CX300 ComXpert

Communication Service Monitor

TETRA Option Guide

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Communication Service Monitor

TETRA Option Guide

22166297 Rev.000

VIAVI Solutions
1-844-GO-VIAVI
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- Type CX300 to find the manuals associated with the CX300 ComXpert Communications Service Monitor

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- Email: Techsupport.Avcomm@viavisolutions.com

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Record of Revisions

RECORD OF REVISIONS

REV.	DATE	ACCEPTANCE
000	September 2022	VIAVI

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Preface

This preface explains how to use this manual. Topics discussed include the following:

- About this Manual ii
- Conventions iv

About this Manual

Scope of Manual

This manual describes test and measurement functions associated with the *CX300 ComXpert* TETRA Option. Refer to the *CX300 ComXpert Communication Service Monitor Operation Manual* for information about test set operation, system settings, and test and measurement functions.

Intended Audience

This manual is intended for personnel who are familiar with TETRA systems and operation of the *CX300 ComXpert Communication Service Monitor.*

This manual is intended for novice, intermediate, and experienced users who want to use the *CX300 ComXpert TETRA Option* effectively and efficiently.

Related Information

This is the CX300 ComXpert CX300 ComXpert Tetra Option Guide 22166297. This manual is to be used in conjunction with the following publications:

- *CX300 ComXpert Quick Start Guide, 22130635*, which provides basic operating and safety information
- *CX300 ComXpert P25 Option Guide, 22146777,* which provides information about the test and measurement functions found in the CX300 P25 options
- *CX300 ComXpert VNA Option Guide, 22163053,* which provides information about the test and measurement functions found in the CX300 VNA options
- *CX300 ComXpert Communication Service Monitor Operation Manual, 22130634*, which provides instructions to install, configure, and operate the CX300 ComXpert's standard test and measurement functions
- *CX300 Remote Programming Manual, 22146776,* which defines the Standard-Commands-for-Programmable-Instrument (SCPI) Consortium's SCPI standard and provides instructions for using this manual for various test and measurements
- *CX300 Maintenance Manual, 22130636,* provides basic instructions for assembling the instrument components, setting up the CX300 Test Set, instrument specifications, and instructions for removal, installation and calibration procedures

Typographical Conventions

This manual uses the following typographical conventions:

Table 1 Text formatting and other typographical conventions

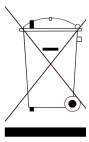
Item(s)	Example(s)
References to terms used to identify key areas of the UI such as screens, panes, menus, or toolbars.	Navigate to the **Date and Time screen**. Open the **RF Receiver settings menu**. Some controls are also accessed from the **Quick Access Toolbar.**
Hardware buttons, keys, or switches that you press or flip.	Press the **On button**. Flip the **Power** switch to the on position.
Software components such as buttons, menus, tabs, or fields on a PC-based or Web-based user interface	Click **Start**. Click **File > Properties**. Type the name of the probe in the **Probe Name** field.
Directory names, file names, and code and output messages that appear in a command line interface or in some graphical user interfaces (GUIs).	`$NANGT_DATA_DIR/results` (directory) – `test_products/users/defaultUser.xml` (file name) – `All results okay.` (output message)
Text you must type exactly as shown into a command line interface, text file, or a GUI text field.	– Restart the applications on the server using the following command: **`$BASEDIR/startup/npiu_init restart`** Type: **`a:\set.exe`** in the dialog box.
References to guides, books, and other publications appear in *this typeface*.	Refer to *Newton's Telecom Dictionary.*
Required arguments (text variables in code).	<`password`>

Conventions

Symbols and Markings

The following conventions are found on the instrument and in product documentation:

Table 2 Symbols and Markings

	This symbol indicates a note that includes important supplemental information or tips related to the main text.
	**Attention Symbol** This symbol represents a general hazard. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	**ESD Sensitive** Indicates item is static sensitive. Item should only be handled by Qualified Service Personnel.
	**Explosive Hazard** This symbol represents a risk of explosion. It may be associated with either a DANGER, WARNING, CAUTION or ALERT message.
	**Voltage Symbol** This symbol represents hazardous voltages. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	**Toxic Symbol** Indicates a toxic hazard. Item should only be handled by Qualified Service Personnel. Dispose of item in accordance with local regulations.
	**WEEE Symbol** This symbol, located on the equipment or the packaging indicates that the equipment must not be disposed of in a land-fill site or as municipal waste, and should be disposed of according to your national regulations.
	**CE Compliant** CE Label indicates item meets the requirements of the applicable European Directives.
	**Fuse Symbol** Indicates a fuse location (AC or DC).

Safety Definitions

This manual uses the following terms to indicate conditions or activities which are potential safety hazards:

Table 3 Safety Definitions

Term	Definition
WARNING	Identifies conditions or activities that, if ignored, can result in personal injury or death.
Avertissement	Identifiez les conditions ou les activités qui, si ignorées, peuvent entraîner des blessures personnelles voire mortelles.
CAUTION	Identifies conditions or activities that, if ignored, can result in equipment or property damage, e.g., Fire.
Mise en Garde	Identifiez les conditions ou les activités qui, si ignorées, peuvent entraîner des dommages à l'équipement ou aux biens, p. ex. un incendie.

