

**OPERATION AND MAINTENANCE
1×N FREQUENCY DIVERSITY
DR 6/11-135A AND 135EC
TWT AMPLIFIER
RF POWER ALARM**

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1. GENERAL

The following logic diagram, MR 1, provides the recommended procedure for determining the source of a TRMTR RF PWR alarm. When a unit has failed, refer to the appropriate chart in the RADIO TRMTR tab under the REPLACEMENT PROCEDURES tab for replacing the unit. When tests or adjustments are necessary, refer to the appropriate chart in the RADIO TRANSMITTER PROCEDURES tab under the TESTS AND ADJUSTMENTS tab.

1.1 UPDATE INFORMATION

This practice is reissued to update the text and to revise the Transmitter RF PWR Alarm Diagnosis procedures.

Warning: *To prevent electrostatic discharge (ESD) damage to a unit, ensure all ESD precautions are followed.*

2. TRANSMITTER RF OUTPUT POWER CONTROL AND MONITORING

For satisfactory digital performance, the RF power level at the output of the power amplifier must be held within a narrow operating range. A transmitter RF PWR alarm is activated whenever there is a high probability that the transmitter is operating outside this power range or is operating with poor performance. Several indicators of transmitter performance are used to trigger an RF PWR alarm. For effective trouble diagnosis, an understanding of these indicators and how they are activated is important.

The radio transmitter IF and RF gain stages are equipped with automatic level control (ALC) circuits. When all transmitter components are working normally, these ALC circuits act to hold the output power nearly constant by compensating for IF input level variations and gain variations in transmitter modules due to aging and environmental changes. The main transmitter ALC loop includes the up-converter and TWT power amplifier stages. The optional IF PREDISTORTER unit, which, when used, precedes the up-converter and TWT power amplifier, has an internal ALC circuit that compensates for variations in input signal level to maintain a near constant output.

For the main ALC loop, an external ALC NETWORK unit located at the output of the TWT power amplifier generates the loop control signal and performs the monitoring and RF PWR alarm functions.

2.1 AUTOMATIC LEVEL CONTROL FUNCTION

An RF detector circuit generates a voltage that is proportional to the RF output power. The voltage from the RF detector circuit is differentially compared with a reference voltage. After amplification, this difference, or error voltage (ALC V), is processed by additional driver shaping circuits to become the ALC loop control voltage. The control voltage (nominally -5 V) is used to control the gain of an IF amplifier in the IF section of the up-converter unit. When working properly, the ALC loop functions to hold the ALC V error voltage at essentially 0 volts. Since the reference voltage is adjusted on the basis of the desired RF output power, the ALC loop thus acts to hold the RF output power nearly constant by holding the ALC V error voltage close to 0 volts. The loop automatically adjusts the up-converter IF gain to compensate for changes in the IF input level to the up-converter, for gain changes in the internal RF stages of the up-converter, and for gain changes in the TWT power amplifier.

2.2 TRANSMITTER RF OUTPUT MONITORING AND PERFORMANCE INDICATORS

For alarm purposes, the ALC V error voltage is monitored with the ALC NETWORK unit. When this voltage is outside prescribed limits, the output power is outside of prescribed limits and a PWR OUT-OF-RANGE alarm is triggered on the face of the ALC NETWORK unit.

The ALC NETWORK unit is also equipped with an ON/OFF switch that, when off, disables the ALC loop by forcing the ALC loop control voltage to a fixed level at the input to the up-converter unit (midrange of variable gain stage of up-converter). When the switch is in the OFF position, an ALC OFF indicator lights. This switch position is used when a manual gain adjustment is made on the transmitter using the IF LEV adjustment on the up-converter.

