



**Advanced Test Equipment Rentals**  
**www.atecorp.com 800-404-ATEC (2832)**

**OPERATION MANUAL**

**MICROWAVE RADIO TEST SET**

**ME 645 A**

**SUPPLIER: ANRITSU AMERICA, INC.**

**MANUFACTURER: ANRITSU ELECTRIC CO., LTD.**

**SECTION 1**  
**GENERAL INFORMATION**

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**1. INTRODUCTION**

**1.01** This operation manual contains all the information necessary to operate the Microwave Radio Test Set (MRTS) ME645A. Calibration, adjustment, troubleshooting, repair and replaceable parts are covered in the separate Service Manual.

**A. FEATURES**

**1.02** The MRTS is designed to meet the requirements of AT & T Company. Principal measurement items are power, frequency, amplitude response, return loss, noise figure, IF spectra, carrier resupply, fade margin, and DC voltage.

**1.03** The MRTS has the following special features:

**1.04 *Versatile Capabilities:*** Most measurements can be made at the repeater site of a microwave relay system.

**1.05 *Easy Operation:*** In most cases the measurement item can be switched by merely pushing a single function switch for the desired item. The power meter uses autoranging. The RF sweep generator center frequency is set by thumb wheel switch. The IF and RF sweep generator sweep width is selected in one operation.

**1.06 *High Accuracy:*** The power meter has a 4 digits digital indicator. The sensor is calibrated by an internal reference oscillator. The PCD in the IF sweep generator and the PLL in the RF sweep generator assure accurate, stable output frequencies. The CW frequency and  $\Delta F$  mode IF and RF source frequency markers are controlled by crystal oscillators.

\* PCD: Pulse Counted Discriminator  
 PLL: Phase Lock Loop

**1.07 *Alarm Signs:*** When the controls, push button and adjusters are manipulated by an improper procedure or misoperation an alarm signs (blinking of the LED Display or red lamp) tells that to the operator.

**1.08 *Simple Construction:*** The main units are the DISPLAYING UNIT and SENDING UNIT. These units are connected by interface cable.

**1.09 *Portable:*** The compact size and light weight make the test set suitable for hand-carrying and transport by helicopter.

**1.10 *High Reliability and Ruggedness:*** ICs and LSIs are used extensively throughout to reduce the number of components to a minimum. The selection of parts having small failure rates increases reliability. A rugged mechanical designing is used throughout, considering the most severe transportation conditions.

**1.11 *Microprocessor:*** The internal microprocessor assures easy operation, high accuracy, and high reliability.

**2. CONFIGURATION**

**A. Basic Configuration**

**2.01** MRTS ME645A for 4 and 6GHz band is the basic equipment, the units of which are listed below:

Table A—Basic Configuration

| Description                   | Q'ty  |
|-------------------------------|-------|
| Displaying Unit               | 1     |
| Sending Unit                  | 1     |
| Furnished Ancillary Equipment | 1 set |

2.02 Furnished Ancillary Equipment List is as follows.

Table B—Furnished Ancillary Equipment List

| No.  | Descriptions  | Q'ty  | Model No. or Part No. |
|------|---|-------|-----------------------|
| ✓ 1  | IF Power Head, 10 to 300MHz, 75Ω WEC0 440*                | 1     | IF POWER HEAD         |
| ✓ 2  | RF Power Head, 0.1 to 11.7GHz, 50Ω, Type N(M)             | 1     | RF POWER HEAD         |
| 3    | Directional Detector, 3.65 to 11.7GHz                     | 1     | DIRECTIONAL DETECTOR  |
| 4    | Coaxial Low Pass Filter, 4GHz, Type N(M-F)                | 1     | MA62A                 |
| 5    | Coaxial Low Pass Filter, 6GHz, Type N(M-F)                | 1     | MA63A                 |
| ✓ 6  | Leveling Cable Assembly A                                 | 1     | FA6                   |
| ✓ 7  | Cable, BNC(M) to BNC(M) 2.5m                              | 1     | FA7-1                 |
| ✓ 8  | Cable, BNC(M) to BNC(M) 0.13m                             | 1     | FA7-2                 |
| ✓ 9  | Power Head Cable (IF) black 2.5m                          | 1     | FA8-1                 |
| ✓ 10 | Power Head Cable (RF) green 2.5m                          | 1     | FA8-2                 |
| ✓ 11 | Cable, WEC0 440* to WECo 440* 2.5m                        | 2     | FA9                   |
| ✓ 12 | AC Power Cord yellow 7'6"                                 | 1     |                       |
| ✓ 13 | Interface Cable between Displaying Unit and Sending Unit  | 1     | FA11                  |
| ✓ 14 | Instruction Manuals (Operation Manual and Service Manual) | 1 ea. |                       |
| ✓ 15 | P.C. Board Removal Tool                                   | 2     |                       |
| ✓ 16 | Self-contained Card Extender                              | 1 set |                       |
| ✓ 17 | Fuse (5A)   | 1     |                       |
| ✓ 18 | Fuse (0.5A)   | 1     |                       |
| ✓ 19 | Secondary Fuse (10A ... 2, 1.6A ... 3, 2A ... 1)          | 1 set |                       |

Note: \*WEC0 440 or Equivalent

**B. Options**

**2.03** In addition to the basic MRTS ME645A, the following options are available:

(1) *Option 001*: Conversion to add 11GHz capability  
The addition of the 11GHz band is possible both in the original order or on a retrofit basis.  
Furnished Ancillary Equipment for option 001: Coaxial low pass filter, 11GHz, Type N(M-F), MA71A.

