MODEL 360B
VECTOR NETWORK ANALYZER
CALIBRATION AND VERIFICATION KITS

MAINTENANCE AND
OPERATION MANUAL

Anritsu

490 JARVIS DRIVE ● MORGAN HILL, CA 95037-2809

P/N: 10100-00024
REVISION: F
PRINTED: OCTOBER 1997

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This chapter provides illustrations and contents of Models 3650, 3651, 3652, 3653, and 3654 Calibration Kits.

Chapter 2 — Verification Kits

This chapter provides illustrations and contents of Models 3666, 3657, 3668, and 3659 Verification Kits. It also provides operation and verification procedures.

Chapter 3 — Maintenance Instructions

This chapter provides precautionary instructions for the use of precision connectors and cleaning instructions

Chapter 1
Calibration Kits

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Chapter 1
Calibration Kits

1-1 SCOPE

This manual provides description and maintenance instructions for the Models 3650 (SMA/3.5 mm), 3651 (GPC-7), 3652 (K Connector), 3653 (Type N), and 3654/3654B* (V Connector) Calibration Kits and Models 3666 (3.5 mm), 3667 (GPC-7), 3668 (K Connector), and 3669/3659B* (V Connector) Verification Kits.

- ☐ The calibration kits are described in Chapter 1.
- ☐ The verification kits are described in Chapter 2.
- ☐ Maintenance instructions applicable to both kits are provided in Chapter 3.

1-2 INTRODUCTION

This chapter provides illustrations and contents for the Models 3650, 3651, 3652, 3653, and 3654/3654B Calibration Kits.

1-3 PURPOSE

The calibration kits contain all of the precision components and tools required to calibate the 360B Vector Network Analyzer System for a 12-term error-corrected measurement.

1-4 KIT CONTENTS

Contents of the calibrations kits are listed on the following pages.

* "B" suffix denotes 65 GHz version of kit.

Model 3650 Calibration Kit

The SMA/3.5 mm kit (Figure 1-1) includes in the following items:

Index 1. 01-212 female flush short (Option 1)

Index 2. 01-211 male flush short (Option 1)

Index 3. 17SF50 female sliding termination

Index 4. 17S50 male sliding termination (Option 1)

Index 5. 34ASF50-2 female adapter (2)

Index 6. Calibration software diskette

Index 7. 33FSF50 female-female adapter (2)*

Index 8. 33SS50 male-male adapter*

Index 9. 28S50-2 B male termination (2)

Index 10. 28SF50-2 broadband female termination (2)

Index 11. 33SSF50-male-female adapter (2)*

Index 12. 24S50 male open

Index 13. 23SF50 female open

Index 14. 23S50 male short

Index 15. 23SF50 female short

Index 16. 34AS50-2 male adapter (2)

Index 17. Connector thumb wheel (4)

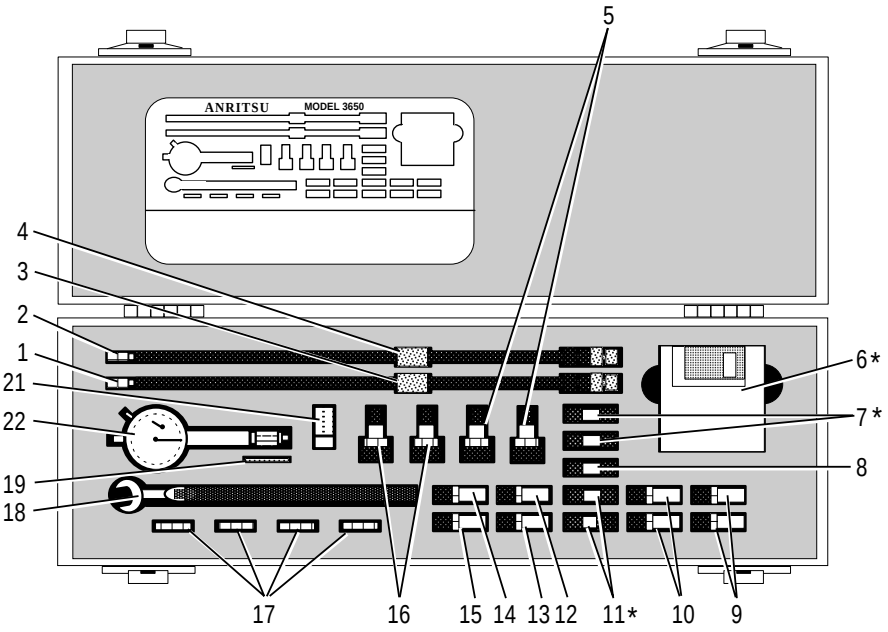
Index 18. 01-201 torque wrench

Index 19. 01-210 reference flat

Index 20. 01-222 pin depth gauge

Index 21. 01-223 pin depth gauge

* Phase Equal Adapters



* Phase Equal Adapters

Figure 1-1. *Model 3650 (SMA/3.5 mm) Calibration Kit Components*

Model 3651 Calibration Kit

The GPC-7 kit (Figure 1-2) includes in the following items:

Index 1. 01-221 collects and extract tools

Index 2. 28A50-2 broadband termination (2)

Index 3. 24A50 open

Index 4. 23A50 short

Index 5. Calibration software diskette

Index 6. 17A50 sliding termination (Option 1)