For either a PWR OUT OF RANGE or ALC OFF condition, a common RF PWR alarm status signal is generated and sent to the centralized ALARM/ALARM AND METER unit. The RF PWR alarm will also be generated when the PREAL indicator on the TWT POWER SUPPLY CONTROL unit is activated. The PREAL indicator is activated when the TWT helix current is considered to be too high. A high helix current is an indicator of excessive beam defocusing within the TWT. The TWT PREAL activates the transmitter RF PWR alarm to alert maintenance personnel that the performance of the transmitter may be degraded to the point that TWT replacement is necessary.

3. SOURCES OF A TRANSMITTER RF PWR ALARM

The transmitter RF PWR alarm is normally caused by one of the following:

- ALC switch on the ALC NETWORK unit is operated to the OFF position (ALC OFF indicator lighted)
- ON/OFF switch on the TWT CONTROL unit is operated to the OFF position (AL indicator lighted)
- TRANS/STBY switch on the TWT CONTROL unit is operated to the STBY position (AL indicator lighted)
- IF input level to the radio transmitter is high or low
- RF input level to the TWT AMPLIFIER unit is high or low
- TWT is on preheat cycle (ON indicator on TWT CONTROL unit not lighted)
- TWT cathode current is too low (ON indicator on TWT CONTROL unit not lighted)
- TWT helix current is too high (PREAL indicator on TWT CONTROL unit lighted)
- TWT POWER SUPPLY unit is shutdown (AL indicator on TWT CONTROL unit lighted)
- IF PREDISTORTER unit, TRANSMITTER UP CONV & MWV GEN unit, TWT AMPL unit, TWT POWER SUPPLY unit, or ALC NETWORK unit has failed.

4. RF PWR ALARM-REPORTING PROBLEMS DIAGNOSIS

Whenever the RF PWR alarm is lighted on the radio ALARM/ALARM AND METER unit, the ALC OFF and/or the PWR OUT OF RANGE indicator on the associated ALC NETWORK unit or the PREAL indicator on the TWT POWER SUPPLY CONTROL unit should also be lighted. (See alarm-reporting information under the STATION ALARM TROUBLE ISOLATION tab.) When an RF PWR alarm exists and the above indicators are not lighted, a failure in the alarm-reporting circuits within one or more of the above units or the ALARM/ALARM AND METER unit is most likely the cause. A DC voltage or an interconnecting circuit path problem may also result in such a situation.

The best way to isolate the problem is to check the alarm status signals coming to the radio transmitter/receiver (T/R) centralized ALARM/ALARM AND METER unit from the various alarm-reporting units mentioned above. This can be done by putting the radio alarm unit into an extender plug-in unit. While in an extender, the access necessary to determine the state of the associated alarm input signals is possible.

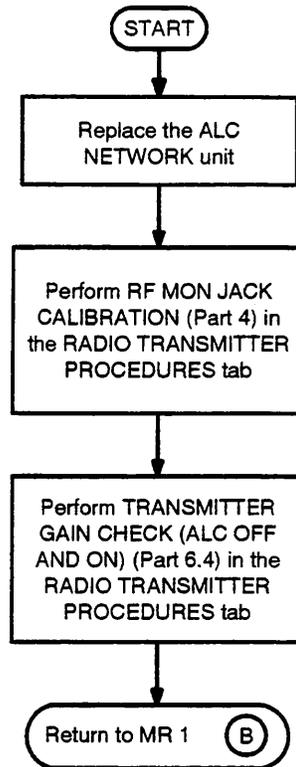
If the alarm status voltage at the ALARM/ALARM AND METER unit agrees with the RF PWR alarm indicator on that unit, the alarm unit is most likely operating properly. The discrepancy is most likely in the circuit reporting the false state or in the wiring path between it and the alarm unit. If the status voltage at the input to the alarm unit does not agree with the RF PWR indicator, then the alarm-reporting discrepancy is most likely due to a failure within the alarm unit.

The Maintenance Support O&M Manual and the applicable SD drawings provide the connection and input pin status information necessary for this evaluation.

Return to MR 1(H) when the alarm-reporting discrepancy problem is resolved.

