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DR 6/11-135A and 135EC 1×N Frequency Diversity Operation and Maintenance Radio Receiver Trouble Isolation

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1 Introduction

Use this practice to isolate an equipment-alarm trouble to a specific unit in a radio receiver or to clear any of the following problems discovered while doing receiver test procedures.

- RF level
- IF level
- Combiner or Differential Absolute Delay Equalization (DADE).

Because this practice applies to both types of radio receivers (Antenna Diversity and non-Diversity), all references pertain to both unless marked specifically for one or the other.

Figures 1 and 2 are Function and Level Diagrams which illustrate the functional relationships of the units within the receivers and expected signal levels at measurement points. A comparison of measured levels with the nominal levels on these diagrams may be useful during trouble isolation.

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 Equipment-Alarm Trouble Isolation

Trouble clearing for any radio receiver alarm begins with Flowchart 1, Equipment-Alarm Trouble Isolation. All radio bay receiver alarms, except a DC power unit failure alarm, are indicated on the ALARM AND METER unit, located in the radio transmitter shelf. A DC power unit failure will activate one or more of these receiver alarms.

Five receiver alarms are indicated on the ALARM AND METER unit:

a. RCVR—GEN OVEN (microwave generator oven)

b. RCVR—IF AMP (IF AGC amplifier)

c. RCVR—ADPT EQL (adaptive slope equalizer)

d. RCVR—COMB (IF combiner)

e. RCVR—RF PREAMP (RF preamplifier)

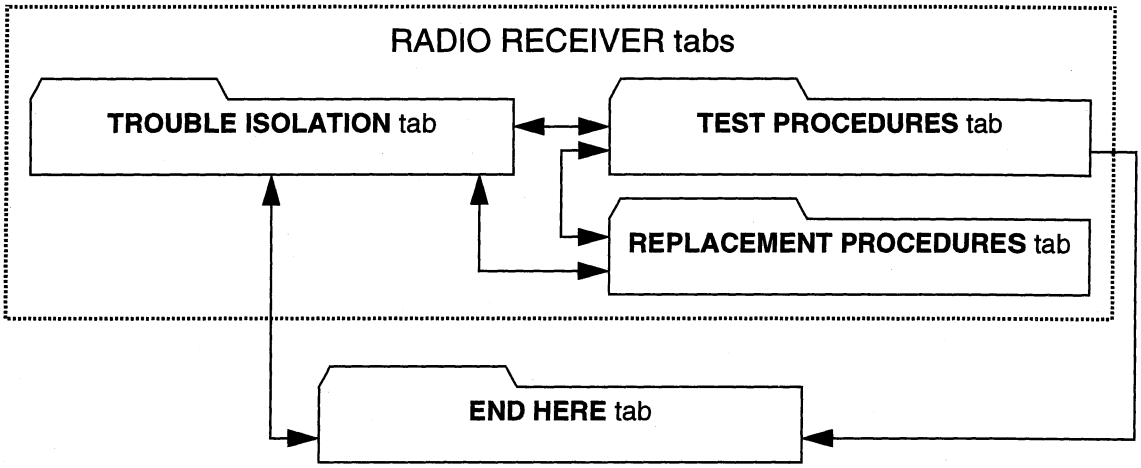
Unless there is trouble in the alarm-reporting system, one of the first four alarm indicators should be lighted whenever a radio receiver fail alarm has been sent to the alarm center. The RF PREAMP alarm is processed separately to the alarm center as a preamplifier fail alarm. A preamplifier alarm indicator is wired to only one receiver although the amplifier is common to several.

The ALARM AND METER unit also has a meter position that indicates the operational status of the receiver. An automatic gain control (AGC) circuit in the receiver IF amplifier maintains a constant radio receiver IF output power level. The RCVR—AGC V position monitors this voltage. The AGC circuit has a dynamic range of approximately 80 dB. A lower than normal AGC voltage (less negative) indicates that the input power level of the amplifier is higher than normal. A higher than normal AGC voltage (more negative) indicates that the input power level is lower than normal. The AGC voltage is useful when monitoring fading activity in a hop. If a 4400-series receiver down-converter is installed, its AGC voltage is available at a set of AGC V test jacks on the faceplate (but not on the ALARM AND METER unit) and may be used in the same manner as the IF amplifier AGC voltage.

The trouble isolation portion of this section consists of flowcharts that guide you through a structured process of isolating and clearing a trouble and performing any required tests.

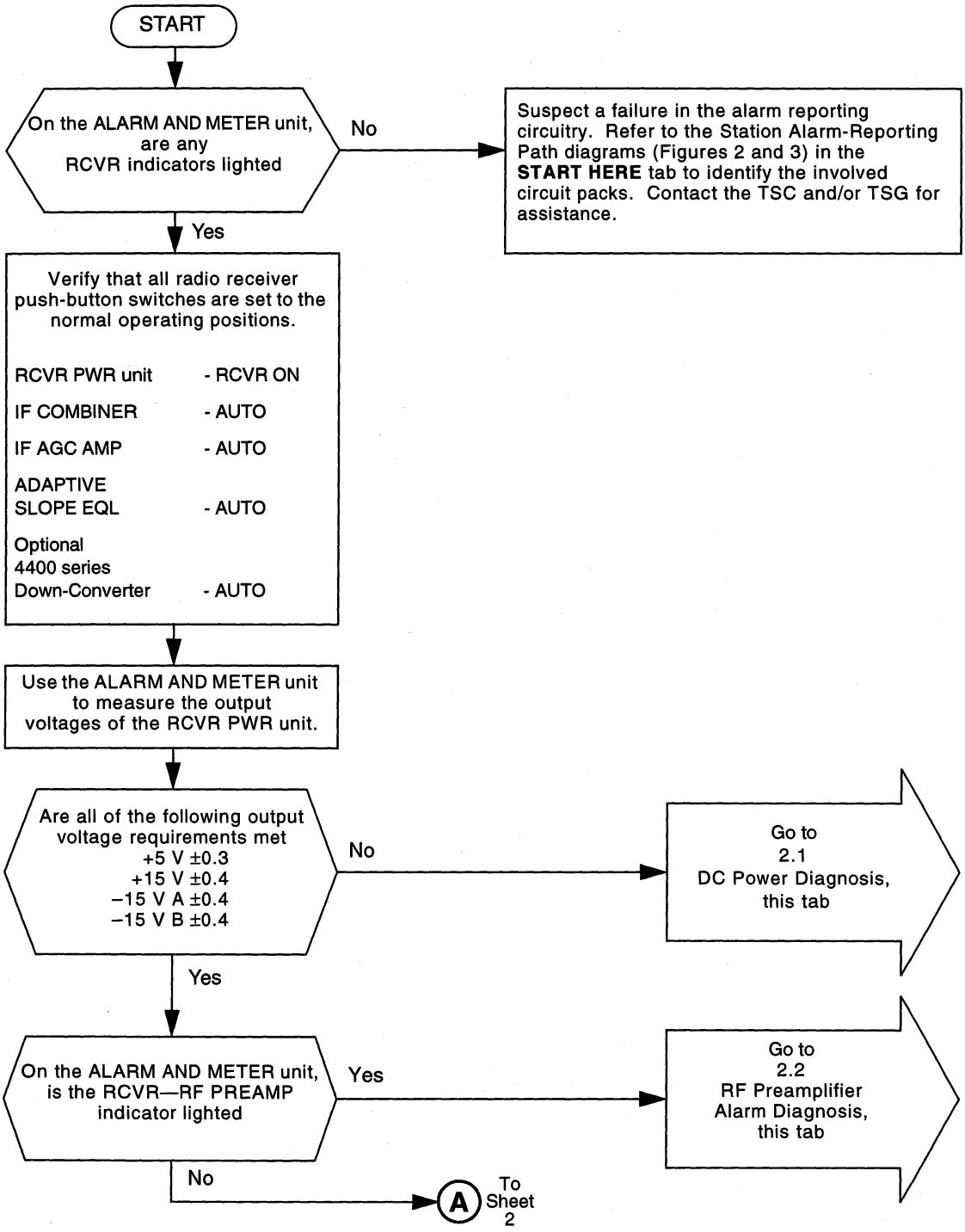
Flowchart 1 is the starting point for isolating and clearing equipment-alarm conditions in a radio receiver. Alarm-clearing flowcharts are not specifically designed to clear multiple failures or take into account faulty spare units; if there is a multiple failure, the COM ALARM will still be lighted after you have cleared the first trouble. A flowchart will direct you to the beginning of the trouble isolation process to isolate and clear the second trouble.

As you go through the trouble isolation process, you will be interacting with the test procedures and the replacement procedures as shown below:

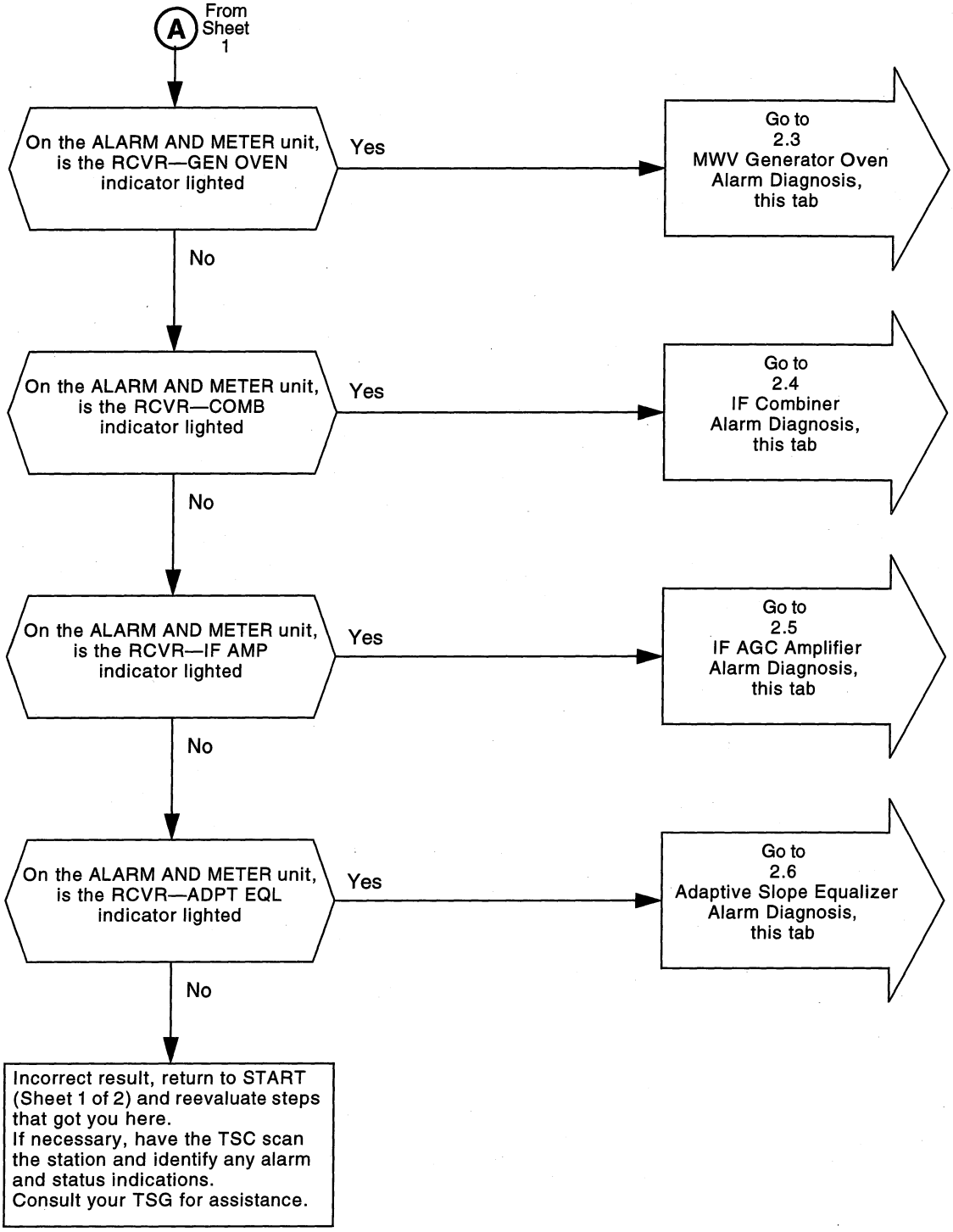


Because of critical operating levels in a radio receiver, no receiver unit can be replaced without one or more follow-up tests. Therefore, when you are directed by the trouble isolation flowcharts to replace a unit, go to Flowchart 3, Unit Replacement and Alignment, in the **TEST PROCEDURES** tab. Follow that flowchart to its completion to perform any required tests.

Prerequisite: Channel controller has a radio receiver alarm indicator lighted.



Flowchart 1. Equipment-Alarm Trouble Isolation (Sheet 1 of 2)



Flowchart 1. Equipment-Alarm Trouble Isolation (Sheet 2 of 2)

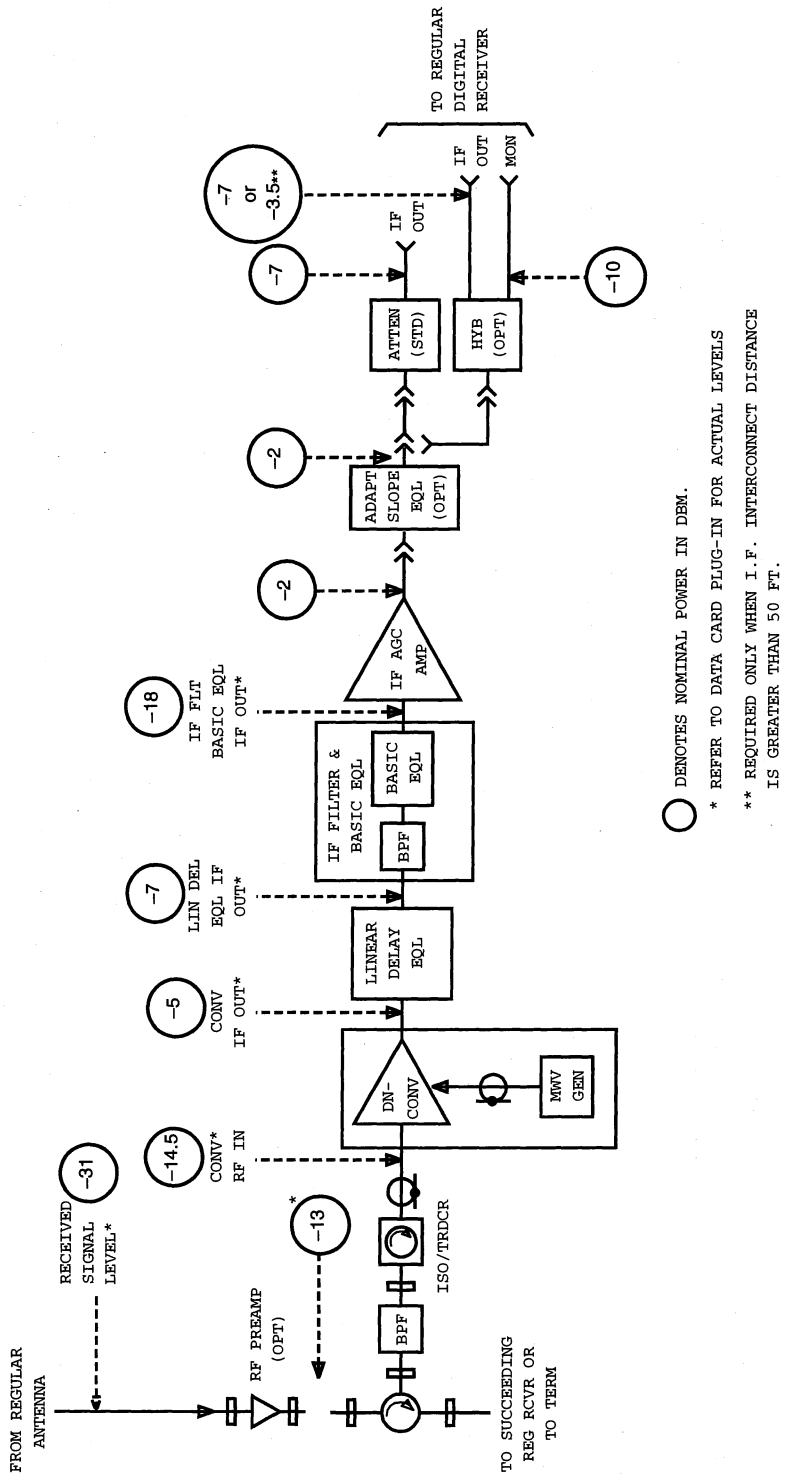


Figure 1. Function and Level Diagram (Non-DIV)

