CX100 ComXpert

Handheld Radio Test Set

Test and Measurement Guide

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Handheld Radio Test Set

Test and Measurement Guide

22144016 Rev 000

Part of CD 22144014

VIAVI Solutions
1-844-GO-VIAVI
www.viavisolutions.com

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Revision History

The following table contains a record of this manual's revision history.

Table -1 Revision History

Doc Version	Date	Accepted by
Rev 000	October 30, 2022	Lance Woods

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Notice

Every effort was made to ensure that the information in this manual was accurate at the time of release. However, information is subject to change without notice, and VIAVI reserves the right to provide an addendum to this manual with information not available at the time that this manual was created.

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Declaration of Conformity

VIAVI recommends keeping a copy of the Declaration of Conformity that shipped with the unit with the test set at all times.

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This product was tested and conforms to the Low Voltage Directive, 73/23/EEC as amended by 93/68/EEC.

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This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment was tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

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ALERT

- To comply with FCC RF Exposure compliance requirements, a separation distance of at least 20 cm must be maintained between the antenna of this device and all persons.
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This product, and the batteries used to power the product, should not be disposed of as unsorted municipal waste and should be collected separately and disposed of according to your national regulations.

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This manual is a product of the VIAVI Technical Publications Department, issued as part of the CX100 ComXpert Handheld Radio Test Set. The PDF format of this manual is available and distributed with new equipment on a CD-ROM.

- The part number associated with the PDF form of this publication is 22144016
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Contact Information

Contact the Technical Assistance Center (TAC) for technical support or with any questions regarding this or other VIAVI products.

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- Email: Techsupport.Avcomm@viavisolutions.com

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Preface

This preface contains the following product information:

Purpose and Scope

This guide provides step by step instructions for using the CX100 to perform various tests and measurements.

This guide should be used in combination with the *CX100 ComXpert Operation Manual*. Refer to the *CX100 ComXpert Operation Manual* for information about device operation and User Interface (UI) navigation.

Intended Audience

This manual is intended for personnel who are familiar with the use and operation of the CX100 as well as with radio test systems and associated equipment and terminology.

Related Information

This document provides step by step instructions for using the CX100 to perform various test and measurements.

Use this guide in conjunction with the following information:

- **#22144015, CX100 ComXpert Operation Manual**

  The *CX100 ComXpert Operation Manual* contains product safety information, installation and operational instructions and functional descriptions of the capabilities supported by the CX100 ComXpert Handheld Radio Test Set.

Contact Information

Contact the Technical Assistance Center (TAC) for technical support or with any questions regarding this or another VIAVI products.

- Phone: 1-844-GO-VIAVI

For the latest TAC information, go to:

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Document History

The following table contains a record of this manual's revision history.

Table 1 Document Revisions

Doc Version	Date	Description
Rev 000	October 30, 2022	Test and Measurement Guide

Symbols and Markings

Symbol Conventions

The following symbols are used throughout this publication.

Table 2 Symbol Conventions

	**Alert Symbol** This symbol indicates a note that includes important supplemental information or tips related to the main text.

Conventions

This guide uses typographical and symbols conventions as described in the following tables.

Table 3 Text and Symbol Conventions

Item(s)	Example(s)
Buttons, keys, switches, or connectors on the device (hardware components).	Press the **On** button. Press the **Enter** key. Flip the **Power** switch to the on position.
Buttons, links, menus, menu options, tabs, or fields on a UI (software components).	Click **Start**. Click **File > Properties**. Click the **Properties** tab. Type the name of the probe in the **Probe Name** field.
References to guides, books, and other publications appear in *this typeface*.	See *Newton's Telecom Dictionary.*

Acronyms

The following acronyms are used in this document:

AF — Audio Frequency

AM — Amplitude Modulation

CX100 — CX100 ComXpert Handheld Radio Test Set

DUT — Device Under Test

LCD — Liquid Crystal Display

LED — Light Emitting Diode

RF — Radio Frequency

Rx — Receive or Receiver

Tx — Transmit or Transmitter

UI — User Interface

VNC — Virtual Network Computing

I/O — Input/Output

1

Getting Started

This chapter provides a basic overview of the CX100 ComXpert Handheld Radio Test Set. This chapter contains the following information:

1.1 Device Controls and Connectors

Refer to the *CX100 ComXpert Operation Manual* for a description of controls and connectors.

1.1.1 RF and Audio I/O Connectors

This section identifies the CX100's RF and Audio input and output connectors: the connectors identified in Figure 1-1 are used to perform various test and measurements described in this guide.

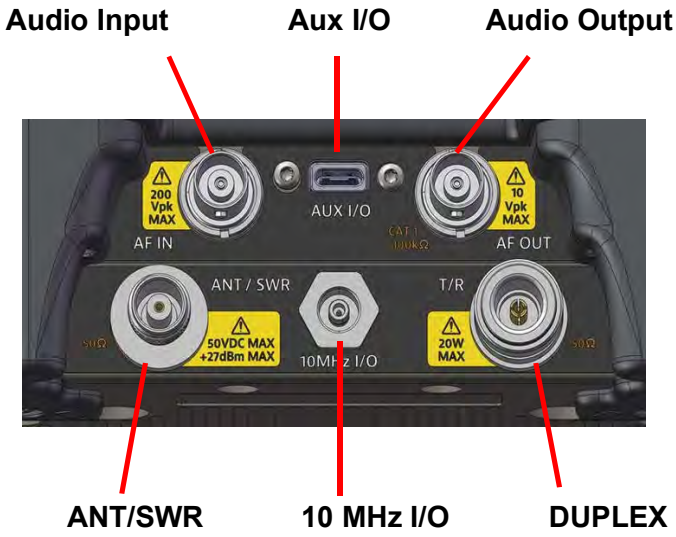

Figure 1-1 CX100 RF Input/Output Connectors

CAUTION

Do not overload input connectors. Refer to product Safety and Compliance Specifications or the product data sheet for maximum input ratings.

Mise en Garde

Ne surchargez pas les connecteurs d'entrée. Reportez-vous aux spécifications du produit ou à la fiche technique du produit pour connaître les valeurs d'entrée maximales.

1.1.2 Front Panel Controls

The following controls are used to operate and control the device. Many of the functions performed using the front panel controls are also performed using the touchscreen.

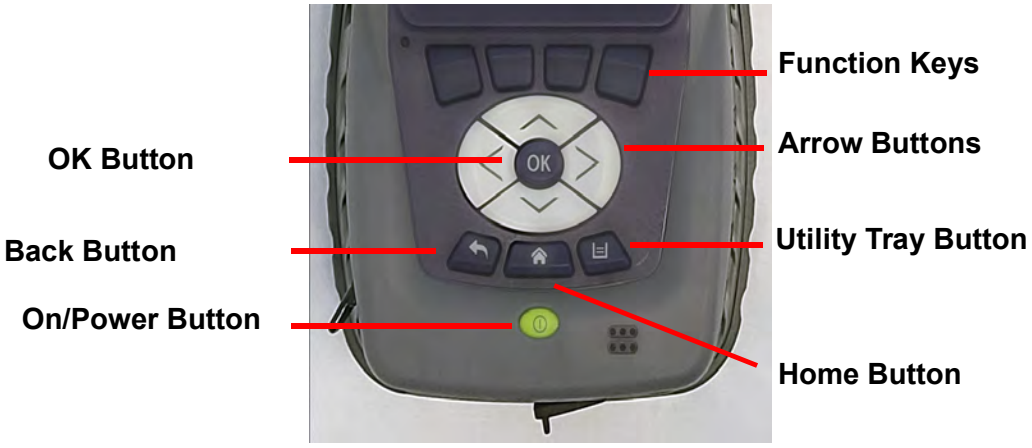

Figure 1-2 CX100 Controls and Buttons

1.2 Powering the Device

The CX100 is designed to be powered by an internal battery or an external AC power supply.