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

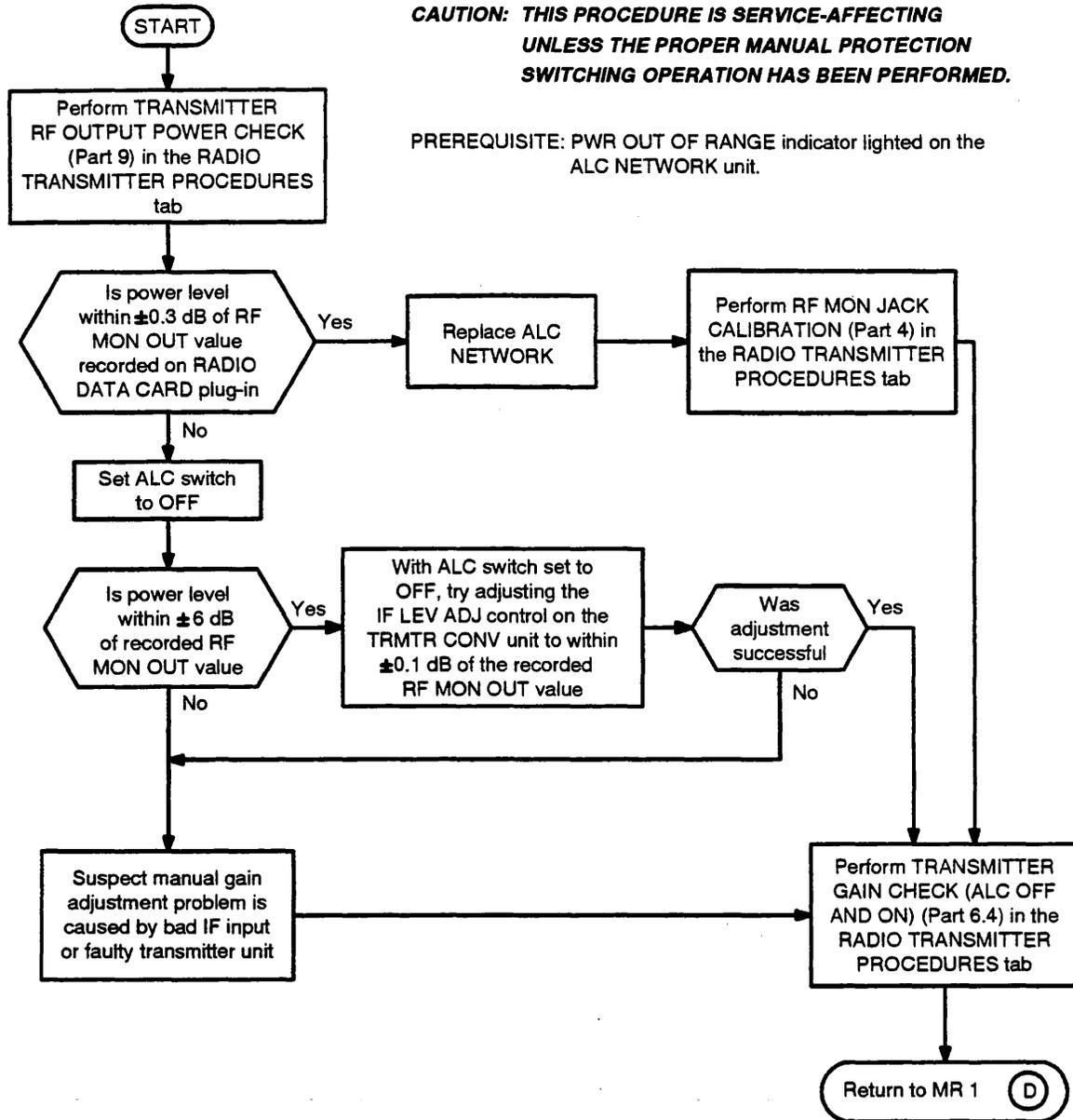
PREREQUISITE: ALC OFF indicator lighted on
the ALC NETWORK unit with switch
set to ALC ON position



MSR 1—ALC Switch Indicator Problem Diagnosis

CAUTION: THIS PROCEDURE IS SERVICE-AFFECTING UNLESS THE PROPER MANUAL PROTECTION SWITCHING OPERATION HAS BEEN PERFORMED.

