
Meridian 1

Remote Peripheral Equipment

Maintenance procedures

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About this document

Remote Peripheral Equipment (RPE) is a hardware option available for the Meridian 1. RPE is used to extend the serving range of the Meridian 1 to a maximum of 112 km (70 miles) from the main Meridian 1 location.

A carrier system must be used to link the local and remote RPE locations. This can be provided by Northern Telecom or by the customer. The system should conform to “T1” carrier specifications.

Remember that the Meridian 1 RPE and the carrier constitute a unified system. In the first stages of the fault-clearing procedure, you should identify the location of the fault.

Before you use this document to diagnose faults and guide the repair of faults, read *Remote Peripheral Equipment description, installation, and testing* (553-2601-200) to gain familiarity with RPE.

This publication gives fault-clearing procedures for the Meridian 1 RPE only. It refers to carrier equipment in general terms only, since the proper documentation for each carrier system should be obtained from the manufacturer.

Equipment description

Each RPE system extends a Meridian 1 network loop to a maximum of 70 miles (112 km). Each loop serves up to a maximum of four peripheral equipment (PE) shelves.

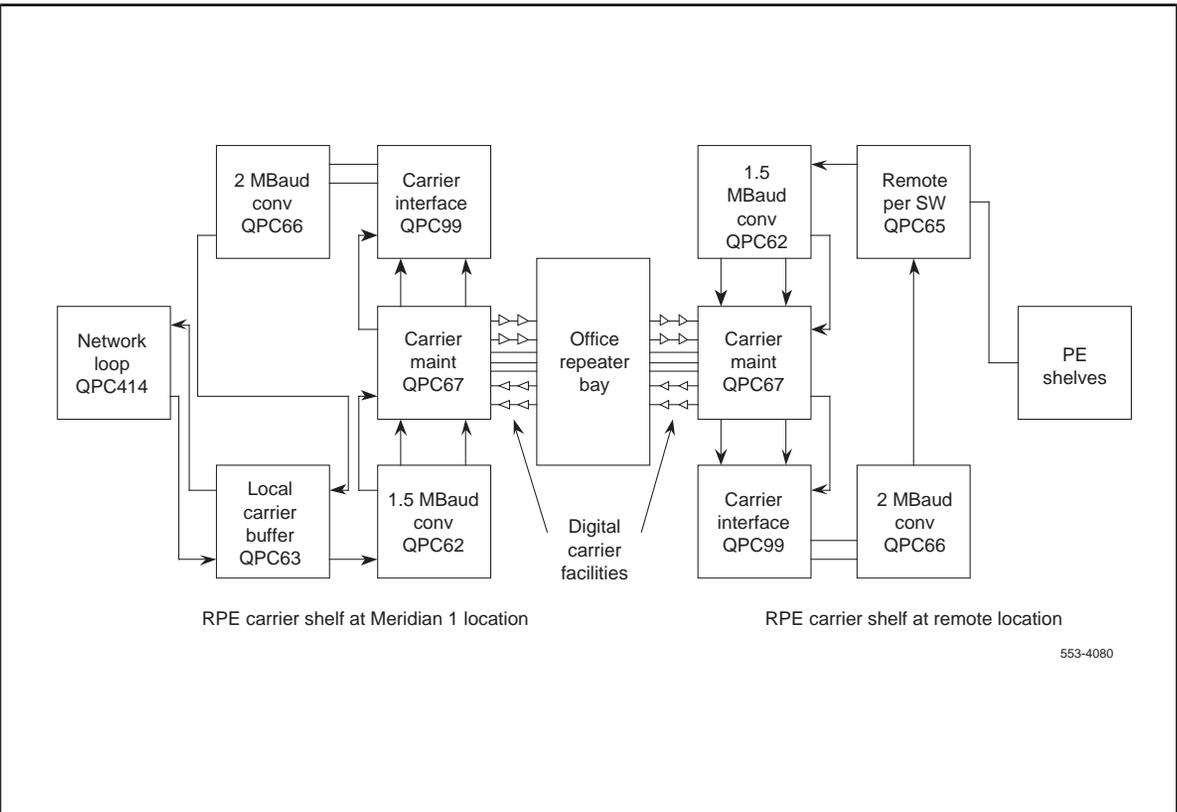
A network loop card connects to an RPE carrier shelf at the Meridian 1 equipment (local end), and the PE shelves connect to an RPE carrier shelf at the remote location (see [Figure 1](#)). The two carrier shelves interface with a 1.544 Mb/s multiplexed digital carrier system (such as LD-1) by means of four cable pairs for signaling and transmission. The two carrier shelves (one local, one remote) will serve two remote network loops.

An office repeater bay (ORB) is required in an RPE system if the remote PE equipment is more than 762 m (2500 ft) from the local Meridian 1 carrier shelf.

An ORB provides the following:

- span line monitoring
- error monitoring
- fault-locate system access
- order-wire termination with direct distance dialing (DDD) access
- line looping

Figure 1
RPE block diagram



553-4080

Fault detection

Overlay programs

Most faults are detected automatically by diagnostic routines that are provided on the system tape.

The Background Signaling and Switching program (LD 45) is run continuously to test the signaling paths to all PE shelves.

The 1.5 Mb/s RPE Diagnostic program (LD 33) should be included in the midnight routines; see the *X11 input/output guide* (553-3001-400) for procedures that automatically test RPE systems every 24 hours. The program can also be loaded manually to test an RPE system.

The 1.5 Mb/s RPE Diagnostic program for the local end (LD 62) can be loaded manually to test the local equipment associated with an RPE system.

LD 45 and LD 33 may disable parts of RPE systems (network loops) that fail during a test. LD 45 may light the LED on PE shelf cards. Faults are also indicated by an output on a system terminal or by a code on a maintenance display on the common equipment shelf.