√ (2) *Option 002*: Direct RF counting  
Direct RF counting can be included only in the original order.

(3) *Option 003*: Conversion to add 2GHz capability  
The addition of the 2GHz band is possible both in the original order or on a retrofit basis.  
Furnished Ancillary Equipment for option 003:

- a. Directional Detector (2GHz)
- b. Coaxial low pass filter, 2GHz, Type N(M-F), MA64A

(4) *Available Ancillary Equipment*: The available ancillary equipment list is shown in Table C.

Table C--Available Ancillary Equipment (Optional Accessories)

| No. | Description  | Q'ty        | Model or Part No.        | Note        |
|-----|--|-------------|--------------------------|-------------|
| 1   | RF Coaxial Attenuator, 10 ±0.5dB, 2W, DC to 11.7GHz, VSWR<1.25, Type N(M-F)  | 1           | 757C-10                  | A           |
| 2   | RF Coaxial Attenuator, 20 ±0.5dB, 2W, DC to 11.7GHz, VSWR<1.25, Type N(M-F)  | 1           | 757C-20                  | A           |
| 3   | RF Coaxial Attenuator, 30 ±1dB, 2W, DC to 11.7GHz, VSWR<1.25, Type N(M-F)  | 1           | 757C-30                  | A           |
| 4   | RF Coaxial Attenuator, 20 ±0.75dB, 20W, DC to 6.5GHz, VSWR<1.3, Type N(M-F)  | 1           | 768-20-SP                | A           |
| 5   | RF Coaxial Attenuator, Continuously variable 0 to 20dB, 3.65 to 6.5GHz, Type N(M-F)  | 1           | 793F-M-SP                | A           |
| 6   | IF Coaxial Attenuator, 3 ±0.3dB, DC to 95MHz, WEC0 560* to 440*  | 1           | MP531E                   | A           |
| 7   | IF Coaxial Attenuator, 5 ±0.3dB, DC to 95MHz, WEC0 560* to 440*  | 1           | MP531F                   | A           |
| 8   | IF Coaxial Attenuator, 10 ±0.3dB, DC to 95MHz, WEC0 560* to 440*   | 1           | MP531A                   | A           |
| 9   | IF Coaxial Attenuator, 15 ±0.3dB, DC to 95MHz, WEC0 560* to 440*   | 1           | MP531B                   | A           |
| 10  | IF Coaxial Attenuator, 20 ±0.5dB, DC to 95MHz, WEC0 560* to 440*   | 1           | MP531G                   | A           |
| 11  | IF Coaxial Attenuator, 35 ±1dB, DC to 95MHz, WEC0 560* to 440*   | 1           | MP531H                   | A           |
| 12  | IF Cable, WEC0 358* to 440*, 2.5m  | 2           | AA12                     | A           |
| 13  | IF Cable, WEC0 440* to BNC(M), 2.5m  | 1           | AA13                     | A           |
| 14  | IF Cable RG188A/U, WEC0 440* to SEALECTRO P/N 52-024-0000, 2.5m  | 1           | AA14                     | A           |
| 15  | RF Cable, Type N(M) to Type N(M), 2.5m   | 2           | AA15                     | A           |
| 16  | Adapter, WEC0 358* to 560*, Return Loss ≥ 40dB   | 1           | MP533A                   | A           |
| 17  | Adapter, WEC0 477* to 560*   | 1           | MP537A                   | A           |
| 18  | Adapter, WEC0 560* to 560*   | 1           | MA58A                    | A           |
| 19  | Adapter, Type N(M) to WEC0 560*, (Used for IF Power Head Calibration)  | 1           | MA411A                   | A           |
| 20  | Adapter, Type N(F) to Type N(F)  | 2           | 77                       | A           |
| 21  | Adapter, Fibow, Type N(M) to Type N(F)   | 1           | N-LA1014                 | A           |
| 22  | Transition, Type N(F) to WR229 Waveguide, VSWR<1.04, 4GHz band   | 2           | B40M-NA                  | A           |