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1

Introduction to the CX300

This chapter provides a general description of the CX300 TETRA option. Topics discussed in this chapter include the following:

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NOTE

The Figures used in this guide are examples of specific screens on the CX300 TETRA option and may not reflect the exact screen the user sees while operating the CX300 TETRA option.

1.1 CX300 Overview

The CX300 ComXpert is a compact, bench-top communications test set for use in the Land Mobile Radio or Two-Way Communications Industry. The CX300 is ideal for performing preventative maintenance on two-way radios and their applicable support infrastructure.

Refer to the CX300 product brochure for an overview of the unit, and to the CX300 Operation Manual for additional details.

The CX300 TETRA software option provides various features for testing TETRA radio systems.

1.2 CX300 Tetra Option Features and Capabilities

This section highlights key features and capabilities of CX300 TETRA software options. The CX300 TETRA Test System Option provides the user with the following capabilities:

- Comprehensive modulation analysis with power profile, constellation, phase trajectory, Error Vector Magnitude and Symbol Rate Error
- Display of parameters (BST1) and decoded data received from mobiles and base stations to aid diagnosis of system problems
- Constellation graph plots
- Uplink T1 Test Signal generator synchronized to base station down link frame structure supporting conformance testing of base station receivers

1.2.1 TETRA

The CX300 TETRA Option supports TETRA protocol radios and has the following CX300 options:

- CX300-DTPM - TETRA Parametric Mobile Station
- CX300-DTPB - TETRA Parametric Base Station

TETRA Systems provide features for testing TETRA Trunked Mobile Radios and TETRA Base Stations. Mobiles and Base Stations with T1 Test capability can also be tested with the TETRA Systems. This manual describes how to use the Test Set to test the performance of mobiles and base stations designed to operate to TETRA specifications.

Each TETRA System functions as an independent test function, with no interchange of settings or configurations with other TETRA Systems or other Systems installed on the Test Set.

1.3 Verifying TETRA Option Installation

The CX300 provides several test and measurement functions which allow the user to evaluate the transmit and receive performance of a communications system.

1.3.1 Factory Installed Option

When a TETRA software option(s) is purchased as a factory installed option, the TETRA software is ready to use when the test set is received from the factory.

1.3.2 Post Production Option

When a TETRA software option is purchased post production, the option software and option license files must be installed on the test set by the end user. See the following steps for selecting and installing Options.

Refer to the CX300 ComXpert Communication Service Monitor Operation Manual for more information on option selection.

CX300 software is a field-upgradeable software which can be updated using StrataSync™ or a USB device.

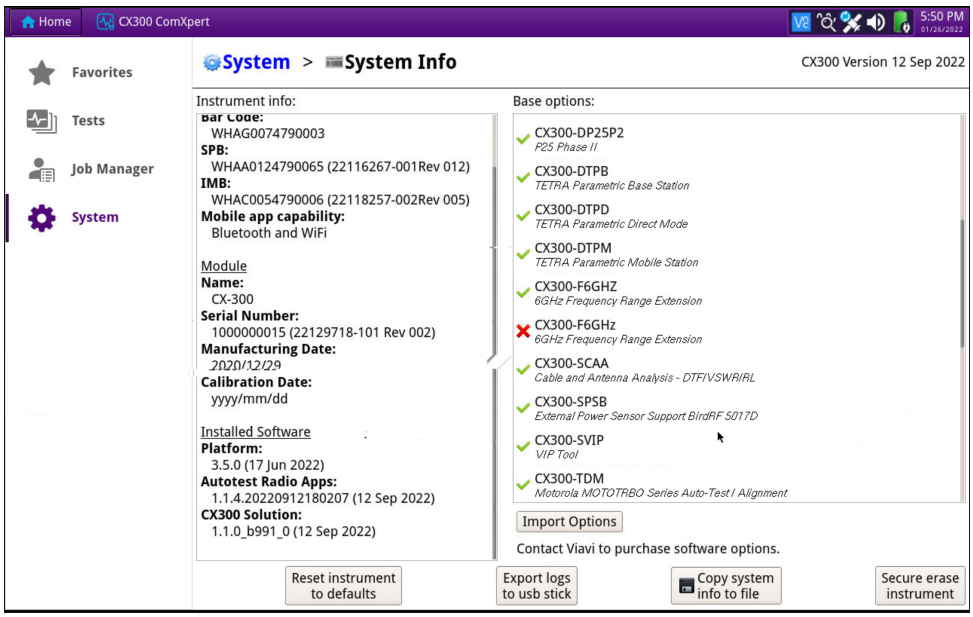

Figure 1-1 System Info Screen Example

To Install CX300 Options:

