SERIES 560-9XXXX AND 5400-6XXXX SWR AUTOTESTERS OPERATION AND MAINTENANCE MANUAL

1. INTRODUCTION

This manual provides product descriptions and specifications for ANRITSU Series 560-9XXXX and 5400-6XXXX SWR Autotesters (Figure 1). It also includes Performance Verification procedures for these components.

2. GENERAL DESCRIPTION

The ANRITSU Series 560-9XXXX and 5400-6XXXX SWR Autotesters integrate a high directivity bridge, a detector, a low reflection test port, a precision reference termination, and a connecting cable. In the Series 560-9XXXX Offset SWR Autotesters, the precision reference termination is replaced with a 15 dB or 20 dB offset termination.

Series 5400-6XXXX models have F, N, or BNC type test port connectors. Series 560-97XXX models have N or GPC-7 type test port connectors, and series 560-98XXX models have WSMA, K, or V type test port connectors. The Model 560-98C50A Convertible SWR Autotester (Figure 2) has six interchangeable test port heads—male and female for WSMA, 3.5 mm, and K type test connectors.

Figure 1. Typical Series 560-9XXXX SWR Autotesters

Figure 2. Model 560-98C50A Convertible SWR Autotester.

These units are broadband microwave measurement components that are used with the Model 56100A and 562 Scalar Network Analyzers and with Series 541XXA, 540XXA, and 54XXA Scalar Measurement Systems for making fixed-frequency and swept-frequency return loss (SWR) measurements. Return loss measurements are used over a wide range of radio and microwave frequencies to check the performance of systems, subsystems, and microwave components such as amplifiers, directional couplers, attenuators, filters, splitters, and terminations.

3. PERFORMANCE SPECIFICATIONS

Performance specifications for the Series 560-9XXXX and 5400-6XXXX SWR Autotesters are listed in Table 1 (pages 2 and 3).

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490 JARVIS DRIVE ● MORGAN HILL, CA 95037-2809

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NOTE: ANRITSU Company was formerly known as WILTRON Company.

Table 1. 560-9XXX and 5400-6XXXX SWR Autotester Performance Specifications (Page 1 of 2)

Models	Direc-tivity (dB)	Accuracy ① ②				Freq Sensi-tivity (dB)	Test Port Conn.	Physical
560-97XXXX Series SWR Autotesters, 10 MHz to 18 GHz ③								
560-		***0.01–8 GHz***	***8–18 GHz***					
-97A50	36	0.016 ±0.06ρ^2	0.016 ±0.10ρ^2			±1.2	GPC–7	*Dimensions* ⑥: 7.6 x 5.1 x 2.8 cm (3 x 2 x 1 ⅛ in.) *Weight:* 340 g (12 oz)
-97A50-1	40	0.010 ±0.06ρ^2	0.010 ±0.10ρ^2			±1.2	GPC–7	
-97N50 -97NF50	35	0.018 ±0.08ρ^2	0.018 ±0.12ρ^2			±1.5	Type N (m) Type N (f)	
-97N50-1 -97NF50-1	38	0.013 ±0.08ρ^2	0.013 ±0.12ρ^2			±1.5	Type N (m) Type N (f)	
560-98XXXX Series SWR Autotesters, 10 MHz to 40 GHz ④								
560-		***0.01–8 GHz***	***8–18 GHz***	***18–26.5 GHz***	***26.5–40 GHz***			
-98S50 -98SF50	37 36	0.014 ±0.07ρ^2	0.014 ±0.10ρ^2	0.016 ±0.13ρ^2		±2.0	WSMA (m) WSMA (f)	*Dimensions* ⑥: 1.9 x 3.8 x 2.9 cm (¾ x 1-½ x 1-⅛ in.) *Weight:* 198 g (7 oz)
-98S50-1 -98SF50-1	40 38	0.010 ±0.07ρ^2	0.010 ±0.10ρ^2	0.013 ±0.13ρ^2		±2.0	WSMA (m) WSMA (f)	
-98K50 -98KF50	35 32 30	0.018 ±0.07ρ^2	0.018 ±0.07ρ^2	0.026 ±0.15ρ^2	0.032 ±0.18ρ^2	±3.0	Type K (m) Type K (f)	
560-98C50A Convertible SWR Autotester, 10 MHz to 40 GHz ④								
560-		***0.01-20 GHz***	***20-26.5 GHz***	***26.5-40 GHz***				
-98C50A	34 32 29	0.020 ±0.09ρ^2	0.025 ±0.13ρ^2	0.036 ±0.13ρ^2		±3.0	WSMA (m) WSMA (f) 3.5 mm (m) 3.5 mm (f) Type K (m) Type K (f)	*Dimensions* ⑥: 2.2 x 6.6 x 5.3 cm (⅞ x 2-⅝ x 2-⅛ in.) *Weight:* 198 g (7 oz)
560-98XXXX Series SWR Autotesters, 10 MHz to 50 GHz ⑤								
560-		***0.01-50 GHz***						
-98VA50 -98VFA50	30	0.032 ±0.11ρ^2				±4.0	Type V (m) Type V (f)	*Dimensions* ⑥: 2.2 x 6.6 x 5.3 cm (⅞ x 2-⅝ x 2-⅛ in.) *Weight:* 198 g (7 oz)
All Models:								
Input Port Impedance: 50Ω				*Output Time Constant:* 2 µs				
Insertion Loss (from input to test port): 6.5 dB nominal				*Maximum Power Input:* 0.5 watts (+27 dBm) + (560-98C50A: +24 dBm)				
Detector Output Polarity: Negative								
Cable Length: 122 cm (4 ft.)								

① Where ρ is the reflection coefficient being measured. Accuracy includes the effects of test port reflections and directivity.

② See paragraph 4 for an explanation of accuracy and other terms.

③ Input Connector: Type N Female

④ Input Connector: Ruggedized Type K Female

⑤ Input Connector: Ruggedized Type V Female

⑥ Plus connectors and cable

Table 1. 560-9XXX and 5400-6XXXX SWR Autotester Performance Specifications (Page 2 of 2)

Models	Directivity (dB)	Accuracy ① ②				Freq Sensitivity (dB)	Test Port Conn.	Physical
5400-6XXXX Series SWR Autotesters, 1 MHz to 3000 MHz								
5400-		***10–1000 MHz***						*Dimensions*⑤: 2.5 x 5.1 x 7.0 cm (1 x 2 x 2-¾ in.) *Weight:* 255 g (9 oz)
-67FF75③⑥	40	0.010 ±0.01ρ²					F (f)	
		1-1500 MHz						
-6B50B④	40	0.010 ±0.01ρ²					BNC (m)	
-6BF50B④	40	0.010 ±0.01ρ²					BNC (f)	
-6B75B④⑥	40	0.010 ±0.10ρ²					BNC (m)	
-6BF75B④⑥	40	0.010 ±0.10ρ²					BNC (f)	
		1-1000 MHz	***1000-2000 MHz***	***2000-3000 MHz***				
-6N50④	40	0.010 ±0.05ρ²	0.010 ±0.05ρ²	0.010 ±0.05ρ²			Type N (m)	
-6NF50④	40	0.010 ±0.05ρ²	0.010 ±0.05ρ²	0.010 ±0.05ρ²			Type N (f)	
-6N75④⑥	40	0.010 ±0.05ρ²	0.010 ±0.05ρ²	0.010 ±0.08ρ²			Type N (m)	
-6NF75④⑥	40	0.010 ±0.05ρ²	0.010 ±0.05ρ²	0.010 ±0.08ρ²			Type N (f)	

All Models:

Input Port Impedance: 50Ω (Except as Noted)
Insertion Loss (from input to test port): 6.5 dB nominal
Detector Output Polarity: Negative
Output Time Constant: 2 µs
Maximum Power Input: 0.5 watts (+27 dBm)
Cable Length: 122 cm (4 ft.)