1.2.1 AC Power Operation

The CX100 can be powered externally using the AC Power Adapter to connect the device to a grounded AC power supply. When the CX100 is connected to an AC power supply, the device automatically initiates recharging the battery.

CAUTION

- Use only the AC Adapter/Charger supplied with the product. Contact VIAVI for approved replacement parts.
- Do not use the AC Adapter/Charger outdoors or in a wet or damp location.
- Only connect the AC Adapter/Charger to the correct mains voltage indicated on the ratings label.

Mise en Garde

- Utilisez uniquement l'adaptateur / chargeur CA fourni avec l'instrument.
- N'utilisez pas l'adaptateur / chargeur CA à l'extérieur ou dans un endroit mouillé ou humide.
- Connectez uniquement l'adaptateur / chargeur CA à la tension secteur correcte indiquée sur l'étiquette des caractéristiques nominales.

WARNING

Improper grounding of equipment can result in electrical shock. To ensure proper grounding, this device should only be connected to a grounded AC Power Supply.

Avertissement

La mise à la terre inadéquate de l’équipement peut entraîner un choc électrique. Pour s'assurer d’une mise à la terre adéquate, cet appareil doit seulement être branché à une alimentation électrique CA mise à la terre.

1.2.2 Connecting to an AC Power Supply

1. Connect the power cord to the AC Adapter/Charger.
2. Connect the DC connector to the device’s DC input connector.
3. Connect the power cord to a grounded AC power supply.

1.2.3 Battery Operation

The internal battery supports up to 3 hours of continuous operation, after which time the battery needs recharging. The amount of battery operation time remaining is displayed as a percentage (%) next to the Battery LED.

ALERT

Refer to the *CX100 ComXpert Operation Manual* for information about battery replacement and disposal.

1.2.4 Charging the Battery

1. Connect the device to an AC power supply.
2. Verify the device's **Battery LED** turns Amber to indicate the battery is charging.
3. The **Battery LED** turns green when the battery is fully charged.

1.3 Power On/Off Procedures

The CX100 is powered on and off using the **Power button** located on the front panel.

To Turn the Device ON

1. Press and hold the **Power button** for approximately 3 seconds, then release.
2. An initializing indicator screen is displayed during the boot-up process. Wait while the device completes the boot-up process; this takes several seconds.
3. The **Home Screen** is displayed when the device is ready for use.

To Turn the Device OFF

1. Press and hold the Front Panel **Power button** for approximately 3 seconds, then release.
2. The device performs a series of power-down processes.
3. When the power down process is finished, the front panel **LED**s will no longer be illuminated.

1.4 Device Control and Operation

The CX100 can be operated locally using the device's LCD touch screen and front panel controls, or remotely using a VNC (Virtual Network Computing) viewing application.

1.4.1 LCD User Interface

The OneExpert User Interface (UI) is designed to be intuitive and easy to use. The Liquid Crystal Display (LCD) is a capacitive touch screen that operates similarly to a mobile device. The touch screen supports gestures such as press to open/select/activate, press and hold, press and drag, swipe sideways and pinch to zoom.

1.4.2 Remote Operation

The CX100 can be controlled from a remote location such as a laptop using a VNC viewing application.

2

Performing FM Transmitter Tests

This chapter provides step by step instructions to use the CX100 to evaluate performance characteristics of an FM Transmitter.

This procedure is divided into the following sections:

2.0.1 Scope of Test

This test is used to evaluate the following performance characteristics of an FM Transmitter:

- Transmitter Power
- Transmitter Frequency
- Transmitter Distortion
- Voice Modulation Level
- Squelch Tone Frequency
- Squelch Tone Modulation Level

2.0.2 DUT Parameters/Characteristics

The example in this section assumes the following DUT characteristics and settings; adjust settings according to the operational capabilities of the DUT.

Table 2-1 FM Transmitter Test - DUT Settings

Parameter	Setting
Transmit Frequency	151.1 MHz
Transmit Power	5 Watts
Transmit Modulation	FM
Maximum Deviation	2.5 kHz
Maximum Modulation Frequency	3 kHz
Microphone/Mod Input	AC Coupled, Hi-Z
Modulation Input Level for Test Deviation	20 mV
Squelch Tone Deviation	500 Hz
Squelch Tone Frequency	67 Hz

2.0.3 Equipment Needed

The following equipment is required to perform the test procedures defined in this section:

- CX100 ComXpert
- Audio cable and MIC/Audio Adapter combination capable of interfacing an audio signal from the CX100 audio output to the transmitter modulation input (typically the microphone input on the transmitter).
- RF Coaxial Cable

2.0.4 Test Setup

2.0.4.1 Hardware Setup Diagram

Connect the CX100 and DUT as shown in Figure 2-1, then proceed to the next section.

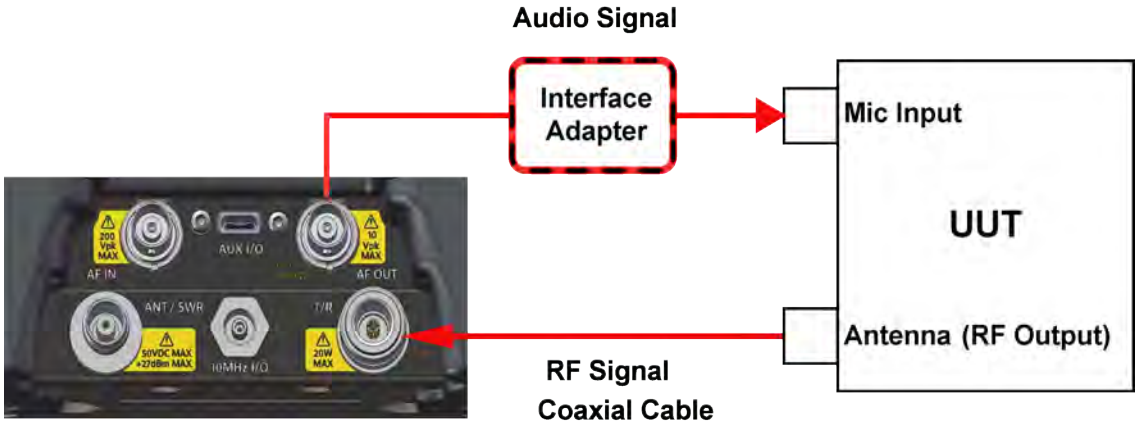

Figure 2-1 FM Transmitter Test Setup Diagram

2.0.4.2 Configure the CX100 Receiver

In this example, the CX100 RF Receiver uses the following settings:

Table 2-2 FM Transmitter Test - RF Receiver Settings

Parameter	Setting
Rx Port	DUPLEX
Rx Frequency	151.100000 MHz
Rx External Attenuator	0.0 dB
Reference level	37.0 dBm
Demodulation Type	FM
IF Bandwidth	12.5 kHz
AF Filter	Band-Pass
Low-Pass Corner Frequency	300 Hz
High-Pass Corner Frequency	3 kHz
De-Emphasis	0 µs

To Configure the CX100 RF Receiver:

1. Power on the CX100.
2. Launch the **RF Instrument** application on the CX100.

3. Select **RF Test**.
4. Select either **Duplex** or **Tx Test tab**.

NOTE

If operating in Duplex Mode, verify RF Generator is turned OFF.

5. Open the **RF Receiver panel**.
6. RF Receiver **Port:** select **DUPLEX**.
7. RF Receiver **Frequency**: set to **151.1 MHz**.
8. RF Receiver **External Attenuator**: set to **0.0 dB**.