1. If using a USB device, install the USB device.
2. Navigate to the System Info Screen. See Figure 1-1.

3. Select the **Import Options** button. See Figure 1-1 and Figure 1-2.

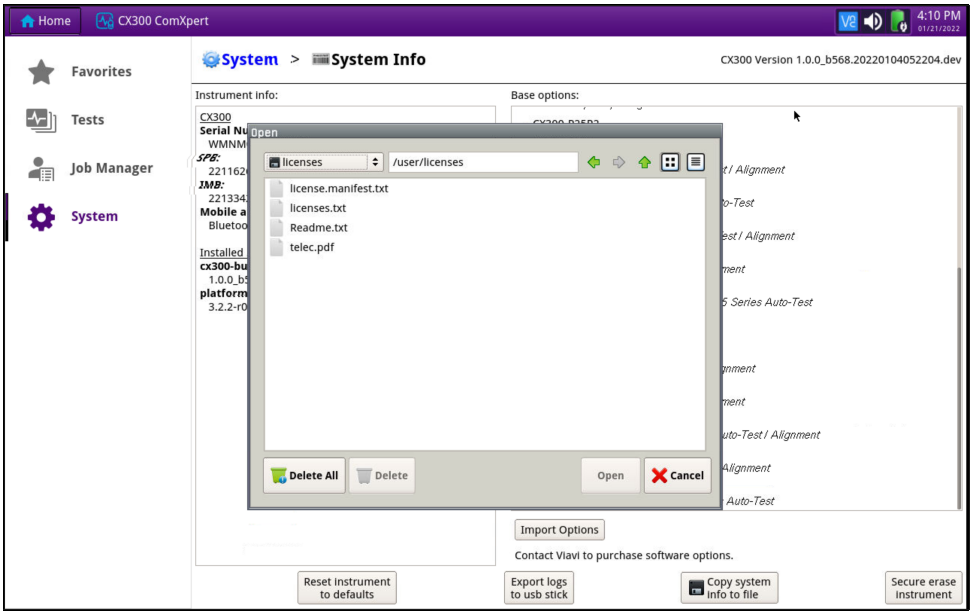

Figure 1-2 Import Options Selected

4. Select the Option to install, or use the Select All button. See Figure 1-2.
5. Select Open.
6. Select OK. The Option selected is automatically installed to the system.

1.4 TETRA Test Modes

TETRA provides several test modes for the purpose of evaluating the transmit and receive performance of a TETRA system. Each test mode contains controls and settings that are required to use the functions in the selected mode. The CX300 contains the following test modes:

- Transmitter Tests
- Receiver Tests
- TETRA MST1 System
- TETRA BST1 System

1.4.1 Transmitter Tests

The CX300 tests the performance of transmitters in TETRA mobiles and TETRA base stations. Test capabilities are:

- Measured power
- Tx frequency error
- Modulation accuracy for peak and RMS vector error and Carrier Feed-Thru
- Constellation, rotated vector and phase trajectory diagrams
- Display of parameters (BST1) and data received from mobiles and base stations

1.4.2 Receiver Tests

The signal generator within the Test Set produces the following signals:

- Simulated base station Main Control Channel (MCCH)
- Simulated base station Traffic Channel (TCH)
- T1 Test Signals for mobile testing
- Synchronization to base station downlink frame structure for synchronized up link T1 Type TCH/7.2 signal generation for base station test

1.4.3 TETRA MST1 System

The CX300 TETRA MST1 System provides features for testing TETRA Mobiles in T1 Test Mode. The TETRA MST1 System provides the following test capabilities:

- T1 Test Signal generation
- T1 Test Mode control of mobile transmission and burst
- Transmitter measurements (burst, modulation accuracy, frequency error)
- Receiver measurements on T1 Test Signals
- Graphical displays of power profile and modulation
- Capture and demodulation of mobile transmissions (5000 bursts)

1.4.4 TETRA BST1 System

Th e CX300 tests the base station using T1 Test Mode. The TETRA BST1 System provides the following test capabilities:

- Base station identification (MCC, MNC, BCC)
- T1 Test signal generation
- Optional synchronization to base station using sync pulse signal from base station
- Transmitter measurements (power, modulation accuracy, frequency error)
- Graphical displays of modulation
- Capture, demodulation, and decoding of base station transmissions (5000 bursts)

1.5 Accessing Tetra Option

The following procedure describes how to select a test mode of operation.

To Select Test Mode of Operation

1. Navigate to the T**est Home Screen**.
2. Select the desired test mode from the **Mode Pane** (Communications Test, Spectrum Analyzer, Auto Test, or Network Analyzer, etc.).
3. Select **TETRA** from the **Measure Pane**.
4. Perform one of the following to load TETRA:
   - Press the **TETRA** button twice.

   or
   - Select **TETRA** and select the **Done Button**.
5. Select the desired test mode from the **TETRA User Interface (UI)**, (Receive Test, Transmit Test or Duplex Test). See Figure 1-4.