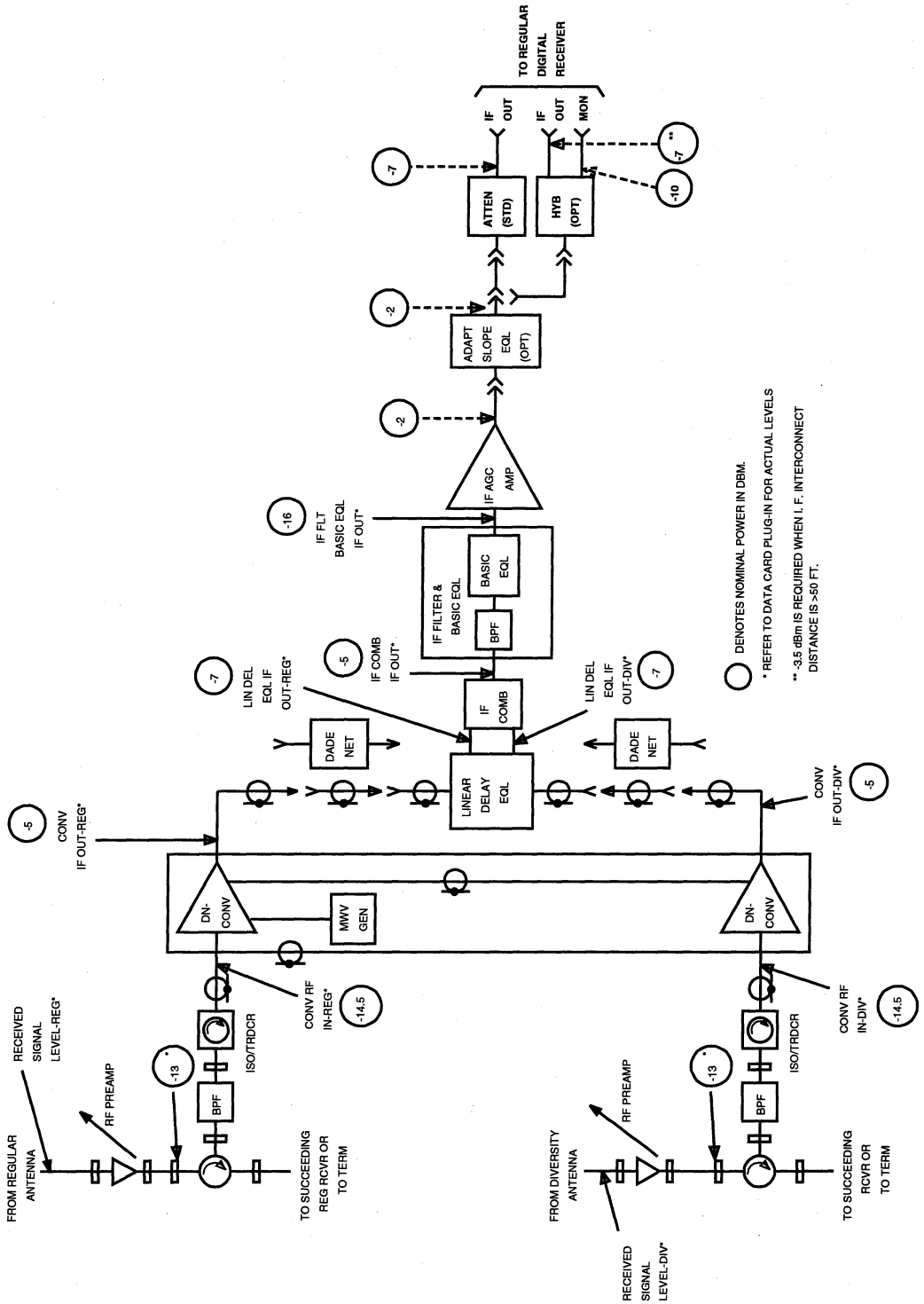


Figure 2. Function and Level Diagram (ANT DIV)

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2.1 DC Power Diagnosis

Each vertical transmitter/receiver (T/R) pair in a radio bay (frame) is separately powered and fused by the –24 V/–48 V station power plant. In addition, each T/R pair is connected either by a single power-feed or by a double power-feed from the power plant. A single power-feed provides one input voltage supply to the top of the radio frame, and it provides power to both the transmitter and receiver. A double power-feed provides two separate input supplies; one for the transmitter and one for the receiver.

Figure 3 is a block diagram of the power distributions for a radio receiver.

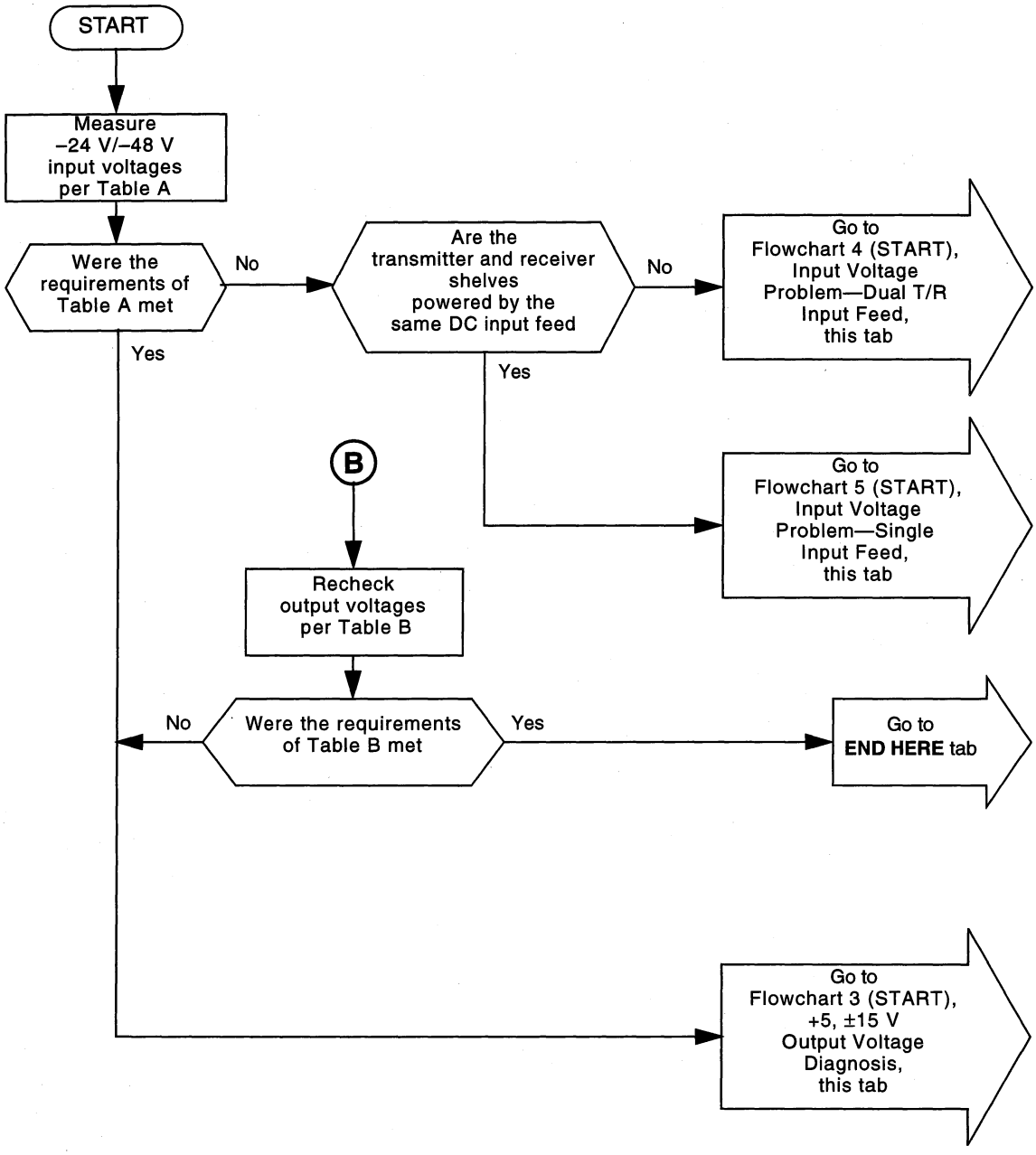
Basic low-voltage power for the receiver is furnished by a 1474-type power unit (RCVR PWR) mounted in the receiver shelf.

Here are some trouble-isolation considerations:

a. Low-output voltage usually indicates a failed power unit. However, a faulty equipment unit may draw excessive power and pull the output voltage down or shut the power unit down.

b. A voltage transient may cause a power unit to shut down. That power unit can be reset by releasing, then re-latching, the latch catch.

Prerequisite: A power unit did not meet one or more output voltage requirements.



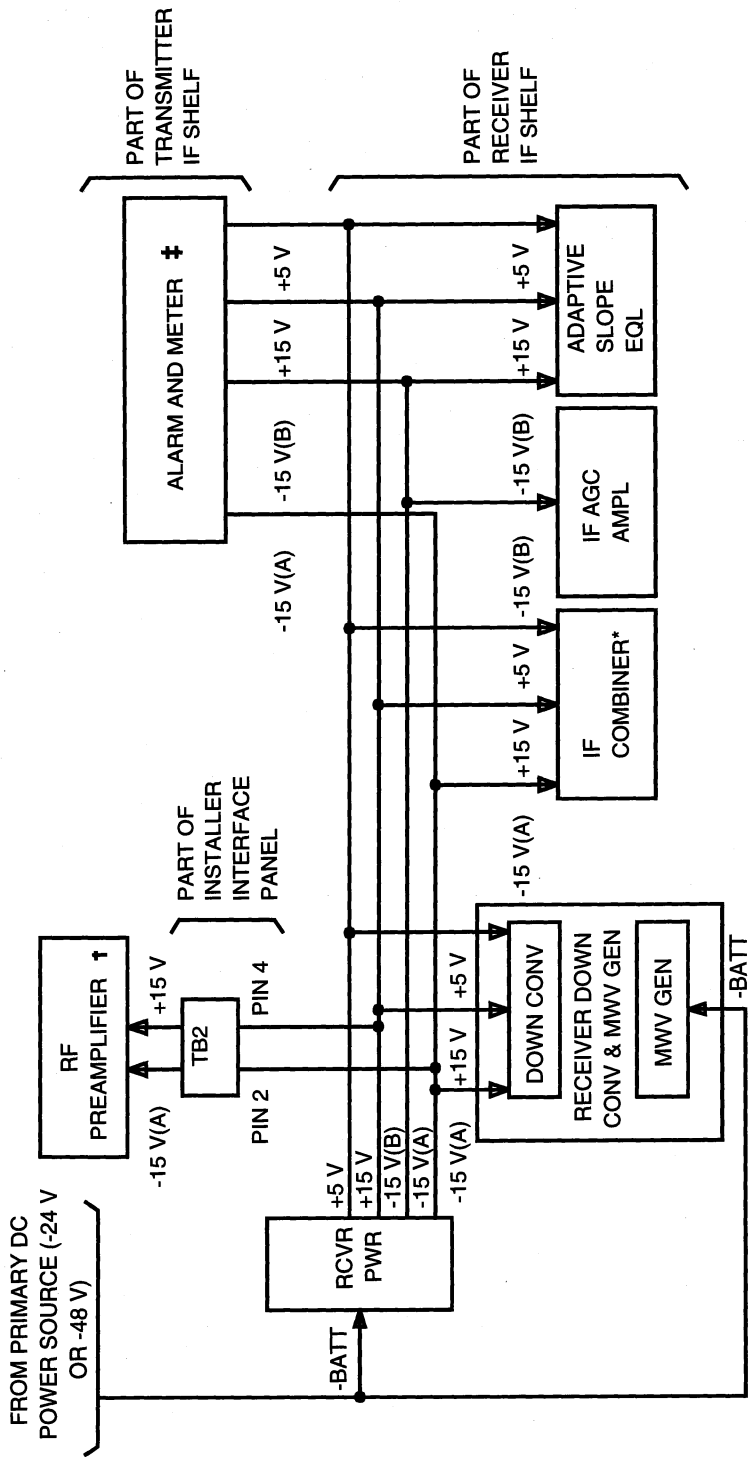
Flowchart 2. DC Power Diagnosis

Table A. DC Input Voltage Requirements

Battery Input Supply	Multimeter Test Connections			Requirement	Units Supplied
	Unit	Positive Test Lead	Common Test Lead		
–24 V	RCVR PWR	–24V jack	GRD jack	–20.0 V to –28.5 V	RCVR PWR MWV Generator
–48 V	RCVR PWR	–48V jack	GRD jack	–42.0 V to –60.0 V	

Table B. DC Output Voltage Requirements

ALARM AND METER Unit Switch Position	Multimeter Test Connections		Requirement	Units Supplied
	Positive Test Lead	Common Test Lead		
RCVR +5V	+5V jack	GRD jack	+4.7 V to +5.3 V	Alarm and Meter Unit Down-Converter IF Combiner Adaptive Slope Equalizer
RCVR –15VA	–15VA jack	GRD jack	–14.6 V to –15.4 V	Alarm and Meter Unit Down-Converter RF Preamplifier IF Combiner
RCVR –15VB	–15VB jack	GRD jack	–14.6 V to –15.4 V	Alarm and Meter Unit IF AGC Amplifier Adaptive Slope Equalizer
RCVR +15V	+15V jack	GRD jack	+14.6 V to +15.4 V	Alarm and Meter Unit Down-Converter RF Preamplifier IF Combiner Adaptive Slope Equalizer



* Equipped in space diversity receivers only

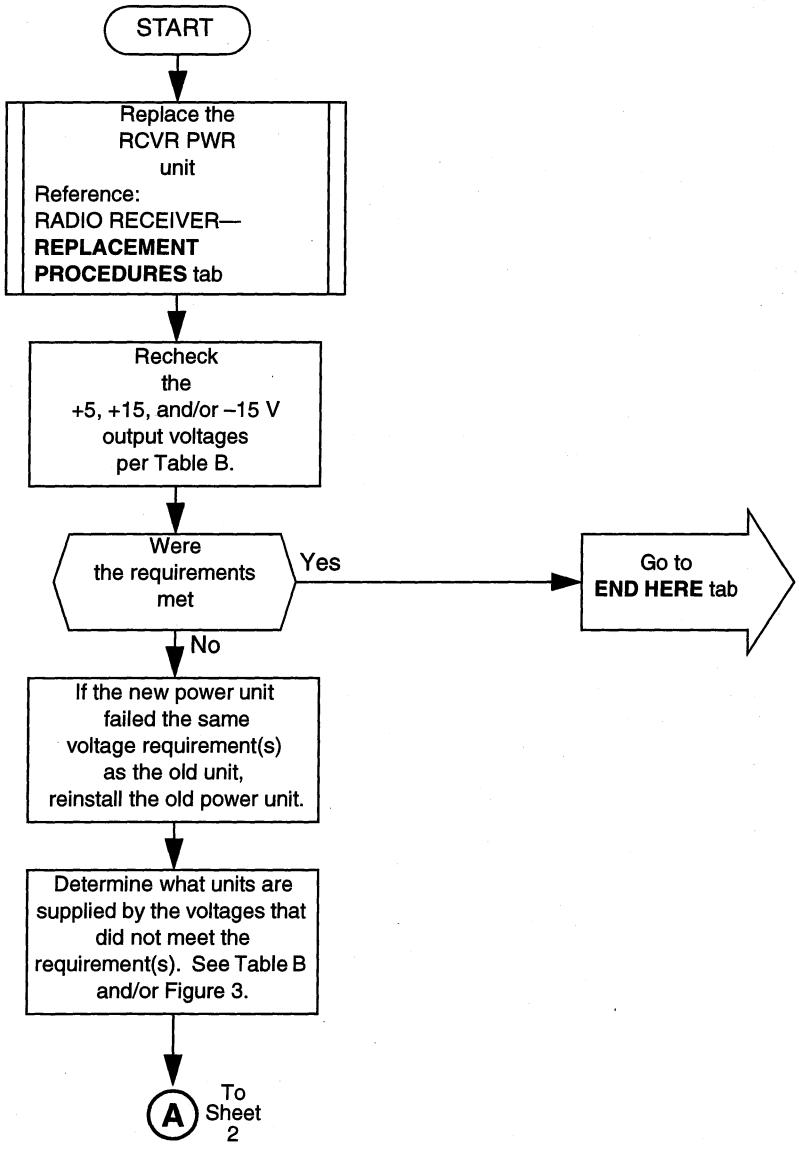
† The RF preamplifier (if equipped) is normally powered by the first and second receiver equipped in a radio frame

‡ ALARM AND METER unit powered from transmitter shelf. Receiver voltage leads provided for monitoring purposes only.

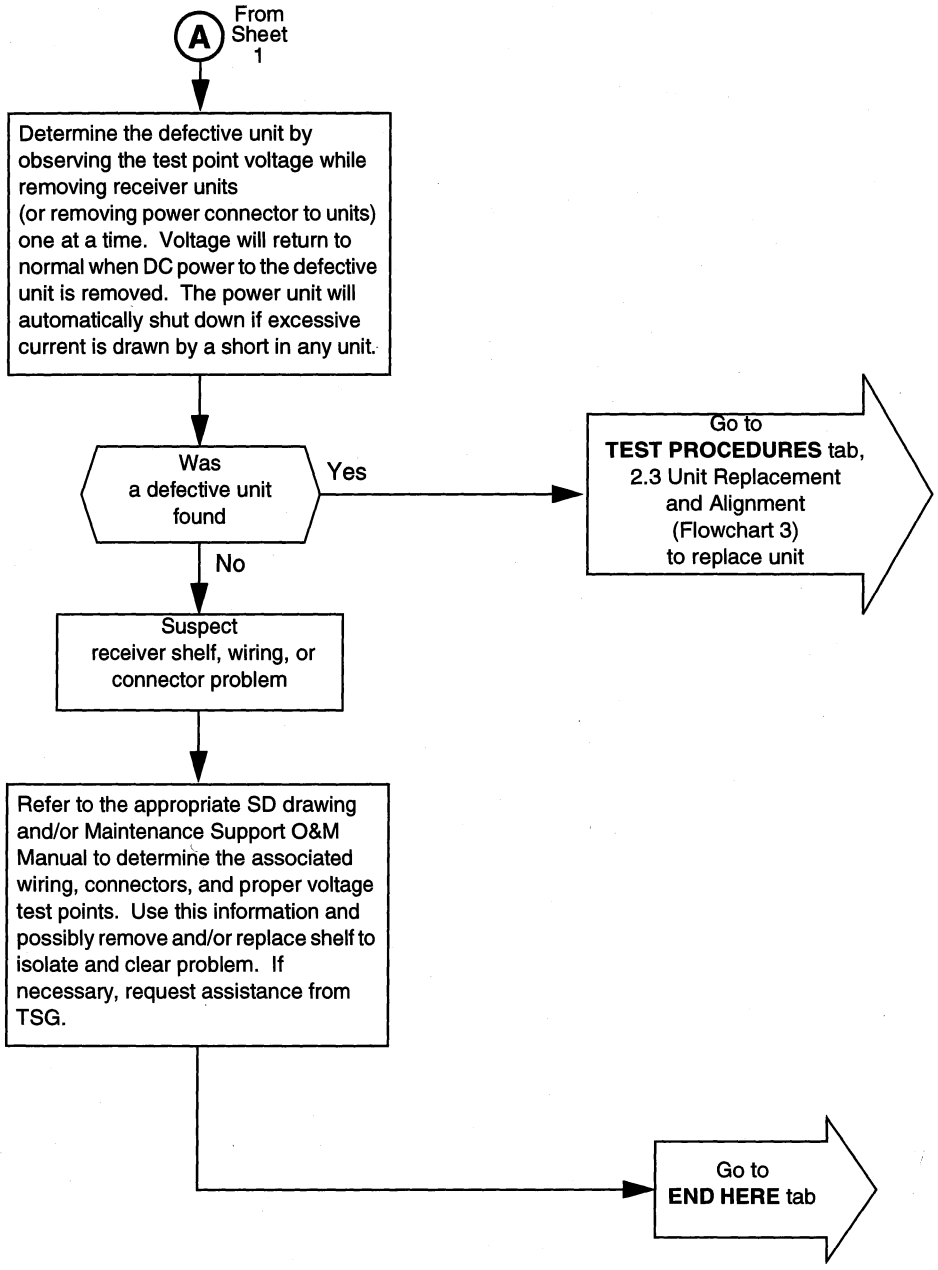
Figure 3. Power Distribution Diagram

CAUTION:
This is an Out-of-Service procedure. Verify that service is protected.