① Where ρ is the reflection coefficient being measured. Accuracy includes the effects of test port reflections and directivity.
② See paragraph 4 for an explanation of accuracy and other terms.
③ Input Connector: BNC Female
④ Input Connector: Type N Female
⑤ Plus connectors and cable
⑥ Impedance 75Ω

4. EXPLANATION OF SWR AUTOTESTER SPECIFICATIONS

Certain key specification terms are explained below.

a. Accuracy. This three-element term defines the accuracy with which an SWR Autotester can make a reflected signal measurement. The three elements (0.01 ±0.06 ρ^2) are described below.

1st Element: (0.01) is the directivity of the SWR Autotester expressed as a reflection coefficient (40 dB for this example, refer to Table 6 on page 14).

2nd and 3rd Elements: ±0.06ρ^2 is the degradation in accuracy due to test port mismatch (impedance discontinuity). Element 2 (0.06) is the inherent test port mismatch expressed as a reflection coefficient. The 3rd element, rho (ρ), is the reflection coefficient of the device under test (DUT). The entire expression describes the measurement uncertainty caused by the reflected signal being re-reflected by the test port mismatch.

b. Directivity. A figure of merit expressed in dB. This figure represents the ratio of the power levels as seen at the output port when (1) the test port signal is fully reflected, and (2) the test port is perfectly terminated.

c. Frequency Sensitivity. The maximum variation in output power/voltage that can be expected due to a change in frequency over the specified range when the input power is held constant

d. Output Time Constant. The amount of time required for the selected output pulse to either rise from the 10% to the 90% point or fall from the 90% to the 10% point on the waveform.

5. PRECAUTIONS FOR USE OF SWR AUTOTESTERS

ANRITSU SWR Autotesters are high-quality, precision laboratory instruments and should receive the same care and respect afforded such instruments. Follow the precautions listed below when handling or connecting these devices. Complying with these precautions will guarantee longer component life and less equipment downtime due to connector or device failure. Also, such compliance will ensure that SWR Autotester failures are not due to misuse or abuse—two failure modes not covered under the ANRITSU warranty.

a. Beware of Destructive Pin Depth of Mating Connectors. Based on RF components returned for repair, destructive pin depth of mating connectors is the major cause of failure in the field. When an RF component connector is mated with a connector having a destructive pin depth, damage will usually occur to the RF component connector. A destructive pin depth is one that is too long in respect to the reference plane of the connector (Figure 3).

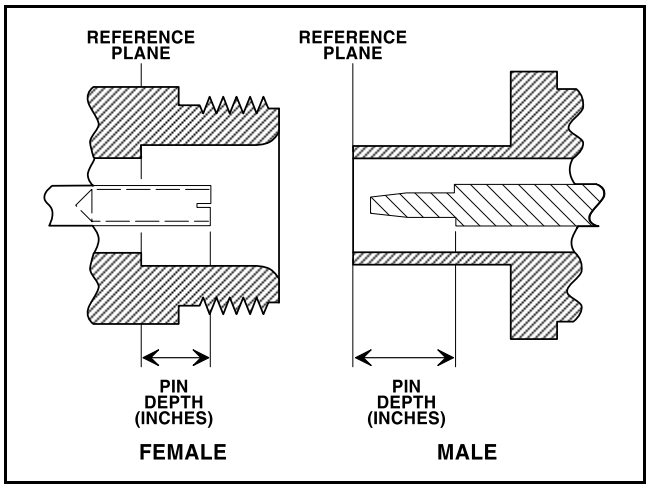


Figure 3. N Connector Pin Depth Definition

The center pin of a precision RF component connector has a precision tolerance measured in mils (1/1000 inch). The mating connectors of various RF components may not be precision types. Consequently, the center pins of these devices may not have the proper depth. The pin depth of DUT connectors should be measured to assure compatibility before attempting to mate them with SWR Autotester connectors. A ANRITSU Pin Depth Gauge (Figure 4), or equivalent, can be used for this purpose.

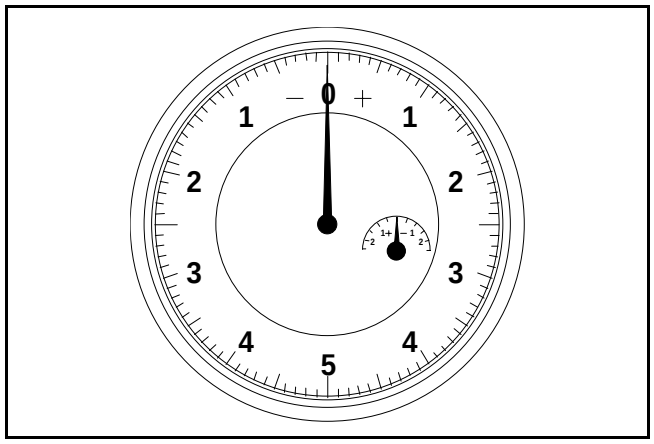


Figure 4. Pin Depth Gauge

If the measured connector is out of tolerance in the "+" region, the center pin is too long (see Tables 2). Mating under this condition will likely damage the precision RF component connector. If the test device connector measures out of tolerance in the "–" region, the center pin is too short. This will not cause damage, but it will result in a poor connection and a consequent degradation in performance.