Index 7. 01-200 torque wrench

Index 8. 01-210 reference flat

Index 9. 01-220 pin depth gauge

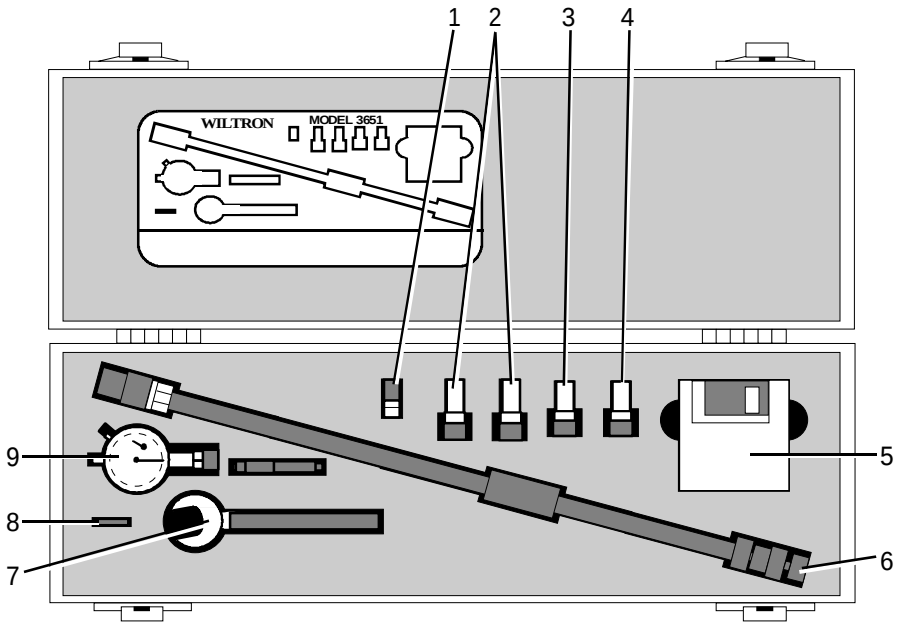


Figure 1-2. *Model 3651 (GPC-7) Calibration Kit Components*

Model 3652 Calibration Kit

The K Connector kit (Figure 1-3) includes in the following items:

Index 1. 01-212 female flush short (Option 1)

Index 2. 01-211 male flush short (Option 1)

Index 3. 17KF50 female sliding termination

Index 4. 17K50 male sliding termination (Option 1)

Index 5. 34AKF50-2 female adapter (2)

Index 6. Calibration software diskette

Index 7. 33FKF50 female-female adapter (2)*

Index 8. 33KK50 male-male adapter*

Index 9. 28K50-2 male termination (2)

Index 10. 28KF50-2 broadband female termination (2)

Index 11. 33KKF50-male-female adapter (2)*

Index 12. 24K50 male open

Index 13. 23KF50 female open

Index 14. 23K50 male short

Index 15. 23KF50 female short

Index 16. 34AK50-2 male adapter (2)

Index 17. Connector thumb wheel (4)

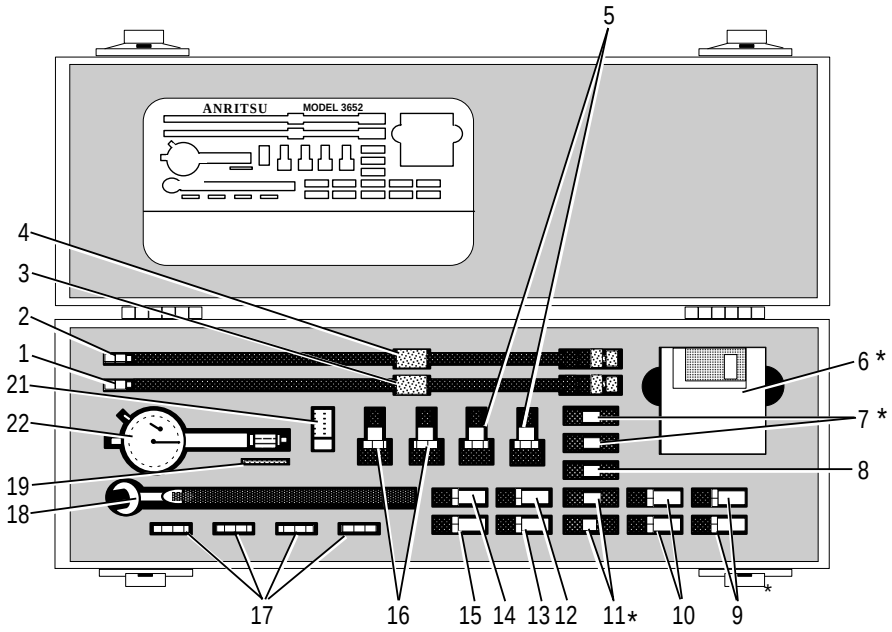
Index 18. 01-201 torque wrench

Index 19. 01-210 reference flat

Index 20. 01-222 pin depth gauge

Index 21. 01-223 pin depth gauge

* Phase Equal Adapters



* Phase Equal Adapters

Figure 1-3. *Model 3652 (K Connector) Calibration Kit Components*

Model 3653 Calibration Kit

The Type N kit (Figure 1-4) includes in the following items:

Index 1. 28N50-2 broadband male termination (2)

Index 2. 34AN50-2 male adapter (2)

Index 3. Calibration software diskette

Index 4. 34ANF50-2 female adapter (2)

Index 5. 28NF50-2BBraodband female termination (2)

Index 6. 24NF50 female open

Index 7. 24N50 male open

Index 8. 23NF50 female short

Index 9. 23N50 male short

Index 10. 01-213 reference gauge

Index 11. 01-224 pin depth gauge

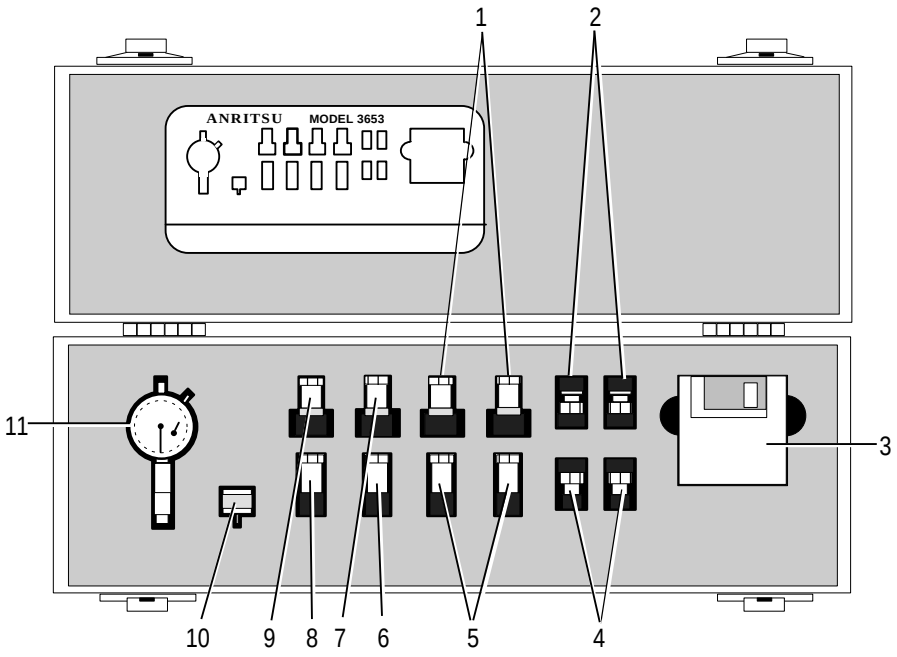


Figure 1-4. *Model 3653 (Type N) calibration kit Components*

Model 3654/ 3654B Calibration Kit

The V Connector kit (Figure 1-5) includes in the following items:

Index 1. 17VF50B female sliding termination

Index 2. 17V50B male sliding termination

Index 3. 33VVF50 male-female adapter (2)

Index 4. Calibration software, 2360-54B

Index 5. 28V50B male broadband termination (2)

Index 6. 28VF50B female broadband termination (2)

Index 7. 24V50B male open

Index 8. 24VF50B female open

Index 9. 23V50B-5.1 male short 5.1mm

Index 10. 23VF50B-5.1 female short 5.1mm

Index 11. 33VV50 male-male adapter

Index 12. 33VFVF50 female-female adapter (2)

Index 13. Connector thumb wheel (4)

Index 14. 01-201 torque wrench

Index 15. 01-323 female adapter for pin gauge

Index 16. 01-322 pin depth gauge

Index 17. 01-210 reference flat

Index 18. 01-204 adapter wrench

Index 19. 01-312 male flush short

Index 20. 01-311 female flush short

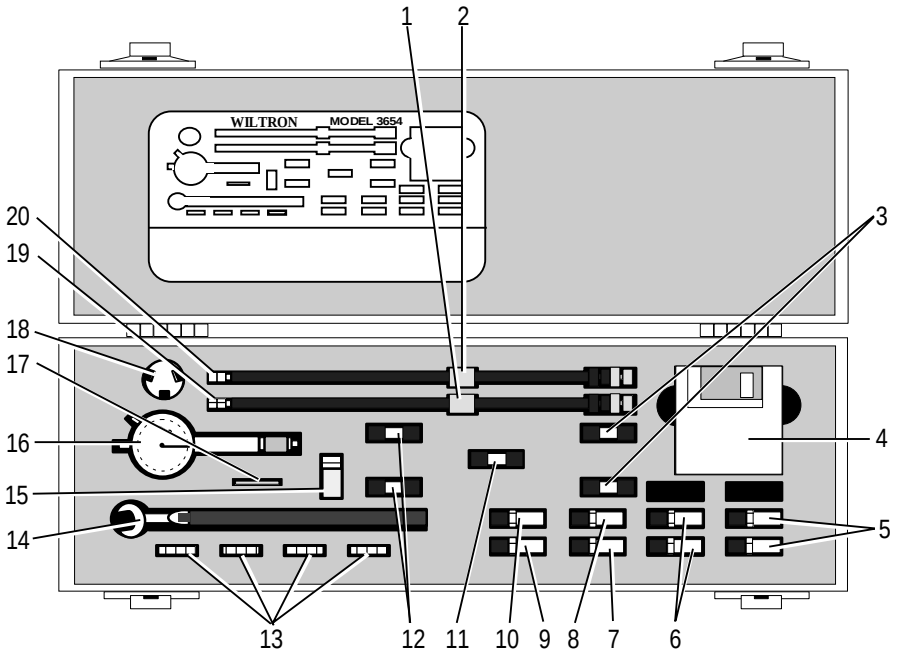


Figure 1-5. *Model 3654 (V Connector) Calibration Kit Components*

Chapter 2
Verification Kits

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Chapter 2
Verification Kits

2-1 INTRODUCTION

This chapter lists the contents of the verification kits and provides operation and verification procedures.

NOTE

The components in these kits of the highest quality and accuracy. All components are NBS(National Bureau of Standards) traceable, which means that the components are very accurate and repeatable. Handle with care.

2-2 PURPOSE

The verification kits let you verify the performance of a calibrated vector network analyzer. The components in these kits are based upon standards that are traceable to the NIST (National Institute of Standards and Technology). They provide the basis for issuing a calibration certification label.

2-3 KIT CONTENTS

Contents of the calibrations kits are listed on the following pages.

Model 3666 (3.5 mm) Verification Kit

This kit (Figure 2-1) includes the following items:

Index 1. 19S50-7, 7.5 cm Air Line

Index 2. 19SF50-7B, 7.5 cm Stepped Impediance Air Line (Beatty Standard)

Index 3. 42S-50, 50 dB Attenuator

Index 4. 42S-20, 20 dB Attenuator

Index 5. Verification software diskette

CAUTION

The diskette included in the Verification Kit is for use by ANRITSU service personnel. It contains component data used during the automated verification procedure that is accomplished with an external PC. It is NOT INTENDED TO BE USED WITH ANRITSU 360 or 37000 VNA's internal floppy disk drive.

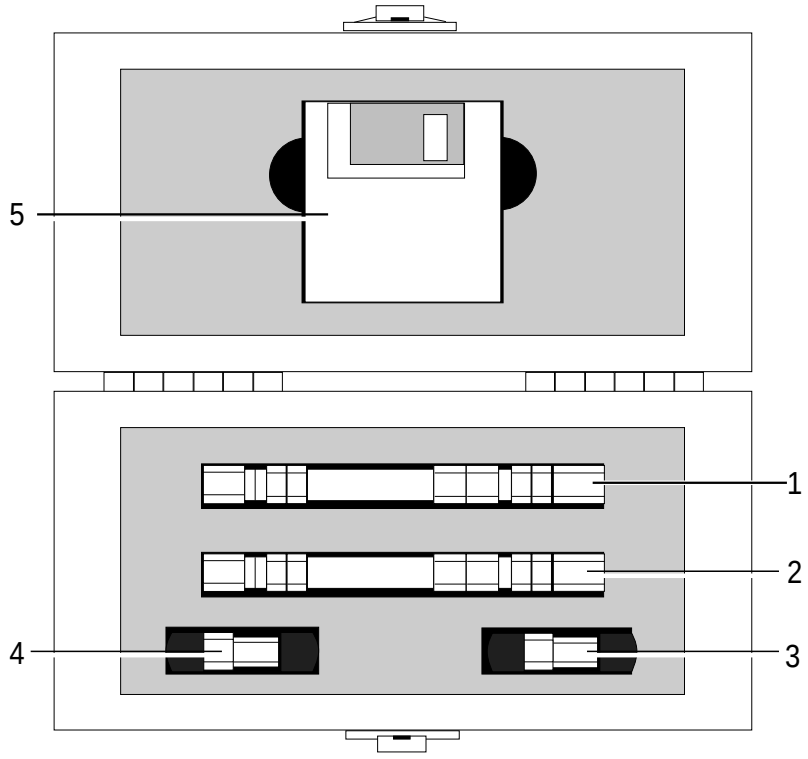


Figure 2-1. *Model 3666 (SMA/3.5) Verification Kit Components*

Model 3667 (GPC-7) Verification Kit

This kit (Figure 2-2) includes in the following items:

Index 1. Verification software diskette

Index 2. 42A-50, 50 dB Attenuator

Index 3. 18A50-10, 10 cm Air Line

Index 4. 42A-20, 20 dB Attenuator

Index 5. 18A50-10B, 10 cm Stepped Impediance Air Line (Beatty Standard)

CAUTION

The diskette included in the Verification Kit is for use by ANRITSU service personnel. It contains component data used during the automated verification procedure that is accomplished with an external PC. It is NOT INTENDED TO BE USED WITH ANRITSU 360 or 37000 VNA's internal floppy disk drive.

