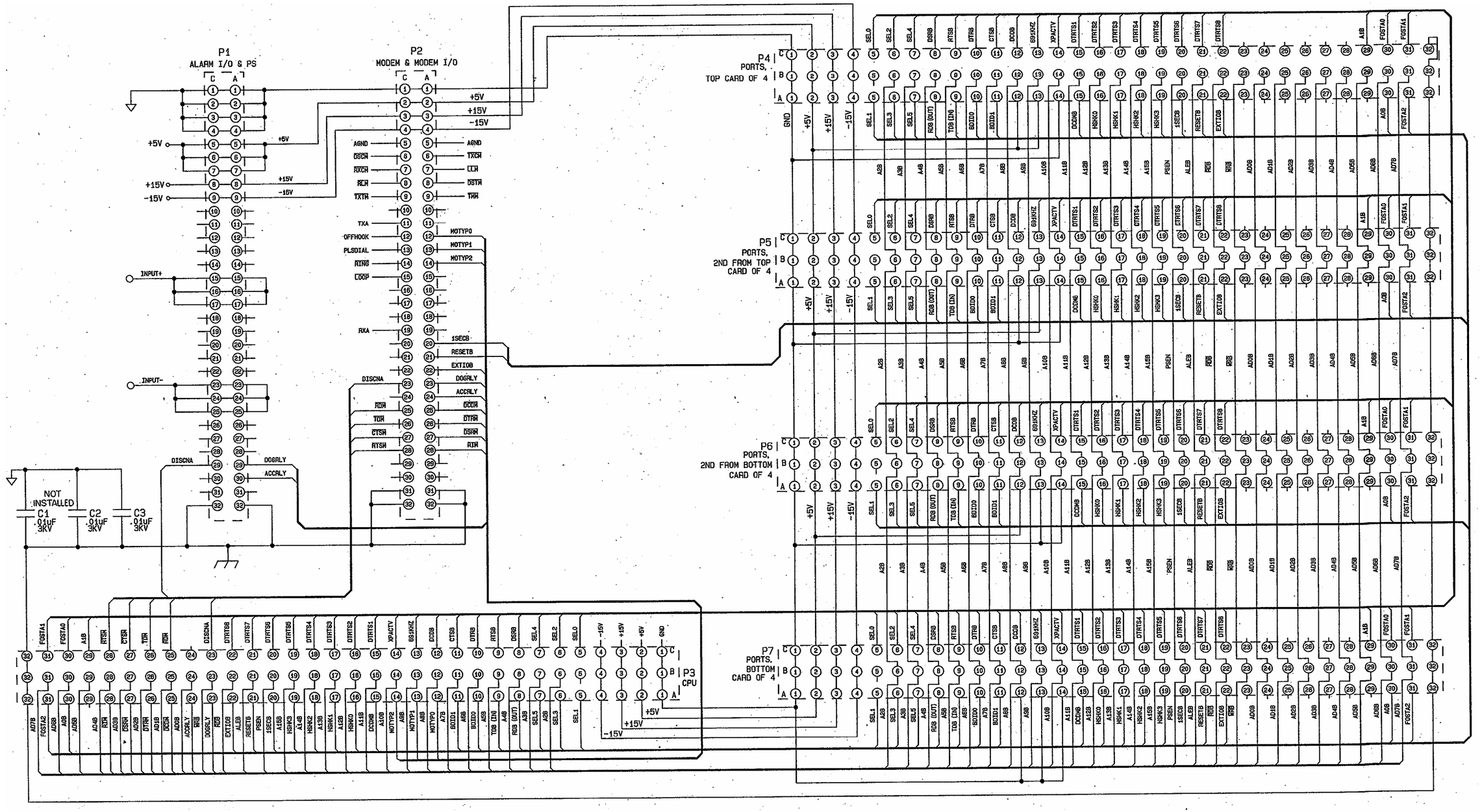


Figure 14-25. Schematic, motherboard for RFL 9660 Digital Switch (Assembly No. 104470; Schematic No. D-104474, Rev B)

Table 14-13. Replaceable parts, fiber optic remote module transceiver board
Assembly No. 104460-1

Circuit Symbol (Figs. 14-26 & 14-27)	Description	Part Number
	CAPACITORS	
C1-3	Capacitor,ceramic,33pF,5%,200V,AVX SA101A330JAA or equiv.	0125 23305
C4,10-22,24, 28-39	Capacitor,ceramic,0.1μF,10%,50V,AVX SA305C104KAA or equiv.	0130 51041
C5,41	Capacitor,ceramic,0.001μF,10%,100V,AVX SA101C102KAA or equiv.	0130 11021
C6-8	Not used.	
C9,25	Capacitor,tantalum,4.7μF,20%,20V,Kemet T322B475M020AS or equiv.	1007 711
C23	Capacitor,tantalum,10μF,20%,20V,Kemet T110B106M020AS or equiv.	1007 1610
C26	Capacitor,tantalum,100μF,20%,20V,Kemet T110D107M020AS or equiv.	1007 883
C27	Capacitor,tantalum,220μF,20%,10V,Kemet T110D227M010AS or equiv.	1007 717
	RESISTORS	
R1,3,6	Not used.	
R2	Resistor,metal film,15.0MΩ,1%,1/4W, Type RN1/4	0410 1689
R4	Resistor,metal film,100KΩ,1%,1/4W, Type RN1/4	0410 1480
R5	Resistor,metal film,2.49KΩ,1%,1/4W, Type RN1/4	0410 1326
R7	Resistor,composition,8.2Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 971
R8	Resistor,metal film,562Ω,1%,1/4W, Type RN1/4	0410 1264
R9	Resistor,composition,10Ω,5%,1/4W,Allen-Bradley CB Series or equiv.	1009 823
RZ1	Resistor network,five 10KΩ 2% resistors,0.75W total,6-pin SIP,Bourns 4306R-101-103 or equiv.	32664
RZ2	Resistor network,five 330Ω 2% resistors,1.0W total,6-pin SIP,Allen-Bradley 406A-331 or equiv.	96381
RZ3	Not used.	
RZ4	Resistor network,nine 3.3KΩ 2% resistors,2.7W total,10-pin SIP,Dale MSP10C01332G or equiv.	32632
RZ5	Resistor network,five 560Ω 2% resistors,1W total,6-pin SIP,Bourns 4306R-101-561 or equiv.	101158
RZ6	Resistor network,five 150Ω 2% resistors,1W total,6-pin SIP, Bourns 4306R-101-151 or equiv.	101156
	SEMICONDUCTORS	
CRZ1,2	Suppressor,array,voltage	101456
DS1-4,7	Not used.	
DS5	Light-emitting diode,green,right-angle PC mount,Industrial Devices 5300H5 or equiv.	32567
DS6	Light-emitting diode,amber,right-angle PC mount,Hewlett-Packard HLMP-5040 or equiv.	99798
U1,17	MOS shift register,8-bit,serial in/parallel out,16-pin DIP, National Semiconductor MM74HC164N or equiv.	0615 173
U2	MOS 8-bit magnitude comparator,20-pin DIP, National Semiconductor MM74HC688N or equiv.	0615 183
U3	MOS tri-state octal D-type flip-flop,20-pin DIP, National Semiconductor MM74HC374N or equiv.	0615 178

<< table continues on next page >>

Table 14-13. Replaceable parts, fiber optic remote module transceiver board - continued.

Circuit Symbol (Figs. 14-26 & 14-27)	Description	Part Number
	SEMICONDUCTORS - continued	
U4	RS-232 line driver,4 drivers/3 receivers,24-pin narrow DIP,Maxim MAX236ENG or equiv.	0680 23
U5	Fiber optic transmitter,ST connector,pc-mount right-angle,Hewlett-Packard HFBR-1414 (ST) or equiv.	101112
U6	Fiber optic receiver,ST connector,pc-mount right-angle,Hewlett-Packard HFBR-2412 (ST) or equiv.	101111
U7	MOS Manchester,medium,20-pin DIP,Harris HDI-6409-9 or equiv.	0615 396
U8	MOS shift register,8-bit,parallel in/serial out,14-pin DIP, National Semiconductor MM74HC165N or equiv.	0615 174
U9,13,23,24,26	Not used.	
U10,21,27	MOS dual D-type flip-flop w/preset and clear,14-pin DIP,National Semiconductor MM74HC74N or equiv.	0615 166
U11	MOS dual 4-input data select,16-pin DIP,Motorola MC74HC253N or equiv.	0615 400
U12	MOS dual precision monostable multivibrator,16-pin DIP, Motorola MC74HC4538N or equiv.	0615 301
U14	MOS 12-stage binary counter,16-pin DIP,National Semiconductor MM74HC4040N or equiv.	0615 179
U15,18,31	Custom PAL (Programmable Array - Logic),factory-programmed|Contact factory	Contact factory
U16,25	MOS dual 4-bit binary counter,14-pin DIP,National Semiconductor MM74HC393N or equiv.	0615 192
U19	TTL hex inverting driver,14-pin DIP,Texas Instruments SN74AS1004AN or equiv.	0610 153
U20	Microprocessor supervisor,8-pin DIP,Maxim MAX690EPA or equiv.	0635 27
U22	MOS quad 2-input NOR gate,14-pin DIP,National Semiconductor MM74HC02N or equiv.	0615 160
U28	MOS 128-bit shift register,14-pin ceramic DIP,Motorola MC14562BCP or equiv.	0615 77
	MISCELLANEOUS COMPONENTS	
S1	Switch array,five SPST piano switches,10-pin DIP,AMP 1-435802-6 or equiv.	101145
S2	Switch array,two SPST piano switches,4-pin DIP,AMP 1-435802-3 or equiv.	101157
Y1	Crystal,quartz,16 MHz	99215 9

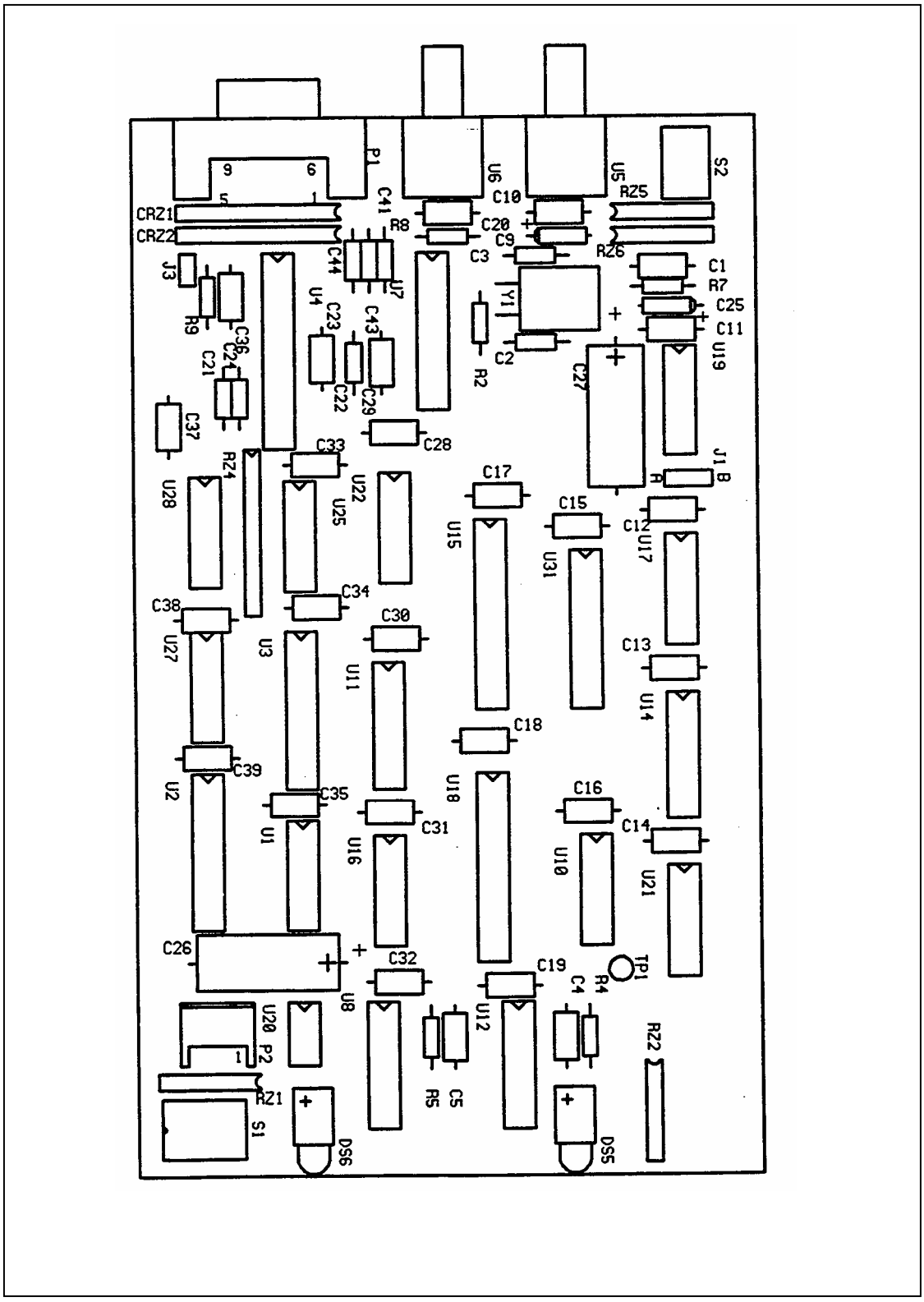


Figure 14-26. Component locator drawing, fiber optic remote module transceiver board (Assembly No. 104460-1; Drawing No. D-104463-1, Rev. A)

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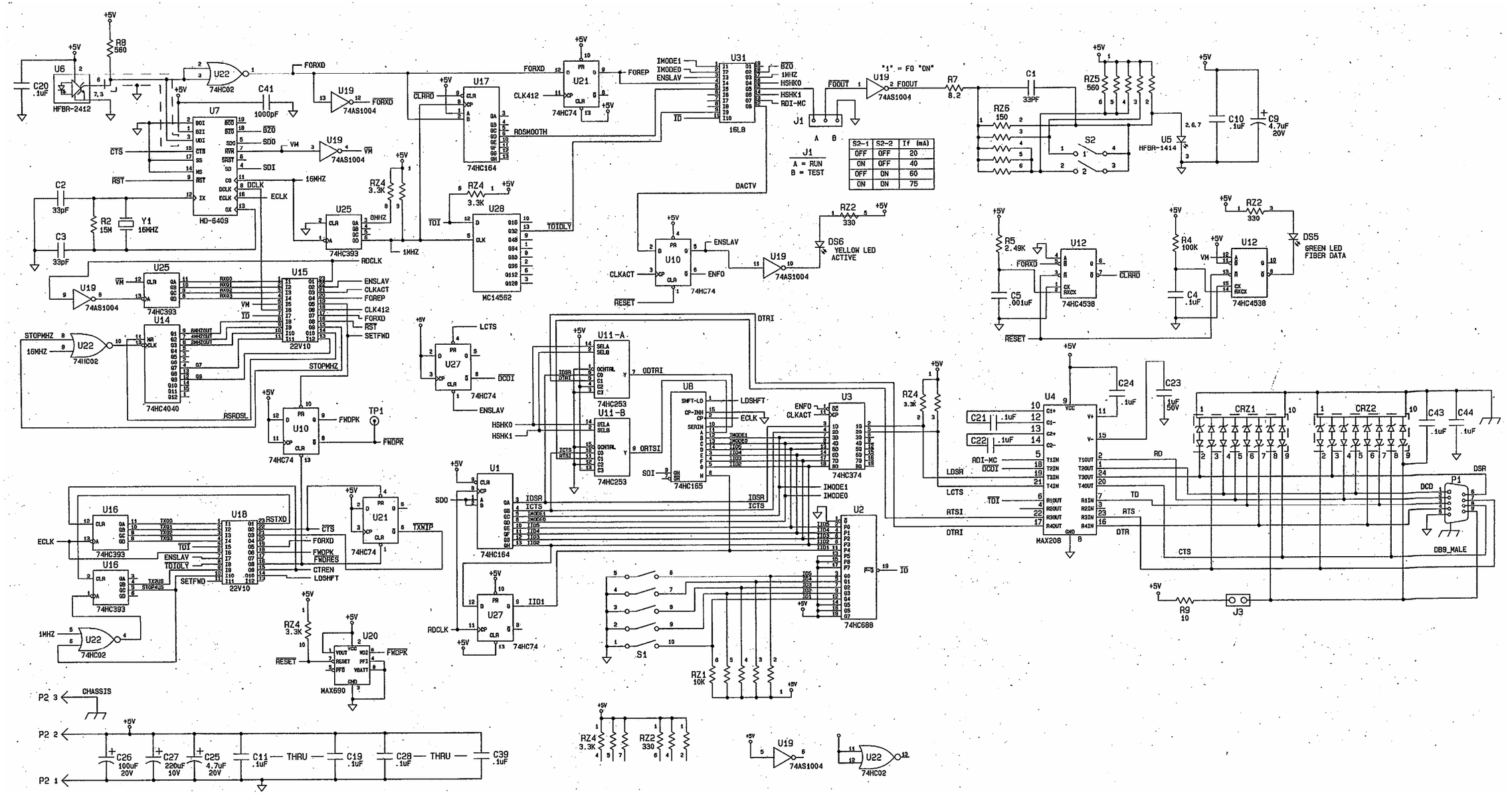


Figure 14-27. Schematic, fiber optic remote module Transceiver board (Assembly No. 104460-1; Schematic No. D-104464-1, Rev A)

Table 14-14. Replaceable parts, fiber optic remote module power supply board
Fiber optic remote module (9-Vdc) Assembly No. 104495-1
Fiber optic remote module (48-Vdc) Assembly No. 104495-2
Fiber optic remote module (125-Vdc) Assembly No. 104495-3

Circuit Symbol (Figs. 14-28 & 14-29)	Description	Part Number
C1,2	Capacitor,ceramic,disc	
	104495-1: not used	not used
	104495-2: 0.005uF,20%,3KV	1007 1264
	104495-3: 0.005uF,20%,3KV	1007 1264
C3	Capacitor,electrolytic	
	104495-1: 470uF,20%,25V	1007 1760
	104495-2: 1000uF,20%,25V	1007 1489
	104495-3: 470uF,20%,25V	1007 1760
C4	Capacitor,electrolytic	
	104495-1: 100uF,20%,25V	1007 1556
	104495-2: 2200uF,20%,10V	1007 1823
	104495-3: 100uF,20%,25V	1007 1556
CR5	Suppressor,transient,voltage,1.5KE30CA	100556
DS1	Optoelectric,device,LED,green	32567
F1	Fuse,Slow-blow	
	104495-1: not used	not used
	104495-2: 1/2A,250V	6723
	104495-3: 15/100A,3AG,250V	14392
L1,2	Inductor	
	104495-1: not used	not used
	104495-2: 10uH,5%,1.5Amps	30285
	104495-3: 10uH,5%,1.5Amps	30285
L3	Inductor,100uH,10%,2Amps	41074
R1	Resistor,metal film,precision	
	104495-1: not used	not used
	104495-2: 35.7KΩ,1%,1/4W	0410 1437
	104495-3: 35.7KΩ,1%,1/4W	0410 1437
R2	Resistor,metal film,precision	
	104495-1: not used	not used
	104495-2: 8.06KΩ,1%,1/4W	0410 1375
	104495-3: 8.06KΩ,1%,1/4W	0410 1375
R3	Resistor,metal film,precision,249Ω,1%,1/4W	0410 1230
U1	Converter,DC-DC	
	104495-1: not used	not used
	104495-2: 48V input,12V output,25W	101143
	104495-3: 150V input,12V output,25W	101144
U2	IC,linear,voltage regulator,5V,Motorola MC7805CT or equiv.	0620 77

