Meridian 1

Remote Peripheral Equipment

Description, installation, and testing

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Contents

Description

Remote peripheral equipment (RPE) increases the 15 m (50 ft.) range of the loop between the common equipment (CE) and peripheral equipment (PE) shelves in an SL-1 system.

The increased range enables the PE to be placed closer to the stations it serves, which in turn increases the serving range of the SL-1 system.

RPE uses a carrier link between the local and remote ends. The carrier link may consist of one of the following:

— a wire pair with no repeaters or other interfaces (in-house IRPE)

— a digital carrier link meeting T1 interfacing specifications (such as Nortel Networks LD 1)

— a microwave radio link (which meets T1 interfacing specifications)

— a fiber-optic link (which meets T1 interfacing specifications)

Equipment configuration

Reference list

The following are the references in this section:

- *Circuit card installation and testing (553-3001-211)*

Carrier system

A block diagram of the basic RPE system is shown in Figure 1. A 1.544 Mbps multiplexed digital carrier system (such as LD-1), or a microwave radio link, is required for each RPE system. A maximum of two network loops may be connected through two RPE carrier shelves (one shelf at the local equipment location, and one at the remote location). A complete RPE shelf (two network loops) requires four digital carrier lines.

Carrier shelf

The same type of carrier shelf for the RPE is used at the local and remote locations. The QSD6 (left-hand mounted) and QSD11 (right-hand mounted) shelves may be mounted in any SL-1 peripheral equipment (PE) cabinet. The power supply connector is a two-pin type. Each shelf has a power converter card to derive its required voltages from a –48 V supply provided by a QBL14 Power Distribution Box. All cables from the carrier shelves are connectorized.

Each loop services a maximum of four PE shelves. RPE network loops are fully assigned to RPE use, and no other PE shelves can be served by these loops.

Each loop requires four cable pairs (two carrier lines) between the carrier shelf and the carrier system for transmission and signaling. A maximum of two cable pairs is required for maintenance purposes. These are the order-wire (OW) and fault-locating (FL) pairs, and are optional depending on the distance between the carrier shelves and on the location of the office repeater bay (ORB) in the system.

Each RPE system requires at least one ORB (see Figure 2) and line repeaters, unless the remote equipment is within about 762 m (2500 ft) of the SL-1 equipment. Locating the ORB at both local and remote ends of the carrier line is strongly recommended. This effectively allows the isolation of the carrier span from the SL-1.

An ORB provides the following:

— span line powering

— error monitoring

— fault-locating (FL) system access

— order-wire (OW) termination with digital distance dialing (DDD) access

— line looping

A typical RPE configuration is shown in Figure 3. Each RPE system requires a carrier shelf at the local and remote locations. These are cabled to the SL-1 cross connect terminal through two NE-A25B cables.

Carrier shelves at the local equipment location and at the remote location are connected to QPC50 network cards and peripheral equipment shelves, respectively, through NE-A18QA connector cables.

Peripheral equipment shelves at the remote location are connected to the cross connect terminal through four NE-A25B connector cables in the same manner as are regular SL-1 PE shelves. For cabling and termination instructions, see the installation procedures for the system.

Two network loops connect to the carrier shelf. Each can serve a maximum of four PE shelves. Circuit card positions 1 through 4 and 5 through 8 serve network loops X and Y, respectively.

Circuit cards

The same circuit cards are used in the local and remote carrier shelves (see Figure 3), except for the QPC63 (local) and the QPC65 (remote) cards. All circuit cards have designated slot positions on the carrier shelves, and they must be kept in these positions to function properly. The QPC62 and QPC99 cards have option switches on their circuit boards. Circuit card handling procedures and option switch settings are given in *Circuit card installation and testing (553-3001-211)*.

Emergency transfer

Designated 500-type telephones can be cross connected through emergency transfer units to outgoing trunks at the remote location. The telephones are connected to these trunks when the normally operated relays of the emergency transfer units release as a result of any of the following:

— loss of –48 V carrier shelf power

— loss of –48 V or ±10 V (under control of the QPC84 Power Monitor circuit card)

— carrier failure

Note: Network loops are controlled independently.

— manual operation of emergency transfer switch on consoles

Note: This will not affect a remote location.

— manual operation of emergency transfer switch on the QPC84 circuit card

Figure 1
RPE block diagram

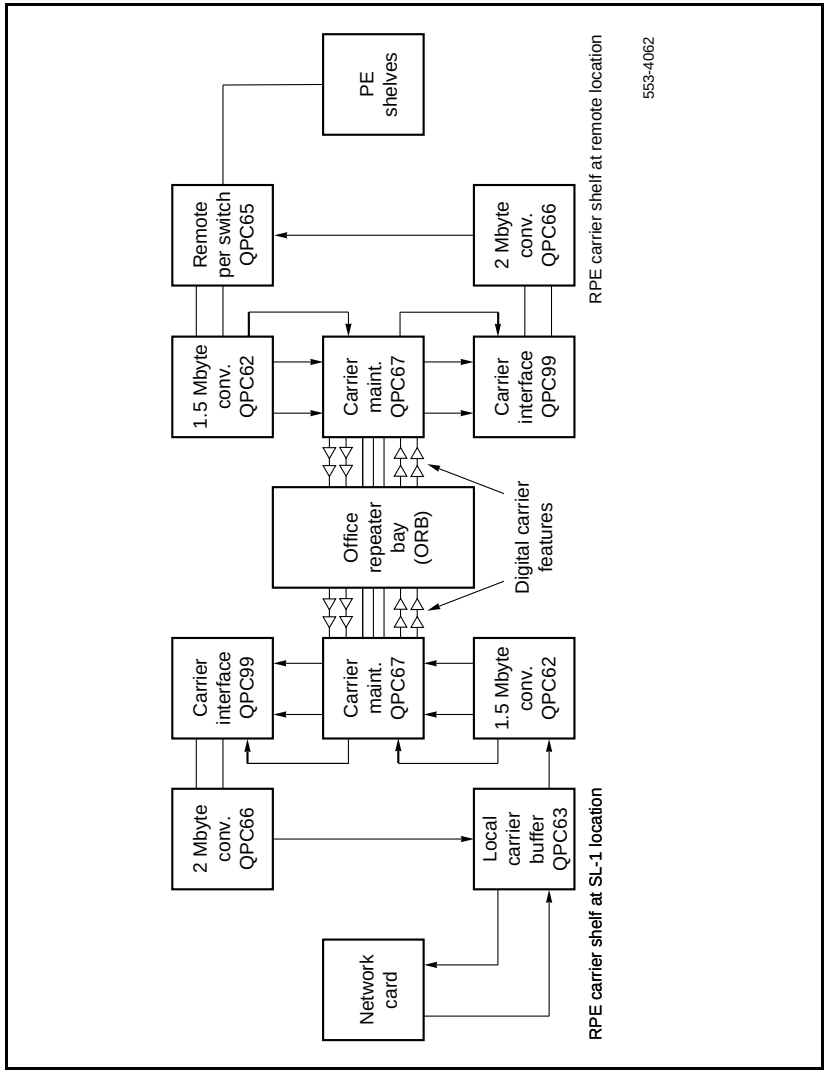


Figure 2
Possible ORB locations in the RPE system

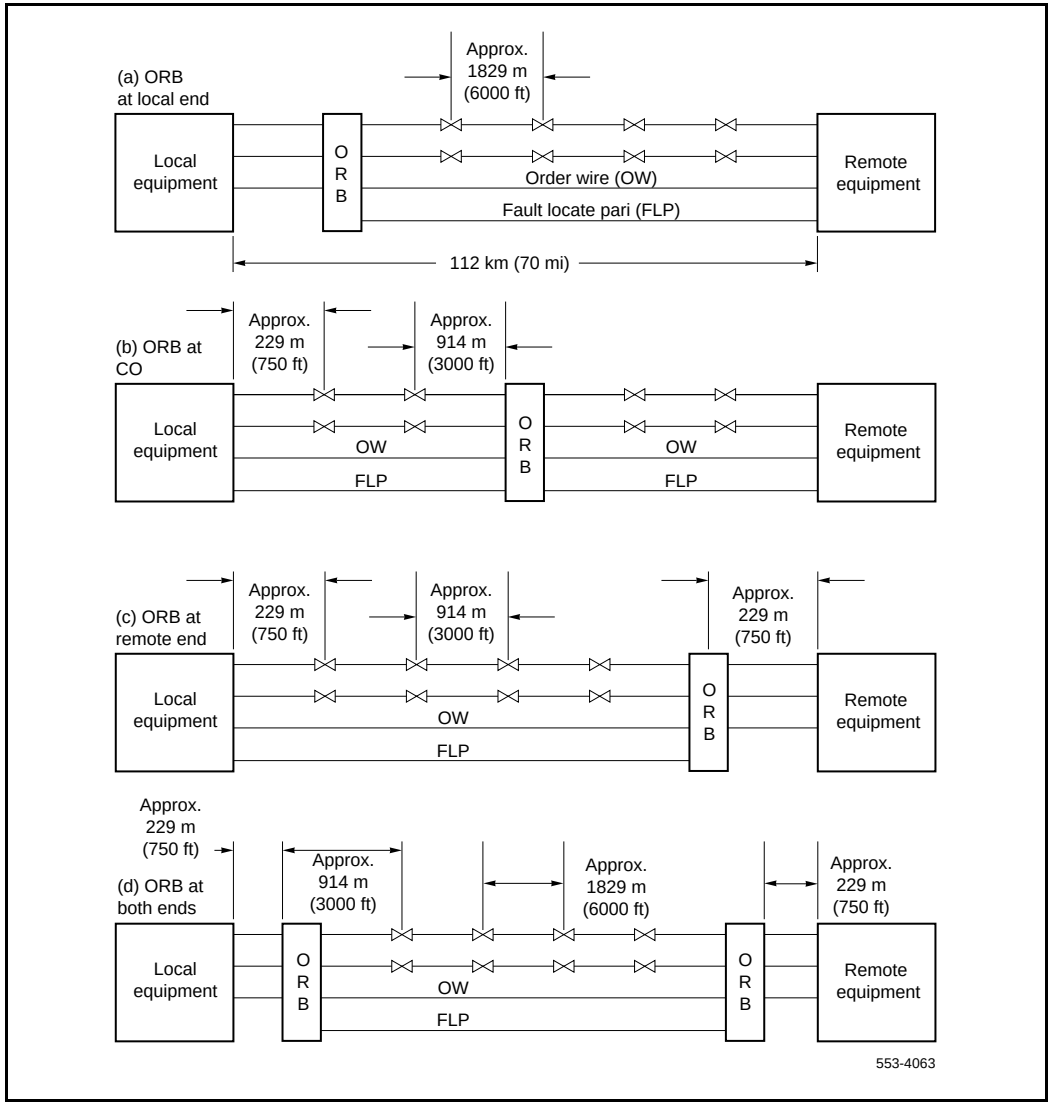
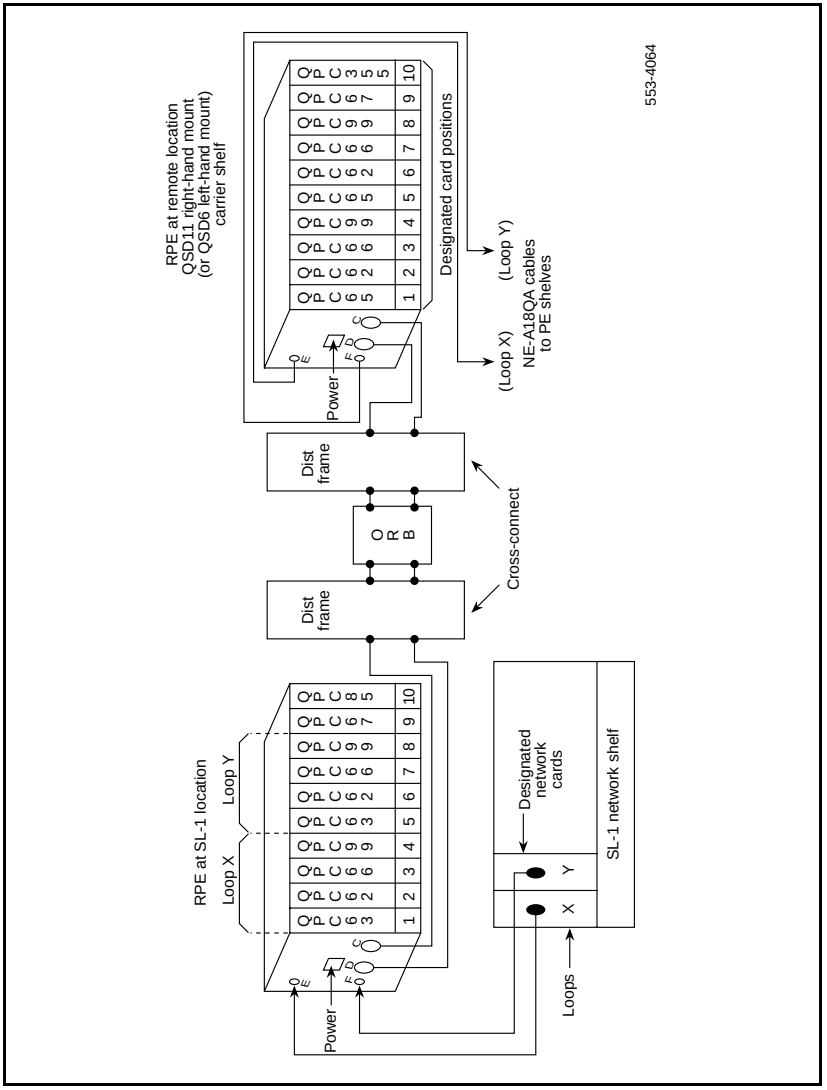