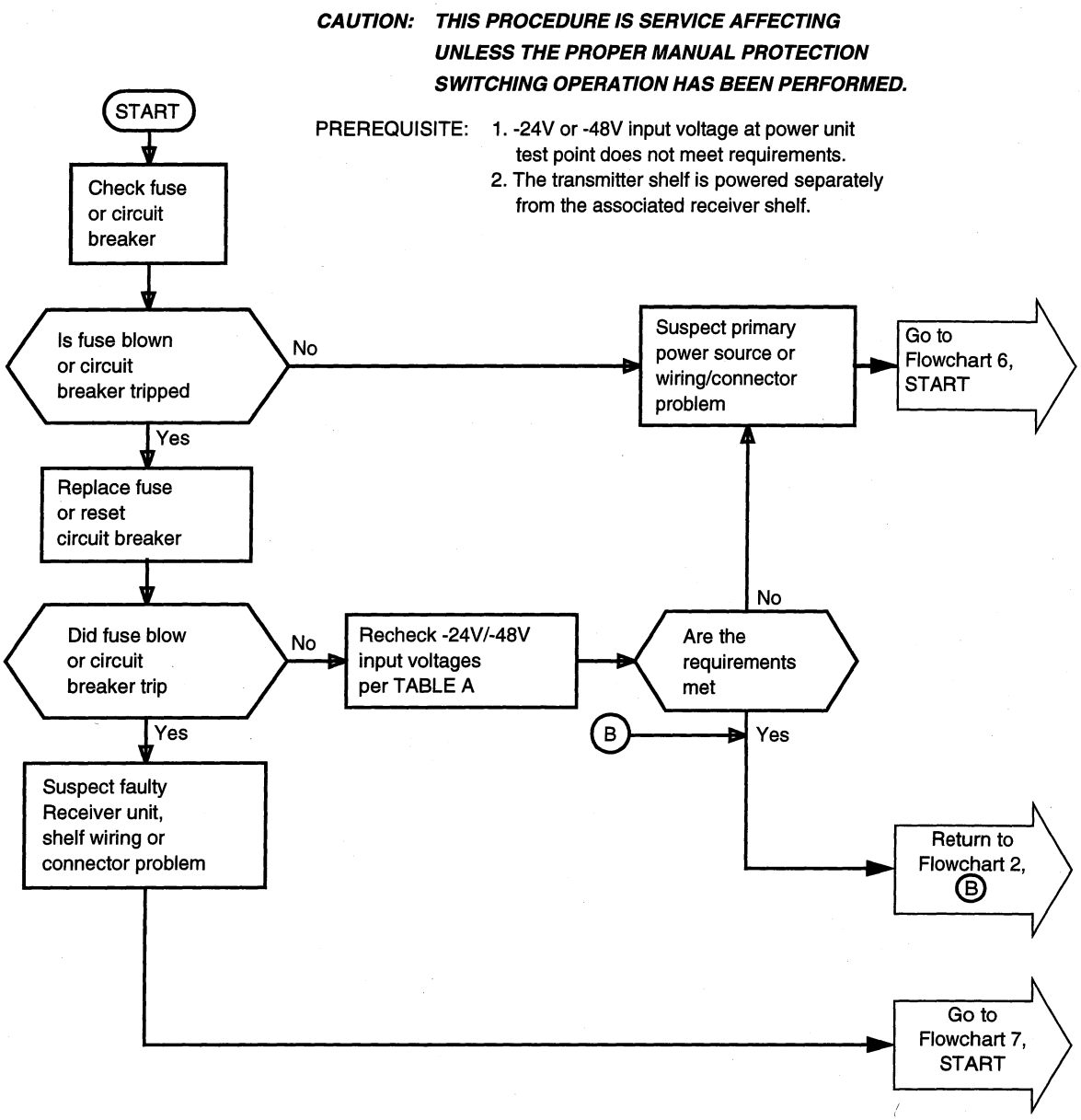
Prerequisites: 1. The +5, +15, and/or –15 V output voltages of the RCVR PWR unit did not meet requirement.
2. The –24 V or –48 V input voltage is within limits.



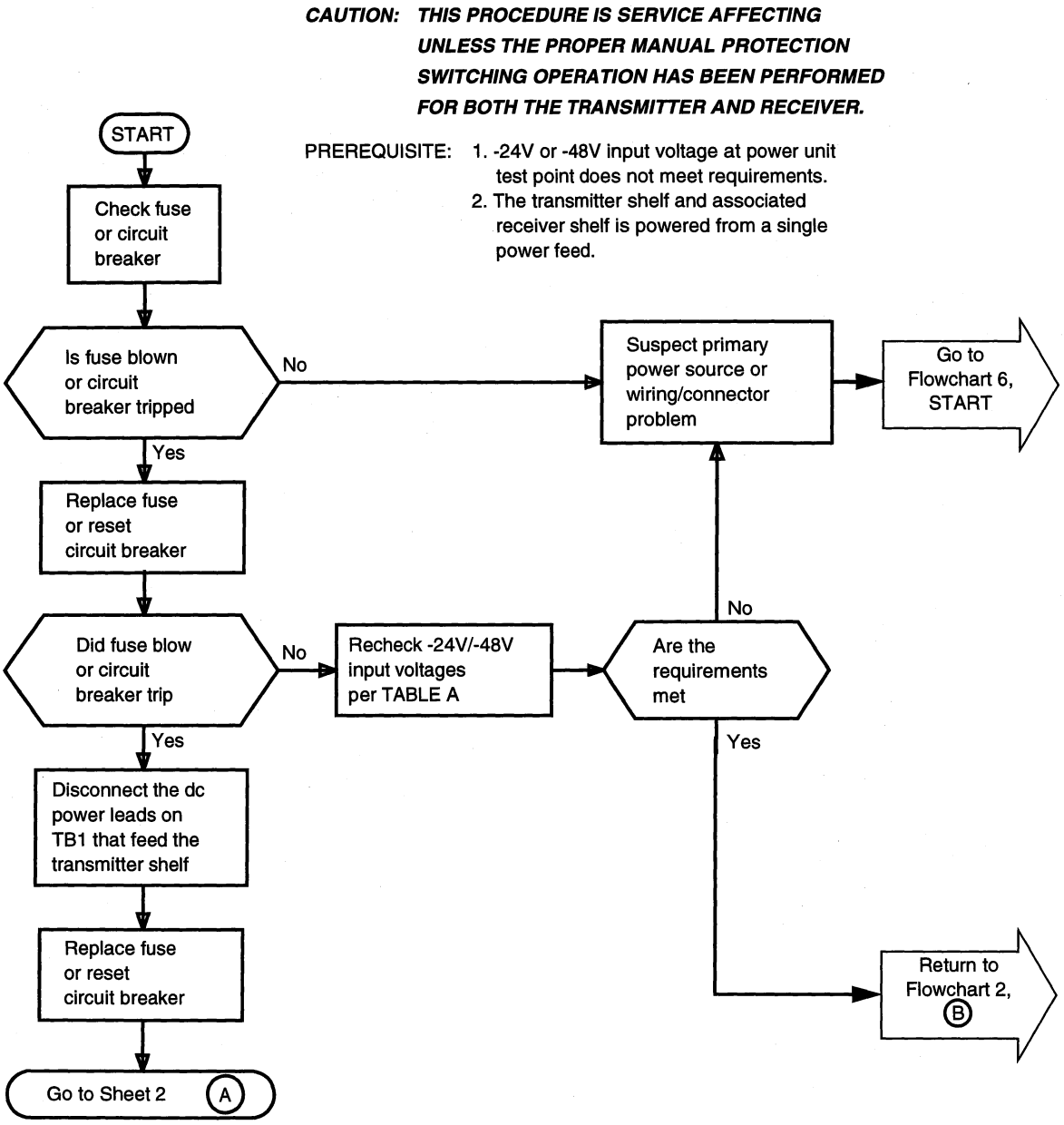
Flowchart 3. +5 /±15 V Output Voltage Diagnosis (Sheet 1 of 2)



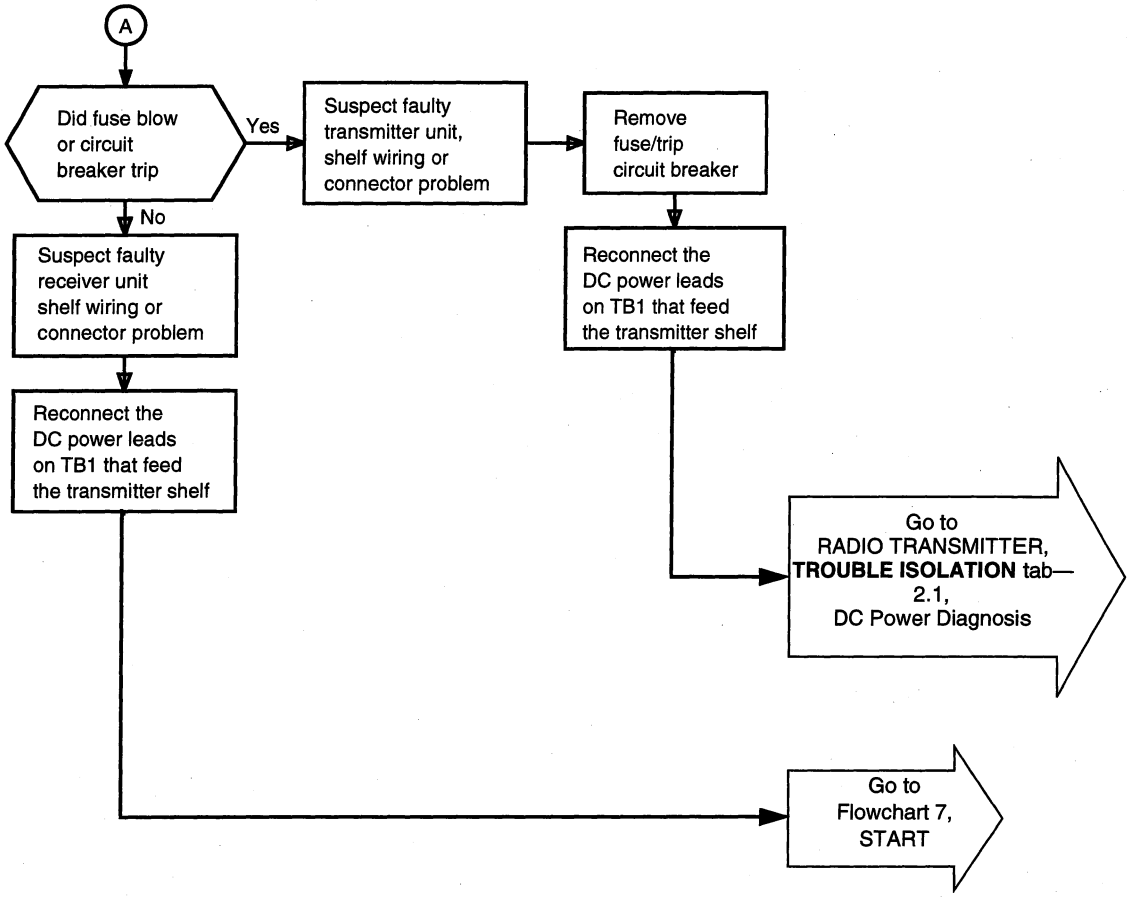
Flowchart 3. +5 /±15 V Output Voltage Diagnosis (Sheet 2 of 2)



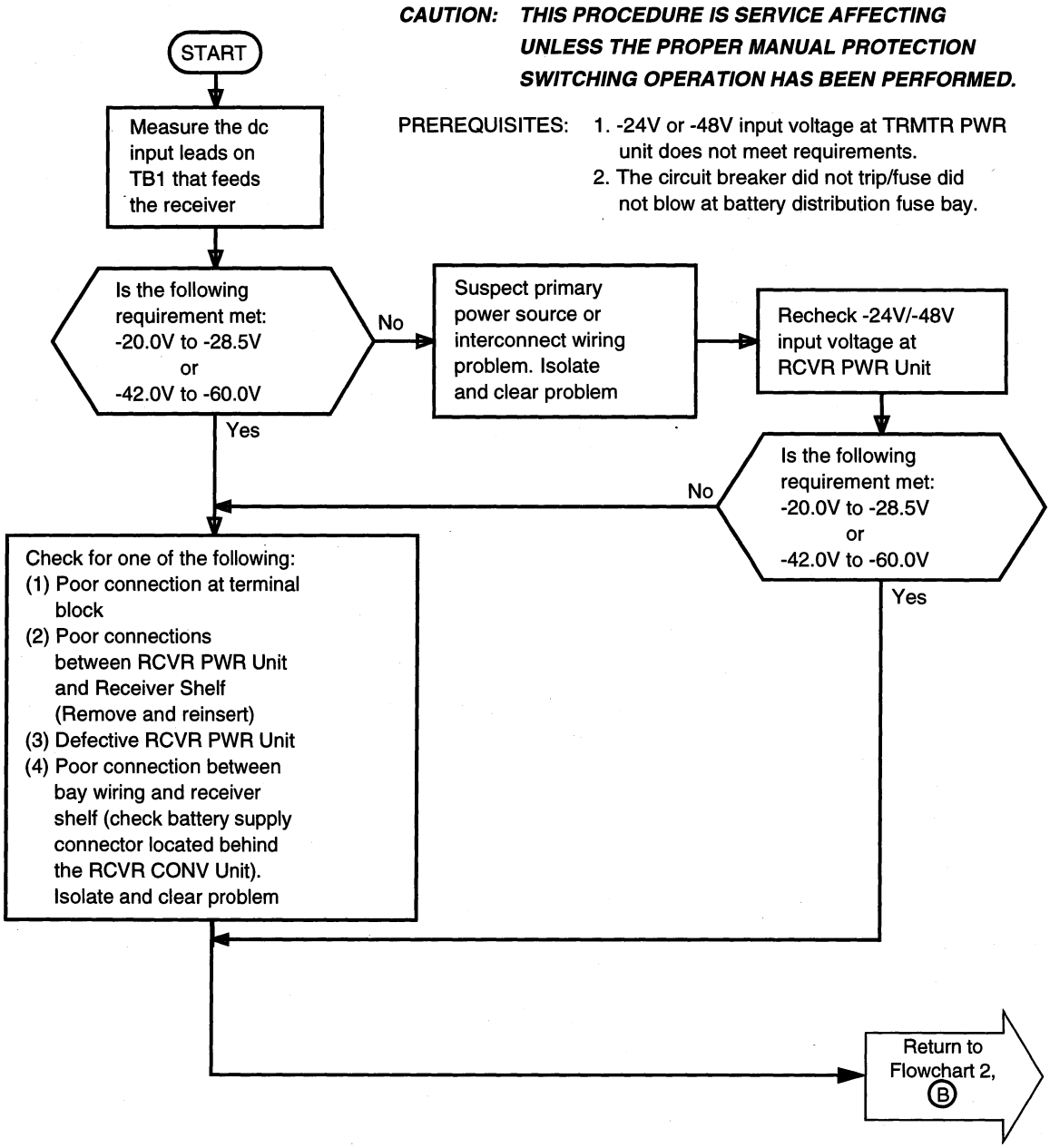
Flowchart 4. Input Voltage Diagnosis—Dual T/R Input Feed