NOTE

The expected transmit power of the DUT is 5 Watts (37 dBm), which is well below the maximum input power of the CX100 (47 dBm), so no external attenuator is required for this test.

9. RF Receiver **Reference Level**: set to **37.0 dBm**.
10. RF Receiver **Demodulation Type**: select **FM**.
11. RF Receiver **IF Bandwidth**: select **12.5 kHz**.

NOTE

To Calculate Proper Bandwidth

The DUT Transmitter Bandwidth can be determined with Carson's Rule (Sinusoidal Tone):

2 X [Maximum Deviation + Maximum Audio Frequency]

2 X [3 kHz + 3 kHz] = 12 kHz

The formula above provides the value, which in this example is 12 kHz, that is used to determine the proper setting for the CX100 IF Bandwidth. In this example, the closest CX100 IF Bandwidth greater than 12 kHz is 12.5 kHz IF Bandwidth, therefore, in this example procedure, 12.5 kHz is selected for the CX100 RF Receiver IF Bandwidth.

AF Filter Selection

When the DUT is keyed, it generates a 67 Hz squelch tone. To determine the voice modulation level and distortion, the 67 Hz tone must be filtered out so that only the 1 kHz test tone is received by the CX100 when measuring these parameters.

In this example, a Band Pass filter is selected so that frequencies lower than 300 Hz will not be received by the CX100 Receiver, and frequencies higher than 3 kHz are also blocked so as not to interfere with the 1 kHz test tone.

2.0.4.3 Configure the CX100 AF Function Generator

In this example, the CX100 AF Function Generator uses the following settings:

Table 2-3 FM Transmitter Test - AF Function Generator Settings

Parameter	Setting
Encode Type	Single Tone
Coupling	AC
Load Impedance	HiZ
AF Generator 1	
Frequency	1.0000 kHz
Level Type	Vrms
Level	0.02 V
Waveform	Sine
AF Gen 1	OFF
AF Generator 2	
AF Gen 2	OFF

To Configure the CX100 AF Function Generator:

1. Open the **AF Function Generator panel**.
2. Select the **Settings soft-key**.
3. AF Function Generator **Coupling**: select **AC**.
4. AF Function Generator **Load Impedance**: select **HiZ**.
5. AF Generator 1 **Frequency**: set to **1 kHz** (test modulation frequency).
6. AF Generator 1 **Level Type**: select **Vrms**.
7. AF Generator 1 **Level**: set to **0.02 V**.
8. AF Generator 1 **Waveform**: select **SINE**.
9. Set **AF Gen 1 soft-key** to **OFF**.
10. Set **AF Gen 2 soft-key** to **OFF**.

2.0.4.4 Configure the CX100 Meters

NOTE

This example does not use upper and lower limits to define pass/fail criteria. Pass/fail criteria can be entered as upper and lower limit values in each meter menu for visual feedback of pass/fail status.

To Configure the CX100 Meters

1. Open the **Meters panel**.
2. Use the **Analog Demod Measurements > Distortion/SINAD/SNR soft-key** to display the **Distortion Meter.**
3. Open the **RF Power Meter configuration window**.
4. Upper and Lower Limit values can be assigned if pass/fail criteria are known.
5. **Power Meter Measurement Type**: select **Live**.

NOTE

Before proceeding to Step 8, cease transmitting signals to the CX100.

6. Set the **Measurement Type** on the following meters to **Live**:
   - Modulation
   - Distortion
   - AF Counter
   - RF Frequency Error
7. Select RF Analyzer and press the **Normalize** key.
8. Press the **Run Normalize** soft-key to normalize the **RF Power Meter**.

2.0.5 Gathering Test Data

2.0.5.1 Viewing Test Data

Open either the **Test Setup Summary panel** or the **Meters panel**.

NOTE

If upper and lower limits are being used, recommendation is to view results on the Meters panel instead of the Test Setup Summary panel in order to utilize the color coded pass/fail indicators on meters.

2.0.5.2 Test DUT Power and Frequency

1. Key the DUT.
2. Review the **RF Power Meter** reading along with overall settings.
3. Review the **RF Frequency Error** reading.
4. Unkey the DUT.

2.0.5.3 Test DUT Modulation Level and Transmitter Distortion

1. Open the **AF Function Generator panel**.
2. Set **AF Gen 1 soft-key** to **ON**.
3. Open the **Test Setup Summary panel**.
4. Key the DUT and hold.
5. Review the **Modulation Meter** reading.
6. Review the **Distortion Meter** reading along with overall settings.
7. Unkey the DUT.

2.0.5.4 Test DUT Squelch Tone Modulation Level and Frequency

1. Open the **RF Receiver panel**.
2. Open the **Test Setup Summary panel**.
3. Key the DUT and hold.
4. Review the **Modulation Meter** reading.
5. Review the **AF Counter** reading along with overall settings.
6. Unkey the DUT.

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3

Performing AM Transmitter Tests

This chapter provides step by step instructions to use the CX100 to evaluate the performance characteristics of an AM Transmitter:

This procedure is divided into the following sections:

3.0.1 Scope of Test

This section explains how to configure the CX100 to evaluate the transmit performance of an AM device. The test setup in this section can be used to evaluate the following DUT parameters:

- AM Transmitter Power
- AM Transmitter Frequency
- Modulation Level
- Transmitter Distortion

3.0.1 DUT Parameters/Characteristics

The example in this section assumes the following DUT characteristics and settings; adjust settings according to the operational capabilities of the DUT.

Table 3-1 AM Transmitter Test - DUT Settings

Parameter	Setting
Transmit Frequency	116.5 MHz
Transmit Power	50 Watts
Transmit Modulation	AM
Maximum Modulation Index	100%
Maximum Modulation Frequency	3 kHz
Microphone/Mod Input	DC Coupled, 600 Ohm
Modulation Input Level for Test Modulation	30 mVrms

3.0.2 Equipment Needed

The following equipment is required to perform the test procedures defined in this section:

- CX100 ComXpert
- Audio cable and MIC/Audio Adapter combination capable of interfacing an audio signal from the CX100 audio output to the transmitter modulation input (typically the microphone input on the transmitter).
- Two RF Coaxial Cables
- 10 dB RF Attenuator

3.0.3 Test Setup

3.0.3.1 Hardware Setup Diagram

Connect the CX100 and DUT as shown in Figure 3-1, then proceed to the next section.

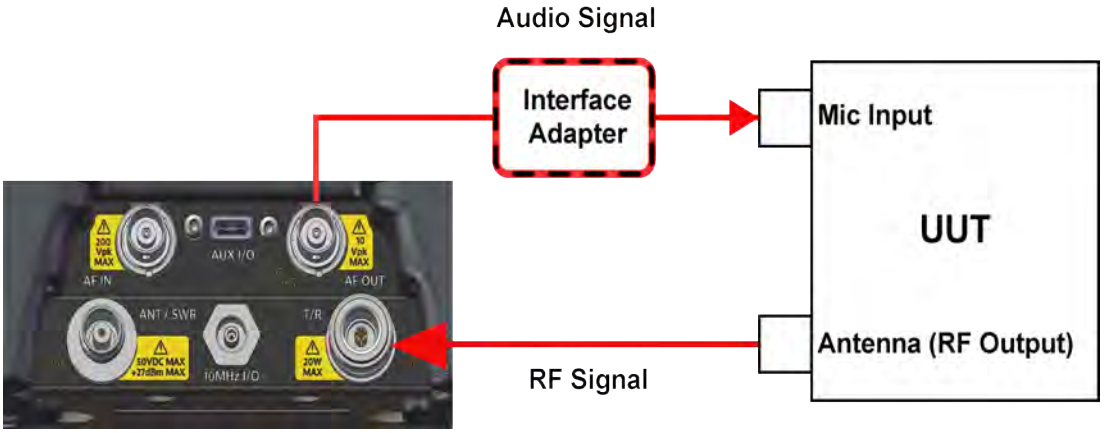

Figure 3-1 AM Transmitter Test Setup Diagram

3.0.3.2 Configure the CX100 Receiver

In this example, the CX100 RF Receiver uses the following settings:

Table 3-2 CX100 Settings - RF Receiver Settings

Parameter	Setting
Rx Port	DUPLEX
Rx Frequency	116.500000 MHz
Rx External Attenuator	10.0 dB
Reference level	37.0 dBm
Demodulation Type	AM
IF Bandwidth	6.25 kHz
AF Filter	Band-Pass
Low-Pass Corner Frequency	3 kHz
High-Pass Corner Frequency	300 kHz
De-Emphasis	0 µs

To Configure the CX100 RF Receiver:

1. Power on the CX100.
2. Launch the **RF Instrument** application on the CX100.

3. Select **RF Test**.
4. Select either **Duplex** or **Tx Test** tab.

NOTE

If operating in Duplex Mode, verify RF Generator is turned OFF.