| 23  | Transition, 7mm connector to WR229 Waveguide, VSWR<1.02, 4GHz band   | 1           | B40M-7A-SP               | A           |
| 24  | Transition, Type N(F) to WR159 Waveguide, VSWR<1.04, 6GHz band   | 2           | D40M-NA                  | B           |
| 25  | Transition, 7mm connector to WR159 Waveguide, VSWR<1.02, 6GHz band   | 1           | D40M-7A-SP               | B           |
| 26  | Transition, Type N(F) to WR90 Waveguide, VSWR<1.04, 11GHz band   | 1           | X40L-NA                  | C           |
| 27  | Transition, 7mm connector to WR90 Waveguide, VSWR<1.02, 11GHz band   | 1           | X40L-7A-SP               | C           |
| 28  | Filter 70MHz Band Pass, WEC0 440* to 560*<br>Insertion Loss 35dB (50MHz) 3dB (61MHz) 1.2dB (70MHz) 3dB (79MHz) 35dB (90MHz)<br>Return Loss > 26dB (64 to 76MHz, 75Ω)                               | 1           | MA49A                    | A           |
| 29  | Filter 70MHz Low Pass, WEC0 440* to 560*<br>61MHz Pass, 70MHz Suppress > 60dB, 79MHz Reject > 14dB   | 1           | MA410A                   | A           |
| 30  | Filter 74.1MHz Band Pass, WEC0 440* to 560*<br>Insertion Loss 35dB (54.1MHz) 3dB (65.1MHz) 1.2dB (74.1MHz) 3dB (83.1MHz) 35dB (94.1MHz)<br>Return Loss > 26dB (68.1 to 80.1MHz, 75Ω)               | 1           | MA49B                    | D           |
| 31  | Filter 74.1MHz Low Pass, WEC0 440* to 560*<br>65.1MHz Pass, 74.1MHz Suppress > 60dB, 83.1MHz Reject > 14dB   | 1           | MA410B                   | D           |
| 32  | Filter Low Pass, Pass Band (0.5 to 0.7GHz, VSWR<1.17, Loss<1.5dB)<br>Stop Band (1 to 1.4GHz, Loss > 40dB), Type N(M-F)   | 1           | MA56A                    | E           |
| 33  | Filter Low Pass, Pass Band (0.7 to 1GHz, VSWR<1.17, Loss<1.5dB)<br>Stop Band (1.4 to 2GHz, Loss > 40dB), Type N(M-F)   | 1           | MA57A                    | E           |
| 34  | IF Amplifier, 35 to 45dB adjustable, 55 to 95MHz, Flatness < 0.3dB, Po (Max.) > +5dBm<br>with 3m DC Cable, WEC0 560* to 560*   | 1           | MA48A                    | A           |
| 35  | IF Return Loss Bridge, 55 to 90MHz, Bridge Balance > 55dB, Test port WEC0 440*   | 1           | MR54A                    | A           |
| 36  | RF Return Loss Bridge, 2 to 12GHz, Directivity > 44dB, Test port APC-7<br>Fixed Short, (for RF Return Loss Measurement Calibration)<br>Adapter, 7mm to Type N(M), (for RF Return Loss Measurement) | 1<br>1<br>1 | SP2369<br>5230<br>34ANS0 | A<br>A<br>A |
| 37  | Test Lead for D.V.M., Dual banana plug to alligator clip and pick  | 2           | AA37                     | A           |
| 38  | Splitting Pad 75Ω, Loss 6dB nominal, 50 to 95MHz, Connectors three WEC0 560*   | 1           | MA59A                    | A           |
| 39  | Portable Test Rack, Displaying Unit and Sending Unit are stacked   | 1           | MB23A                    | A or G      |
| 40  | Soft Pack Carrying Cases, for Displaying Unit-1, for Sending Unit-1, for Auxiliary Equipment-1   | 3           |                          | A           |
| 41  | Protective Shipping Cases, for Displaying Unit-1, for Sending Unit-1, for Auxiliary Equipment-1  | 3           |                          | F           |
| 42  | IF Harmonic Filter, WEC0 440* to 560*, Pass Band (70 to 74.1MHz, Loss < 0.5dB,<br>Return Loss > 30dB), Stop Band (140 to 148.2MHz, Loss > 40dB)  | 1           | MA510A                   | A           |