Figure 3
Typical RPE equipment configuration



Equipment description

Reference list

The following are the references in this section:

- *Meridian 1 equipment identification (553-3001-154)*

Cabinets

RPE equipment is housed in standard SL-1 cabinets. A QCA8, QCA37, or QCA74 cabinet is required at the remote location to provide power for the QBL14 Power Distribution Box that powers the carrier shelves. A QCA6, QCA8, QCA23, QCA37, or QCA74 cabinet may be used at the local location to house the QBL14 Power Distribution Box.

The RPE carrier shelves may be installed in any SL-1 cabinet (except QCA60). They must be within 3.8 m (12.5 ft) of the QBL14 Power Distribution Box.

Carrier shelves

The following carrier shelves are available:

— QSD6 left-hand mount shelf

— QSD11 right-hand mount shelf

Function

The carrier shelves accommodate the circuit cards listed in Table 1. These cards can function only in the designated card positions shown in Figure 3.

Table 1
Carrier shelf circuit cards

Location	Product code	Description	Quantity
Local and remote	QPC62 QPC66 QPC67 QPC85, QPC190, QPC355 QPC99	1.5 Mbaud converter 2.0 Mbaud converter Carrier maintenance 5/12-V converter Carrier interface	2 per network loop 2 per network loop 1 per shelf 1 per shelf (Note) 2 per network loop
Local only	QPC63	Local carrier buffer	1 per network loop
Remote only	QPC65	Remote peripheral switch	1 per network loop

Note: QPC190 and QPC355 circuit cards can be used only in QSD11B series B and QSD6B series B shelves or QSD11C and QSD6C shelves. QSD11B series A and QSD6B series A shelves only work with a QPC85 circuit card. Using the QPC190 in the earlier vintage shelves will damage both the QPC190 itself and the QPC99 carrier interface.

Quantity

One shelf is required at the local and remote locations for each two network loops.

Location

Any PE shelf position in a cabinet must be within 3.8 m (12.5 ft) of the QBL14 Power Distribution Box that powers the shelf.

Features

The carrier shelf features are as follows:

— steel and aluminum construction

— printed circuit backplane

— fully connectorized power and signaling connections

— international rack mounting standards (48.3 cm [19 in.])

— approximate weight of 15.9 kg (35 lbs) when fully equipped

PE shelves

Left- or right-hand mount shelves are used. See *Meridian 1 equipment identification (553-3001-154)* for a description of these.

QPC62 1.5 Mbaud Converter Card

Function

The QPC62 converts an SL-1 loop into two carrier loops. It contains switch-selectable line equalizers.

> ***Note:*** QPC62C converters, and converters of later vintage, must be used when the 12 V option setting is required.

Quantity

Two are required for each network loop: one in the local carrier shelf, and one in the remote carrier shelf.

Location

Place the QPC62 in the following positions:

— slot 2 for the first network loop in each carrier shelf

— slot 6 for the second network loop in each carrier shelf

QPC63 Local Carrier Buffer Card

Function

The QPC63 performs the following functions:

— generates a 1.544-MHz clock from the 2.048-MHz clock

— provides enables and decodes outgoing and incoming data

— delays incoming data from the carrier so that its frame, relative to the outgoing data frame, is equivalent to that returning from a peripheral buffer

— relays line status information to the processor

— decodes line control information from the processor

Quantity

One is required for each network loop connected to the carrier shelf at the local equipment location.

Location

Place the QPC63 in the following positions:

— slot 1 for the first network loop in the local carrier shelf

— slot 5 for the second network loop in the local carrier shelf

QPC65 Remote Peripheral Switch Card

Function

Each SL-1 loop at a remote site has a remote peripheral switch (RPS) card associated with it. The card provides:

— shelf, card, and line enables, along with the bypass bit to the shelves it serves at the remote site

— cyclic scanning of the terminals it serves for incoming signaling messages

— monitoring of timeslot 0 for outcoming messages from the peripheral signaling (PS) card to the RPS or terminal

— assembling of incoming messages (RPS to PS)

Quantity

One is required for each network loop.

Location

Place the QPC65 in the following positions:

— slot 1 for the first network loop in the remote carrier shelf

— slot 5 for the second network loop in the remote carrier shelf

QPC66 2 Mbaud Converter Card

Function

The QPC66 converts two carrier loops into a single SL-1 loop.

Quantity

Two are required for each network loop: one in the local carrier shelf, and one in the remote carrier shelf.

Location

Place the QPC66 in the following positions:

— slot 3 for the first network loop in each carrier shelf

— slot 7 for the second network loop in each carrier shelf

QPC67 Carrier Maintenance Card

Function

The QPC67 performs the following functions:

— conducts fault-locate testing, using an M-type (3017 Hz) fault-locate filter

— detects DC for the fault-locate pair by means of DC-detection circuitry

— facilitates software maintenance testing, using loopback relays

— terminates and gives access to the order-wire pair through a jack and binding posts on the faceplate

Quantity

One is required in each carrier shelf.

Location

Place the QPC67 in slot 9 in each carrier shelf.

QPC85, QPC190, and QPC355 5/12 V Converter Cards

Function

The QPC85, QPC190, and QPC355 cards convert –48 V dc to +5 V dc and +12 V dc for the carrier shelves.

CAUTION

To avoid damage to the equipment, do not install QPC190 or QPC355 cards in QSD11B series A and QSD6B series A shelves; these shelves only work with a QPC85 card. Use QPC190 or QPC355 cards only in QSD11B series B and QSD6B series B shelves, or in QSD11C and QSD6C shelves.

Quantity

One is required for each carrier shelf.

Location

Place the QPC85, QPC190 or QPC355 in slot 10 in each carrier shelf.

QPC99 Carrier Interface Card

Function

The QPC99 performs the following functions:

— With two carrier line receivers and built-in 7.5 dB pads, it converts the bipolar line signals into TTL level signals. It also provides facilities for LD-1 carrier looping, monitors the system, and invokes emergency transfer if the carrier fails.

— By means of option switches on its circuit board, the card can be configured for a variety of locations and loopback conditions. In cards of vintages F and later, the –7.5 dB pads are also switch selectable. The settings on switches 1 through 4, and 7 through 12, determine the location of the card. Switches 5 and 6 determine loopback conditions. With switch 5 closed, the loop carrier is looped for an additional 8 seconds. With switch 6 closed, loopback occurs when DC is on the FL (fault-locating) pair and bipolar violations occur on the carrier. With switch 6 open, loopback occurs when

- DC is on the fault-locate pair and TRIOS is present
- DC is on the fault-locate pair and excessive bipolar violations (BPV) occur
- TRIOS is present

— The later vintages also have a ROUT jack for each channel to allow a test signal to input into the system. A manual loopback (MLB) switch is also added to allow looping of the system for fault clearing. All other features of the earlier vintages are retained.

Quantity

Two are required for each network loop: one in the local carrier shelf, and one in the remote carrier shelf.

Location

Place the QPC99 in the following positions:

— slot 4 for the first network loop in each carrier shelf

— slot 8 for the second network loop in each carrier shelf

Cables

The following cables are used in RPE installations:

— NE-A18Q to connect the local carrier shelf to a network card and to connect the PE shelves to each other and to the remote carrier shelf.

— NE-A25B cables are used to connect jacks C and D of the local and remote carrier shelves to the cross connect terminal, and to connect jacks A, B, C, and D of each PE shelf to the cross connect terminal.

QBL14 Power Distribution Box

Function

Distributes –48 V to a maximum of four carrier shelves. Equipped with circuits to provide a low voltage (–42 V) disconnect.

Quantity

One is required for every four carrier shelves.

Location

The QBL14 is placed above the QUX3 Power Distribution Unit, or above the QBL5 Power Distribution Box in a QCA8 cabinet. It may also be installed in a QCA6 cabinet above the QUX1 or QBL3 unit. In QCA28 and QCA37 cabinets, the unit can be mounted in any unequipped shelf location.

Assembly and installation

Reference list

The following are the references in this section:

- *Circuit card installation and testing (553-3001-211)*
- *Telephone and attendant console installation (553-3001-215)*

RPE equipment may be shipped fully assembled in PE cabinets or shelves, or the circuit cards may be shipped individually packaged for installation in existing PE cabinets.

When new cabinets are to be installed, refer to the appropriate system installation instructions for grounding and power requirements, wiring diagrams, and cabinet installation and inspection procedures.

Procedures 1 and 2 give the installation and cabling procedures for RPE shelves at the local and remote equipment locations, respectively. Procedure 3 describes the remote alarm installation. Figures 4 and 5 illustrate RPE shelf cabling.

Telephones, consoles, and add-on-modules are installed and connected as described in *Telephone and attendant console installation (553-3001-215)* and system installation procedures.