5. Open the **RF Receiver panel**.
6. RF Receiver **Port**: select **DUPLEX**.
7. RF Receiver **Frequency**: set to **116.5 MHz**.
8. RF Receiver **Reference Level**: set to **37 dBm**.

NOTE - Use of External Attenuator

The expected transmit power of the DUT is 50 Watts (47 dBm) which is the maximum input power of the CX100, so an external attenuator is required for this test.

The DUT transmits at 47 dBm through the 10 dB external attenuator, reducing the amplitude received by the CX100 to 37 dBm (5 W), therefore the Reference Level of the CX100 is set to 37 dBm so that the power measurements factor in external attenuation to reflect the actual power generated by the DUT.

9. RF Receiver **Demodulation Type**: select **AM**.
10. RF Receiver **IF Bandwidth**: select **6.25 kHz**.

NOTE - IF Bandwidth Selection

For this test, the DUT will generate AM using a 1 kHz tone, which is a narrow-band signal, so the IF Bandwidth is set to the narrowest setting of 6.25 kHz.

NOTE - AF Filter Selection

The DUT distortion is specified as being measured with a 300 Hz to 3 kHz band pass filter, so the AF Filter field is set to Band Pass to filter.

3.0.3.3 Configure the CX100 AF Function Generator

In this example, the CX100 AF Function Generator uses the following settings:

Table 3-3 AM Transmitter Test - AF Function Generator Settings

Parameter	Setting
Encode Type	Single Tone
Coupling	DC
Load Impedance	600 Ω
AF Generator 1	
Frequency	1.0000 kHz
Level Type	Vrms
Level	0.03 V
Waveform	Sine
AF Gen 1	OFF
AF Generator 2	
AF Gen 2	OFF

To Configure the CX100 AF Function Generator:

1. Open the **AF Function Generator panel**.
2. AF Function Generator **Coupling**: press the settings soft key and select **coupling DC**.
3. AF Generator 1 **Load Impedance**: select **600 Ω**.
4. AF Generator 1 **Frequency**: set to **1 kHz**.
5. AF Generator 1 **Level Type**: select **Vrms**.
6. AF Generator 1 **Level**: set to **0.03 V**.
7. AF Generator 1 **Waveform**: select **Sine**.
8. Set **AF Gen 1 soft-key** to **OFF**.
9. Verify **AF Gen 2 soft-key** is set to **OFF**.

3.0.3.4 Configure the CX100 Meters

NOTE

This example does not use upper and lower limits to define pass/fail criteria. Pass/fail criteria can be entered as upper and lower limit values in each meter menu for visual feedback of pass/fail status.

RF Power Meter

1. Open the **Meters Configuration Window**.
2. Use the **Analog Demod Measurements > Distortion/SINAD/SNR soft-key** to display the **Distortion Meter** on the **Meters panel.**
3. Open the **RF Power Meter configuration window**.
4. Upper and Lower Limit values can be assigned if pass/fail criteria are known.
5. **Power Meter Measurement Type**: select **Live**.

NOTE

Before proceeding to Step 8, cease transmitting signals to the CX100.

6. Set the **Measurement Type** on the following meters to **Live**:
   - Modulation Meter
   - Distortion Meter
   - AF Counter Meter
   - RF Frequency Error Meter
7. Select RF Analyzer and press the **Normalize** key.
8. Press the **Run Normalize** soft-key to normalize the **RF Power Meter**.

3.0.4 Gather Test Data

3.0.4.1 Viewing Test Data

Open either the **Test Setup Summary** panel or the **Meters** panel.

NOTE

If upper and lower limits are being used, recommendation is to view results on the Meters panel in order to utilize the color coded pass/fail indicators on meters.

3.0.5 Test DUT Power and Frequency

1. Key the DUT.
2. Review the **RF Power Meter** reading along with overall settings.
3. Review the **RF Frequency Error Meter** reading.
4. Unkey the DUT.

3.0.6 Test DUT Modulation Level and Distortion

1. Open the **AF Function Generator panel**.
2. Set **AF Gen 1 soft-key** to **ON**.
3. Open the **Test Setup Summary panel**.
4. Key the DUT and hold.
5. Review the **Modulation Meter** reading.
6. Review the **Distortion Meter** reading along with overall settings
7. Unkey the DUT.

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4

Performing FM Receiver Tests

This chapter provides step by step instructions to use the CX100 to evaluate performance characteristics of an FM Receiver.

This procedure is divided into the following sections:

4.0.1 Scope of Test

This test is used to evaluate the following performance characteristics of an FM Receiver:

- Radio Receive Sensitivity
- Squelch Tone Response
- Audio Level

4.0.1 DUT Parameters/Characteristics

The example in this section assumes the following DUT characteristics and settings; adjust settings according to the operational capabilities of the DUT.

Table 4-1 FM Receiver Test - DUT Parameters

Parameter	Setting
FM Receiver	Narrowband
FM Receiver Frequency	151.1 MHz
Rate Deviation	2.5 kHz
Distortion	Less than 1% at 700 mV audio level
12 dB SINAD	-118 dBm
Squelch Tone Deviation	350 Hz
Squelch Tone Frequency	67 Hz

4.0.2 Equipment Needed

The following equipment is required to perform the test procedures defined in this section:

- CX100 ComXpert
- Audio cable and MIC/Audio Adapter combination capable of interfacing an audio signal from the DUT demodulated output (typically speaker out signal) to the CX100 audio input connector.
- RF Coaxial Cable

4.0.3 Test Setup

4.0.3.1 Hardware Setup Diagram

Connect the CX100 and DUT as shown in Figure 4-1, then proceed to the next section.