Table 2. Allowable Device Under Test (DUT) Connector Pin Depth

DUT Connector Type	ANRITSU Gauging Set Model	Pin Depth (inches)	Pin Depth Gauge Reading
N-Male N-Female	01-163	.207 –0.000 +0.030	207 +0.000 –0.030
GPC-7	01-161	+0.000 –0.030	Same as Pin Depth
WSMA-Male WSMA-Female	01-162	–0.000 –0.010	Same as Pin Depth
SMA-Male, SMA-Female	01-162	–0.000 –0.010	Same as Pin Depth
3.5 mm-Male 3.5 mm-Female	01-162	–0.000 –0.010	Same as Pin Depth
K-Male, K-Female	01-162	+0.000 –0.010	Same as Pin Depth
V-Male V-Female	01-164	+0.000 –0.010	Same as Pin Depth

b. Avoid Over Torquing Connectors. Over torquing connectors is destructive; it may damage the connector center pin. Finger-tight is usually sufficient for Type N connectors. *Always* use a connector torque wrench (8 inch-pounds) when tightening GPC-7, WSMA, K, or V type connectors. *Never use pliers to tighten connectors*.

c. Avoid Mechanical Shock. SWR Autotesters are designed to withstand years of normal bench handling. However, do not drop or otherwise treat them roughly. Mechanical shock will significantly reduce their service life.

d. Avoid Applying Excessive Power. The Series 560-9XXXX and Series 5400-6XXXX SWR Autotesters are rated at +27 dBm (0.5W) maximum input power. Exceeding this input power level, even for short durations, will permanently damage their internal components.

e. Do Not Disturb Teflon Tuning Washers On Connector Center Pins. The center conductor of many RF component connectors contains a small teflon tuning washer that is located near the point of mating (Figure 5). This washer compensates for minor impedance discontinuities at the interface. *Do not disturb this washer*. The location of this washer is critical to the performance of the RF component.

f. Compensation Washers (WSMA Connectors). WSMA connectors are optimized for connection to standard SMA connectors. SMA connectors are not used on instruments because they are not designed for repeated connector insertions. Instead, instruments have mechanically compatible connectors that mate to SMA. The WSMA connector presents a slightly inductive interface to the SMA connection so as to cancel capacitance through the SMA's dielectric. Whenever two WSMA connectors are mated, a beryllium copper compensation washer should be inserted between the two connectors at the point of mating (to provide pin-depth compensation for this connector combination). The only exceptions are the WSMA Open/Short and the RF Output connectors of the 541XXA and other ANRITSU RF signal sources. A vial containing five of these washers (P/N ND38252) is packaged with each Series 19SX50 Air Line. Figure 14, page 13, shows a typical compensation washer installation.

NOTE

The teflon washer is shown on a GPC-7 connector. A similar washer may be installed on any ANRITSU precision connector.

Figure 5. Tuning Washer on GPC-7 Connector

g. Keep Connectors Clean. The precise geometry that makes possible the RF component's high performance can be easily disturbed by dirt and other contamination adhering to connector interfaces. When not in use, keep the connectors covered. Refer to paragraph 7 for cleaning instructions.

6. PERFORMANCE VERIFICATION

Performance verification consists of measuring the test port connector pin depth and measuring the directivity of the SWR Autotester.

6.1. Pin Depth Measurement

Gauging sets for measuring the pin depth of the test port connectors of SWR Autotesters and other precision RF components are available from ANRITSU. Tables 3 and 4 (page 6) list the appropriate gauging set and pin-depth specifications for the N, GPC-7, WSMA, SMA, 3.5 mm, K, and V type connectors used in the Series 560-9XXXX and 5400-6XXXX SWR Autotesters. Refer to the connector pin depth measurement instructions that are provided with each gauging set.

6.2. Directivity Measurements

Directivity measurements are frequency limited. For frequencies ≥500 MHz (GPC-7 and N type connectors) and ≥800 MHz (WSMA and K type connectors), a *magnified reflection technique* (air line) measurement is used. Below these frequencies, where an air line is not effective, an *error averaging measurement method* is used.

Table 3. Allowable Test Port Connector Pin Depth

Test Port Connector Type	ANRITSU Gauging Set Model	Pin Depth (inches)	Pin Depth Gauge Reading
N-Male	01-163	.207 –0.000 +0.003*	207 +0.000 –0.003*
N-Female	01-163	.207 –0.000 +0.002*	207 +0.000 –0.002*
GPC-7	01-161	+0.000 –0.003	Same as Pin Depth
WSMA-Male	01-162	–0.0025 –0.0035	Same as Pin Depth
WSMA-Female	01-162	–0.0003 –0.0007	Same as Pin Depth
K-Male, K-Female	01-162	+0.000 –0.001	Same as Pin Depth
V-Male V-Female	01-164	+0.000 –0.001	Same as Pin Depth
* 0.004 for 5400-6XXXX Series SWR Autotesters			

Table 4. Allowable Test Port Connector Pin Depth, 560-98C50A Convertible Autotester

Test Port Connector Type	ANRITSU Gauging Set Model	Pin Depth (inches)	Pin Depth Gauge Reading
SMA-Male	01-162	–0.0005 –0.0015	Same as Pin Depth
SMA-Female	01-162	–0.0005 –0.0015	Same as Pin Depth
3.5 mm-Male	01-162	–0.006 –0.008	Same as Pin Depth
3.5 mm-Female	01-162	–0.006 –0.008	Same as Pin Depth
K-Male	01-162	–0.0000 –0.0005	Same as Pin Depth
K-Female	01-162	–0.0000 –0.0005	Same as Pin Depth

Table 5. Recommended Test Equipment

Instrument	Required Characteristics	Recommended Model and Manufacturer
Scalar Network Analyzer System*	*Includes:* *Scalar Network Analyzer* Vertical Sensitivity: 0.5 dB/Div. Variable Offset Control *Synthesizer* Leveled Output: ±1.0 dB Frequency Range: 0.01 – 40 GHz*	ANRITSU 56100A SNA and ANRITSU Series 68XXXA/rB Synthesizer or ANRITSU 541XXA Scalar Measurement System
Air Line	GPC-7 Connector (SWR: 1.003) Type N Connector (SWR: 1.006) WSMA Connector (SWR: 1.006) K Connector (SWR: 1.020)	ANRITSU 18A50 ANRITSU 18NX50 Series ANRITSU 19SX50 Series ANRITSU 19KX50 Series
Precision Offset Termination	15 dB or 20 dB Return Loss	ANRITSU 29 Series
Precision Termination	*50 ±0.5 Ohms* GPC-7 Test Port Connector Type N Male/Female Test Port Connector WSMA Male/Female Test Port Connector Type K Male/Female Test Port Connector *75 ±0.5 Ohms* Type N Male/Female Test Port Connector	ANRITSU: 28A50/28A50-1 26N50/26NF50 28S50/28SF50 28K50/28KF50 ANRITSU: 26N75A/26NF75A
* The Scalar Network Analyzer System used should have a frequency range that matches (or exceeds) the frequency range of the SWR Autotester being tested.		