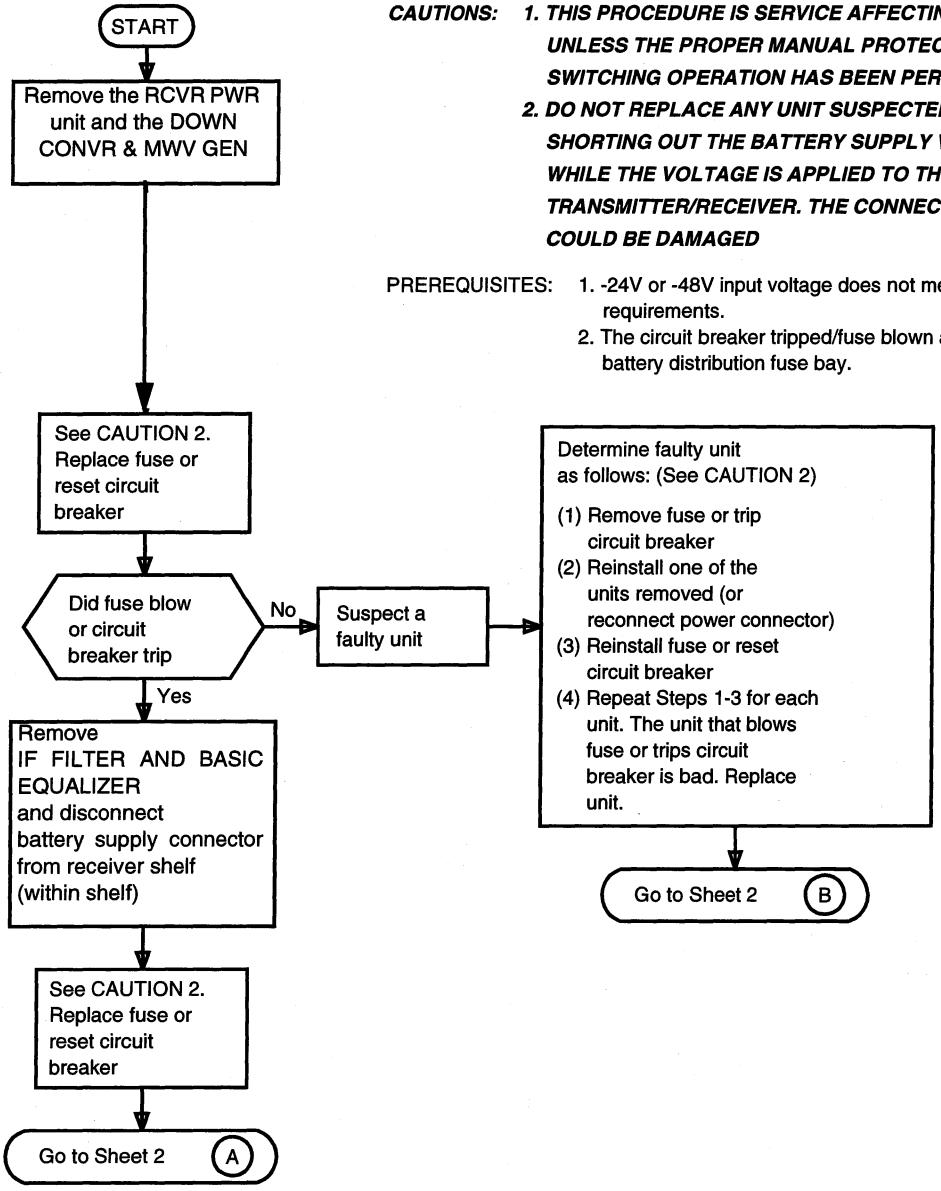
Flowchart 5. Input Voltage Diagnosis—Single T/R Input Feed (Sheet 1 of 2)



Flowchart 5. Input Voltage Diagnosis—Single T/R Input Feed (Sheet 2 of 2)



Flowchart 6. Input Voltage Diagnosis—Circuit Breaker Did Not Trip or Fuse Did Not Blow

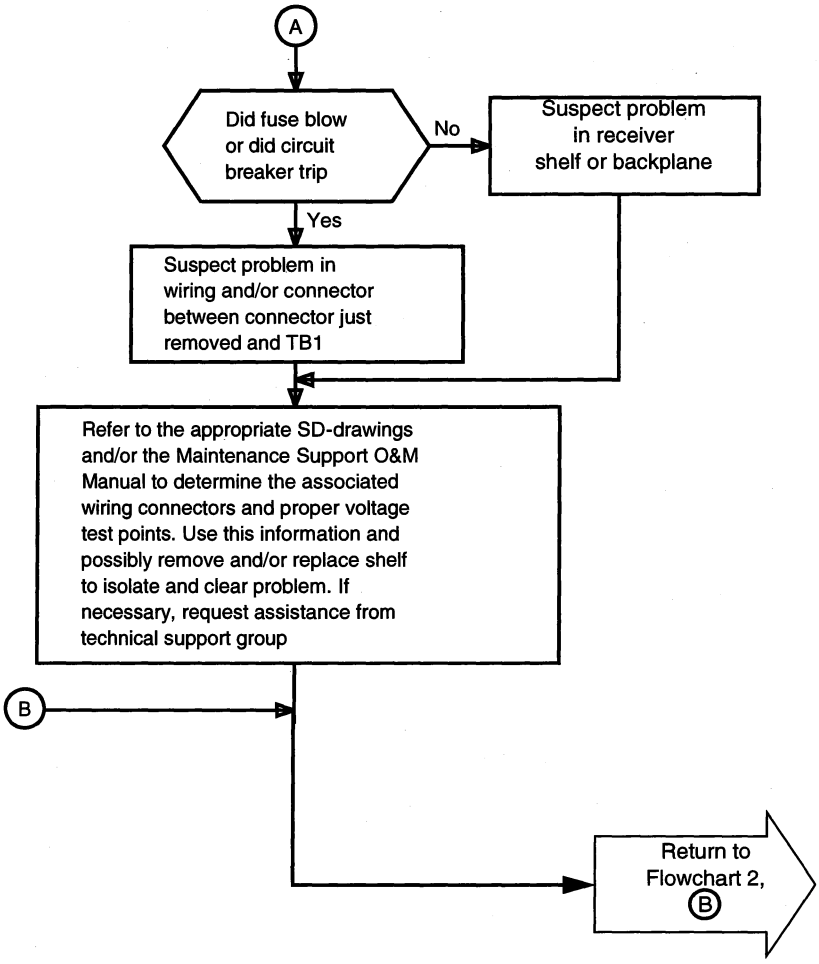


CAUTIONS: ***1. THIS PROCEDURE IS SERVICE AFFECTING UNLESS THE PROPER MANUAL PROTECTION SWITCHING OPERATION HAS BEEN PERFORMED.***

2. DO NOT REPLACE ANY UNIT SUSPECTED OF SHORTING OUT THE BATTERY SUPPLY VOLTAGE WHILE THE VOLTAGE IS APPLIED TO THE TRANSMITTER/RECEIVER. THE CONNECTOR COULD BE DAMAGED

PREREQUISITES:
1. -24V or -48V input voltage does not meet requirements.
2. The circuit breaker tripped/fuse blown at battery distribution fuse bay.

Flowchart 7. Input Voltage Diagnosis—Circuit Breaker Is Tripped or Fuse Is Blown (Sheet 1 of 2)



Flowchart 7. Input Voltage Diagnosis—Circuit Breaker Is Tripped or Fuse Is Blown (Sheet 2 of 2)

2.2 RF Preamplifier Alarm Diagnosis

Flowchart 8 is used to clear an RCVR—RF PRE AMP indicator on the ALARM AND METER unit. The RF preamplifier is equipped with a green light-emitting diode (LED) that is ON during normal operation. The RF PRE AMP alarm monitors the field-effect transistor (FET) bias current. When bias current is insufficient or excessive, a relay in the RF preamplifier closes a contact that activates the RF PRE AMP alarm in the ALARM AND METER unit. When the alarm is activated, the green LED on the RF preamplifier is off. Pulling the DC power plug of the RF preamplifier results in a silent RF preamplifier failure. When an RF preamplifier has failed, you will be referred to the Unit Replacement and Alignment flowchart in the RADIO RECEIVER—**TEST PROCEDURES** tab to replace the failed amplifier and perform the required test procedures.

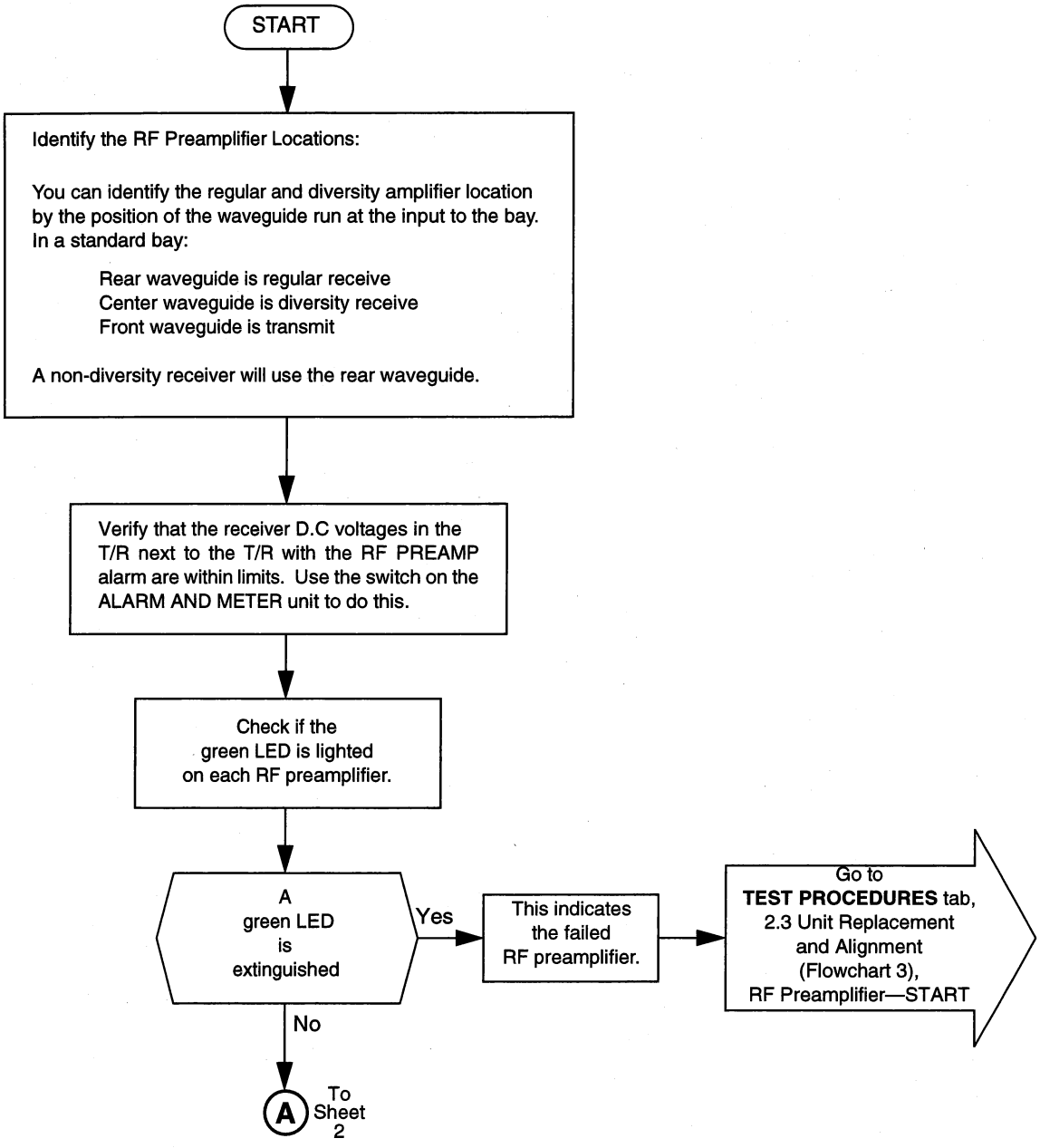
The DC power arrangement for the RF preamplifier depends on the receiver configuration. Figure 4 shows the standard DC power and alarm arrangement when the bay is equipped with two or more transmitters/receivers (T/Rs).

Under severe fading conditions, a reduced signal level from the output of a failed RF preamplifier will be compensated for by the receiver automatic gain control (AGC) circuits. Therefore, even with a partial preamplifier failure, the proper IF output signal level for each radio receiver will be maintained, and no alarms other than the RF PRE AMP alarm will be generated. However, the AGC voltage(s) for the receiver(s) being fed may be abnormal.

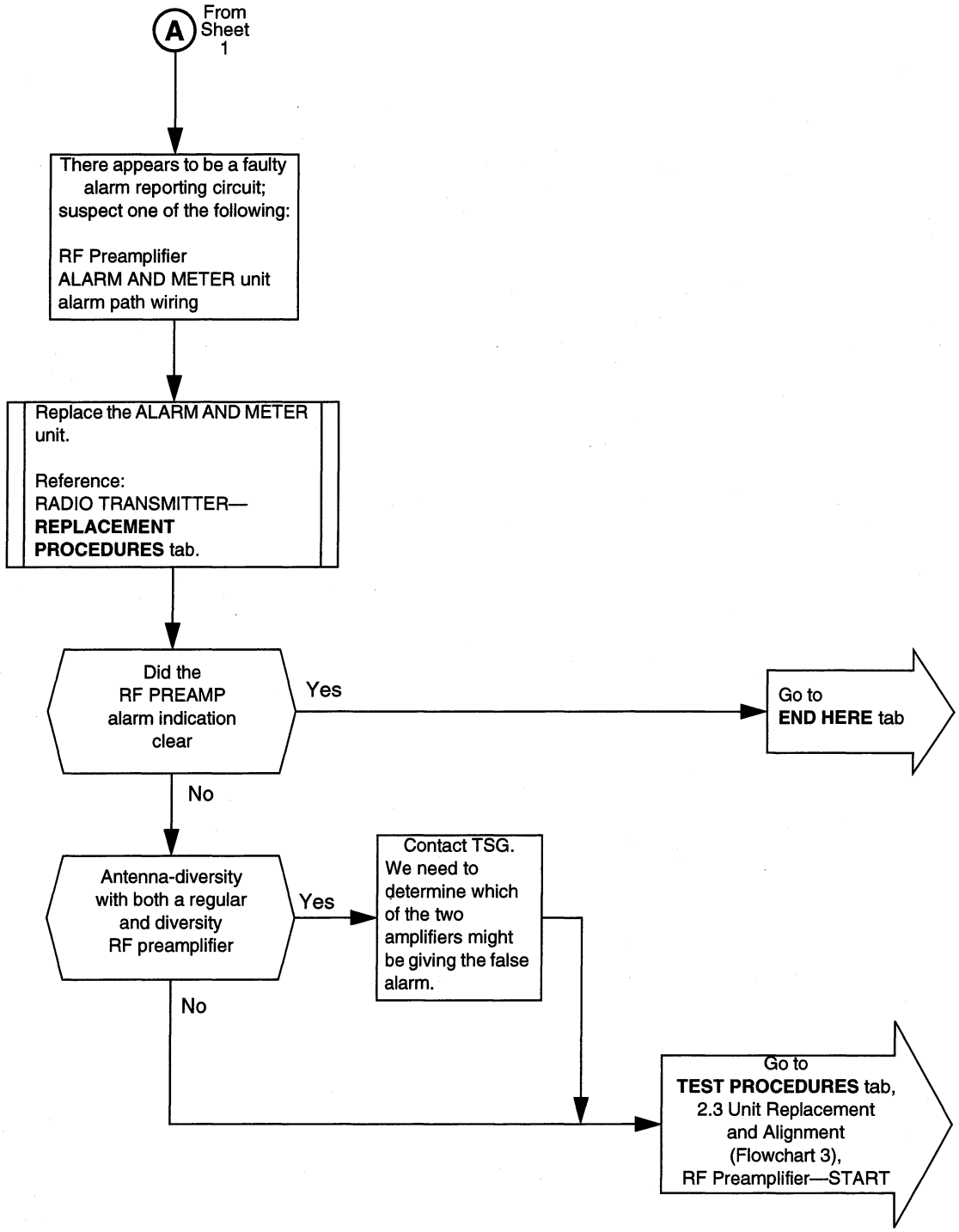
The nominal gain of the RF preamplifier is stamped on the unit. Since the RF preamplifier provides gain for all receivers connected to the same waveguide run, a decrease in signal level equally affects all receivers associated with that particular waveguide run. This decrease in signal level, if large enough, may cause an increase in AGC voltage that can be measured and compared with the nominal AGC voltage recorded on the RADIO DATA CARD. The AGC voltage can be measured by setting the selector switch on the associated ALARM AND METER unit to the RCVR—AGC V position or at the AGC V test point on the IF AGC amplifier for the associated receiver(s). If a 4400-series receiver down-converter is installed, RF signal level changes can be detected by measuring the AGC voltage at the jacks on the down-converter faceplate.

Rarely, an RF preamplifier can fail and not turn off the green LED or not activate the RF PRE AMP alarm. This trouble may be identified by observing if the AGC voltages associated with the receivers on the affected waveguide run have increased. This trouble can also be identified by measuring the down-converter RF input signal level for the affected receiver(s) and comparing the results with the value recorded on the RADIO DATA CARD.

Prerequisites: 1. RCVR—RF PREAMP alarm indicator lighted on the ALARM AND METER unit.
2. Receiver DC output voltages at the radio bay in alarm are within limits.



