DR 6/11-135A and 135EC 1×N Frequency Diversity Operation and Maintenance Degraded Performance

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1 Introduction

Degraded performance is a condition detected by continuous monitoring of the error performance of each digital radio channel at its receive terminal. You will usually be notified of degraded performance by the alarm center before customer service is impaired.

Isolating a degraded performance problem to a specific equipment unit is often a challenging process. There are usually no equipment alarms and the degraded performance condition may be intermittent. If there is an equipment alarm on the radio channel with degraded performance, clear the alarm first. This may clear the performance problem.

You will have to work closely with the alarm center and Technical Support Group (TSG) personnel.

1.1 Safety Labels

Safety labels are strategically placed symbols and messages that will alert you to potential risks. There are three types of safety labels.

DANGER:
DANGER *indicates the presence of a hazard that* ***will*** *cause death or severe personal injury if the hazard is not avoided.*

WARNING:
WARNING *indicates the presence of a hazard that* ***can*** *cause death or severe personal injury if the hazard is not avoided.*

CAUTION:
CAUTION *indicates the presence of a hazard that* ***will*** *or* ***can*** *cause minor personal injury or property damage if the hazard is not avoided.*

Within the **CAUTION** safety label, the term "property damage" refers also to possible service interruption or impairment.

Please refer to the Safety Labels heading in the **START HERE** tab for additional information about, and examples of, safety labels.

2 General

2.1 System Monitoring

The alarm center is referred to as the Transport Servicing Center (TSC). The Transport Maintenance and Administration System (TMAS) is the Operations Support System at each TSC that monitors digital radio systems. One function of TMAS is Performance Monitoring (PM).

Performance Monitoring is the automatic and continuous monitoring of error performance at the digital terminal receiver of each digital radio channel. There are two categories of PM and associated errors.

a. **Line-Rate PM** (also called 64-QAM PM) is based on errors detected within the 64-QAM signal format at the 135-Mb/s line rate. These are the Cyclic Redundancy Check (CRC) Section errors and 64-QAM Out of Frame (OOF). They are a measurement of the system performance ***before*** Error Correction (EC) has been applied (if equipped).

b. **DS3 PM** [via Violation Pulse Monitor (VPM)] is based on errors detected within the DS3 signal format at the 45-Mb/s rate. These are the DS3 parity errors and DS3 OOF. The DS3 errors indicate service impairments to the customer. They are a measurement of system performance ***after*** EC (if equipped) has been applied.

The TMAS has maintenance thresholds set for each category. For trouble isolation and repair verification, TSC personnel can initiate demand PM tests without thresholds. To further isolate Line-Rate PM problems, they can initiate a Fault Locate (FL) test to see how each regenerative section is performing and identify the radio hop that is contributing the highest amount of detected errors.

Performance reports generated by TMAS may be included with the degraded performance report (ticket) that you will usually receive from the Work Management System (WMS). The PM results (with thresholds) for the past 14 days are also available in TMAS.

The TMAS reports use terminology that is not directly related to radio equipment indications and on-site measurements. Here are definitions of some of the terms:

a. **Observation Intervals**—Although TMAS counts errors continuously, thresholds are based on errors accumulated in 15-minute intervals called observation intervals. There are 96 intervals per day.

b. **Observation Interval Report (OIR)** is a listing of observation intervals that exceeded the high and low thresholds. The current day's data can be taken from the GTP and up to 14 days history can be taken from TMAS.

c. **Error Types** is a quantity-rating of detected errors.

— ES-A (Error Seconds, Type A) are seconds in which only one error occurred.

For Line-Rate PM, an ES-A contains only one CRC section error.

For DS3 PM, an ES-A contains only one DS3 parity error.

— ES-B are seconds in which more than one error occurred, but less than 1 X 10^{-6} Bit Error Rate (BER).

For Line-Rate PM, an ES-B contains more than one but less than 135 (non-EC) or 144 (EC) CRC section errors.

For DS3 PM, an ES-B contains more than one but less than 45 DS3 parity errors.

— ES-C are seconds with greater than or equal to 1 X 10^{-6} BER (enough errors to initiate a line switch).

d. **Error Patterns**

— **Dribbling errors** refer to a steady, low rate of errors. When they exceed a threshold, it is time to isolate the cause.

— **Error Bursts** are brief intervals of errors. ***Severe error bursts*** contain ES-C and/or OOF errors; they often cause service impairment because they can occur too fast for service to switch to protection and they exceed EC capability (if equipped).

— **Intermittent errors** occur intermittently; the problem is usually harder to isolate and repair. They need to be observed very closely to see if there is any pattern or periodicity. If it has an identifiable period, the problem could be caused by some external interference (such as weather radar).

The TSC will generally provide you with:

- The identity of the radio hop with the highest error-activity
- Which location is most likely to be the source of the problem.

Your TSG will assist you with additional suggestions and guidelines, but some suggestions are:

a. Dribbling errors that occur more or less continuously are often caused by intermodulation (linearity) problems in TWT Transmitter Amplifiers.

b. The OOF's that occur during times of fading often indicate a trouble in a radio receiver or a digital receiver.

c. Intermittent OOF's and ES-C are usually caused by a bad microwave generator at either the radio transmitter or receiver where both:

— The number of OOF's and ES-C match at the Line-Rate.

— The number of ES-C are double the OOF's at the DS3 (VPM) rate.

2.2 Isolation Techniques

2.2.1 Intermittent

Causes of intermittent error bursts that occur once every hour or at a less frequent interval are hard to isolate and repair. Two techniques to use are:

a. **Unit rotation and re-monitor—**
Units that are common in the equipment associated with all channels may be swapped with similar units in the protection channel. If the problem moves with the unit, the isolation process is complete.

At regenerator stations, an alternative to using the protection channel is using the reverse direction of the channel with the trouble.

b. **Unit replacement and re-monitor—**
Spare units are used to replace suspected bad units. When the problem is corrected, it is a good idea to re-verify that the suspected unit is bad.

Put the original unit back in the channel if the spare unit does not fix the problem because sometimes the spare may be bad and you will end up putting additional problems into the system.

Unit rotation and re-monitor is the preferred method of the two to use. There is usually a lot of guesswork involved in clearing these types of intermittent problems.

2.2.2 Steady State

Steady state errors are much easier to isolate and repair. The most common source of steady state ES-A's and ES-B's is radio transmitter linearity. A quick test technique for a linearity related problem is the **IF Predistorter Bypass** (with 10-dB pad).

Other useful techniques consist of reconnecting the IF (or RF) interconnect signal paths to and from different radio and digital equipment units. Using the following techniques, a problem on a radio hop can be isolated to the transmit or receive end and then to the radio or digital shelf.

a. **Loopback—**
Signal is looped back in the reverse direction using same channel.

b. **Frogging—**
Equipment is substituted by changing both the input and output connections.

c. **Injection—**
A signal is borrowed from another source (same or different channel).

3 Trouble Isolation

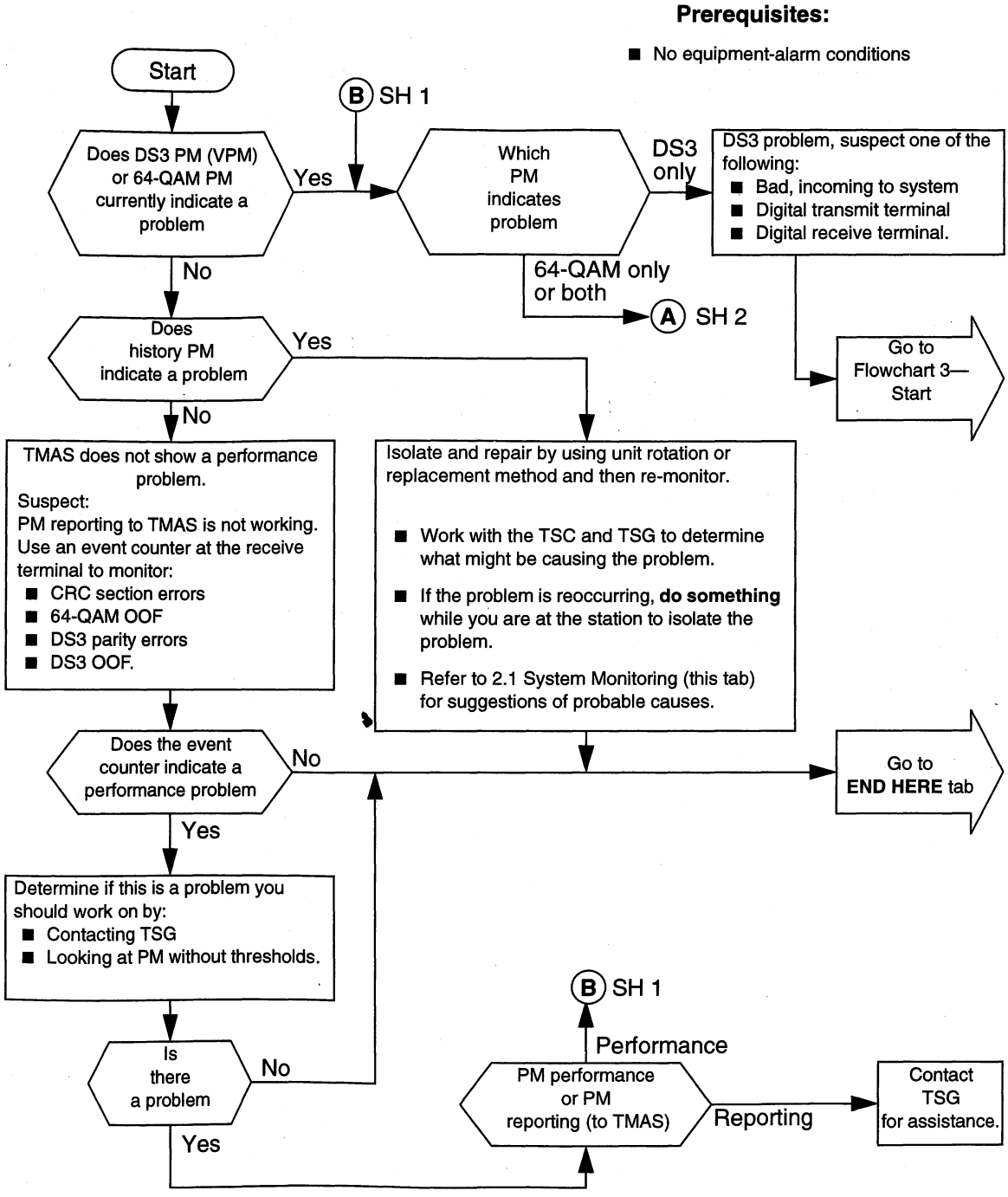
Flowchart 1 is the starting point to isolate and repair a degraded performance problem. All equipment-alarm conditions on the radio system should be cleared before entering this flowchart. From Flowchart 1, you will be directed to Flowchart 2 if it is a Line-Rate (64-QAM) PM problem or to Flowchart 3 if it is a DS3 PM problem.

