

Reference Manual

365XA, 365XA-1, 365XD, and 365XD-1 Mechanical Calibration Kits

3650A Calibration Kit, SMA/3.5 mm Connectors

3650A-1 Calibration Kit, SMA/3.5 mm Connectors with Sliding Loads

3651A Calibration Kit, GPC-7 Connectors

3651A-1 Calibration Kit, GPC-7 Connectors with a Single Sliding Load

3652A Calibration Kit, K Connectors

3652A-1 Calibration Kit, K Connectors with Sliding Loads

3653A Calibration Kit, Type N Connectors

3654D Calibration Kit, V Connectors

3654D-1 Calibration Kit, V Connectors with Sliding Loads



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Table of Contents

Chapter1 — Calibration Kit Reference

1-1 Introduction	1-1
1-2 Document Organization	1-1
1-3 Calibration Kit Overview	1-1
1-4 Access to Manuals	1-1
1-5 Model 3650A / Model 3650A-1 SMA/3.5 mm Calibration Kit	1-2
Calibration Kit Description	1-2
Calibration Kit Components	1-2
1-6 Model 3651A / Model 3651A-1 GPC-7 Calibration Kit	1-4
Calibration Kit Description	1-4
Calibration Kit Components	1-4
1-7 Model 3652A / Model 3652A-1 K Connector Calibration Kit	1-6
Calibration Kit Description	1-6
Calibration Kit Components	1-6
1-8 Model 3653A N Connector Calibration Kit	1-8
Calibration Kit Description	1-8
Calibration Kit Components	1-8
1-9 Model 3654D / Model 3654D-1 V Connector Calibration Kit	1-10
Calibration Kit Description	1-10
Calibration Kit Components	1-10

Chapter2 — Maintenance Instructions

2-1 Introduction	2-1
2-2 Connector Do's and Don'ts	2-1
2-3 Coaxial Connector Care	2-1
2-4 Visual Inspection	2-1
2-5 Connector Pin Depth Precautions	2-3
Pin Depth Dimensions	2-3
Pin Depth Gauge	2-4
Pin Depth Tolerances	2-4
Over Torquing Connectors	2-5
Teflon Tuning Washers	2-5
Mechanical Shock	2-5
2-6 Connector Cleaning Instructions	2-6
Cleaning Items Required	2-6
Important Cleaning Tips	2-6
Cleaning Procedure	2-7
2-7 Connection and Disconnection Techniques	2-9
Connection Procedure	2-9
2-8 Disconnection Procedure	2-9

Table of Contents (Continued)

Chapter 1 — Calibration Kit Reference

1-1 Introduction

This manual provides description and maintenance instructions for the following calibration kit models:

- 3650A Calibration Kit, SMA/3.5 mm Connectors
3650A-1 Calibration Kit, SMA/3.5 mm Connectors with Sliding Loads
- 3651A Calibration Kit, GPC-7 Connectors
3651A-1 Calibration Kit, GPC-7 Connectors with a Single Sliding Load
- 3652A Calibration Kit, K Connectors
3652A-1 Calibration Kit, K Connectors with Sliding Loads
- 3653A Calibration Kit, Type N Connectors
- 3654D Calibration Kit, V Connectors
3654D-1 Calibration Kit, V Connectors with Sliding Loads

Note	The components in these kits are of the highest quality and accuracy. All components are NIST (National Institute of Standards Technology) traceable, which means that the components are very accurate and repeatable. Handle with care.
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1-2 Document Organization

This chapter provides illustrations and a contents list for the manual calibration kits listed above. Chapter 2 provides maintenance instructions applicable to all the kits listed above.

An overview of using mechanical calibration kits is described in the Measurement Guide for each VNA. Additional use and procedures for these kits are documented in the VNA Operation Manuals and Programming Guides.

1-3 Calibration Kit Overview

The calibration kits contain all of the precision components and tools required to calibrate the Anritsu Vector Network Analyzer (VNA) systems including the VectorStar MS4640A Series VNA and the Lightning 37xxxX Series VNA for a 12-term error-corrected measurement.

Calibration kits contain components used to identify and separate error sources inherent in microwave test setups. Each kit contains memory devices (either 3.5" floppy disk and/or a USB memory device) which provide coefficient or measurement data for each component. Each kit and its contents is described in detail in the sections following.

1-4 Access to Manuals

This and most other VNA manuals are available for download as an Adobe Acrobat Portable Document Format (.pdf) file.

The Acrobat Reader program is required to view the manual, and is available free from Adobe at: <http://www.adobe.com>.

Except for the maintenance manual, all documents are available for free on the Anritsu Internet site.

Printed copies of manuals and the maintenance guide are available for sale at nominal prices. Updates to this manual, if any, may also be downloaded from the Anritsu Internet site at: <http://www.us.anritsu.com>