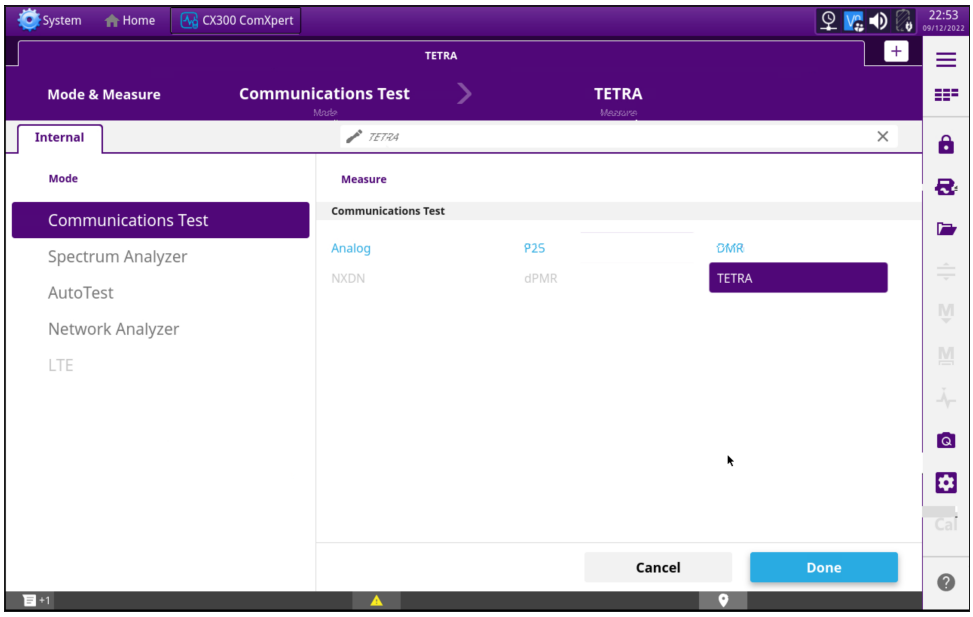

Figure 1-3 TETRA Selection

1.6 TETRA User Interface Layout

The TETRA User Interface (UI) uses the same layout, methods of navigation, and control used in the CX300 Duplex test and measurement mode of operation. Refer to the *CX300 ComXpert Operation Manual* for a detailed description about the UI layout, accessing system and test screens, and configuring controls and settings.

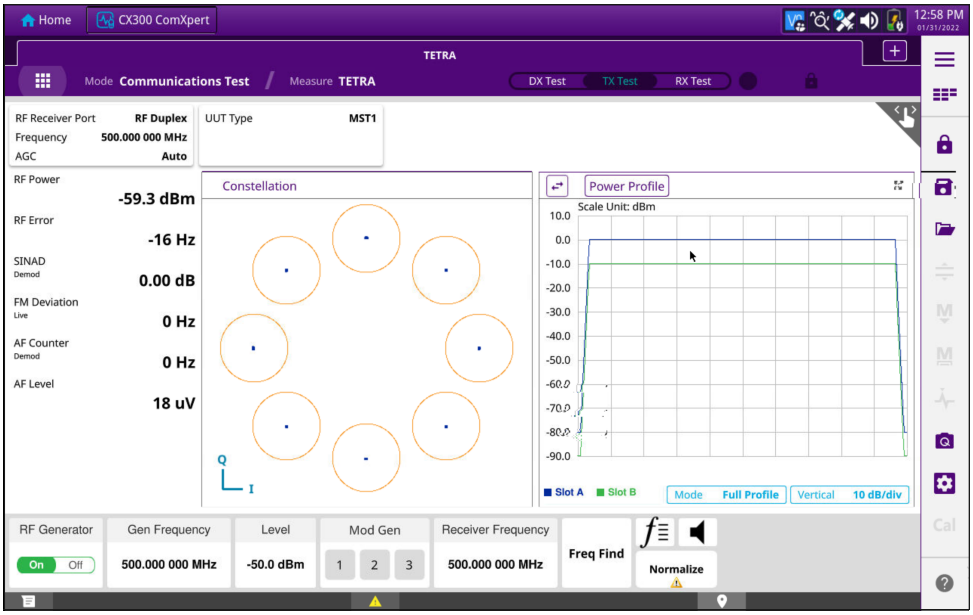

Figure 1-4 TETRA User Interface (UI) - Example only

1.7 Selecting Full Test Settings Button

To operate the CX300 efficiently, the user should become familiar with the buttons located in the Test Controls Toolbar. To activate any of these functions, momentarily push and release the button.

Table 1-1 CX300 Test Function Controls

Button	Name	Description
	**Full Test Settings Button**	This **Full Test Setting Button** displays all controls and settings for each test and measurement function that is available in the selected mode of operation. Selecting one of the settings or buttons opens a configuration window or alters the state of the setting.

Refer to the ***CX300 ComXpert Communication Service Monitor Operation Manual*** for a complete list of the CX300 Test Function Controls.