Figure 1 illustrates one two-way digital radio channel and Figures 2 through 6 show equipment configurations using isolation techniques discussed in 2.2.

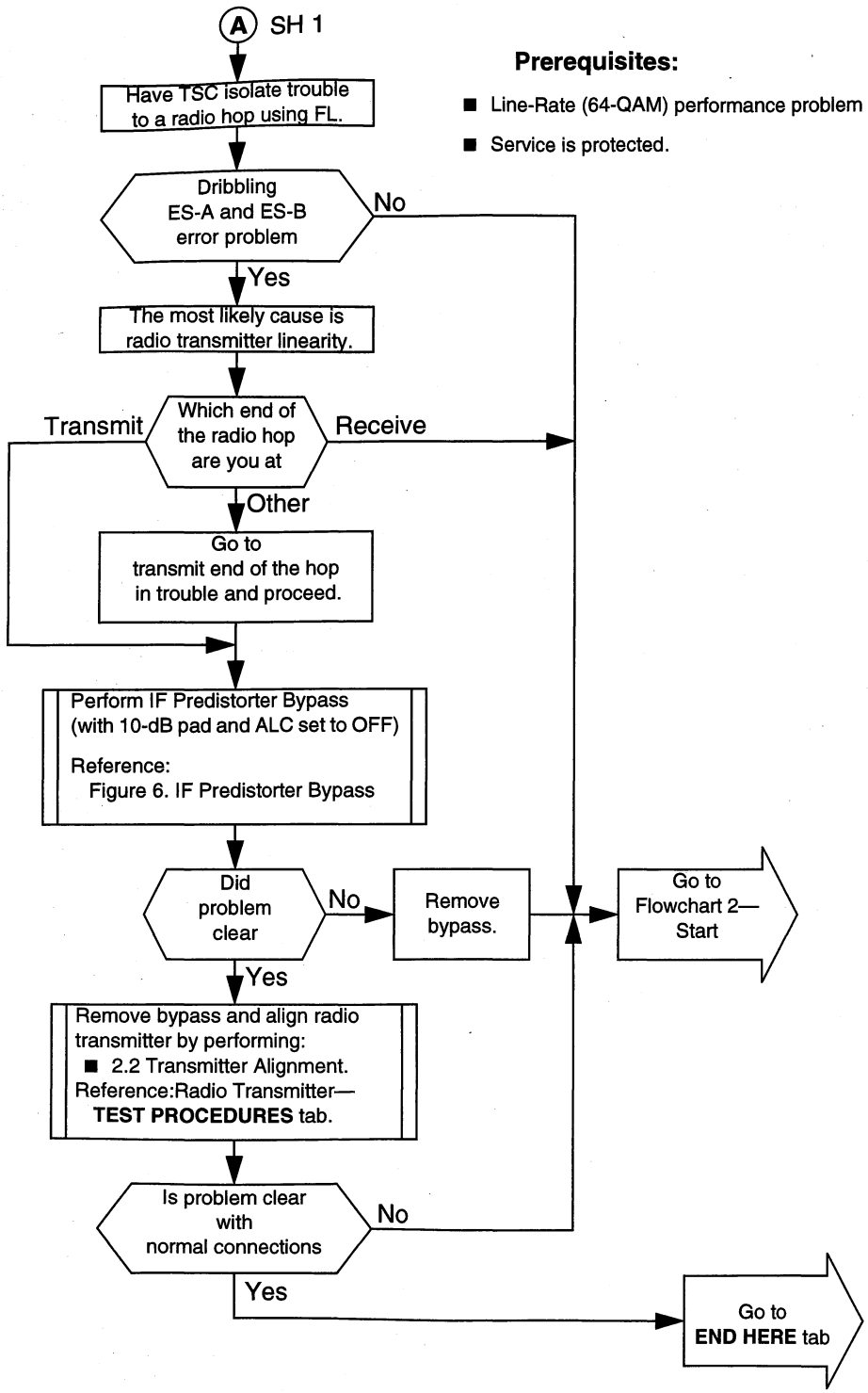
CAUTION:
To prevent service interruptions, ensure that:

a. *Service is protected before removing cables.*

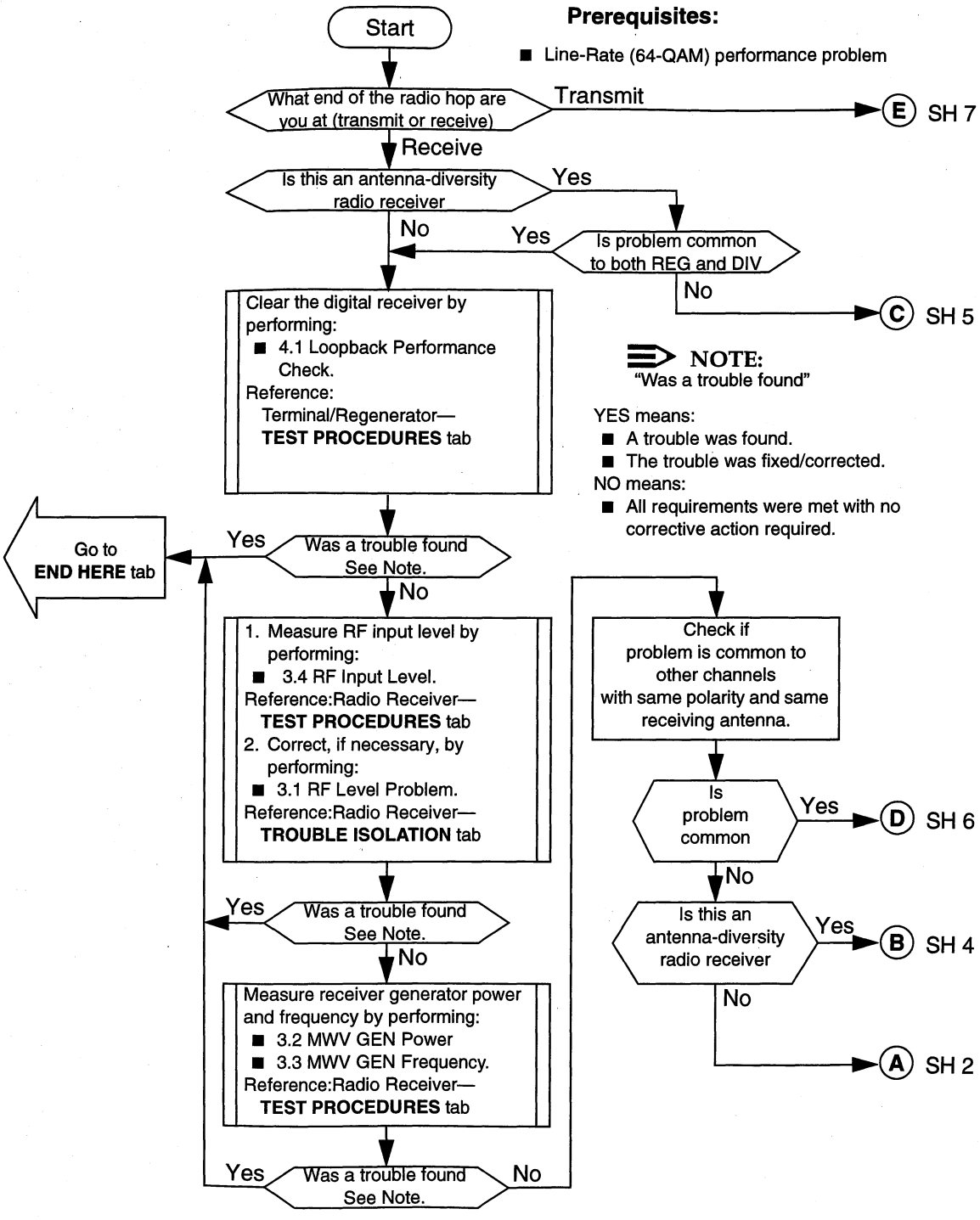
b. *Replacement procedures are followed when replacing units.*