Note

- A: To be provided with all orders for the MF645A.
- B: To be provided with orders for stations with TH-1, TH-3 and AR-6.
- C: To be provided with orders for stations with 11GHz equipment.
- D: To be provided with orders for TH-1 and AR-6.

- E: To be provided with orders for TD-3, early vintage.
- F: To be provided as requested.
- G: To be provided as requested.  
WEC0 560, 440, 358, 477 or Equivalent

① AA34 Cable

## 3. SPECIFICATIONS

Table D—Specifications

| 1. POWER METER                        |   |
|---------------------------------------|---|
| (1) Absolute Measurement Accuracy     | Within $\pm 0.5\text{dB}$ , when using the $75\Omega$ power head over the range 10 to 300MHz or the $50\Omega$ power head over the range 100MHz to 11.7GHz, including the effects of ancillary equipment.   |
| (2) Accuracy of Power Meter Alone     | Within $\pm 0.2\text{dB}$   |
| (3) Harmonics                         | <p>Capable of maintaining its accuracy when measuring power at +10dBm in the presence of second harmonics down 12dB from the measured signal.</p> <p>RF band (<math>50\Omega</math>) with low pass filter:<br/>           500 to 700MHz<br/>           700 to 1000MHz<br/>           2.11 to 2.18GHz<br/>           3.65 to 4.25GHz<br/>           5.8 to 6.5GHz<br/>           10.6 to 11.7GHz</p> <p>IF band (<math>75\Omega</math>) with low pass filter:<br/>           70MHz and 74.1MHz</p> |
| (4) Range                             | +10 to $-30\text{dBm}$ without external pads or amplifiers.   |
| (5) Resolution                        | 0.01dB  |
| (6) Overload Rating of the Power Head | Capable of withstanding continuously +20dBm without burnout or change in characteristics.   |
| (7) Power Head Marking                | <p>Marked as to the maximum average power the power head are capable of withstanding without burnout or change in characteristics.</p> <p>Displaying unit: "+20dBm MAX"</p> <p>Power head: "CAUTION-MAX INPUT POWER +20dBm"</p>   |
| (8) Readout                           | <p>Digital: A 4 digit LED display in dBm.</p> <p>Analog: 12dB full scale (calibrated in 0.5dB increments) peaking meter.</p>  |
| (9) Stability                         | Maximum drift of $\pm 0.1\text{dB}$ for +10 to $-25\text{dBm}$ and $\pm 0.15\text{dB}$ for $-25$ to $-30\text{dBm}$ , over a 2 hour period at $24^\circ\text{C}$ room temperature.  |
| (10) Drift Correction                 | Automatic with front panel pushbutton.  |

Table D (Cont)

|  |   |
|--|---|
| <b>(11) IF Power Head Return Loss (75Ω)</b>  |   |
| 14 to 50MHz  | no less than 25dB   |
| 50 to 95MHz  | no less than 30dB   |
| 95 to 300MHz   | no less than 20dB   |
| <b>(12) RF Power Head Return Loss (50Ω)</b>  |   |
| 0.1 to 11.7GHz   | no less than 20dB without filter  |
| [ 2.11 to 2.18GHz<br>3.65 to 4.25GHz<br>5.8 to 6.5GHz ]                                    | no less than 23dB without filter  |
| [ 500 to 700MHz<br>700 to 1000MHz<br>2.11 to 2.18GHz<br>3.65 to 4.25GHz<br>5.8 to 6.5GHz ] | no less than 15dB with filter   |
| 10.6 to 11.7GHz  | no less than 13dB with filter   |
| <b>(13) Response Time</b>  | Within 2 seconds after applying the input power to be measured.   |
| <b>(14) Spurious Signals</b>   | The power meter and head do not introduce AC or DC signals into the circuit being measured.   |
| <b>(15) Calibration Signal</b>   | The IF calibration source is energized or de-energized independent of any meter calibration through front panel CAL and rear panel CAL power Switch, ON and OFF push-button switches. |
| <b>(16) Swept Amplitude Response Range of Power Head (Oscilloscope display only)</b>       | IF band: +12 to -12dBm<br>RF band: +10 to -10dBm  |
| <b>(17) Detector Flatness (Power head acting as detector)</b>                              |   |
| <b>Frequency Band *</b>  | Transmission Flatness for up to +10dBm  |
| IF: 50 to 95MHz  | ± .025dB  |
| RF: [ 2.11 to 2.18GHz<br>3.65 to 4.25GHz<br>5.8 to 6.5GHz<br>10.6 to 11.7GHz ]             | ± .025dB  |
|  | ± .025dB  |
|  | ± .025dB  |
|  | ± .05dB   |
| * Requirements to be met over any 40MHz segment.   |   |

Table D (Cont)

|   |   |
|---|---|
| <b>(18) Detector (Power head) Harmonic Distortion</b>   | The IF detector flatness is less than $\pm 0.03\text{dB}/\pm 20\text{MHz}$ with second harmonic distortion 25dB below the measured signal (with low pass filtering for RF). |
| <b>2. DIGITAL VOLT METER</b>  |   |
| <b>(1) Ranges</b>   | $\pm 0.1$ to $\pm 100\text{VDC}$ and $\pm 100$ to $\pm 999\text{VDC}$   |
| <b>(2) Accuracy</b>   | $\pm 0.3\text{V}$ on 100V range and $\pm 3\text{V}$ on 999V range.  |
| <b>3. RETURN LOSS CIRCUITRY</b>   |   |
| The return loss is measured combination with IF and RF Return Loss Bridges.   |   |
| <b>(1) Ranges (oscilloscope display only)</b>   |   |
| IF ( $75\Omega$ )   | 0 to 20dB<br>10 to 30dB<br>20 to 40dB   |
| RF ( $50\Omega$ )   | 0 to 20dB<br>10 to 30dB   |
| <b>(2) Test Signal Power</b>  |   |
| IF ( $75\Omega$ )   | -10dBm nominal  |
| RF ( $50\Omega$ )   | -5dBm nominal   |
| <b>(3) Accuracy</b>   |   |
| IF R.L. measurement accuracy is (for test terminal of WEC0 560—without adapter):<br>within 1dB for 10 to 30dB R.L.<br>within 2dB for 0 to 10dB R.L. and 30 to 40dB R.L. |   |
| Return loss of adapter WEC0 358 to WEC0 560 (MP533A) is more than or equal to 40dB.   |   |
| RF R.L. measurement accuracy is within 3dB for up to 25dB and visible on the display for up to 30dB.  |   |
| <b>4. SPECTRUM ANALYZER</b>   |   |
| <b>(1) General Requirement</b>  |   |
| Provides a visual indication of the spectra of the total IF bands of $f_0 \pm 32\text{MHz}$ with a dynamic range of over 70dB.  |   |
| <b>(2) Scan Width Selection IF Bands</b><br>( $f_0 = 70\text{MHz}$ & $74.1\text{MHz}$ ,<br>$f_0$ is centered on display)  |   |
| $\pm 1\text{MHz}$<br>$\pm 5\text{MHz}$<br>$\pm 15\text{MHz}$<br>$\pm 32\text{MHz}$  |   |