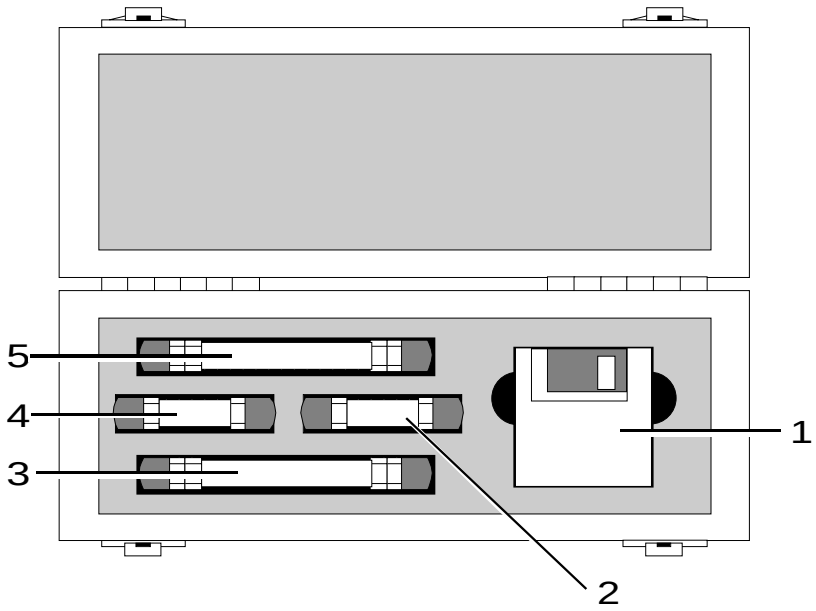


Figure 2-2. *Model 3667 (GPC 7) Verification Kit Components*

Model 3668 (K Connector) Verification Kit

This kit (Figure 2-3) includes the following items:

Index 1. Verification software diskette

Index 2. 19K50-7, 7.5 cm Air Line

Index 3. 42K-50, 50 dB Attenuator

Index 4. 42K-20, 20 dB Attenuator

Index 5. 18K50-7B, 7.5 cm Stepped Impediance Air Line (Beatty Standard)

CAUTION

The diskette included in the Verification Kit is for use by ANRITSU service personnel. It contains component data used during the automated verification procedure that is accomplished with an external PC. It is NOT INTENDED TO BE USED WITH ANRITSU 360 or 37000 VNA's internal floppy disk drive.

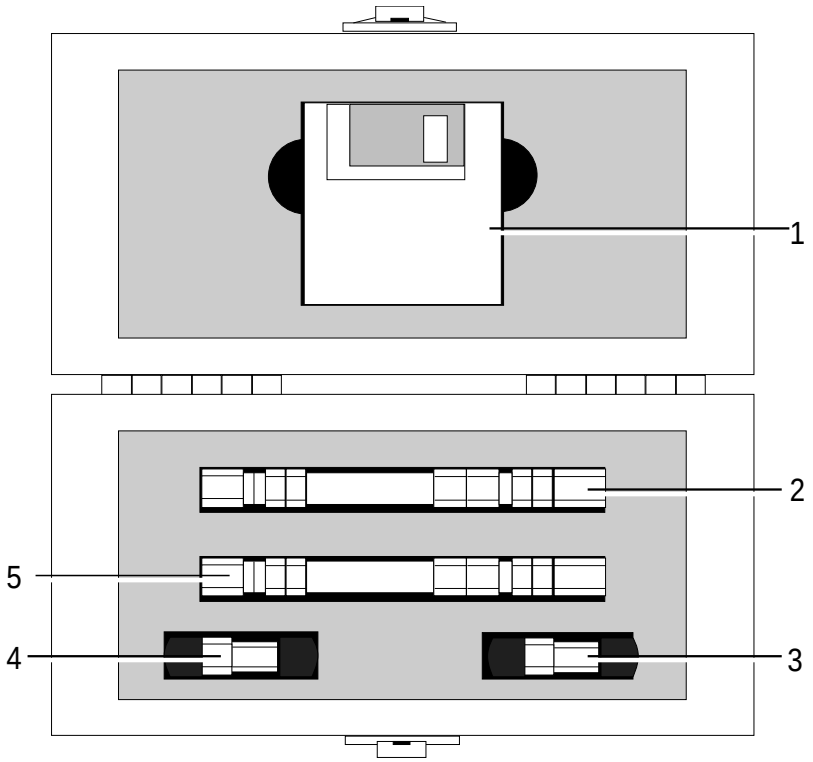


Figure 2-3. *Model 3668 (K Connector) Verification Kit Components*

Model 3663 (Type N) Verification Kit

This kit (Figure 2-4) includes in the following items:

Index 1. Verification software diskette

Index 2. 42N-50, 50 dB Attenuator

Index 3. 18N50-10, 10 cm Air Line

Index 4. 42N-20, 20 dB Attenuator

Index 5. 18N50-10B, 10 cm Stepped Impediance Air Line (Beatty Standard)

CAUTION

The diskette included in the Verification Kit is for use by ANRITSU service personnel. It contains component data used during the automated verification procedure that is accomplished with an external PC. It is NOT INTENDED TO BE USED WITH ANRITSU 360 or 37000 VNA's internal floppy disk drive.