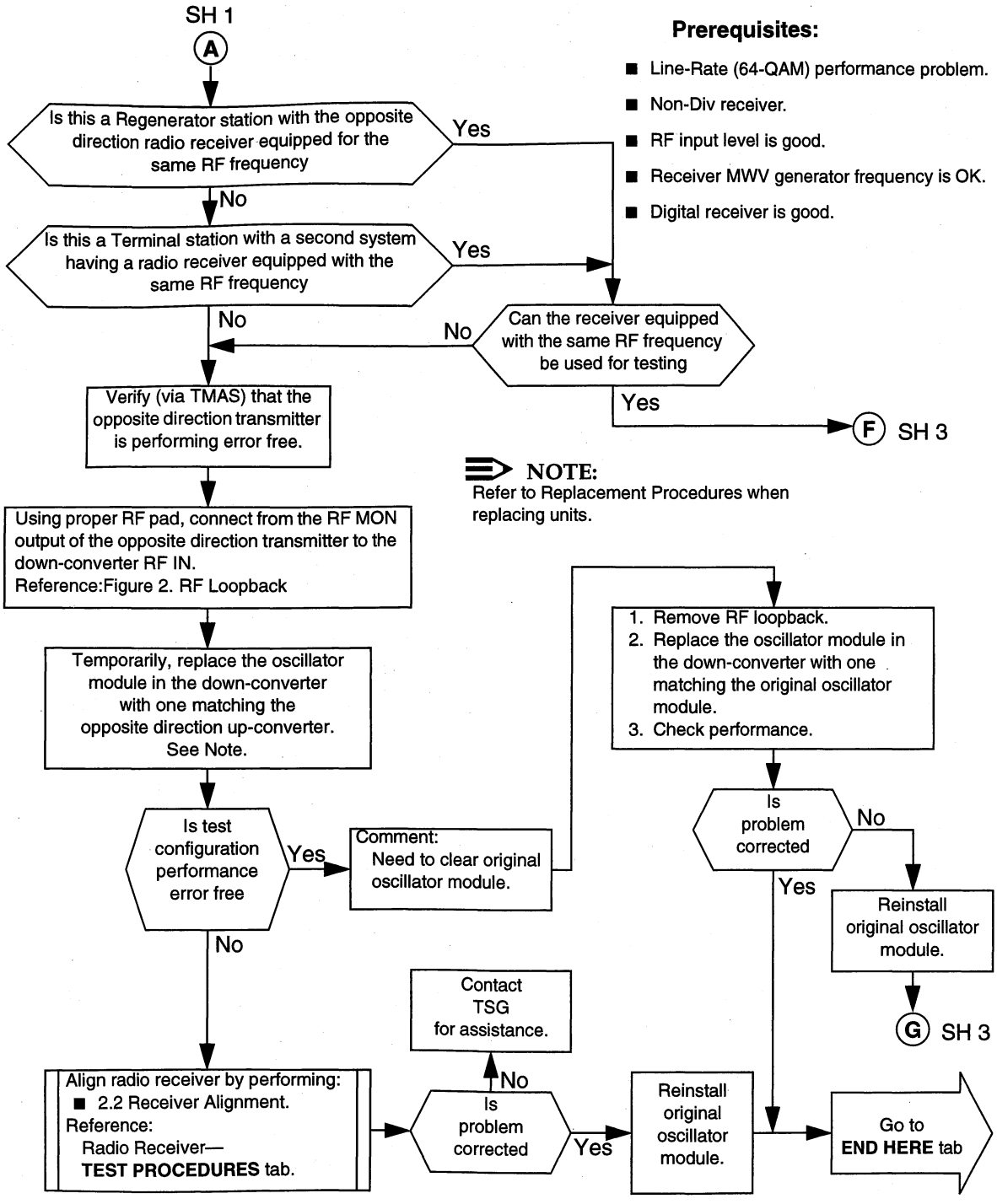
Flowchart 1. Degraded Performance Trouble Isolation (Sheet 1 of 2)



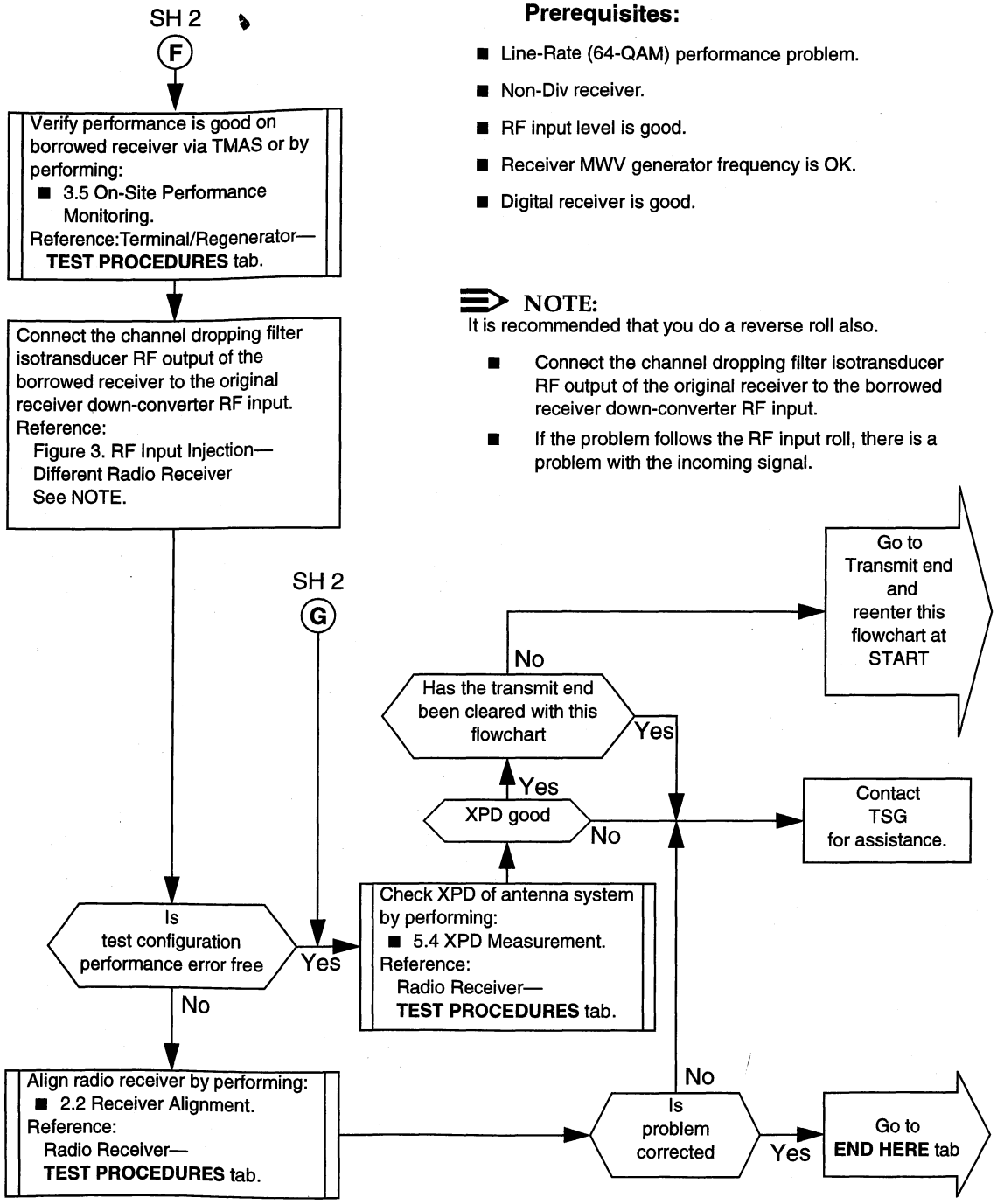
Flowchart 1. Degraded Performance Trouble Isolation (Sheet 2 of 2)



Flowchart 2. Line-Rate (64-QAM) Trouble Isolation (Sheet 1 of 7)



Flowchart 2. Line-Rate (64-QAM) Trouble Isolation (Sheet 2 of 7)