J

Table D (Cont)

|   |  |
|---|--|
| (3) Dynamic Range                                     | 70dB ( $\pm 1$ MHz)<br>60dB (all other scan widths)<br>10dB sensitivity/cm of deflection                       |
| (4) Spurious  | -60dBm (all scan widths except $\pm 32$ MHz; Spurious at $\pm 32$ MHz is -50dBm)                               |
| (5) Reference Selection                               | 0dBm only  |
| (6) XY Plotter Output                                 | <b>Compatible</b> with existing Baseband Analyzer (S/A)  |
| (7) Input Buffer Amplifier                            | Limits L.O. Leakage out at Input Port  |
| (8) Sweep Speed                                       | 10ms/cm  |
| <b>5. DISPLAY CIRCUITRY</b>                           |  |
| (1) Vertical External Input                           | BNC Connector  |
| (2) Common Mode Rejection                             | At least 50dB on vertical external input   |
| (3) Vertical Sensitivity (a to d)                     |  |
| (Type of Signal Input)                                | dB sensitivity per cm of deflection  |
| a. IF (Detected)                                      | 0.05, 0.1, 0.5 and 1.0dB   |
| b. RF (Detected)                                      | 0.1, 0.5 and 1.0dB   |
| c. RF & IF Return Loss                                | 2.5dB  |
| d. External DC (Detected)                             | 50mV/cm of deflection  |
| (4) Vertical Bandwidth                                | Fixed at DC to 10kHz and no less than 310kHz for the external input.   |
| (5) Input Network (both Vertical and Horizontal)      | 1M $\Omega$ ( $\pm 10\%$ ) shunted by not more than 50pF.  |
| (6) Horizontal External Input                         | BNC connector; single ended DC Coupled such that a positive going voltage causes beam deflection to the right. |
| (7) Horizontal Sensitivity (including external input) | Adjustable over the range from 0.5V to 2.0V per cm.  |
| (8) Blanking  | Blank on an external +3V pulse, regardless of intensity (TTL compatible)                                       |
| (9) Z - Axis  | BNC Connector accessible from the rear panel.  |

Table D (Cont)

|  |  |
|--|--|
| <b>(10) Out of Range Indication</b>                      | Bright line display on CRT and LED (Vertical Sensitivity) lamp blink on and off when the power head input level is from $-13$ to $-39.99\text{dBm} \pm 0.2\text{dB}$ .   |
| <b>(11) Horizontal Axis</b>                              | Divided into 10 equally spaced 1cm divisions.  |
| <b>(12) Vertical Axis</b>                                | Divided into 8 equally spaced 1cm divisions.   |
| <b>(13) Faceplate</b>                                    | Shatterproof safety-shield.  |
| <b>(14) Bezel</b>  | Accommodates camera adapters from major scope camera suppliers such as HP Models CO1-10369A, 10369A and 197A and Polaroid CU-5.  |
| <b>6. RF SWEEP GENERATOR</b>                             |  |
| <b>(1) CW Mode</b>                                       | 2GHz band: 2.11 to 2.18GHz (option 003)<br>4GHz band: 3.65 to 4.25GHz<br>6GHz band: 5.8 to 6.5GHz<br>11GHz band: 10.6 to 11.7GHz (option 001)<br>(50 $\Omega$ output impedance)  |
| <b>(2) Frequency Setting Accuracy</b>                    | Within $\pm 1 \times 10^{-5}$  |
| <b>(3) <math>\Delta F</math> Sweep Mode</b>              | Fixed sweep width<br><br>sweep width: $\pm 2, \pm 10, \pm 15, \pm 20\text{MHz}$  |
| <b>(4) Leveled Power Output</b>                          | Continuously adjustable over the following ranges:<br><br>0dBm to +10dBm (2, 4, 6GHz bands)<br>0dBm to +5dBm (11GHz band)  |
| <b>(5) Cable (RF Oscillator to Directional Detector)</b> | Cable assembly is encased in a common sheath.  |
| <b>(6) Power Output Continuity</b>                       | The Power Output does not vary more than 0.2dB when switching from a swept mode to the CW mode.<br><br>in 2 and 4GHz bands, $\Delta F = \pm 10\text{MHz}$<br>in 6GHz band, $\Delta F = \pm 15\text{MHz}$<br>in 11GHz band, $\Delta F = \pm 20\text{MHz}$ |
| <b>(7) Power Output Stability</b>                        | Within $\pm 0.05\text{dB}$ over any 15 minute interval and within $\pm 0.1\text{dB}$ over any continuous 24 hour period.   |