Procedure 1
Local RPE installation

Step	Procedure
1	Install the QSD6 or QSD11 (left-hand or right-hand mounted) carrier shelf with no circuit cards inserted.
2	Install an NE-A18Q cable from carrier shelf connector jacks E and F to each network card (see Figure 5).
3	Install two NE-A25B cables from shelf connector jacks C and D to the cross connect terminal (see Figure 4).
4	Insert a QPC85, QPC190, or QPC355 5/12-V Converter Card (depending on the shelf vintage) in slot 10. The QPC190 and QPC99 (Carrier Interface) will be damaged if the wrong card is used with the wrong shelf: see page 20 for instructions and cautions.
5	Follow cabinet inspection procedures if a new cabinet is installed.
6	If there is no existing RPE equipment, install a QBL14 Power Distribution Box (see Figure 6). See Note for trip circuitry information.
7	Install the power cable (supplied with the carrier shelf), connecting it from the QBL14 unit to the carrier shelf power jack (see Figure 6).
8	Terminate the cables.
9	Connect power to the RPE carrier shelf.
10	Check the option switch settings and header pin strapping on the QPC62, QPC66, and QPC99 cards (see Figures 7, 8, and 9). For more information, see *Circuit card installation and testing (553-3001-211)*.
11	Insert all other circuit cards in their designated positions (refer to Figure 3).

Note: The QBL14 Power Distribution Box located in the RPE contains undervoltage detection circuitry that trips the input circuit breaker when the DC input voltage drops below –42 V. This circuit prevents the RPE from dropping the battery voltage below –42 V, which would cause permanent battery damage.

Where battery backup is not provided, a short interruption of the main AC input power will cause the input breaker to trip. This interruption keeps the power to the RPE off when the AC power source is restored.

In this situation (no battery backup), you can disable the trip circuitry by removing the single wire from the D terminal on the input breaker of the QBL14 (see Figure 10). Wrap the disconnected end with insulating tape and dress the wire back.

Procedure 2
Remote RPE installation

Step	Procedure
1	Install the QSD6 or QSD11 (left-hand or right-hand mounted) carrier shelf.
2	Install the PE shelves (left-hand or right-hand mounted).
3	Install two NE-A25B cables from carrier shelf connector jacks C and D to the cross connect terminal (see Figure 4). Terminate the cables.
4	Install NE-A18QA cables from carrier shelf jacks E and F to the PE shelves for network loops X and Y (see Figure 4).
5	Install NE-A18QA cables between the PE shelves (see Figure 4).
6	Install four NE-A25B type cables from jacks A, B, C, and D of each PE shelf to the cross connect terminal. See *Telephone and attendant console installation (553-3001-215)* for designations and terminating procedures.
7	Follow cabinet inspection procedures if a new cabinet is installed.
8	If there is no existing RPE equipment, install a QBL14 Power Distribution Box (see Figure 6).
9	Install the power cable (supplied with the carrier shelf), connecting it from the QBL14 unit to the carrier shelf power jack (see Figure 6). See Note for trip circuitry information.
10	Insert a QPC85, QPC190, or QPC355 card (depending on the shelf vintage) in slot 10. Equipment will be damaged if the wrong card is used with the wrong shelf; see page 20 for instructions and cautions.
11	Connect power to the RPE carrier shelf.
12	Check the option switch settings and header pin strapping on the QPC62, QPC66, and QPC99 cards (see Figures 7, 8, and 9). For more information, see *Circuit card installation and testing (553-3001-211)*.
13	Insert all other circuit cards in their designated positions (refer to Figure 3).

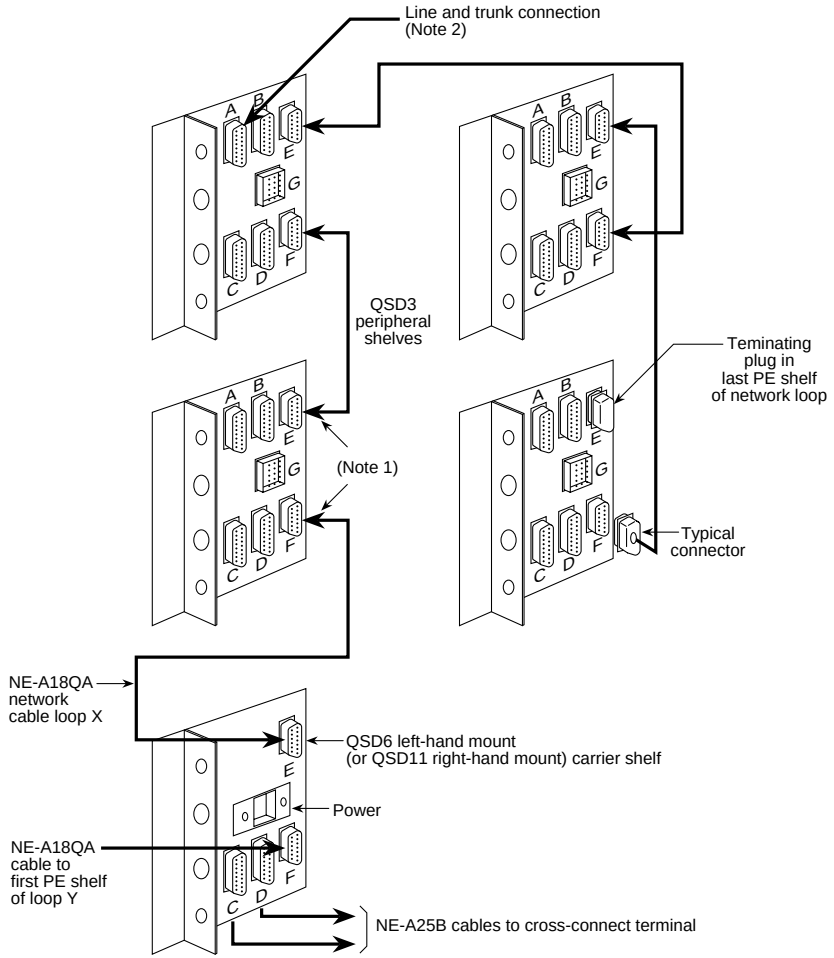
Note: The QBL14 Power Distribution Box located in the RPE contains undervoltage detection circuitry that trips the input circuit breaker when the DC input voltage drops below –42 V. This circuit prevents the RPE from dropping the battery voltage below –42 V, which would cause permanent battery damage.

Where battery backup is not provided, a short interruption of the main AC input power will cause the input breaker to trip. This interruption keeps the power to the RPE off when the AC power source is restored.

In this situation (no battery backup), you can disable the trip circuitry by removing the single wire from the D terminal on the input breaker of the QBL14 (see Figure 10). Wrap the disconnected end with insulating tape and dress the wire back.

The foregoing also applies to the QBL14 used with the local carrier shelves if reserve battery is not installed at the main location.

Figure 4
Remote end PE shelf and carrier shelf cabling



Note 1: NE-A18QA cables are available in the following lengths:
0.3, 0.6, 1.2, 3.0, 4.6, 6.0, 7.6, 9.1, 10.9, 12.1, 13.7 m
(1, 2, 4, 10, 15, 20, 25, 30, 35, 40, 45 ft)
Total length of cable from PE shelf to RPE carrier shelf must not exceed 13.7 m (45 ft).

Note 2: One of four connectors (A, B, C, D) cabled to cross-connect terminal via NE-A25B cables.

Note 3: Connector designations are similar on other PE shelf types.

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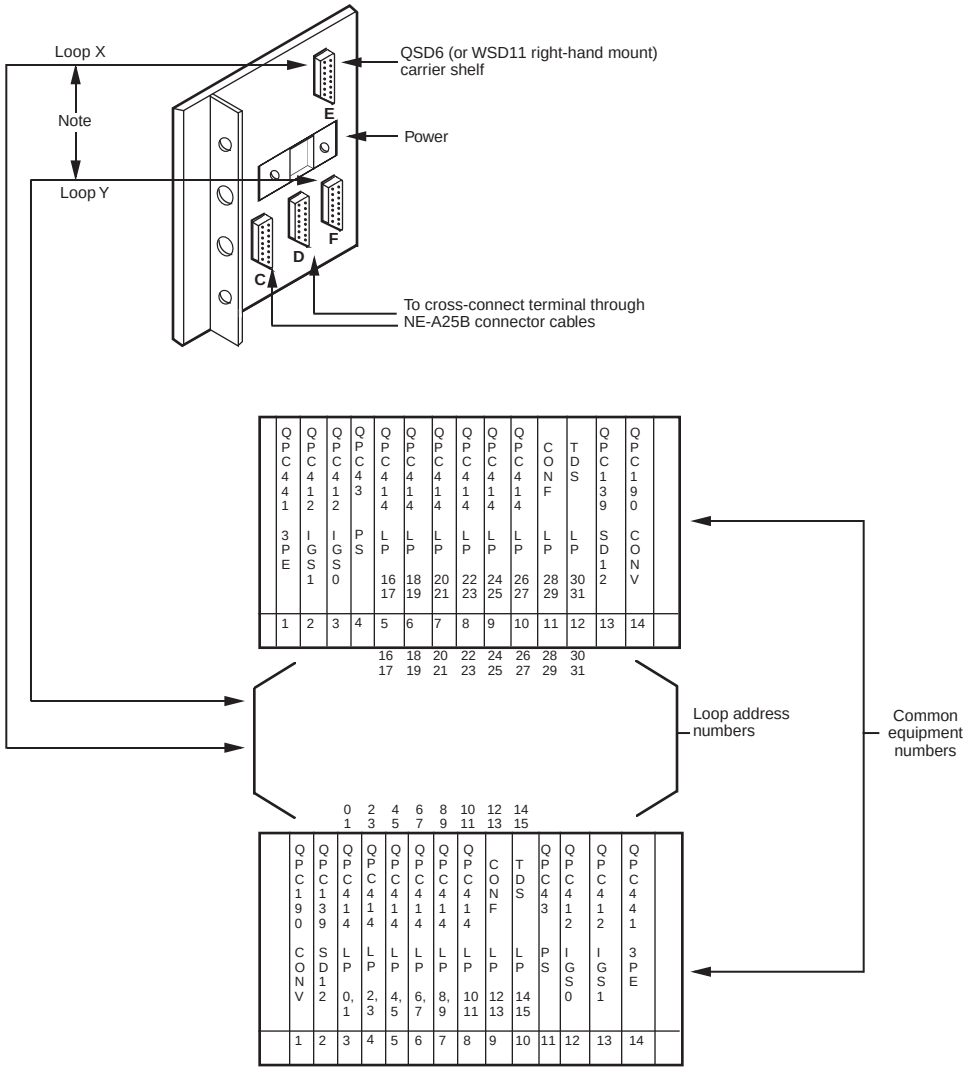
Figure 5
Local end network loop and carrier shelf cabling



Note: Cables are available in the following lengths:
0.3, 0.6, 1.2, 3.0, 4.6, 6.0, 7.6, 9.1, 10.7, 12.1, 13.7 m
(1, 2, 4, 10, 15, 20, 25, 30, 35, 40, 45 ft)
Total length of cable from network card to RPE carrier shelf must not exceed 13.7 m (45 ft).