To determine the meaning of the mnemonics output on the system terminal, refer to the *X11 input/output guide* (553-3001-400). The first three characters of the output identify the program, and the other characters identify the meaning of the output.

Alarm indications

Local and remote error monitors in the QPC99 indicate when the following occurs:

- the error rate at one of the two carriers exceeds one in 10^4 bits, or
- the carrier loses framing

When a remote error monitor detects an error it sends a message to the central control. If the local monitor is in the error condition or receives an error message from the remote monitor, the background signaling diagnostic takes the following actions:

- The minor alarm lamp at the locally served attendant console(s) is steadily lit.
- The time slots served by the faulty line are busied out.
- The diagnostic messages at all maintenance terminals are printed out.

Lamps are provided on circuit cards QPC62 and QPC99 to indicate out of frame, high error-rate conditions, or both. If the errors are in the carrier line going from the remote equipment to the ORB, an alarm is sounded at the ORB.

Errors in peripheral equipment at the remote location raise the same error and alarm indications as local peripheral equipment.

Fault clearing

Fault clearing procedures are shown in the flowchart in [Figure 2](#). The steps in the flowchart are designed to isolate the fault with the use of LD 33 and LD 62 and then to replace the defective apparatus.

Precautions

Circuit cards in an RPE network loop should not be changed without disabling the loop according to the following procedure:

- Enter LD 33 (RPD).
- Issue the DISL L command. See the *X11 input/output guide* (553-3001-400) for more detail.
- Change the circuit card.
- Issue the ENLL L command.

If a card has been changed while the loop was enabled, the loop should be reenabled in two steps:

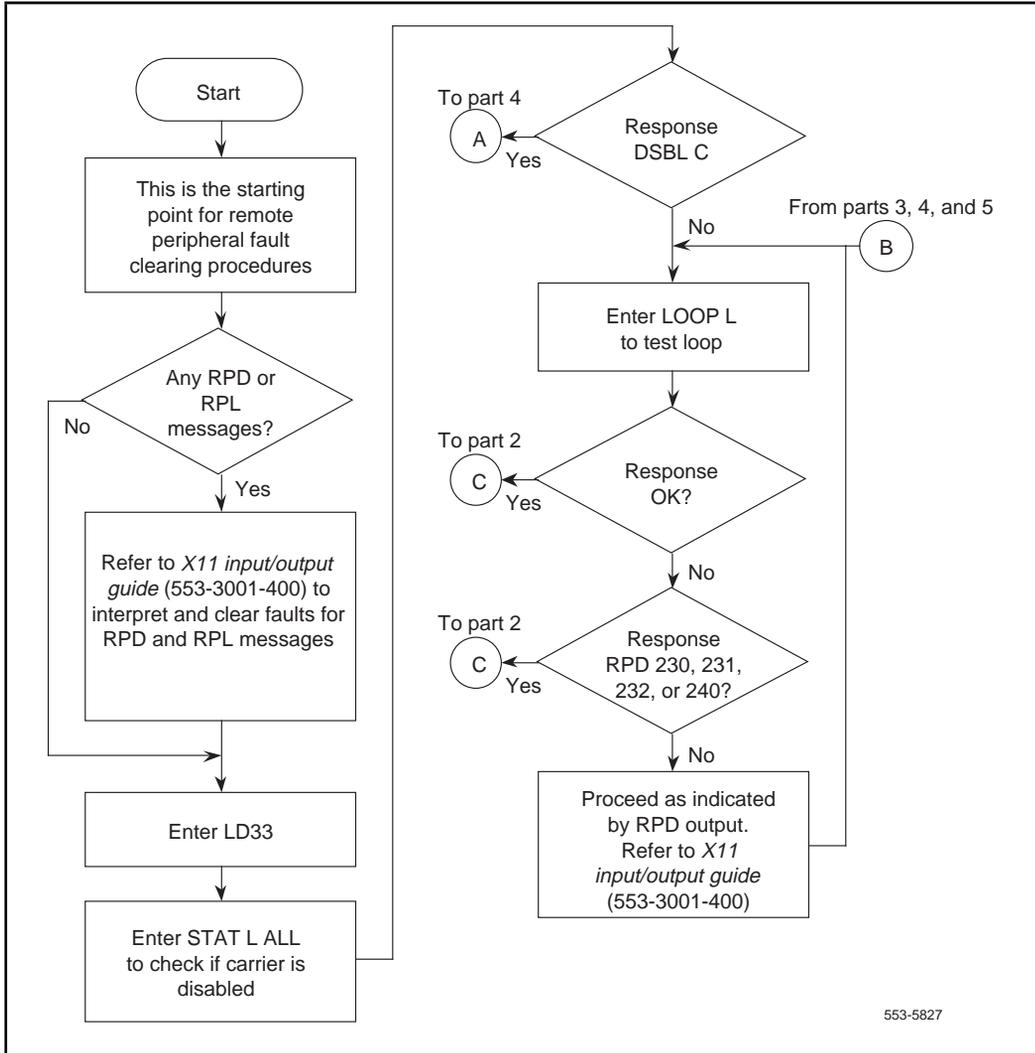
- Disable the loop (DISL L).
- Enable the loop (ENLL L).

Other precautions are listed in *Circuit card installation and testing* (553-3001-211) and should be followed while replacing the faulty apparatus.