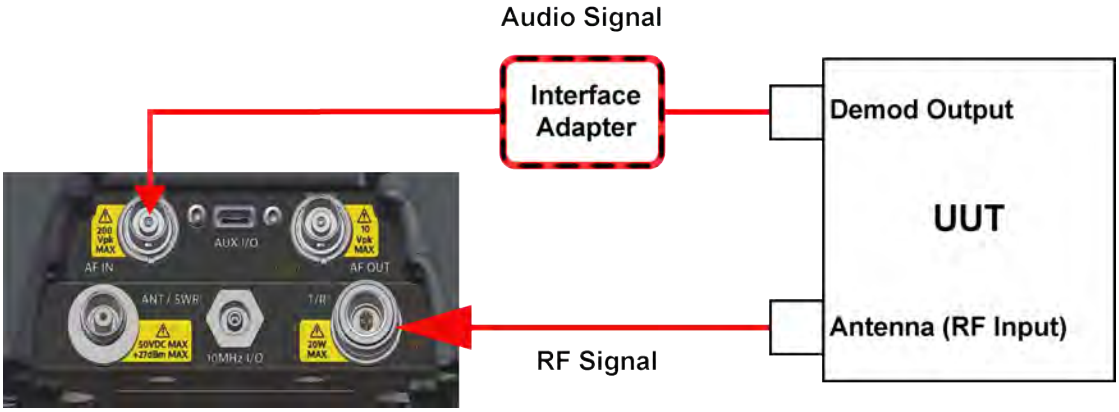

Figure 4-1 FM Receiver Test Setup Diagram

4.0.3.2 Configure the CX100 RF Generator

In this example, the CX100 RF Generator uses the following settings:

Table 4-2 CX100 Settings - RF Generator Settings

RF Generator	
Frequency	151.100000 MHz
Output Level	-50 dBm

To Configure the CX100 RF Generator:

1. Power on the CX100.
2. Launch the **RF Instrument** application on the CX100.
3. Select **RF Test**.
4. Select either **Duplex** or **Rx Test tab**.
5. Open the **RF Generator** panel.
6. RF Generator **Frequency**: set to **151.1 MHz**.
7. RF Generator **Output Level**: set to **-50 dBm**.
8. Turn on **RF Generator**.

4.0.3.3 Configure the CX100 Modulation Generators

In this example, the CX100 Modulation Generators use the following settings:

Table 4-3 FM Receiver Test- Modulation Generator Settings

Modulation Generator 1	
Type	FM
Deviation	1.8 kHz
Rate	1 kHz
Waveform	Sine
Mod 1 soft-key	Mod 1 ON
Modulation Generator 2	
Type	FM
Deviation	350 Hz
Rate	0.067 kHz
Waveform	Sine
Mod 2 soft-key	Mod 2 ON
External Modulation	
Mod Ext soft-key	Mod Ext OFF

To Configure the CX100 Modulation Generators:

1. Open the **Modulation Generator 1 panel**.
2. Modulation Generator 1 **Modulation Type**: select **FM**.
3. Modulation Generator 1 **Deviation**: set to **1.8 kHz** (60% of 2.5 kHz max deviation rating of radio).
4. Modulation Generator 1 **Rate**: set to **1.000 kHz**.
5. Modulation Generator 1 **Waveform**: select **Sine**.
6. **Mod 1 soft-key**: set to **ON**.
7. Open the **Modulation Generator 2 panel**.
8. Modulation Generator 2 **Modulation Type**: select **FM**.
9. Modulation Generator 2 **Deviation**: set to **350 Hz**.
10. Modulation Generator 2 **Rate**: set to **0.0670 kHz**.
11. Modulation Generator 2 **Waveform**: select **Sine**.
12. **Mod 2 soft-key**: set to **ON**.

13. Open the **External Modulation panel**.
14. **Mod Ext soft-key**: set to **OFF**.

4.0.4 Configure the CX100 Meters

NOTE

Meter parameters should be configured according to DUT performance characteristics and test requirements.

In this example, the CX100 Meters are configured as follows:

Table 4-4 FM Receiver Test - Meter Settings

SINAD Meter	
Enable Lower Limit	Enabled
Lower Limit	12.0 dB
Measurement Type	Average
Average Count	20
Distortion Meter	
Enable Upper Limit	Enabled
Upper Limit	1%
Measurement Type	Live
Audio Level Meter	
Enable Upper Limit	Enabled
Upper Limit	+0.710 V
Enable Lower Limit	Enabled
Lower Limit	+0.690 V
Measurement Type	Live
AF Counter	
Enable Upper Limit	Disabled
Enable Lower Limit	Disabled
Measurement Type	Live

To Configure the CX100 Meters:

1. Open the **Meters panel**.
2. Use the **Audio Measurements > Distortion/SINAD/SNR soft-key** to display the **SINAD Meter** on the **Meters panel.**
3. Open the **SINAD Meter configuration window**.
4. Enable the **Lower Limit**.
5. Set the **Lower Limit** to **12.0 dB**.
6. Select **Average** from the **Measurement Type menu**.
7. Set **Average Count** to **20**.
8. Close the **SINAD Meter configuration window**.
9. Use the **Audio Measurements > Distortion/SINAD soft-key** to display the **Distortion Meter**.
10. Open the **Distortion Meter configuration window**.
11. Enable the **Upper Limit**.
12. Set the Upper Limit to **1%**.
13. Select **Live** from the **Measurement Type menu**.
14. Close the **Distortion Meter configuration window**.
15. Open the **Audio Level Meter configuration window**.
16. Enable the **Upper Limit**.
17. Set the **Upper Limit** to **+0.710 V**.
18. Enable the **Lower Limit**.
19. Set the **Lower Limit** to **+0.690 V**.
20. Select **Live** from the **Measurement Type menu**.
21. Close the **Audio Level Meter configuration window**.
22. Set the **Audio Level Meter Vrms/Vpp toggle soft-key** to **Vrms**.
23. Open the **AF Counter Meter configuration window**.
24. Select **Live** from the **Measurement Type menu**.
25. Close the **AF Counter Meter configuration window**.

4.0.5 Gather Test Data

4.0.5.1 Viewing Test Data

Open either the **Test Setup Summary** panel or the **Meters panel**.

NOTE

If upper and lower limits are being used, recommendation is to view results on the Meters panel in order to utilize the color coded pass/fail indicators on meters.

4.0.5.2 DUT Audio Level and Distortion Tests

1. Adjust the DUT volume until the **Audio Level Meter** displays approximately 700 mV and the meter background color is green and the pass icon is displayed.
2. Verify the **Distortion Meter** displays less than 1% distortion and the meter background color is green and the pass icon is displayed.

4.0.5.3 DUT Squelch Tone Function Tests

1. Turn **Mod 2 soft-key** to **OFF**.
2. Observe the **Audio Level Meter** to verify the DUT is quieted, and that the **AF Counter** does not display 1.000 kHz audio.
3. Turn **Mod 2 soft-key** to **ON**.
4. Use the **Audio Level Meter** to verify the DUT is demodulating the CX100 modulation, and that the **AF Counter** displays 1.000 kHz audio.

4.0.5.4 DUT Receiver Sensitivity Tests

1. Set the CX100 **RF Generator Level** to -118.000 dBm.
2. **Audio Measurements > Distortion/SINAD soft-key** - select **SINAD** to display the **SINAD Meter** on the **Rx Test Meters** panel.
3. Press the **Rx Test Meters Clear/Reset soft-key**.
4. Observe the **SINAD Meter** and verify its reading is 12 dB or greater, and that the meter background color is green and the pass icon is displayed.

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5

Performing AM Receiver Tests

This chapter provides step by step instructions to use the CX100 to evaluate performance characteristics of an AM Receiver.

This procedure is divided into the following sections:

5.0.1 Scope of Test

This test is used to evaluate the following performance characteristics of an AM Receiver:

- Radio Receive Sensitivity
- Squelch Tone Response
- Audio Level

5.0.1 DUT Parameters/Characteristics

The example in this section assumes the following DUT characteristics and settings; adjust settings according to the operational capabilities of the DUT.

Table 5-1 AM Receiver Test - DUT Parameters

Parameter	Setting
AM Receiver	Narrowband
AM Receiver Frequency	151.1 MHz
Distortion	Less than 1% at 700 mV audio level
12 dB SINAD	-118 dBm

5.0.2 Required Equipment

The following equipment is required to perform the test procedures defined in this section:

- CX100 ComXpert
- Audio cable and MIC/Audio Adapter combination capable of interfacing an audio signal from the DUT demodulated output (typically speaker out signal) to the CX100 audio input connector.
- RF Coaxial Cable

5.0.3 Configuring the Equipment

5.0.3.1 Hardware Configuration

Connect the CX100 and DUT as shown in Figure 5-1, then proceed to the next section.