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Figure 6
QBL14 Power Distribution Box wiring and connections

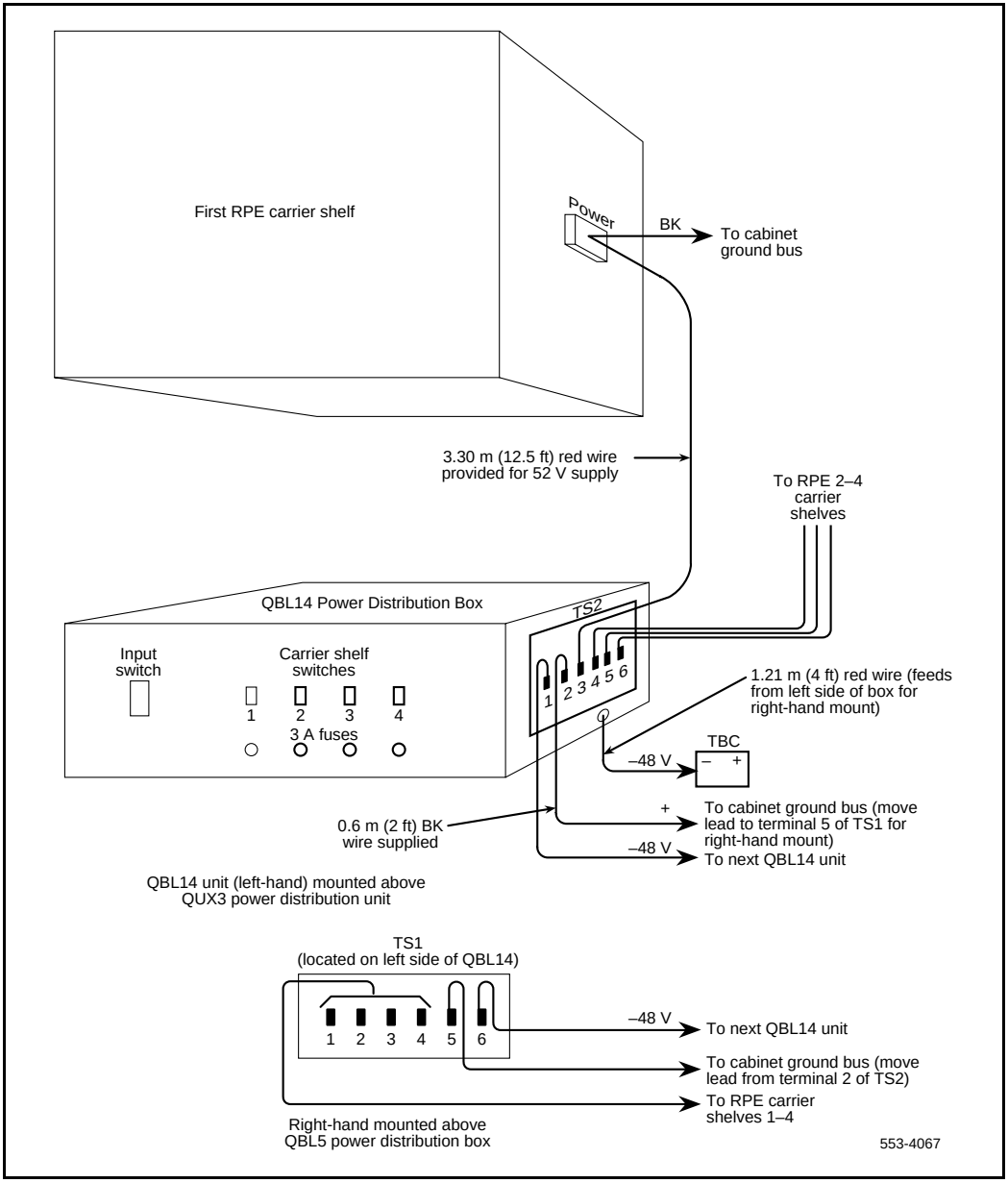
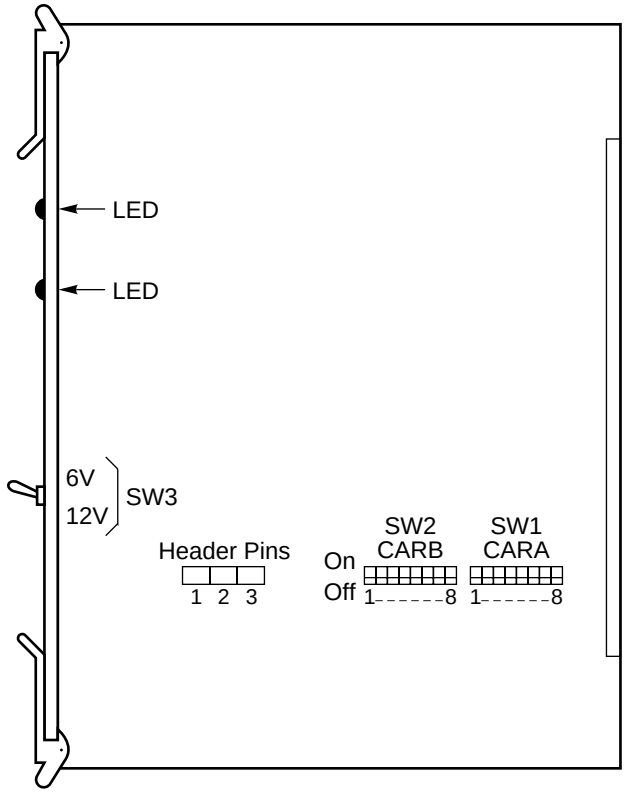


Figure 7
QPC62 1.5 Mbaud Converter Card option switches and header pins



Note 1: If cards are QPC62E or later vintage, insert the plug-in jumper (U-link) between header pins 1 and 2.

Note 2: If cards are QPC62D or earlier vintage, insert the U-link between header pins 2 and 3.

Note 3: QPC62E or later vintage cards must be provided for M, MS, N, N (QCA96), XN, XN (QAC97), and S systems.

Note 4: If QPC50K or later vintage is inserted in any system for RPE loop, QCD62E, or later vintage, must be used.

Note 5: Refer to *Circuit card installation and testing* (553-3001-211) for switch options.

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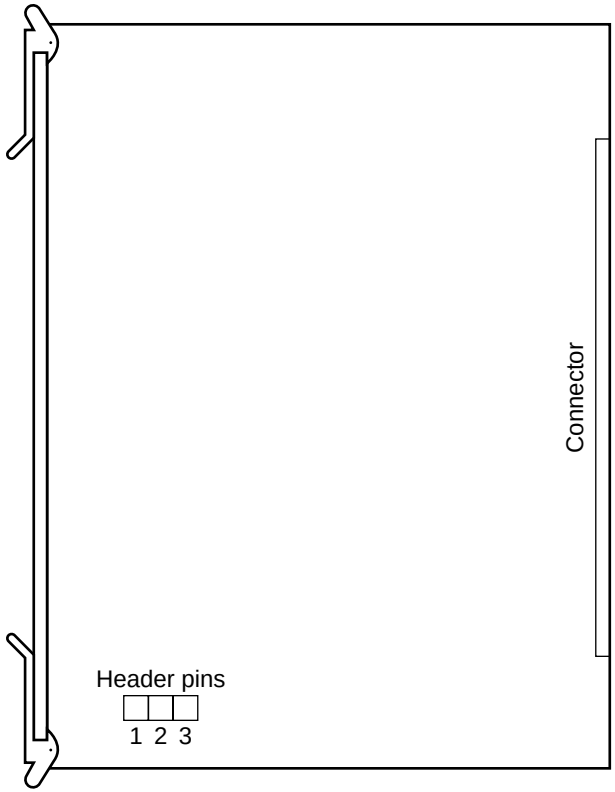
Figure 8
QPC66 2 Mbaud Converter Card header pins



Note 1: If cards are QPC66D or later vintage, insert the plug-in jumper (U-link) between header pins 1 and 2.

Note 2: If cards are QPC66C or earlier vintage, insert the U-link between header pins 2 and 3.

Note 3: QPC66D or later vintage cards must be provided for M, MS, N, N (QCA96), XN, XN (QAC97), and S systems.

Note 4: If QPC50K or later vintage is inserted in any system for RPE loop, QCD66D or later vintage must be used.

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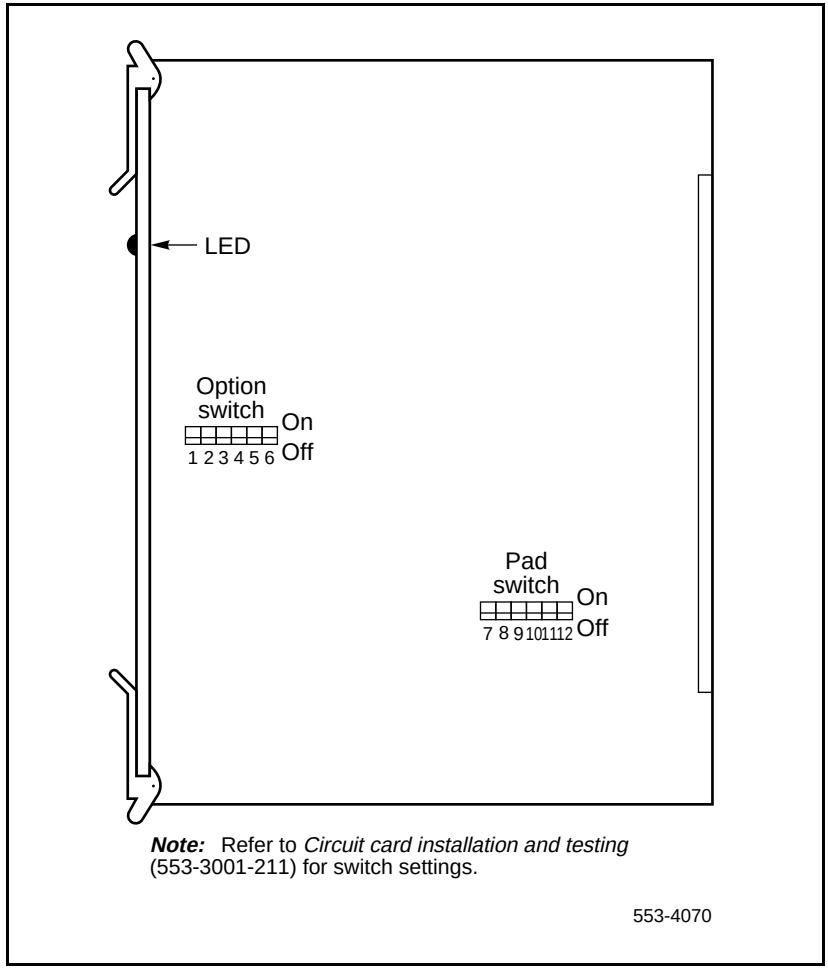
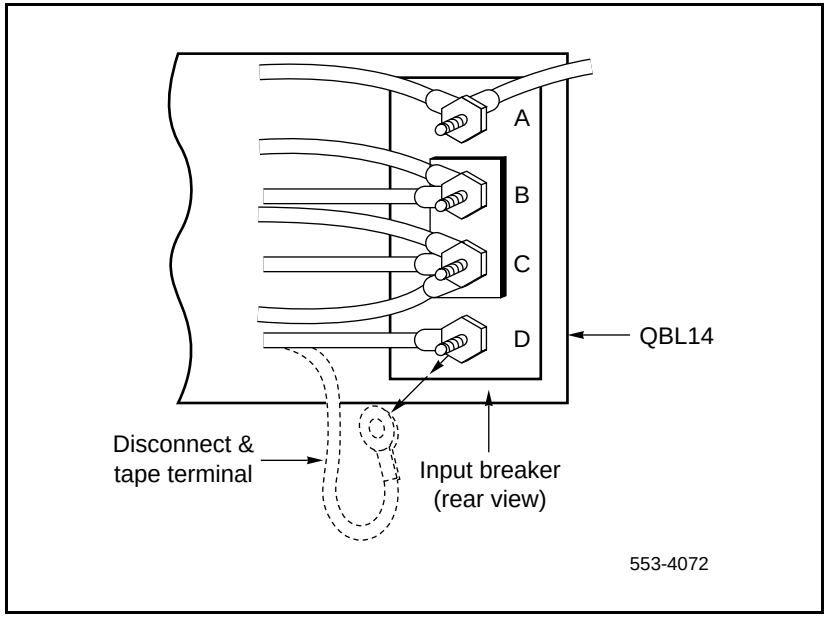
Figure 9
QPC99 Carrier Interface Card option switches



Note: Refer to *Circuit card installation and testing* (553-3001-211) for switch settings.