Option switches

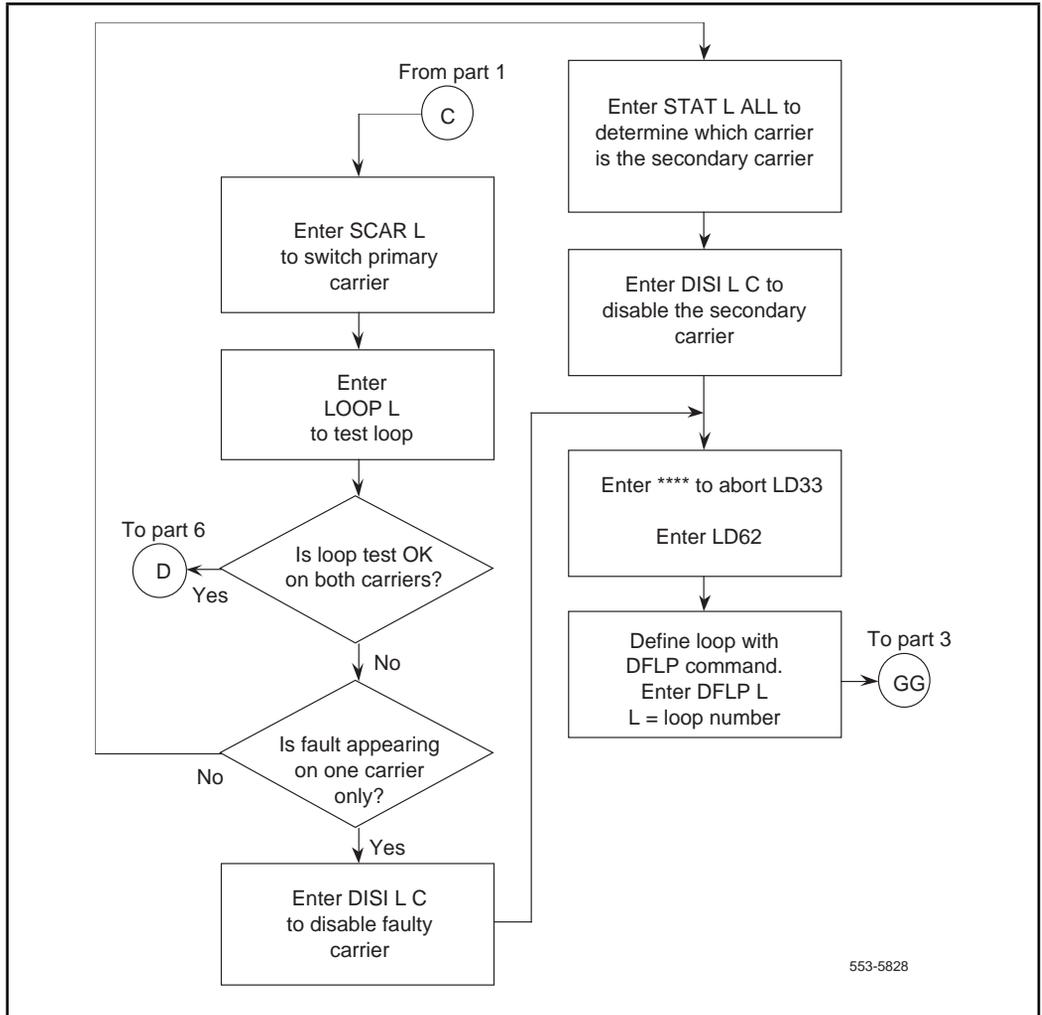
See *Circuit card installation and testing* (553-3001-211) for the option switch settings on the QPC62 and QPC99 circuit cards. When replacing these cards, you must also set the option switches on the replacement card accordingly.

Figure 2
RPE fault-clearing procedures (Part 1 of 6)