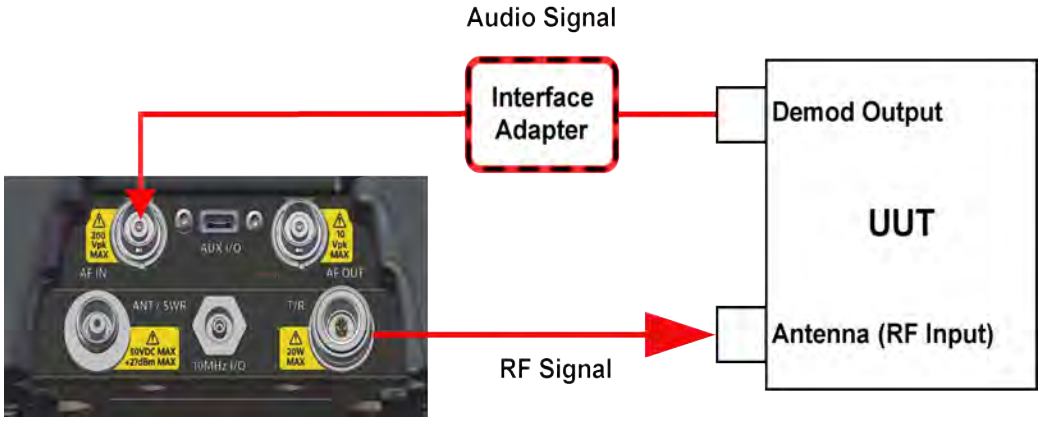

Figure 5-1 AM Receiver Test - Setup Diagram

5.0.3.2 Set Up the CX100 RF Generator

In this example, the CX100 RF Generator uses the following settings:

Table 5-2 AM Receiver Test - RF Generator Settings

RF Generator	
Frequency	151.100000 MHz
Output Level	-50 dBm

To Set Up the CX100 RF Generator:

1. Power on the CX100.
2. Launch the **RF Instrument** application on the CX100.
3. Select **RF Test**.
4. Select either **Duplex** or **Rx Test tab**.
5. Open the **RF Generator panel**.
6. RF Generator **Frequency**: set to **151.1 MHz**.
7. RF Generator **Output Level**: set to **-50 dBm**.

5.0.3.3 Set Up the CX100 Modulation Generators

In this example, the CX100 Modulation Generators use the following settings:

Table 5-3 AM Receiver Test - Modulation Generator Settings

Modulation Generator 1	
Type	AM
Rate	1 kHz
Depth	60%
Waveform	Sine
Mod 1 soft-key	Mod 1 ON
Modulation Generator 2	
Type	AM
Rate	0.067 kHz
Depth	50%
Waveform	Sine
Mod 2 soft-key	Mod 1 ON
External Modulation	
Mod Ext soft-key	Mod Ext OFF

To Set Up the CX100 Modulation Generators:

1. Open the **Modulation Generator 1 panel**.
2. Modulation Generator 1 **Modulation Type**: select **AM**.
3. Modulation Generator 1 **Rate**: set to **1.000 kHz**.
4. Modulation Generator 1 **Depth**: set to **60%**.
5. Modulation Generator 1 **Waveform**: select **Sine**.
6. **Mod 1 soft-key**: set to **ON**.
7. Open the **Modulation Generator 2 panel**.
8. **Mod 2 soft-key**: set to **OFF**.
9. Open the **External Modulation panel**.
10. **Mod Ext soft-key**: set to **OFF**.

5.0.4 Configure CX100 Meters

NOTE

Meter parameters should be configured according to DUT performance characteristics and test requirements.

In this example, the CX100 Meters are configured as follows:

Table 5-4 AM Receiver Test - Meter Settings

SINAD Meter	
Enable Lower Limit	Enabled
Lower Limit	10.0 dB
Measurement Type	Average
Average Count	20
Distortion Meter	
Upper Lower Limit	Enabled
Upper Limit	1%
Measurement Type	Live
Audio Level Meter	
Enable Upper Limit	Enabled
Upper Limit	+0.710 V
Enable Lower Limit	Enabled
Lower Limit	+0.690 V
Measurement Type	Live
AF Counter	
Enable Upper Limit	Disabled
Upper Limit	N/A
Enable Lower Limit	Disabled
Measurement Type	Live

To Set Up the CX100 Meters:

1. Open the **Meters panel**.
2. Use the **Audio Measurements > Distortion/SINAD soft-key** to display the **SINAD Meter**.
3. Open the **SINAD Meter configuration window**.
4. Enable the **Lower Limit**.
5. Set the **Lower Limit** to **12.0 dB**.
6. Select **Average** from the **Measurement Type menu**.
7. Set **Average Count** to **20**.
8. Close the **SINAD Meter configuration window**.
9. Use the **Audio Measurements > Distortion/SINAD soft-key** to display the **Distortion Meter**.
10. Open the **Distortion Meter configuration window**.
11. Enable the **Upper Limit**.
12. Set the **Upper Limit** to **1%**.
13. Select **Live** from the **Measurement Type menu**.
14. Close the **Distortion Meter configuration window**.
15. Open the **Audio Level Meter configuration window**.
16. Enable the **Upper Limit**.
17. Set the **Upper Limit** to **+0.710 V**.
18. Enable the **Lower Limit**.
19. Set the **Lower Limit** to **+0.690 V**.
20. Select **Live** from the **Measurement Type menu**.
21. Close the **Audio Level Meter configuration window**.
22. Set the **Audio Level Meter Vrms/Vpp toggle soft-key** to **Vrms**.
23. Open the **AF Counter Meter configuration window**.
24. Select **Live** from the **Measurement Type menu**.
25. Close the **AF Counter Meter configuration window**.

5.0.5 Gather Test Data

5.0.5.1 Viewing Test Data

Open either the **Test Setup Summary panel** or the **Meters panel**.

NOTE

If upper and lower limits are being used, recommendation is to view results on the Meters panel in order to utilize the color coded pass/fail indicators on meters.

5.0.5.2 Test DUT Audio Level and Distortion

1. Adjust the DUT volume until the **Audio Level meter** displays reading around 700 mV and the meter background color is green and the pass icon is displayed.
2. Verify the **Distortion meter** reading is less than 1% Distortion and that the background color is green and the pass icon is displayed.

5.0.5.3 Test DUT Receiver Sensitivity

1. Change the CX100 **RF Generator Level** to **-118.000 dBm**.
2. Use the **Audio Measurements > Distortion/SINAD soft-key** to display the **SINAD Meter** on the **Rx Test Meters panel.**
3. Press the **Rx Test Meters Clear/Reset soft-key**.
4. Observe the **SINAD Meter** and verify its reading is 12 dB or greater, and that the meter background color is green and the pass icon is displayed.

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6

Performing VSWR and DTF Tests

This chapter provides step by step instructions to use the CX100 to perform VSWR, Distance to Fault (DTF) and Return Loss (RL) cable tests.

This procedure is divided into the following sections:

6.1 Performing VSWR/DTF Testing

6.1.1 Scope of Test

This test is used to evaluate how well an antenna's impedance matches the impedance of the radio or transmission line to which it is connected.

6.1.2 UUT Parameters/Characteristics

The example in this section assumes the following UUT characteristics and settings; adjust settings according to the operational capabilities of the UUT.

Table 6-1 VSWR Test - Example Cable Characteristics

Parameter	Setting
Frequency Range	30 to 85 MHz

6.1.3 Equipment Needed

The following equipment is required to perform the procedures defined in this section:

- CX100 ComXpert
- Cable to be tested
- Calibration Kit

6.1.4 Calibrate the CX100 Before VSWR Testing

6.1.4.1 Hardware Setup Diagram

Connect the CX100 and UUT as shown in Figure 6-1, then proceed to the next section.