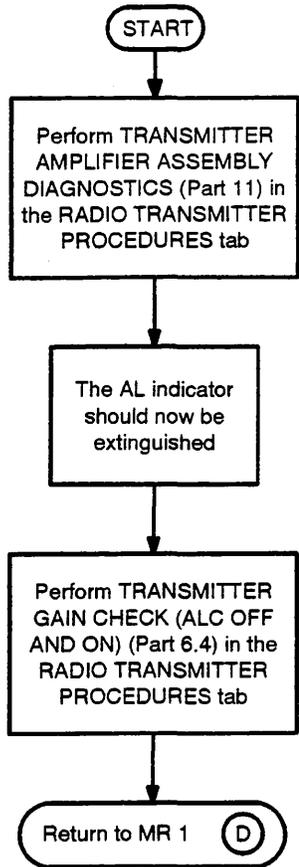
PREREQUISITE: PWR OUT OF RANGE indicator lighted on the ALC NETWORK unit.



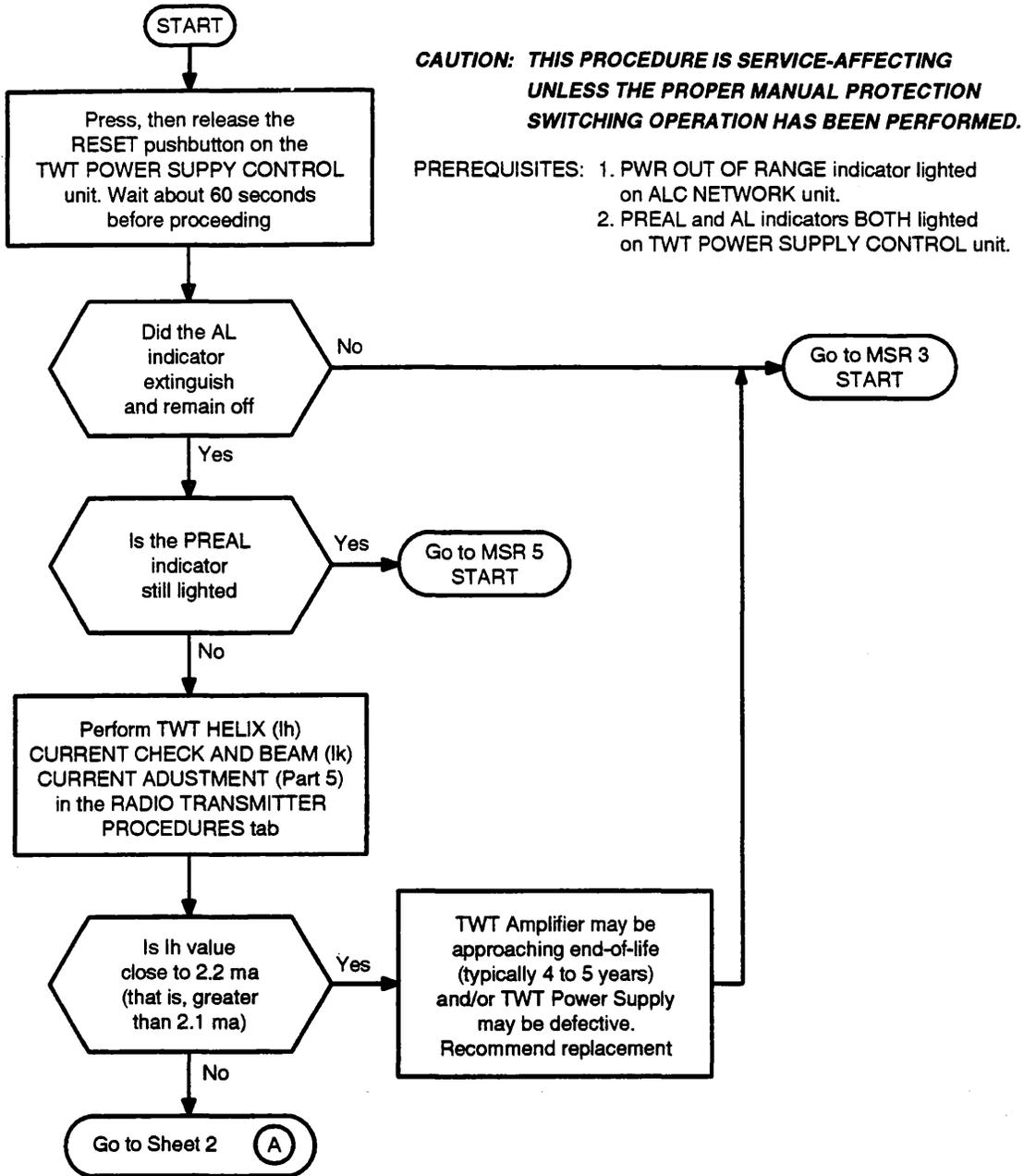
MSR 2— Transmitter Output Power Problem Diagnosis