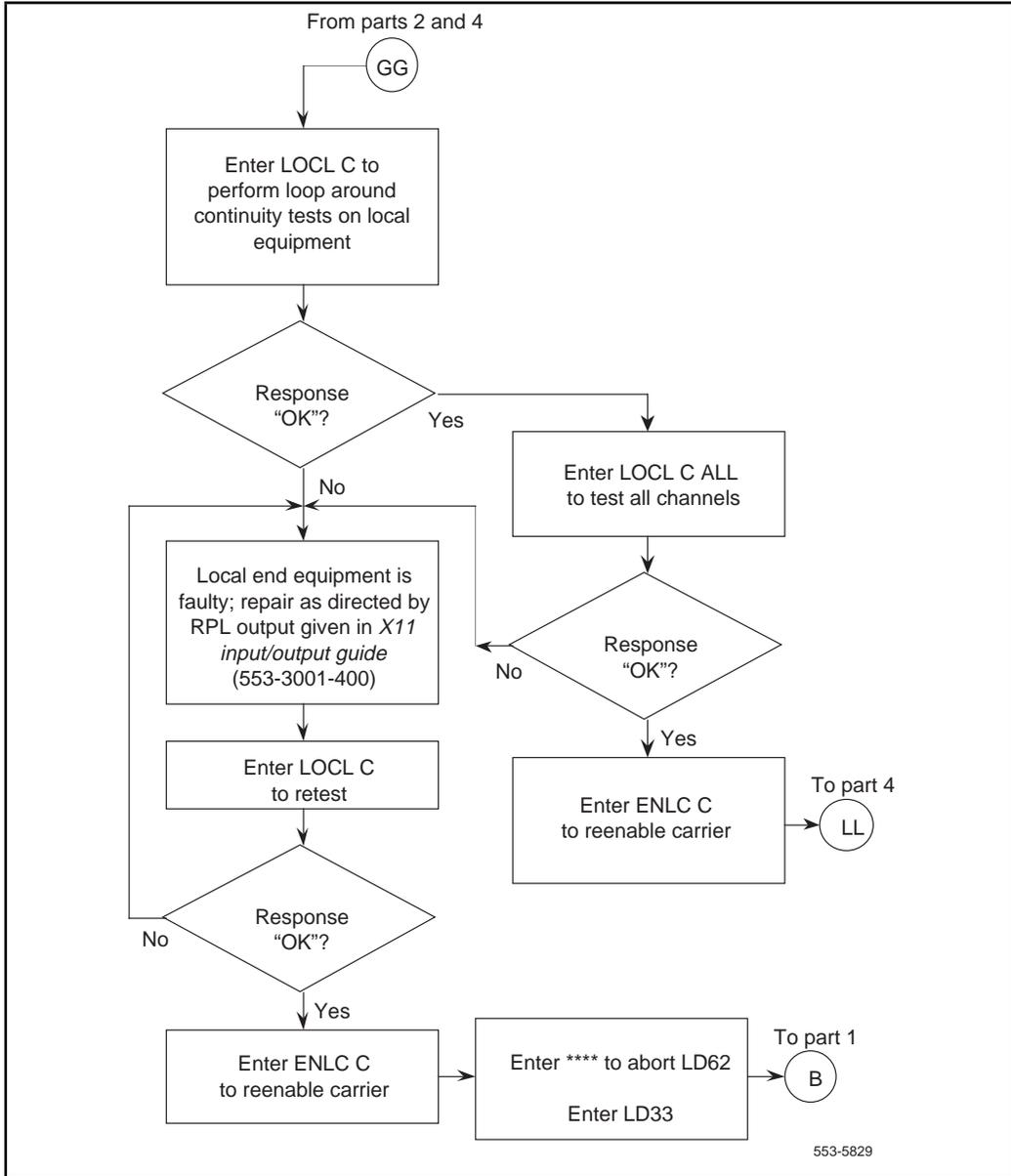
553-5827

Figure 2
RPE fault-clearing procedures (Part 2 of 6)



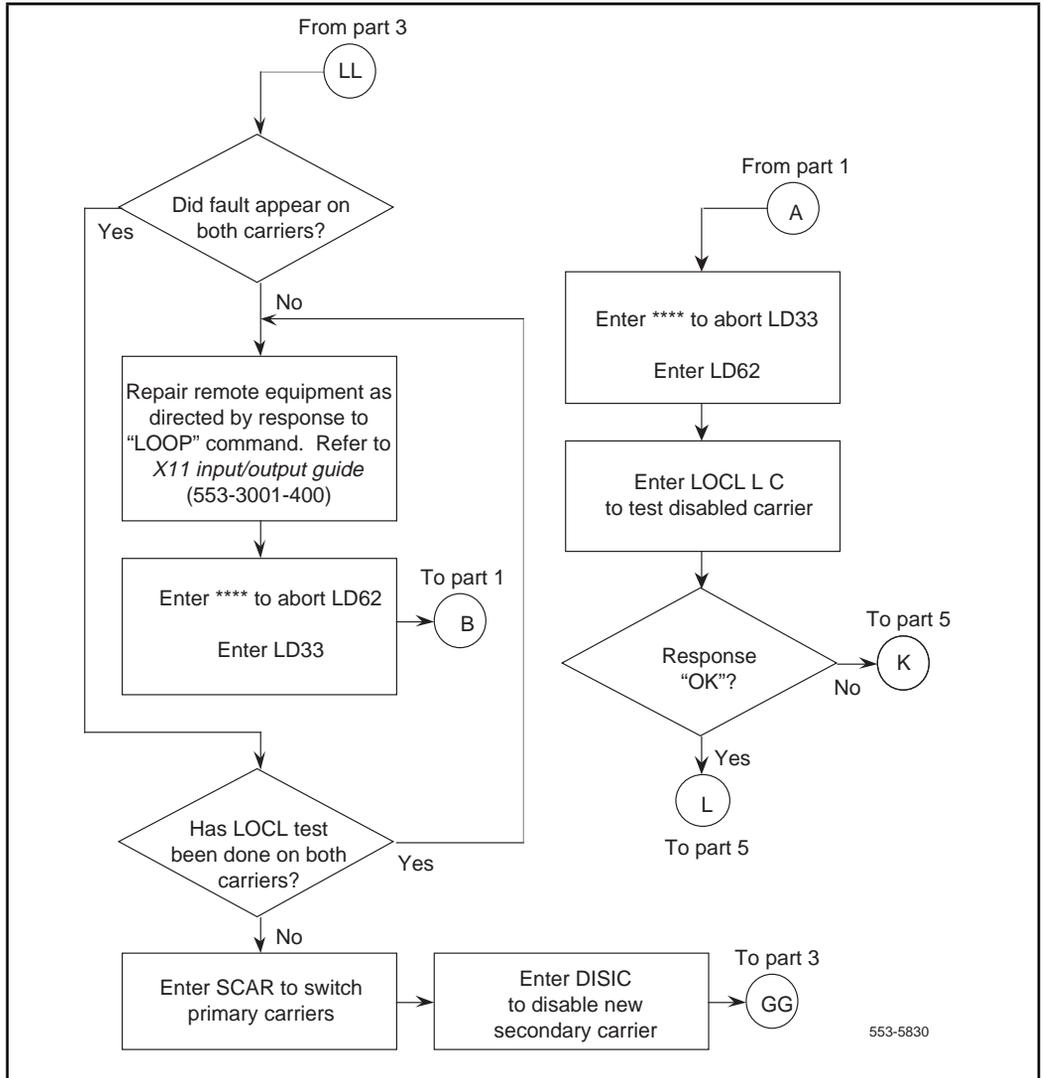
553-5828

Figure 2
RPE fault-clearing procedures (Part 3 of 6)



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Figure 2
RPE fault-clearing procedures (Part 4 of 6)



553-5830

Figure 2
RPE fault-clearing procedures (Part 5 of 6)

