

TECHNICAL MANUAL

GENERAL SUPPORT

MAINTENANCE MANUAL

**MEASURING SET, STANDING WAVE
RATIO**

AN/USM-37E

(NSN 6625-00-197-6910)

TECHNICAL MANUAL

No. 11-6625-369-40-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 30 May 1978**GENERAL SUPPORT****MAINTENANCE MANUAL****MEASURING SET, STANDING WAVE RATIO AN/USM-37E****(NSN 6625-00-197-6910)****REPORTING OF ERRORS**

You can improve this manual by recommending improvements using DA Form 2028-2 (Test) located in the back of the manual. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

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CHAPTER 1 INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual presents a functional description of Measuring Set, Standing Wave Ratio AN/USM-37E, and covers general support maintenance of the equipment. The major component of the test set, SWR Indicator IM-157E/U, is the principal concern of general support maintenance personnel and therefore, the majority of information contained herein pertains to the IM-157E/U. Where appropriate, instructions for maintenance of the minor components are included.

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR700-58/NAVSUPINST4030.29/AFR7113/MCO P4030.29A, and DLAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR55-38/NAVSUPINST4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

1-4. Administrative Storage

Prior to temporary storage (less than 90 days) of the AN/USM-37E, the following preparations must be taken:

a. Determine serviceability of equipment by performing operating procedures described in TM 11-6625-369-1.

b. Remove battery pack from the SWR indicator IM-157E/U. Refer to TM 11-6625-369-1 for proper battery storage.

CAUTION

Avoid short-circuiting the battery pack terminals. The cells of this battery have a very low internal resistance and will discharge at an extremely high-current level when shorted, resulting in high temperature and possible battery damage.

1-5. Destruction of Army Materiel

Destruction of Army materiel to prevent enemy use shall be as prescribed in TM 750-244-2.

1-6. Calibration

Refer to TB 43-180 for calibration requirements for the AN/USM-37E.

1-7. Reporting Equipment Improvement Recommendations (EIR).

EIR's will be prepared using DA Form 2407, (Maintenance Request). Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed direct to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN:DRSEL-MA-Q, Fort Monmouth, NJ 07703. A reply will be furnished directly to you.

Section II. DESCRIPTION AND DATA

1-8. Description.

A description of the capabilities, purpose, and use of the AN/USM-37E may be found in TM 11-6625-369-12-1.

1-9. Tabulated Data.

The technical specifications for the AN/USM-37E may be found in TM 11-6625-369-12-1.

CHAPTER 2 FUNCTIONING OF EQUIPMENT

2-1. General

The mechanical functioning of the various minor components of the AN/USM-37E is described in the operating instructions of TM 11-6625369-12-1. Only the major component, the SWR Indicator, is dealt with in this chapter.

2-2. Theory

a. The ratio $E_{\max}/E_{\min}$ is referred to as the standing wave ratio of the electric field intensity. Since the electric field intensity is proportional to voltage, $E_{\max}/E_{\min}$ is ordinarily termed the voltage standing wave ratio or VSWR.

Thus,

$$\text{VSWR} = \frac{E_{\max} (A) + (B)}{E_{\min} (A) - (B)}$$

where (A) = peak voltage magnitude of incident wave.

(B) = peak voltage magnitude of reflected wave.

b. If the end of an rf line is shorted, the incident voltage wave is totally reflected. In this case the magnitude of the reflected signal equals that of the incident signal; i.e., (B) = (A) resulting in a VSWR = ∞. On the other hand, an ideal match means complete absorption of the incident wave. The reflected signal magnitude is then zero; i.e., B = 0 and VSWR = 1. Both these VSWR's (1 and ∞) are extreme ideal cases. Most of the values encountered in actual practice lie between 1.03 and 100. Standing wave ratios can also be expressed in db using the formula

$$\text{db} = 20 \log_{10} (\text{VSWR}).$$

c. The reflection coefficient r , is the ratio between the reflected and incident wave amplitudes, and contains the same information as VSWR. It can be written as

$$r = \frac{(R)}{(A)}$$

or, in terms of VSWR

$$r = \frac{(\text{VSWR}) - 1}{(\text{VSWR}) + 1}$$

It is readily apparent from the above expressions that r can only lie between 0 (for an ideal match) and 1 (for total signal reflection).

2-3. Circuit Analysis

(fig. 2-1)

The SWR Indicator is a high-gain tuned amplifier which produces a meter reading, calibrated in VSWR, proportional to an input signal received from a square-law detector. The high-gain amplifier permits detection of small signals, while the flexibility provided by the wide attenuation range of the amplifier permits on-scale readings of large signals. Discussion of the circuitry of the SWR Indicator is given below.

a. Input Circuit. The input circuit provides an input impedance much higher than that of any crystal detector or bolometer normally used with the instrument. This results in a lower noise figure and in the highest possible input signal to the SWR Indicator. When INPUT SELECTOR S101 is placed in either BOLO position, bolometer bias current (4.5mA or 8.7 mA) is applied to INPUT connector J1. The bolometer bias current is generated by the + 13V regulated (nominal) supply and emitter follower Q101. An internal meter bias current calibration adjustment (R351 on circuit board assembly) is provided. This calibration adjustment is set for a 4.5 or 8.7 mA reading (depending on setting of S101) on the BOLO BIAS meter scale when the rear panel BIAS CHECK switch S201 is activated.

b. Range Switching Circuit. RANGE DB switch S201 is divided into two sections. The first section of this switch receives the signal from INPUT SELECTOR S101 and feeds it to the input amplifier. The first section provides up to 30-db gain in 10-db steps. The second section of RANGE DB switch S201 is located between the input amplifier and the second amplifier and provides a gain of 30-60 db in 10-db steps. EXPAND switch S202 provides signal level measurement on an expanded scale (0 to 2 db) with continuous coverage. The EXPAND switch applies an exact dc offset current from Q317 to the meter while simultaneously increasing the third amplifier input signal.

c. Amplifier Circuits.

(1) The input amplifier comprises four cascaded transistors (Q301, Q302, Q303 and Q304) and receives the signal from the first section of RANGE DB switch S201. The signal input is