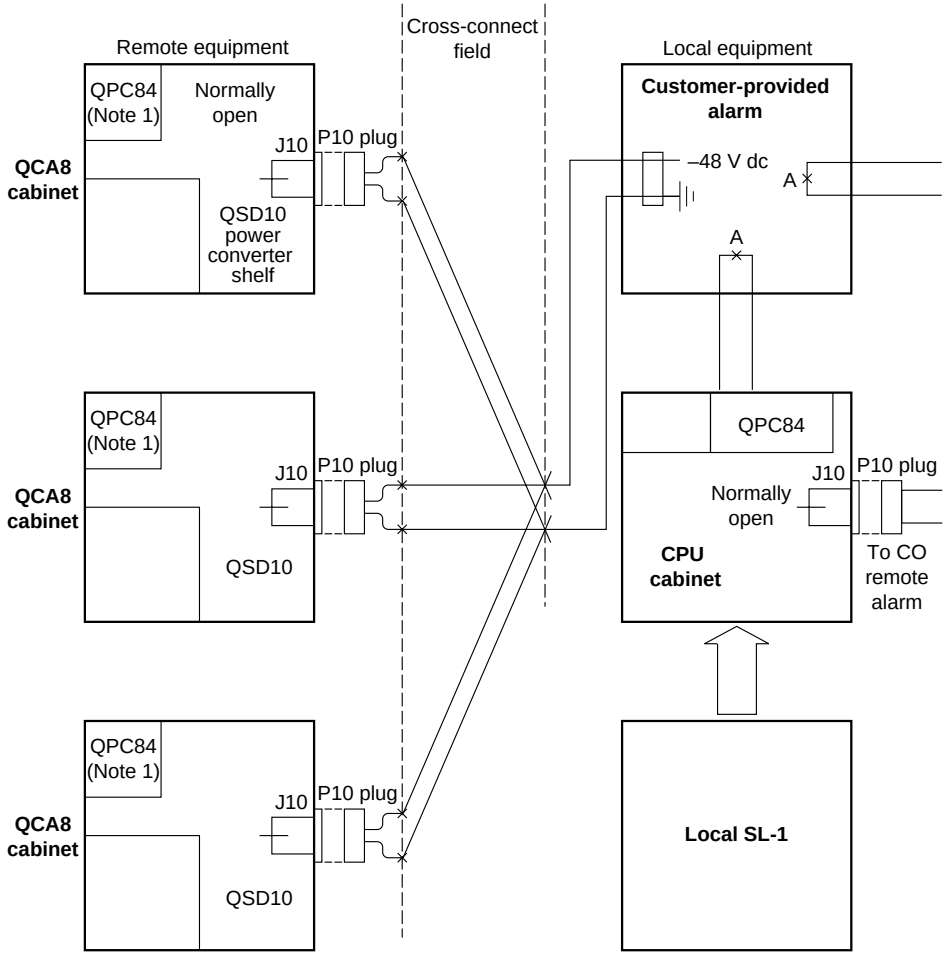
Figure 10
QBL14 Power Distribution Box input breaker



Procedure 3
Remote alarm installation

Step	Procedure
	Note: In an RPE installation, a power failure at the remote end cannot be detected at the local end. To overcome this, a wire pair can be connected from the remote QPC84 Power Monitor to the alarm input of the local QPC84 (see Figure 11). This can be used to generate a system terminal message, or a visual alarm, or both to indicate a power failure at the remote end.
1	Use the system installation procedures to install connector cables (NEA25B or equivalent) from the P10 plug of each remote QCA8 to the cross connect field.
2	Install and designate an NEA25B connector cable (or equivalent) from the cross connect terminal to the main location.
3	At the main location, connect the two alarm leads (through the cross connect terminal) to a customer provided alarm with provision for audio indication of remote power failure.
4	Connect two leads from the main alarm to TS3 of the QCA6 (L system), QCA10 (VL system), QCA23 (LE system), QCA24 (VLE and XL systems), QCA28 (A system), or QCA37 (SL-1M system).

Figure 11
Remote alarm connection



Note 1: The QPC84 card, in the power converter shelf, provides LED indication of out-of-tolerance voltages, and controls the system alarm indication.

Note 2: The rectifier is present in L, LE, M, and A systems only. When the QSD4 is not present, TS3 is located on OUT type power units (for fans).

Note 3: Refer to *System installation procedures* (553-3001-210) and *Telephone and attendant console installation* (553–3001–215).

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Carrier interface

Land-based carrier

The SL-1 RPE hardware interfaces with LD-1 carrier apparatus, which conforms to the T1 industry standard. Therefore, any carrier system conforming to T1 signaling standards should be able to interface with SL-1 RPE. Minor differences in carrier maintenance can generally be accommodated by option switches in the carrier interface card.

General engineering considerations

In addition to the T1 carrier rules, the following standards apply:

— The distance from local to remote equipment cannot exceed 112.7 km (70 mi).

— Line repeaters are powered from the office repeater bay (ORB), since no power is available from the SL-1 interface.

— The SL-1 interface with the LD-1 carrier line contains an M-type fault-location filter (3017 Hz) without level-of-polarity options. The FL filter is powered by the SL-1 RPE equipment. No other M-type filters can be used in the same span.

If an ORB is being used, the cable between the ORB and the cross connect (MDF) should have the following characteristics:

— The impedance presented to the SL-1 equipment should be 100 ohm at 722 kHz.

— The total distance between the SL-1 and the ORB or first line repeater should not exceed 228.6 m (750 ft).

— Cable should be designed for pulse code modulation (PCM) or digital signals, and should consist of individually shielded twisted pairs. Cable types NE-750A through NE-759A all meet these criteria.

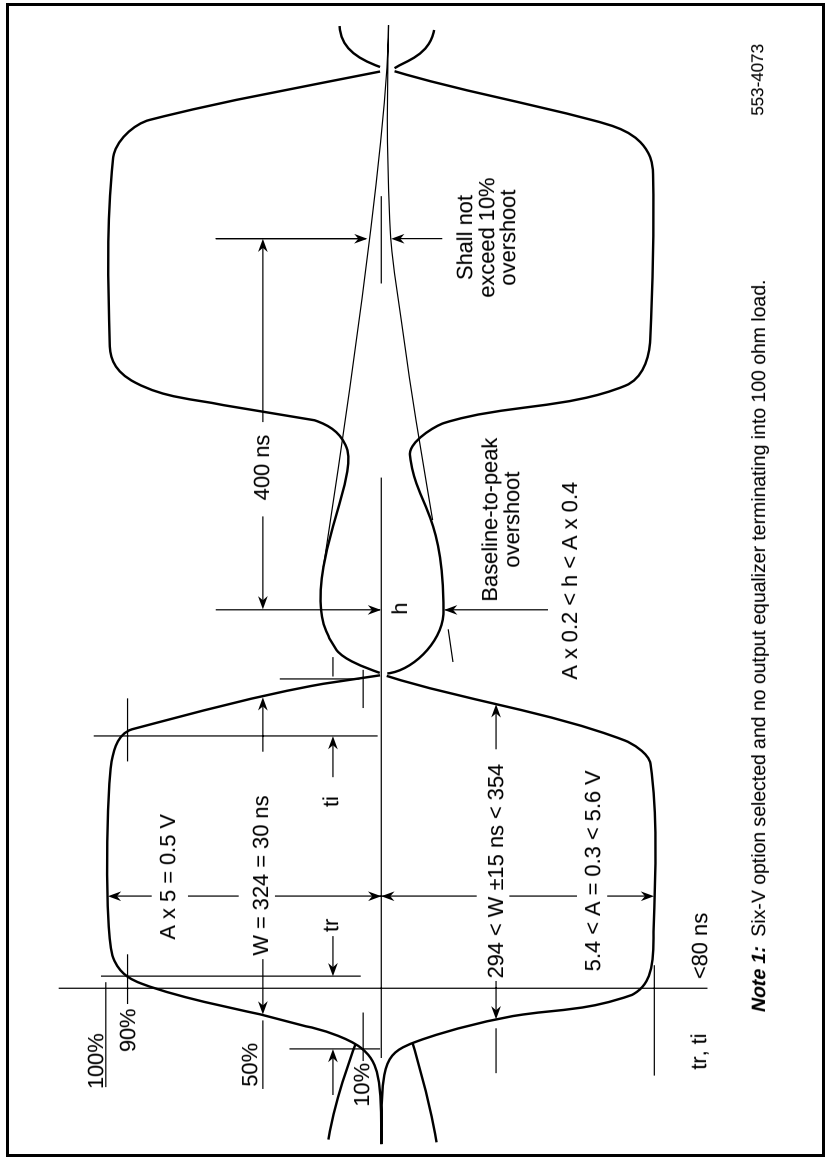
Carrier specifications

The SL-1 RPE is compatible with carrier facilities having the characteristics shown in Table 2 and Figure 12.

Table 2
Carrier characteristics

Line rate	1.544 Mb/s (±200 b/s)
Signal	bipolar, 50% duty cycle
Output level	**Option 1:** If the equipment interfaces directly with the carrier line, or with an ORB that is less than 45.7 m (150 ft) away from the common equipment, the positive and negative output pulse heights are 3 V ±10%, and the imbalance between the positive and negative pulses is less than 5%. **Option 2:** When interfacing with an ORB that is between 45.7 m (150 ft) and 228.6 m (750 ft) away from the common equipment, the positive and negative output pulse heights are 6 V ±10%, and the imbalance between positive and negative pulses is less than 5%. With this configuration, one of two possible equalizers is inserted in the carrier line in order to make the total cable and equalizer loss about 6 dB. This will provide the required 3 V pulses at the ORB.
Output pulse width	The output pulse width at half pulse height is 324 ± 30 ns. Imbalance between positive and negative pulse width at half pulse height is less than ±15 ns.
Output rise-and-fall time	The output rise-and-fall time is less than 90 ns.
Overshoot	The overshoot at the trailing edge of the output pulse is between 20% and 40% of pulse height, with decay to 10% or less of baseline-to-peak overshoot (within 400 ns).
Impedance	The nominal impedance at the line interface is 100 ¾.
Output jitter	The maximum jitter on the digital output signal can be 30 ns rms.
Input level	The positive and negative input pulse height will be in the range of 0.07 V to 3 V, with a possible imbalance between positive pulses of 5%.
Input jitter	The system can accommodate a low frequency input jitter of up to 20 ns rms. Jitter with frequencies above 2 kHz should not be more than ±50 ns peak.
Interpulse time	The time between pulses in adjacent time slots will be 648 ns ±20 ns.

Figure 12
Output pulse characteristics



Note 1: Six-V option selected and no output equalizer terminating into 100 ohm load.