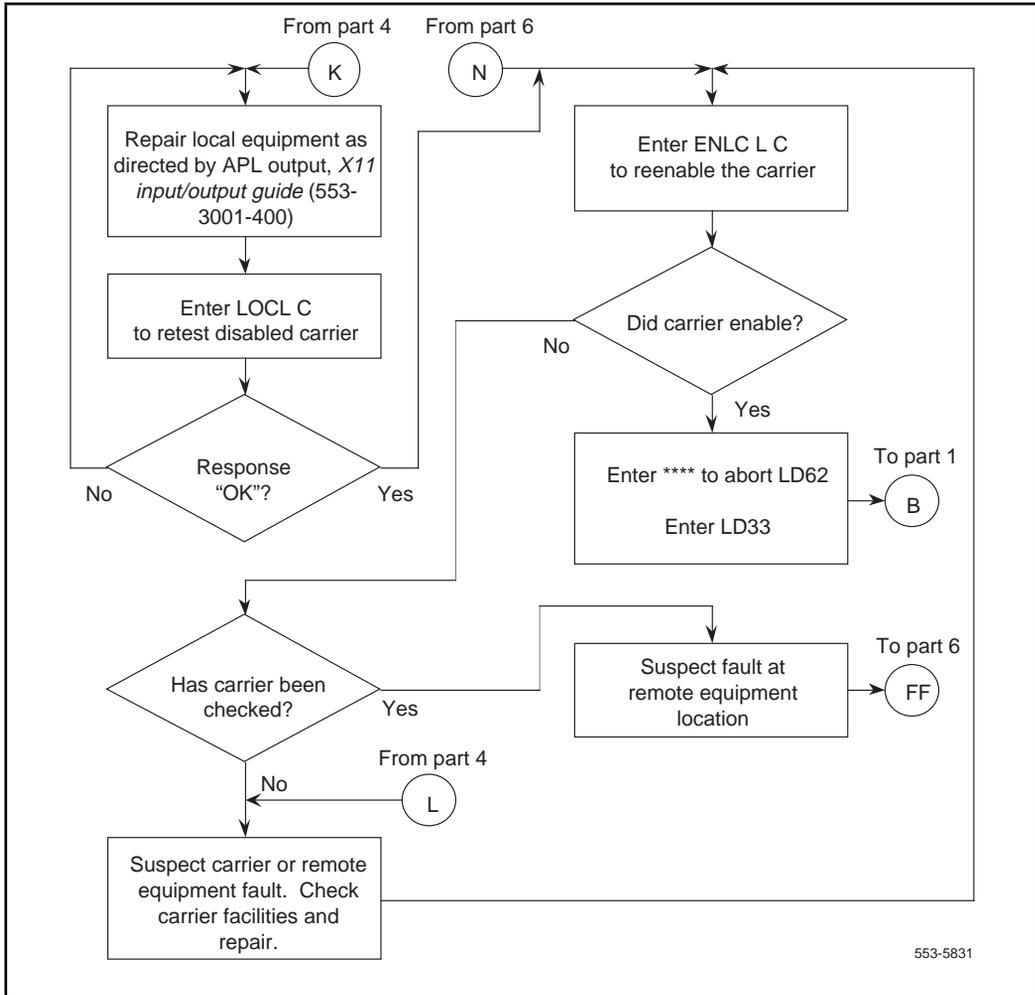
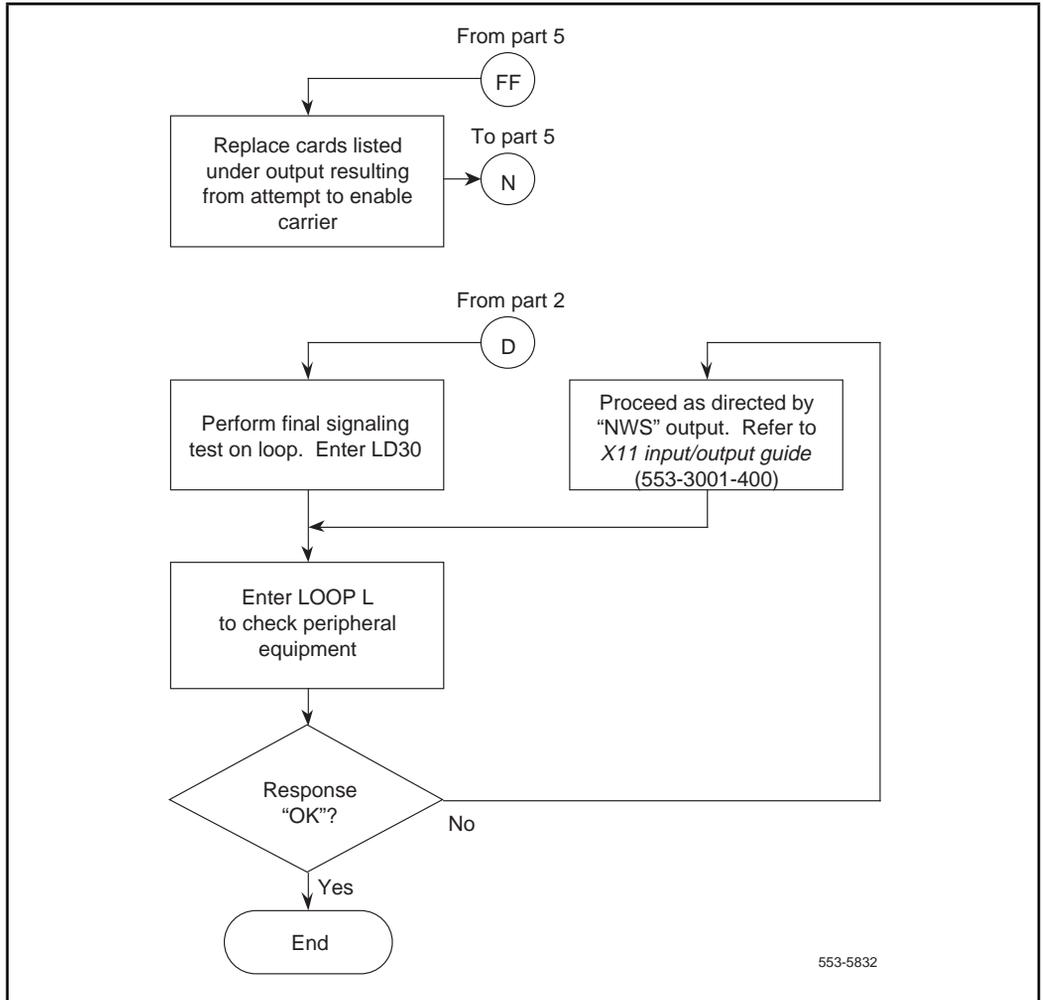