Table D (Cont)

| (8) Power Output Flatness                       | Frequency Band   | Output Power | Output Flatness                       |
|---|--|--------------|---------------------------------------|
|   | 2 and 4GHz bands   | 0 to +10dBm  | $\pm 0.025\text{dB}/\pm 10\text{MHz}$ |
|   | 6GHz band  | 0 to +10dBm  | $\pm 0.025\text{dB}/\pm 20\text{MHz}$ |
|   | 11GHz band   | 0 to +5dBm   | $\pm 0.05\text{dB}/\pm 20\text{MHz}$  |
| (9) Sweep Frequency                             | 46Hz nominal   |              |                                       |
| (10) Sweep Linearity                            | Within $\pm 2.5\%$ of the sweep width  |              |                                       |
| (11) RF Frequency Markers                       | One pair of markers for each of the sweep modes, switch selectable in increments of 1MHz from 0 to 20MHz.  |              |                                       |
| (12) RF Frequency Markers Accuracy              | Within $\pm 0.005\%$   |              |                                       |
| (13) RF Generator Frequency Stability (a to d)  | Maximum change in frequency is:  |              |                                       |
| a. With temperature                             | $\pm 160\text{kHz}/^\circ\text{C}$ from $0^\circ\text{C}$ to $50^\circ\text{C}$<br>$\pm 200\text{kHz}/^\circ\text{C}$ from $0^\circ\text{C}$ to $50^\circ\text{C}$<br>$\pm 1.2\text{MHz}/^\circ\text{C}$ from $0^\circ\text{C}$ to $50^\circ\text{C}$  |              |                                       |
| 2 and 4GHz bands<br>6GHz band<br>11GHz band     |  |              |                                       |
| b. With line voltage                            | $\pm 1\text{MHz}$ max. for AC 103 to 127V variation  |              |                                       |
| c. With output Power                            | $\pm 1\text{MHz}$ max. for 0dBm to +10dBm change<br>$\pm 1\text{MHz}$ max. for 0dBm to +5dBm change  |              |                                       |
| 2, 4 and 6GHz bands<br>11GHz band               |  |              |                                       |
| d. With time                                    | $\pm 0.012\%$ max. over a 15-minute interval and $\pm 0.03\%$ over any continuous 24 hour period.  |              |                                       |
| (14) Aging                                      | $\pm 0.03\%$ for at least 10 years.  |              |                                       |
| (15) Spurious Radiation                         | Less than $-50\text{dBm}$ when output is delivering +10dBm (+5dBm for 11GHz band) into a resistive termination at any frequency. The harmonic radiation up to 11.7GHz is no greater in magnitude than the fundamental radiation. The unit is measured radially for radiation 12-inches from the cabinet using WR-430 waveguide for 2GHz band, WR-229 for 4GHz band, WR-159 for 6GHz band and WR-90 waveguide for 11GHz band. |              |                                       |
| (16) Harmonics                                  | At least 40dB down.  |              |                                       |
| (17) Spurious Signal (non harmonically related) | At least 64dB below the selected output power when terminated into $50\Omega$ .  |              |                                       |

Table D (Cont)

|   |  |
|---|--|
| <b>(18) Residual Amplitude Modulation</b>             | At least 40dB below the output signal.   |
| <b>(19) Residual Frequency Modulation</b>             |  |
| <b>2, 4 and 6GHz bands</b>                            | 30kHz peak   |
| <b>11GHz band</b>                                     | 50kHz peak   |
| <b>7. IF SWEEP GENERATOR</b>                          |  |
| <b>(1) CW Mode</b>                                    | 70MHz and 74.1MHz  |
| <b>(2) Frequency Setting Accuracy</b>                 | Within $\pm 2 \times 10^{-5}$  |
| <b>(3) <math>\Delta F</math> Sweep Mode</b>           | Fixed sweep width $\pm 2, \pm 10, \pm 15, \pm 20$ MHz  |
| <b>(4) Leveled Power Output</b>                       | Variable from $-70$ dBm to $+10$ dBm at a $75\Omega$ output impedance.                                       |
| <b>(5) Continuously Variable</b>                      | 10dB range ( $+10$ dBm max.)   |
| <b>(6) Step Variable</b>                              | 70dB range, 1dB steps  |
| <b>(7) Power Output Stability</b>                     | Within $\pm 0.05$ dB/15 minute interval and within $\pm 0.1$ dB/24 hour period.                              |
| <b>(8) Power Output Flatness</b>                      | Within $\pm 0.025$ dB at $\Delta F$ sweep modes between 0 and $+10$ dBm                                      |
| <b>(9) Sweep Frequency</b>                            | 46Hz nominal   |
| <b>(10) Sweep Linearity</b>                           | Within $\pm 2.5\%$ of sweep width  |
| <b>(11) IF Frequency Markers</b>                      | One pair of markers for each of the sweep modes switch selectable in increments of 1MHz between 0 and 20MHz. |
| <b>(12) IF Frequency Markers Accuracy</b>             | $\pm 0.005\%$  |
| <b>(13) IF Generator Frequency Stability (a to d)</b> |  |
| <b>a. With temperature</b>                            | $\pm 30$ kHz max./ $^{\circ}$ C at $0^{\circ}$ C to $50^{\circ}$ C   |
| <b>b. With line voltage</b>                           | $\pm 10$ kHz max. for AC 103 to 127V variation   |
| <b>c. With output power</b>                           | $\pm 10$ kHz max. for 0 to $+10$ dBm change  |
| <b>d. With time</b>                                   | $\pm 50$ kHz max. over a 15 minute interval<br>$\pm 100$ kHz max./24 hour period                             |