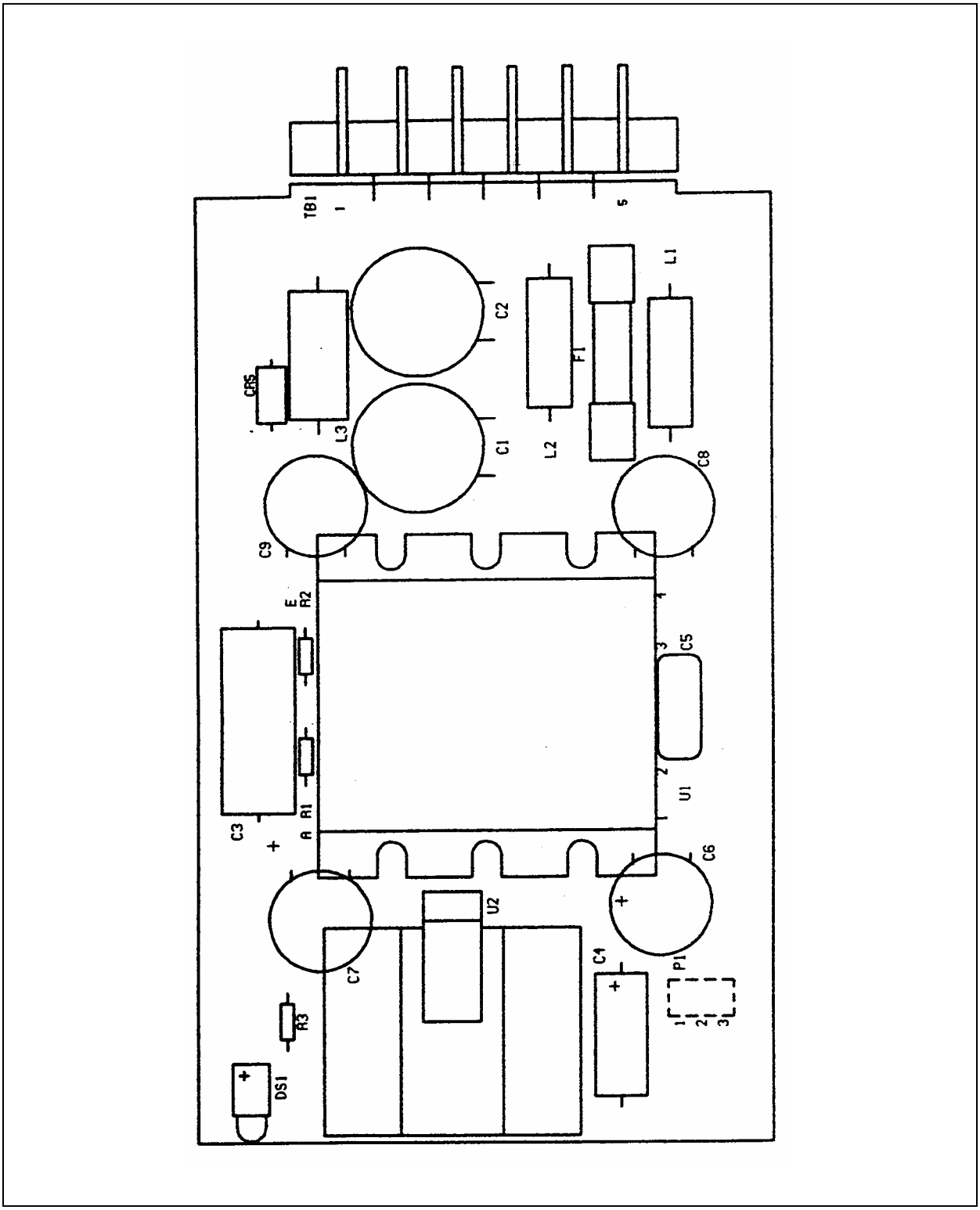
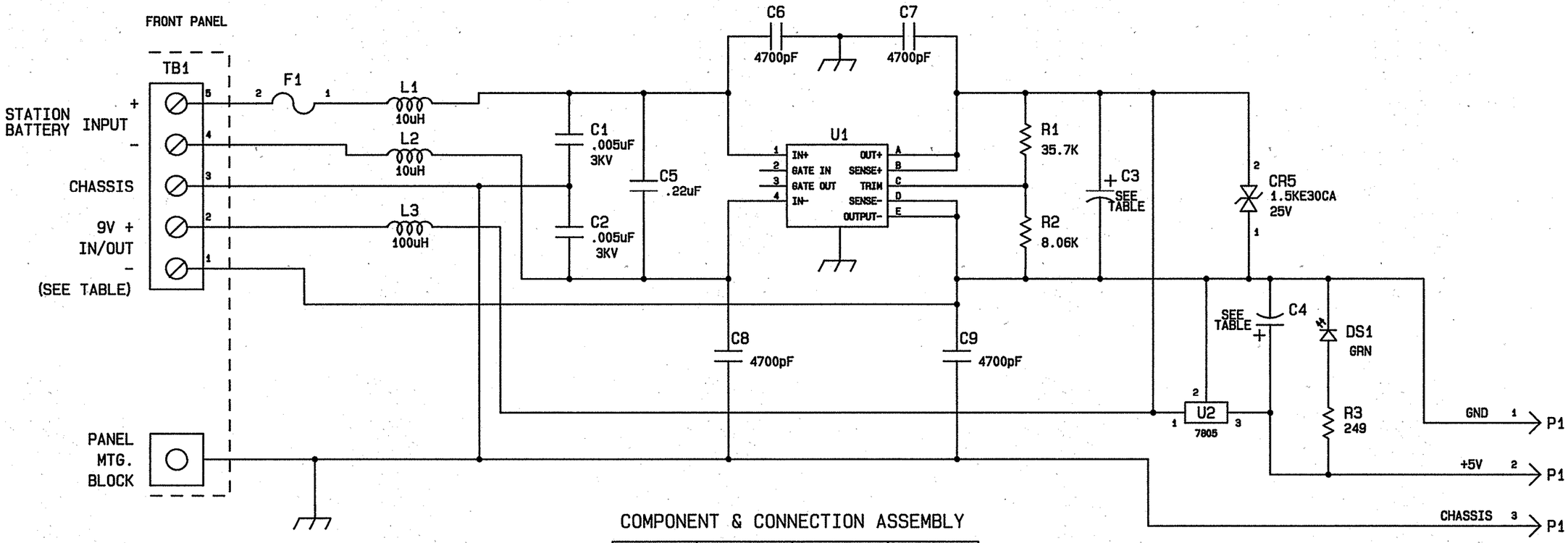


Figure 14-28. Component locator drawing, fiber optic remote module power supply board (Assembly No. 104495-1, -2, -3; Drawing No. D-104498, Rev. B)



COMPONENT & CONNECTION ASSEMBLY

		ASS'Y NO. 104495-1	ASS'Y NO. 104495-2	ASS'Y NO. 104495-3
REF. DESIG.		INPUT VOLTAGE		
		9V	48V	125V
COMPONENTS	L1-2	——	X	X
	C1-2	——	X	X
	C3	470uF	1000uF	1000uF
	C4	100uF	2200uF	2200uF
	U1	——	X	X
	R1	——	X	X
	R2	——	X	X
	F1	——	.5A	.15A
CONNECTIONS	TB1-2	+9V IN	+9V OUT	+9V OUT
	TB1-1	GND	GND	GND
	C6-9	——	4700pF	4700pF
	C5	——	.22uF	.22uF

KEY: X = IN —— = OUT

Figure 14-29. Schematic, fiber optic remote module Power supply board (Assembly No. 104495-1, -2, -3; Schematic No. D-104499, Rev C

Section 15. INDEX

Section 16. APPLICATION NOTES

This section contains all of the RFL 9660 Application Notes that were issued as of the date this manual was printed. These Application Notes provide the user with information on interfacing other manufacturer's devices to the RFL 9660 Digital Switch. If you are trying to interface a device that is not covered by these notes, refer to the device's instruction manual for interface information, or call the RFL Customer Service Department at (973) 334-3100 between 8:00 a.m. and 4:30 p.m. (Eastern Time).

APPLICATION NOTE INDEX:

Note No.	Device(s) Covered	Application Software	Manufacturer
9660-001	Quantum Meter	Mini-Pro Release 4.0	Schlumberger Industries Inc.
9660-001A	Quantum Meter	Mini-Pro Release 5.0	Schlumberger Industries Inc.
9660-002	Series 100, 200, And 300 Relays	Any ASCII terminal emulation program	Schweitzer Engineering Laboratories, Inc.
9660-003	Hathaway Fault Recorder	Generic RFL	Hathaway Corporation, Data Systems Division
9660-004	Optimho Relay	Opticom	GEC Alsthom, T&D Inc.
9660-005	DDP Relay	D-Link	General Electric Company
9660-006	JEM-2 Multifunction Meter	JAV	Scientific Columbus
9660-007	MDAR Relay With PONI Module	WRELCOM	ABB Power T&D Company
9660-008	MDAR Relay With MINT Module	WRELCOM	ABB Power T&D Company
9660-009	DLP Relay	D-Link	General Electric Company
9660-010	NEI Microphase Fiber Modem	REYDISP	Reyrolle Protection
9660-011	NEI Duobias Fiber Modem	REYDISP	Reyrolle Protection
9660-012	RFL 9300 Charge Comparison System	Any ASCII terminal emulation program	RFL Electronics Inc.
9660-013	RFL 6720P Checkback System	Any ASCII terminal emulation program	RFL Electronics Inc.
9660-014	Metrosonics RV-2, RV-3, and SRV-3 Recording Voltmeters	Metrosoft	Metrosonics, Inc.
9660-015	RFL 9720 Pilot Wire Interface	Any ASCII terminal emulation program	RFL Electronics Inc.

APPLICATION NOTE INDEX (continued):

Note No.	Device(s) Covered	Application Software	Manufacturer
9660-016	GEC, K Series Relay with KITZ101	Access 2.0	GEC Alsthom T & D Protection & Control Limited
9660-017	RFL 9660 DTE	See 9660 Application Note	RFL Electronics Inc.
9660-018	Transcan Digital Recorder	DATACOMM	Mehta Tech Inc.
9660-019	DPU 245D/445H/445V Relay	WRELCOM	ABB Power T & D Company
9660-020	DVU-4 Recording Voltmeter	Series-D	Angus Electronics Company
9660-021	LFCB Relay	LFCB	GEC Alsthom, T & D Inc.
9660-022	ASADC2, ATADC2, AQADC2 VSAMC2, VTAMC2, GQWMC2	BiComm	Bitronics, Inc.
9660-023	2600 Remote Events Recorder	Terminal Emulation Program	Dranetz Technologies Inc.
9660-024	BEI-DFPR or BEI-25/79TR	Terminal Emulation Program with VT-100 Terminal Emulation	Basler Electric
9660-025	Pride M-0420 Multifunction Relay	Becocom	Beckwith Electric Company, Inc.
9660-026	RFL 9001	Terminal Emulation Program	RFL Electronics Inc.
9660-027	REL 301/302 Relay With PONI Module	WRELCOM	ABB Power T & D Company
9660-028	RFL 9745	Terminal Emulation Program	RFL Electronics Inc.
9660-029	TPU 2000	WRELCOM	ABB Power T & D Company
9660-030	M-3430	IPScom Version 2.5.0	Beckwith Electric Company, Inc.
9660-031	Optimho Relay	Opticom Version 5.1	GEC Alsthom, T&D Inc.

RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-001

DEVICE: Quantum Meter

MANUFACTURER: Schlumberger Industries Inc.

APPLICATION SOFTWARE: Mini-Pro Release 4.0

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 1200	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- On	Modem String	- \,+++\,AT\G0\Q0\X1O\N
Local Flow Ctrl	- Off	Port Password	-

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See Figure 1.

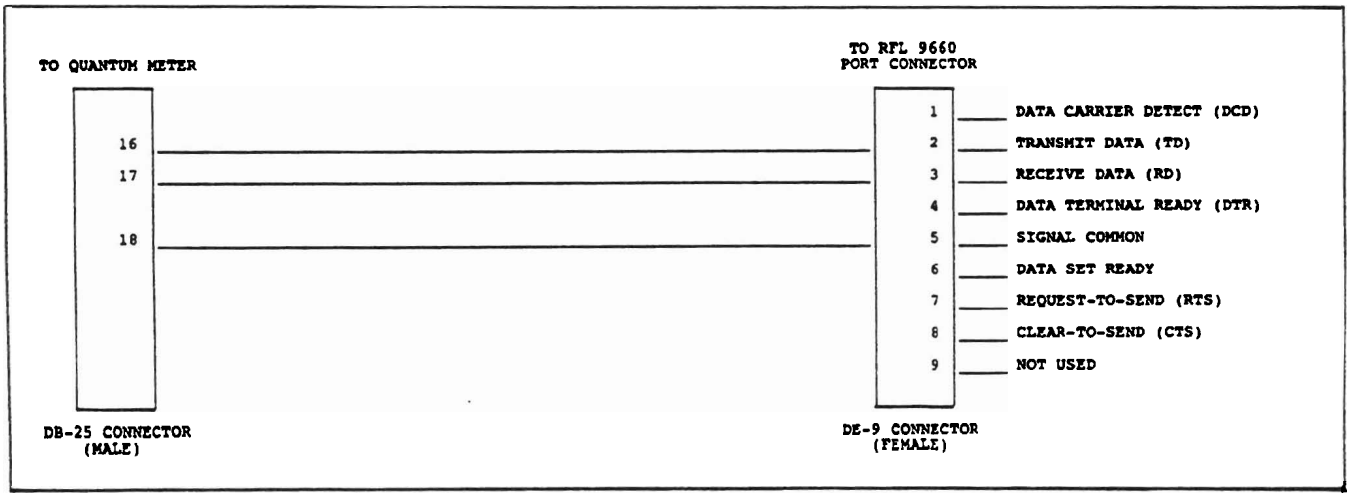


Figure 1. Wiring diagram for cable between Quantum Meter and RFL 9660 PORT connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Choose the communication parameters and change the baud rate to 1200.

5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

6. Choose the port for the Quantum meter you wish to interrogate.

7. Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.

8. Load the Mini-pro software, and log on with your password.

9. Check the "SC" command to be sure that you have Mini-pro set for the port where your modem is installed (COM1, COM2, etc).

10. Choose the "OC" (direct connect) command. Next, you must correctly enter the label that you have previously programmed into Quantum, a "D" for direct connect, and a "1" for 1200 baud.
    After several seconds, Mini-Pro should indicate that you are on-line with the Quantum.

12. When you are finished, log off the meter with the "DF" command and completely exit Mini-pro.

13. Reload the Windows Terminal application, the file for the switch, and reset the communication parameters for 1200 baud.

14. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.

15. You may now choose another port on the RFL 9660.

NOTE

You may also communicate with the Quantum meter at 9600 baud, as long as the Quantum meter is not equipped with the optional internal modem module.

RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-001A

DEVICE: Quantum Meter

MANUFACTURER: Schlumberger Industries Inc.

APPLICATION SOFTWARE: Mini- Pro Release 5.0

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 1200	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- None	Port String	
Local Port DTR	- On	Modem String	
Local Flow Ctrl	- Off	Port Password	

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See figure 1

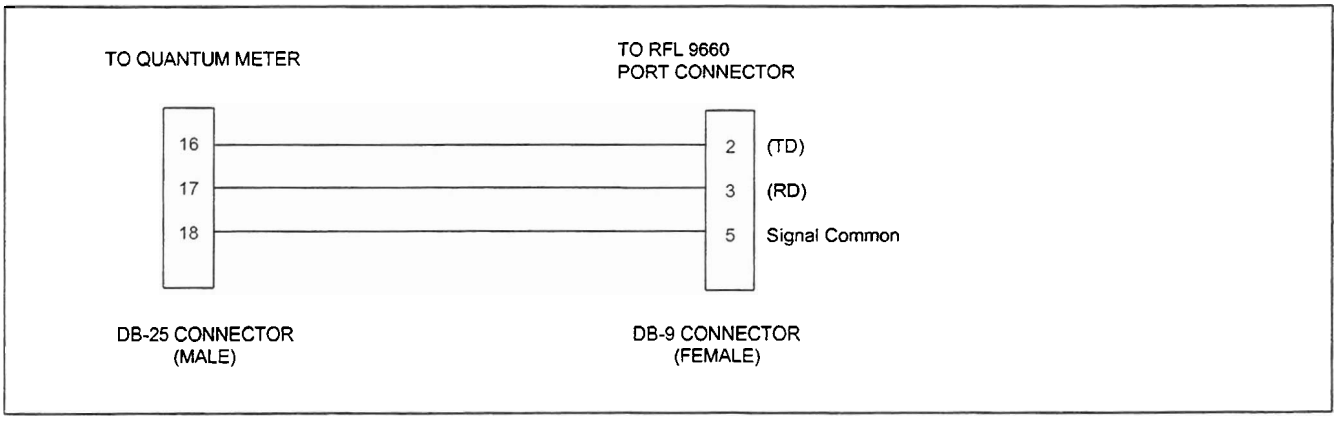


Figure 1. Wiring diagram for cable between Quantum Meter and RFL 9660 PORT connector.