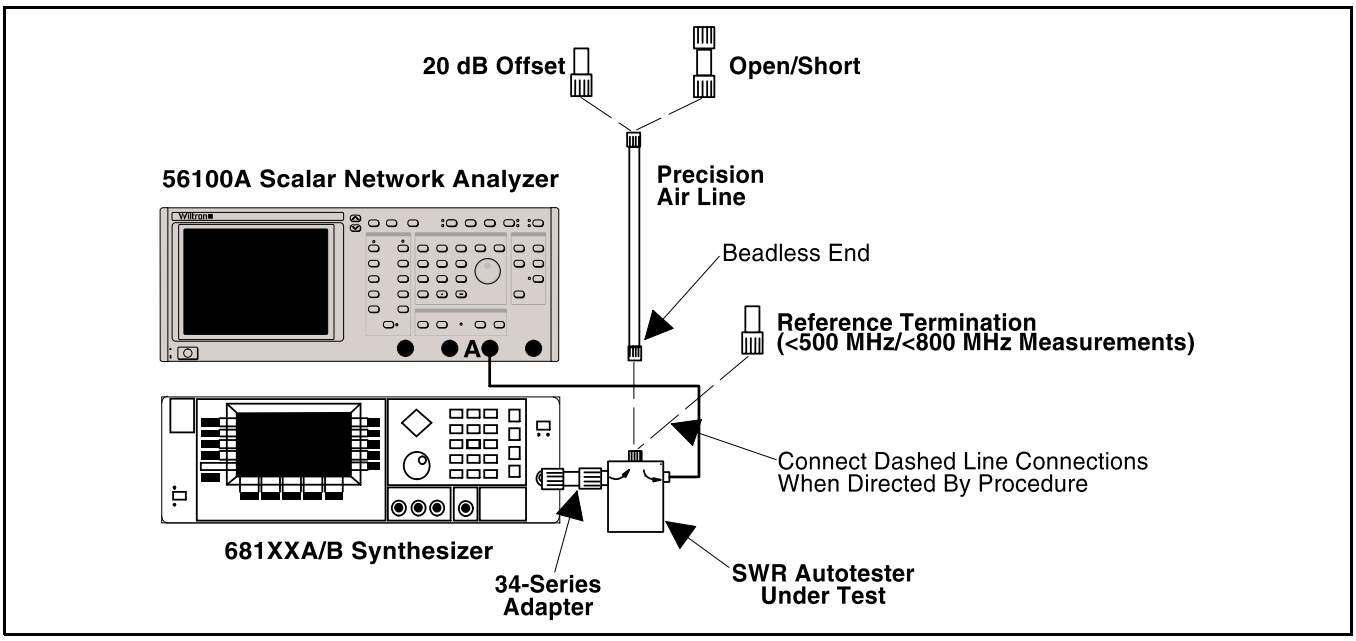


Figure 6. Test Equipment Setup for Directivity Measurement Using 56100A Scalar Network Analyzer

Table 5 lists recommended test equipment for performing these measurements. Measurement procedures are given below.

Measuring the directivity of Series 560-9XXXX and 5400-6XXXX SWR Autotesters above 500 MHz/ 800 MHz requires the use of a Series 18XX50 or 19XX50 Air Line that matches the test port connector of the SWR Autotester being tested (see Table 5). If a series 19SX50 air line is used (WSMA connectors), compensation washers are required.

The following paragraphs contain procedures for measuring the directivity of SWR Autotesters. The procedures in paragraphs ***a*** thru ***c*** use the Model 56100A Scalar Network Analyzer (SNA) in conjunction with an appropriate 681XXA/B Synthesizer. The procedures in paragraphs ***d*** thru ***f*** , beginning on page 11, use an appropriate model 541XXA Scalar Measurement System (SMS).

a. Equipment Setup — Using 56100A SNA

1. Connect test setup as shown in Figure 6.
2. Press the LINE key on the 681XXA/B signal source to OPERATE.
3. Press the Power key on the 56100A network analyzer to On.
4. Press the SYSTEM key on the signal source, then select the **Reset** key, from the displayed menu.
5. Set the signal source for frequency range of the SWR Autotester under test and for maximum possible power, as described below.
   (a) Press CW/SWEEP SELECT key.
   (b) Select the **Analog** softkey from the displayed menu.
   (c) Select the **Edit F1** softkey from the displayed menu.
   (d) Using the Cursor Control Key or Rotary Data Knob, edit the F1 parameter to equal the low-end frequency of the SWR Autotester under test.
   (e) Select the **Edit F2** softkey and repeat step (d) for the high-end frequency.
   (f) Select the **Edit L1** softkey and repeat step (d) for the source's maximum power level.
6. Press System Menu key on the scalar network analyzer.
7. Using Menu up-down keys, highlight **RESET**, then press Select key.
8. Press Graticule key to On.

b. Directivity Measurement—500 MHz/ 800 MHz to 40 GHz

1. On the network analyzer, press Channel 2 Display On/Off key to Off.
2. Press Channel 1 Menu key.

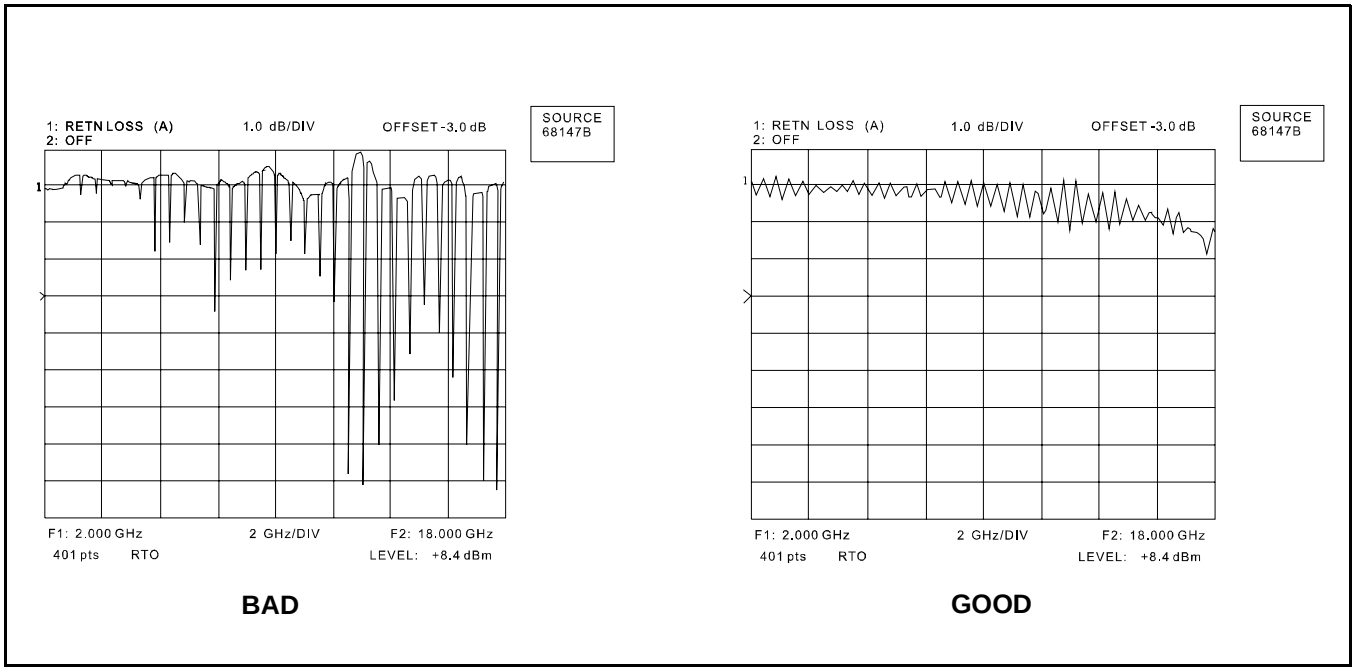


Figure 7. Examples of Good and Bad Air Line Connections

3. Using the Menu up-down keys: Highlight **RETURN LOSS**, then press Select key.
4. Press the Calibration key.
5. Using the Menu up-down keys: Highlight **START CAL**, then press the Select key.
6. Connect the SWR Autotester to INPUT A, if you have not done so yet.