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

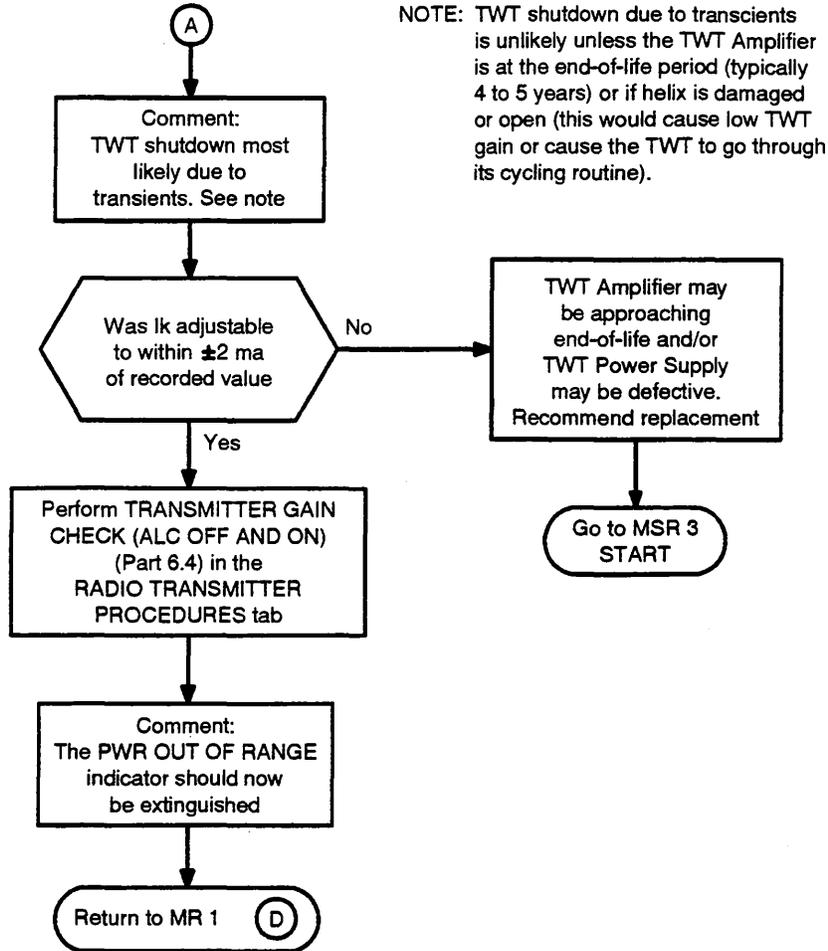
PREREQUISITE: PWR OUT OF RANGE indicator lighted on the
ALC NETWORK unit and AL indicator lighted
on the TWT POWER SUPPLY CONTROL unit.