Connecting to the Quantum Meter:

1. Connection to the 9660 Digital Switch must be accomplished prior to using the Mini-Pro software.

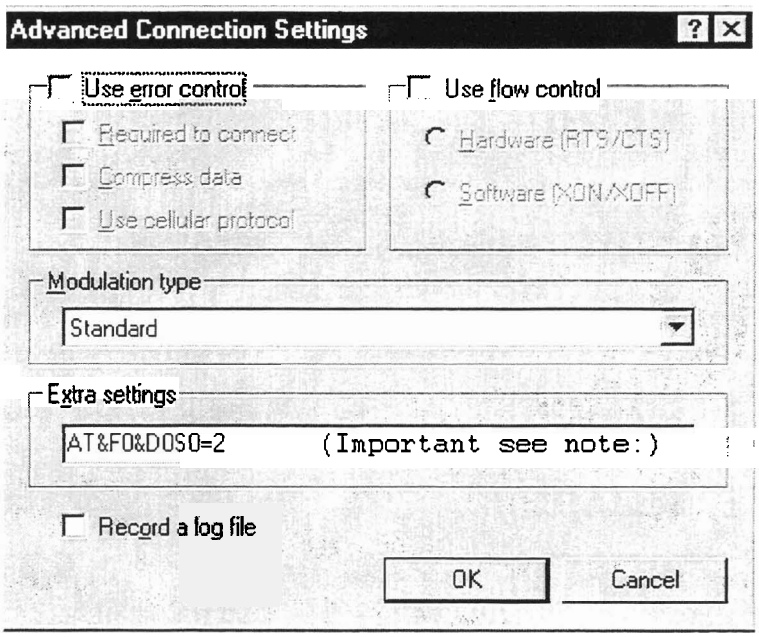
2. Any terminal application may be used to establish connection, Windows Terminal, Hyperterminal, Procomm Plus etc.

3. The following terminal parameters must be changed to ensure proper connection in conjunction with the Quantum Meter.:

   Baud Rate - 1200, Data Bits - 8, Stop Bits - 1, Parity - None, Flow Control - None, Parity CK - No, Carrier DT - No, Error Control - No.

4. The most important thing to understand is, Mini-Pro software does not use flow control. Flow control must be disabled on the initiating modem only. Do not for any reason make changes to the modem used by the 9660 Digital Switch.

5. The modem command that disables flow control can be inserted into a setting screen available through most terminal applications. Here is an example using Hyperterminal from windows 95:



NOTE

The **&f0** command can vary between different modem manufactures. This command is used to turn off all means of flow control. It is very important to include this command in the above string. Most (not all) modem manufactures seem to use the **&fn** as their read-only (non-programmable) factory configuration. Find the commands that work with your modem, do not assume **&f0** is the only option. (US Robotics Sportster modems use the **&f0** to disable flow control.) **Do not for any reason make changes to the modem used by the 9660 Digital Switch.**

6. The **&D0** in the above command string allows the line to remain open when exiting out of Terminal.

7. Using a terminal command string is useful because it sets up your modem correctly for use with a particular device, but when your finished it returns your modem back to its initial settings.

8. Initiate the call to the RFL 9660. Log on in the usual manner

9. Choose the port for the Quantum Meter you wish to interrogate.

10. Once the connection is established, exit the Terminal application completely. You cannot just minimize the terminal screen. The **&D0** command will stop the terminal from hanging up the line.

11. Load the Mini-Pro software, and log on with your password.

12. Check the "SC" command to be sure that you have Mini-Pro set for the port where your modem is installed (com 1, com 2, etc.).

13. Choose the "OC" (direct connect) command. Next, you must correctly enter the label that you have previously programmed into Quantum, a "D" for direct connect, and a "1" for 1200 baud.

14. After several seconds, Mini-Pro should indicate that you are on-line with Quantum.

15. When you are finished, log off the meter with the "DF" command and completely exit Mini-Pro.

16. Reload your Terminal application and type "BYE" which is the RFL 9660 deselect sequence.

17. You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-002

DEVICE: Series 100, 200, 300, and 500 Relays

MANUFACTURER: Schweitzer Engineering Laboratories, Inc.

APPLICATION SOFTWARE: Any ASCII terminal emulation program.

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 2	Remote String	
Port Flow Ctrl	- XON/XOFF	Port String	
Local Port DTR	- On	Modem String	
Local Flow Ctrl	- On	Port Password	

SWITCH CONFIGURATION: No special configuration settings required; use factory default settings.

CABLE CONFIGURATION: Series 100 Relays: See Figure 1.
All Others: See Figure 2.

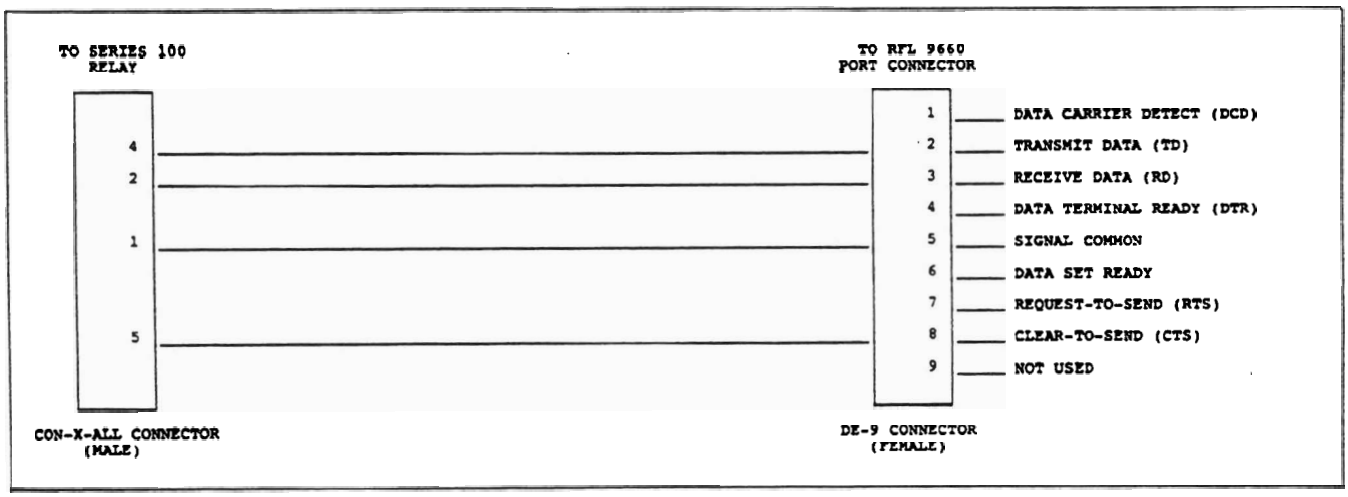

Figure 1. Wiring diagram for cable between Series 100 Relay and RFL 9660 PORT connector

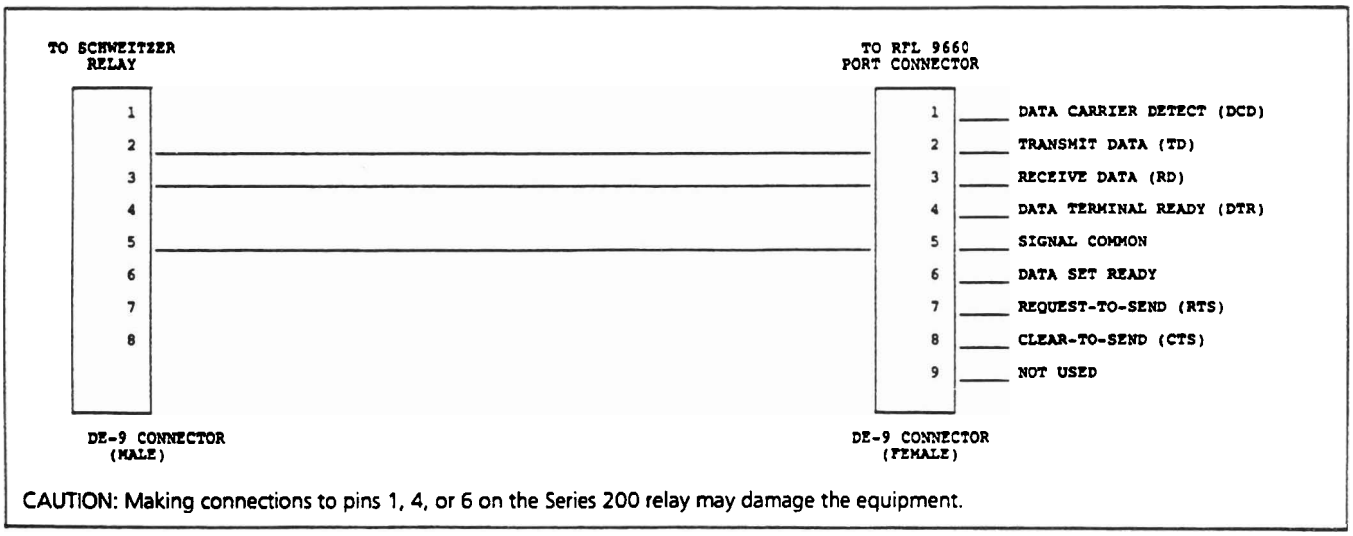

Figure 2. Wiring diagram for cable between Series 200, 300 or 500 Relay and RFL 9660 PORT connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

5. Choose the port for the Schweitzer relay you wish to interrogate.
   Once the connection is established, you will be able to communicate with the Schweitzer relay by entering commands on your keyboard; the relay will send responses to your display. Refer to the documentation supplied with your Schweitzer relay for more information.

6. When you are finished communicating with the relay, type in your RFL 9660 deselect sequence.
   "BYE" is the factory default.

7. You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-003

DEVICE: Hathaway Fault Recorder

MANUFACTURER: Hathaway Corporation, Data Systems Division

APPLICATION SOFTWARE: Generic RFL

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- On
Baud Rate	- 9600	Call Request	- RTS + DTR
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	- AT\Q0\X1\G0DT(phone number)\N\D\4
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- None	Port String	
Local Port DTR	- On	Modem String	- \,+++\,AT\Q0\X1\G0O\N
Local Flow Ctrl	- Off	Port Password	- None (no password allowed)

SWITCH CONFIGURATION:

1. No special configuration settings required; the factory default settings may be used.
2. The port connected to the fault recorder must be labeled "HATHAWAY".
3. No switch or port passwords are allowed on RFL 9660's connected to Hathaway fault recorders.

CABLE CONFIGURATION: See Figure 1.

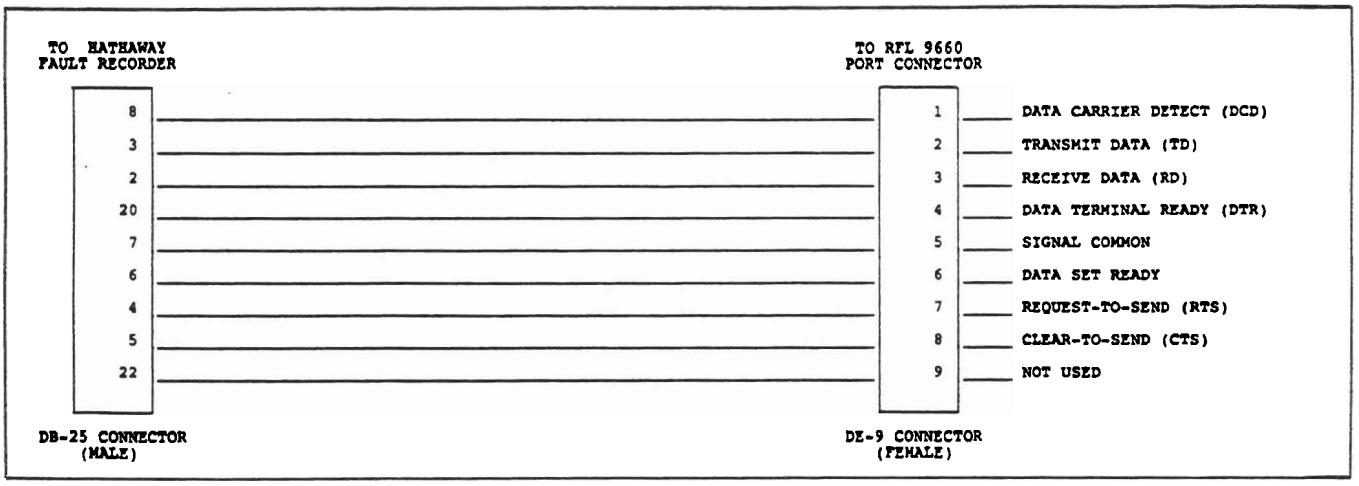

Figure 1. Wiring diagram for cable between Hathaway Fault Recorder and RFL 9660 PORT connector

TYPICAL SESSION:

No special operating instructions required; the Hathaway generic RFL software will operate normally.

The modem being used with the Hathaway master station must be programmed with the following options:

1. Keep CTS true.
2. Disable slave speed, constant speed interface.
3. The DCD (carrier detect) line follows the carrier.
4. Receipt of DTR forces a disconnect.
5. Long space disconnect must be disabled.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-004

DEVICE: Optimho Relay

MANUFACTURER: GEC Alsthom, T&D Inc.

APPLICATION SOFTWARE: Opticom

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- None	Port String	
Local Port DTR	- On	Modem String	
Local Flow Ctrl	- On	Port Password	

SWITCH CONFIGURATION: Set port label to be the same as the relay password.

CABLE CONFIGURATION: See Figure 1.

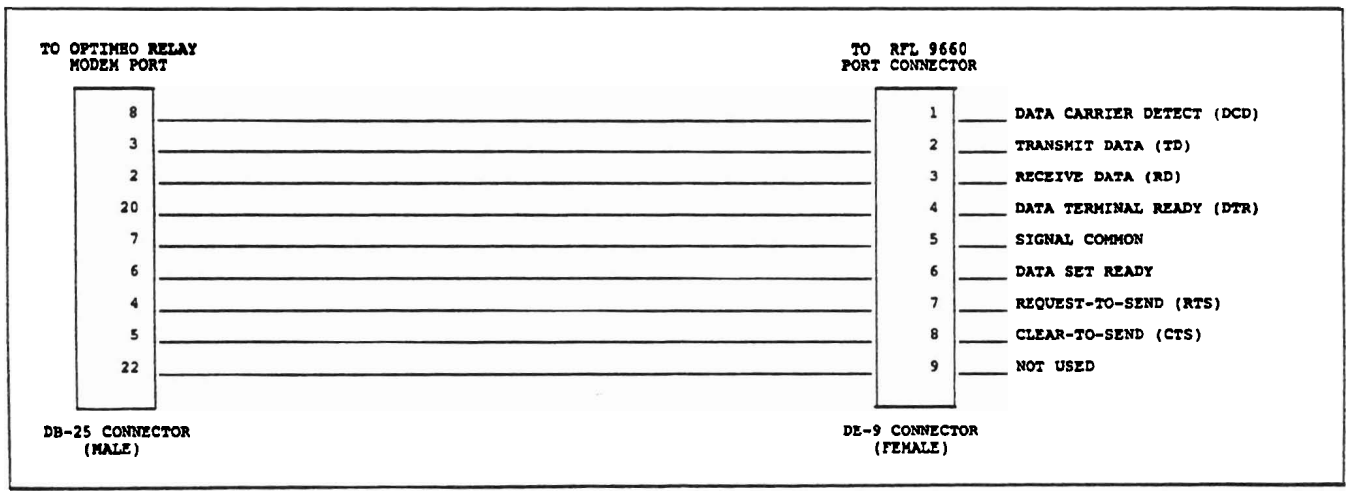

Figure 1. Wiring diagram for cable between Optimho Relay and RFL 9660 PORT connector

TYPICAL OPTICOM SESSION:

1. **Make sure the the port label** is set to the same value as the relay password.
2. Load the Opticom software package.
3. Set Opticom to communicate at 2400 baud, 8 data bits, no parity, and one stop bit.
4. Make sure the Optimho relay is also programmed for the above word format.
5. Initiate the call with Opticom in the normal manner.
6. Once the connection is established, Opticom will send the relay password which will select the port and connect with the relay.

CONNECTING THROUGH THE OPTIMHO LOCAL PORT:

The cable to the Optimho must be connected to the SERIAL port on the front of the relay. This port is a DCE, so you must use an "X-modem" adapter which switches TX and RX.

1. Set the Opticom software to Local communication.
2. Choose the "dumb terminal emulation" from the Opticom menu.
3. Press the **[ENTER]** key to access the switch.
4. Select the port that is connected to the Optimho relay's serial port.
5. Press **[ALT][Q]** to exit back to the menu.
6. Communicate normally.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-005

DEVICE: DDP Relay

MANUFACTURER: General Electric Company

APPLICATION SOFTWARE: D-Link

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- OFF
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- On	Modem String	- \,+++\,AT\G0\Q0\X1O\N
Local Flow Ctrl	- Off	Port Password	

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See Figure 1.

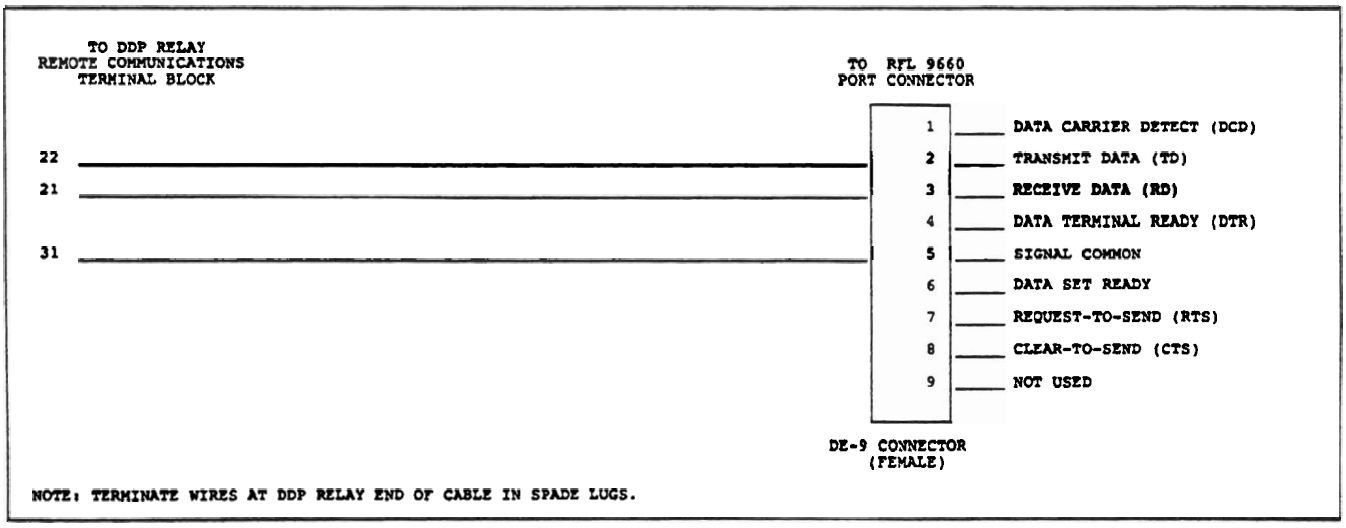

Figure 1. Wiring diagram for cable between DDP Relay and RFL 9660 PORT connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Choose the communication parameters and make sure the baud rate is set to 2400.

5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

6. Choose the port for the DDP Relay you wish to interrogate.

7. Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.

8. Load the D-Link software, select the "begin" command, and log on with your password and unit ID.

9. Select "View/Change Relay Log-In Data."

10. Select the unit number of the relay being interrogated.

11. Set the phone number to seven zeroes (0000000).

12. Set the baud rate to 2400.
    The D-Link software is now ready to interrogate the DDP Relay.

13. When you are finished, log off the DDP Relay with the "LOGOUT" command, and completely exit D-Link.

14. Reload the Windows Terminal application, the file for the switch, and reset the communication parameters for 2400 baud.

15. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.

You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-006

DEVICE: JEM-2 Multifunction Meter

MANUFACTURER: Scientific Columbus

APPLICATION SOFTWARE: JAV

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 1200	Call Request	- None
Data Bits	- 7	Call Request	- 0
Parity	- Even	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- On	Modem String	- \,+++\,AT\G0\Q0\X1 O\N
Local Flow CTRL	- Off	Port Password	-

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: P1 Position 1 (full left): See Figure 1.
P1 Position 2 (centered): See Figure 2.

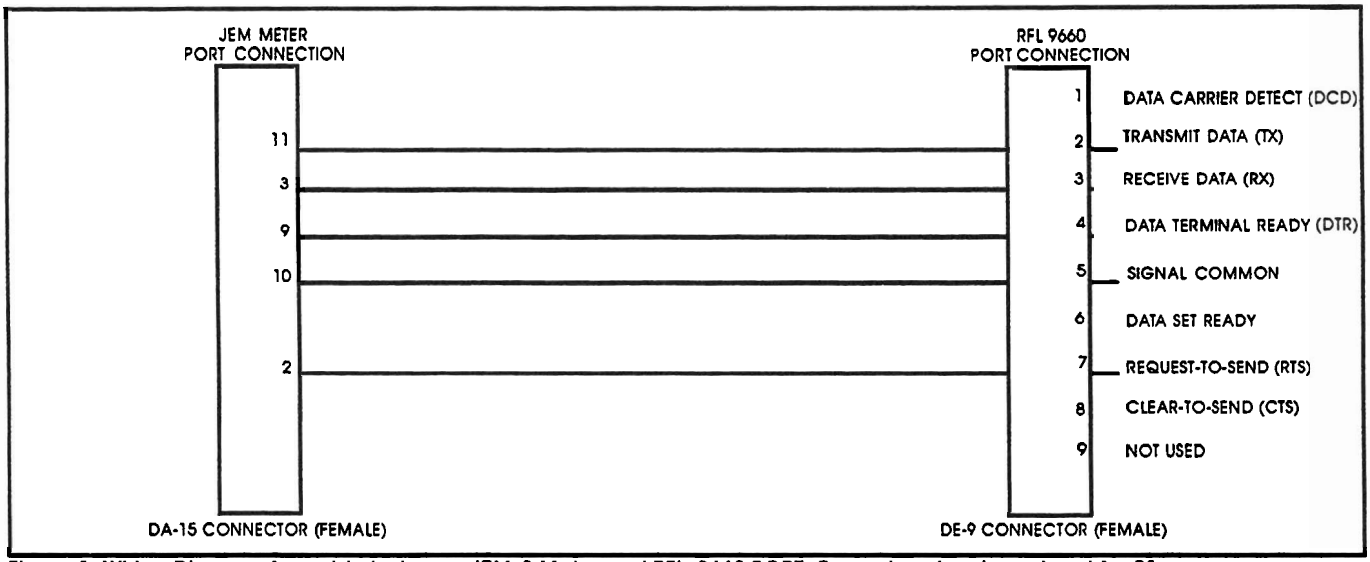

Figure 1. Wiring Diagram for cable between JEM-2 Meter and RFL 9660 PORT Conector, showing pinout for P1 Position 1 (full left).

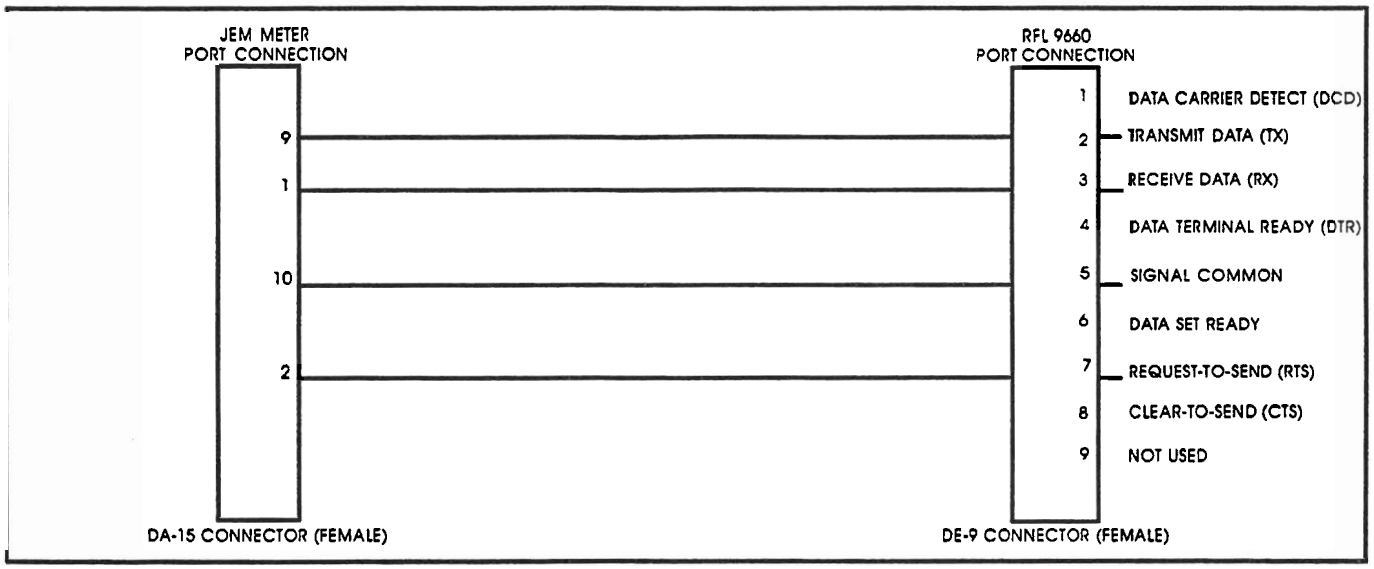

Figure 2. Wiring diagram for cable between JEM-2 Meter and RFL 9660 PORT connector, showing pinout for P1 Position 2 (centered).

TYPICAL WINDOWS SESSION:

1. Load the Windows in the normal manner.
2. Choose the Windows Terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communication parameters and change the baud rate to 1200.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the JEM 2 meter you wish to interrogate.
7. Once the connection is established, exit the Windows Terminal application completely. **Be sure you tell the Windows Terminal application not to hang up the phone.**
8. Load the JAV software, and log on with your password. **Be sure that the COM port you have connected to the RFL 9660 is set to "DIRECT" in the JAV "Communication Ports" screen, even if you are using a modem.**
9. Select "F1" (Retrieve) from the main menu.
10. Select "F1" (Manual Retrieve) from the "Retrieve" menu.
11. Select "F1" (Metering Device) from the "Manual Retrieve" menu.
12. Communicate normally.

13. When you are finished, log off the JEM 2 with the "ESC" command, and completely exit JAV.

14. Reload the Windows Terminal application, the file for the switch, and reset the communication parameters for 1200 baud.

15. Type in your RFL deselect sequence.
"BYE" is the factory default.

16. You may now choose another port on the RFL 9660.

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(2400 baud, 8 bits, 1 stop bit, no parity)

RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-007

DEVICE: MDAR Relay With PONI Module

MANUFACTURER: ABB Power T&D Company

APPLICATION SOFTWARE: WRELCOM

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 1200	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow Ctrl	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See Figure 1.

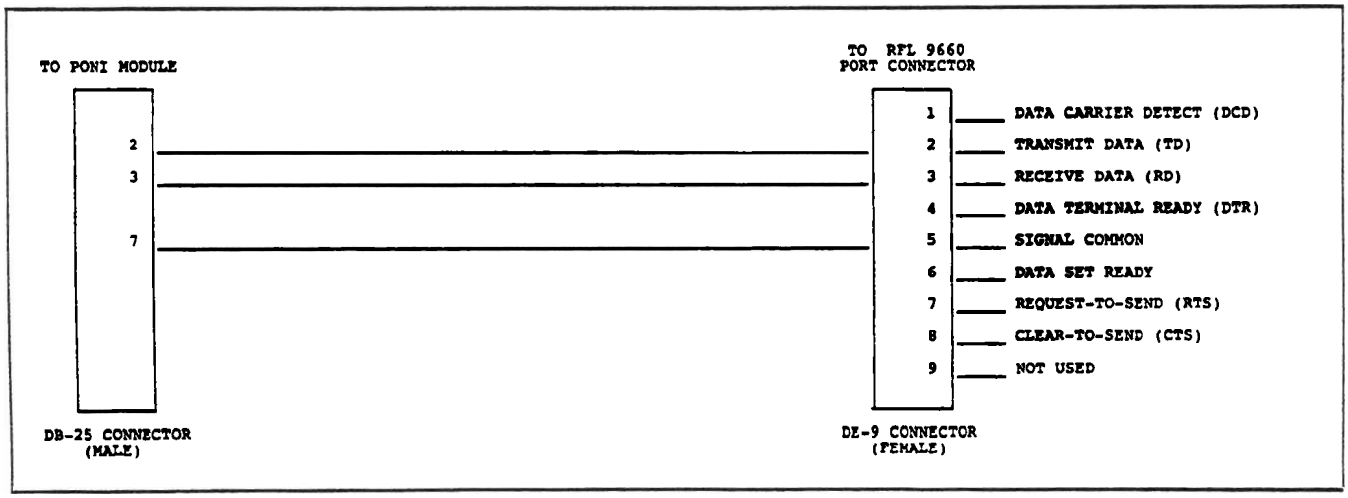

Figure 1. Wiring diagram for cable between MDAR Relay With PONI Module and RFL 9660 PORT connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.
2. Choose the Windows Terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communication parameters and change the baud rate to 1200.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the MDAR relay you wish to interrogate.
7. Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.
8. Load the WRELCOM software, and log on with your password.
9. Communicate normally.
10. When you are finished, log off the MDAR relay and completely exit WRELCOM.
11. Reload the Windows Terminal application and the file for the switch.
12. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.
13. You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-008

DEVICE: MDAR Relay With MINT Module

MANUFACTURER: ABB Power T&D Company

APPLICATION SOFTWARE: WRELCOM

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- CTS/RTS	Port String	
Local Port DTR	- On	Modem String	
Local Flow Ctrl	- Off	Port Password	

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: Figure 1 shows the configuration of the cable between one of the RFL 9660's 32 PORT connectors and the MINT module on the MDAR relay. If you intend to access the MDAR relay through a terminal connected to the RFL 9660's local port (the front-panel LOCAL connector), you will also need a cable wired as shown in Figure 2.

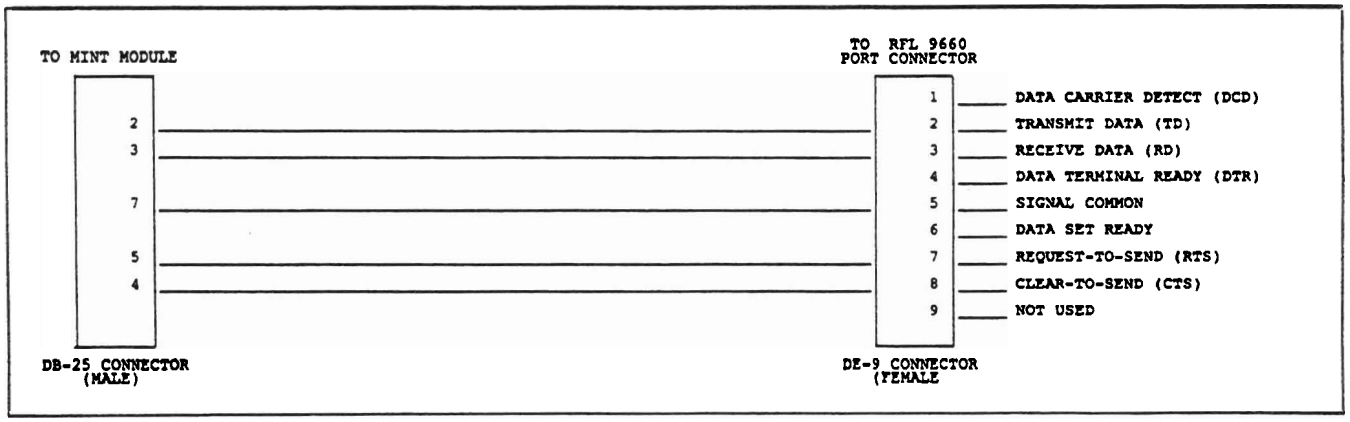

Figure 1. Wiring diagram for cable between MDAR Relay and RFL 9660 PORT connector

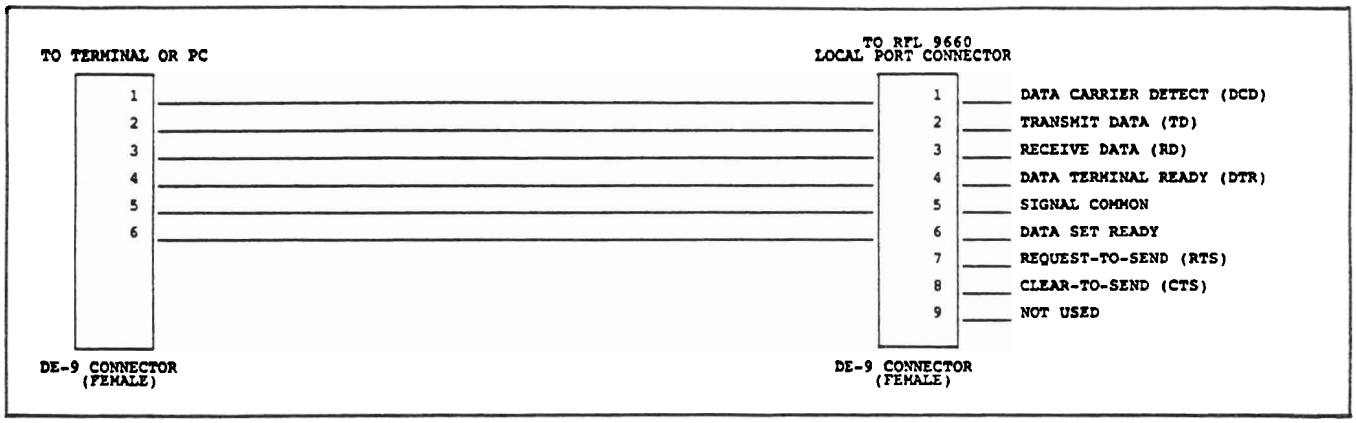

Figure 2. Wiring diagram for cable between terminal or PC and RFL 9660 LOCAL connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Choose the communication parameters and change the baud rate to 2400.

5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

6. Choose the port for the MDAR relay you wish to interrogate.

7. Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.

8. Load the WRELCOM software, and log on with your password.

9. Communicate normally.

10. When you are finished, log off the MDAR relay and completely exit WRELCOM.

11. Reload the Windows Terminal application and the file for the switch.

12. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.

13. You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-009

DEVICE: DLP Relay

MANUFACTURER: General Electric Company

APPLICATION SOFTWARE: D-Link

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- On	Modem String	- \,+++\,AT\G0\Q0\X1O\N
Local Flow Ctrl	- Off	Port Password	-

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See Figure 1.

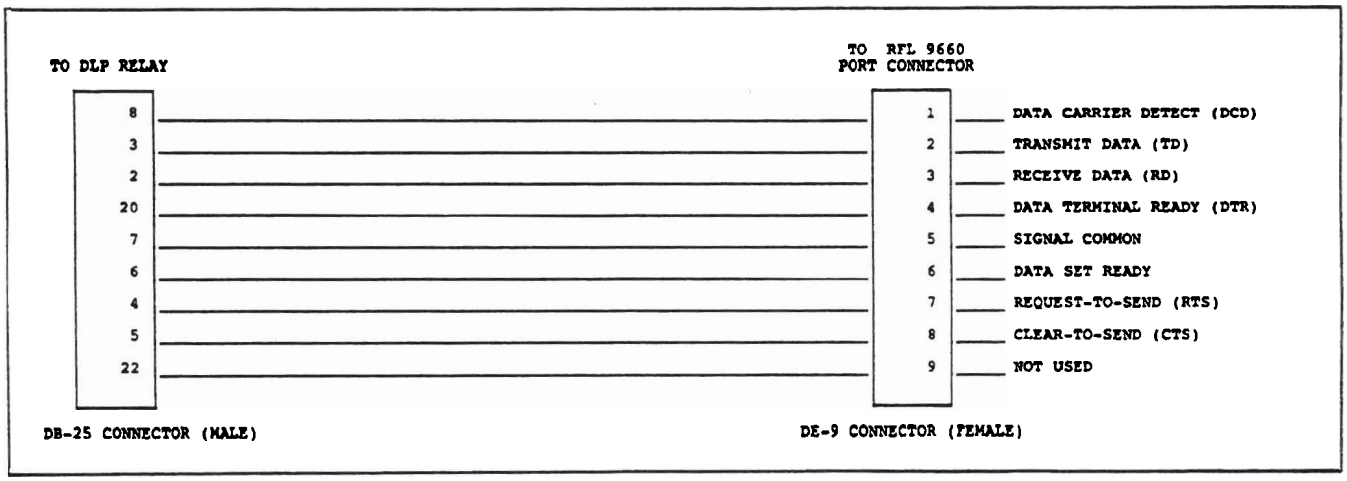

Figure 1. Wiring diagram for cable between DLP relay and RFL 9660 PORT connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.
2. Choose the Windows Terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communication parameters and make sure the baud rate is set to 2400.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the DLP Relay you wish to interrogate.
7. Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.
8. Load the D-Link software, select the "begin" command, and log on with your password and unit ID.
9. Select "View/Change Relay Log-In Data."
10. Select the unit number of the relay being interrogated.
11. Set the phone number to seven zeroes (0000000).
12. Set the baud rate to 2400.
    The D-Link software is now ready to interrogate the DLP Relay.
13. When you are finished, log off the DLP Relay with the "LOGOUT" command, and completely exit D-Link.
14. Reload the Windows Terminal application, the file for the switch, and reset the communication parameters for 2400 baud.
15. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.

You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-010

DEVICE: NEI Microphase Fiber Modem

MANUFACTURER: Reyrolle Protection

APPLICATION SOFTWARE: REYDISP for Microphase

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- OFF
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- On	Modem String	
Local Flow Ctrl	- On	Port Password	

SWITCH CONFIGURATION: Set port baud rate to match communications link.

CABLE CONFIGURATION: See Figure 1.