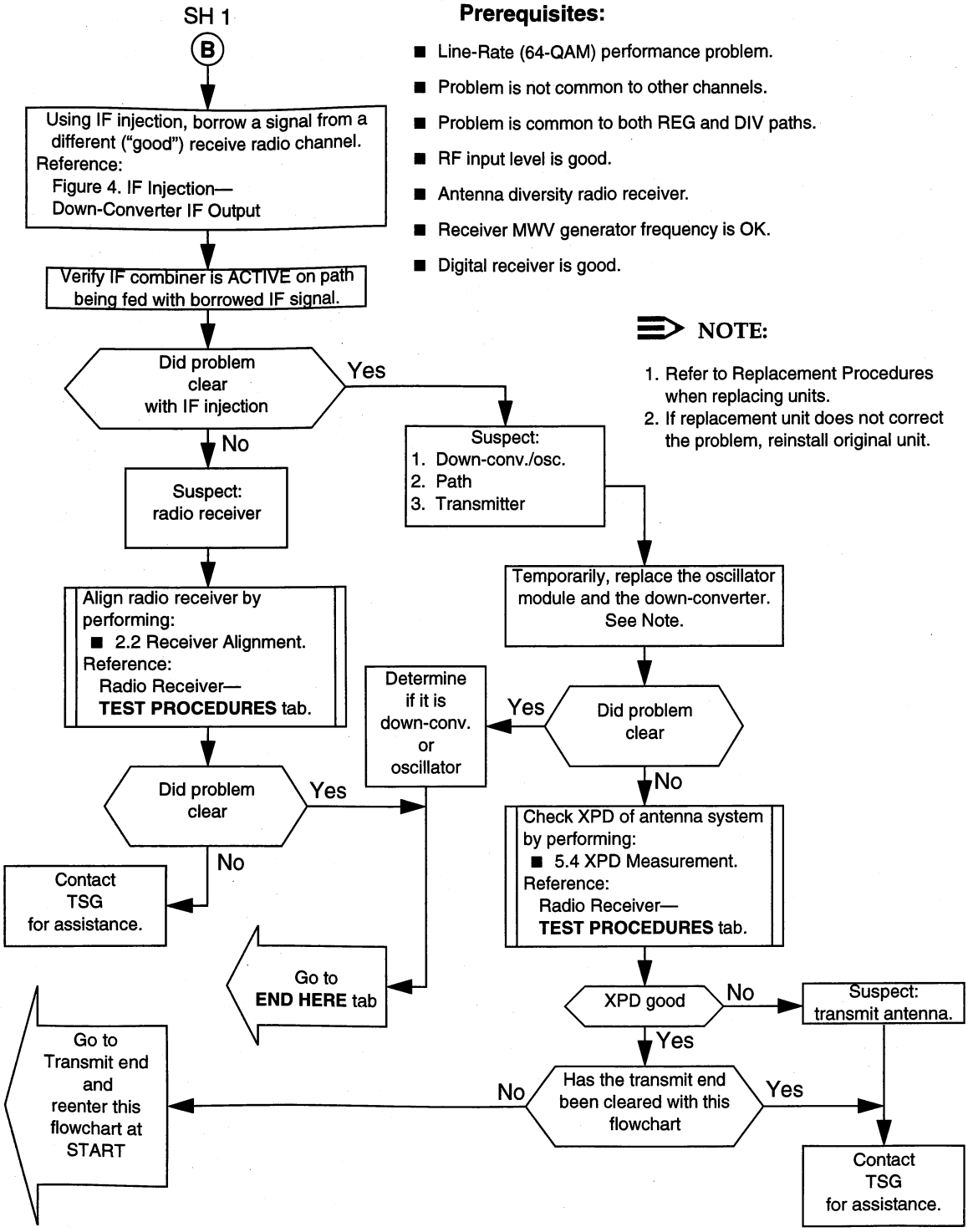
Prerequisites:

- Line-Rate (64-QAM) performance problem.
- Non-Div receiver.
- RF input level is good.
- Receiver MWV generator frequency is OK.
- Digital receiver is good.

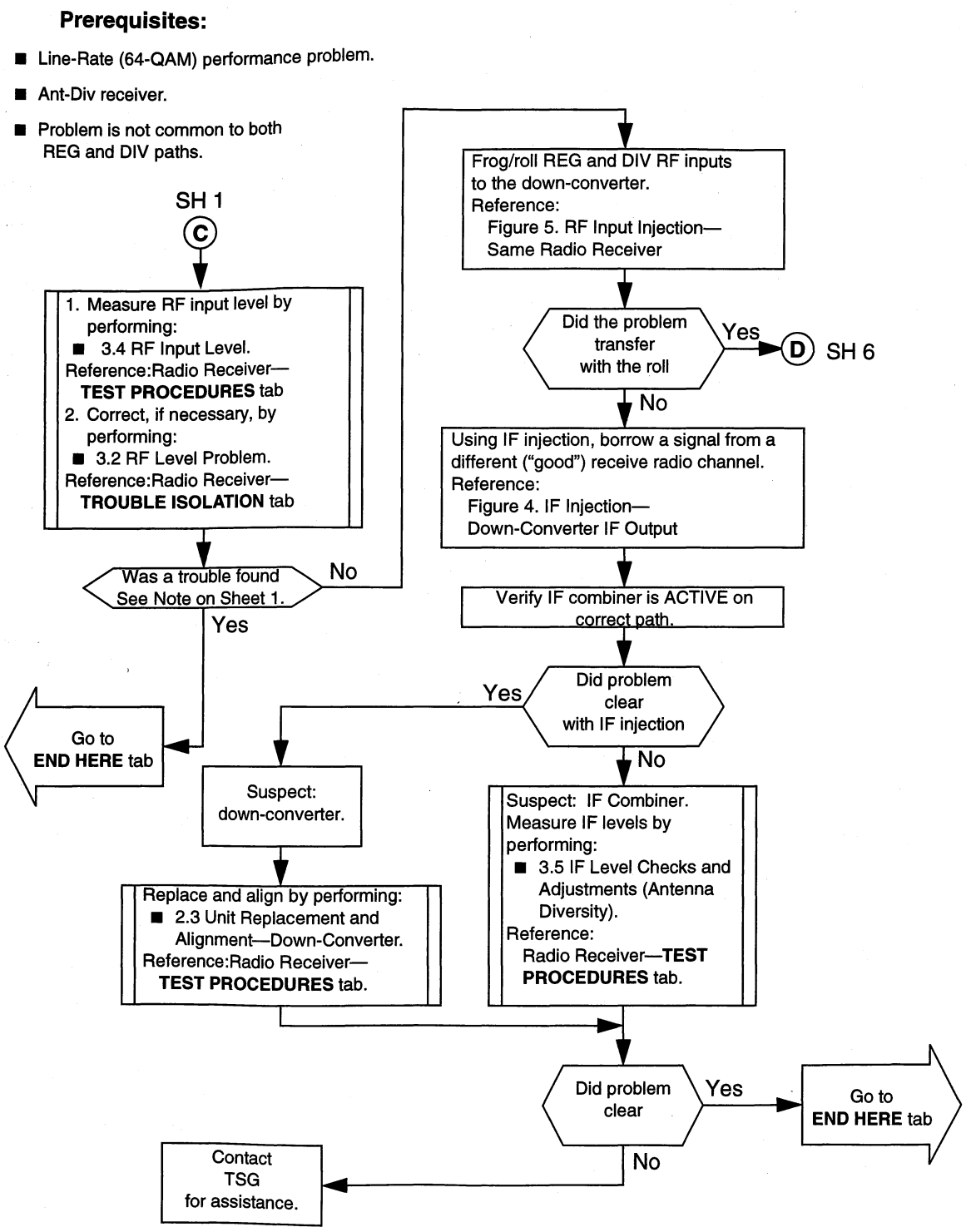
NOTE:
It is recommended that you do a reverse roll also.

- Connect the channel dropping filter isotransducer RF output of the original receiver to the borrowed receiver down-converter RF input.
- If the problem follows the RF input roll, there is a problem with the incoming signal.