1-5 Model 3650A / Model 3650A-1 SMA/3.5 mm Calibration Kit

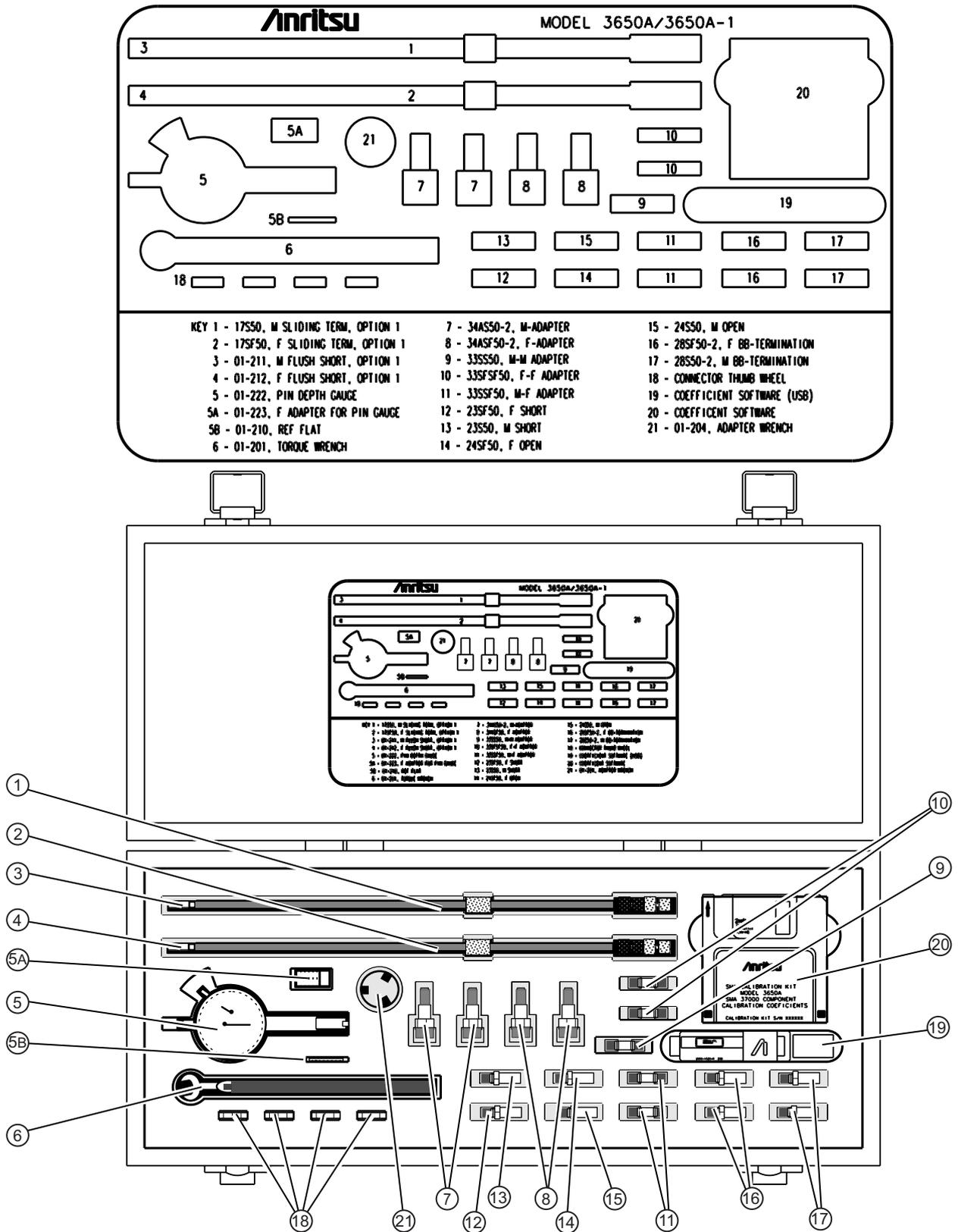
Calibration Kit Description

The 3650A/3650A-1 Calibration Kit contains all the precision components and tools required to calibrate VNAs with 12-term error-corrected measurements for test devices with SMA or 3.5 mm connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads.

Calibration Kit Components

See [Figure 1-1](#) below for the kit label and component locations. The calibration kit consists of the following components:

1. 17S50 Male Sliding Load Termination (3650A-1 only)
2. 17SF50 Female Sliding Load Termination (3650A-1 only)
3. 01-211 Male Flush Short (3650A-1 only)
4. 01-212 Female Flush Short (3650A-1 only)
5. 01-222 Pin Depth Gauge
 - a. 01-223 Female Adapter for Pin Depth Gauge
 - b. 01-210 Reference Flat
6. 01-201 5/16" (8 mm) Torque End Wrench, set to 8 lbf in (0.9 N m)
7. 34AS50-2 GPC-7 to 3.5 mm Male Adapter (2 each)
8. 34ASF50-2 GPC-7 to 3.5 mm Female Adapter (2 each)
9. 33SS50 Male-Male Phase Equal Adapter
10. 33SFSF50 Female-Female Phase Equal Adapter (2 each)
11. 33SSF50 Male-Female Phase Equal Adapter (2 each)
12. 23SF50 Female Short
13. 23S50 Male Short
14. 24SF50 Female Open
15. 24S50 Male Open
16. 28SF50-2 Broadband Female Termination (2 each)
17. 28S50-2 Broadband Male Termination (2 each)
18. A18311 Connector Thumb Wheel (4 each)
19. Calibration Component Coefficients on USB Memory Device
20. Calibration Component Coefficients on 3.5" Diskette
21. 01-204 Universal Adapter Wrench



See "Section 1-5" on page 1-2 above for component identification and description.

Figure 1-1. Model 3650A / Model 3650A-1 SMA/3.5 mm Connector SOLT Calibration Kit

1-6 Model 3651A / Model 3651A-1 GPC-7 Calibration Kit

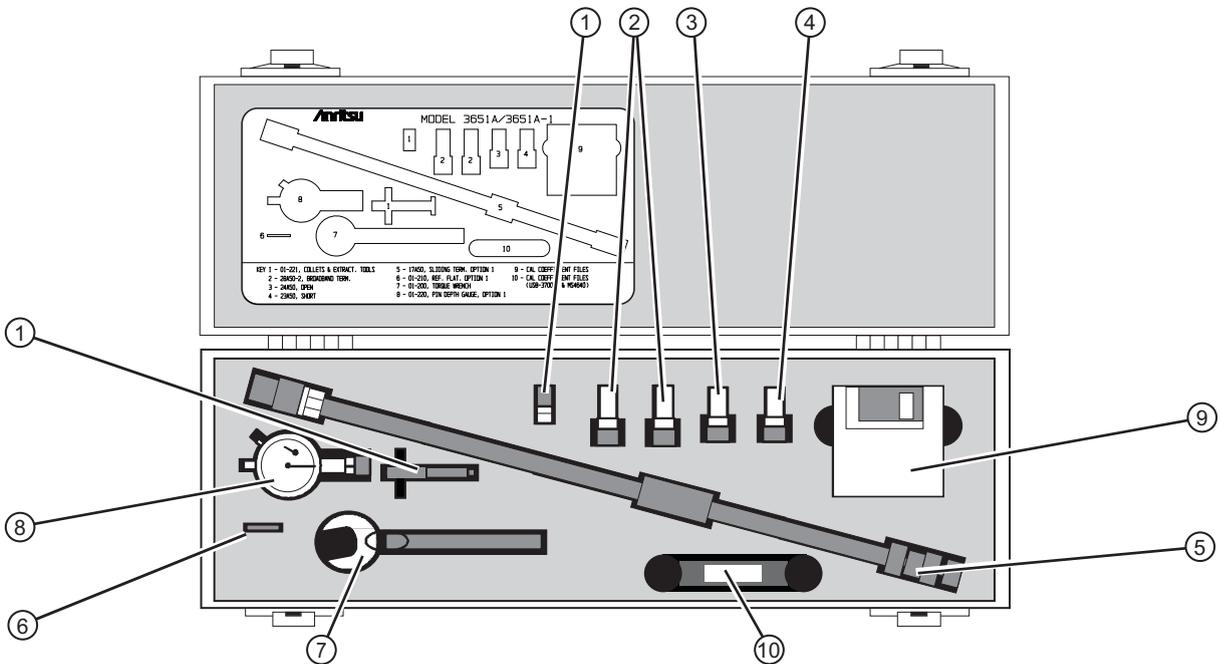
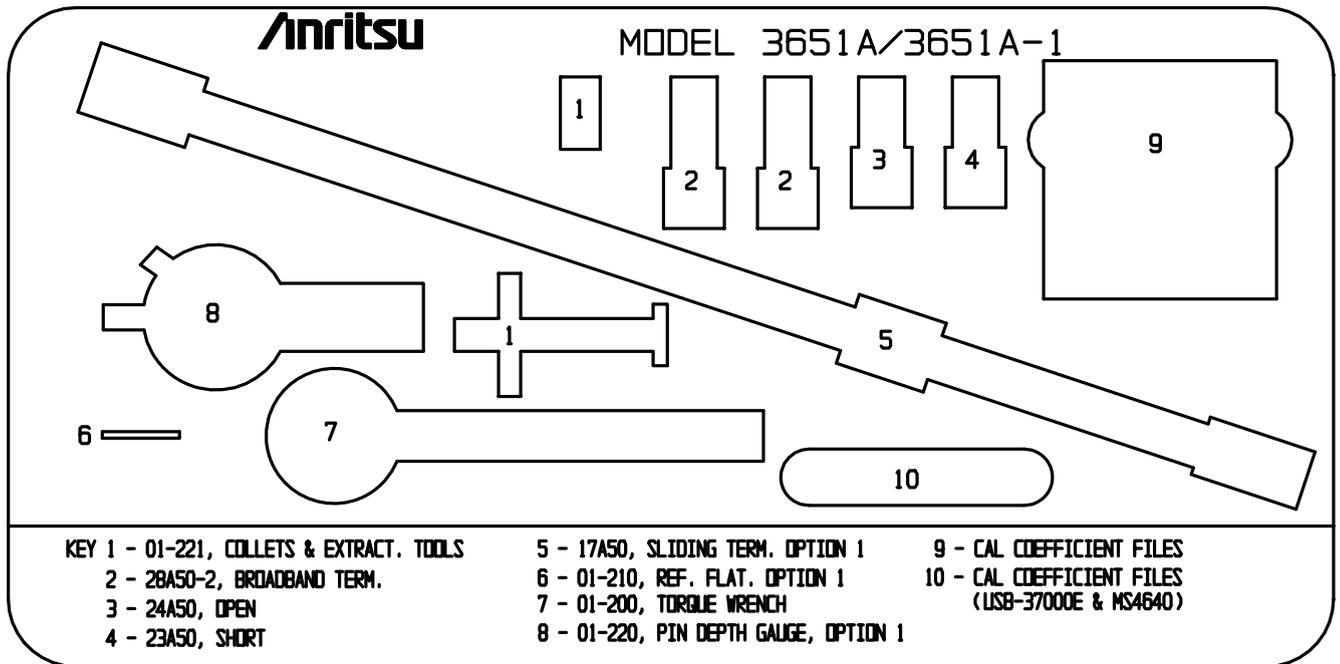
Calibration Kit Description