Flowchart 8. RF Preamplifier Alarm Diagnosis (Sheet 1 of 2)



Flowchart 8. RF Preamplifier Alarm Diagnosis (Sheet 2 of 2)

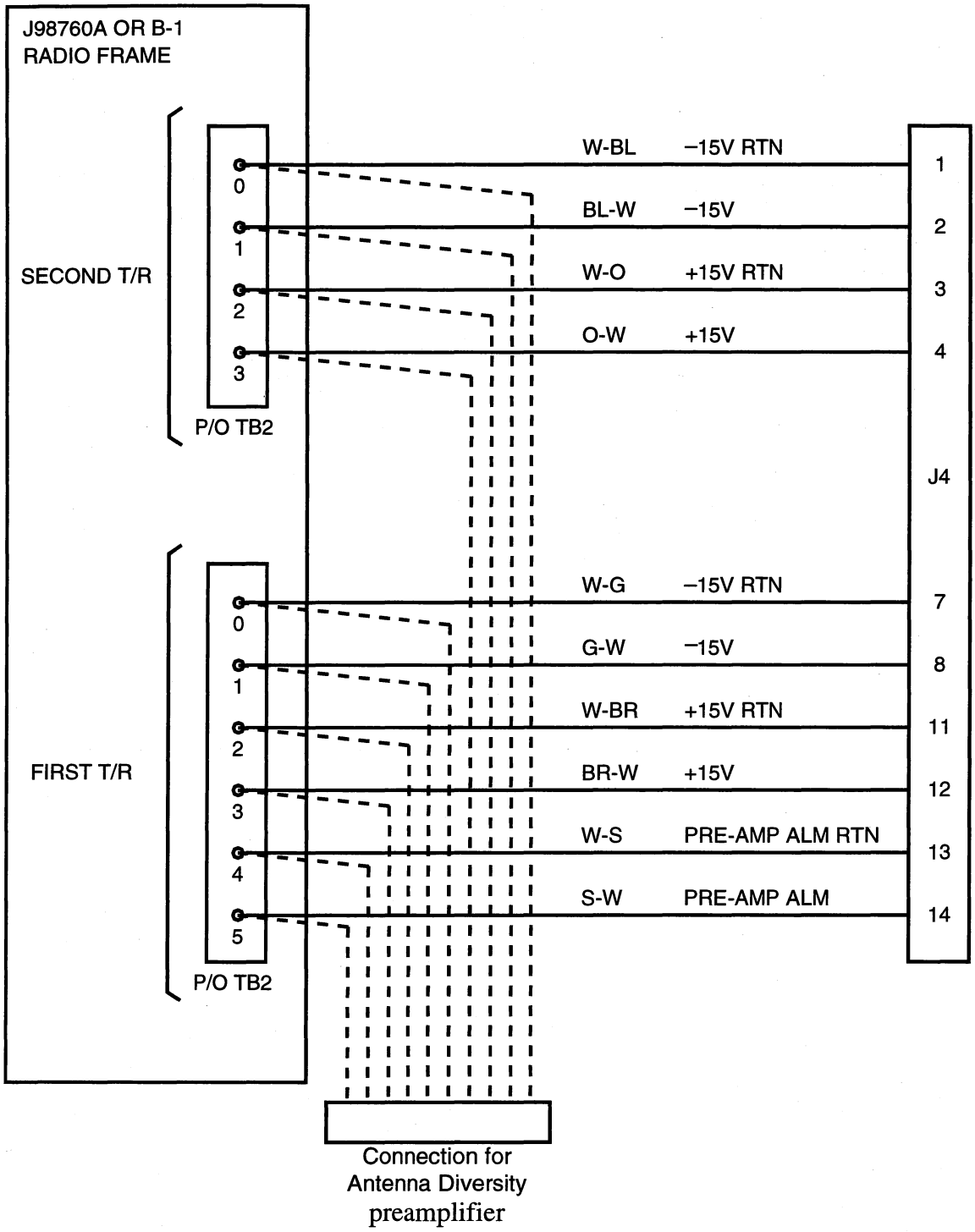


Figure 4. Typical RF Preamplifier Connections

2.3 MWV Generator Oven Alarm Diagnosis

Flowchart 9 will guide you through the process of clearing an RCVR—GEN OVEN alarm. The alarm occurs when the DC current to the oven in the microwave generator is outside specified limits.

Generally, the cause is a faulty MWV Generator, which is mounted inside the RECEIVER DOWN CONV & MWV GEN unit.

To replace the MWV Generator, you will be referred to a Unit Replacement and Alignment Flowchart in the RADIO RECEIVER—**TEST PROCEDURES** tab.

In that flowchart, you will perform these functions in this sequence:

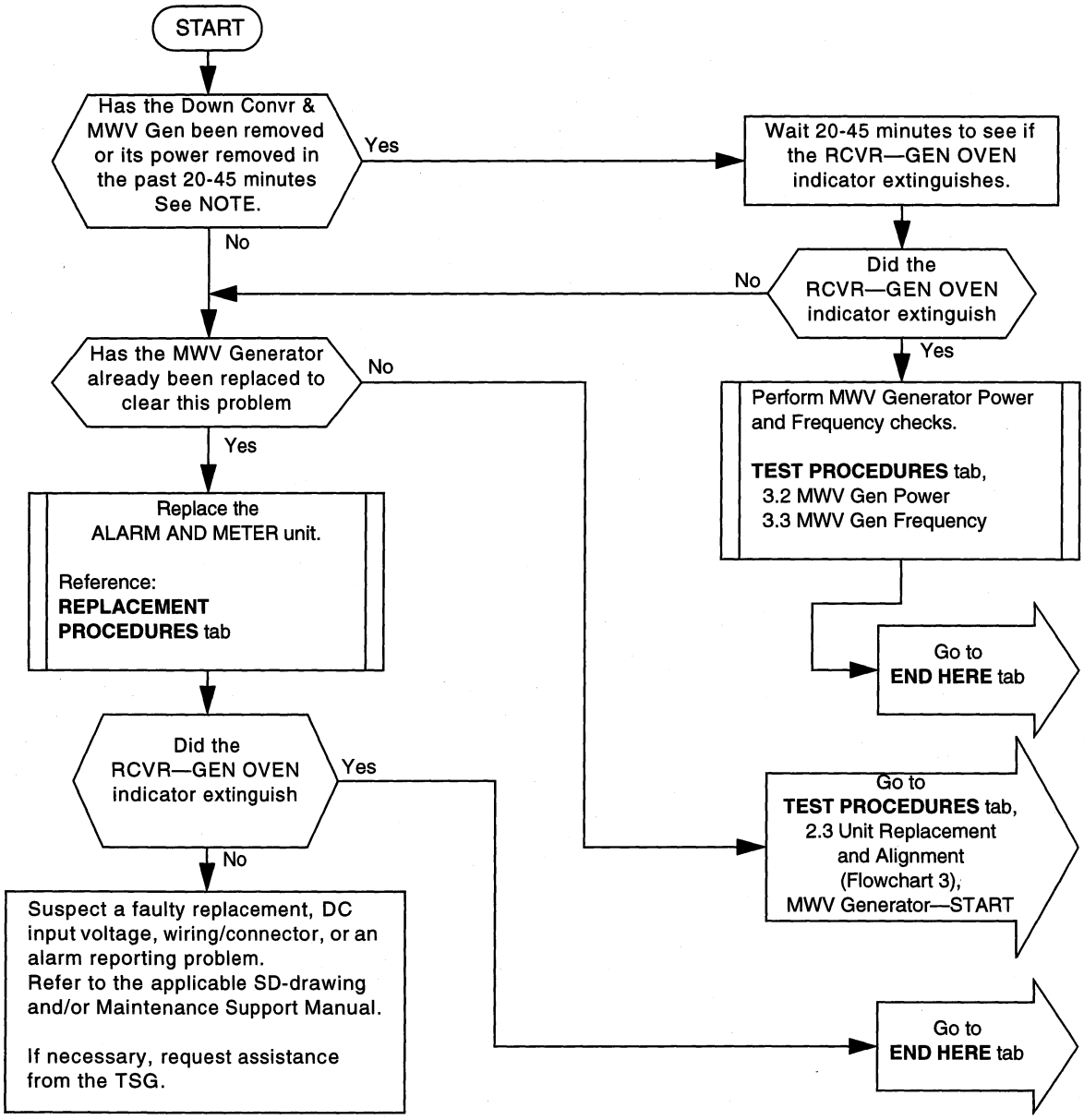
1. Replace the generator.
2. Wait for the GEN OVEN indicator to go off.
3. Perform the MWV Gen Power measurement.
4. Wait for warm-up.
5. Perform the MWV Gen Frequency measurement.

You will then return to Flowchart 9 in this tab.

CAUTION:
This is an Out-of-Service procedure. Verify that service is protected.

Prerequisites: 1. RCVR—GEN OVEN indicator is lighted on the ALARM AND METER unit.
2. AGC AUTO/MAN switch in AUTO position on 4400-series Down Convr & MWV Gen.

NOTE:
The GEN OVEN indicator should clear in about 20 minutes if the replacement is at room temperature and about 45 minutes if it is cold.



Flowchart 9. MWV Generator Oven Alarm Diagnosis

2.4 IF Combiner Alarm Diagnosis

Flowchart 10 is used to clear the RCVR—COMB alarm indicator on the ALARM AND METER unit. This alarm activates under the following conditions:

- Deep fade or signal loss on either the regular, diversity, or both antenna paths for a continuous period of 60 seconds
- Operation of the push-button switch on the combiner faceplate to the MAN position
- An IF Combiner internal failure
- A defective ALARM AND METER unit.

Indicators on the combiner faceplate are as follows:

a. REG ACTIVE: green LED, status condition, the combiner has selected the signal from the regular antenna path.

b. DIV ACTIVE: green LED, status condition, the combiner has selected the signal from the diversity antenna path.

c. REG LPW IN: amber LED, local alarm on the combiner, the RCVR—COMB alarm on the ALARM AND METER unit activates after the LPW IN indicator is on continuously for 60 to 100 seconds, caused by a deep fade or signal loss on the regular antenna path.

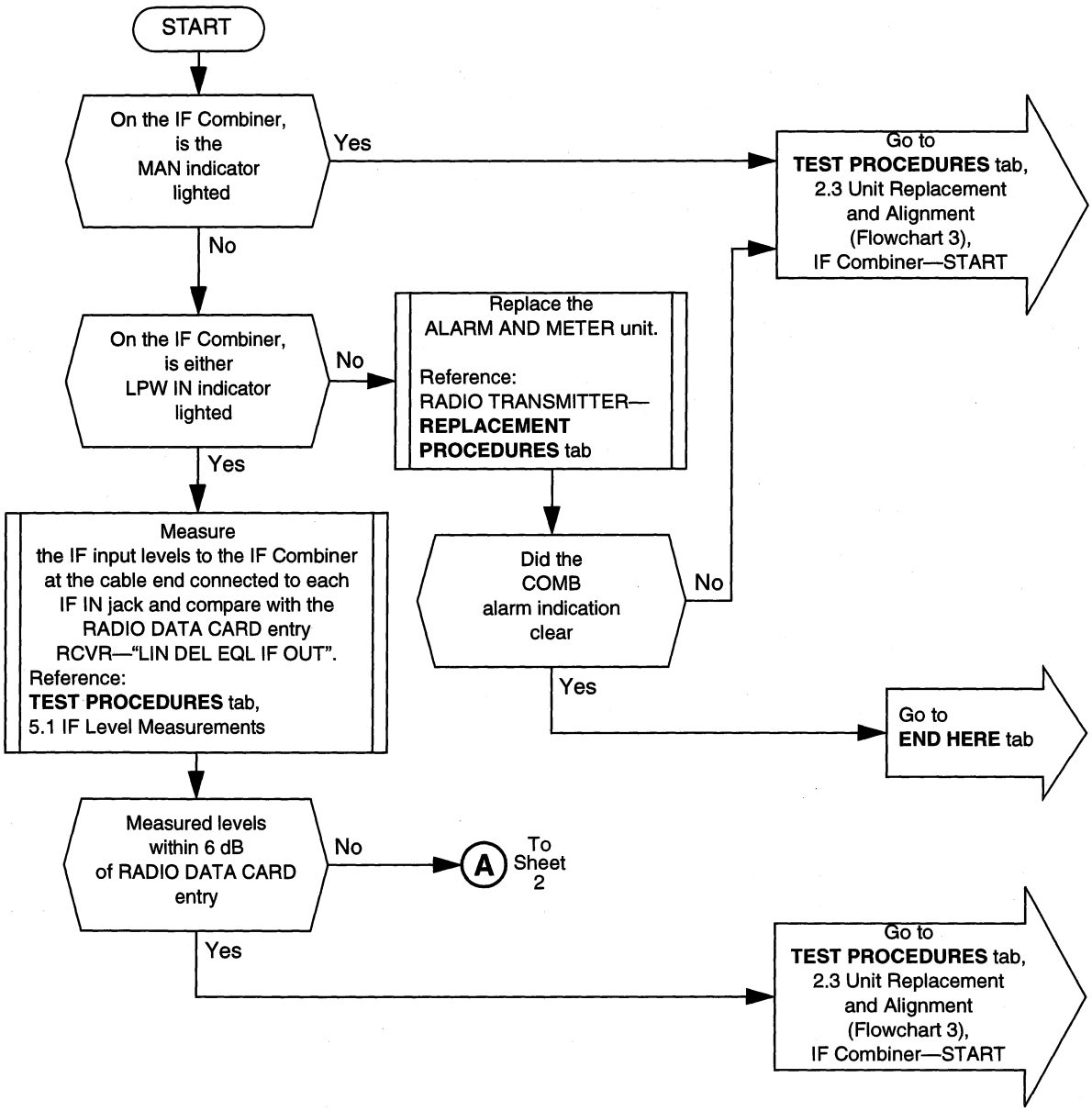
d. DIV LPW IN: same as for REG LPW IN except that it is caused by a deep signal fade or signal loss on the diversity antenna path.

e. MAN: red LED, alarm, caused by operating the push button on the unit to the MAN position. The RCVR—COMB alarm indicator appears simultaneously when this switch is operated to MAN.

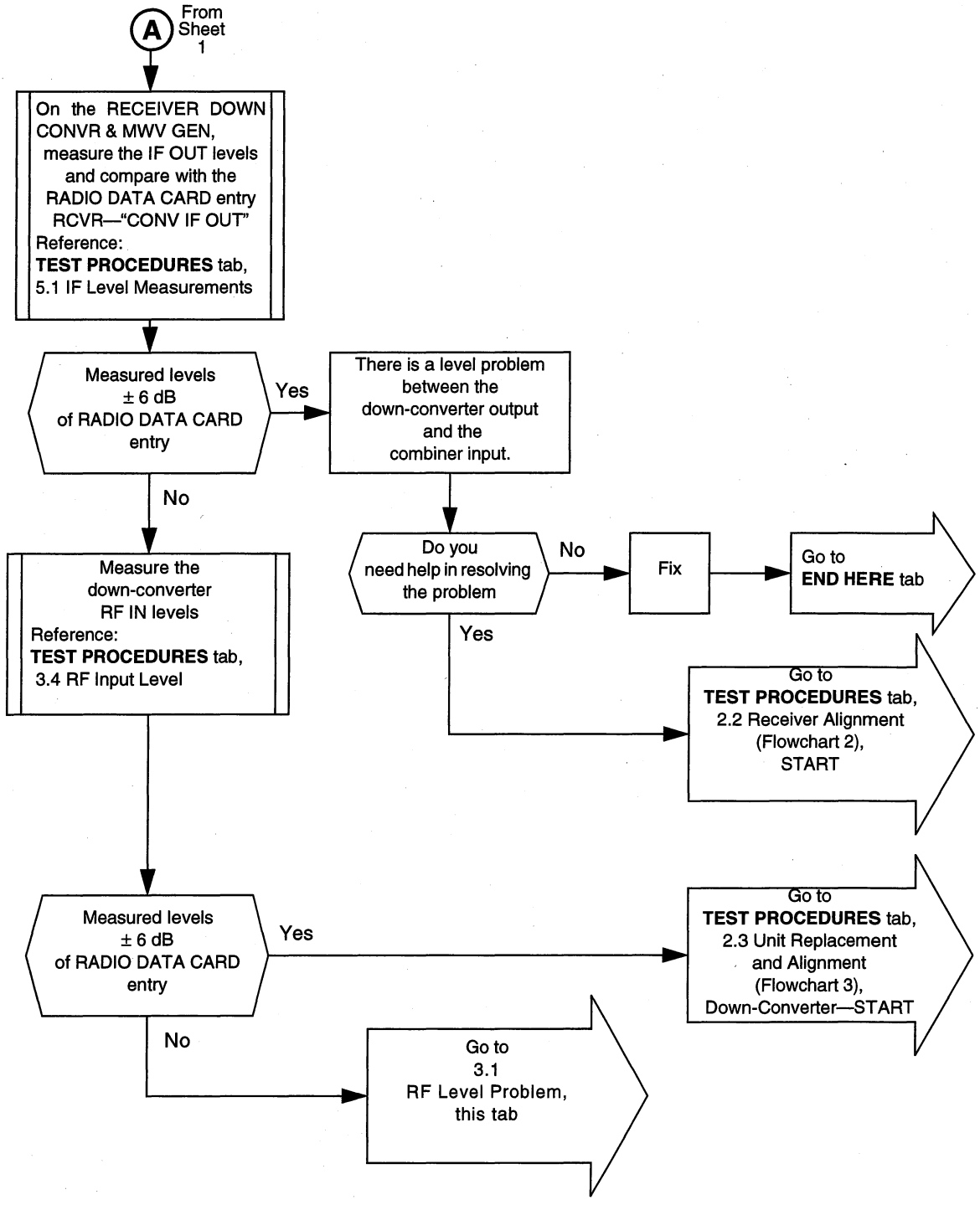
When an IF Combiner has failed, you will be referred to the Unit Replacement and Alignment flowchart in the RADIO RECEIVER—**TEST PROCEDURES** tab to replace the failed combiner and perform the required test procedures.

CAUTION:
This is an Out-of-Service procedure. Verify that service is protected.

Prerequisites: 1. RCVR—COMB alarm indicator is lighted on the ALARM AND METER unit.
2. Receiver DC output voltages are within limits.
3. Combiner AUTO/MAN push button is in AUTO position.