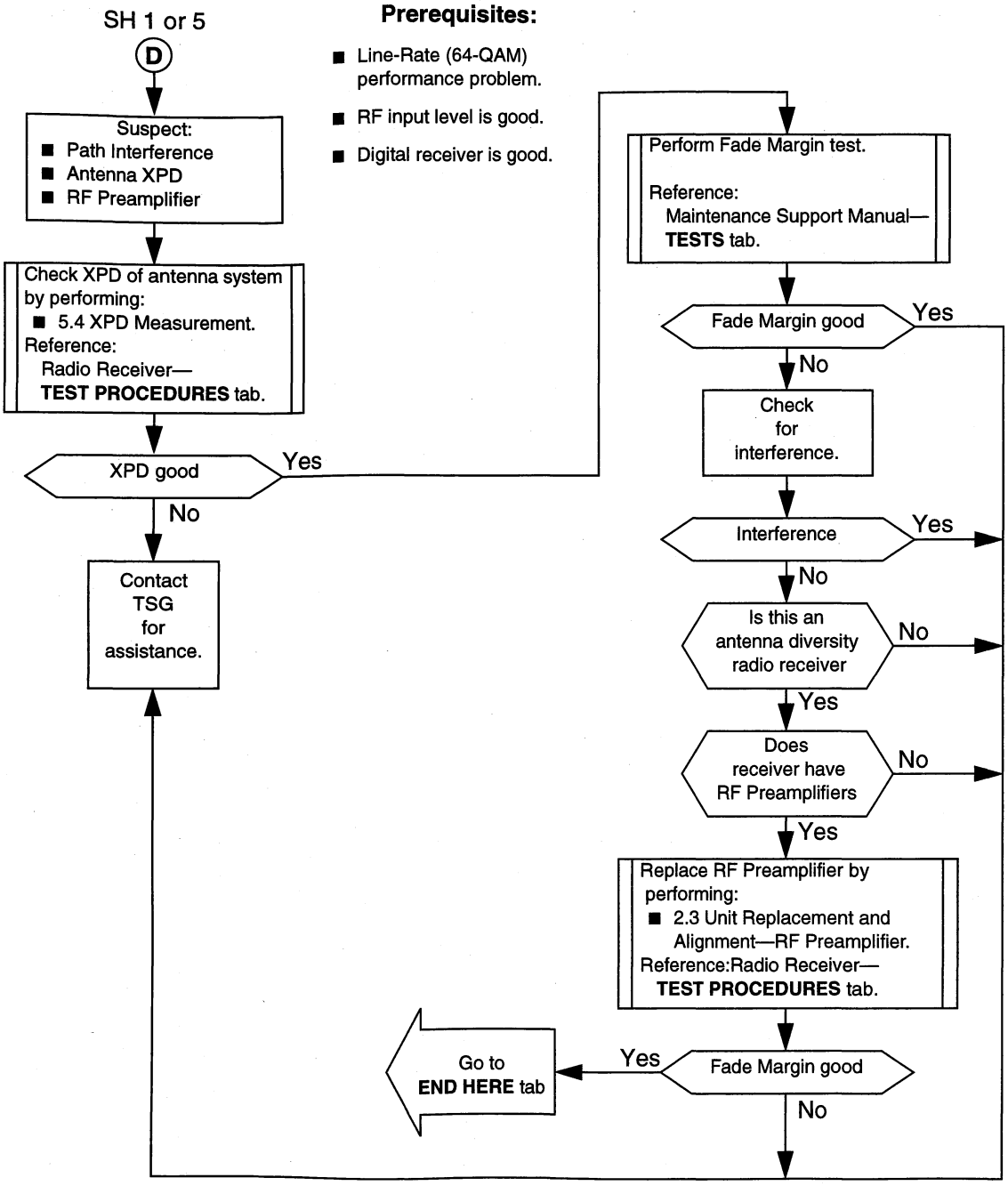
Flowchart 2. Line-Rate (64-QAM) Trouble Isolation (Sheet 3 of 7)



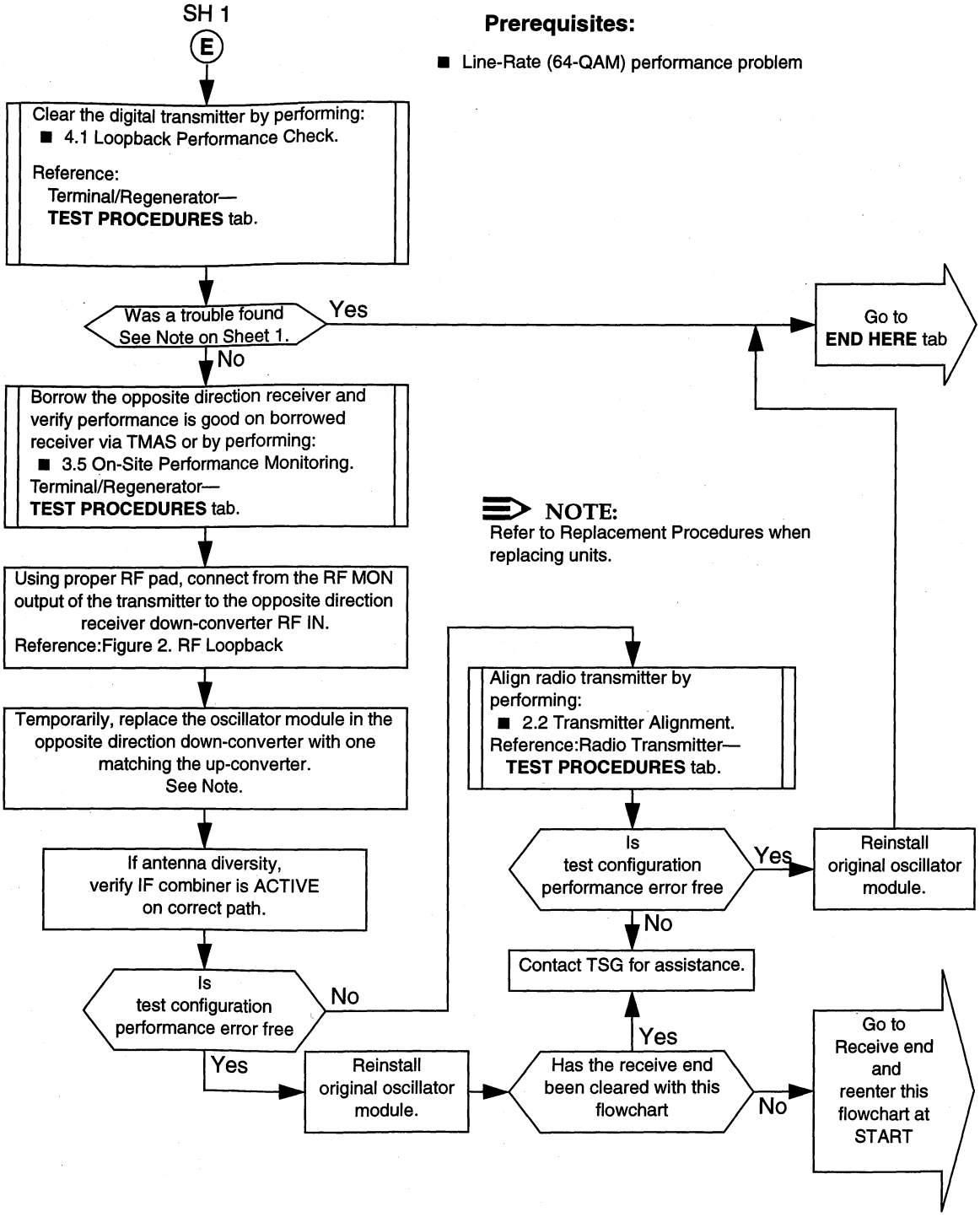
Flowchart 2. Line-Rate (64-QAM) Trouble Isolation (Sheet 4 of 7)



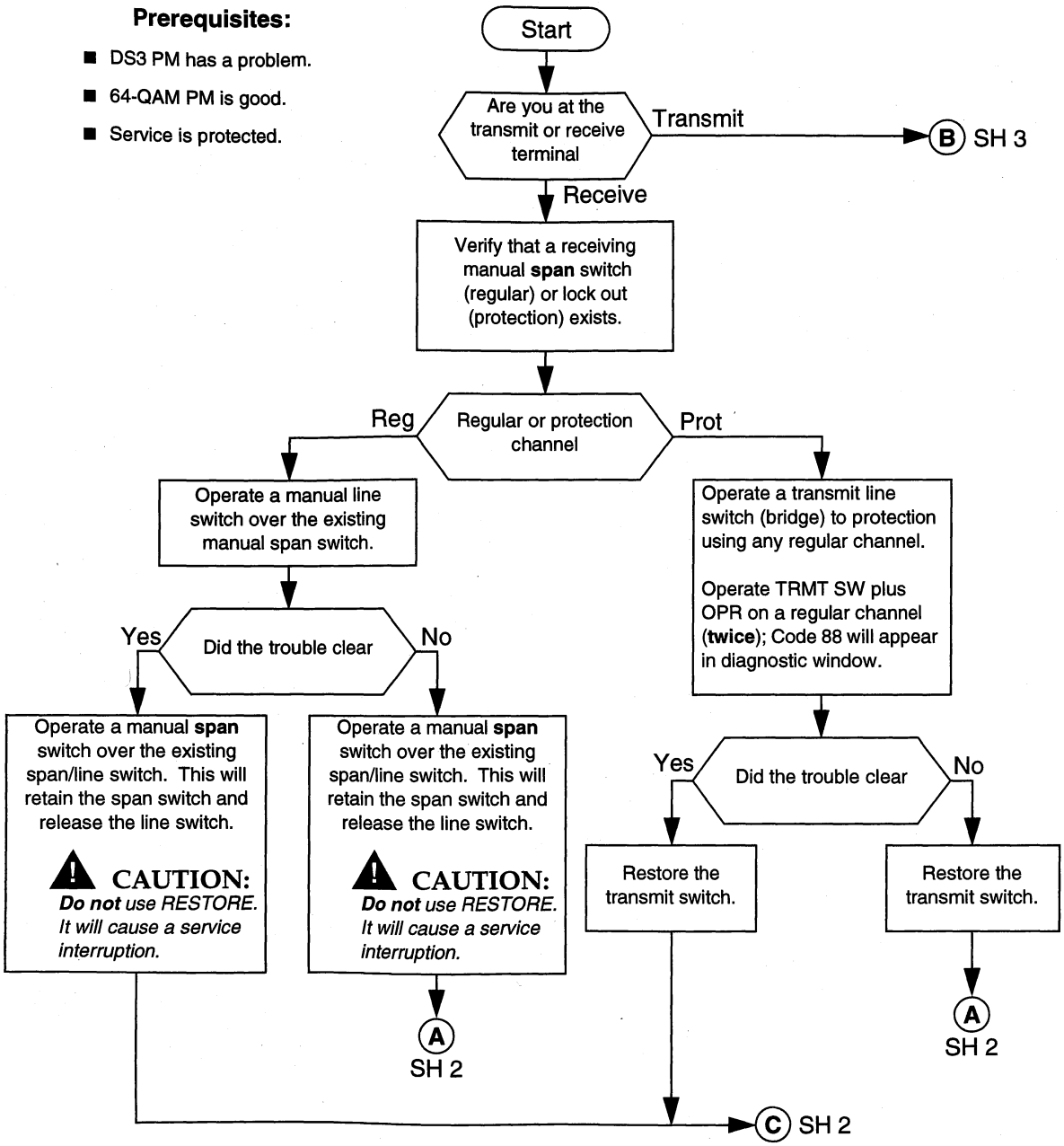
Flowchart 2. Line-Rate (64-QAM) Trouble Isolation (Sheet 5 of 7)