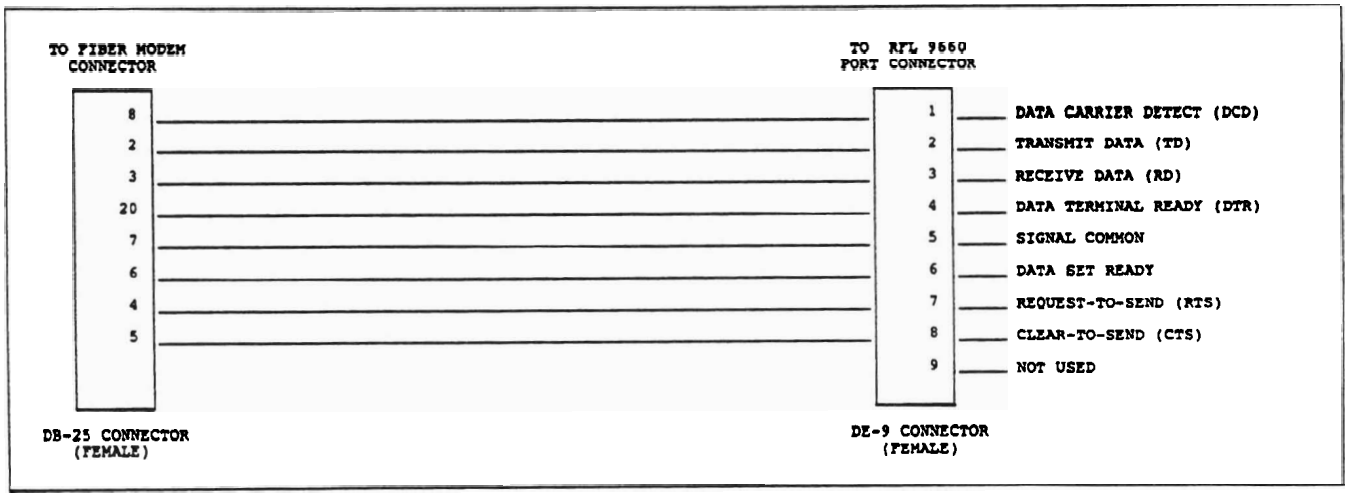

Figure 1. Wiring diagram for cable between NEI Microphase Fiber Modem and RFL 9660 PORT connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.
2. Choose the Windows Terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communication parameters and change the baud rate to 2400.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the Microphase FM you wish to interrogate.
7. Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.
8. Load the REYDISP For Microphase software, and log on with your password.
9. Using the instructions supplied with the REYDISP software as a guide, interrogate the Microphase FM.
10. When you are finished, log off REYDISP with the "exit to DOS" command, and completely exit REYDISP.
11. Reload the Windows Terminal application, the file for the switch, and reset the communication parameters for 2400 baud.
12. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.
13. You may now choose another port on the RFL 9660.

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RFL 9660 Bulletin Board: (201) 334-3099
(2400 baud, 8 bits, 1 stop bit, no parity)

Publication No. AN 9660-010
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Revised March 29, 1994

RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-011

DEVICE: NEI Duobias Fiber Modem

MANUFACTURER: Reyrolle Protection

APPLICATION SOFTWARE: REYDISP for Microphase

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- OFF
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- ON	Modem String	-
Local Flow Ctrl	- ON	Port Password	-

SWITCH CONFIGURATION: Set port baud rate to match communications link.

CABLE CONFIGURATION: See Figure 1.

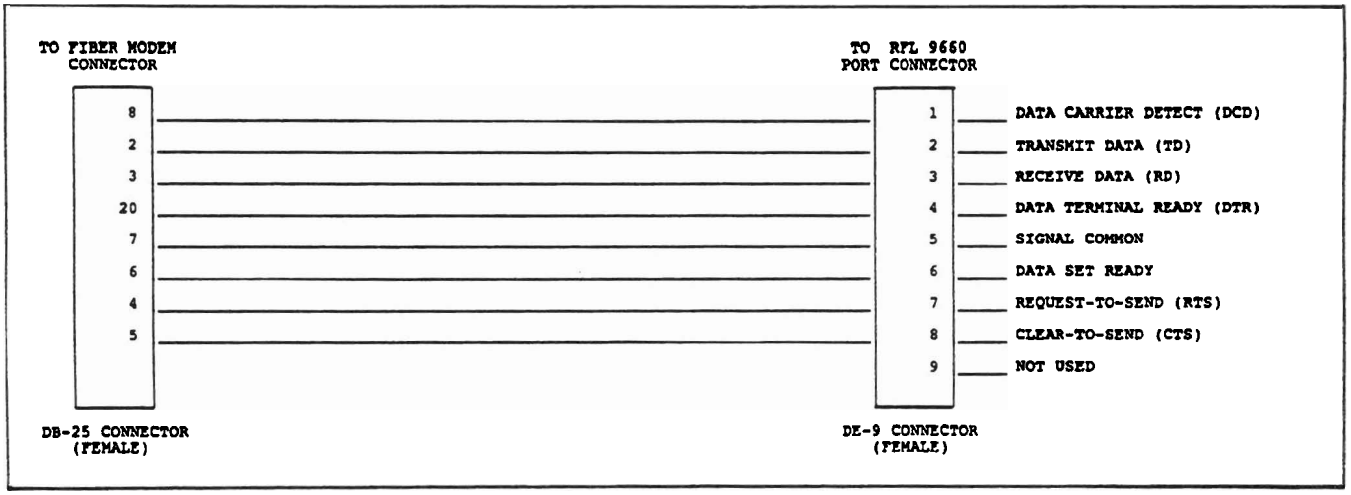

Figure 1. Wiring diagram for cable between NEI Duobias Fiber Modem and RFL 9660 PORT connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner

2. Choose the Windows Terminal application

3. Load the file that contains the normal switch parameters.

4. Choose the communication parameters and change the baud rate to 2400.

5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

6. Choose the port for the Duobias you wish to interrogate.

   Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.

8. Load the REYDISP For Microphase software, and log on with your password.

9. Using the instructions supplied with the REYDISP software as a guide, interrogate the Duobias.

10. When you are finished, log off REYDISP with the "exit to DOS" command, and completely exit REYDISP.

11. Reload the Windows Terminal application, the file for the switch, and reset the communication parameters for 2400 baud.

12. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.

13. You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-012

DEVICE: RFL 9300 Charge Comparison System

MANUFACTURER: RFL Electronics Inc.

APPLICATION SOFTWARE: Terminal Emulation Program

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- Off	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1

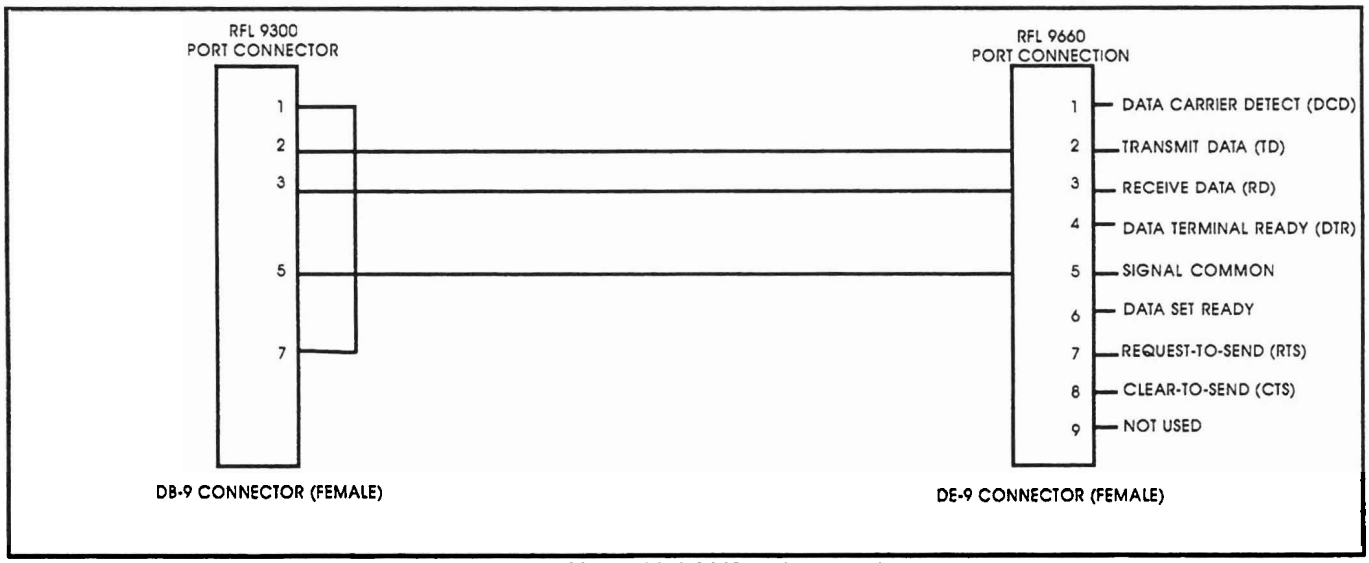

Figure 1. Wiring diagram for cable between the RFL 9300 and RFL 9660 port connector.

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.
2. Choose the Windows Terminal application.
3. Load the file that contains the normal switch parameters.
4. Check that the RFL 9300 is programmed for the same communication parameters as the RFL 9660.
5. Initiate the call to the RFL 9660 in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the RFL 9300 you wish to interrogate.
7. Once the connection is established, you may communicate using the Windows Terminal application.
8. When you are finished, type in your RFL 9660 deselect sequence.
   "BYE" is the factory default.
9. You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-013

DEVICE: RFL 6720P Checkback System

MANUFACTURER: RFL Electronics Inc.

APPLICATION SOFTWARE: Terminal Emulation Program

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 1200	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- Off	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

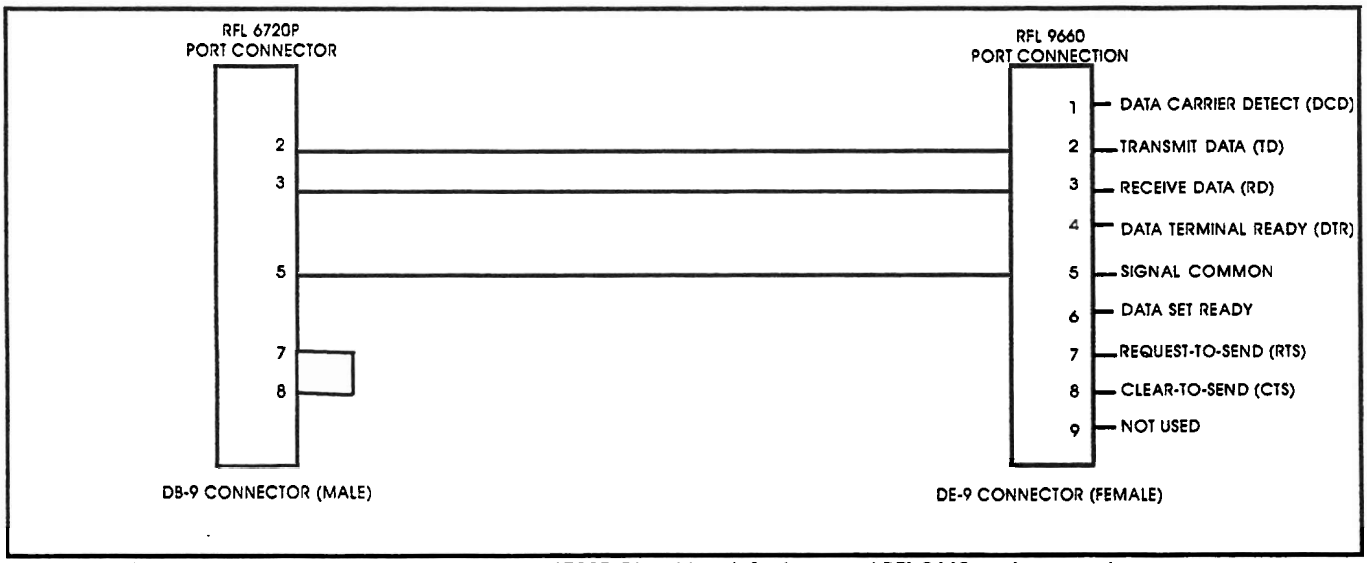

Figure 1. Wiring diagram for cable between the RFL 6720P Checkback System and RFL 9660 port connector.

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Initiate the call to the RFL 9660 in the usual manner, entering passwords as required by your RFL 9660 configuration.

5. Choose the port for the RFL 6720P you wish to interrogate.

6. Once the connection is established, you may communicate using the "APRIL" commands described in the RFL 6720P Instruction Manual.

7. When you are finished, type in your RFL 9660 deselect sequence.
   "BYE" is the factory default.

8. You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-014

DEVICE: Model RV-2, RV-3, RV-4A, and SRV-3 Recording Voltmeters

MANUFACTURER: Metrosonics, Inc.

APPLICATION SOFTWARE: Metrosoft

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 9600	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- Xon/Xoff	Port String	-
Local Port DTR	- On	Modem String	
Local Flow Ctrl	- On	Port Password	

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See Figure 1.

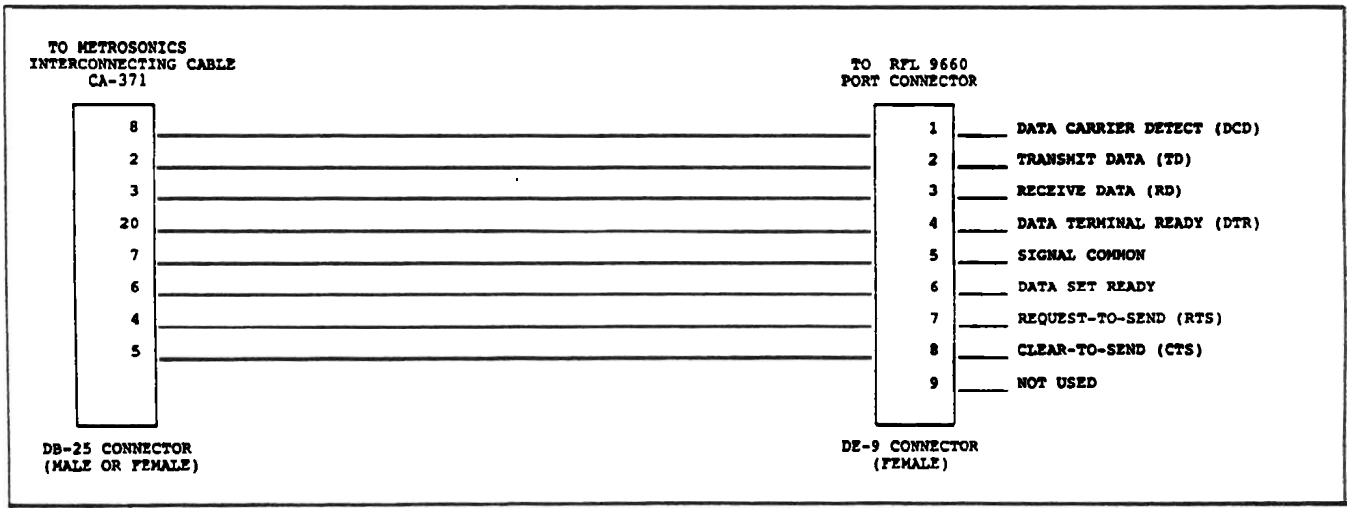

Figure 1. Wiring diagram for cable between Metrosonics Recording Voltmeters and RFL 9660 PORT connector (Switch Position 2)

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

5. Choose the port for the Metrosonics recorder you wish to interrogate.

6. Once the connection is established, exit the Windows Terminal application completely.
   Be sure you tell the Windows Terminal application not to hang up the phone.

7. Load the Metrosoft software.

8. Use Metrosoft to communicate with the recorder.
   Refer to the Metrosonics software manual for more information.

9. When you are finished, exit the Metrosoft program.

10. Reload the Windows Terminal application.

11. Type in your RFL 9660 deselect sequence.
    "BYE" is the factory default.

You may now choose another port on the RFL 9660.

NOTE

If you are running Metrosoft software on a 386 or 486 PC running Windows, you do not have to completely exit the Metrosoft application if you are running it within a window.

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RFL Electronics Inc.

A P P L I C A T I O N N O T E

NUMBER: 9660-015

DEVICE: RFL 9720 Digital Pilot Wire Interface

MANUFACTURER: RFL Electronics Inc.

APPLICATION SOFTWARE: Terminal Emulation Program

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow Ctrl	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See Figure 1.

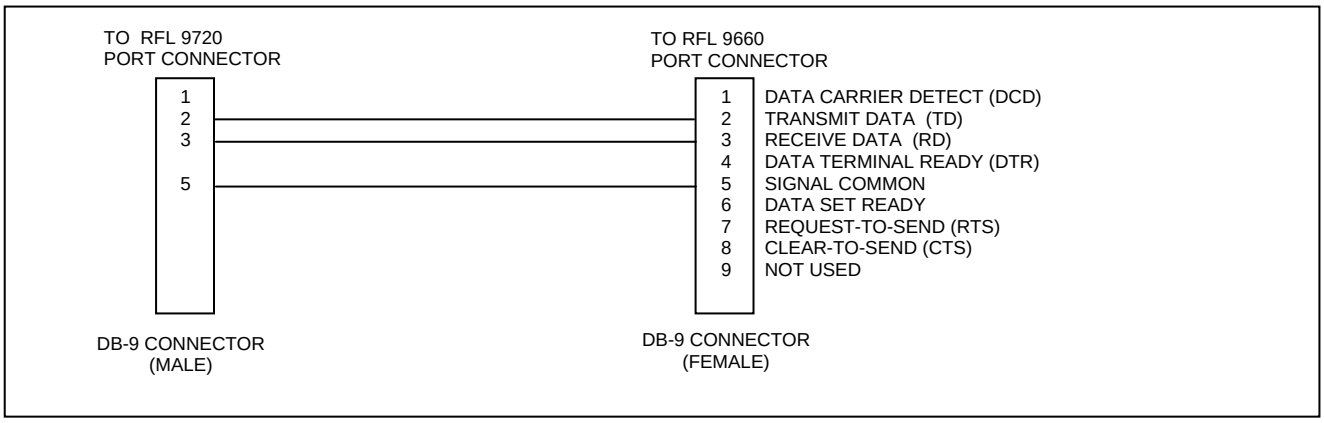

Figure 1. Wiring diagram for cable between RFL 9720 Digital Pilot Wire Interface and RFL 9660 PORT connector.

NOTE

DIP switch SW1-8 on the RFL 9720 CCM module must be placed in the ON position to disable flow control. (Refer to the RFL 9720 manual for more information.)

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

5. Choose the port for the RFL 9720 you wish to interrogate.

6. Once the connection is established, you may communicate using the ASCII commands described in the RFL 9720 Instruction Manual.
   All commands must be preceded by "9720."

7. When you are finished, Type in your RFL 9660 deselect sequence.
   "BYE" is the factory default.

You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-016

DEVICE: GEC K Series Relay with KITZ101

MANUFACTURER: GEC Alsthom T&D Protection & Control Limited

APPLICATION SOFTWARE: Access 2.0

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	-
Data Bits	- 8	Call Request	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- Off	Modem String	- \,+++\,Q0\X1\G0 O\N
Local Flow CTRL	- Off	Port Password	-

SWITCH CONFIGURATION: Use the following modem reset code: \,+++\,at&F1 O\N
Higher baud rates may be used, but the comm settings in ACCESS, 9660 port and KITZ101 must be the same.