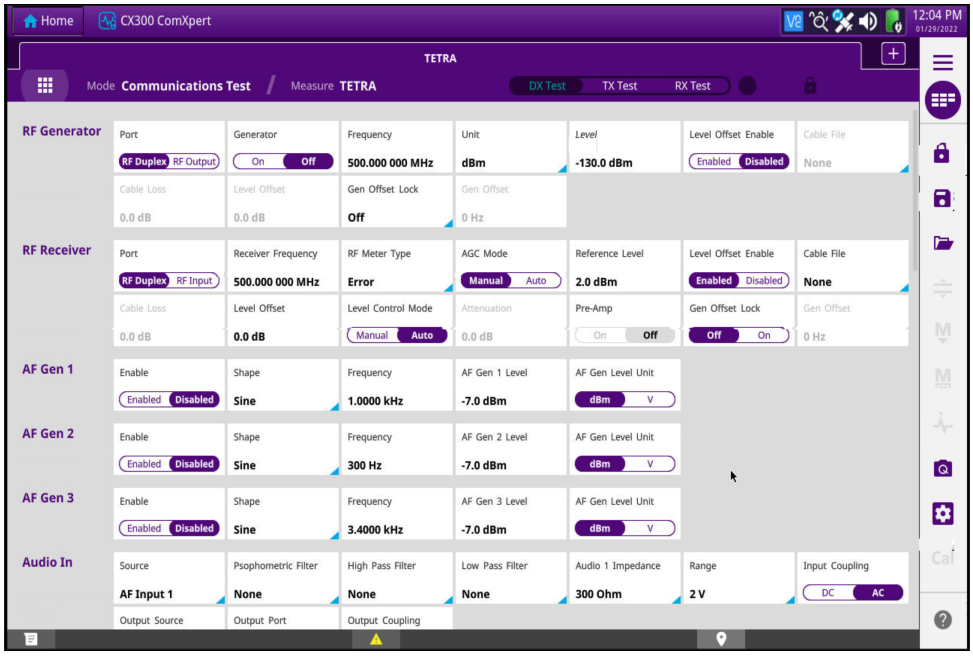

Figure 1-5 Full Test Setting Button Selected Example

In the example shown in Figure 1-5, for **RF Receiver**, **Level Offset Enable** is **Enabled.** This allows **Cable File** and **Level Offset** to be adjusted as necessary. Also shown in the example shown in Figure 1-5, for **RF Generator**, **Level Offset Enable** is **Disabled.** This keeps **Cable File** and **Level Offset** unchanged**.**

1.8 Selecting Full Profile Mode

To operate the CX300 efficiently, the user should become familiar with the buttons located in the Main Screen Controls. To activate any of these functions, momentarily push and release the button.

Table 1-2 CX300 Main Screen Controls

Button	Name	Description
	**Full Profile Button (OFF and ON)**	The **Full Profile Button** opens or closes the displays to a larger portion of the Main Screen that is available in the selected mode of operation. Selecting one of the settings or buttons opens a configuration window or alters the state of the setting to a larger view.

Refer to the ***CX300 ComXpert Communication Service Monitor Operation Manual*** for a complete list of the CX300 Test Function Controls.

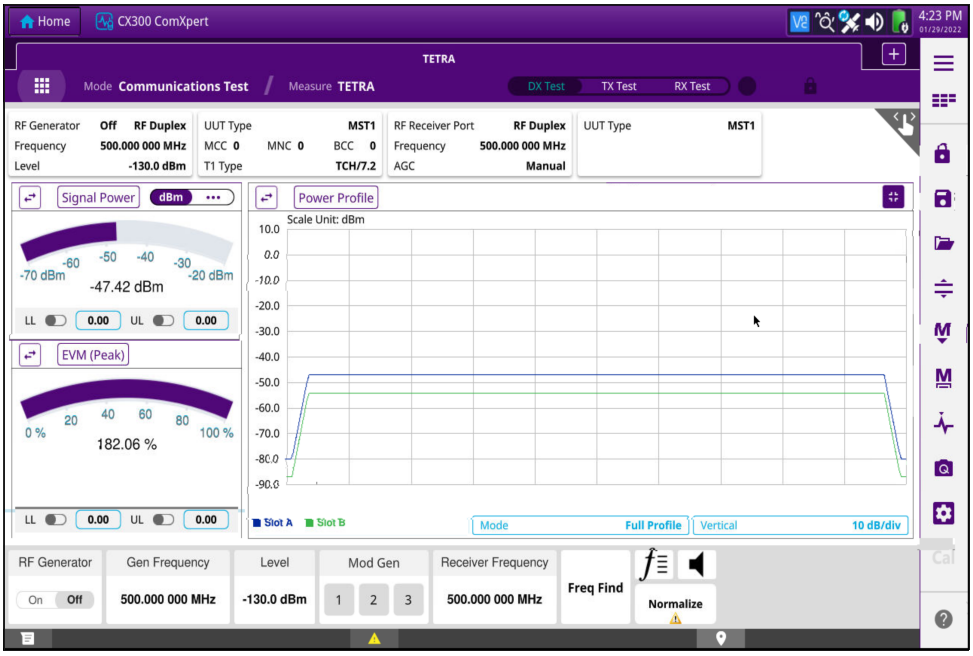

Figure 1-6 Full Profile Selected - Example only

1.9 Meter/Graph Selection

To operate the CX300 efficiently, the user should become familiar with the buttons located in the Main Screen Controls. To activate any of these functions, momentarily push and release the button.

Table 1-3 CX300 Main Screen Controls

Button	Name	Description
	**Select Meter, Meter/Data, and Meter/Graph Selection Button**	The **Meter/Data/Graph Selection Button** opens or closes the displays to a larger portion of the Main Screen that is available in the selected mode of operation. Selecting one of the settings or buttons opens a configuration window or alters the state of the setting to a larger view.

Refer to the ***CX300 ComXpert Communication Service Monitor Operation Manual*** for a complete list of the CX300 Test Function Controls.