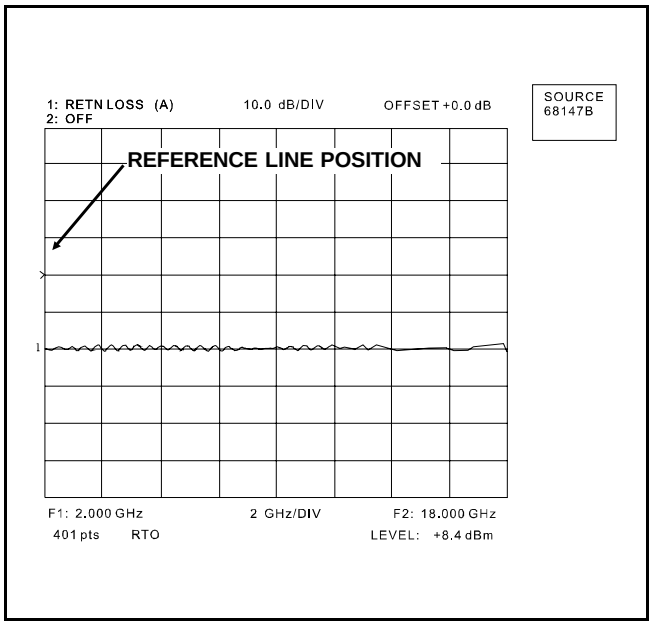


Figure 8. Reference Line Position

7. Connect the beadless end of the air line to the SWR Autotester test port. Pay careful attention to making a good connection. Refer to Figure 7, which shows examples of good and bad connections. If you are using 19SX50 series air lines (WSMA connectors), use a compensation washer.
8. Connect the OPEN to the air line and press the Select key.
9. Remove the OPEN and connect the SHORT to the air line and press the Select key.
10. Remove the SHORT and connect the Offset Termination (15 dB or 20 dB) to the air line and press the Select key.
11. Press the Channel 1 Menu key.
12. Using the Menu up-down keys: Highlight **REF LINE** and press the Select key. Then highlight **ON** and again press the Select key.
13. Using the Data Entry knob, set the reference line to the fourth graticule line from the top of the display (Figure 8).
14. Press the Channel 1 Autoscale key.
15. Press the Channel 1 Offset/Resolution key.
16. Using the Menu up-down keys: Highlight **OFFSET dB**, then press the Select key.

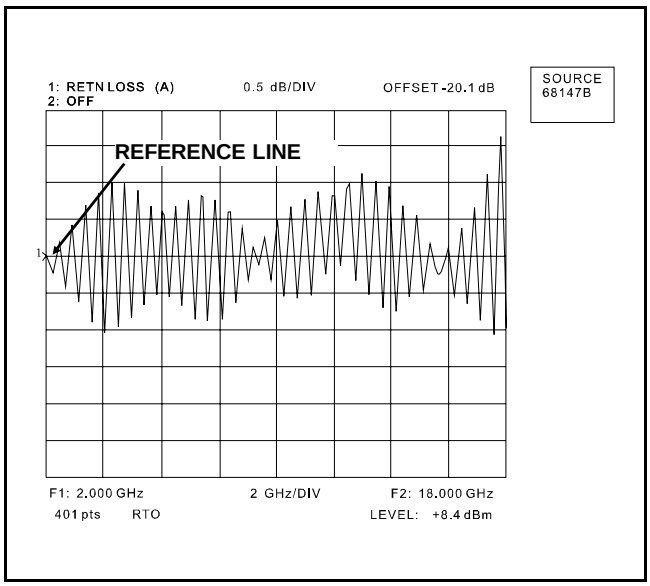


Figure 9. Signal Aligned With the Reference Line

17. Using the Data Entry/Cursor knob, align the Channel 1 signal with the reference line (Figure 9).

NOTE

The **OFFSET** value displayed at the top of the display should be approximately the value of the Offset Termination used.

18. Observe the displayed ripple pattern. Select the ripple with the greatest amplitude and use the Data Entry/Cursor knob to reposition the waveform so that the average point of the selected ripple is on the reference line. Read the **OFFSET** value from the top of the display.
19. Measure the peak-to-peak value of the selected ripple.
20. In the "REF ±X. Peak to Peak Ripple, dB" column of Table 6 (page 14), find the value nearest to the peak-to-peak signal value measured in step 19.
21. Read the coordinate value from the "X dB Below Reference" column of the table.
22. Add the "X dB Below Reference" value from step 21 to the value read in step 18. The sum is the worst- case directivity of the SWR Autotester. It should equal or exceed the specification for the SWR Autotester shown in Table 1.

c. Directivity Measurements Below 500 MHz/ 800 MHz

1. Perform the setup procedure in subparagraph a.
2. Perform steps 1 thru 6 of subparagraph b.
3. Connect the precision termination to the test port of the SWR Autotester being measured*.
4. Press Channel 1 Menu key.
5. Using the Menu up-down keys: Highlight **REF LINE** then press the Select key.
6. Using the Data Entry knob, set the reference line to midscale on the display.
7. Press the Channel 1 Offset/Resolution key.
8. Using the Menu up-down keys: Highlight **OFFSET dB**, then press the SELECT key.
9. Using the Data Entry knob, set **OFFSET dB** for the specified directivity value of the SWR Autotester being measured (refer to Table 1).
10. Using the Menu up-down keys: Highlight **RESOLUTION dB**, then press the Select key.
11. Using the Data Entry knob, set **RESOLUTION dB** for a convenient value.
12. Observe the display. If the measured directivity signal is below the reference line at all frequencies, then the directivity is within the specified value.

* The return loss of the precision termination used for this test must be higher than the directivity of the SWR Autotester being measured. The ANRITSU terminations recommended in Table 5 meet this requirement.