The 3651A Calibration Kit contains all the precision components and tools required to calibrate a VNA with 12-term error-corrected measurements for test devices with GPC-7 connectors. The kit supports calibration with broadband loads. The 3651A Cal Kit with Option 1 adds a sliding load and a pin depth gauge.

Calibration Kit Components

See [Figure 1-2](#) below for kit label and component locations. The calibration kit consists of the following components:

1. 01–221 Collet Extractor Tool and Vial of Four Collets
2. 28A50-2 Termination, DC to 18 GHz (2 each)
3. 24A50 Open
4. 23A50 Short
5. 17A50 Sliding Termination (3651A-1 only)
6. 01–210 Reference Flat (3651A-1 only)
7. 01-200 3/4" Torque End Wrench, set to 12 lbf in (1.36 N · m)
8. 01–220 Connector Gauge (3651A-1 only)
9. Calibration Component Coefficients on 3.5" Diskette
10. Calibration Component Coefficients on USB Memory Device



See "Section 1-6" on page 1-4 above for component identification and description.

Figure 1-2. Model 3651A / Model 3651A-1 GPC-7 Connector SOLT Calibration Kit

1-7 Model 3652A / Model 3652A-1 K Connector Calibration Kit

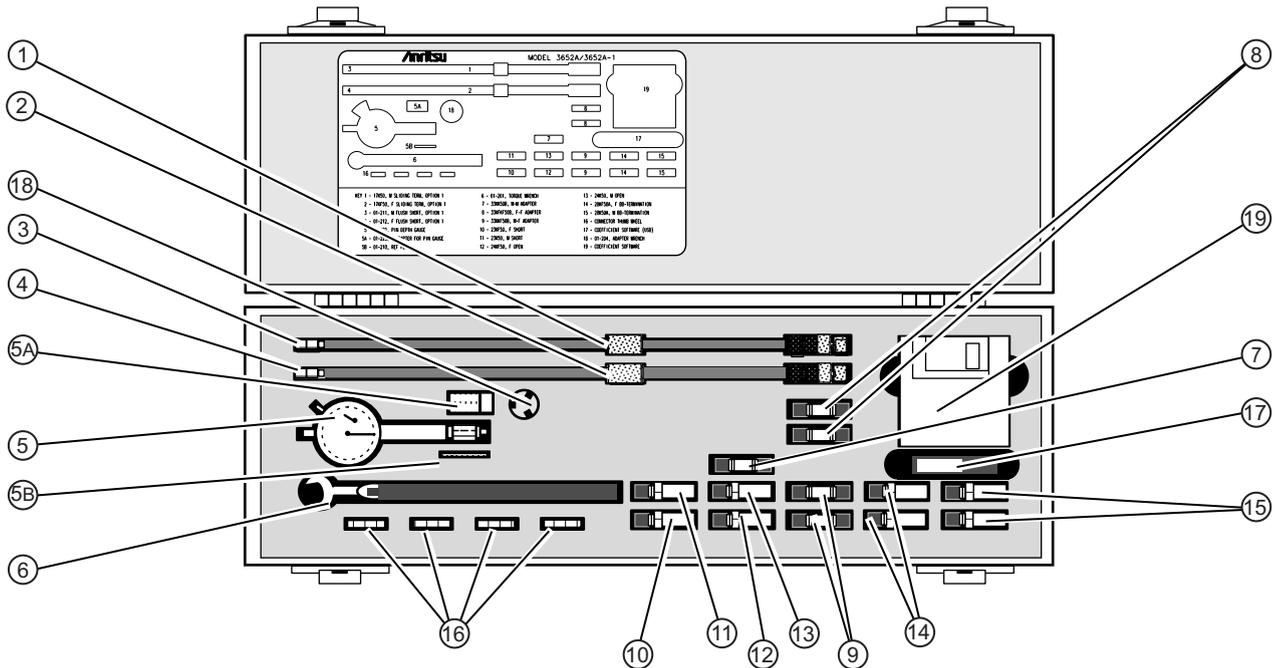
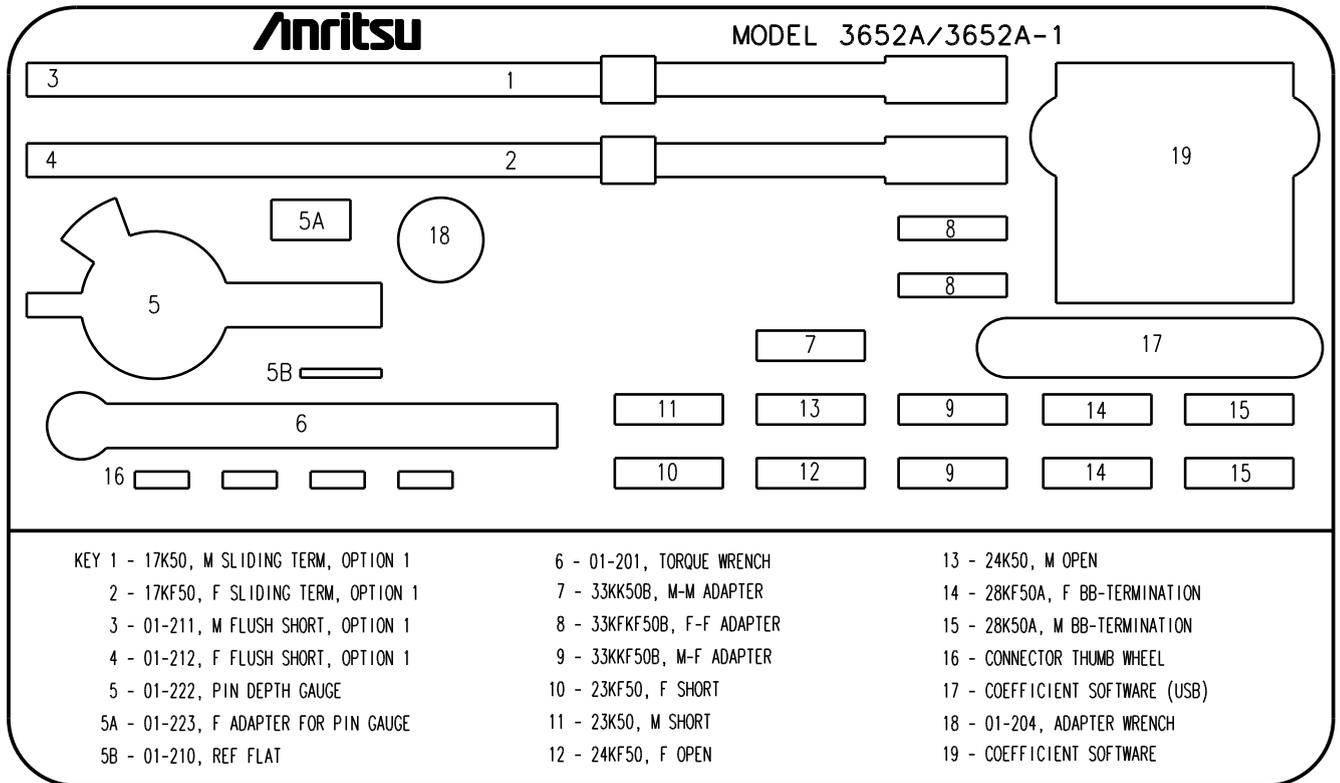
Calibration Kit Description