Figure 2
RPE fault-clearing procedures (Part 6 of 6)



Power

Carrier shelves are powered by a QBL14 power distribution box. See *Remote Peripheral Equipment description, installation, and testing* (553-2601-200) for connections and wiring. If the power fault lies elsewhere, refer to the fault-clearing procedures for the system.

Faceplate layout

Figure 3 depicts the faceplates of circuit cards located on the local and remote carrier shelves. **Table 1** gives the functions of the switches and the meanings of the LEDs on each faceplate.

Disabling loop for testing

An RPE loop uses two carrier links. If a fault can be isolated to one carrier link, the suspected link should be disabled. In this case, the traffic handled by a single link is 360 ccs. Fault clearing can then be done with unnoticeable effects for the end user. If a spare compatible carrier link is available, it can be switched into the system until the fault is cleared.

Figure 3
Carrier shelf circuit card faceplates

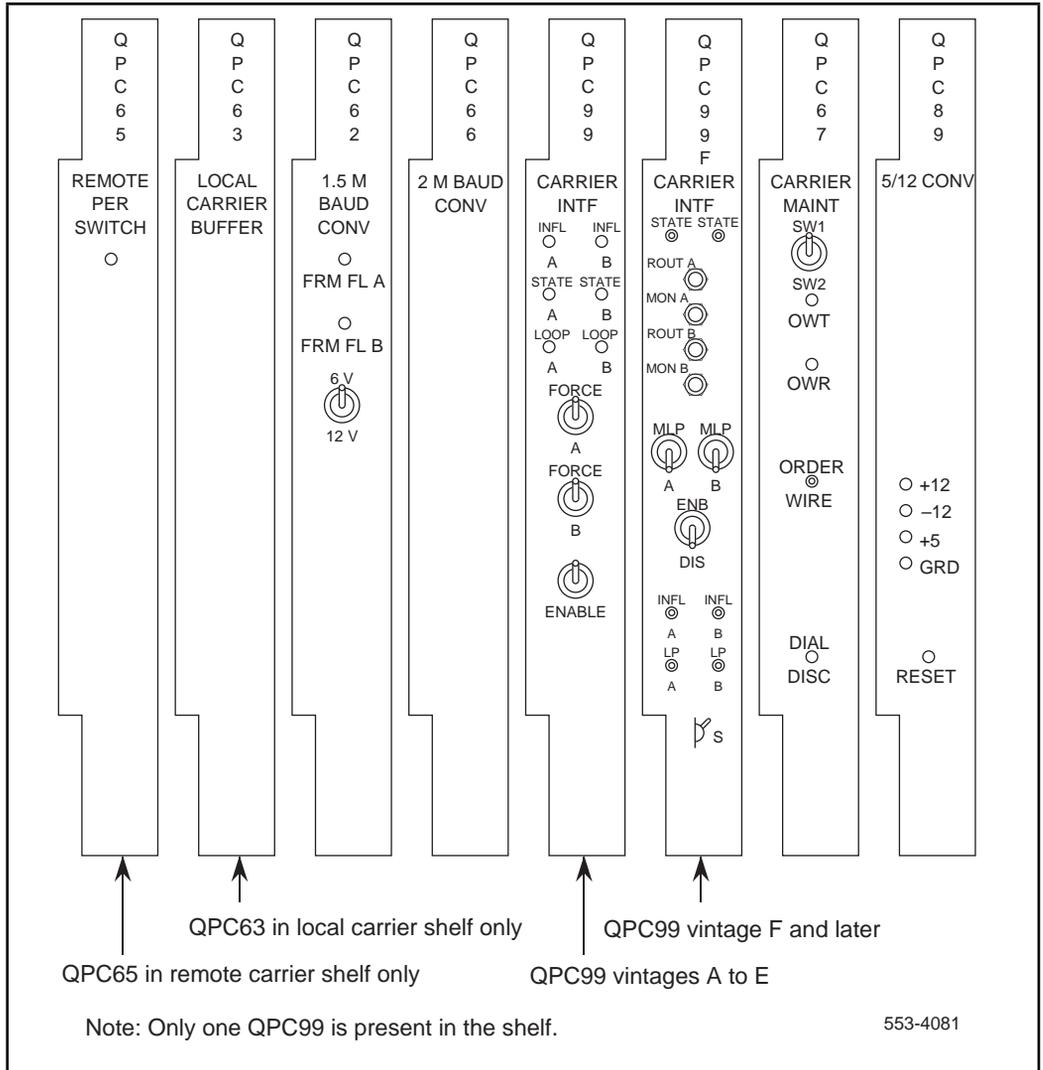


Table 1
Circuit card LEDs

Circuit card								Comments
QPC62				QPC99				
LED designation								
FRM FL A	FRM FL B	INFL A	INFL B	STATE A	STATE B	LPA	LPB	
Status of LED				● = Lit ○ = Extinguished				
○	○	○	○	●	○	○	○	System is normal and operating on STATE A. If unable to switch to STATE B, the outgoing Carrier 0 has failed.
○	○	○	○	○	●	○	○	System is normal and operating on STATE B. If unable to switch to STATE A, the outgoing Carrier 1 has failed.
●	○	●	○	○	●	○	○	Incoming Carrier 1 has failed.