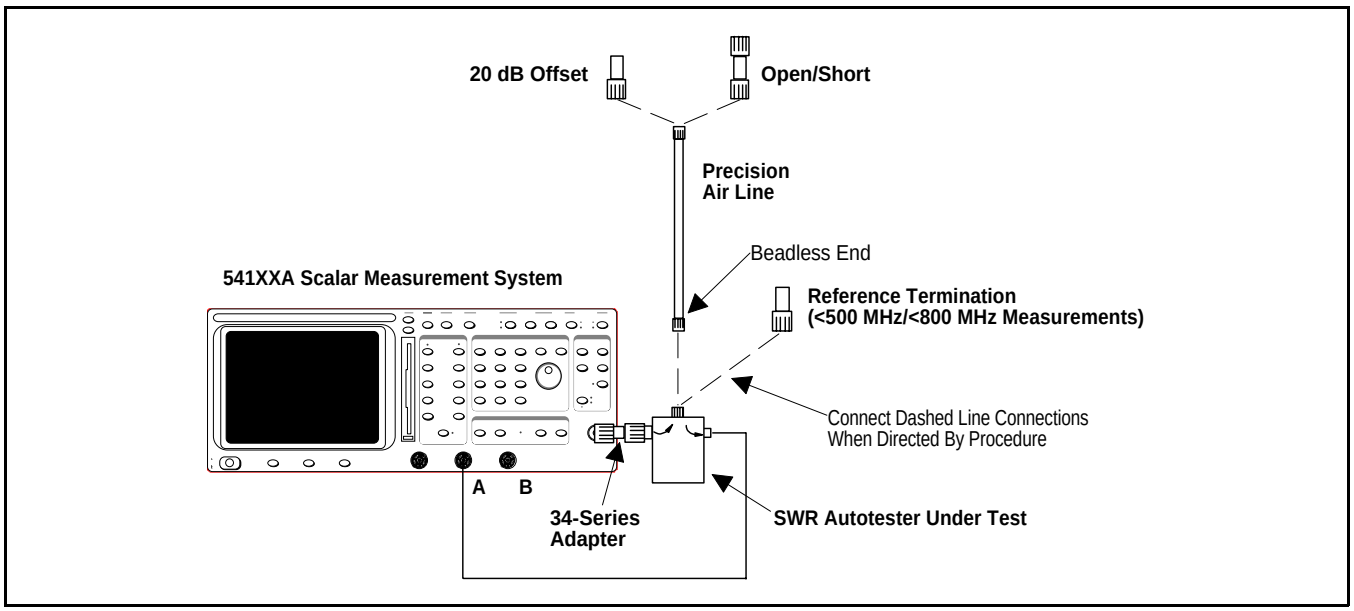


Figure 10. Test Equipment Setup for Directivity Measurement Using 541XXA Scalar Measurement System

d. Equipment Setup — Using 541XXA SMS

1. Connect test setup as shown in Figure 10.
2. Press the Power key on the 541XXA to On.
3. Press the System Menu key .
4. Using the Menu up-down keys: Highlight **RESET**, then press the Select key.
5. At the RESET MENU display, use the Menu up-down keys to highlight **RESET TO FACTORY DEFAULTS**, then press the Select key.
6. Set the signal source for the frequency range of the SWR Autotester under test as follows:
   (a) Press the Frequency key.
   (b) Using the Data Entry Keypad or Data Entry Knob, set the **START** frequency to the low-end frequency of the SWR Autotester under test. Press the Enter key.
   (c) Using the Data Entry Keypad or Data Entry Knob, set the **STOP** frequency to the high-end frequency of the SWR Autotester under test. Press the Enter key.

e. Directivity Measurements—500 MHz/ 800 MHz to 40 GHz

1. Press the Channel 2 Display On/Off key to Off.
2. Press the Channel 1 Menu key.
3. Using the Menu up-down keys: Highlight **PRECISION RL**, then press the Select key.
4. At the PRECISION RETURN LOSS menu display, use the Menu up-down keys to highlight **FINAL**, then press the Select key.
5. Press the Calibration key.
6. At the CALIBRATION menu display, use the Menu up-down keys to highlight **START CAL**, then press the Select key.
7. At the PRECISION RETURN LOSS CALIBRATION menu display prompt, connect the SWR Autotester to Input A, if you have not done so yet.
8. Connect the beadless end of the air line to the SWR Autotester test port. Position the air line pointing vertically upward. Downward or horizontal positions make connector center pin alignment difficult. If you are using 19SX50 series air lines (WSMA connectors), use a compensation washer.
9. Press the Select key when ready.
10. Verify that the display resembles that shown in Figure 11.

NOTE

The presence of spikes in the display waveform indicates improper alignment of the beadless connector on the air line.

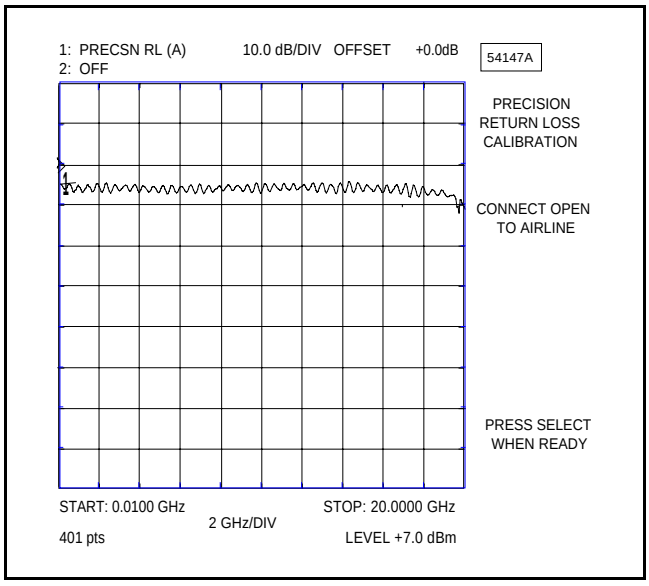


Figure 11. Example of a Good Connection

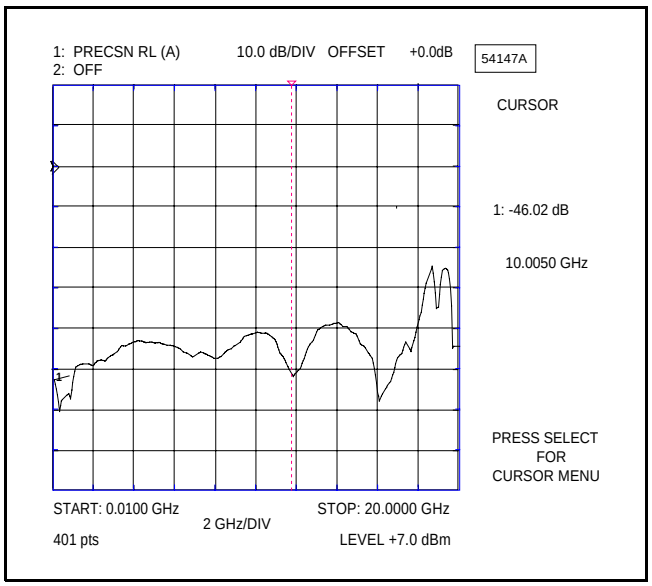


Figure 12. Direct Readout of Directivity

11. At the PRECISION RETURN LOSS CALIBRATION menu prompt, connect the Open to the beaded end of the air line. Press the Select key to start the calibration process.
12. At the next menu prompt, remove the Open and connect the Short to the beaded end of the air line. Press the Select key to start the calibration process.
13. At the next menu prompt, remove the Short and connect the Offset Termination (15 dB or 20 dB) to the beaded end of the air line. Press the Select key to start the calibration process.
14. When the calibration is completed, leave the Offset Termination in place and press the Select key to perform the measurement.
15. Observe that the waveform displayed resembles that shown in Figure 12.
16. Press the Cursor On/Off key to On.
17. Observe the CURSOR menu readout. This is the return loss (directivity) of the SWR Autotester under test at the frequency shown.