The 3652A/3652A-1 Calibration Kits contain all the precision components and tools required to calibrate a VNA with 12-term error-corrected measurements for test devices with K Connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. The 3652A-1 kit with Option 1 adds sliding loads.

Calibration Kit Components

See [Figure 1-3](#) below for kit label and component locations. The calibration kit consists of the following components:

1. 17K50 Male Sliding Termination (3652A-1 only)
2. 17KF5 Female Sliding Termination (3652A-1 only)
3. 01-211 Male Flush Short (3652A-1 only)
4. 01-212 Female Flush Short (3652A-1 only)
5. 01-222 Pin Depth Gauge
 - a. 01-223 Female Adapter for Pin Depth Gauge
 - b. 01-210 Reference Flat
6. 01-201 5/16" (8 mm) Torque End Wrench, set to 8 lbf in (0.9 N m)
7. 33KK50B Male to Male Phase Equal Adapter
8. 33KFKF50B Female to Female Phase Equal Adapter (2)
9. 33KKF50B Male to Female Phase Equal Adapter (2 each)
10. 23KF50 Female Short
11. 23K50 Male Short
12. 24KF50 Female Open
13. 24K50 Male Open
14. 28KF50A Broadband Female Termination, DC to 40 GHz (2 each)
15. 28K50A Broadband Male Termination, DC to 40 GHz (2 each)
16. A18311 Connector Thumb Wheel (4 each)
17. Calibration Component Coefficients on USB Memory Device
18. 01-204 Universal Adapter Wrench
19. Calibration Component Coefficients on 3.5" Diskette



See “Section 1-7 ” on page 1-6 above for component identification and description.

Figure 1-3. Model 3652A / Model 3652A-1 K Connector SOLT Calibration Kit

1-8 Model 3653A N Connector Calibration Kit

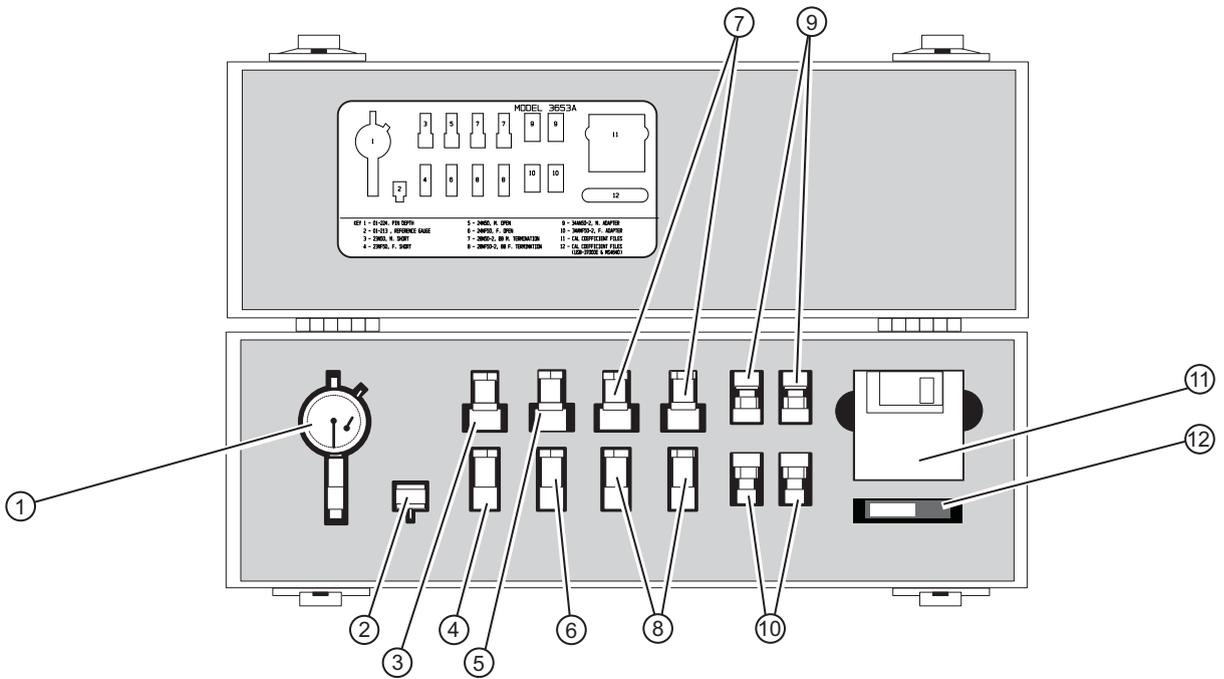
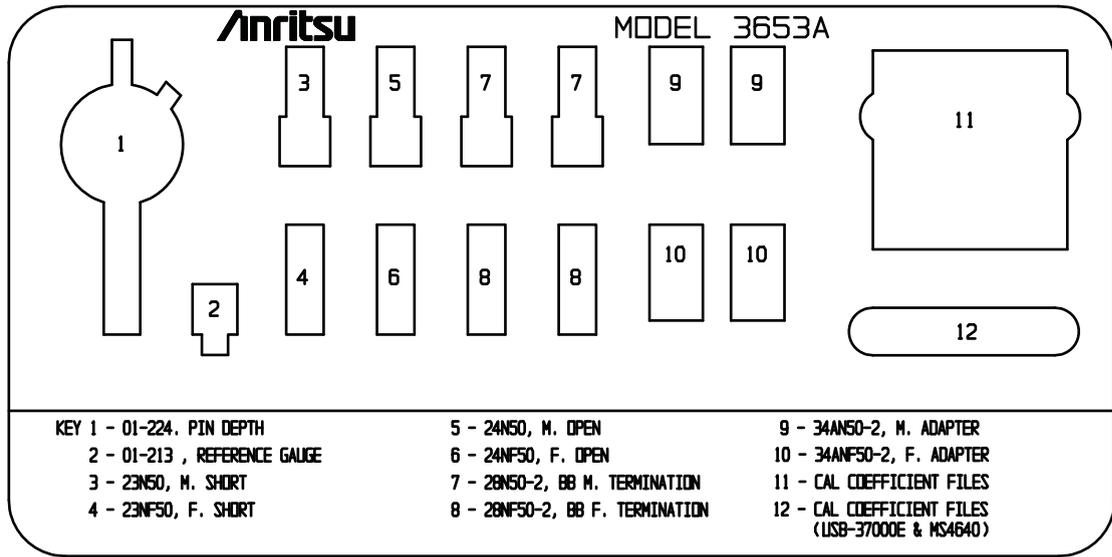
Calibration Kit Description