Flowchart 10. IF Combiner Alarm Diagnosis (Sheet 1 of 2)



Flowchart 10. IF Combiner Alarm Diagnosis (Sheet 2 of 2)

2.5 IF AGC Amplifier Alarm Diagnosis

Flowchart 11 is used to clear the RCVR—IF AMP alarm indicator on the ALARM AND METER unit. This alarm activates under the following conditions:

a. The amplifier input signal level drops approximately 30 dB for a continuous period of 60 seconds.

b. Operation of the push-button switch on the amplifier faceplate to the MAN position.

c. A defective AGC amplifier.

d. A defective ALARM AND METER unit.

Indicators on the amplifier faceplate are as follows:

- LPW IN: amber LED, status condition, the input level has dropped 30 dB

  An LPW IN status is generated when the signal level applied to the amplifier drops approximately 30 dB below the normal input level. The trip point for this indication is set using the LPW IN TRIP control on the faceplate. The primary purpose of the LPW IN status signal is to indicate a permanent high-loss condition that would indicate equipment failure and not fading activity. When the input drops to the trip point, the LPW IN status indicator lights immediately. The IF AMP alarm indicator on the ALARM AND METER unit does not light until the LPW IN indicator has been lighted for 60 seconds. This delay is normally adequate to avoid fade-induced LPW IN alarms.

- MAN: red LED, alarm, the AUTO/MAN push button is in the MAN position

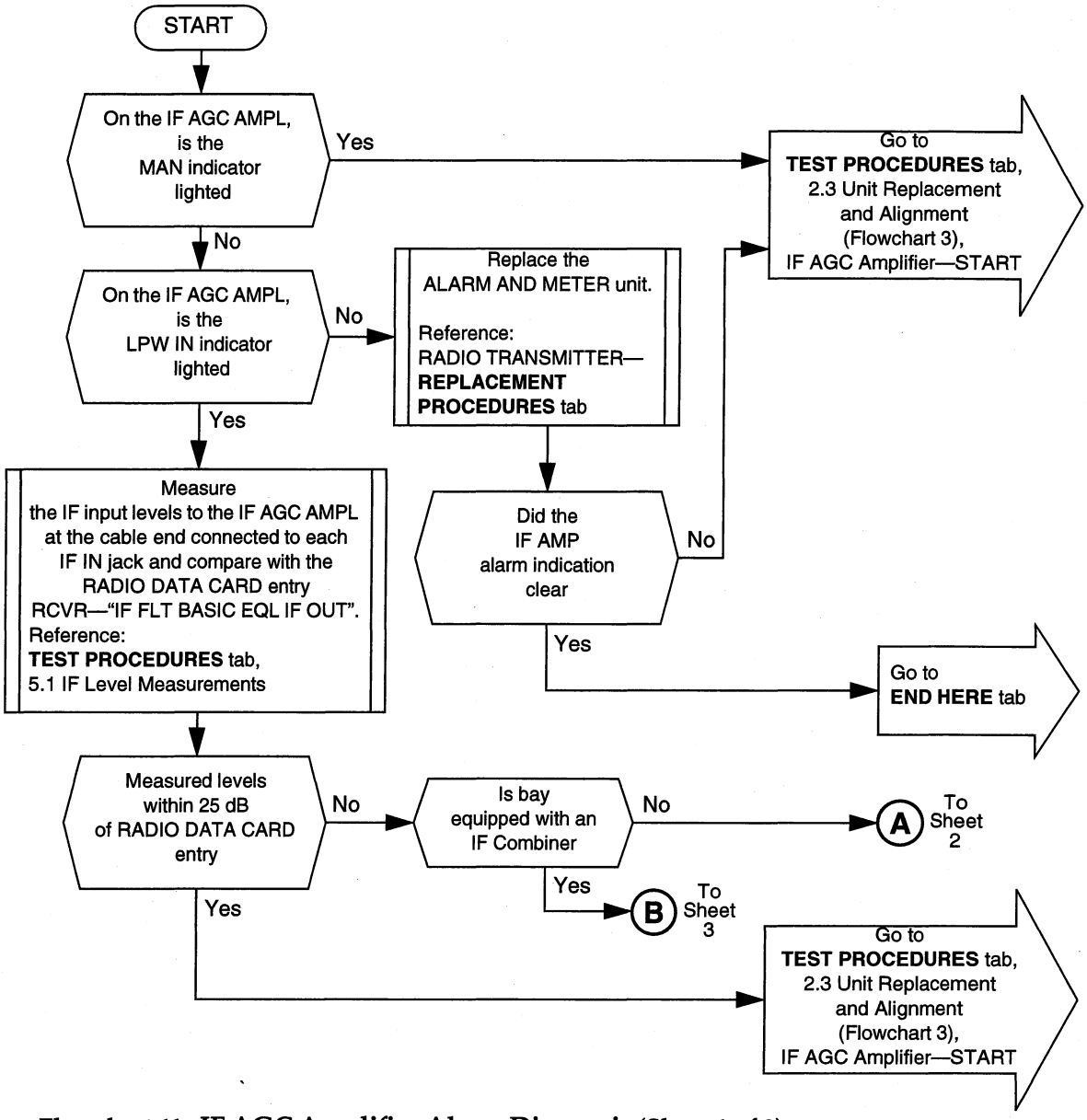
  The MAN indicator is activated whenever the AUTO/MAN switch on the IF amplifier is operated to the MAN position. When this switch is operated to the MAN position, the MAN indicator on the IF amplifier faceplate and the RCVR—IF AMP alarm indicator on the ALARM AND METER unit will light immediately.

The IF AGC amplifier maintains a relatively constant output level of –2 dBm for an input level in the range of –10 to –55 dBm.

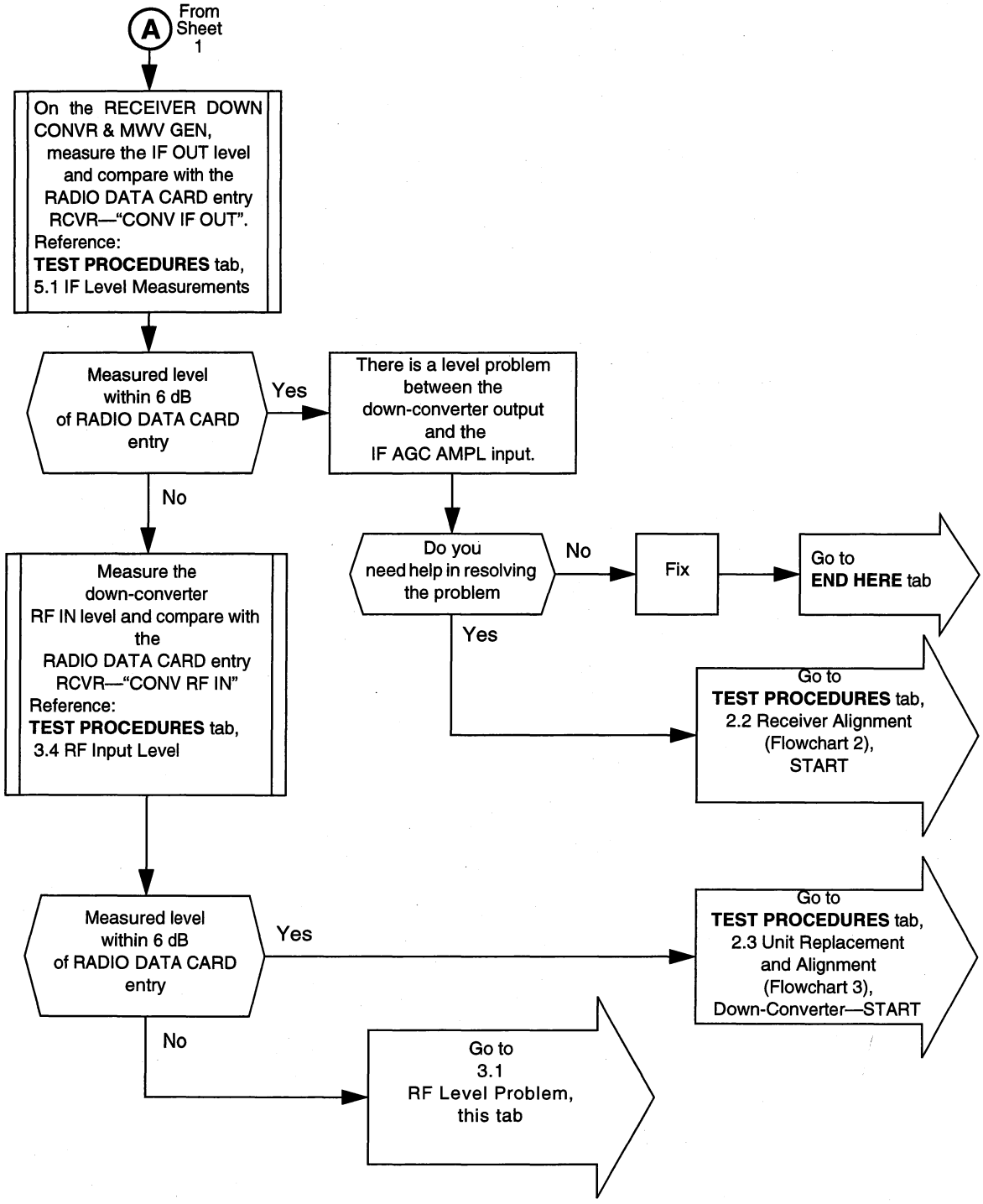
When an IF AGC amplifier has failed, you will be referred to the Unit Replacement and Alignment flowchart in the RADIO RECEIVER—**TEST PROCEDURES** tab to replace the failed amplifier and perform the required test procedures.

CAUTION:
This is an Out-of-Service procedure. Verify that service is protected.

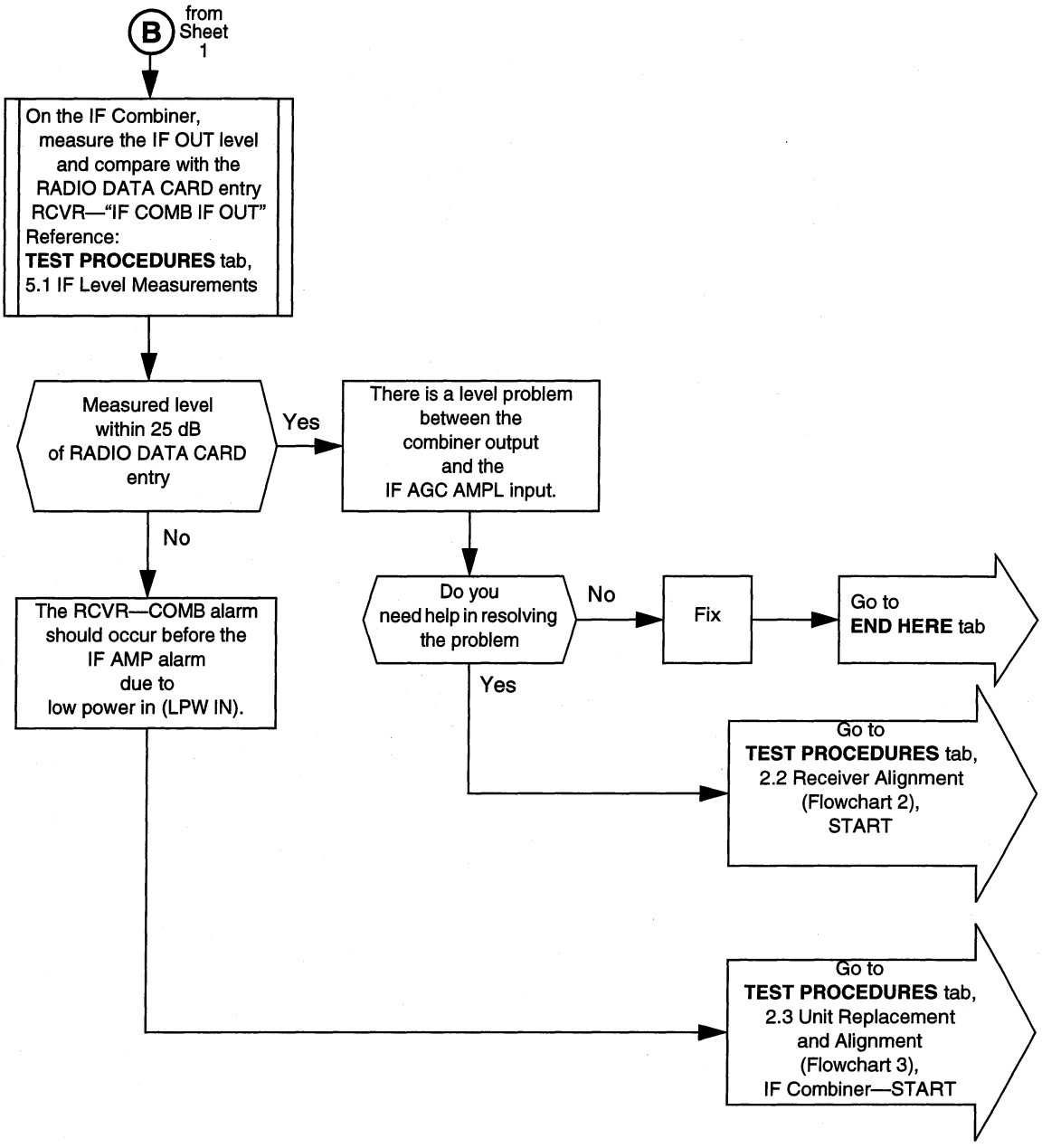
Prerequisites:
1. RCVR—IF AMP alarm indicator is lighted on the ALARM AND METER unit.
2. Receiver DC output voltages are within limits.
3. RCVR—COMB alarm indicator is not lighted on the ALARM AND METER unit.
4. AGC amplifier AUTO/MAN push button is in the AUTO position.



Flowchart 11. IF AGC Amplifier Alarm Diagnosis (Sheet 1 of 3)



Flowchart 11. IF AGC Amplifier Alarm Diagnosis (Sheet 2 of 3)



Flowchart 11. IF AGC Amplifier Alarm Diagnosis (Sheet 3 of 3)

2.6 Adaptive Slope Equalizer Alarm Diagnosis

Flowchart 12 is used to clear the RCVR—ADPT EQL alarm indicator on the ALARM AND METER unit. This alarm activates under the following conditions:

a. The Adaptive Slope Equalizer (ASE) is correcting for 7 dB of amplitude slope for a continuous period of 60 seconds.

b. Operation of the push-button switch on the equalizer faceplate to the MAN position.

c. A defective ASE.

d. A defective ALARM AND METER unit.

Indicators on the ASE faceplate are as follows:

- EXCS SLP: amber LED, status condition, approximately 7 dB of amplitude slope correction is being made

  The RCVR—ADPT EQL alarm indicator on the ALARM AND METER unit will light after the EXCS SLP indicator on the ASE unit is on for a continuous period of 60 seconds or longer.

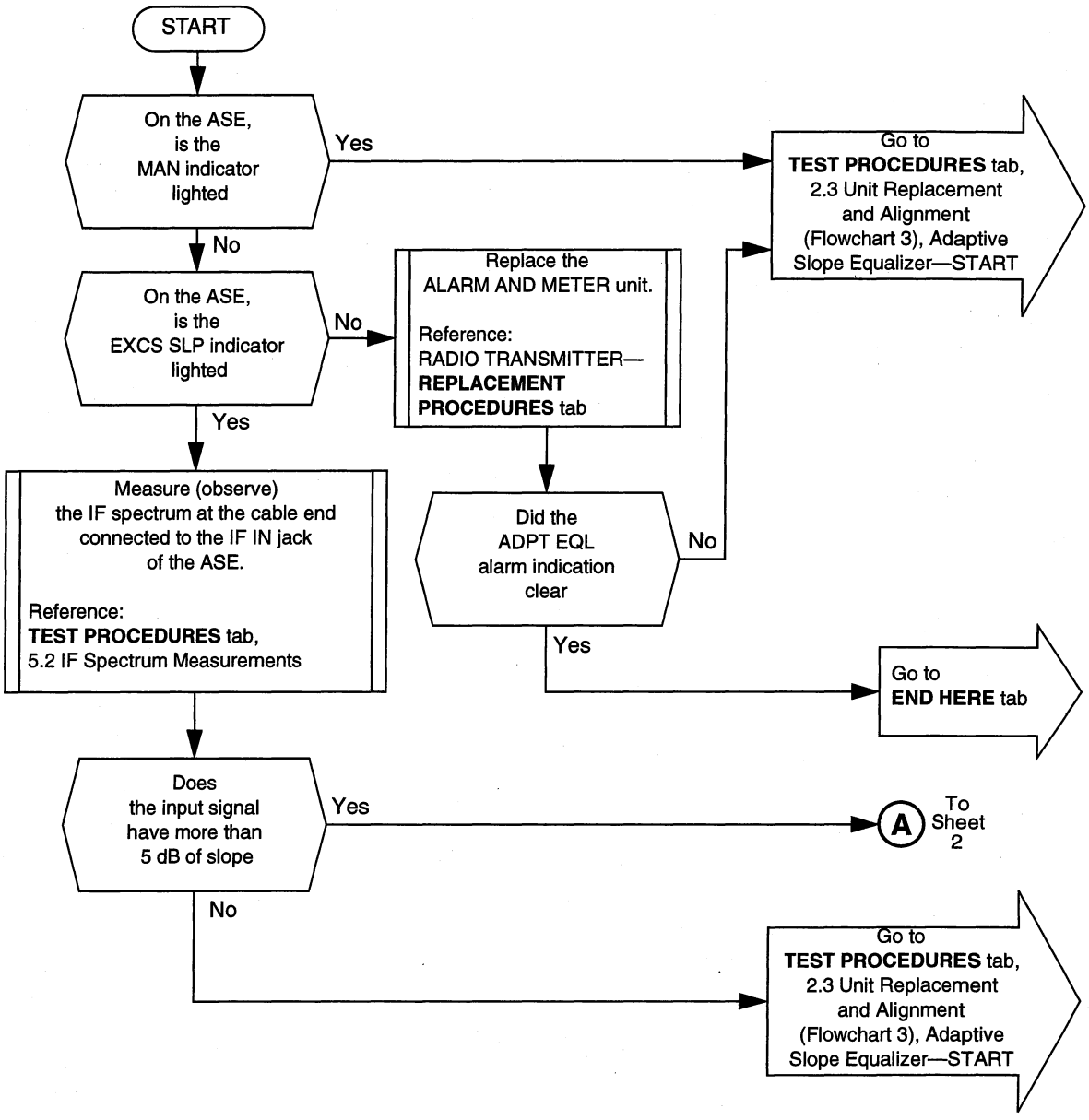
- EQL OFF: red LED, alarm, the AUTO/MAN push button is in the MAN position

  The EQL OFF indicator is activated whenever the AUTO/MAN switch on the adaptive slope equalizer is operated to the MAN position. When this switch is operated to the MAN position, the EQL OFF indicator on the equalizer faceplate and the RCVR —ADP EQL alarm indicator on the ALARM AND METER unit will light immediately.