f. Directivity Measurements Below 500 MHz/ 800 MHz

1. Perform the setup procedure in subparagraph d.
2. Press the Channel 2 Display On/Off key to Off.
3. Press the Channel 1 Menu key.
4. Using the Menu up-down keys: Highlight **RETURN LOSS**, then press the Select key.
5. Press the Calibration key.
6. Using the Menu up-down keys: Highlight **START CAL**, then press the Select key.
7. At the RETURN LOSS CALIBRATION menu display prompt, connect the SWR Autotester to Input A, if you have not done so yet.
8. Connect the precision termination to the test port of the SWR Autotester being measured*.
9. Press the Channel 1 Menu key.
10. Using the Menu up-down keys: Highlight **REF LINE**, then press the Select key.
11. Using the Data Entry knob, set the reference line to midscale on the display.
12. Press the Channel 1 Offset/Resolution key.
13. Usingthe Menu up-down keys: Highlight **OFFSET dB**, then press the Select key.
14. Using the Data Entry knob, set **OFFSET dB** for the specified directivity value of the SWR Autotester being measured (refer to Table 1).
15. Using the Menu up-down keys: Highlight **RESOLUTION dB/DIV**, then press the Select key.

* The return loss of the precision termination used for this test must be higher than the directivity of the SWR Autotester being measured. The ANRITSU terminations recommended in Table 5 meet this requirement.

16. Using the Data Entry knob, set **RESOLUTION dB/DIV** for a convenient value.

17. Observe the display. If the measured directivity signal is below the reference line at all frequencies, then the directivity is within the specified value.

g. Directivity Measurements—Above 40 GHz

Directivity measurements above 40 GHz require the use of special test fixtures. Contact ANRITSU for assistance.

7. MAINTENANCE

ANRITSU recommends that no maintenance other than cleaning be attempted by the customer. The SWR Auotester should be returned to ANRITSU for repair and/or service when needed.

7.1. Cleaning Connectors

The precise geometry that makes possible the RF component's high performance can easily be disturbed by dirt and other contamination adhering to the connector interfaces.

To clean the connector interfaces, use a clean cotton swab that has been *dampened* with denatured alcohol. Figure 13 illustrates the cleaning of male and female connectors.

NOTE

Most cotton swabs are too large to fit in the smaller connector types. In these cases it is necessary to peel off most of the cotton and then twist the remaining cotton tight. Be sure that the remaining cotton does not get stuck in the connector. Cotton swabs of the appropriate size can be purchased through a medical-laboratory-type supply center.

The following are some important tips on cleaning connectors:

- Use only denatured alcohol as a cleaning solvent.
- Do not use excessive amounts of alcohol as prolonged drying of the connector may be reqiured.
- Never put lateral pressure on the center pin of the connector.
- If installed, do not disturb the teflon washer on the center conductor pin.
- Verify that no cotton or other foreign material remains in the connector after cleaning it.
- If available, use compressed air to remove foreign particles and to dry the connector.
- After cleaning, verify that the center pin has not been bent or damaged.

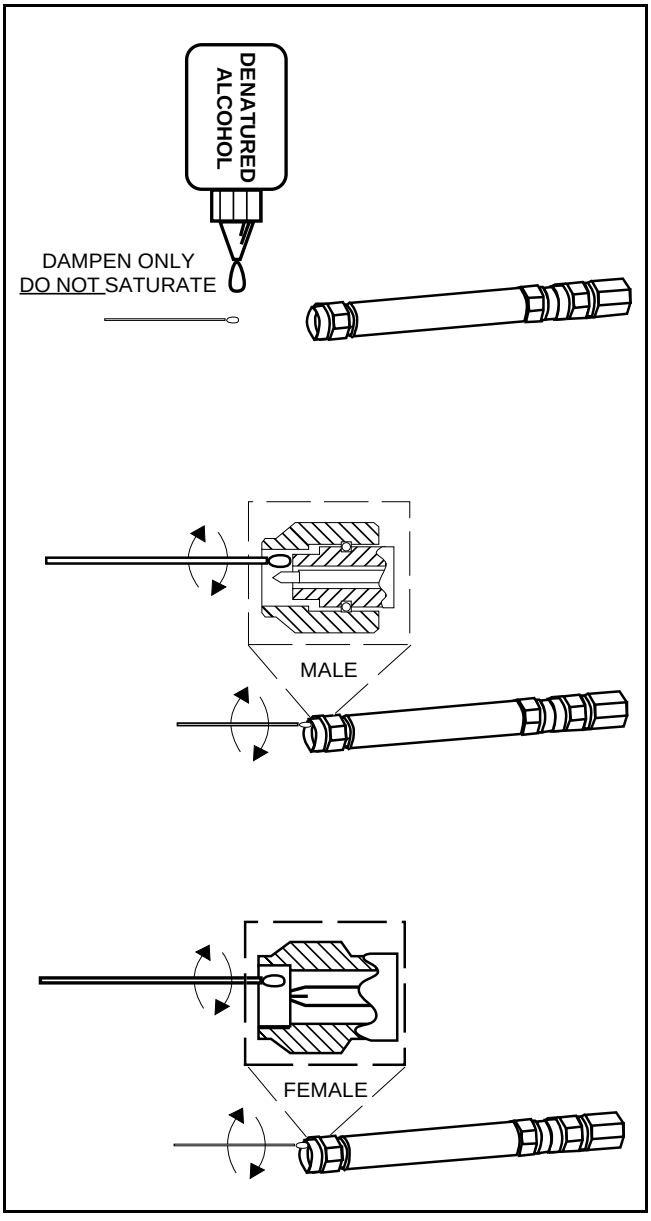
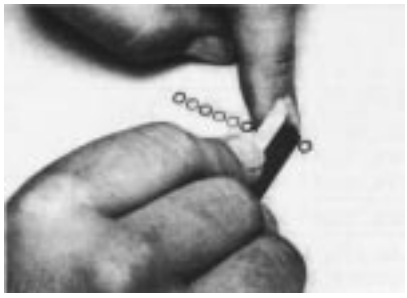


Figure 13. Cleaning Male and Female Connectors

WSMA connectors are optimized for connection to standard SMA connectors. Whenever two WSMA connectors are mated, a compensation washer should be inserted between the two connectors near the point of mating (to provide optimum mating depth for this connector combination). The only exceptions are: the WSMA Open/Short and the RF Output connectors of the 541XXA and other ANRITSU RF sources.