The 3653A N Connector Calibration Kit contains all the precision components and tools required to calibrate a VNA with 12-term error-corrected measurements for test devices with Type N connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. Note that a 3653A N Calibration Kit with sliding loads is not available.

Calibration Kit Components

See [Figure 1-4](#) below for the kit label and component locations. The calibration kit consists of the following components:

1. 01–224 Connector Pin Depth Gauge (for Type N Connectors)
2. 01–213 Reference Gauge (for Type N Connectors)
3. 23N50 Male Short
4. 23NF50 Female Short
5. 24N50 Male Open
6. 24NF50 Female Open
7. 28N50-2 Broadband Male Termination (2 each)
8. 28NF50-2 Broadband Female Termination (2 each)
9. 34AN50-2 Male Adapter, GPC-7 to N (2 each)
10. 34ANF50-2 Female Adapter, GPC-7 to N (2 each)
11. Calibration Component Coefficients on 3.5” Diskette
12. Calibration Component Coefficients on USB Memory Device



See "Section 1-8" on page 1-8 above for component identification and description.

Figure 1-4. Model 3653A N Connector SOLT Calibration Kit

1-9 Model 3654D / Model 3654D-1 V Connector Calibration Kit

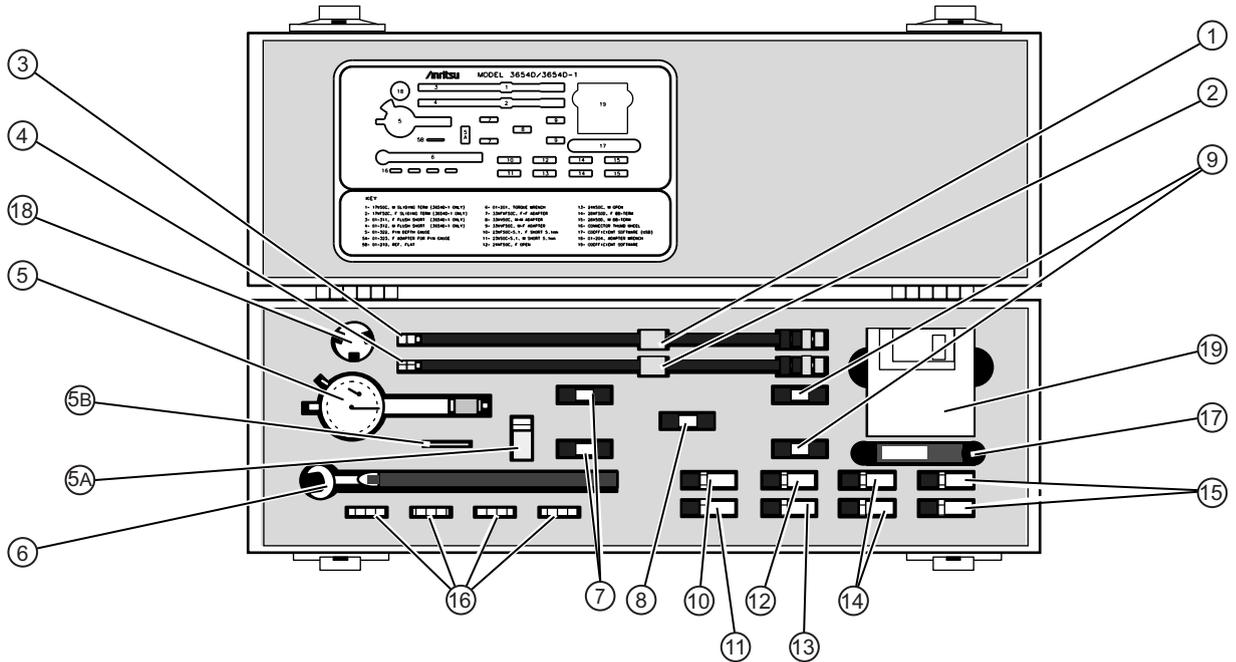
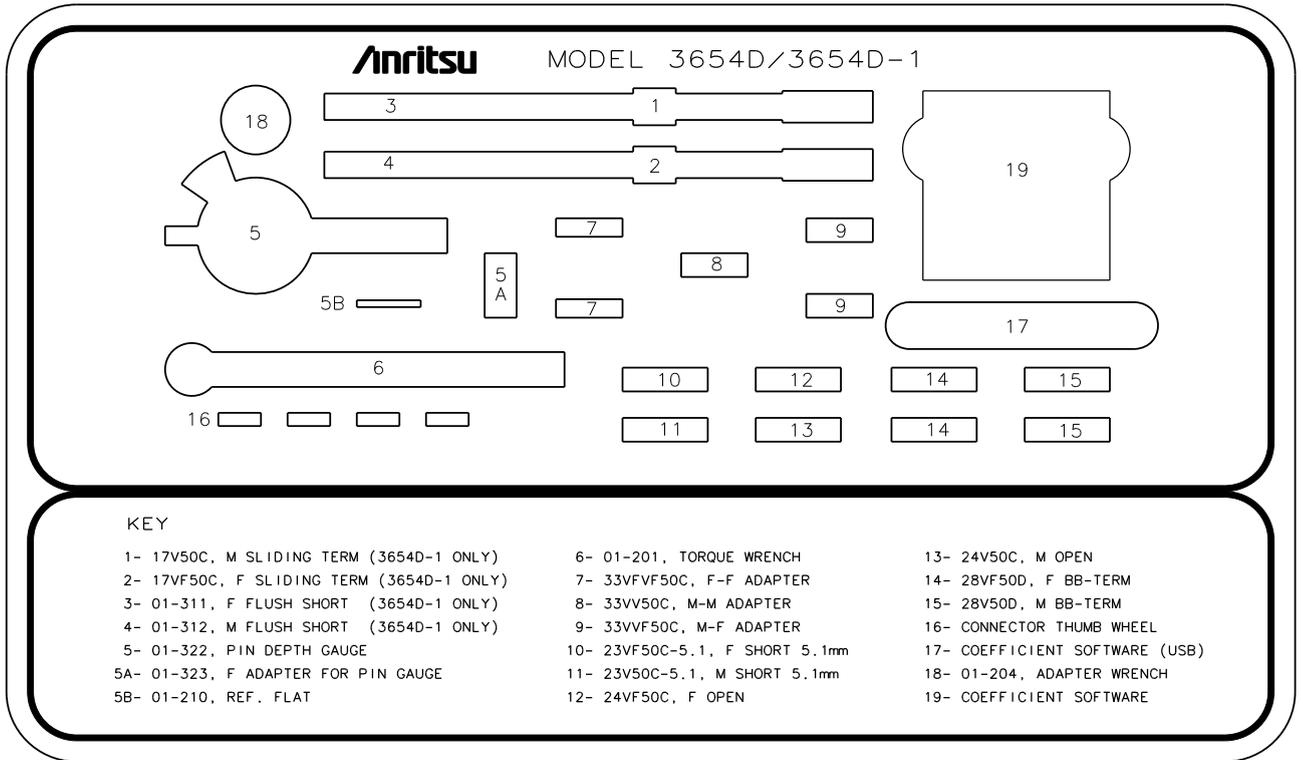
Calibration Kit Description