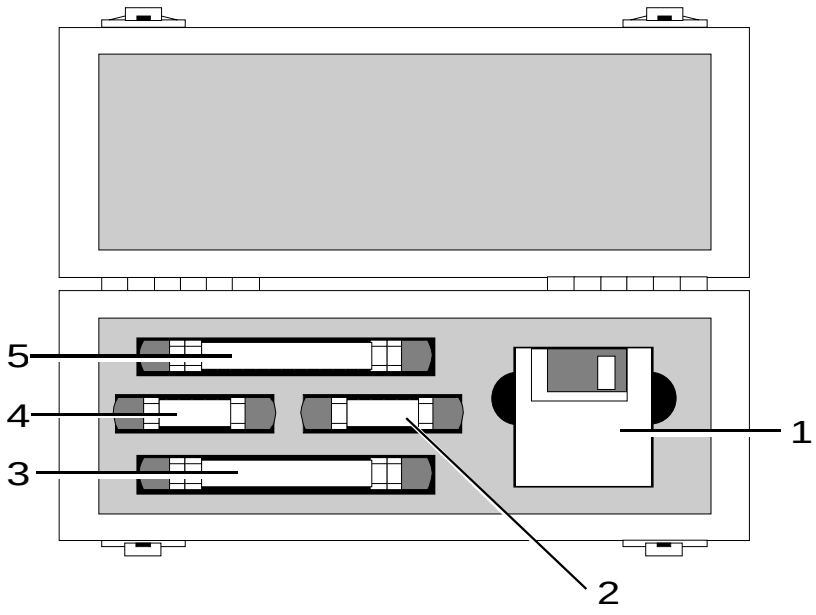


Figure 2-4. *Model 3663 (Type N) Verification Kit Components*

Model 3669/ 3669B* (V Connector) Verification Kit

This kit (Figure 2-5 includes the following items:

Index 1. Verification software diskette, 2360-69B*

Index 2. 42V-40, 40 dB Attenuator

Index 3. 42V-20, 20 dB Attenuator

Index 4. 19V50-5, 5 cm Air Line

Index 5. 18V50-5B, 5 cm Stepped Impedance Air Line (Beatty Standard)

CAUTION

The diskette included in the Verification Kit is for use by ANRITSU service personnel. It contains component data used during the automated verification procedure that is accomplished with an external PC. It is NOT INTENDED TO BE USED WITH ANRITSU 360 or 37000 VNA's internal floppy disk drive.

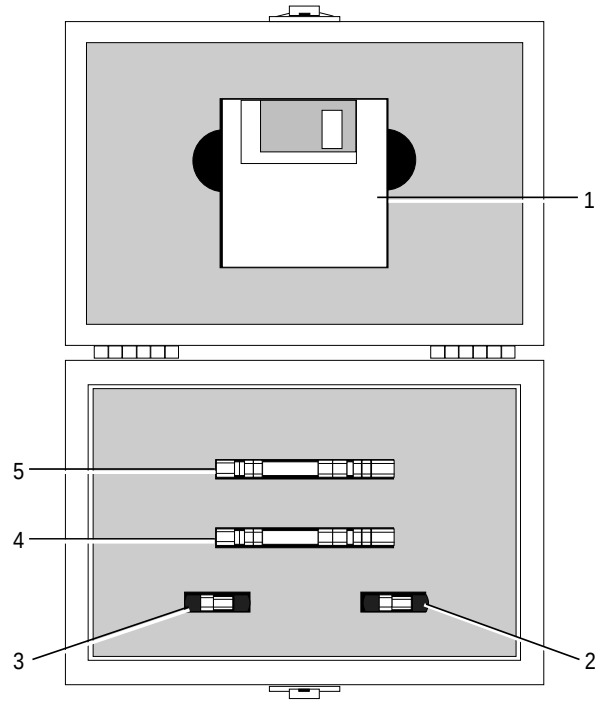


Figure 2-5. *Model 3669 (V Connector) Verification Kit Components*

2-4 OPERATION

Each verification kit consists of four standards, each are supplied with S-parameter data. Each standard verifies a primary S-parameter, as follows:

- 20 dB Attenuator — S_{21}, S_{12} Magnitude and Phase
- 50 (or 40) dB Attenuator — S_{21}, S_{12} Magnitude and Phase
- Beadless Airline — S_{21}, S_{12} Phase
- Beatty Standard — S_{11}, S_{22} Magnitude

Uncertainty windows are provided at each data point. The uncertainty associated with the primary S-parameter for each device is small. Conversely, the uncertainty window can be large for some of the other S-parameter data. Take the beadless airline, for example. Its physical length is very stable and can be measured with high precision. It is, therefore, an excellent phase standard for the measurement of S_{21} and S_{12}. However, S_{11} is very low. Therefore, the uncertainty associated with the phase measurement of S11 is large.

2-5 PERFORMANCE VERIFICATION PROCEDURE

The following is an outline procedure for verifying the 360B system performance. Specific selections of frequency and other parameters depend on the type of test set and verification kit being used. If additional help is needed to work through a measurement calibration, refer to Chapter 8 in the 360B Operating Manual (OM) (PN: 10410-00110) for instructions.

Table 2-1. *Test Port Configuration*

Connector Type	Port 1	Port 2
GPC 7	GPC 7	GPC 7
3.5 mm	3.5 mm female (Use 33SFSF50)	3.5 mm male (Use 33SS50)
K	KF (Use 33KFKF50)	K(Use 33KK50)
V	VF (Use 33VFVF50)	V (Use 33VV50)

CAUTION

Allow the 360B system to warm up for at least four hours before performing this procedure.

Step 1. Inspect and clean the components in the verification and calibration kits to be used. Refer to Chapter 3 for cleaning instructions.

Step 2. Set the pin depth on the sliding loads for a gap of between –0.0002 and +0.0000. Refer to Chapter 8 in the 360B OM.

Step 3. Configure the test set ports per Table 2-1 (left). Use precision ANRITSU 3670 or 3671 Series cables to make the connections.

BEGIN CAL

KEEP EXISTING CAL DATA

REPEAT PREVIOUS CAL

CAL METHOD **STANDARD**

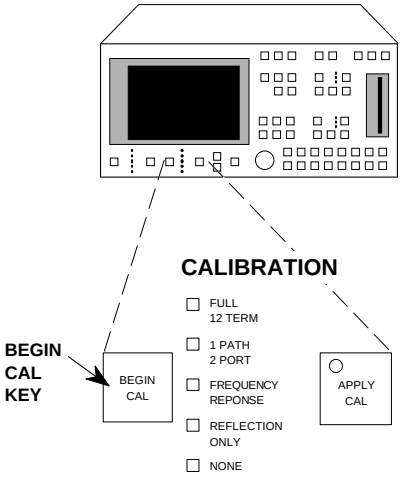
TRANSMISSION LINE TYPE: **COAXIAL**

CHANGE CAL METHOD AND LINE TYPE

NEXT CAL STEP

PRESS <ENTER> TO SELECT

Step 4. Turn-on the 360B system and press the BEGIN CAL key on the analyzer unit (VNA).