The washer is not necessary when testing devices with SMA connectors.

Step 1 Separate a single WSMA connector compensation washer and trim away the interconnecting tabs.



Step2 Insert the compensation washer into the opening of the WSMA connector, as shown

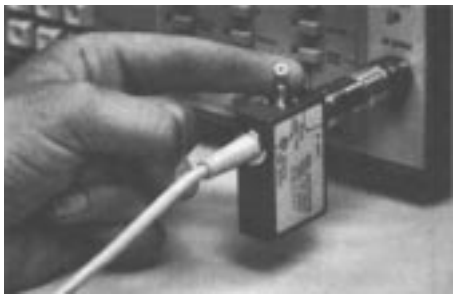
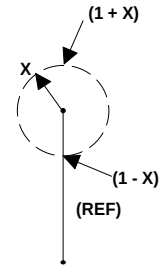


Figure 14. Example of Using a Compensation Washer with WSMA Connectors Prior to Measuring a Device with a WSMA Mating Connector.

Table 6. RF Measurement Chart

Conversion tables for Return Loss, Reflection Coefficient, and SWR with tabular values for interaction of a small phasor X with a large phasor (unity reference) expressed in dB related to reference.



PHASOR INTERACTION

TERM002.DRW

SWR	Reflection Coefficient	Return Loss (dB)	Relative to Unity Reference: X dB Below Reference	Relative to Unity Reference: REF + X dB	Relative to Unity Reference: REF – X dB	Relative to Unity Reference: REF ± X Peak to Peak Ripple dB
17.3910	0.8913	1	1	5.5350	–19.2715	24.8065
8.7242	0.7943	2	2	5.0780	–13.7365	18.8145
5.8480	0.7079	3	3	4.6495	–10.6907	15.3402
4.4194	0.6310	4	4	4.2489	–8.6585	12.9073
3.5698	0.5623	5	5	3.8755	–7.1773	11.0528
3.0095	0.5012	6	6	3.5287	–6.0412	9.5699
2.6146	0.4467	7	7	3.2075	–5.1405	8.3480
2.3229	0.3981	8	8	2.9108	–4.4096	7.3204
2.0999	0.3548	9	9	2.6376	–3.8063	6.4439
1.9250	0.3162	10	10	2.3866	–3.3018	5.6884
1.7849	0.2818	11	11	2.1567	–2.8756	5.0322
1.6709	0.2512	12	12	1.9465	–2.5126	4.4590
1.5769	0.2239	13	13	1.7547	–2.2013	3.9561
1.4985	0.1995	14	14	1.5802	–1.9331	3.5133
1.4326	0.1778	15	15	1.4216	–1.7007	3.1224
1.3767	0.1585	16	16	1.2778	–1.4988	2.7766
1.3290	0.1413	17	17	1.1476	–1.3227	2.4703
1.2880	0.1259	18	18	1.0299	–1.1687	2.1986
1.2528	0.1122	19	19	0.9237	–1.0337	1.9574
1.2222	0.1000	20	20	0.8279	–0.9151	1.7430
1.1957	0.0891	21	21	0.7416	–0.8108	1.5524
1.1726	0.0794	22	22	0.6639	–0.7189	1.3828
1.1524	0.0708	23	23	0.5941	–0.6378	1.2319
1.1347	0.0631	24	24	0.5314	–0.5661	1.0975
1.1192	0.0562	25	25	0.4752	–0.5027	0.9779
1.1055	0.0501	26	26	0.4248	–0.4466	0.8714
1.0935	0.0447	27	27	0.3796	–0.3969	0.7765
1.0829	0.0398	28	28	0.3391	–0.3529	0.6919
1.0736	0.0355	29	29	0.3028	–0.3138	0.6166
1.0653	0.0316	30	30	0.2704	–0.2791	0.5495
1.0580	0.0282	31	31	0.2414	–0.2483	0.4897
1.0515	0.0251	32	32	0.2155	–0.2210	0.4365
1.0458	0.0224	33	33	0.1923	–0.1967	0.3890
1.0407	0.0200	34	34	0.1716	–0.1751	0.3467
1.0362	0.0178	35	35	0.1531	–0.1558	0.3090
1.0322	0.0158	36	36	0.1366	–0.1388	0.2753
1.0287	0.0141	37	37	0.1218	–0.1236	0.2454
1.0255	0.0126	38	38	0.1087	–0.1100	0.2187
1.0227	0.0112	39	39	0.0969	–0.0980	0.1949
1.0202	0.0100	40	40	0.0864	–0.0873	0.1737
1.0180	0.0089	41	41	0.0771	–0.0778	0.1548
1.0160	0.0079	42	42	0.0687	–0.0693	0.1380
1.0143	0.0071	43	43	0.0613	–0.0617	0.1230
1.0127	0.0063	44	44	0.0546	–0.0550	0.1096
1.0113	0.0056	45	45	0.0487	–0.0490	0.0977
1.0101	0.0050	46	46	0.0434	–0.0436	0.0871
1.0090	0.0045	47	47	0.0387	–0.0389	0.0776
1.0080	0.0040	48	48	0.0345	–0.0346	0.0692
1.0071	0.0035	49	49	0.0308	–0.0309	0.0616
1.0063	0.0032	50	50	0.0274	–0.0275	0.0549
1.0057	0.0028	51	51	0.0244	–0.0245	0.0490
1.0050	0.0025	52	52	0.0218	–0.0218	0.0436
1.0045	0.0022	53	53	0.0194	–0.0195	0.0389
1.0040	0.0020	54	54	0.0173	–0.0173	0.0347
1.0036	0.0018	55	55	0.0154	–0.0155	0.0309
1.0032	0.0016	56	56	0.0138	–0.0138	0.0275
1.0028	0.0014	57	57	0.0123	–0.0123	0.0245
1.0025	0.0013	58	58	0.0109	–0.0109	0.0219
1.0022	0.0011	59	59	0.0097	–0.0098	0.0195
1.0020	0.0010	60	60	0.0087	–0.0087	0.0174

WARRANTY

The ANRITSU product(s) listed on the title page is (are) warranted against defects in materials and workmanship for one year from the date of shipment.
ANRITSU's obligation covers repairing or replacing products which prove to be defective during the warranty period. Buyers shall prepay transportation charges for equipment returned to ANRITSU for warranty repairs. Obligation is limited to the original purchaser. ANRITSU is not liable for consequential damages.

LIMITATION OF WARRANTY

The foregoing warranty does not apply to ANRITSU connectors that have failed due to normal wear. Also, the warranty does not apply to defects resulting from improper or inadequate maintenance by the Buyer, unauthorized modification or misuse, or operation outside of the environmental specifications of the product. No other warranty is expressed or implied, and the remedies provided herein are the Buyer's sole and exclusive remedies.

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