The 3654D/3654D-1 Calibration Kits contain all the precision components and tools required to calibrate a VNA with 12-term error-corrected measurements for test devices with V Connectors. Components are included for calibrating both male and female test ports. The kit supports calibration with broadband loads. The Option 1 3654D-1 kit adds sliding loads.

Calibration Kit Components

See [Figure 1-5](#) below for the kit label and component locations. The calibration kit consists of the following components:

1. 17V50C Male Sliding Termination (3654D-1 only)
2. 17VF50C Female Sliding Termination (3654D-1 only)
3. 01-311 Female Flush Short (3654D-1 only)
4. 01-312 Male Flush Short (3654D-1 only)
5. 01-322 Pin Depth Gauge
 - a. 01-323 Female Adapter for Pin Depth Gauge
 - b. 01-210 Reference Flat
6. 01-201 5/16" (8 mm) Torque End Wrench, set to 8 lbf in (0.9 N m)
7. 33VFVF50C Female to Female Phase Equal Adapter (2 each)
8. 33VV50C Male to Male Phase Equal Adapter
9. 33VVF50C Male to Female Adapter (2 each)
10. 23VF50C-5.1 Female Short (5.1 mm offset)
11. 23V50C-5.1 Male Short (5.1 mm offset)
12. 24VF50C Female Open
13. 24V50C Male Open
14. 28VF50D Female Broadband Termination (2 each)
15. 28V50D Male Broadband Termination (2 each)
16. A18311 Connector Thumb Wheel (4 each)
17. Calibration Component Coefficients on USB Memory Device
18. 01-204 Universal Adapter Wrench (2 each)
19. Calibration Component Coefficients on 3.5" Diskette



See "Section 1-9" on page 1-10 above for component identification and description.

Figure 1-5. Model 3654D / Model 3654D-1 V Connector Calibration Kit Contents

Chapter 2 — Maintenance Instructions

2-1 Introduction

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

Note	The components in these kits are of the highest quality and accuracy. All components are NIST (National Institute of Standards Technology) traceable, which means that the components are very accurate and repeatable. Handle with care.
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2-2 Connector Do's and Don'ts

- These are high frequency connectors so be gentle and handle them with care.
- Do not use any part of calibration kit as an “adapter”. If you need a special adapter get one from outside of the cal kit.
- Avoid touching connector mating planes with bare hands. Natural skin oils and microscopic dirt particles are very hard to remove.
- Keep connectors clean.
- When using cotton swaps to clean connectors, make sure that you don't damage the center conductor.
- Always check the pin depth of a new connector before use to determine if they are out of spec. One bad connector can damage many.
- The connector can be damaged by turning in the wrong direction. Turning right tightens and turning left loosens. If you have trouble remembering, use the mnemonic “righty tighty, lefty loosely”.
- Always use an appropriate torque wrench.
- Put dust caps on the connector after use.
- Never store adapters loose in a box, in a desk, or in a drawer.
- Calibration kit components are a unique set. Keep them together.

2-3 Coaxial Connector Care

Most coax connectors are assembled into a system and forgotten, but some, especially on test equipment are used almost continuously. The care and cleaning of these connectors is critical to accurate and reliable performance. Remember that all connectors have a limited life time and usually a maximum connect/disconnect specification, typically about 5,000 connections. Most will last well beyond this number but poor usage and poor care can destroy a connector well before that number. Good connector performance can be achieved with the following:

- Periodic visual inspection
- Cleaning
- Proper connection and disconnection techniques using torque wrench
- Appropriate gauging techniques

2-4 Visual Inspection

To ensure a long and reliable connector life, careful visual inspection should be performed on the connectors before they are used on a particular job at a minimum of once per day when the item is being used. A “good” connector may get damaged if it is mated with a “bad” one.

The minimum magnification for connector inspection for damage varies with the connector:

- 7X for K and V connectors
- 2X for N connectors
- 10X for W1 connectors

Any connector with the following defects should be repaired or discarded:

- Plating
 - Deep scratches showing bare metal on the mating plane
 - Bubbles and blisters
 - The connectors may lose some gloss over time due to usage. Light scratches, marks and other cosmetic imperfections can be found on the mating plane surfaces. These should be of no cause for concern.
- Threads
 - Damaged threads. Don't force the connectors to mate with each other.
- Center conductors
 - Bent, broken or damaged contacts.