Step 5. Set menu options to the choices shown in boldface type (top left), then select **NEXT CAL STEP.**

Step 6. Make selections shown in boldface type in the next three menus to appear (below).

CALIBRATION TYPE

FULL 12-TERM

1 PATH 2 PORT

FREQUENCY RESPONSE ONLY

REFLECTION ONLY (PORT 1)

PRESS <ENTER> TO SELECT

SELECT USE OF ISOLATION IN APPLIED CALIBRATION

INCLUDE ISOLATION (NORMAL)

EXCLUDE ISOLATION

PRESS <ENTER> TO SELECT

SELECT CALIBRATION DATA POINTS

NORMAL (501 POINTS MAXIMUM)

C.W. (1 POINT)

N-DISCRETE FREQUENCIES (2 TO 501 POINTS)

TIME DOMAIN (HARMONIC)

PRESS <ENTER> TO SELECT

MENU C2

FREQ RANGE OF CALIBRATION

START
XX.XXXX GHz

STOP
XX.XXXX GHz

XXX DATA PTS
USING ABOVE
START AND STOP
XX.X MHz
STEP SIZE

NEXT CAL STEP

PRESS <ENTER>
TO SELECT

CONFIRM CALIBRATION PARAMETERS

PORT 1 CONN
XXXXXXXXX

PORT 2 CONN
XXXXXXXXX

REFLECTION PAIRING
MIXED

LOAD TYPE
SLIDING

THROUGH PARAMETERS

REFERENCE IMPEDANCE

TEST SIGNALS

START CAL

PRESS <ENTER>
TO SELECT
OR CHANGE

Step 7. Enter your start and stop frequencies — based on the test set in use — when the next menu (top left) appears.

Step 8. When the Confirm Calibration Parameters menu (bottom left) appears, set or confirm test port connectors are correct.

Step 9. Place the cursor next to **THROUGH PARAMETERS** and press the ENTER key.

Step 10. Set or check that **OFFSET LENGTH** is **0.0000** mm when the menu (below) appears.

MENU C20

ENTER THROUGH LINE PARAMETERS

OFFSET LENGTH OF THROUGH

OFFSET LENGTH
0.0000 mm

LOSS EQUATION
A+B*FREQ^c

A: DC COEFF
(dB/m)
0.0000

B: FREQ COEFF
(dB/m*FREQ^c
0.0000 e-6

C: FREQ EXPONENT
0.500

PRESS <ENTER>
WHEN COMPLETE

ENTER REF IMPEDANCE

REFERENCE IMPEDANCE
XX.XXX Ω

PRESS <ENTER> WHEN COMPLETE

Step 11. Place the cursor next to **REFERENCE IMPEDANCE,** in the Confirm Calibration Parameters menu (page 2-10), and press the ENTER key.

Step 12. Set or check that **REFERENCE IMPEDANCE** is correct for your device (default is 50Ω), when the menu (top left) appears.

Step 13. Place the cursor next to **TEST SIGNALS,** in the Confirm Calibration Parameters menu (page 2-10), and press the ENTER key.

Step 14. Set or check that SOURCE 1 POWER is set to the maximum value for your instrument, and verify that all step attenuators are set to **0 dB**.

Step 15. When you have made all of the choices in the Confirm Calibration Parmeters menu (page 2-10), select **START CAL** and follow the promts that appear on the VNA display.

REDUCED TEST SIGNALS

SOURCE 1 PWR
XX.X dBm

SOURCE 2 PWR
X.X dBm

PORT 1 SOURCE
X**0 dB** (0-70)

PORT 1 TEST
X**0 dB** (0-00)

PORT 2 SOURCE
X**0 dB** (0-70)

PORT 2 TEST
X**0 dB** (0-40)

FLAT TEST
PORT POWER

PREVIOUS MENU

PRESS <ENTER> TO SELECT

SELECT
DISPLAY MODE

SINGLE
CHANNEL

DUAL
CHANNELS 1 – 3

OVERLAY DUAL
CHANNELS 1 – 3

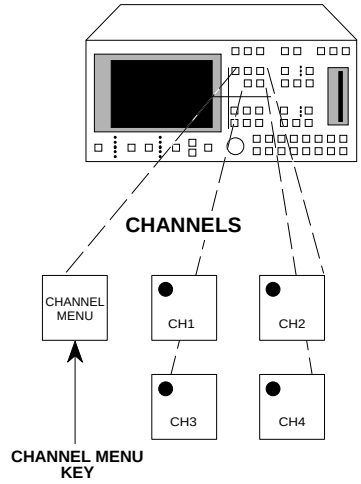
DUAL
CHANNELS 2 – 4

OVERLAY DUAL
CHANNELS 2 – 4

ALL FOUR CHANNELS

PRESS <ENTER>
TO SELECT

Step 16. Press the CHANNEL MENU key (below) and select **ALL FOUR CHANNELS** from the menu (left) that appears.



Step 17. Press the GRAPH TYPE (below) key, and select the appropriate **LOG MAGNITUDE AND PHASE** or **LINEAR MAGNITUDE AND PHASE** from the available menus (left).