○	●	○	●	●	○	○	○	Incoming Carrier 0 has failed.
●	●	●	●	○	○	○	○	Both incoming carriers have failed.
○	○	○	○	○	○	○	○	Both incoming carriers have failed.
●	○	●	○	○	●	●	○	Carrier looping test in progress on Carrier 1.
○	●	○	●	●	○	○	●	Carrier looping test in progress on Carrier 0.
○	○	●	●	○	○	○	○	Loop is manually disabled; disable switch in disable position.

Carrier fault clearing

Radio carrier system

The considerations for clearing faults in land carrier systems also apply to radio links. The radio link should meet T1 interfacing specifications, and any cable connections between the radio and the RPE should meet the same requirements as for ground links.

Land-line carrier systems

Because of the number of carrier systems available, this section can give only general ideas for clearing faults in carrier systems. Clearing carrier faults requires the following:

- a general understanding of carrier systems
- an oscilloscope
- a carrier line test set
- complete documentation for the carrier system

Figure 4 shows a simplified diagram of the looping options in an RPE carrier system. The system can be partitioned at any of several points to determine whether any component (for example, the ORB or line repeater) is causing the fault. To assist in this, the Meridian 1 RPE system has a facility to inject test patterns at the ROUT jacks in the QPC99 (**Figure 5**).

Figure 4
Carrier looping options

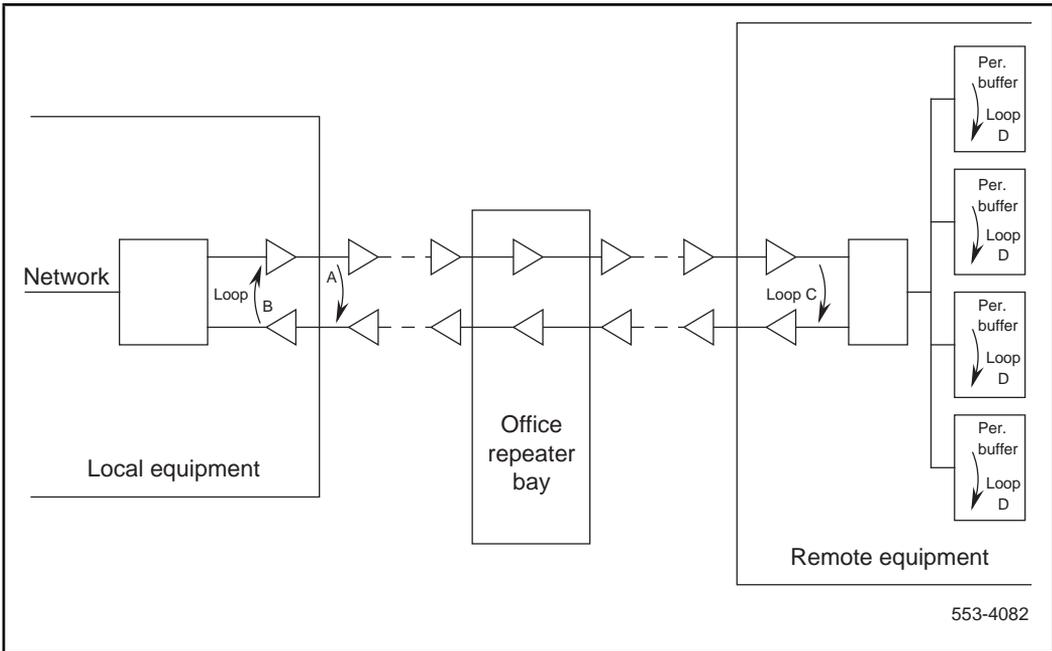
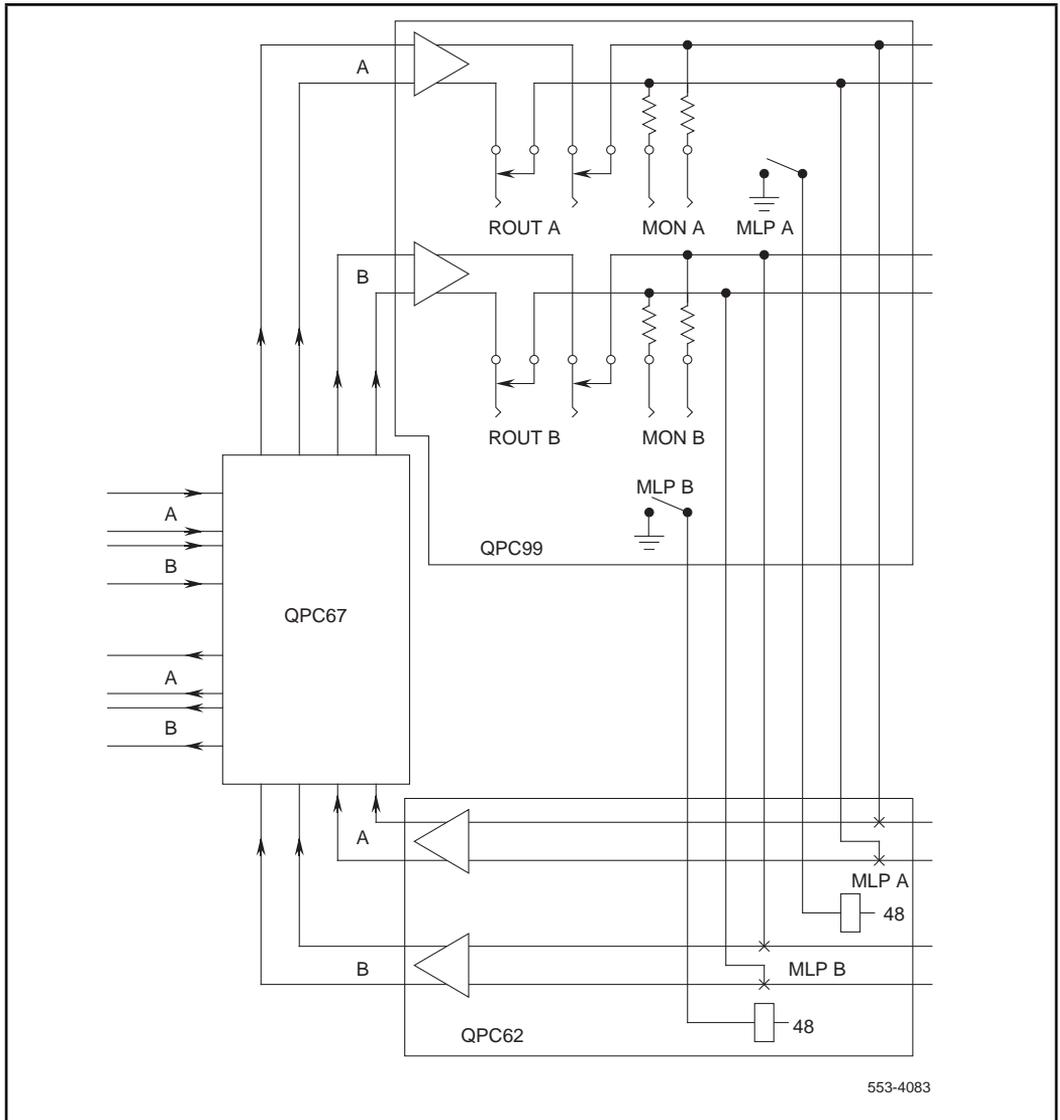