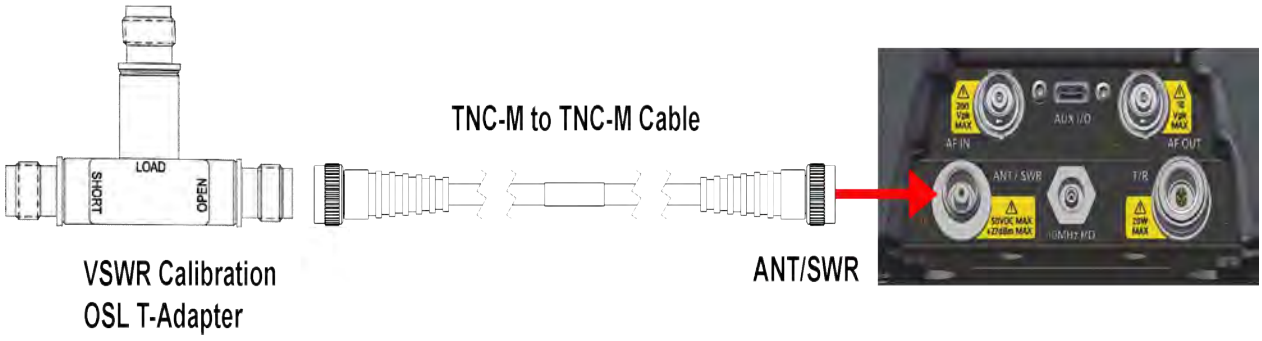

Figure 6-1 VSWR Calibration Setup Diagram

6.1.4.2 Running VSWR Calibration

1. Power on the CX100.
2. Select the **Home icon** on the CX100.
3. Select the **RF Instrument** tab at the top of the application on the CX100 screen.
4. Select **VSWR/DTF**.
5. Select the **VSWR tab**.
6. Open the **Instrument Settings menu**.
7. Press the **Calibrate soft-key**.
8. Select **External Standards**. Select **OK button** to confirm.
9. Follow the instructions on the UI to configure the device for external calibration.
10. Press the **OK button** to run the calibration. See Figure 6-2.
11. When external calibration has been completed, the calibration plot should resemble data in Figure 6-2.

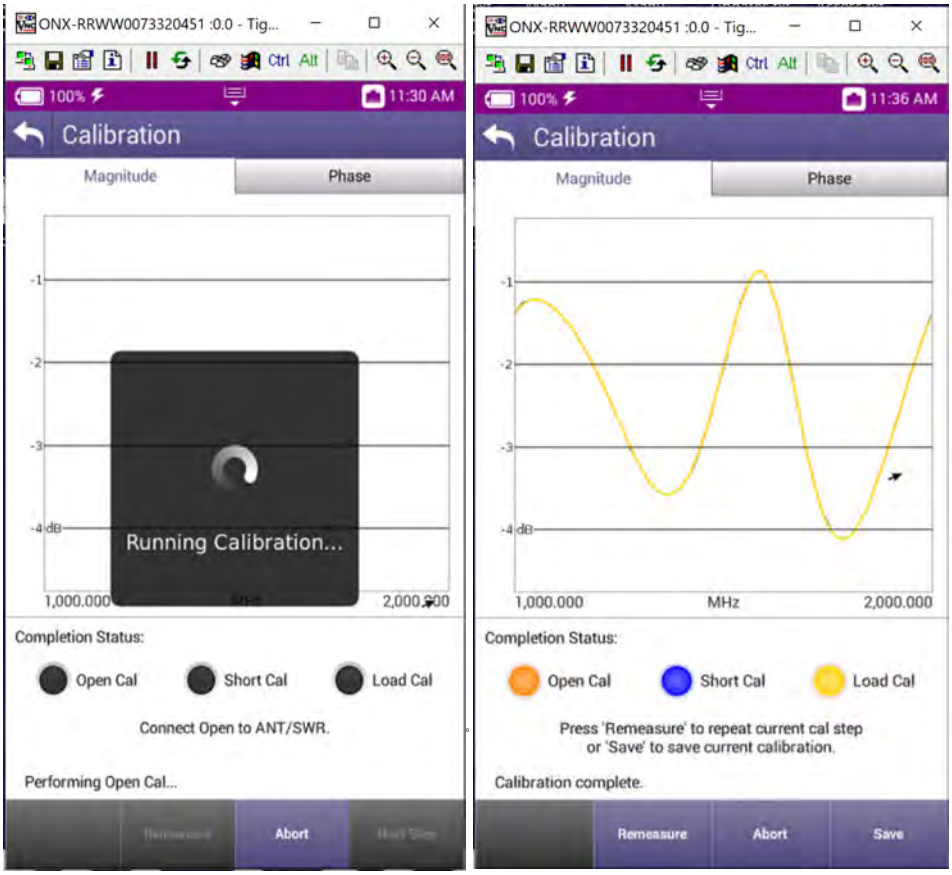

Figure 6-2 Calibration running and complete

6.1.5 To Perform VSWR Test

6.1.5.1 Hardware Setup Diagram

Connect the CX100 and UUT as shown in Figure 6-3, then proceed to the next section.

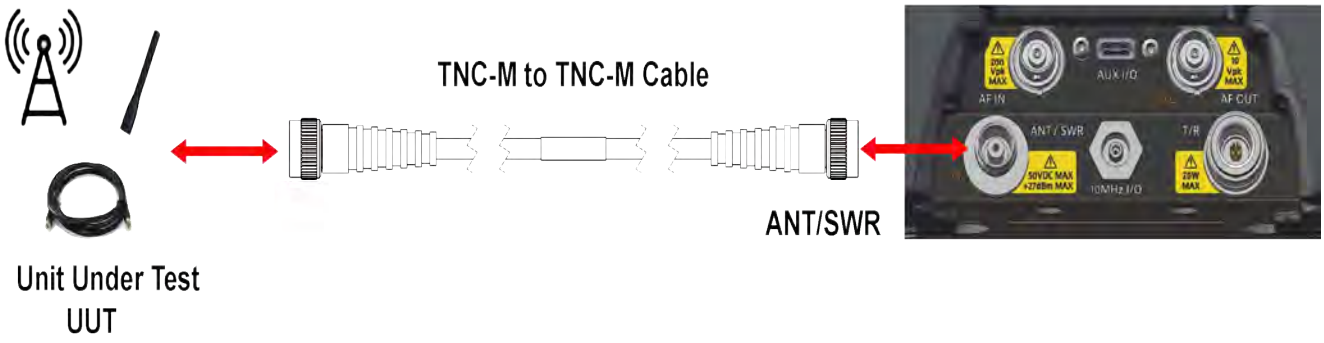

Figure 6-3 VSWR Test Setup Diagram

6.1.5.2 Configure the CX100 VSWR Settings

In this example, the CX100 uses the following VSWR settings:

Table 6-2 CX100 VSWR Test Settings

Parameter	Setting
Start Frequency	20 MHz
Stop Frequency	100 MHz
Step Frequency	100 (points)

To Configure the CX100 for VSWR Test

1. Power on the CX100.
2. Select the **RF Instrument** tab at the top of the application on the CX100 screen.
3. Select **VSWR/DTF**.
4. Select the **VSWR tab**.
5. Open the **Instrument Settings menu**.
6. Set the **Start Frequency** to **20 MHz**.
7. Set the **Stop Frequency** to **100 MHz**.
8. Set measurement mode to **VSWR** and Press the OK button.