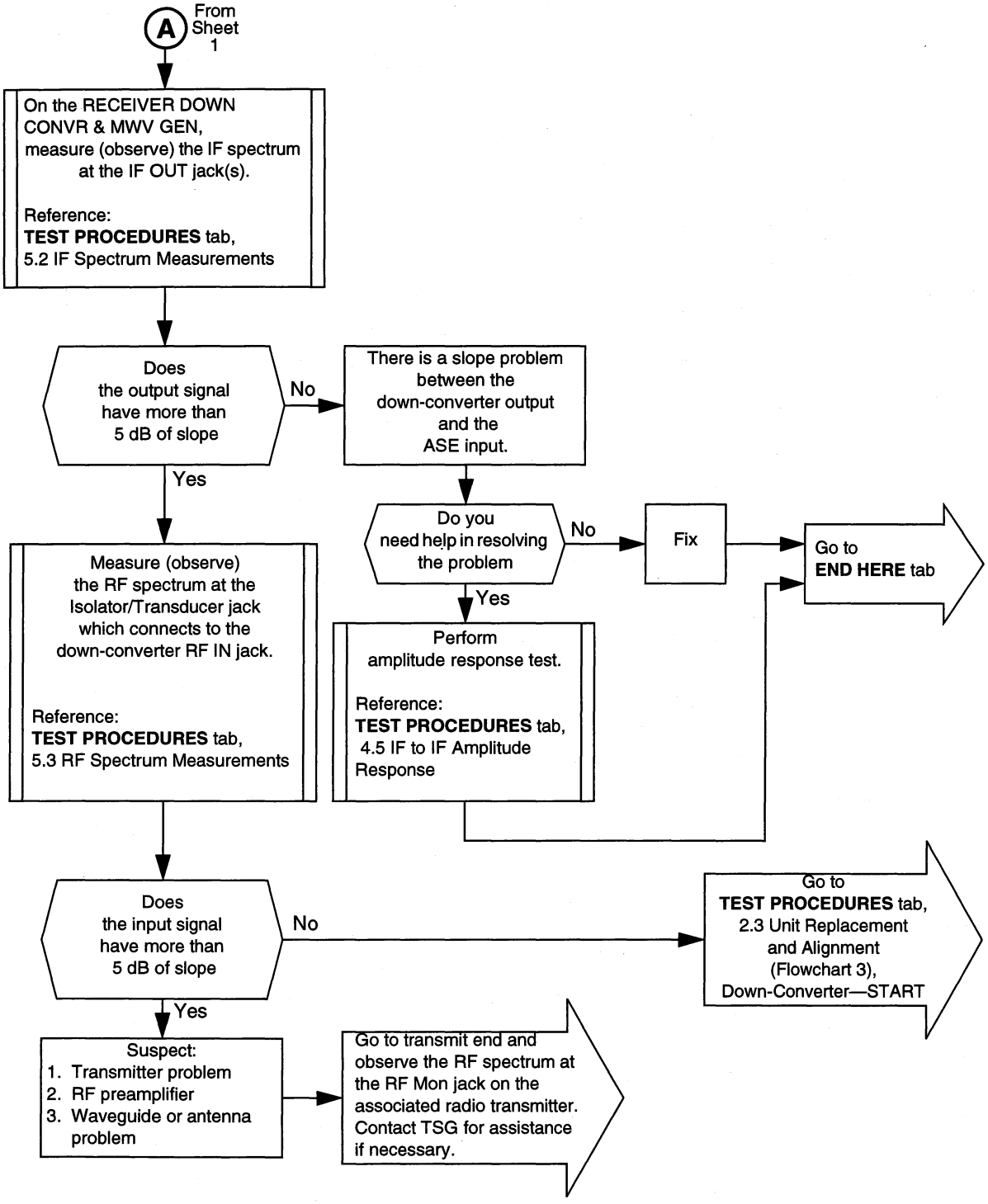
When an Adaptive Slope Equalizer has failed, you will be referred to the Unit Replacement and Alignment flowchart in the RADIO RECEIVER—**TEST PROCEDURES** tab to replace the failed equalizer and perform the required test procedures.

CAUTION:
This is an Out-of-Service procedure. Verify that service is protected.

Prerequisites: 1. RCVR—ADPT EQL alarm indicator is lighted on the ALARM AND METER unit.
2. Receiver DC output voltages are within limits.
3. Adaptive Slope Equalizer AUTO/MAN push button is in the AUTO position.



Flowchart 12. Adaptive Slope Equalizer Alarm Diagnosis (Sheet 1 of 2)



Flowchart 12. Adaptive Slope Equalizer Alarm Diagnosis (Sheet 2 of 2)

3 Additional Trouble Isolation

3.1 RF Level Problem (Receiver)

This procedure will assist you in locating a radio receiver RF level problem.

Flowchart 13, RF Level Problem, is entered from one of the following radio receiver test procedures.

- 3.4 RF Input Level

  The measured down-converter input level did not agree with the value recorded on the RADIO DATA CARD.

- 4.1 Received Signal Level (RSL) Calculation

  The calculated RSL based on the measured down-converter input level did not agree with the value recorded on the RADIO DATA CARD.

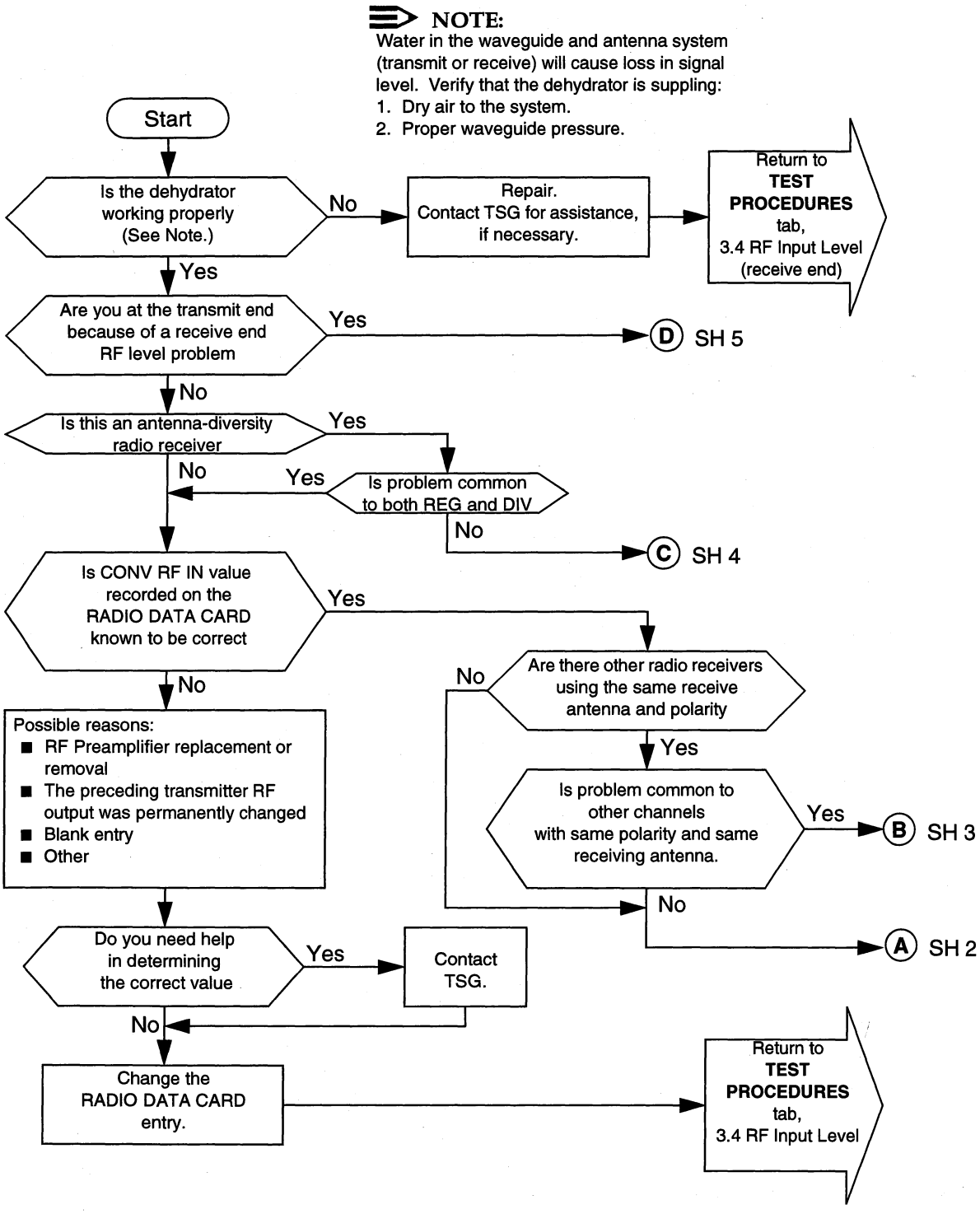
If you are directed to repeat a test or procedure that you have already performed during this maintenance activity, and you already know the results of the test, you may go on to the next step. In other words, do not repeat tests if you already know the results.

The following items can cause an RF level problem.

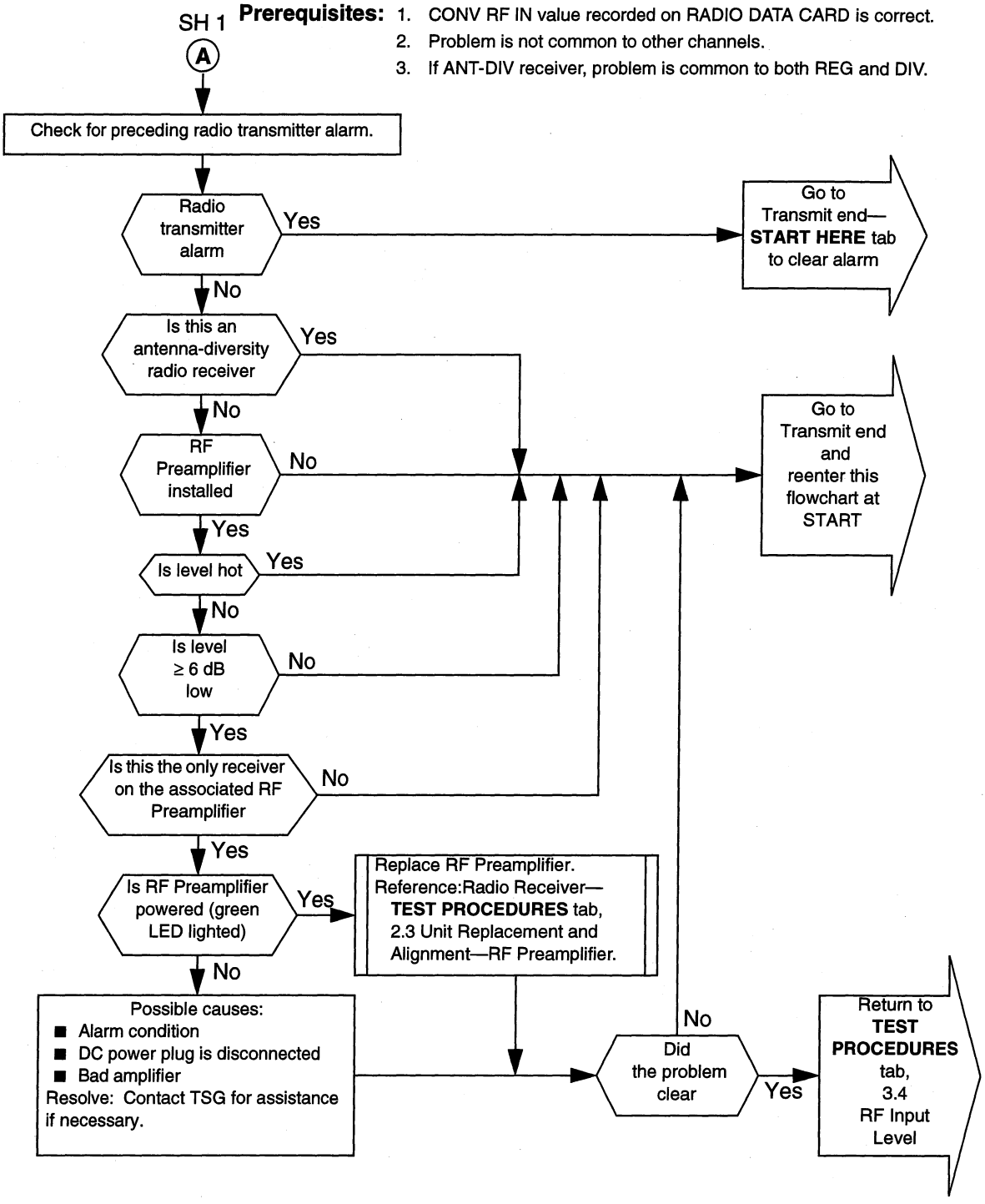
a. Antenna problem.
b. Waveguide problem.
c. Water in waveguide and antenna system caused by defective dehydrator.
d. Defective RF preamplifier.
e. Replacement RF preamplifier has different gain.
f. Incorrect entry on RADIO DATA CARD.
g. Low radio transmitter output at preceding station.
h. Fading.

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

Prerequisite: CONV RF IN exceeds requirement by ± 3 dB.

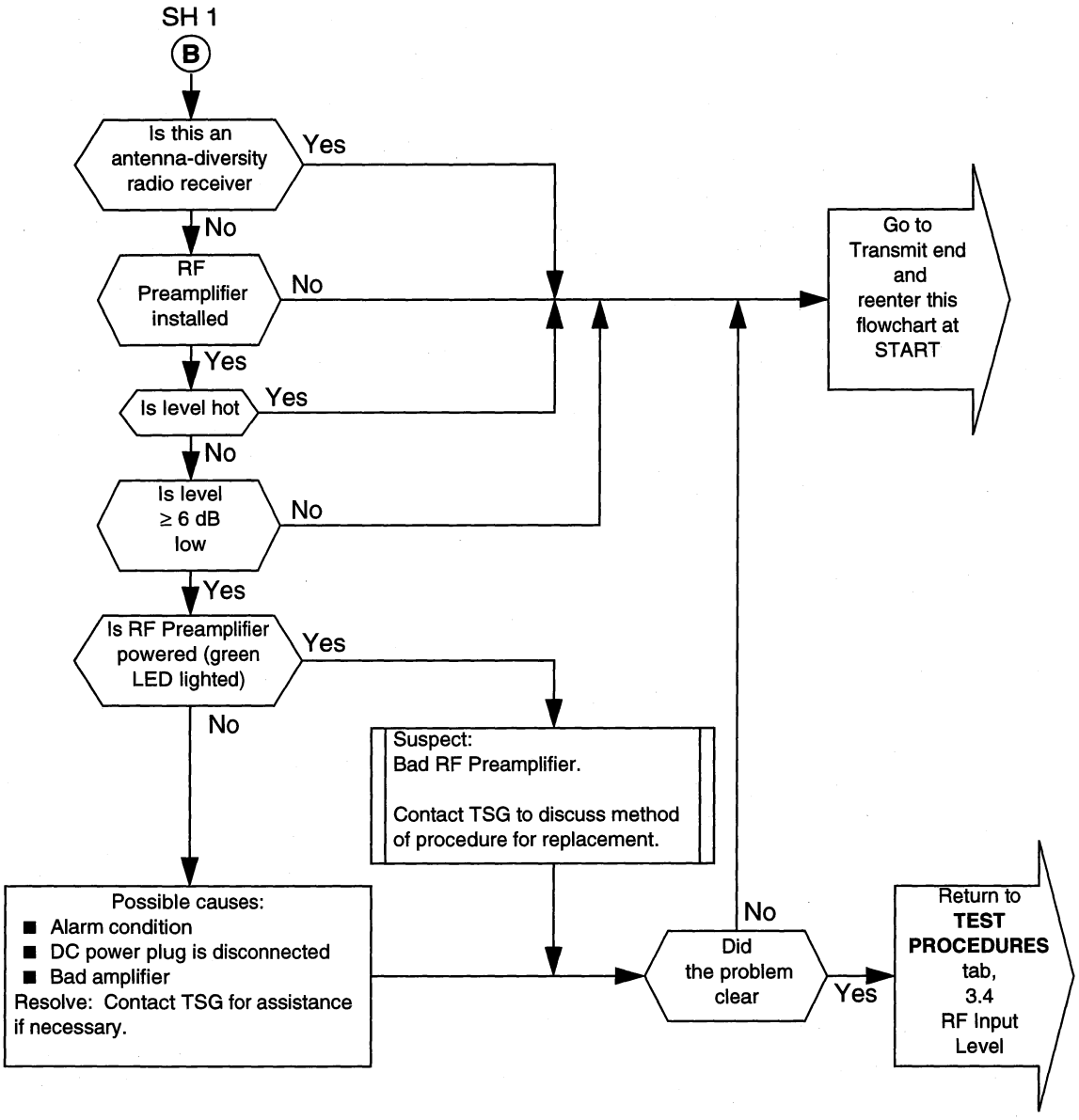


Flowchart 13. RF Level Problem (Sheet 1 of 5)