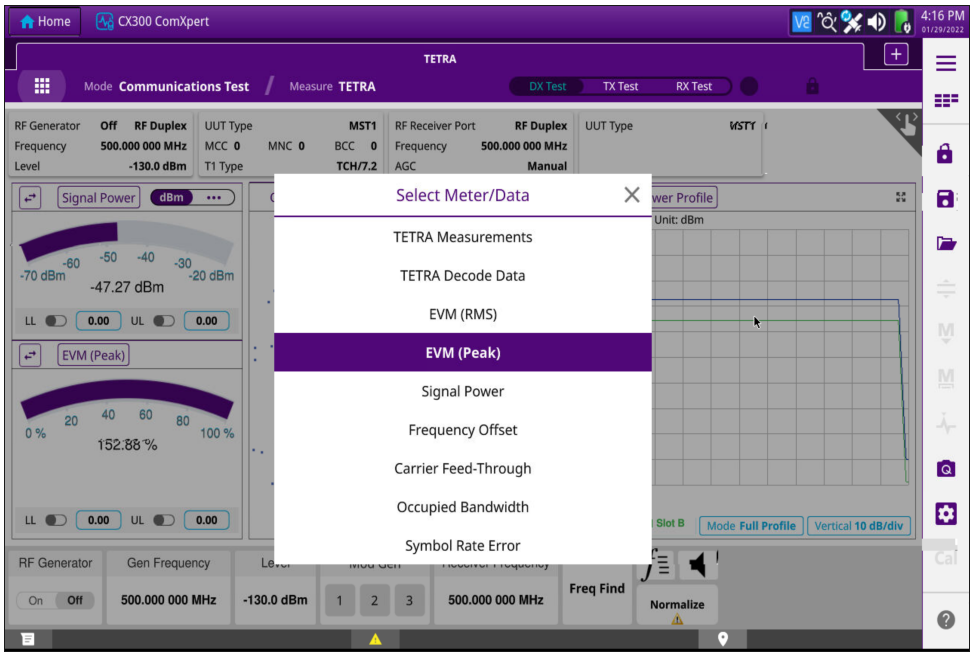

Figure 1-7 Select Meter/Data

When the **Meter/Graph Selection Button** is selected on the **Measurement Pane**, the user can select the type of Meter or Graph to display in the **Measurement Pane**. See examples shown in Figure 1-7, Figure 1-8, and Figure 1-9.

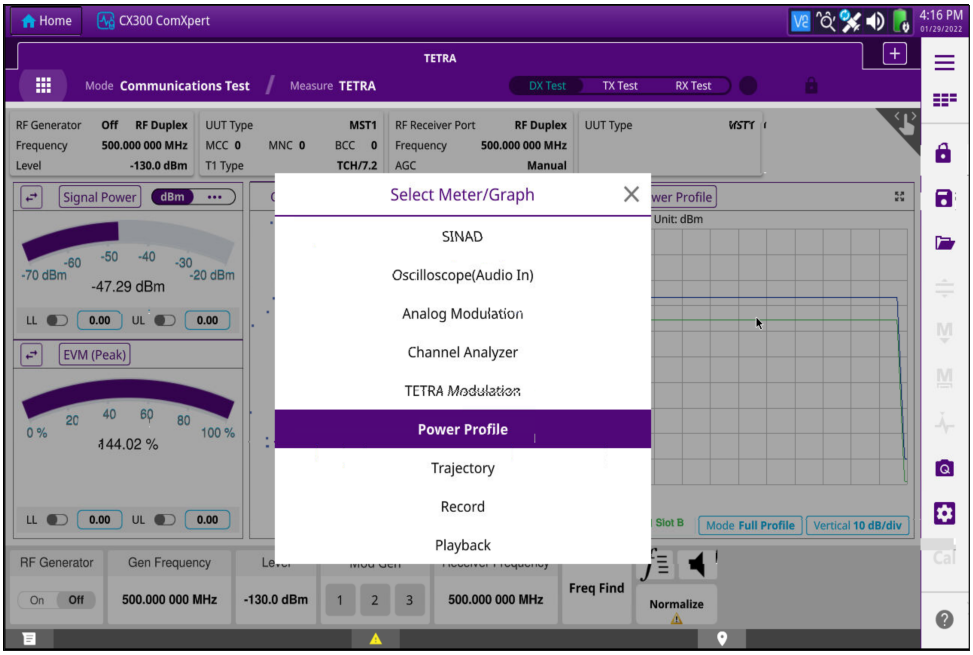

Figure 1-8 Select Meter/Graph

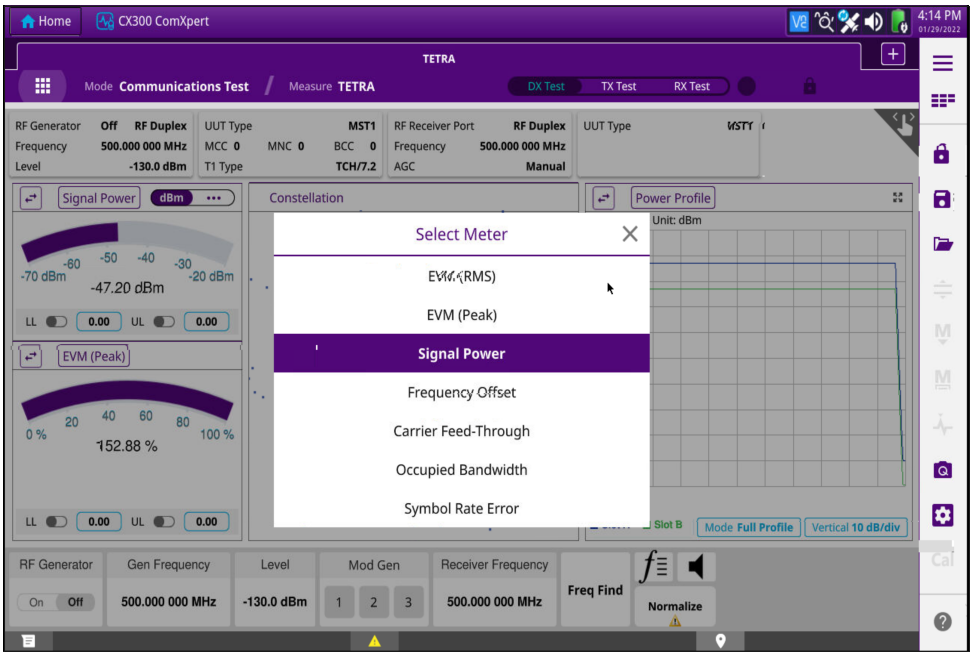

Figure 1-9 Select Meter

2

TETRA Test and Measurement Functions

This chapter describes the test and measurement functions that are supported in TETRA. Topics discussed in this chapter include the following:

- Generate and Receive Functions 2-2
  - RF Generator 2-2
  - TETRA Modulation Controls and Settings 2-2
  - Modulation Controls and Settings 2-3
  - RF Receiver 2-3
- TETRA Meters 2-3
  - Meter Controls and Settings 2-3
  - Meter Scale Settings 2-4
  - TETRA Demod Controls and Settings 2-5
  - Demod Meter 2-6
  - FREQUENCY Offset Meter 2-6
  - Signal Power Meter 2-6
  - Symbol Rate Error Meter 2-7
  - Channel Analyzer 2-7
  - Constellation Plot 2-8
- Audio Controls and Signal Routing 2-9
- Frequency List Controls and Settings 2-9
- Normalize 2-9

2.1 Generate and Receive Functions

2.1.1 RF Generator

The **RF Generator** provides users with a signal source of known parameters which can be used to evaluate the receive performance of the Unit Under Test (UUT). When configuring **RF Generator** settings, configure the characteristics of the outgoing signal according to the capabilities of the receiver, the test requirements, and the hardware configuration of the test.

RF Generator controls and settings are configured from the **RF Generator** settings menu. Some controls are also accessed from the Quick Access Toolbar or Function Toolbar. Refer to the *CX300 ComXpert Operation Manual* for detailed descriptions of **RF Generator** controls and settings.

2.1.2 TETRA Modulation Controls and Settings

TETRA modulation controls and settings are configured from the **TETRA Mod** settings menu. Some controls are also accessed from the **Quick Access Toolbar** or **Function Toolbar.** The following TETRA modulation controls and settings are used to configure the characteristics of the modulated TETRA signal:

Table 2-1 TETRA Modulation Controls and Settings

Control/Setting	Description
UUT Type (BST1, MST1)	This setting selects the type of modulation applied to the outgoing signal. Selections vary according to the TETRA options available on the test set.
MCC	Base station identification.
MNC	Base station identification.
BCC	Base station identification.
T1 Type	The Test Set identifies the type of T1 Signal requested in the system information contained in the RF signal received from the Base Station and produces a T1 Signal type 7 (TCH/7.2).
Parameter Mode	**Manual** and **Auto**. The user can manually enter BCC, MNC, MCC or if in auto what is decoded will be transmitted.
SYNC Mode	Free Run, Auto, and Pulse.
Auto Sync Offset	The Auto Sync Offset controls the timing offset between the downlink frame structure and the Test Set's T1 Uplink Signal.
Channel	Channel decoding.

2.1.3 Modulation Controls and Settings

The CX300 contains three internal modulation generators and an external modulation source. Modulation controls and settings are configured from the **Mod** settings menu. Some controls are also accessed from the **Quick Access Toolbar** or **Function Toolbar.** Refer to the *CX300 ComXpert Operation Manual* for detailed descriptions Modulation controls and settings.

2.1.4 RF Receiver

The **RF Receiver** controls and settings are used to determine how the instrument processes an incoming signal. In order to obtain accurate test and measurement results, **RF Receiver** parameters must be set according to the known characteristics of the incoming signal.

The **RF Receiver Port**, **Frequency**, **Reference Level**, and **External Attenuator** parameters apply to all types of incoming signals. There are additional parameters that must be configured depending on the type of modulation that has been applied to the incoming signal.

RF Receiver controls and settings are configured from the **RF Receiver settings menu**. Some controls are also accessed from the Quick Access Toolbar or Function Toolbar. Refer to *CX300 ComXpert Communication Service Monitor Operation Manual* for detailed descriptions of **RF Receiver** controls and settings.

CAUTION
Do not overload input connectors. Refer to product labeling or product specifications for maximum input ratings.

2.2 TETRA Meters

CX300 TETRA meters provide users with the test functions necessary to evaluate the operational capabilities of TETRA systems. This section describes the meters supported in TETRA test mode.

2.2.1 Meter Controls and Settings

TETRA supports a variety of TETRA meters. The controls and settings described in this section are found throughout various TETRA meters.

2.2.1.1 Meter Limits

Meter limits are used to define pass/fail criteria for measurements. CX300 meters support upper and lower limits as appropriate for each measurement. When limits are enabled for a meter, visual indicators are provided that indicate enabled limits, limit settings, and reading pass/fail status. Refer to the *CX300 ComXpert Communications Service Monitor Operation Manual* for a complete description of limit features and indicators.

- The **Lower Limit** field sets a minimum acceptable reading for a specific measurement. When a measurement falls below the enabled lower limit value, the meter scale turns blue. When readings are above a defined lower limit, or within enabled upper and lower limits, the meter scale turns green.
- The **Upper Limit** field sets a maximum acceptable reading for a specific measurement. When a measurement exceeds the enabled upper limit value, the meter scale turns red. When readings are under a defined upper limit, or within enabled upper and lower limits, the meter scale turns green.