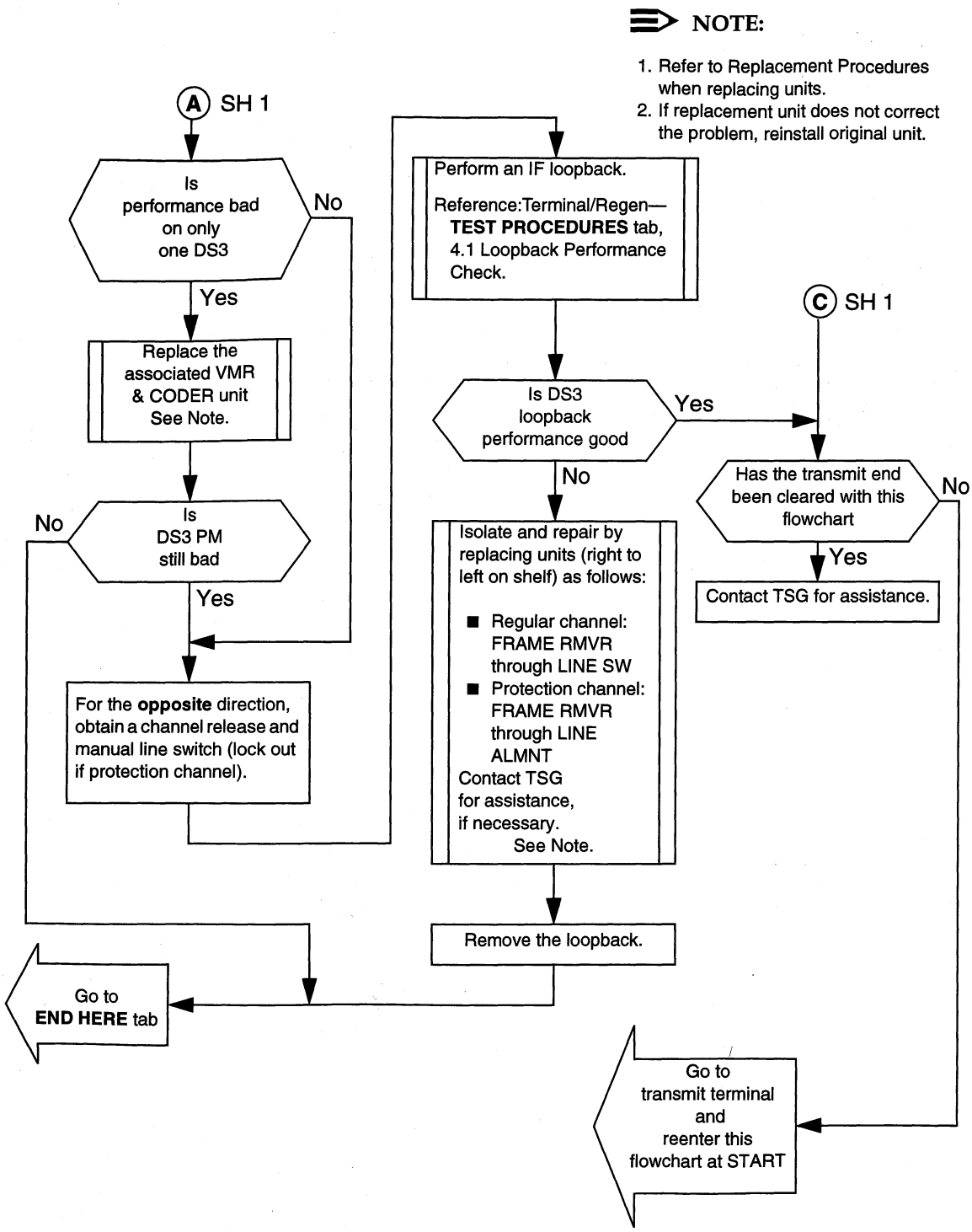
Flowchart 2. Line-Rate (64-QAM) Trouble Isolation (Sheet 6 of 7)



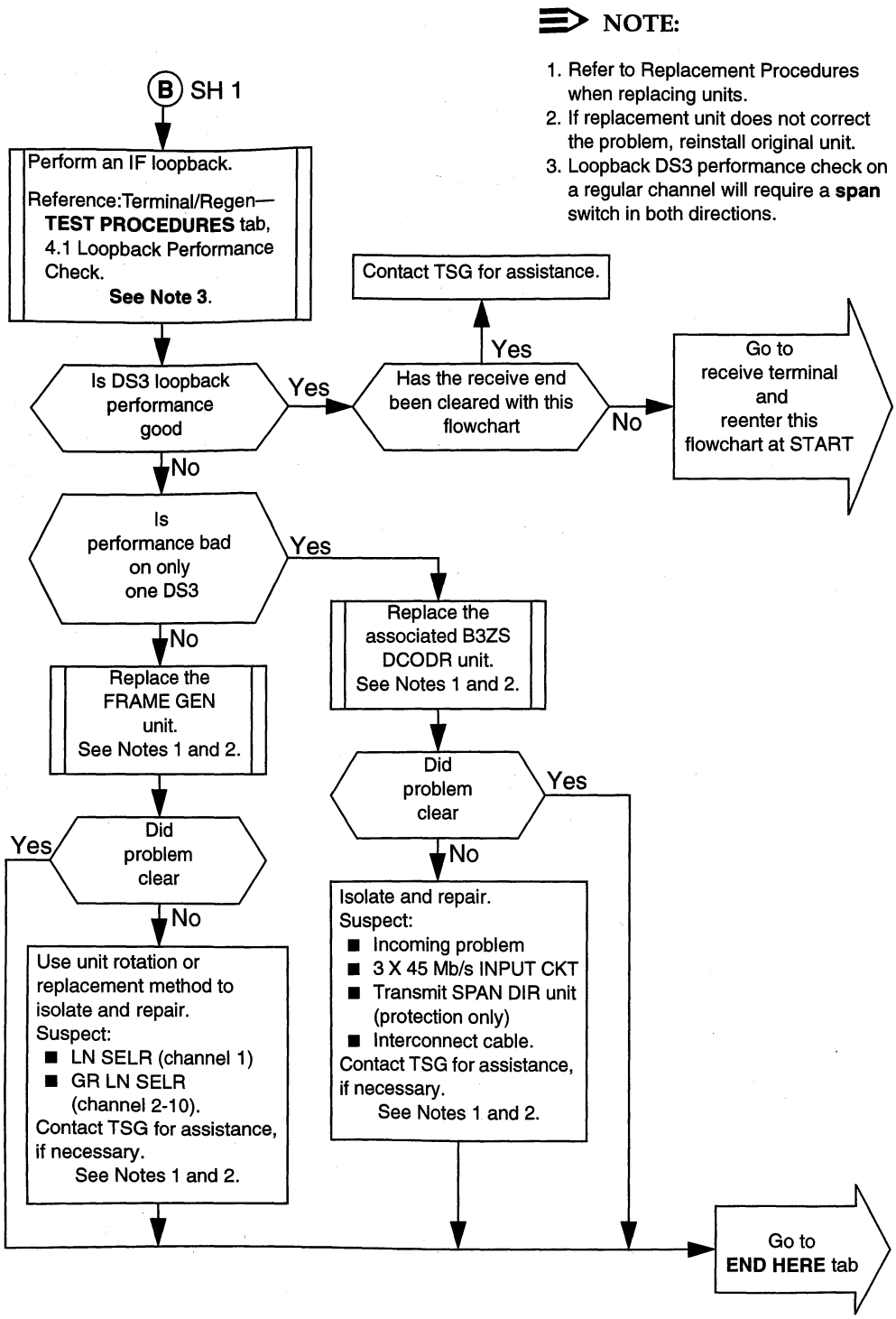
Flowchart 2. Line-Rate (64-QAM) Trouble Isolation (Sheet 7 of 7)