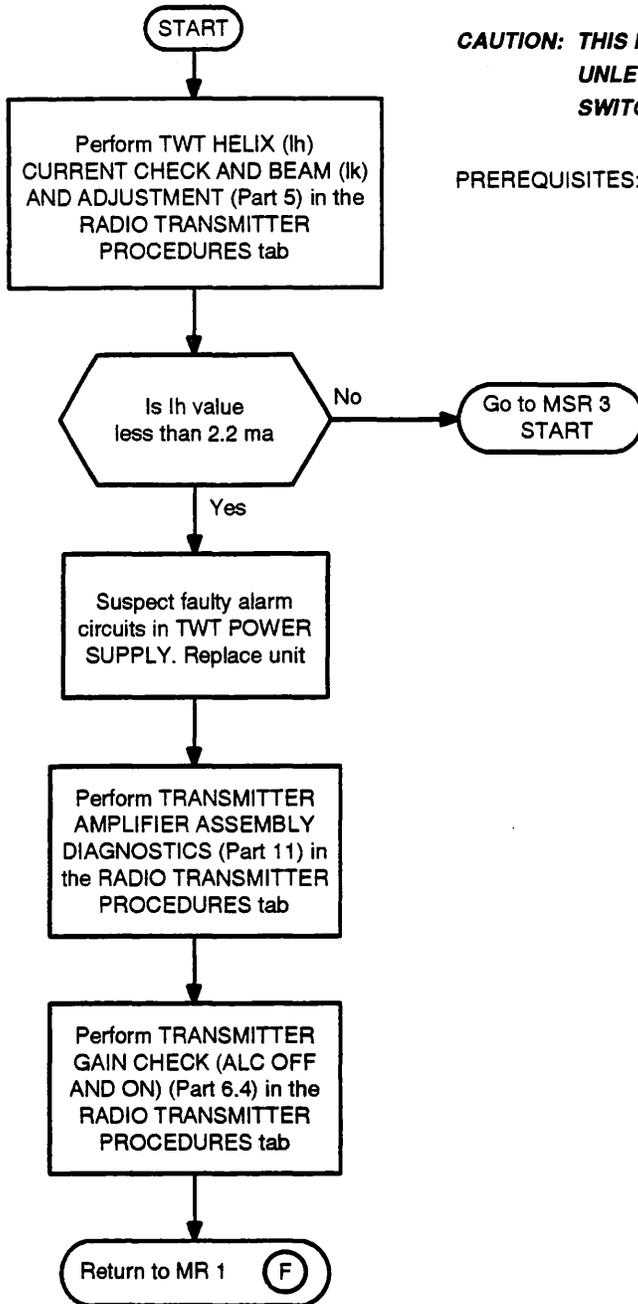
MSR 3—TWT Amplifier and/or TWT Power Supply Problem Diagnosis



MSR 4—TWT Pre-Alarm Problem Diagnosis—Both PREAL and AL Indicators Lighted (Sheet 1 of 2)



MSR 4—TWT Pre-Alarm Problem Diagnosis—Both PREAL and AL Indicators Lighted (Sheet 2 of 2)



CAUTION: THIS PROCEDURE IS SERVICE-AFFECTING UNLESS THE PROPER MANUAL PROTECTION SWITCHING OPERATION HAS BEEN PERFORMED.

PREREQUISITES: 1. PREAL indicator lighted on TWT POWER SUPPLY CONTROL unit.
2. PWR OUT OF RANGE indicator on ALC NETWORK unit may or may not be lighted.

MSR 5—TWT Pre-Alarm Problem Diagnosis—Only PREAL Indicator Lighted