SELECT
GRAPH TYPE

LOG
MAGNITUDE

PHASE

**LOG MAGNITUDE
AND PHASE**

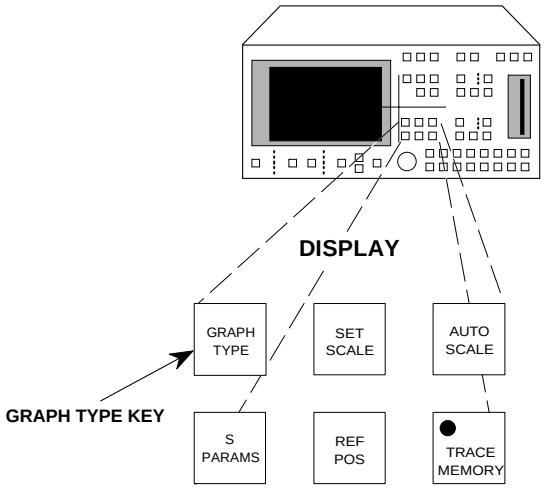
SMITH CHART
(IMPEDANCES)

SWR

GROUP DELAY

MORE

PRESS <ENTER>
TO SELECT



SELECT
GRAPH TYPE

SINGLE
CHANNEL

ADMITTANCE
SMITH CHART

LINEAR POLAR

LOG POLAR

**LINEAR MAG
AND PHASE**

REAL

IMAGINARY

REAL AND
IMAGINARY

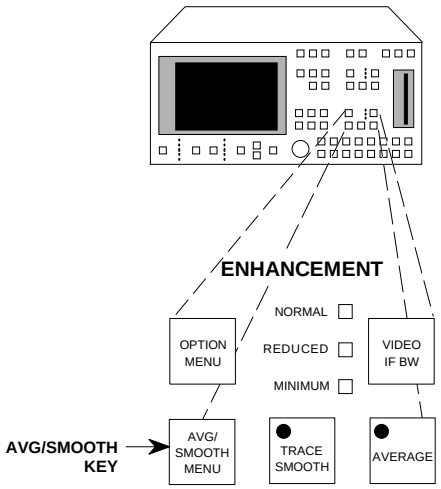
MORE

PRESS <ENTER>
TO SELECT

DATA
ENHANCEMENT

AVERAGING
128 MEAS.
PER POINT

Step 18. Press the AVG/SMOOTH MENU key (below), and enter 128 (512 for 50 dB attenuator).



Step 19. Measure and obtain a tabular-data printout of all four S-parameters for each device in the verification kit. (See Figure 2-5 for tips on using the beadless airline.)

Step 20. Compare the measured data with the data provided with the verification kit. Verify that each measured point falls within the uncertainty window of the appropriate verification data point.

The air lines and Beatty standard in the verification kits are beadless — that is, the center conductor is unsupported in the tube-like outer housing. The use of a support bead would degrade the performance of the standard. The following narrative provides tips on using these devices.

Connecting the 3.5 mm, K, and V air line or Beatty standard

Step 1. Carefully install the center conductor on Port 1 of the test set.

Step 2. Slide the outer conductor over the center conductor and engage the coupling nut loosely. Not tightening the coupling nut lets you move the unattached end of the outer conductor.

Step 3. Orient the the outer conductor so that the center conductor is concentric.

Step 4. Carefully engage the Port 2 connector, which is at the end of the cable connected to Port 2 on the test set.

Step 5. Torque each connector to 8 inch-pounts.

Connecting the GPC 7 air line or Beatty standard

The GPC 7 air line is straight forward, because the center conductor includes spring-loaded center pins. You only have to ensure that the end of the center pin with the black dot (below) connects to Port 1 on the test set.

After making the connection, torque the connectors to 12 inch-pounds.

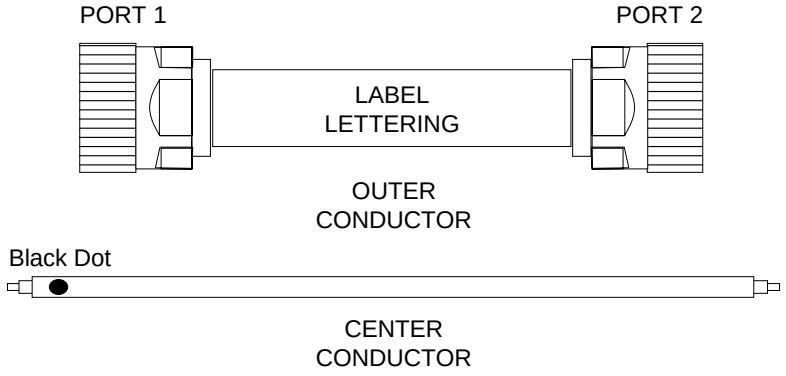


Figure 2-6. *Tips for Using GPC 7 Air Lines and Beatty Standards*

Chapter 3
Maintenance Instructions

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Chapter 3
Maintenance Instructions

3-1 INTRODUCTION

This chapter provides instructions and discussion on the care and use of precision connectors.

3-2 PRECAUTIONS FOR USING CONNECTORS

The following are precautionary notes related to the use of connectors. For specific information on setting pin depths on sliding terminations, refer to the 360B Operation Manual, Chapter 8.

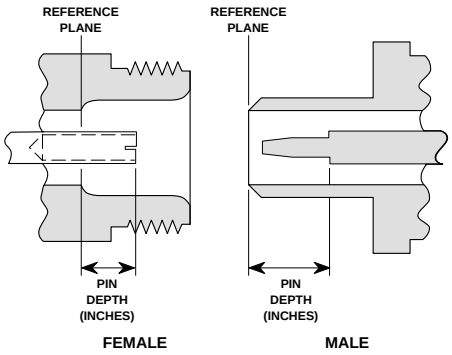


Figure 3-1. *N Connector Pin Depth*

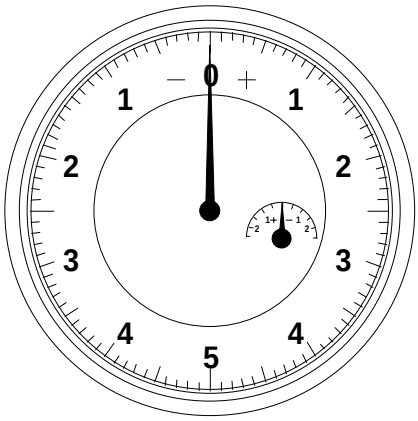


Figure 3-2. *Pin Depth Gauge*

Pin Depth

Before mating, measure the pin depth (Figure 3-1) of the device that will mate with the RF component, using an ANRITSU Pin Depth Gauge or equivalent (Figure 3-2). 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 is mated with a connector having a destructive pin depth, damage will likely occur to the RF component connector. (A destructive pin depth has a center pin that is too long in respect to the connector's reference plane.)

Pin Depth Tolerance

The center pin of RF component connectors has a precision tolerance measured in mils (1/1000 inch). Connectors on test devices that mate with RF components may not be precision types and may not have the proper depth. They must be measured before mating to ensure suitability. When gauging pin depth, if the test device connector measures out of tolerance (Table 3-1) in the "+" region of the gauge (Figure 3-1), the center pin is too long. Mating under this condition will likely damage the termination connector. On the other hand, if the test device connector measures out of tolerance in the "–" region, the center pin is too short. While this will not cause any damage, it will result in a poor connection and a consequent degradation in performance.