9. Ensure the **VSWR soft key** is set to **VSWR On**.

6.1.5.3 Gather Test Data

To Gather Test Data

This is used to gather the required Test Data.

1. Observe the VSWR trace.
2. Adjust the markers to display the VSWR measurement at the desired frequency.
3. To observe Return Loss measurement, open the Instrument Settings menu and set the measurement mode to Return Loss.

6.2 Performing Distance to Fault (DTF) Tests

6.2.1 Scope of Test

Distance to Fault (DTF) measurements, provides the capability to analyze, troubleshoot and identify signal path degradation in cables and transmission lines. Faults are a result of conditions such as poor connections, damaged cables, or faulty antennas.

This test is used to evaluate the following performance issues:

- The distance to fault of a coaxial cable.

6.2.2 UUT Parameters/Characteristics

The example in this section assumes the following UUT characteristics and settings; adjust settings according to the operational capabilities of the UUT.

Table 6-3 DTF Test - Example Cable Characteristics

Parameter	Setting
Coaxial cable type	RG58
Coaxial cable length	20 ft

6.2.3 Equipment Needed

The following equipment is required to perform the test procedures defined in this section:

- CX100 ComXpert
- Cable to best tested

6.2.4 Configuring the Equipment

6.2.4.1 Hardware Setup Diagram

Connect the CX100 and UUT as shown in Figure 6-4, then proceed to the next section.

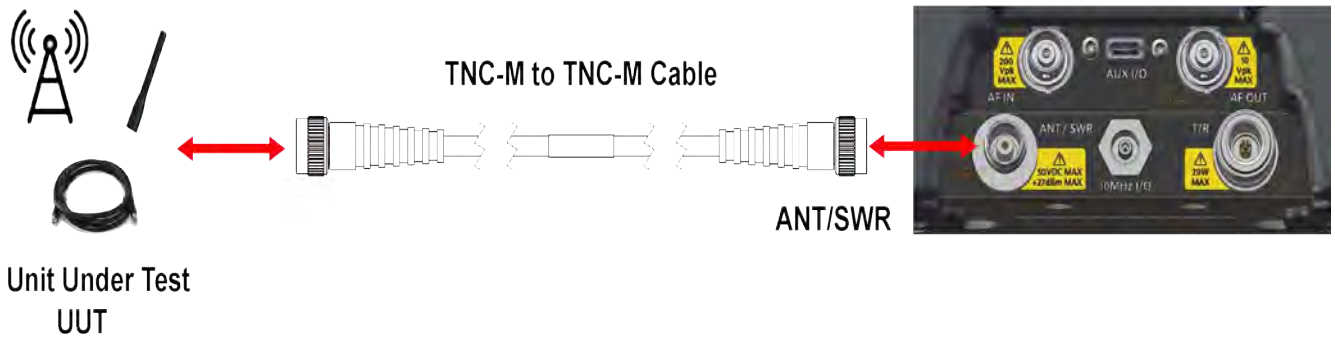

Figure 6-4 DTF Test Setup Diagram

6.2.4.2 Configure the CX100 DTF Settings

In this example, the CX100 uses the following DTF settings:

Table 6-4 DTF Test Settings

Parameter	Setting
Start Frequency	20 MHz
Stop Frequency	100 MHz
Step Frequency	100 (points)

To Configure the CX100

1. Power on the CX100.
2. Launch the **RF Instrument** application on the CX100.
3. Select **VSWR/DTF**.
4. Select **RG-58 cable type**.
5. Select the cable file to be used for the test.
6. Select the **DTF tab**.
7. Open the instrument settings menu.
8. Set measurement mode to Return Loss
9. Select the distance key.
10. Set the start distance to 1 ft.

11. Set the stop distance to 30 ft.
12. Set number of points to 500.
13. Close the **instrument settings tab** and ensure the **DTF enable soft key** displays **DTF on**. See Figure 6-5 and Figure 6-6 for screen examples.

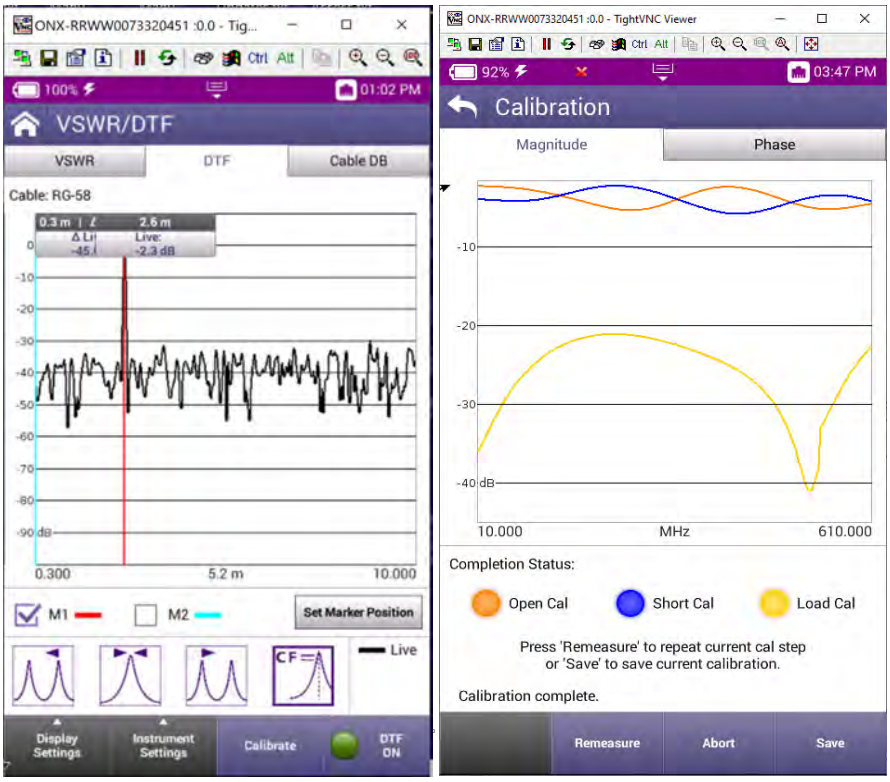

Figure 6-5 DTF (Distance to Fault) and Calibration

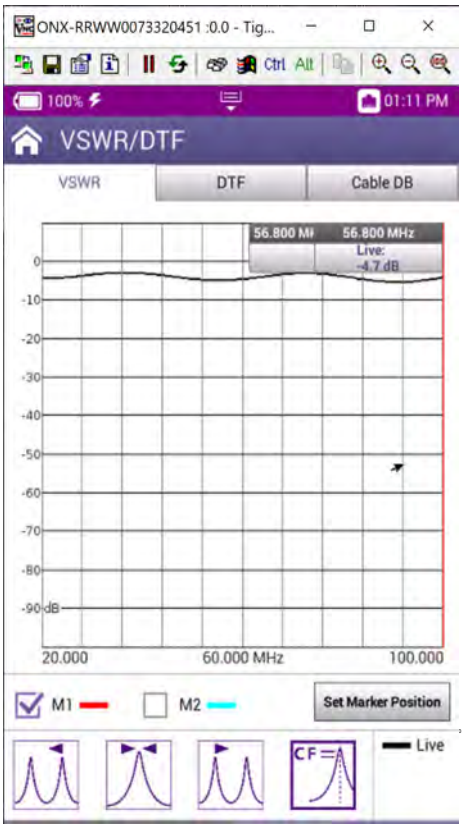

Figure 6-6 Return Loss

6.2.4.3 Gather Test Data

To Gather Test Data

This is used to gather the required Test Data.

1. Observe DTF trace.
2. See Figure 6-5 for screen example.

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CX100 ComXpert

Handheld Radio Test Set
Test and Measurement Guide

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