In-house RPE

Since there is a carrier repeater located in the QPC99, it is not necessary to use ORBs and extra repeaters between the local and remote ends of the RPE if the distance between them is typically less than 762 m (2500 ft). In this case, the standard T1 procedures for cable installation should be followed. Other considerations are as follows:

— The impedance presented to the SL-1 system should be 100 ohm at 772 kHz.

— Unless the cable effectively separates transmit and receive pairs, separate cables for transmit and receive should be used to avoid crosstalk.

— Bridges, taps and loading coils, and building-out capacitors are to be avoided.

— Cable environment can affect transmission line capacitance and resistance, causing impedance mismatches and signal reflections. Cable should therefore be clean and dry.

Permissible in-house RPE operating distances depend on total losses and noise between the local and remote locations.

— If separate cables are used for transmit and receive directions, and if no noise or crosstalk from other pairs or external sources reaches the signal pairs, the maximum allowable loss at 772 kHz is 26 dB. In this case, the following approximate values apply:

Wire gauge (AWG)	Maximum cable length in meters (feet)
26	975 (3200)
24	1158 (3800)
22	1554 (5100)

— The following operating limits apply when several carrier systems are used without any additional equipment in the same group:

Wire gauge (AWG)	Maximum cable length in meters (feet)		
	4 RPE systems per group	8 RPE systems per group	12 RPE systems per group
26	762 (2500)	640 (2100)	579 (1900)
24	853 (2800)	732 (2400)	671 (2200)
22	1097 (3600)	914 (3000)	823 (2700)

— If only one twin carrier system and SL-1 equipment (such as SL-1 or 500-type telephones) are used in the same binder group, the following cable length limits apply:

Wire gauge (AWG)	Maximum cable length in meters (feet)
26	762 (2500)
24	853 (2800)
22	1079 (3600)

— If other high transient switching pairs are used in the same binder group, the maximum cable length is limited by LD-1 engineering rules for high noise environments and the following worst-case limits apply:

Wire gauge (AWG)	Maximum cable length in meters (feet)
26	579 (1900)
24	640 (2100)
22	732 (2400)

Microwave radio

Cabling between the SL-1 and the carrier facility should meet the criteria outlined for land-line carrier systems. In addition, the complete microwave system must also meet the overall limits for land-based carrier systems, and should conform to T1 interfacing specifications.

As in land-line carrier systems, the distance at which the SL-1 can operate is governed by a 1.5-ms timeout in the peripheral signaling card when interrogating the peripheral equipment. This 1.5-ms value is the maximum total round-trip time allowable, including propagation time and any delay introduced by signal processing at microwave stations. The maximum allowable distance (in miles) is given by:

$M \times V - D$

where
M = maximum allowable delay (ms)
V = propagation velocity (mi/ms)
D = any other processing delays (ms)

Example

In the case of a land-line system, assume that the maximum allowable delay (M) is 1.25 ms to give a safety margin of 0.25 ms. The propagation velocity (V) of signals through wire is 115 mi/ms. Assume that there are no delays (D) in the system. Thus the maximum allowable distance is 143.75 mi, as follows:

(1.25 ms x 115 mi/ms) – 0 ms = 143.75 mi

Connections

Reference list

The following are the references in this section:

- *Telephone and attendant console installation (553-3001-215)*

All cables, except cables to connectors C and D of carrier shelves, are terminated and designated as described in *Telephone and attendant console installation (553-3001-215)*. Connector C and D cables are terminated as shown in Tables 3 and 4.

Wiring to a QUA1 emergency transfer unit is cross-connected as shown in Figure 13 and Table 4.

Sets and consoles are cross-connected to PE shelves as described in *Telephone and attendant console installation (553-3001-215)*.

Connections for 500-type telephones and trunks that connect through emergency transfer units are given in Figure 13. A ring ground start button must be provided on these telephones if the trunks are ring ground start.

RPE local and remote carrier shelves are cross-connected to the digital carrier cable pairs as shown in Figures 14 and 15.

RPE maintenance pairs are cross-connected as shown in Figure 16.

Table 3
Cable C designations at local and remote locations

Network loop	Card position	Connector C pin number (Notes 1 and 2)	Lead color	Lead designation
X	9	1	BL-W	C1
X	9	26	W-BL	C2
X	9	2	O-W	C3
X	9	27	W-O	C4
Y	9	3	G-W	C9
Y	9	28	W-G	C10
Y	9	4	BR-W	C11
Y	9	29	W-BR	C12
	9	5	S-W	OWT
	9	30	W-S	OWR
	9	6	BL-R	FLT
	9	31	R-BL	FLR
	4	7	O-R	FLWA
	4	32	R-O	FLWB
	4	8	G-R	WFIT
	4	33	R-G	WFIR
		9 to 25		GND
		34 to 50		GND

Note 1: These leads are grounded in the carrier shelf when cable C is installed in jack C. They are cut off at the main distribution frame (MDF) when cable C goes directly to an MDF. Carrier problems are less likely to occur when the cables terminate directly on the MDF.

Note 2: When cable C goes to an intermediate cross-connect terminal (such as an SL-1 cross-connect terminal), it is terminated at that terminal and extended to the MDF. These leads are then cut off at the MDF.

Table 4
Cable D designations at local and remote locations

Network loop	Card position	Connector D pin number (Notes 1 and 2)	Lead color	Lead designation
X	9	1	BL-W	C5
X	9	26	W-BL	C6
X	9	2	O-W	C7
X	9	27	W-O	C8
Y	9	3	G-W	C13
Y	9	28	W-G	C14
Y	9	4	BR-W	C15
Y	9	29	W-BR	C16
	5	5	S-W	GND
	5	30	W-S	GND
	4	6	BL-R	PFX1
	4	31	R-BL	PFX2
	8	7	O-R	PFY1
	8	32	R-O	PFY2
	9	8	G-R	DCST
	9	33	R-G	DSCR
	9	9	BR-R	DETT
	9	34	B-BR	DETR
		10–25		
		35–50		

Note 1: These leads are grounded in the carrier shelf when cable D is installed in jack D. They are cut off at the main distribution frame (MDF) when cable D goes directly to an MDF.

Note 2: When cable D goes to an intermediate cross-connect terminal (such as an SL-1 cross-connect terminal), it is terminated at that terminal and extended to the MDF. These leads are then cut off at the MDF.

Figure 13
PFT intercabinet and console cross connections (QUA1 shown)