Flowchart 3. DS3 Trouble Isolation (Sheet 1 of 3)



Flowchart 3. DS3 Trouble Isolation (Sheet 2 of 3)



Flowchart 3. DS3 Trouble Isolation (Sheet 3 of 3)

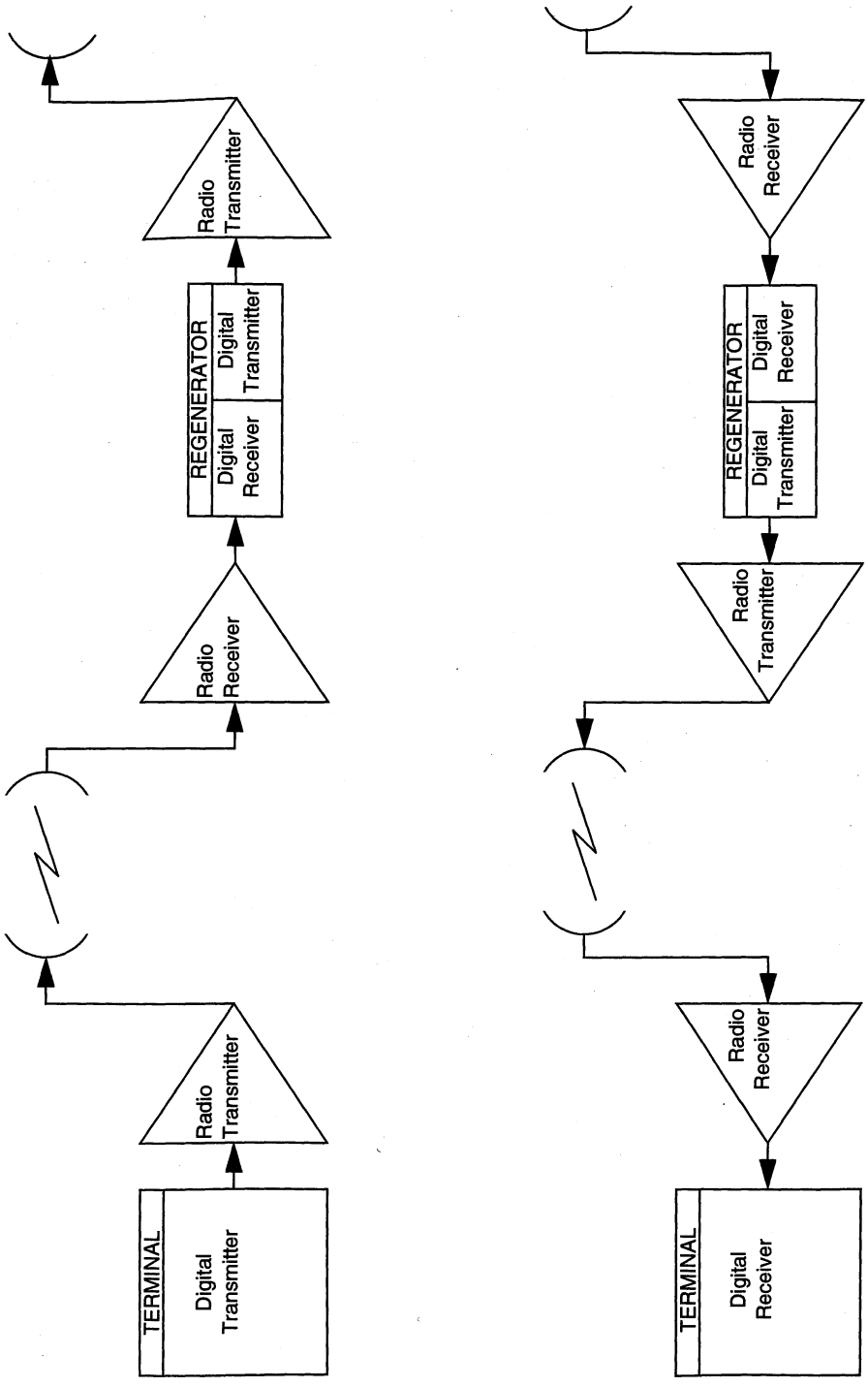


Figure 1. One Two-Way Digital Radio Channel

CAUTION:
To prevent service interruptions, ensure that service is protected before removing cables.

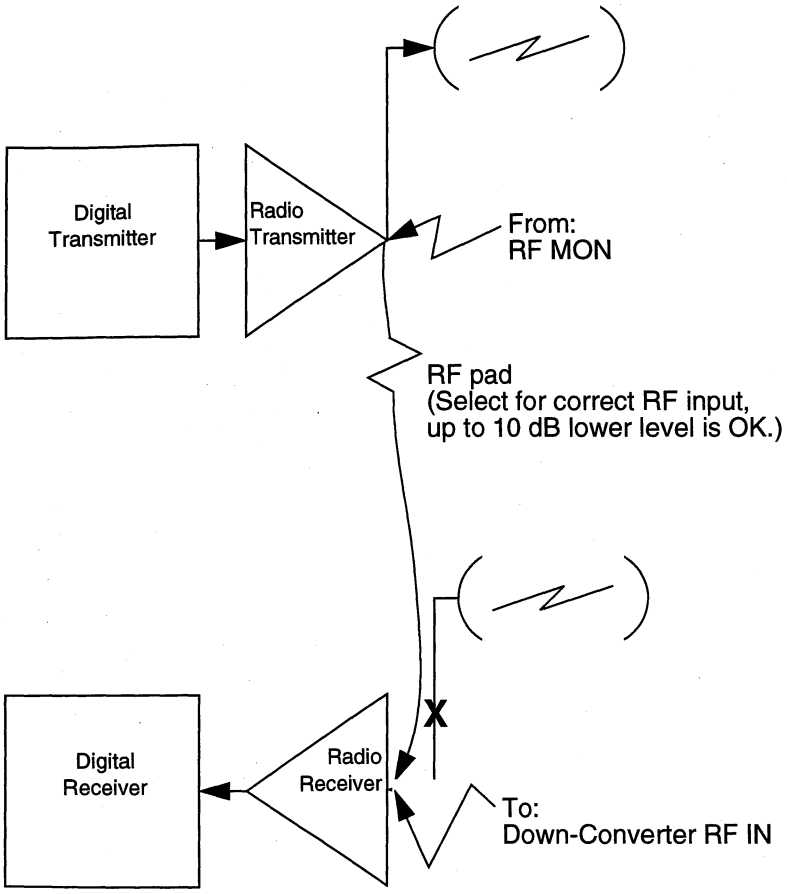


Figure 2. RF Loopback

CAUTION:
To prevent service interruptions, ensure that service is protected before removing cables.

NOTE:
Both radio receivers are equipped for the same RF center frequency.