Table 3-1. *Pin Dept Tolerances*

Port/Connector Type	Pin Depth (mils)	ANRITSU Gauge Setting
GPC 7	+0.000 –0.003	Same as pin depth
N Male	207 –0.000 +0.003	207 +0.000 –0.003
N Female		
WSMA Male	–0.0025 –0.0035	Same as pin depth
WSMA Male		
K Male	+0.000 –0.003	Same as pin depth
K Female		
V Male		Same as pin depth
V Female		

Over Torquing Connectors

Over torquing connectors is destructive; it may damage the connector center pin. Finger-tight is usually sufficient, especially on Type N connectors. *Never* use pliers to tighten connectors.

Teflon Tuning Washers

The center conductor on most RF components contains a small teflon tuning washer located near the point of mating (interface). This washer compensates for minor impedance discontinuities at the interface. The washer's location is critical to the RF component's performance. *Do not disturb it.*

Mechanical Shock

RF components are designed to withstand years of normal bench handling. However, do not drop or otherwise treat them roughly. They are laboratory-quality devices, and like other such devices, they require careful handling.

3-3 CLEANING INSTRUCTIONS

Connector interfaces — especially the outer conductors on the GPC 7 and SMA connectors — should be kept clean and free of dirt and other debris.

Denatured alcohol is the recommended applicator. Figure 3-3 illustrates cleaning male and female connectors.

NOTE

Most cotton swabs are too large to fit in the smaller connector types. It is necessary to peal 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.

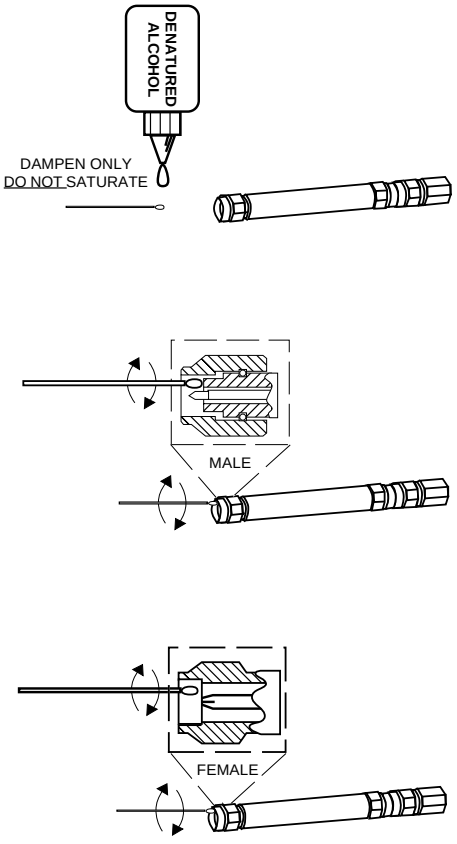
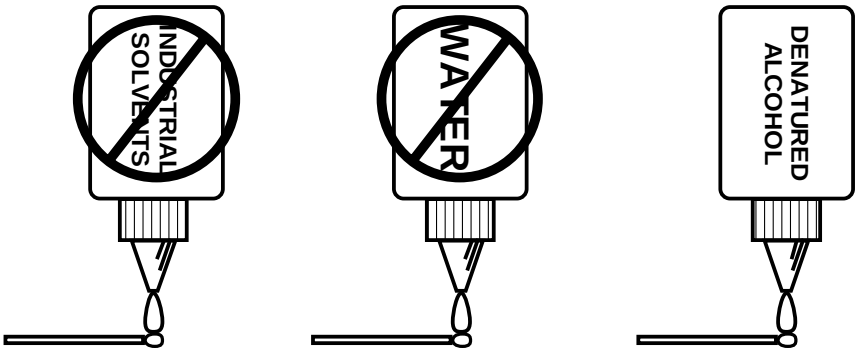


Figure 3-3. *Cleaning Male and Female Connectors*

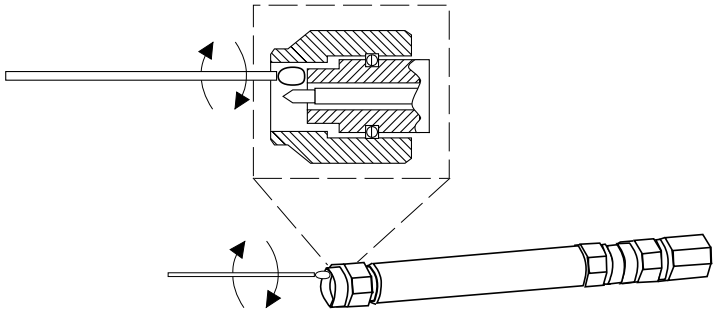
The following are some important tips on cleaning connectors:

- ☐ Use only denatured alcohol as a solvent.
- ☐ Always use an appropriate size of cotton swab.
- ☐ Gently move the cotton swab around the center conductor.
- ☐ Never put lateral pressure on the connector's center pin.
- ☐ Verify that no cotton or other foreign material remains in the connector after cleaning.
- ☐ Only dampen the cotton swab. Do NOT saturate it.
- ☐ Compressed air can be used to remove foreign particles and to dry the connector.
- ☐ Verify that the center pin has not been bent or damaged.

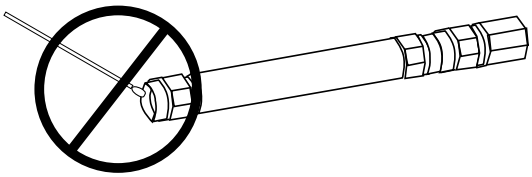
Figure 3-4 illustrates how to clean connectors.



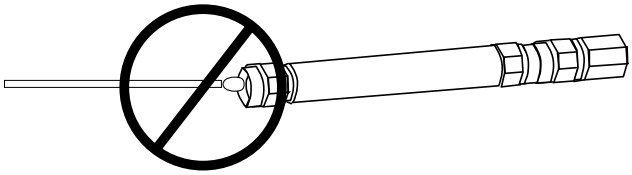
Do NOT use Industrial Solvents or Water on connector. Use only Denatured Alcohol.



Use only denatured alcohol and the proper size of cotton swab. Gently rotate the swab around the center pin being careful not to stress or bend the pin or you will damage the connector.



Do NOT put cotton swabs in at an angle, or you will damage the connectors.



Do NOT use too large of cotton swab, or you will damage the connectors.

Figure 3-4. *How to Clean Connectors*