Figure 5
QPC99 maintenance jacks and looping switches



Looping options

An RPE system has several looping options available to aid fault location. These options are illustrated in [Figure 4](#).

The system can be tested by looping the signal at the peripheral buffer (Loop D). Load LD 32 and refer to the *X11 input/output guide* (553-3001-400) for a list of available commands.

Common causes of faults

Possible causes of carrier faults can include the following:

- Traffic and pattern changes. Each digital repeater regenerates the clock from the incoming signal. When the loop is idle, a high density of 1s is put into the line, making clock recovery easier. Under traffic conditions the signal density decreases, making clock recovery more difficult. If faults occur when traffic is increased, there may be one or more marginal repeaters in the carrier system, or the clock recovery circuit at one or both RPE ends may be mistuned.
- Shortened or partially grounded cable pair.
- The output from the local transmitter can be looped back into the local receiver (A). Load LD 62 and see the *X11 input/output guide* (553-3001-400) for the appropriate commands.
- The carrier can be looped manually and tested from the ORB (B + C), depending on the type of carrier system used.

Carrier looping options include the following:

- loop when the error rate exceeds one in 10^4
- loop when DC is detected on the FLP and error rate exceeds one in 10^4
- loop when the manual loop back (MLP) switch on the QPC99 is closed

The MLP switches on the QPC99 allow the signal from the QPC99 to be put directly back into the carrier line and monitored at the far end using the monitor (MON) jacks on the QPC99 at the far end.

These options are switch-selectable on the QPC99. The use of fault-locating filters is outlined in the Northern Telecom Publication for the LD-1 carrier system. Whichever carrier system is used, documentation for it should be obtained and used to assist in the fault-clearing process.

Problems such as the following may be encountered at the repeater site itself:

- faulty repeater
- faulty cable pair at the input to a regenerative repeater, wherein signal errors are arriving from the line
- faulty cable pair at the repeater output toward the next repeater location, causing reflections and poor impedance characteristics, which result in errors at the repeater
- faulty simplex power loop, causing degraded repeater performance or complete failure
- faulty wiring in the repeater housing, sometimes encountered during pre-service testing

Error measurement

The performance of a pulse code modulation (PCM) system can be observed either “by eye” using an oscilloscope or by using a test set to measure error density.

For voice traffic, a PCM system with 10^{-6} (one error in a million bits) performance is generally considered excellent. With 10^{-5} , clicks may be heard, and 10^{-4} performance results in pops, clicks, and noise. At 10^{-3} most PCM systems go into alarm condition. (At this point, there is one error in only 1000 bits.)

For data traffic, any system performing at less than the 10^{-6} level causes the following problems for customers:

- Cross talk. Every cable has its limits on the number of PCM systems that can be safely operated in the same sheath without intersystem interference. Cross talk causes errors because of the regenerator’s inability to decide whether an induced signal constitutes a “pulse” or not. This shows up as pops, noise, and data transmission errors. The most common cross talk path is within the repeater housing and within the cable near the repeater itself because of the large difference (32 dB or more) between the outgoing and incoming signal.
- unbalanced cable pairs
- load coils, bridge taps, or building-out capacitors not removed
- moisture in cable
- defective lightning protection devices
- crossed cable pairs
- open or very high resistance cable pairs or splices (continuity tests may help in locating this)

When inspecting the waveform on the oscilloscope at various points in the carrier span, keep in mind the requirements listed in *Remote Peripheral Equipment description, installation, and testing* (553-2601-200), since any deviation from the limits listed there causes errors or contributes to them.

Meridian 1

Remote Peripheral Equipment

Maintenance procedures

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