CABLE CONFIGURATION: See Figure 1.

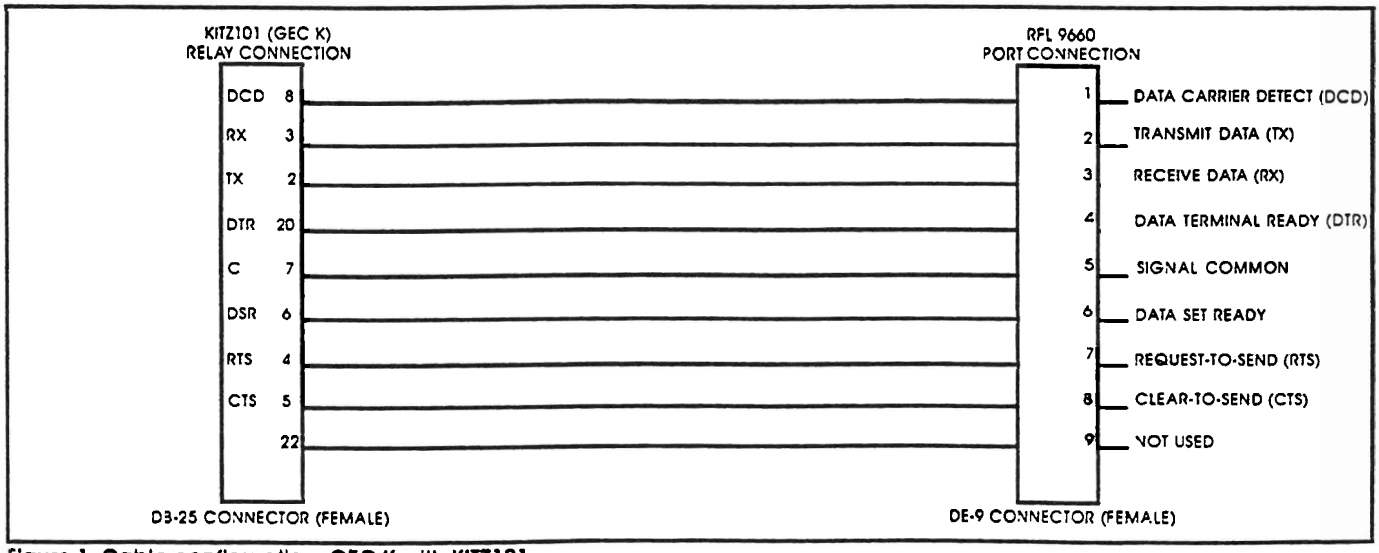

Figure 1. Cable configuration, GEC K with KITZ101

TYPICAL SESSION:

1. Load the Windows 3.1 Terminal application.

2. Configure terminal for the proper communication parameters that you will be using.

3. Establish the connection with the RFL 9660 using the terminal's dialing features.

4. Select the port which is connected to the KITZ101/GEC K relay.

5. Load the ACCESS.EXE program by selecting it's icon or through Windows' File Manager. The modem being used with the PC running ACCESS.EXE must be programmed to ignore DTR or the phone connection will be broken when the program is started.

6. Communicate normally with the relay.

7. When finished, minimize the ACCESS.EXE program or place it into the background. Do not allow background execution.

8. Bring the terminal program into the foreground and deselect the port by entering you deselect code.

9. You may select another port or log off the RFL 9660.

CAUTION: Never allow ACCESS.EXE to become active when the RFL 9660 is in it's command mode (not connected to a port). Doing so will cause the PC running ACCESS.EXE to "lock up". If this occurs you must perform a hard reset of the PC.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-017

DEVICE: RFL 9660 DTE

APPLICATION: External Modem Interface

APPLICATION SOFTWARE: See 9660 Application Note

HARDWARE CONFIGURATION: A blank panel is used in place of the internal modem. A DTE (direct digital interface) I/O 104455 is used in place of the two or four wire I/O.

SWITCH CONFIGURATION: Set CPU protocol (baud rate, no. of data bits, parity and no. of stop bits) the same as the modem settings. See section eight for CPU switch settings.

CAUTION: DO NOT USE SOFTWARE FLOW CONTROL WHEN TRANSFERRING BINARY DATA. USE EITHER HARDWARE FLOW CONTROL OR NO FLOW CONTROL.

MODEM CONFIGURATION: Modem factory default settings will work in most applications. Refer to the modem manual for special configuration settings.

CABLE CONFIGURATION: See Figure 1.

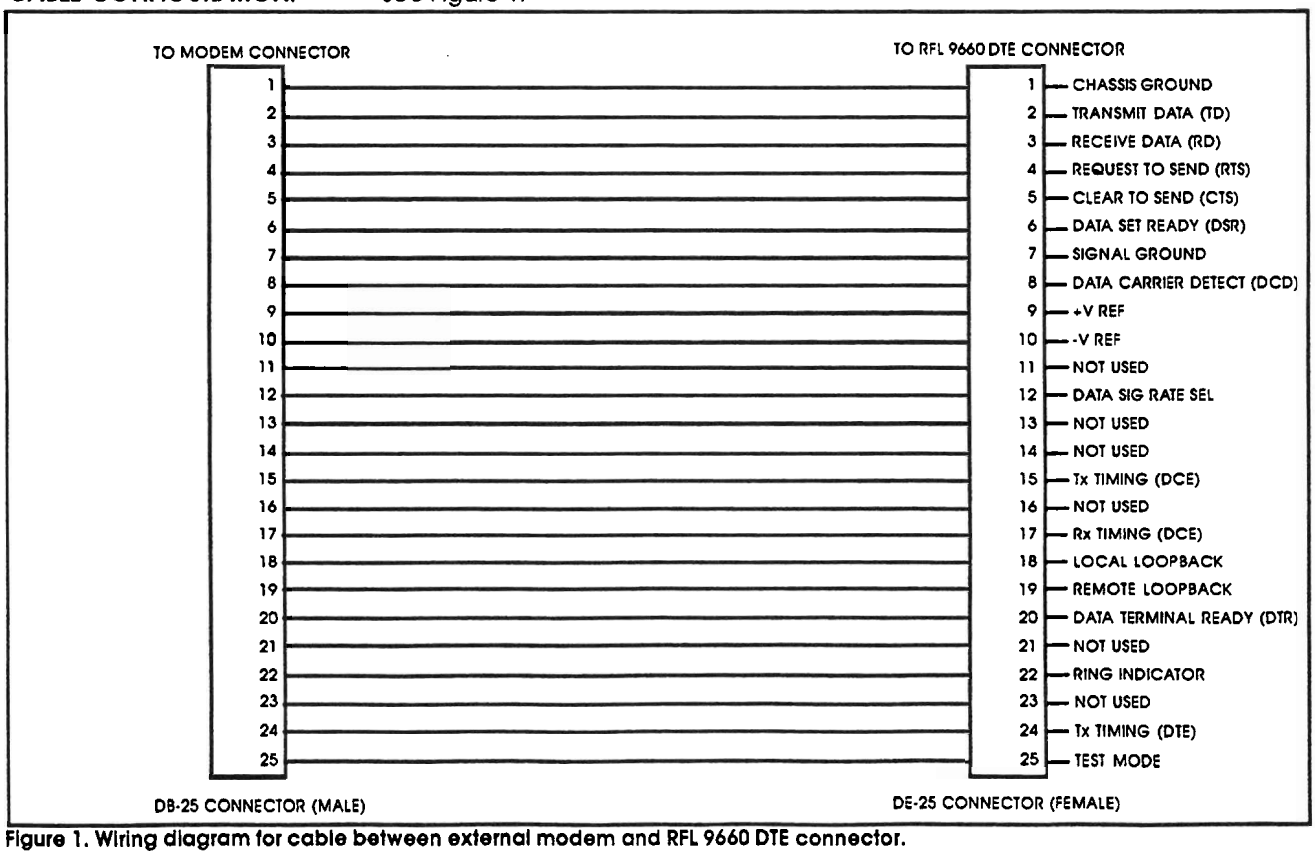

Figure 1. Wiring diagram for cable between external modem and RFL 9660 DTE connector.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-018

DEVICE: Transcan Digital Recorder

MANUFACTURER: Mehta Tech Inc.

APPLICATION SOFTWARE: DATACOMM

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 9600	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- RTS/CTS	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow CTRL	- Off	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CAUTION: USE WITH DIRECT DIGITAL INTERFACE (104455) AND EXTERNAL MODEM. SEE APPLICATION NOTE 9660-017.

CABLE CONFIGURATION: See Figure 1.

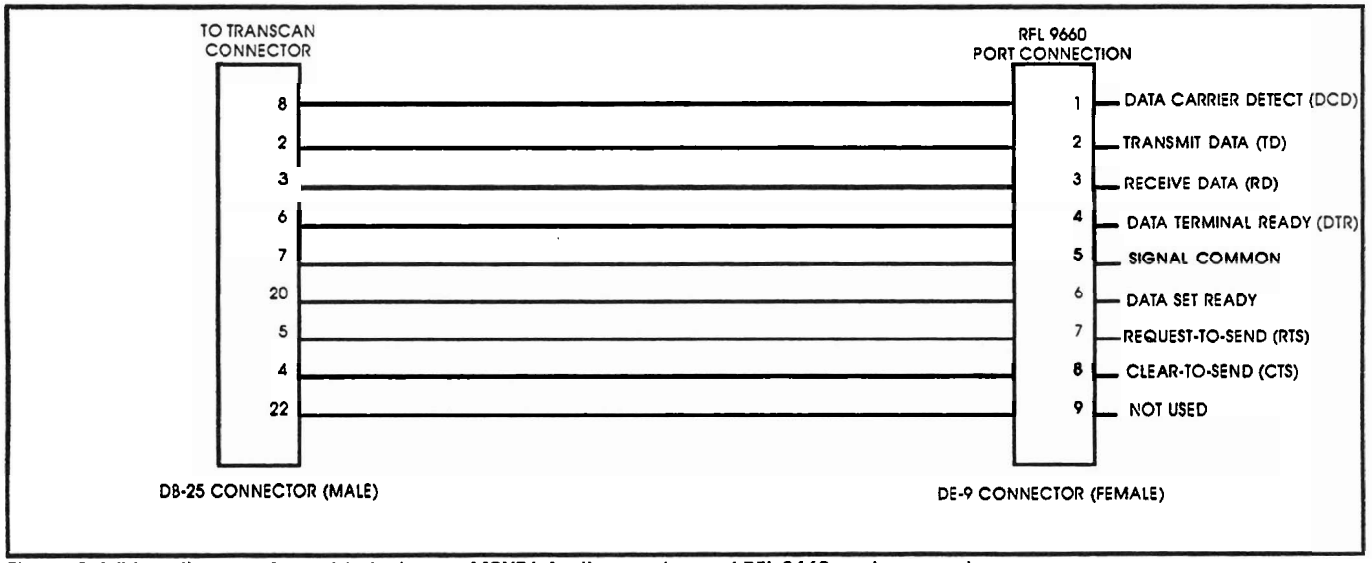

Figure 1. Wiring diagram for cable between MEHTA fault recorder and RFL 9660 port connector

TYPICAL DATACOMM SESSION:

1. Load the DATACOMM Bulletin Board program using the following string: DATACOMM /M/K/Z/BBS/B(+ baud rate)/C(+ com port)/T(+ 9660 phone no.). Modem baud rate is not to exceed 9600 baud.

2. Once the connection is established, select the MEHTA device port then follow the DATACOMM instructions to retrieve recorder data.

3. When you are finished, type in your RFL 9660 deselect sequence which is "BYE", the factory default deselect sequence.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-019

DEVICE: DPU 245D/445H/445V Relay

MANUFACTURER: ABB Brown-Boveri

APPLICATION SOFTWARE: WRELCOM

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 2	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

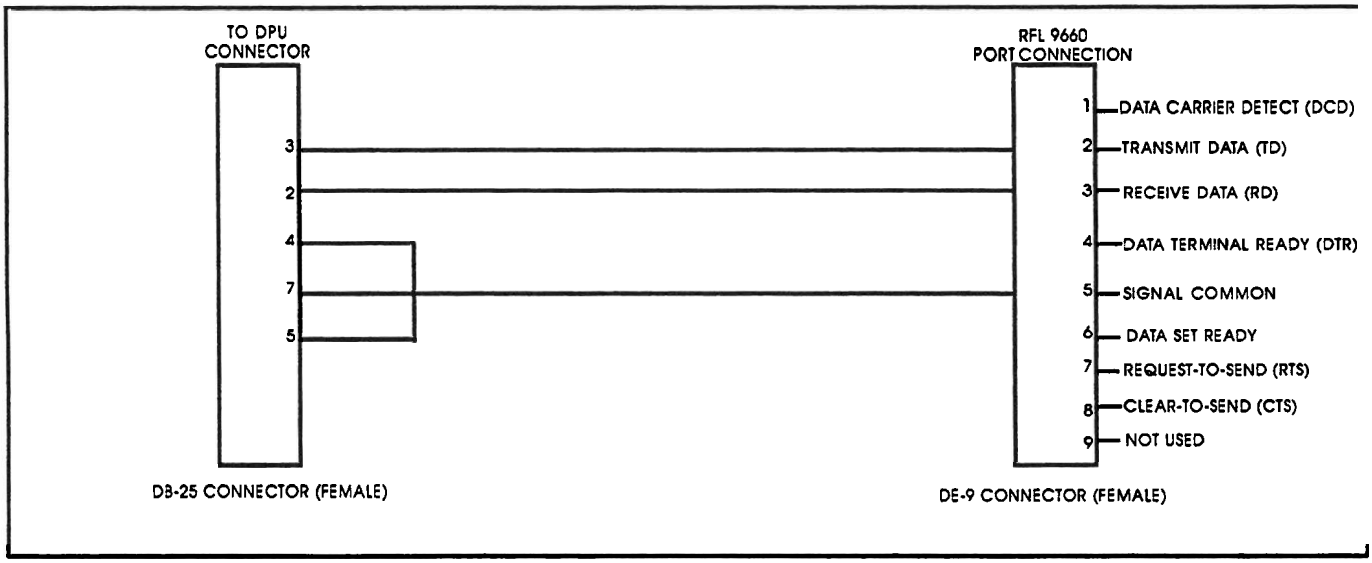

Figure 1. Wiring diagram for cable between DPU Relay and RFL 9660 port connector

TYPICAL WINDOWS SESSION:

1. Load Windows into your PC.
2. Choose the Windows terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communication parameters and change the baud rate to 2400.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the DPU relay you wish to interrogate.
7. Once the connection is established, exit the Windows Terminal application completely. Be sure you tell the Windows Terminal application not to hang up the phone.
8. Load the WRELCOM software, and log on with your password.
9. Communicate normally.
10. When you are finished, log off the DPU relay and completely exit WRELCOM.
11. Reload the Windows Terminal application and the file for the switch.
12. Type in your RFL 9660 deselect sequence. ("BYE" is the factory default.) You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-020

DEVICE: DV4 Recording Voltmeter

MANUFACTURER: Angus Electronics Company

APPLICATION SOFTWARE: Series-D

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 9600	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- OFF	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CAUTION: USE WITH DIRECT DIGITAL INTERFACE (104455) AND EXTERNAL MODEM. SEE APPLICATION NOTE 9660-017.

CABLE CONFIGURATION: See Figure 1.

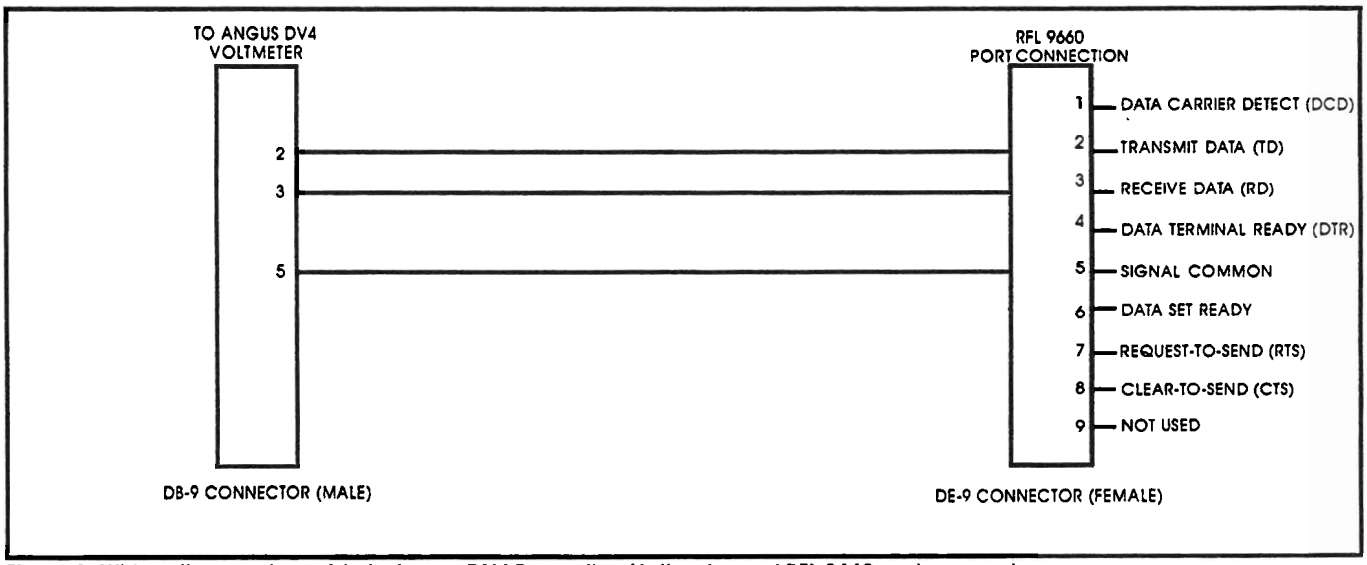

Figure 1. Wiring diagram for cable between DV4 Recording Voltmeter and RFL 9660 port connector

TYPICAL WINDOWS SESSION:

1. Load Windows into your PC.
2. Choose the Windows terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communication parameters and change the baud rate to 9600.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the Angus Recording Voltmeter you wish to interrogate.
7. Once the connection is established, exit the Windows Terminal application completely. Be sure you tell the Windows Terminal application not to hang up the phone.
8. Load the SERIES-D software, and log on with your password.
9. Communicate normally.
10. When you are finished, log off the DV4 recording voltmeter and completely exit SERIES-D.
11. Reload the Windows Terminal application and the file for the switch.
12. Type in your RFL 9660 deselect sequence. ("BYE" is the factory default.) You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-021

DEVICE: LFCB Relay

MANUFACTURER: GEC Alsthom, T&D Inc.