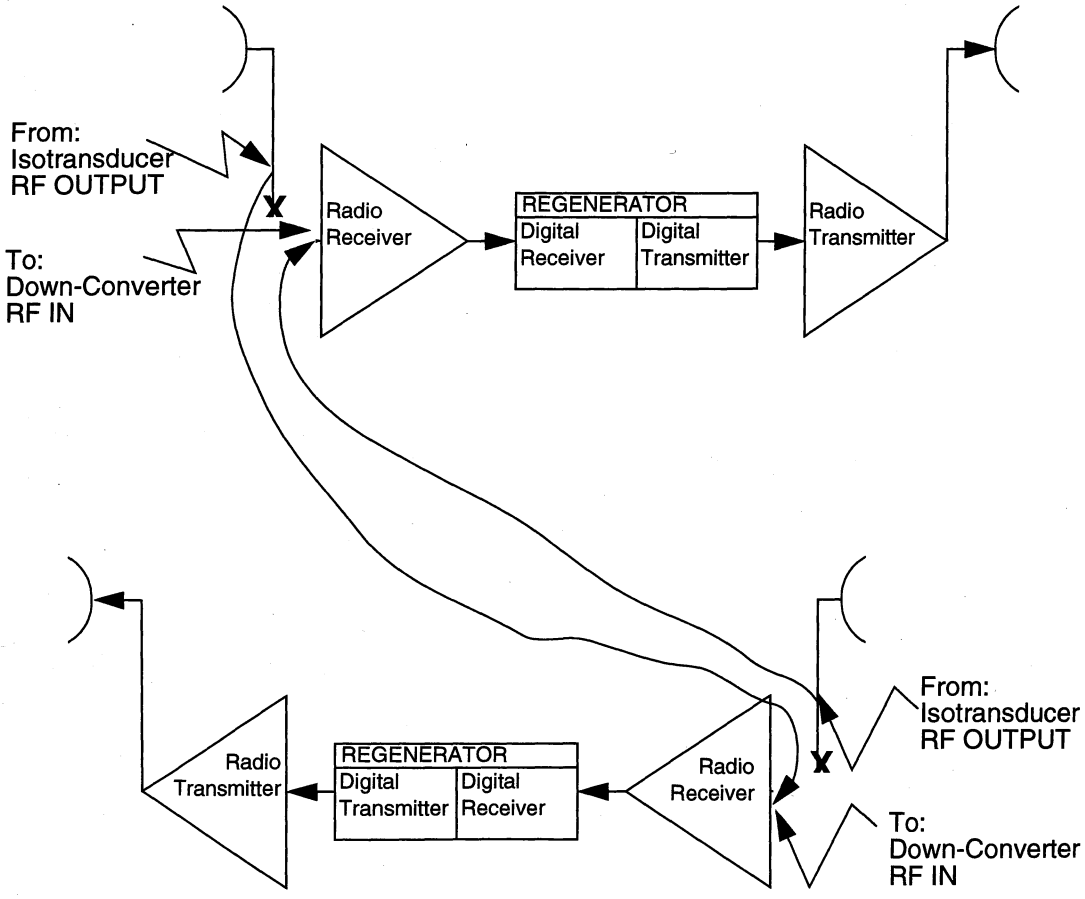


Figure 3. RF Injection—Different Radio Receiver

CAUTION:
To prevent service interruptions, ensure that service is protected before removing cables.

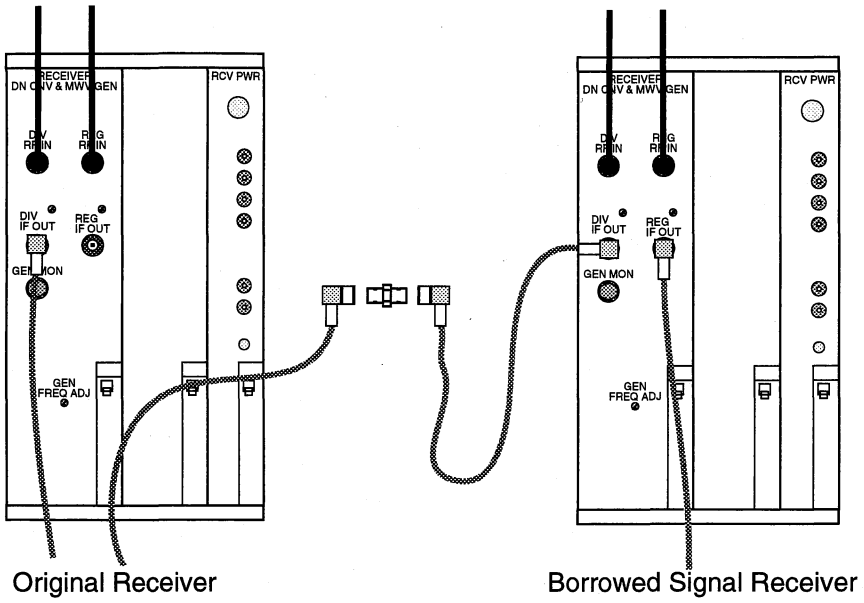
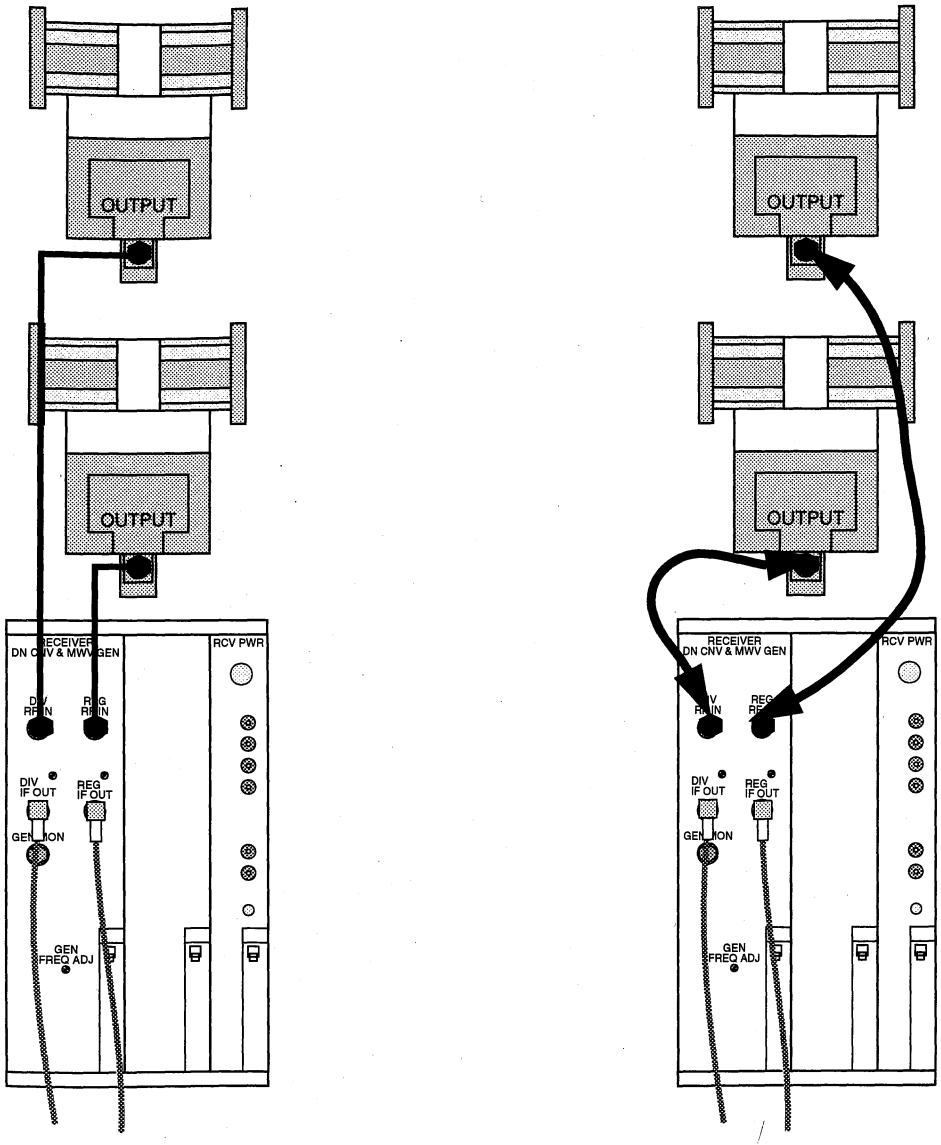


Figure 4. IF Injection—Down-Converter IF Output

CAUTION:
To prevent service interruptions, ensure that service is protected before removing cables.

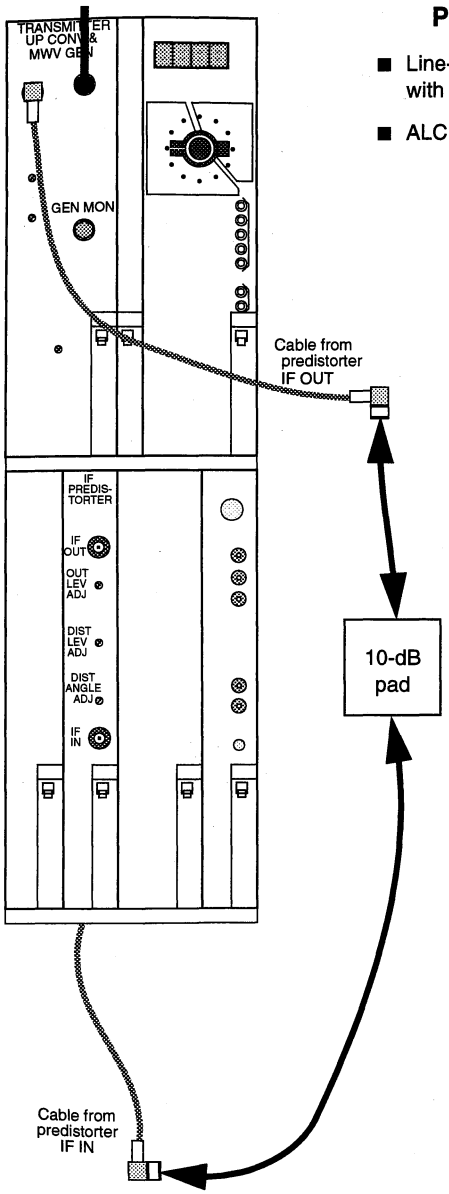


Receiver—Normal

Receiver—Rolled Inputs

Figure 5. RF Injection—Same Radio Receiver

CAUTION:
To prevent service interruptions, ensure that service is protected before removing cables.



Prerequisites:

- Line-Rate (64-QAM) performance problem with dribbling ES-A's and ES-B's.
- ALC ON/OFF switch set to OFF.

Figure 6. IF Predistorter Bypass