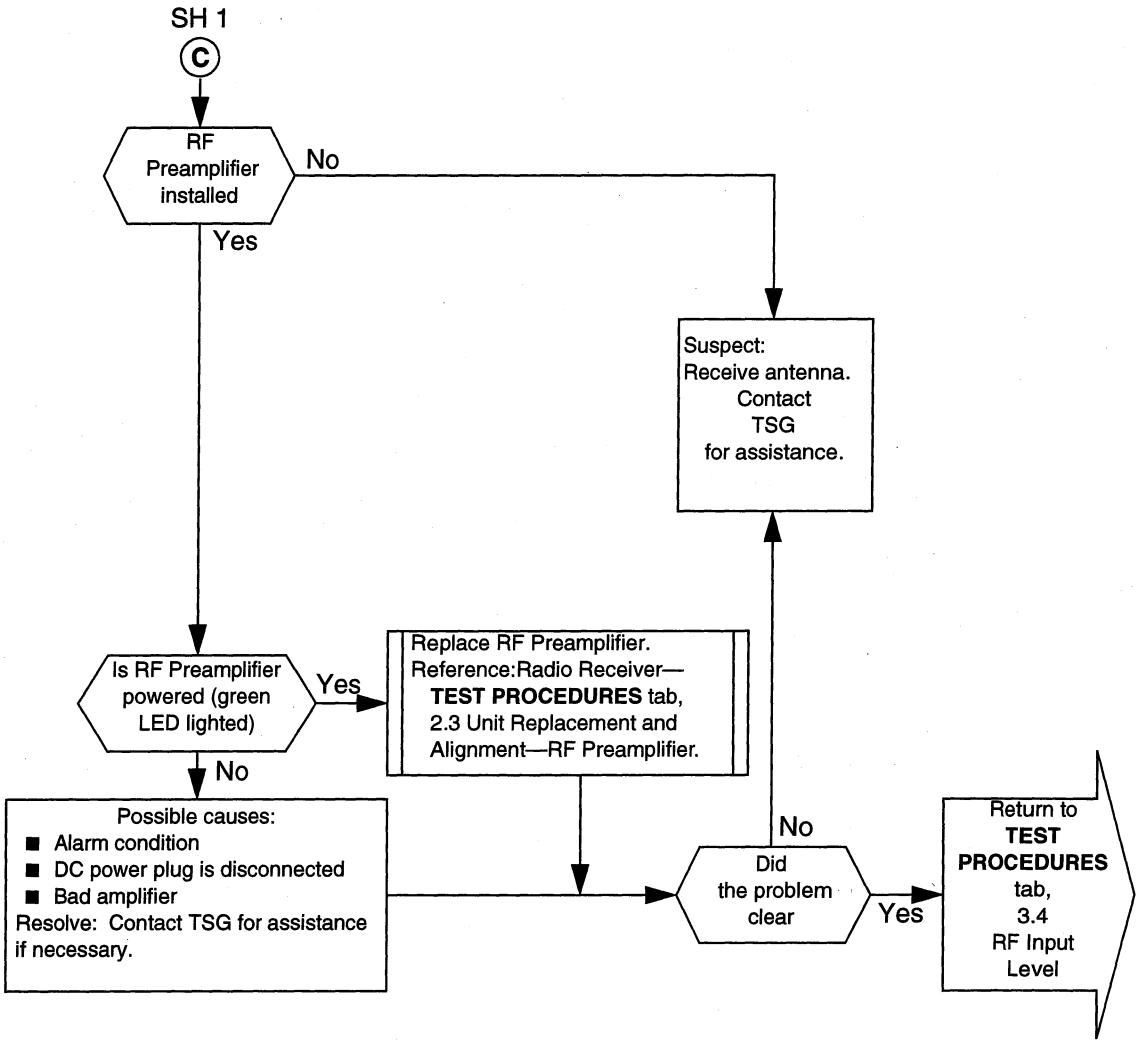
Flowchart 13. RF Level Problem (Sheet 2 of 5)

Prerequisites: 1. CONV RF IN value recorded on RADIO DATA CARD is correct.
2. Problem is common to other channels of same polarity.
3. If ANT-DIV receiver, problem is common to both REG and DIV.



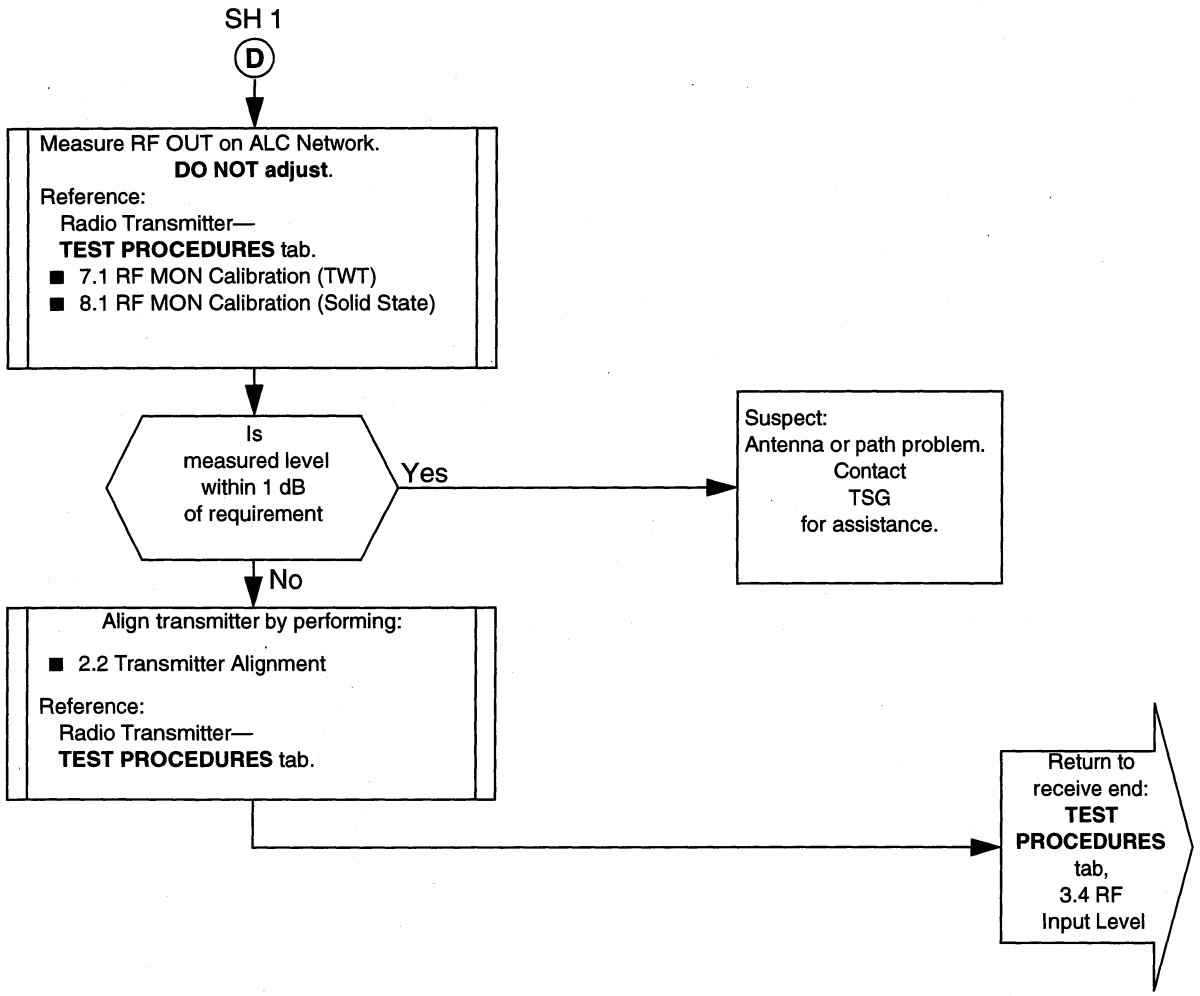
Flowchart 13. RF Level Problem (Sheet 3 of 5)

Prerequisites: 1. CONV RF IN value recorded on RADIO DATA CARD is correct.
2. ANT-DIV receiver.
3. Problem **is not** common to both REG and DIV.



Flowchart 13. RF Level Problem (Sheet 4 of 5)

Prerequisites: 1. CONV RF IN value recorded on RADIO DATA CARD is correct.
2. Receive end has been cleared.



Flowchart 13. RF Level Problem (Sheet 5 of 5)

3.2 IF Level Problem

This procedure will assist you in locating a radio receiver IF level problem.

Flowchart 14, IF Level Problem, is entered from one of the following radio receiver test procedures.

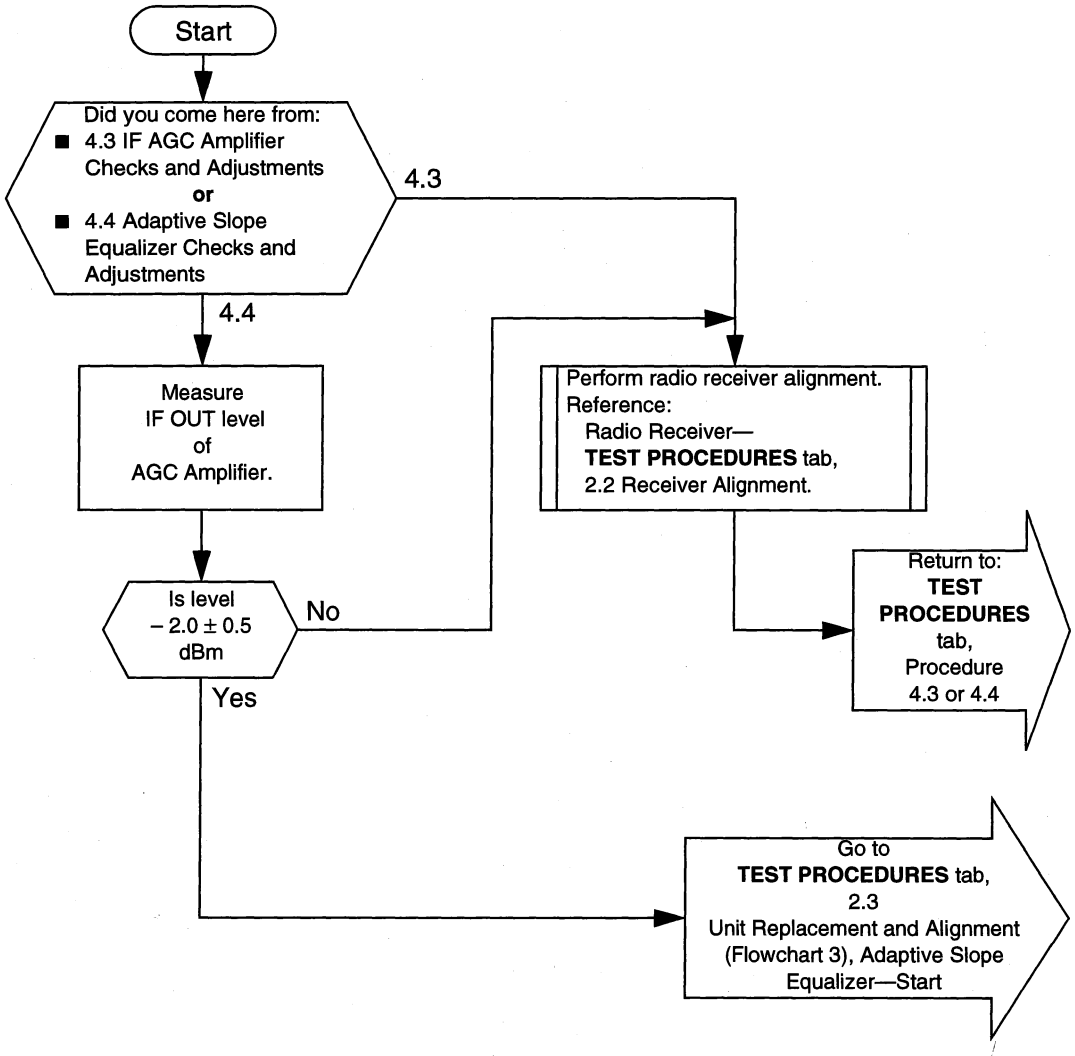
- 4.3 IF AGC Amplifier Checks and Adjustments

  The measured amplifier input level did not agree with the value recorded on the RADIO DATA CARD as IF filter and basic equalizer IF output.

- 4.4 Adaptive Slope Equalizer Checks and Adjustments

  The measured ASE output level did not agree with the value recorded on the RADIO DATA CARD.

If you are directed to repeat a test or procedure that you have already performed during this maintenance activity, and you already know the results of the test, you may go on to the next step. In other words, do not repeat tests if you already know the results.



Flowchart 14. IF Level Problem

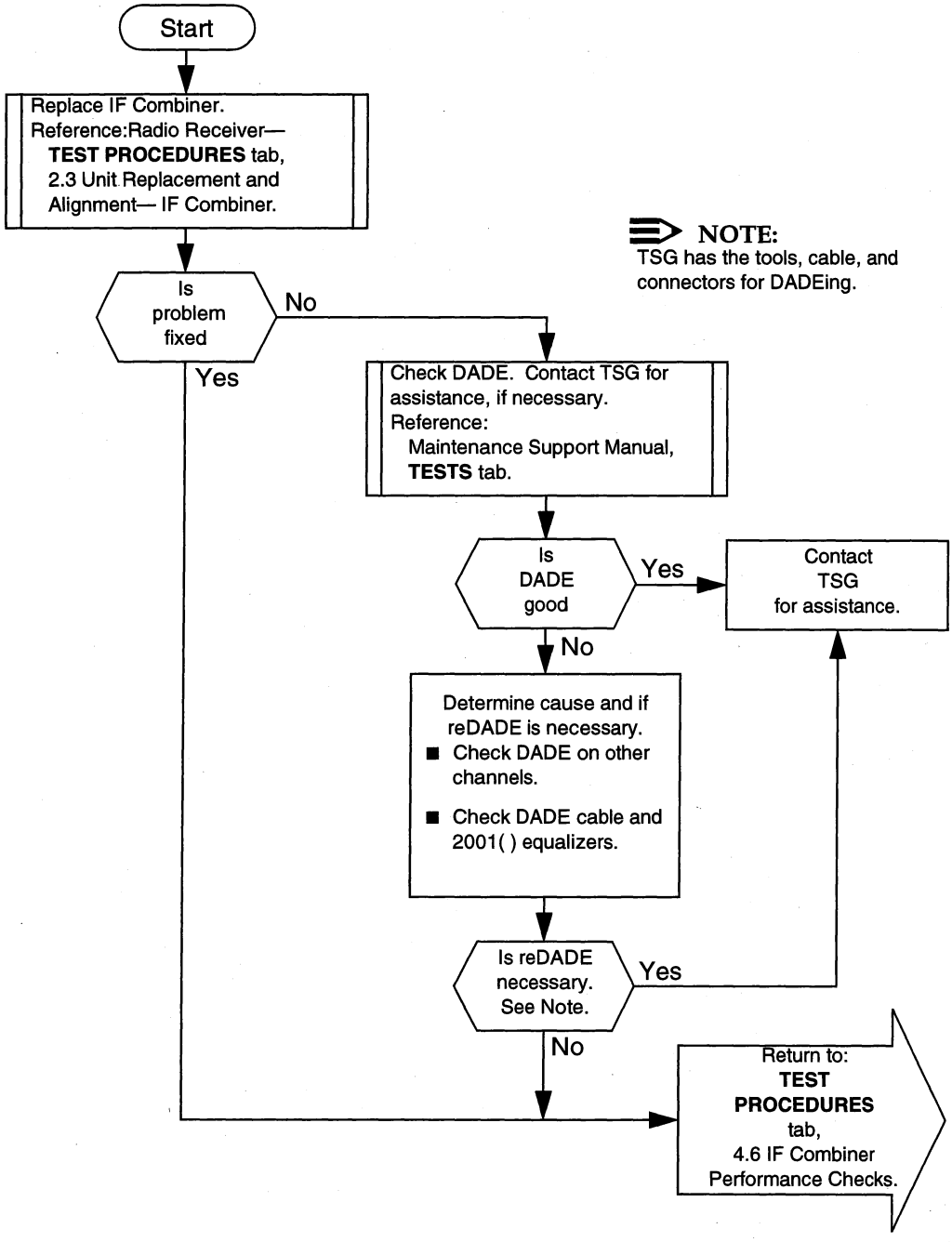
3.3 Combiner or DADE Problem

This procedure will assist you in locating a radio receiver combiner or Differential Absolute Delay Equalization (DADE) problem.

Flowchart 15, Combiner or DADE Problem, is entered from procedure 4.6, IF Combiner Performance Checks ("Annual") of the RADIO RECEIVER - **TEST PROCEDURES** tab.

The IF combiner will not soft switch.

If you are directed to repeat a test or procedure that you have already performed during this maintenance activity, and you already know the results of the test, you may go on to the next step. In other words, do not repeat tests if you already know the results.



Flowchart 15. Combiner or DADE Problem