APPLICATION SOFTWARE: LFCB

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: Set port label to be the same as the relay password.

CABLE CONFIGURATION: See Figure 1.

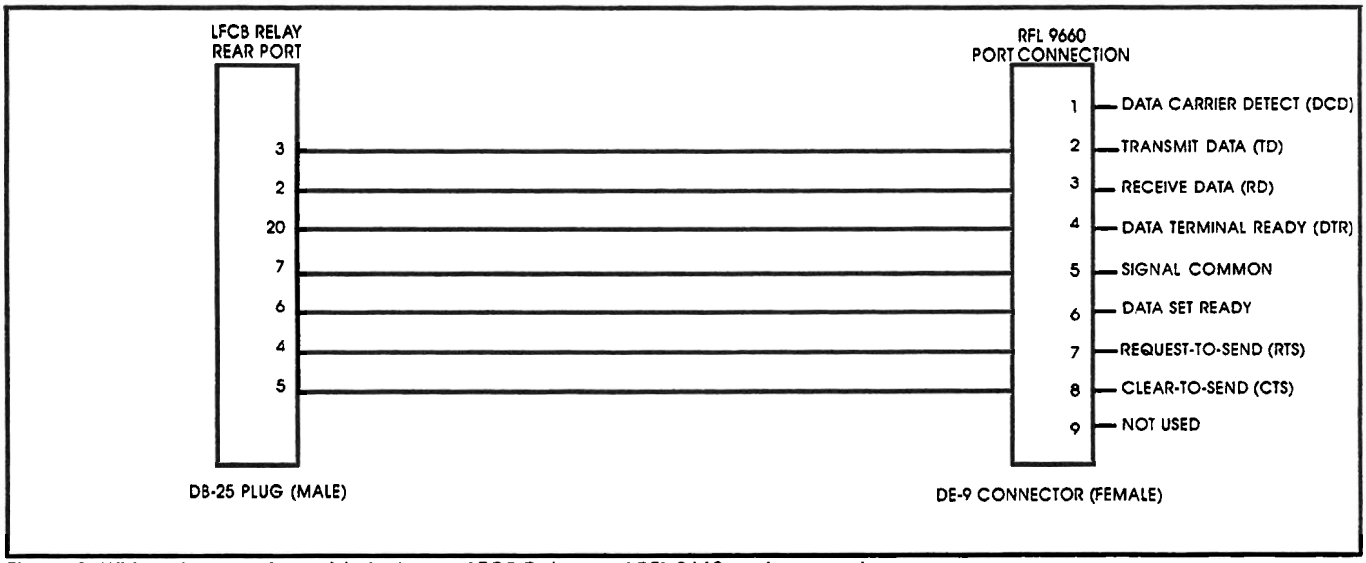

Figure 1. Wiring diagram for cable between LFCB Relay and RFL 9660 port connector

TYPICAL LFCB SESSION:

1. Make sure the port label is set to the same value as the relay password.
2. Load the LFCB software package.
3. Set LFCB to communicate at 2400 baud, 8 data bits, no parity and one stop bit.
4. Make sure that the LFCB relay is also programmed for the above word format.
5. Initiate the call with the LFCB in the normal manner.
6. Once the connection is established, the LFCB will send the relay password which will select the port and connect it with the relay.

CONNECTING THROUGH THE LFCB FRONT (LOCAL) PORT:

The cable to the LFCB must be connected to the serial port on the front of the relay. This port is a DCE, so you must use an "X-modem" adapter which switches TX and RX. Pins 4 and 5 are connected together at the LFCB cable connector. Pins 6,8 and 20 are joined together at the LFCB cable connector.

1. Set the LFCB software to Local communication.
2. Choose the "dumb terminal emulation" from the LFCB menu.
3. Press the [ENTER] key to access the switch.
4. Select the port that is connected to the LFCB relay's serial port.
5. Press [ALT] [Q] to exit back to the menu.
6. Communicate normally.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-022

DEVICE: ASADC2, ATADC2, AQADC2
VSAMC2,VTAMC2,GQWMC2

MANUFACTURER: Bitronics, Inc.

APPLICATION SOFTWARE: BiComm

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- On	Modem String	- \,+++\,AT\GO\QO\X10\N
Local Flow CTRL	- Off	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

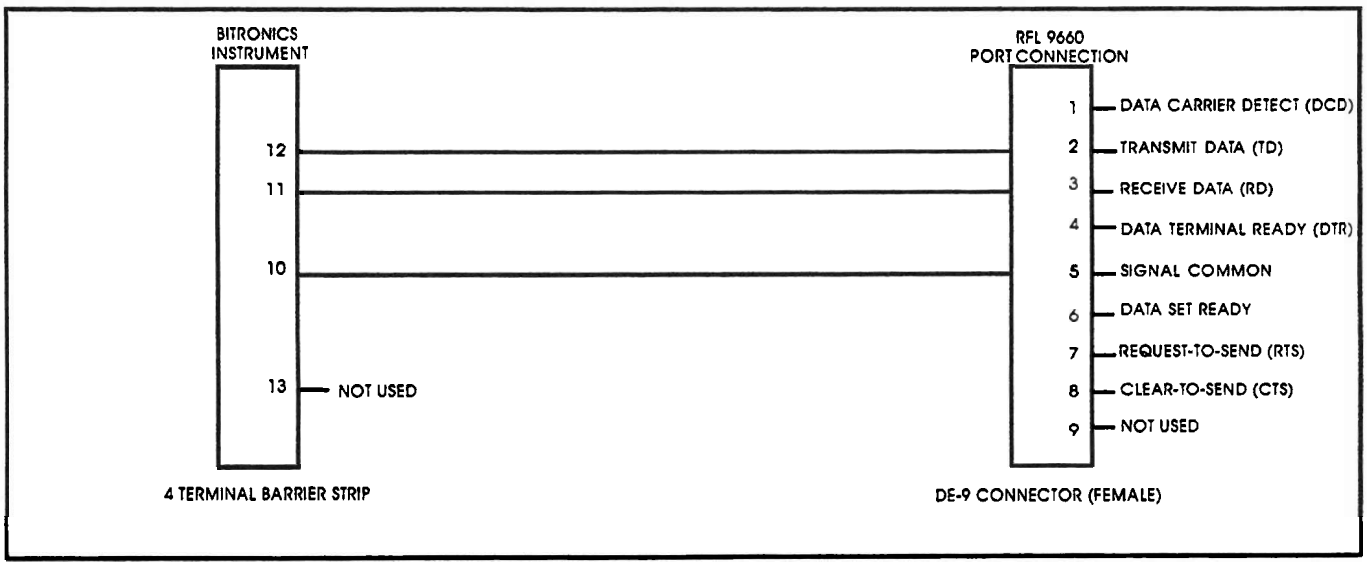

Figure 1. Wiring diagram for cable between the Bitronics, Inc. instrument and RFL 9660 port connector

TYPICAL BICOMM SESSION:

Note: The PC can be directly connected to the 9660 local port using a straight through pin for pin DE-9 M-F cable.

1. Setup the PROCOMM PLUS dialing directory to access the 9660 Digital Switch.

2. Setup the "script" field to point to the substation file.

3. Edit the first line of the substation file to access the 9660 port, example selects Port No 4.
   Example:
   SA 16 03 ~~~~~~~~~~~~~~~~~~~~B~Y~E~~~~~~^M~^N~~4~^M~~~~~~~~~~~~~~~~~~~~~~~~
   This string allows connection to either the front or the modem connector. The 4 represents Port 4 Selection.

   The BiCOMM Software will automatically dial through the RFL 9660 Digital Switch when the user performs a "Select Substation" operation.

   Refer to Section 3.5 of the BiComm manual for setup assistance.

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RFL 9660 Bulletin Board: (201) 334-3099
2400 baud, 8 bits, 1 stop bit, no parity

Publication No. AN 9660-022
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Revised November 15, 1994

RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-023

DEVICE: 2600 Remote Events Recorder

MANUFACTURER: Dranetz Technologies, Inc.

APPLICATION SOFTWARE: Terminal Emulation Program

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- Off	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

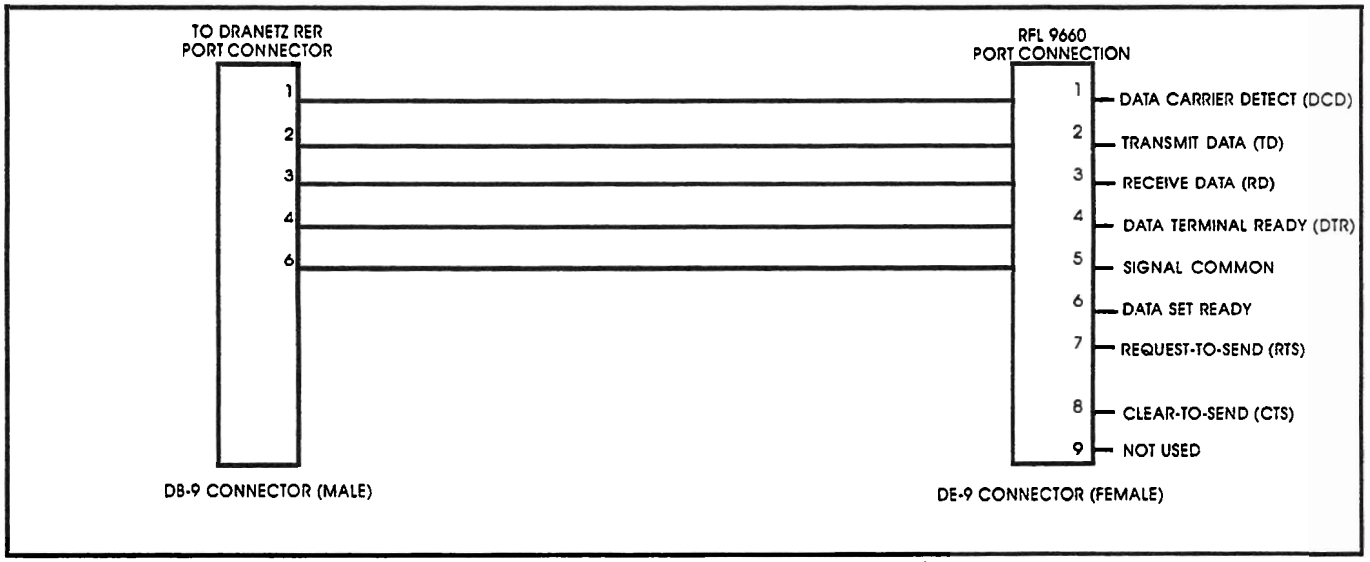

Figure 1. Wiring diagram for cable between Dranetz 2600 RER and RFL 9660 Port Connector

TYPICAL WINDOWS SESSION:

1. Load Windows into your PC.
2. Choose the Windows terminal application.
3. Load the file that contains the normal switch parameters.
4. Initiate the call to the Dranetz 2600 RER. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
5. Choose the port for the Dranetz 2600 RER you wish to interrogate.
6. You may now communicate with the Dranetz 2600 RER by using the Dranetz commands.
7. When you are finished, type in your RFL 9660 deselect sequence ("Bye" is the factory default).

You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-024

DEVICE: BEI-DFPR or BEI-25/79TR

MANUFACTURER: Basler Electric

APPLICATION SOFTWARE: Terminal Emulation Program with VT-100 Terminal Emulation

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Request	- 0
Parity	- None	Call String	-
Stop Bits	- 2	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- Off	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

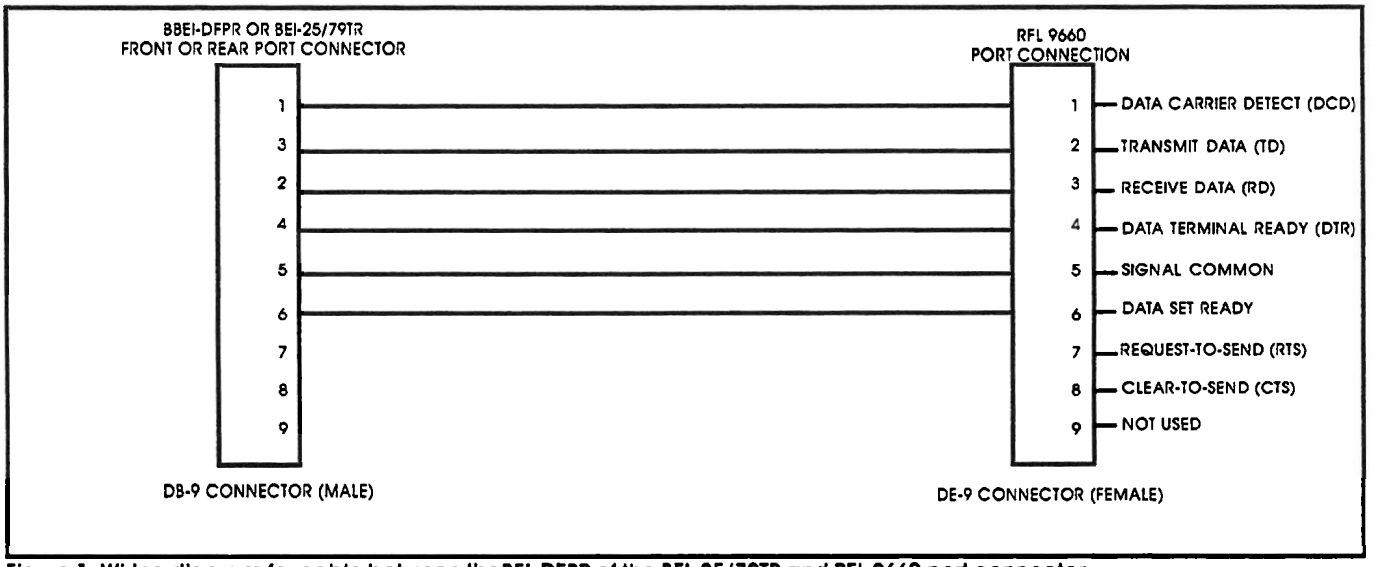

Figure 1. Wiring diagram for cable between theBEI-DFPR of the BEI-25/79TR and RFL 9660 port connector

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Initiate the call to the RFL 9660 in the usual manner, entering passwords as required by your RFL 9660 configuration.

5. Choose the port for the BEI-DFPR or BEI-25/79TR you wish to interrogate.

6. You may now communicate with the BEI-DFPR or BEI-25/79TR using the Basler Electric commands.

7. When you are finished, type in your RFL 9660 deselect sequence. ("BYE" is the factory default.) You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-025

DEVICE: Pride M-0420 Multifunction Relay

MANUFACTURER: Beckwith Electric Company, Inc.

APPLICATION SOFTWARE: Becocom

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- On	Modem String	- \,+++\,AT\G0\Q0\X10\N
Local Flow CTRL	- Off	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

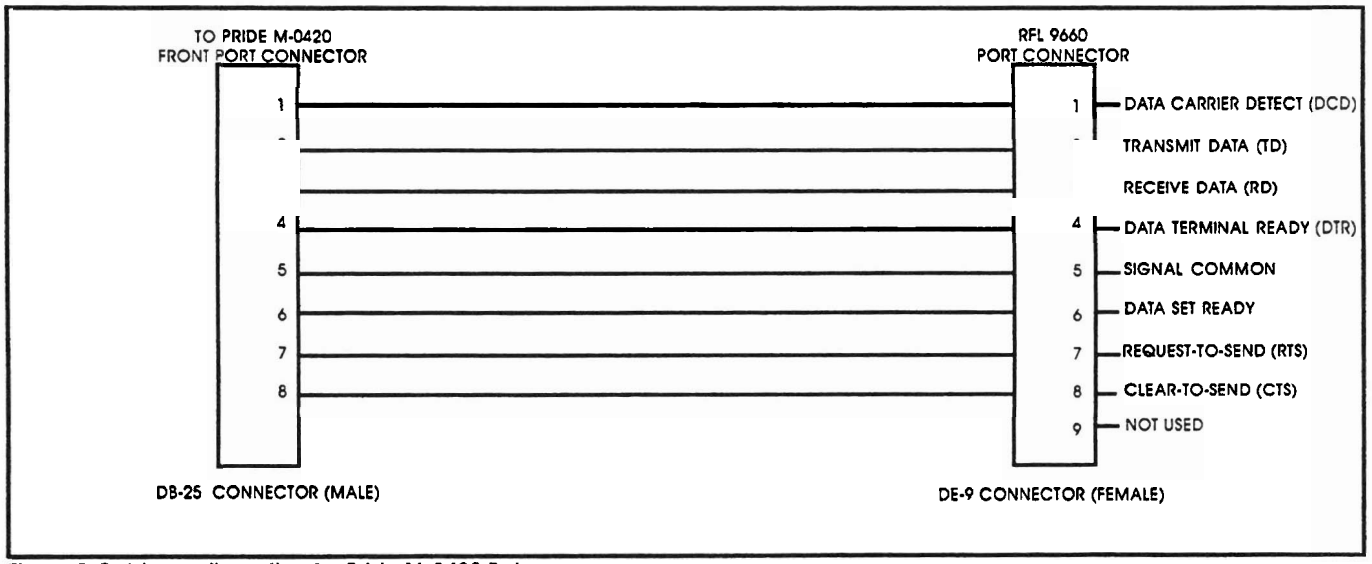

Figure 1.Cable configuration for Pride M-0420 Relay.

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.
2. Choose the Windows Terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communication parameters and set the baud rate to 2400.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Choose the port for the Pride M-0420 Relay you wish to interrogate.
7. Once the connection is established, exit the Windows Terminal application completely. Be sure you tell the Windows Terminal application not to disconnect the phone.
8. Load the Becocom software.
9. Check the Option Menu to be sure that you have Becocom set for the port where your modem is located (COM1, COM2, etc.) and the baud rate your relay is set to.
10. When you are finished completely exit Becocom.
11. Reload the Windows Terminal application, the file for the switch and set the communication parameters for 2400 baud.
12. Type in your RFL 9660 deselect sequence. ("BYE" is the factory default.)

You may now choose another port on the RFL 9660.

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-026

DEVICE: RFL 9001

MANUFACTURER: RFL Electronics Inc.