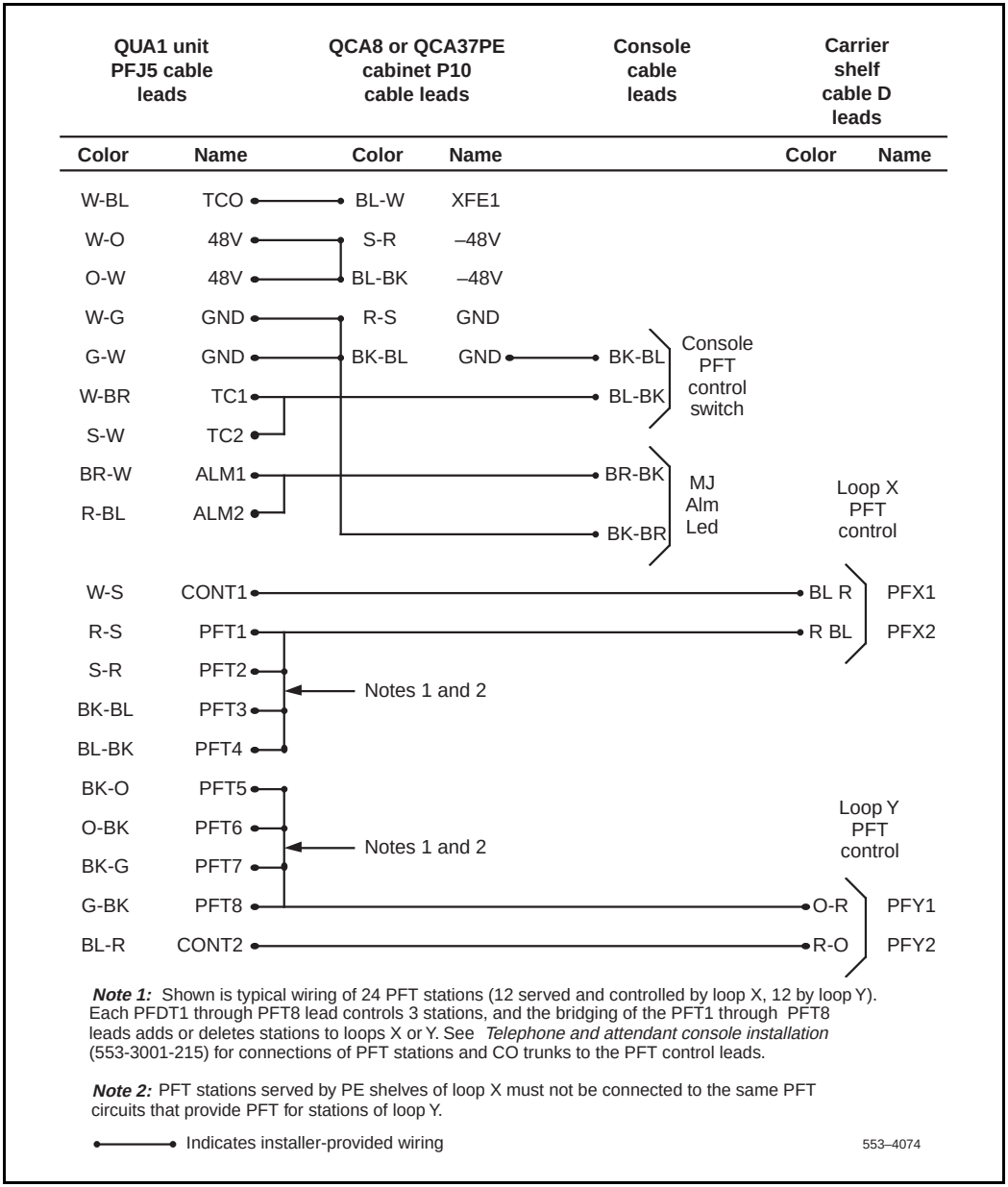


Figure 14
PFT RPE local to remote RPE cross connections

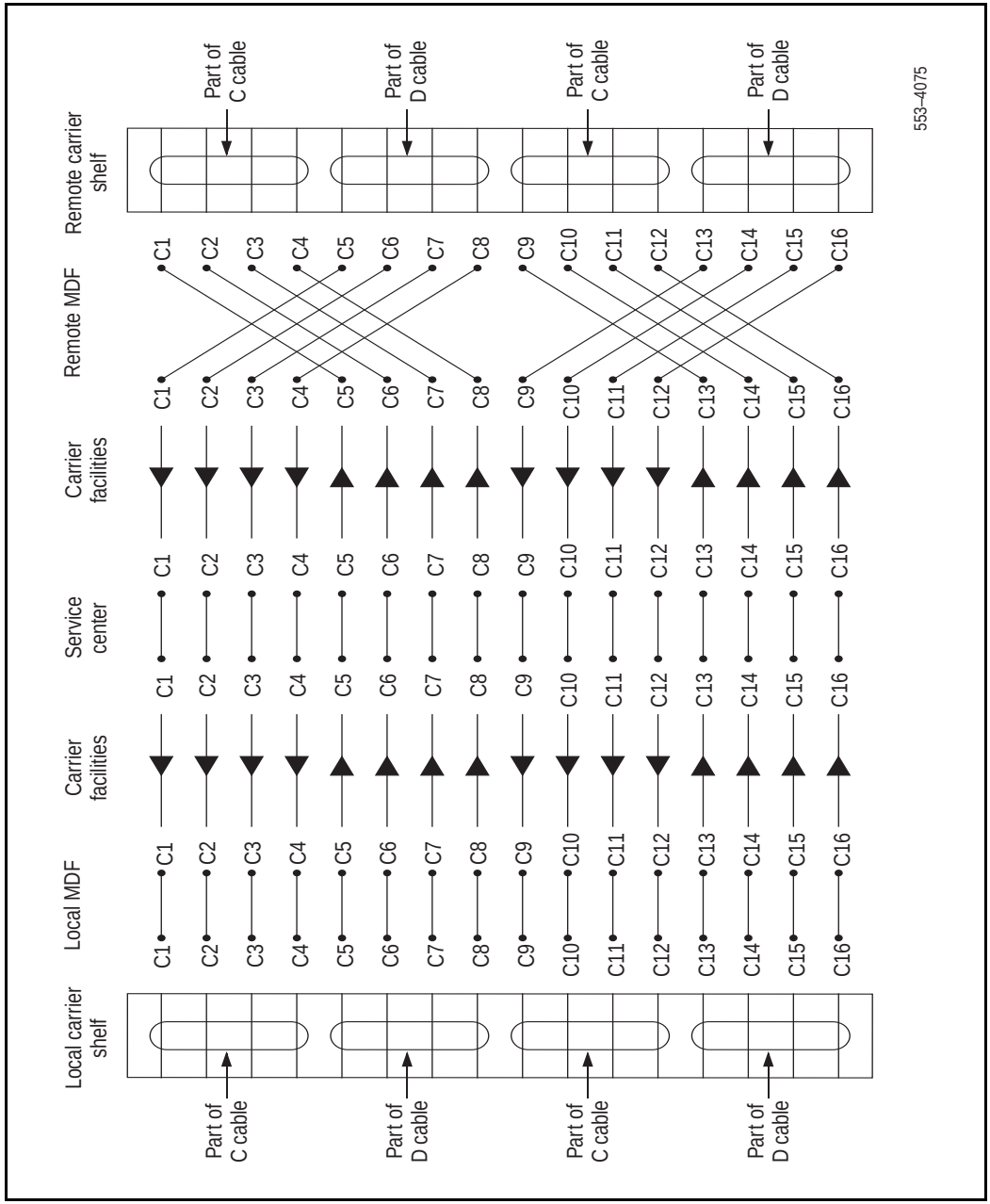
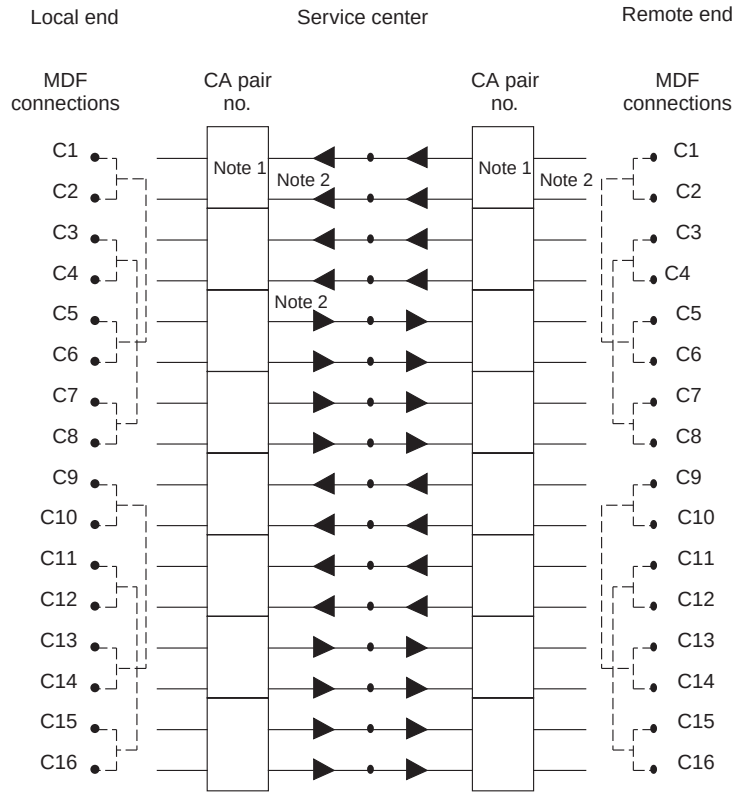


Figure 15
Detail of local and remote MDF cross connections



Note 1: Receiving and transmission cable pairs to be entered in these columns. Obtained from switching center personnel and work order.

Note 2:
- Indicates transmission to service center from local end.
- Indicates receiving from service center at local end.
- Indicates receiving from service center at remote end.
- Indicates transmission to service center from remote end.

Each set of cable pairs (joined by broken lines) is a separate carrier line (system).

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Figure 16
Maintenance lead cross connections (Part 1 of 2)

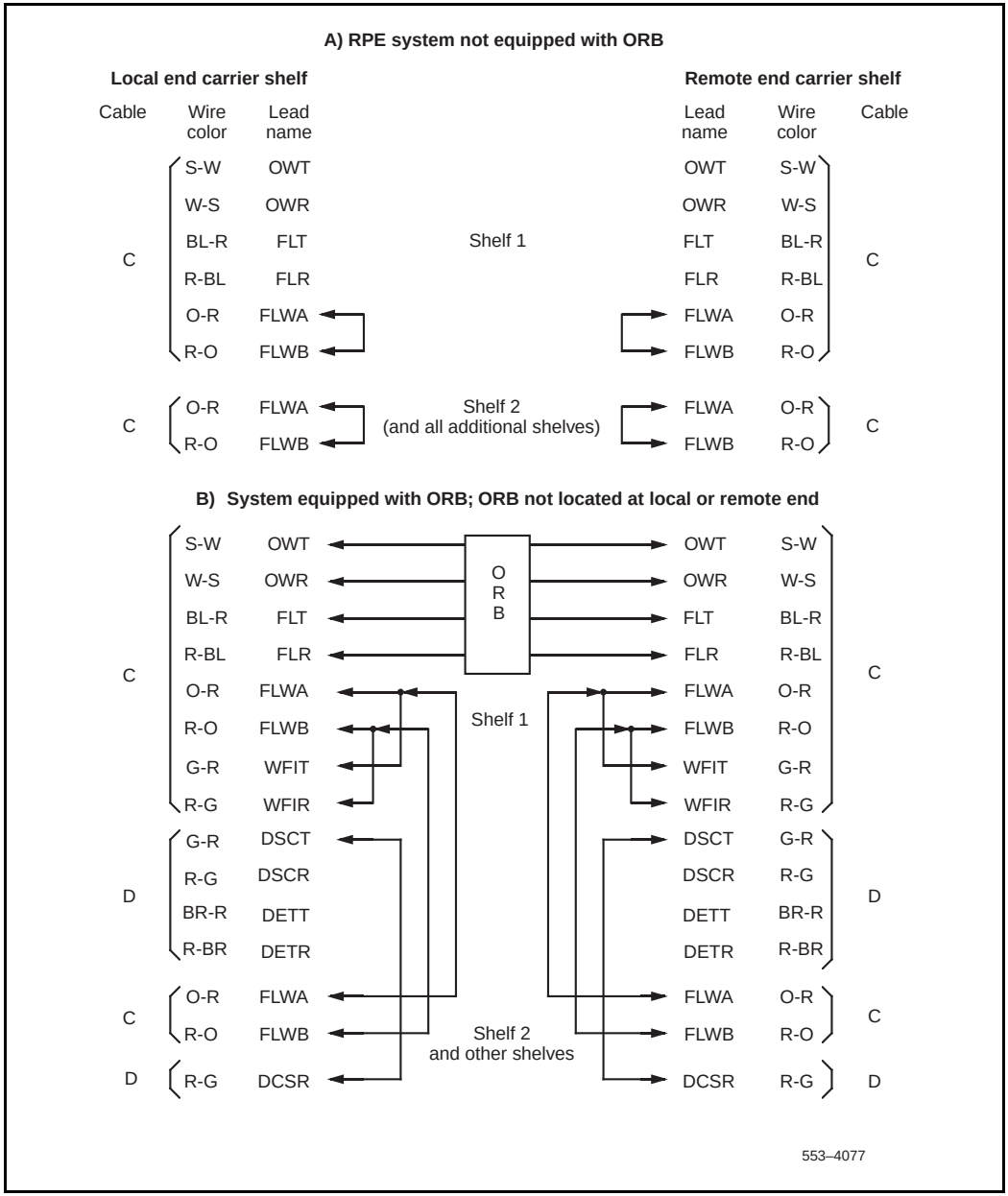
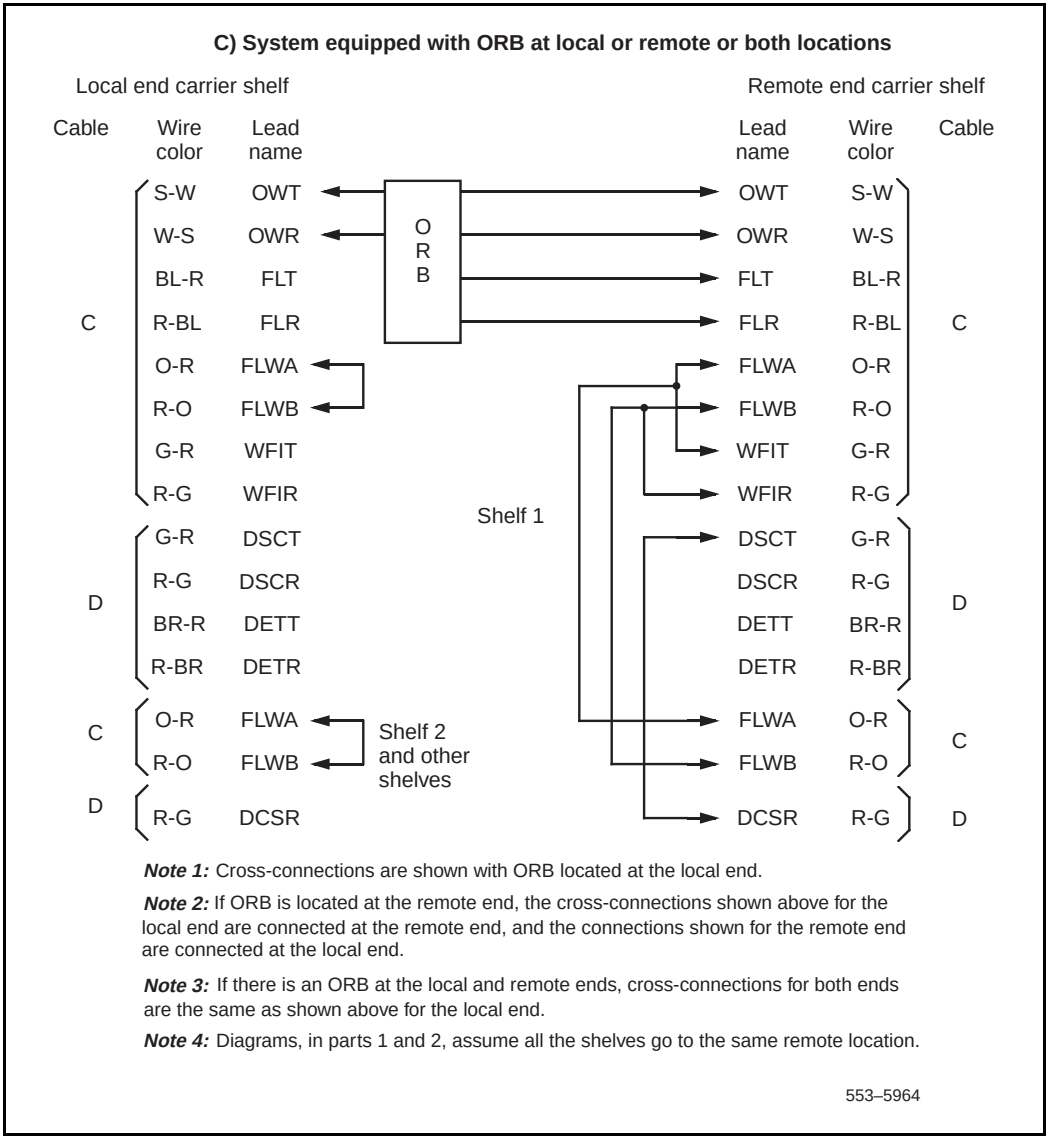


Figure 16
Maintenance lead cross connections (Part 2 of 2)



Note 1: Cross-connections are shown with ORB located at the local end.