**Table D (Cont)**

| <b>(14) Spurious Radiation</b>                         | <p>The radiation from the fundamental frequency from the IF oscillator is no greater than -100dBm when the output is delivering +10dBm into a resistive termination at any frequency. The harmonic radiation up to 300MHz shall be no greater in magnitude than the fundamental radiation. The unit is measured radially for radiation with a suitable field intensity meter, excited by a simple resonant dipole placed no more than 12 feet and no less than 8 feet from the finished chassis, with no additional shielding.</p>   |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
|--|--|---------------------|----------------|----------------|----------|-------|-------|----------|-------|-------|----------|-------|-------|----------|-------|---|----------|-------|---|
| <b>(15) Harmonics</b>                                  | <p>The magnitude of the second and third harmonic of 50(54.1), 60(64.1), and 70(74.1)MHz present in the generator output is measured by means of a suitable selective analyzer. In addition, the second harmonic of 80(84.1) and 90(94.1)MHz is measured and their magnitudes relative to the fundamental, is no greater than the following:</p> <table border="1" data-bbox="764 862 1409 1090"> <thead> <tr> <th data-bbox="764 874 997 901">Fundamental, f, MHz</th> <th data-bbox="1101 862 1133 915"><math>\frac{2f}{f}</math></th> <th data-bbox="1230 862 1263 915"><math>\frac{3f}{f}</math></th> </tr> </thead> <tbody> <tr> <td data-bbox="829 939 922 965">50(54.1)</td> <td data-bbox="1084 939 1166 965">-40dB</td> <td data-bbox="1214 939 1295 965">-40dB</td> </tr> <tr> <td data-bbox="829 969 922 995">60(64.1)</td> <td data-bbox="1084 969 1166 995">-40dB</td> <td data-bbox="1214 969 1295 995">-40dB</td> </tr> <tr> <td data-bbox="829 999 922 1026">70(74.1)</td> <td data-bbox="1084 999 1166 1026">-40dB</td> <td data-bbox="1214 999 1295 1026">-40dB</td> </tr> <tr> <td data-bbox="829 1030 922 1056">80(84.1)</td> <td data-bbox="1084 1030 1166 1056">-40dB</td> <td data-bbox="1252 1030 1263 1056">-</td> </tr> <tr> <td data-bbox="829 1060 922 1086">90(94.1)</td> <td data-bbox="1084 1060 1166 1086">-40dB</td> <td data-bbox="1252 1060 1263 1086">-</td> </tr> </tbody> </table> | Fundamental, f, MHz | $\frac{2f}{f}$ | $\frac{3f}{f}$ | 50(54.1) | -40dB | -40dB | 60(64.1) | -40dB | -40dB | 70(74.1) | -40dB | -40dB | 80(84.1) | -40dB | - | 90(94.1) | -40dB | - |
| Fundamental, f, MHz                                    | $\frac{2f}{f}$   | $\frac{3f}{f}$      |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| 50(54.1)   | -40dB  | -40dB               |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| 60(64.1)   | -40dB  | -40dB               |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| 70(74.1)   | -40dB  | -40dB               |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| 80(84.1)   | -40dB  | -                   |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| 90(94.1)   | -40dB  | -                   |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(16) Spurious Signal (non harmonically related)</b> | <p>At least 70dB below selected output power when terminated in 75Ω</p>  |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(17) Residual Frequency Modulation</b>              | <p>No greater than 1.5kHz peak</p>   |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(18) Slope Adjusting Range</b>                      | <p>No less than ±0.1dB slope over 50 to 90 and 54.1 to 94.1 MHz range, front panel adjustment.</p>   |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(19) Frequency Shift</b>                            | <p>The 70 and 74.1MHz CW frequencies are shifted by +300kHz and -300kHz for C/I measurements.</p>  |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>8. FREQUENCY COUNTER</b>                            |  |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(1) Frequency Range</b>                             | <p>14 to 300MHz directly and without prescaling.</p>   |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(2) Input Network</b>                               | <p>At least 1MΩ shunted by less than 20 pF (14 to 135MHz) and 50Ω (14 to 300MHz) switchable.</p>   |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(3) Input Level</b>                                 | <p>15mV to 5Vrms without need for level adjustment.</p>  |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |
| <b>(4) Accuracy</b>                                    | <p>±1 count ± Time Base oscillator stability.</p>  |                     |                |                |          |       |       |          |       |       |          |       |       |          |       |   |          |       |   |