APPLICATION SOFTWARE: Terminal Emulation Program

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- Off	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

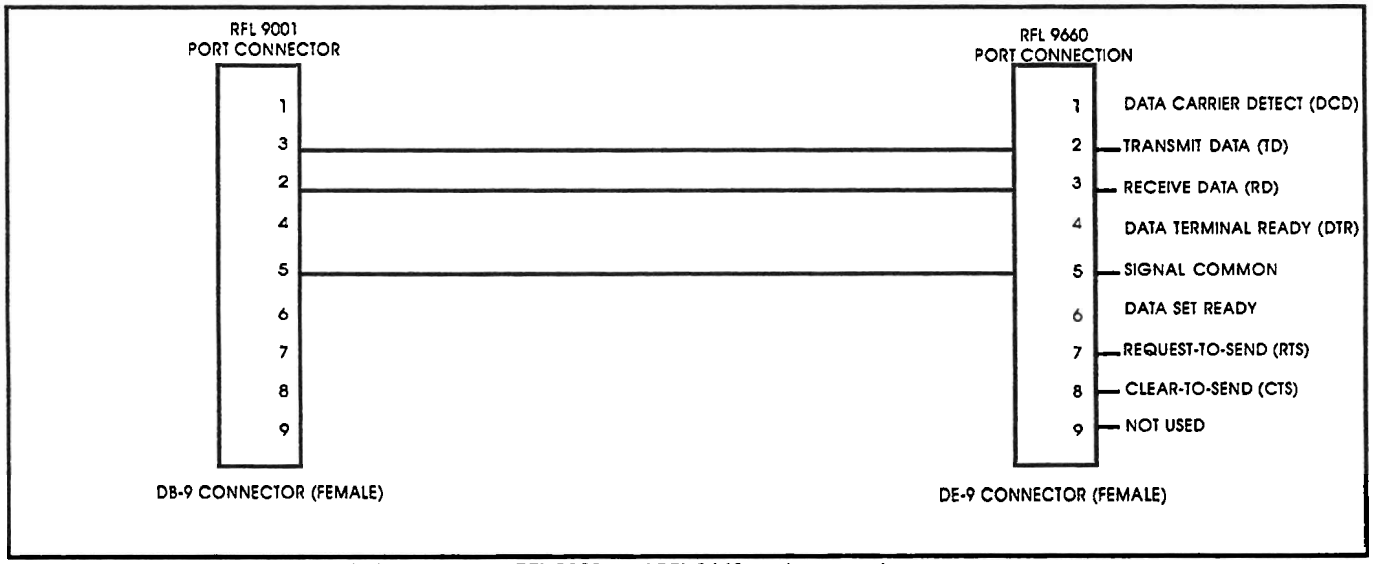

Figure 1. Wiring diagram for cable between the RFL 9001 and RFL 9660 port connector.

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Initiate the call to the RFL 9660 in the usual manner, entering passwords as required by your RFL 9660 configuration.

5. Choose the port for the RFL 9001 you wish to interrogate.

6. You may now communicate with the RFL 9001 by using the Simple Command Language "SCL" commands.

7. When you are finished, type in your RFL 9660 deselect sequence. ("BYE" is the factory default.) You may now choose another port on the RFL 9660.

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2400 baud, 8 bits, 1 stop bit, no parity

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RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-027

DEVICE: REL 301/302 Relay with PONI Module

MANUFACTURER: ABB Power T&D Company

APPLICATION SOFTWARE: WRELCOM

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1.

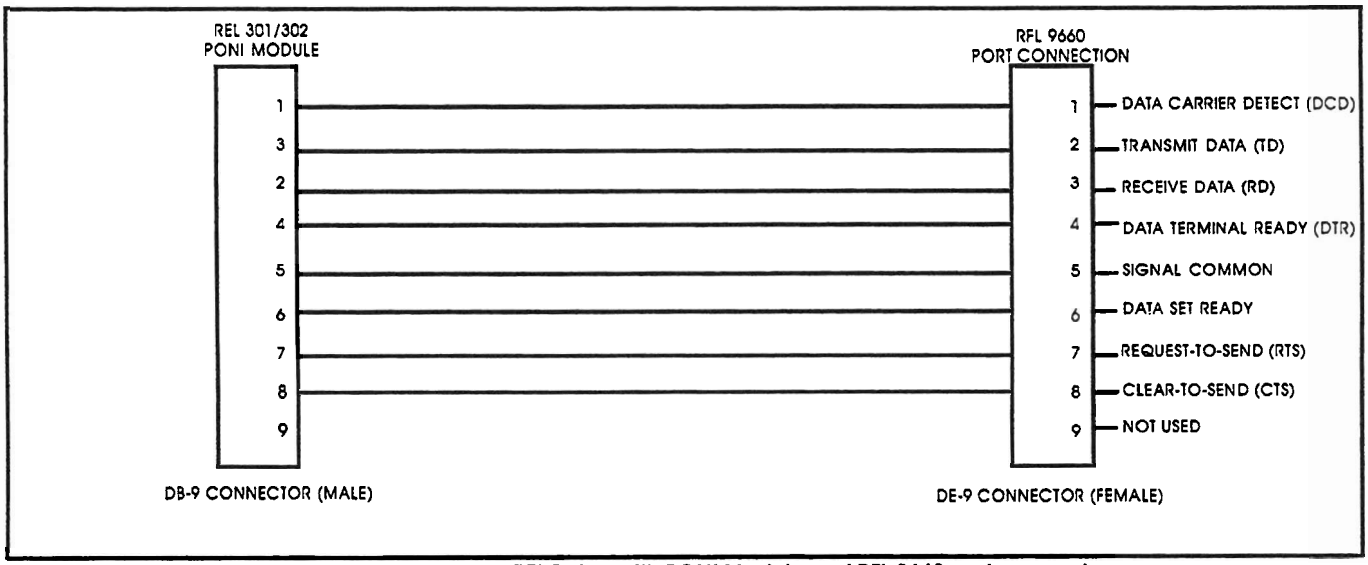

Figure 1. Wiring diagram for cable between the REL Relay with PONI Module and RFL 9660 port connector.

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2400 baud, 8 bits, 1 stop bit, no parity

RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-028

DEVICE: RFL 9745

MANUFACTURER: RFL Electronics Inc.

APPLICATION SOFTWARE: Terminal Emulation Program

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow CTRL	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings are required, use factory default settings.

CABLE CONFIGURATION: See Figure 1

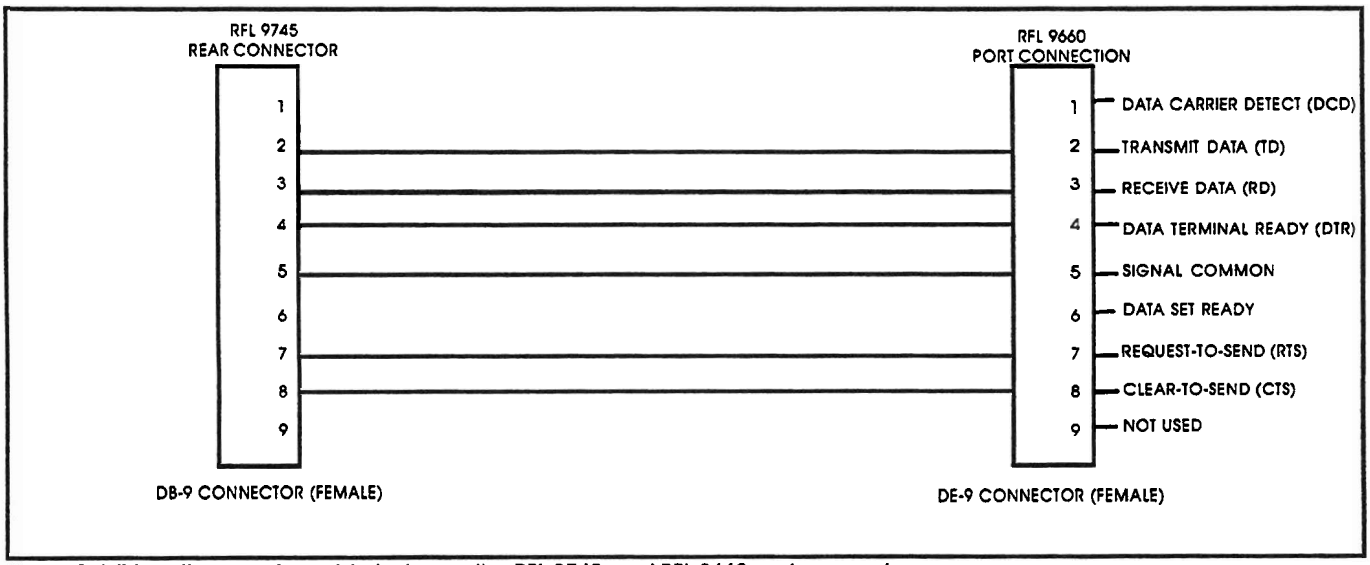

Figure 1. Wiring diagram for cable between the RFL 9745 and RFL 9660 port connector.

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2400 baud, 8 bits, 1 stop bit, no parity

RFL Electronics Inc.

A P P L I C A T I O N N O T E

NUMBER: 9660-029

DEVICE: TPU 2000

MANUFACTURER: ABB Power T&D Company

APPLICATION SOFTWARE: Wrelcom

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 2400	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- XON/XOFF	Port String	-
Local Port DTR	- On	Modem String	-
Local Flow Ctrl	- On	Port Password	-

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See figure 1.

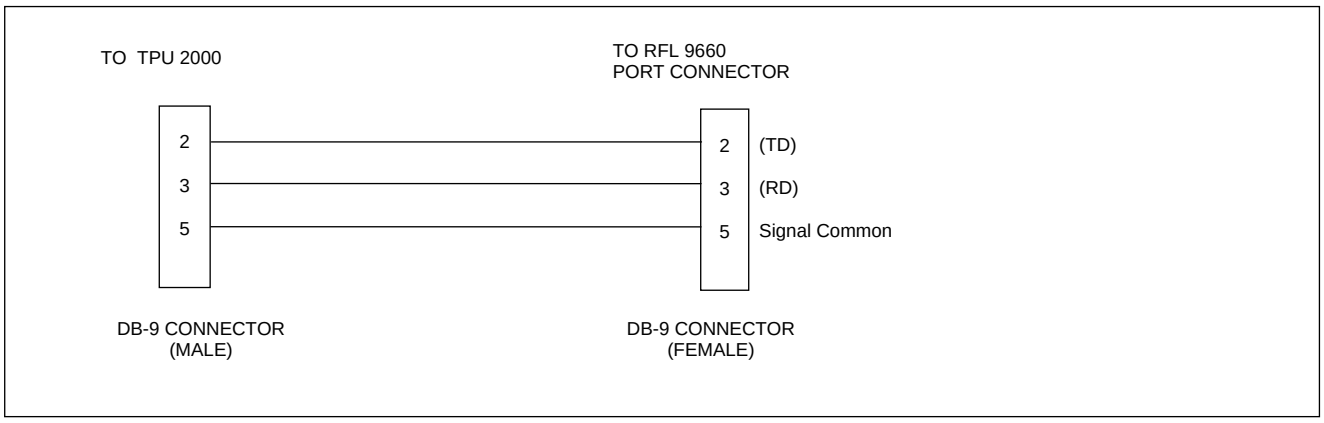

Figure 1. Wiring diagram for cable between TPU 2000 and RFL 9660 PORT connector.

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.

2. Choose the Windows Terminal application.

3. Load the file that contains the normal switch parameters.

4. Choose the communications parameters and change the baud rate to 2400.

5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.

6. Choose the port for the device you wish to interrogate.

7. Once the connection is established, exit the windows terminal application completely. Be sure you tell the Windows Terminal application not to hang up the phone.

8. Load the WRELCOM software, and log on with your password.

9. Communicate normally.

10. When you are finished, log off the TPU 2000 and completely exit WRELCOM.

11. Reload the Windows Terminal application and the file for the switch.

12. Type in your RFL 9660 deselect sequence. (“BYE” is the factory default.)

You may choose another port on the RFL 9660.

RFL Electronics Inc.

A P P L I C A T I O N N O T E

NUMBER: 9660-030

DEVICE: M-3430

MANUFACTURER: Beckwith Electric Company, Inc.

APPLICATION SOFTWARE: IPScom Version 2.5.0

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 9600	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 2	Remote String	-
Port Flow Ctrl	- RTS/CTS	Port String	-
Local Port DTR	- Off	Modem String	-
Local Flow Ctrl	- Off	Port Password	-

SWITCH CONFIGURATION: No special configuration settings required; the factory default settings may be used.

CABLE CONFIGURATION: See figure 1.

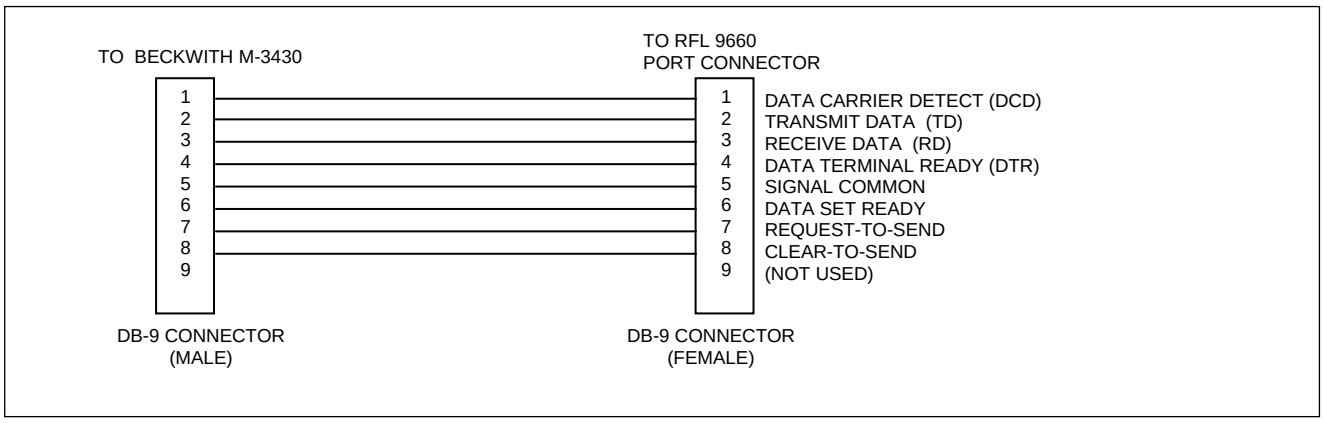

Figure 1. Wiring diagram for cable between BECKWITH M-3430 and RFL 9660 PORT connector.

TYPICAL WINDOWS SESSION:

1. Load Windows in the normal manner.
2. Choose the Windows Terminal application.
3. Load the file that contains the normal switch parameters.
4. Choose the communications parameters and change the baud rate to 2400.
5. Initiate the call to the RFL 9660. Log on in the usual manner, entering passwords as required by your RFL 9660 configuration.
6. Program the 9660 port that is connected to the M-3430.
7. Establish a connection to the 9660 port.
8. Once the connection is established, exit the windows terminal application completely.
9. Start IPScom. (refer to the Beckwith M-3430 instruction manual)
10. When finished, exit IPScom and re-start the Windows Terminal application.
11. Type in your RFL 9660 deselect sequence.(**BYE** is the factory default deselect sequence)

You may choose another port on the RFL 9660.

RFL Electronics Inc.

APPLICATION NOTE

NUMBER: 9660-031

DEVICE: Optimho Relay

MANUFACTURER: GEC Alsthom, T&D Inc.

APPLICATION SOFTWARE: Opticom V 5.1

RFL 9660 PORT PROGRAMMING:

Interface	- RS232	Call Out	- Off
Baud Rate	- 4800	Call Request	- None
Data Bits	- 8	Call Priority	- 0
Parity	- None	Call String	-
Stop Bits	- 1	Remote String	-
Port Flow Ctrl	- None	Port String	-
Local Port DTR	- Off	Modem String	-
Local Flow Ctrl	- Off	Port Password	-

CABLE CONFIGURATION: See Figure 1.

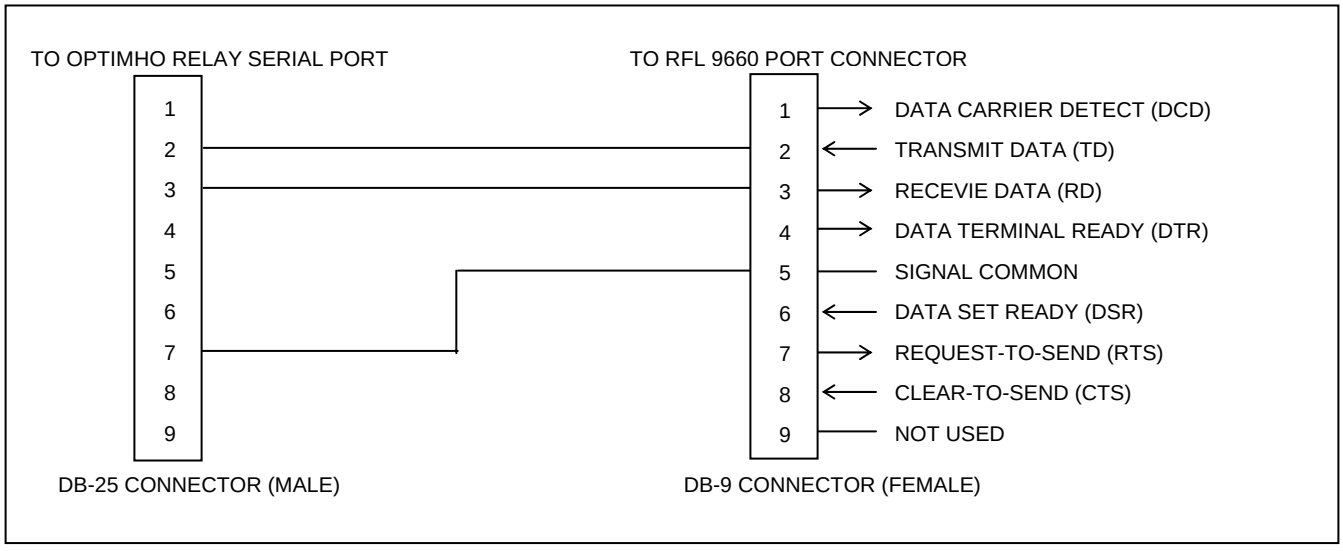

Figure 1. Wiring diagram for cable between Optimho Relay and RFL 9660 PORT connector

RFL 9660 / OPTIMHO RELAY
TYPICAL SESSION

1. Run the **Opticom** software program.

2. From the main menu, select **Relay Data Transfer**.

3. Select **Communication Settings**. (4800 baud, 8 bits, no parity, 1 stop bit.)

4. Select **Dumb Terminal Emulation**.

5. Type "**AT** " <enter> [response: "**OK**"]

6. Type "**AT&D0**" <enter> [response: "**OK**"]

7. Type "**ATDT (phone #)**" <enter>

8. After connection is established, the 9660 responds with "**Enter <CR> For Access**".

9. Hit <**enter**> [response: "**Remote>**"]

10. Type the port number that the Optimho Relay is on, then hit <**enter**> [response: "**Connected to Port #n ( ) to deselect type BYE**"]

11. Press **alt + q** to quit the **Dumb Terminal Emulation**.

12. The user can now select the desired action to execute and log onto the Optimho Relay.

13. When the user is finished and the Optimho has been logged off, the user must re-enter **Dumb Terminal Emulation** mode.

14. Once in **Dumb Terminal Emulation** mode, type "**BYE**" (**BYE** must be in capital letters with no carriage returns before or after).

15. The user may now perform normal 9660 functions.