2-5 Connector Pin Depth Precautions

A connector should be checked before it is used at a minimum of once per day when in use. If the connector is to be used on another item of equipment, the connector on the equipment to be tested should also be gauged.

Connectors should never be forced together when making a connection since forcing often indicates incorrectness and incompatibility. There are some dimensions that are critical for the mechanical integrity, non-destructive mating and electrical performance of the connector. Connector gauge kits are available for many connector types. Please refer to **Anritsu Application Note 10200-00040**. The mechanical gauging of coaxial connectors will detect and prevent the following problems:

- Positive pin depth
 - This may result in buckling of the fingers of the female center conductor or damage to the internal structure of a device due to the axial forces generated.
- Negative pin depth
 - This will result in poor return loss, possibly unreliable connections, and could even cause breakdown under peak power conditions.
- These gages should be checked for cleanliness before they are used at a minimum of once per month. The connector cleaning procedures can also be used to clean the pin depth gauges.

Pin Depth Dimensions

Before mating, measure the pin depth of the device that will mate with the RF component. The dimensions to measure are shown below in [Figure 2-1](#).

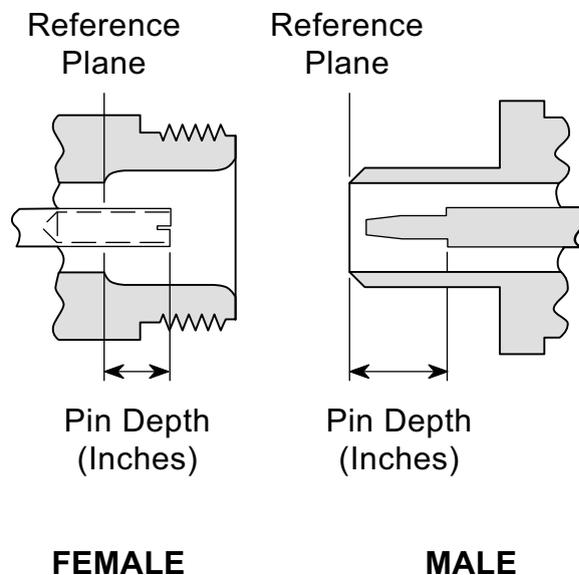
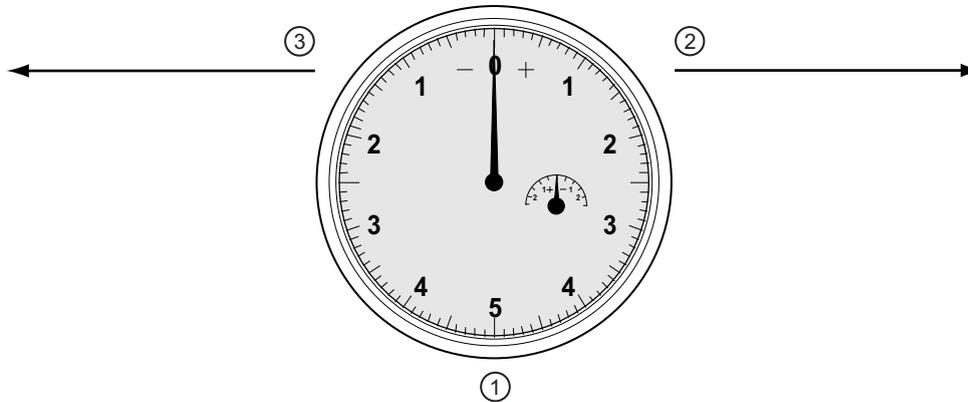


Figure 2-1. N Connector Pin Depth

Pin Depth Gauge

Use an Anritsu Pin Depth Gauge or equivalent as shown below in [Figure 2-2](#) to accurately measure pin depths.



- 1 – Pin Depth Gauge with needle setting at zero.
- 2 – Positive needle direction clockwise to right.
- 3 – Negative needle direction counter-clockwise to left.

Figure 2-2. Pin Depth Gauge

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.

Note A destructive pin depth has a center pin that is too long in respect to the connector's reference plane.

Pin Depth Tolerances

The center pin of RF component connectors has a precision tolerance measured in “mils” which is equal to 1/1000 inch (0.001”) or approximately 0.02540 mm.

V connectors have a higher precision tolerance measured in “tenths” or 1/10,000 inch (0.0001”) or approximately 0.00254 mm.

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 and to avoid connector damage.

When gauging pin depth, if the test device connector measures out of tolerance (see [Table 2-1 on page 2-5](#) below) in the “+” region of the gauge (see [Figure 2-2](#) above), 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 2-1. Pin Depth Tolerances and Required Torque Settings

Connector Type	Pin Depth (Inches)	Anritsu Gauge Setting
GPC-7	+0.000 -0.003	Same as pin depth
N Male	+0.003	0.000
	0.207	0.207
N Female	0.000	-0.003
	0.207	0.000
	-0.003	-0.003
WSMA Male	-0.0025	Same as pin depth
WSMA Female	-0.0035	
K Male	+0.000	Same as pin depth
K Female	-0.003	
V Male	+0.000	Same as pin depth
V Female	-0.002	

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. For other connectors, use the correct torque wrench.

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.

2-6 Connector 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 solvent. Below, [Figure 2-3](#) illustrates the cleaning procedures for male and female connectors.

Note

Most cotton swabs are too large to fit into the ends of 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.

With continuous use, the outer conductor mating interface will build up a layer of dirt and metal chips that can severely degrade connector electrical and mechanical performance. It also tends to increase the coupling torque which then can damage the mating interface. Cleaning of connectors is essential for maintaining good electrical performance. Therefore, connectors should be checked for cleanliness before making any measurements (or calibration).

Cleaning Items Required

- Low pressure compressed air (solvent free)
- Cotton swabs
- Denatured alcohol
- Microscope

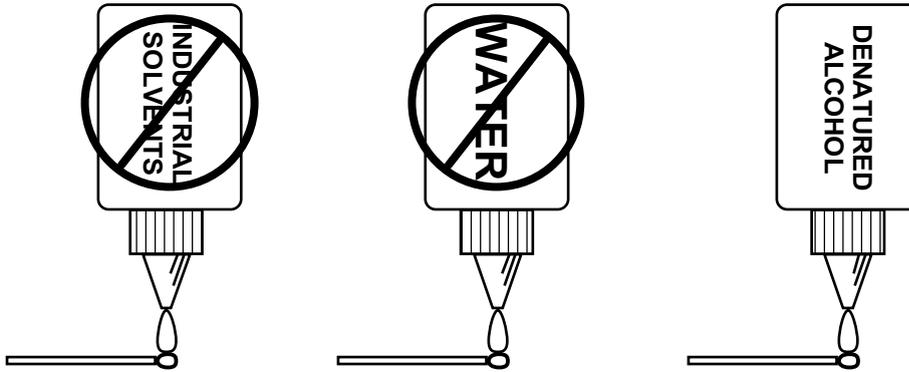
Important Cleaning Tips

The following are some important tips on cleaning connectors:

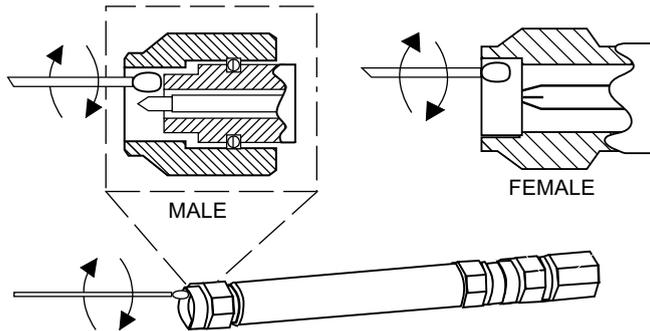
- Use only denatured alcohol as a solvent.
- Always use an appropriate size of cotton swab.
- Gently move the cotton swab around the center conductor.
- Never put lateral pressure on the connector center pin.
- Verify that no cotton or other foreign material remains in the connector after cleaning.
- 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.

Cleaning Procedure

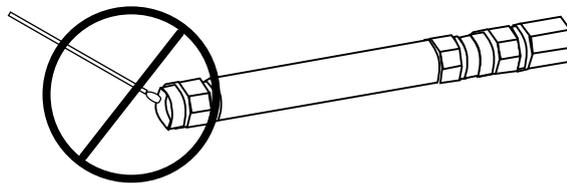
1. Remove loose particles on the mating surfaces, threads, and similar surfaces using low-pressure compressed air.
2. The threads of the connector should be cleaned with cotton swab. When connector threads are clean, the connections can be hand-tightened to within approximately one-half turn of the proper torque.
3. Clean mating plane surfaces using alcohol on cotton swabs ([Figure 2-3](#)).
 - Make sure that the cotton swab is not too large.
 - Use only enough solvent to clean the surface.
 - Use the least possible pressure to avoid damaging connector surfaces.
 - Do not spray solvents directly on to connector surfaces
4. After cleaning with swabs, again use low-pressure compressed air to remove any remaining small particles and to dry the connector surfaces.



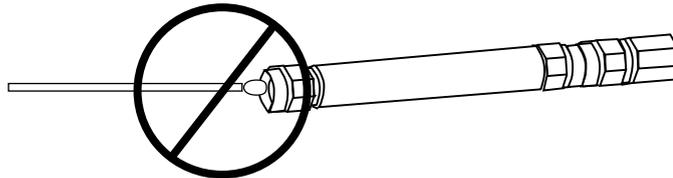
Do NOT use Industrial Solvents or Water on connector. Use only Denatured Alcohol. Dampen only, DO NOT saturate.



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.

CleaningConnectors

Figure 2-3. Cleaning Connectors

2-7 Connection and Disconnection Techniques

Connection Procedure

1. Visually inspect the connectors (see “[Visual Inspection](#)”).
2. If necessary, clean the connectors (see [Figure 2-3](#) above and “[Connector Cleaning Instructions](#)”).
3. Carefully align the connectors. The male connector center pin must slip concentrically into the contact fingers of the female connector.
4. Push connectors straight together. Do not twist or screw them together. As the center conductors mate, there is usually a slight resistance.
5. Do not turn the connector body, turn the connector nut instead. Major damage to the center conductor and the outer conductor can occur if the connector body is twisted.
6. Initial tightening can be done by hand.
7. Relieve any side pressure on the connection from long or heavy devices or cables. This assures consistent torque.
8. *Do not* pre-tighten so much that there is no rotation of the nut with the torque wrench. Leave about 1/8 turn or 45 degrees of rotation for the final tightening with the torque wrench.
 - [Table 2-2](#) below lists the Anritsu Company torque wrench and open end wrench part numbers for different connectors.

Table 2-2. Connector Wrench Requirements – Torque Wrenches and Settings – Open End Wrenches

Connector Type	Torque Wrench Model Number	Torque Specification	Open End Wrench
3.5mm/SMA	01-201	8 in-lbs	01-204
K	01-201	8 in-lbs	01-204
V	01-201	8 in-lbs	01-204

9. Hold torque wrench at the end.
 - Holding the torque wrench elsewhere applies an unknown amount of torque and could damage contacts and/or connectors.
10. Rotate *only* the connector nut when you tighten the connector. Use an open–end wrench to keep the body of the connector from turning.
11. Using two wrenches with an angle greater than 90° causes the connector devices to lift up and tends to misalign the devices and stress the connectors. This becomes more of a problem when there are several devices connected to each other.
12. Breaking the handle fully can cause the wrench to kick back and may loosen the connection.

2-8 Disconnection Procedure

1. Use an open end wrench to prevent the connector body from turning.
2. Use another wrench to loosen the connector nut.
3. Complete the disconnection by hand, turning *only* the connector nut.
4. Pull the connectors straight apart without twisting or bending.

Index

Numerics

12-term error-corrected measurement	1-1
3650A SMA/3.5 mm Cal Kit	1-2
3650A-1 SMA/3.5 mm Cal Kit with Sliding Loads	1-2
3651A GPC-7 Cal Kit	1-4
3651A-1 GPC-7 Cal Kit with Sliding Loads	1-4
3652A K Connector Cal Kit	1-6
3652A-1 K Connector Cal Kit with Sliding Loads	1-6
3653A N Connector Cal Kit	1-8
3654D V Cal Kit	1-10
3654D-1 V Cal Kit with Sliding Loads	1-10

A

Access to Manuals	1-1
-------------------	-----

C

Calibration Kit Overview	1-1
Cleaning Procedure	2-7
Cleaning Tips	2-6
Connectors	
Cleaning Procedure	2-7
Cleaning Tips	2-6
Connection Procedure	2-9
Connector Care	2-1
Connector Cleaning	2-6
Connector Concentricity	2-9
Disconnection	2-9
Pin Depth	2-3
Pin Depth Gauge	2-4
Precautions	2-3
Visual Inspection	2-1

D

Disconnection Procedure	2-9
Document Organization	1-1

G

Gauge	2-4
GPC-7 Cal Kit	1-4

K

K Connector Cal Kit	1-6
---------------------	-----

M

Mechanical Shock	2-5
------------------	-----

N

N Connector Cal Kit	1-8
National Institute of Standards Technology	1-1
Negative Pin Depth	2-3
NIST	1-1

O

On-Line Manuals	1-1
-----------------	-----

P

Pin Depth	
Negative Pin Depth	2-3
Pin Depth Gauge	2-4
Pin Depth Measurement	2-3
Positive Pin Depth	2-3
Precautions	2-3

S

Short-Offset-Load-Termination Calibration	1-1
SMA/3.5 mm Cal Kit	1-2
SOLT Calibration	1-1

T

Teflon Tuning Washers	2-5
Tolerance	2-4
Torquing Connectors	2-5

V

V Connector Cal Kit	1-10
Visual Inspection	2-1

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