Table D (Cont)

|   |   |
|---|---|
| (5) Time Base Stability (a to c)                        |   |
| a. Short term   | a) At least $5 \times 10^{-8}$ (after 15 minutes warm up) for a minimum of 2 hours and<br>b) At least $5 \times 10^{-9}$ per day after 24 hours continuous operation.   |
| b. Aging  | $\pm 1 \times 10^{-7}$ per year   |
| c. With line voltage                                    | $1 \times 10^{-9}$ for AC 103 to 127V   |
| (6) Time Base Frequency                                 | 10MHz   |
| (7) Time Base Output                                    | 1V peak-to-peak minimum across $50\Omega$ (TTL compatible)  |
| (8) Time Base Adjustment                                | A minimum of $\pm 5 \times 10^{-8}$   |
| (9) Oven  | Crystal oven remains on when the front panel power switch is turned off.  |
| (10) Sample Rate  | Minimum 0.08 seconds. Variable by steps of 0.08, 0.8, 2 seconds and hold.   |
| (11) Gate Time  | 10, 1 and 0.1 seconds   |
| (12) Resolution   | 0.1, 1 and 10Hz   |
| <b><u>RF Measurements (Option 002) (13) to (17)</u></b> |   |
| (13) RF Frequency Range                                 | <b>2GHz band:</b> 2.11 to 2.18GHz (option 003)<br>4GHz band: 3.65 to 4.25GHz<br>6GHz band: 5.8 to 6.5GHz<br>11GHz band: 10.6 to 11.7GHz (option 001)<br>directly without manual or external prescaling or tuning. |
| (14) Input Network                                      | Over the specified frequency range the input impedance is a nominal $50\Omega$ .  |
| (15) Input Connector                                    | Type "N" connector.   |
| (16) Input Level  | -20dBm to +7dBm   |
| (17) Resolution   | 1kHz  |
| <b>9. ENVIRONMENTAL</b>                                 |   |
| (1) Specification Compliant Ranges (a to c)             |   |
| a. Temperature  | 0°C to +50°C  |
| b. Altitude   | 0 to 10000 feet above sea level   |
| c. Relative humidity                                    | 10% to 95%  |



Table D (Cont)

|  |   |
|--|---|
| <b>(2) Storage Range</b>                         | -40°C to +60°C  |
| <b>(3) Warm up Time</b>                          | a) 15 minutes from turn-on from an ambient of 24°C and<br>b) 60 minutes from turn-on in an ambient of 24°C after being brought in from an environment of -18°C.                     |
| <b>(4) Burn-in</b>                               | 96 hour operational burn-in at +50°C  |
| <b>(5) AC Input</b>                              | Single phase 115 ±12V, 60Hz, ≤ 250VA power source.  |
| <b>(6) Shock and Vibration</b>                   | MIL-STD-810B, Method 514.7 Procedure X, Sinusoidal Cycling only.  |
| <b>a. Shock</b>                                  | At room ambient conditions per MIL-STD-810B 20g, 10 milliseconds, sawtooth ascending pulse, two repetitions in each direction of three mutually perpendicular axis (12 drops).      |
| <b>b. Vibration</b>                              | 0.25 inches displacement, D.A., 5 to 9Hz and 1.0g from 9 to 100Hz.<br>A sweep rate of two minutes per octave ascending and descending in each of three mutually perpendicular axis. |
| <b>10. MECHANICAL &amp; MISCELLANEOUS</b>        |   |
| <b>(1) Weight (including each carrying case)</b> |   |
| <b>Displaying Unit</b>                           | less than 40 lbs. (<19kg)   |
| <b>Sending Unit</b>                              | less than 40 lbs. (<19kg)   |
| <b>Ancillary Equipment</b>                       | less than 40 lbs. (<19kg)   |
| <b>(2) Dimensions (each unit)</b>                | 16.8in.(426mm)W × 17.8in.(450mm)D × 5.7in.(145mm)H<br>(except for controls, handles, etc.)  |
| <b>(3) AC Power Cord</b>                         | The 7'6" detachable power cord is yellow and equipped with a NEMA 5-15P ground plug.  |
| <b>(4) Line Fuses</b>                            | are accessible from the rear panel.   |
| <b>(5) Ground Loop</b>                           | <b>The MRTS does not exhibit any ground loop problems when in a back-to-back configuration. (RF &amp; IF flatness requirements are met).</b>  |
| <b>(6) N Type Connectors</b>                     | Internal dimensions and tolerances of mating surfaces meet MIL-C-39012.<br>N connector shells and the nut on male connectors are stainless steel.                                   |

Table D (Cont)

|                                    |   |
|------------------------------------|---|
| <b>(7) Repeater Bay Interfaces</b> | The MRTS interfaces repeater bays with N-type connectors for 50 $\Omega$ test points, and WECO 560A, or approved equivalent, jacks for 75 $\Omega$ test points.                         |
| <b>(8) Portable Test Rack</b>      | A collapsible mobile rack is available to support the MRTS. It does not restrict a view of the MRTS while in a kneeling position making adjustments on a repeater bay near floor level. |