Note 2: If ORB is located at the remote end, the cross-connections shown above for the local end are connected at the remote end, and the connections shown for the remote end are connected at the local end.

Note 3: If there is an ORB at the local and remote ends, cross-connections for both ends are the same as shown above for the local end.

Note 4: Diagrams, in parts 1 and 2, assume all the shelves go to the same remote location.

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Testing

Reference list

The following are the references in this section:

- *X11 features and services (553-3001-306)*

The following identifies the testing information for equipment associated with RPE.

Note: The RPE Diagnostic Program (LD 33) should be included in the midnight routines for any system with RPE.

Network loops

Follow these steps:

1 Load the RPE Diagnostic Program (LD 33) by entering **LD 33**.

2 Enter **LOOP L** (L is the loop number).

3 Response will be **OK** if no faults are detected.

4 Enter **SCAR L** to switch primary carriers on loop L.

5 Enter **LOOP L** again.

Note: Any connection memory or channel faults detected result in the affected channel being disabled. Refer to LD 30 to interpret outputs.

Telephone, consoles, and add-on modules

For 500 and 2500 telephones, SL-1 telephones, attendant consoles, and add-on modules, refer to *X11 features and services (553-3001-306)*.

Emergency transfer stations and trunks

Follow these steps:

1 Manually invoke an emergency line transfer by operating the emergency transfer switch on the faceplate of the QPC84 card.

2 Perform an outgoing and incoming call to each station.

Note: If outgoing trunks are ring ground start, momentarily operate the ground start button on the 500-type telephone after lifting the receiver to get dial tone.

Transmission quality test

Figure 17 shows the monitoring facility built into the QPC99 Carrier Interface Card. Using these facilities, transmission quality should be tested when the installation is complete.

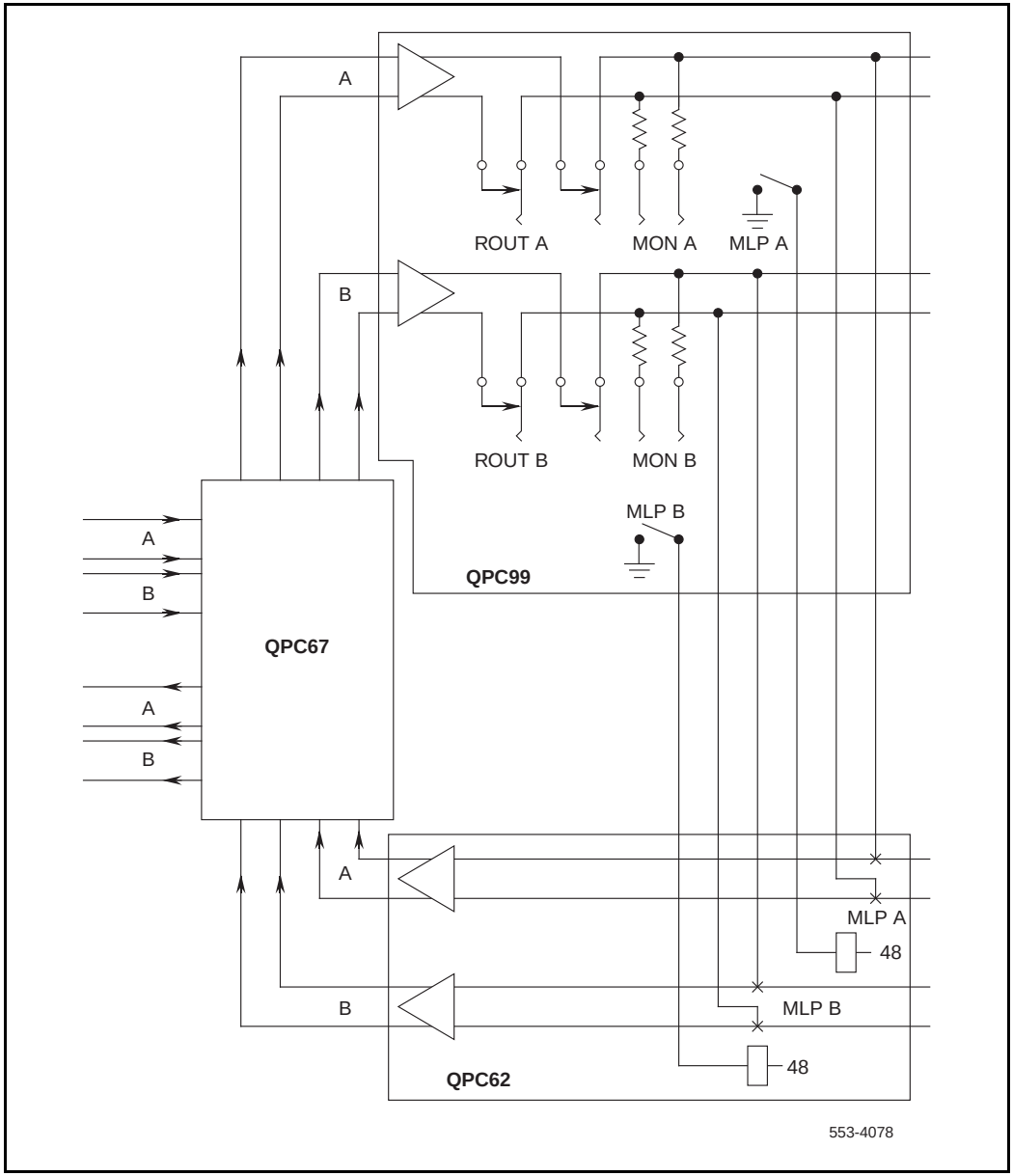
There are two pairs of jacks on the front of the QPC99:

— ROUT A and ROUT B are input jacks for channels A and B, respectively.

— MON A and MON B are output jacks for monitoring the regenerated signal. A test set can be connected to a MON jack at any time to test transmission quality. Connecting a test set to a MON jack does not upset an operating RPE system.

Transmission can be checked by closing the MLP switch at the local end, injecting a test signal at the ROUT jack, and monitoring the output at a remote end MON jack. This checks the transmission path in one direction. The reverse transmission path should be checked in the same way.

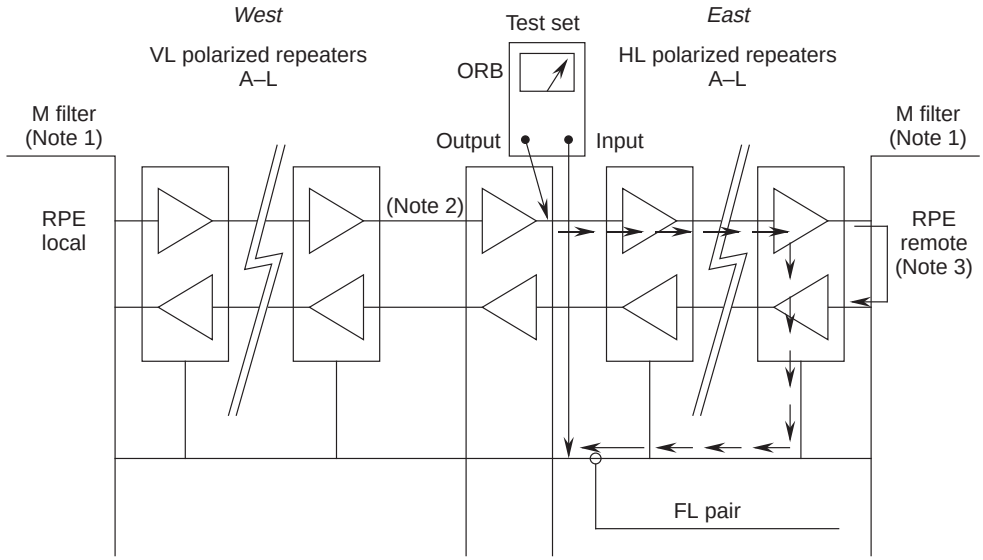
Figure 17
QPC99 maintenance jacks and looping switches



Span line fault locating

The typical repeatered line maintenance arrangement (see Figure 18) includes a series of FL filters and an FL cable pair installed in each span line. One FL filter is used for all repeaters installed in a single housing (with a maximum of 25 two-way repeaters per housing). A filter with a different audio center frequency is installed in each repeater housing in the span line.

Figure 18
Typical span line fault-locating arrangement



Note 1: This is a nonpolarized M filter on the QPC67 card. There must be no M filters within the repeater span.

Note 2: The previous filter must be good for the signal to continue.

Note 3: Loopback conditions, controlled by the QPC99, occur under the following conditions:

- DC on FL pair and TRIOS present
- DC on FL pair and excessive BPV (bipolar violations)
- TRIOS present

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The FL filter is a narrow band selective filter centered at one of 12 audio frequencies. The output of each repeater in the housing is bridged across the input of the respective FL filter. The outputs of all filters in a span are connected to the common FL cable pair. This arrangement permits interrogating each repeater in a span from either span terminal, using a test signal with an audio-frequency component corresponding to the center frequency of the respective FL filter.

When a span line is producing excessive errors or a failure has occurred, it is necessary to locate the defective repeater. An FL test is performed using a Pulse Code Modulation (PCM) line and a repeater test telephone (Lair Seigler Sierra 415A or equivalent). To make the test, the line is removed from service and the test telephone is connected to the line at the span terminal. The output of the test telephone's transmit section is connected to the span line, while the receive section input is connected to the corresponding FL jack.

A series of test pulses with an audio-frequency component is transmitted down the line. The audio-frequency component is selected in turn to correspond to each of the FL filters in the span. This audio-frequency component appears in the output of each repeater in the span. However, a portion of this signal filters through the appropriate associated FL filter and returns to the test telephone over the FL pair. The amplitude of this test signal is measured on the dB meter and is a function of the performance of the repeater under the various test signal conditions. If a repeater has failed completely, no test signal is returned to the test telephone. Changing the audio-frequency component allows each repeater in a span to be tested until the faulty or marginal repeater is located.

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Meridian 1

Remote Peripheral Equipment

Description, installation, and testing

Information is subject to change without notice. Nortel Networks reserves the right to make changes in design or components as progress in engineering and manufacturing may warrant. This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules, and the radio interference regulations of Industry Canada. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.
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