2.2.2 Meter Scale Settings

The upper and lower settings of a meter's scale are defined using the **Meter Scale button** which is located on each meter setting menu. The following methods are supported to define a meter's scale settings:

Pre-Defined

Select from a pre-defined list of values which are appropriate for the measurement. The selected value defines the upper scale value; the lower value defaults to a value appropriate for the measurement.

Custom

Define the upper and lower scale settings. When Custom is selected, the upper and lower scale fields update to editable data fields. Selecting the upper and lower scale field displays the Numeric Keypad which allows you to enter an arbitrary value.

Auto

System adjusts the scale to settings best suited to the characteristics of the received signal.

2.2.2.1 Average Measurements

When appropriate for the measurement type, CX300 measurement meters support average measurements. When supported, the **Avg Samples** field is used to define the number of samples that are used to calculate average measurements.

2.2.2.2 Refresh Meters

Meter readings are refreshed using the **Refresh** button (↻).

2.2.3 TETRA Demod Controls and Settings

TETRA demodulation controls and settings are used to configure the device's RF Receiver to demodulate TETRA modulated signals. The resulting TETRA measurements can be used to evaluate modulation performance characteristics such as modulation accuracy and to identify any distortion present on the signal.

TETRA demodulation controls and settings are configured from the **TETRA Demod** function menu. Some controls are also accessed from the Quick Access Toolbar or Function Toolbar.

See section 2.2.1, "Meter Controls and Settings", on page 2-3 for a description of the controls and settings that are available for TETRA Demod Meters. TETRA Demod Meters also contain the following demodulation controls and setting:

Table 2-2 Screen Name Controls and Settings

Control/Setting	Description
UUT Type (BST1, MST1)	This setting selects the type of modulation to the incoming signal. Selections vary according to the TETRA options available on the test set.
Reset Acquisition	If sync is no longer valid, the user can choose to **Reset Acquisition** at that time to re-acquire the signal.

2.2.4 Demod Meter

The CX300 Demodulation controls and settings are used to configure the device's RF Receiver to demodulate FM modulated signals. The resulting modulation measurements can be used to evaluate modulation performance characteristics such as modulation accuracy and to identify any distortion present on the signal.

Demodulation controls and settings are configured from the **Demod settings menu**. Some controls are also accessed from the Quick Access Toolbar or Function Toolbar. Refer to the *CX300 ComXpert Communication Service Monitor Operation Manual* for detailed descriptions of Demod meters, controls, and settings.

2.2.5 FREQUENCY Offset Meter

The **FREQUENCY Offset Meter** indicates the difference (frequency error) between the received RF signal and the defined receive frequency. **FREQUENCY Offset Meter** controls and settings are configured from the **FREQUENCY Offset settings menu**. Some controls are also accessed from the Quick Access Toolbar or Function Toolbar. See section 2.2.1, "Meter Controls and Settings", on page 2-3 for a description of the controls and settings supported for the **FREQUENCY Offset Meter**.

2.2.6 Signal Power Meter

The **Signal Power Meter** is a tuned power meter that indicates the amount of RF energy that is contained within the CX300's selected receiver bandwidth (i.e. 12.5 kHz). The **Signal Power Meter** is tuned to a specific frequency, giving the ability to selectively measure the power of one channel when other channels are present.

Signal Power Meter controls and settings are configured from the **Signal Power settings menu**. Some controls are also accessed from the Quick Access Toolbar or Function Toolbar. The **Signal Power Meter** support the meter controls and settings described in See section 2.2.1, "Meter Controls and Settings", on page 2-3.

2.2.7 Symbol Rate Error Meter

The **Symbol Rate Error Meter** measures the 4800 baud symbol clock of the incoming TETRA signal. Symbol rate error measurements should not exceed ± 48 mHz per *TIA-102.CAAA Specification*.

Symbol Rate Error Meter controls and settings are configured from the **Symbol Rate Error settings menu**. Some controls are also accessed from the Quick Access Toolbar or Function Toolbar. See section 2.2.1, “Meter Controls and Settings”, on page 2-3 for a description of the controls and settings supported for the **Symbol Rate Error Meter**.

2.2.8 Channel Analyzer

The **Channel Analyzer plot** is supported in Transmit Test and Duplex Test modes.

The Channel Analyzer is an asynchronous, Fast Fourier Transform (FFT) based analyzer that displays the spectrum of the RF signal received by the test set up to a 100 MHz bandwidth, centered on the receive frequency. The source of the signal for the Channel Analyzer is the receiver chain of the test set, therefore the Channel Analyzer is dependent on the receiver for connector selection, global attenuation and center frequency.

The **Channel Analyzer plot** can be viewed in default size, or as an expanded window. When the **Channel Analyzer plot** is expanded, frequently used analyzer controls and settings are available on the measurement window; other controls and settings are accessed from the **Channel Analyzer settings menu**.

The CX300 contains several methods of displaying the Magnitude Error results.

2.2.9 Constellation Plot

The Constellation shows the spread of symbol points for a burst and gives a visual representation of whether the deviations are phase or magnitude related. Limit circles may be displayed as shown in this example. The constellation point circle is pushed into an oval when an I/Q imbalance is present. The measurement results displayed when the view is maximized are the same as the results displayed on the Tx Measurements view.

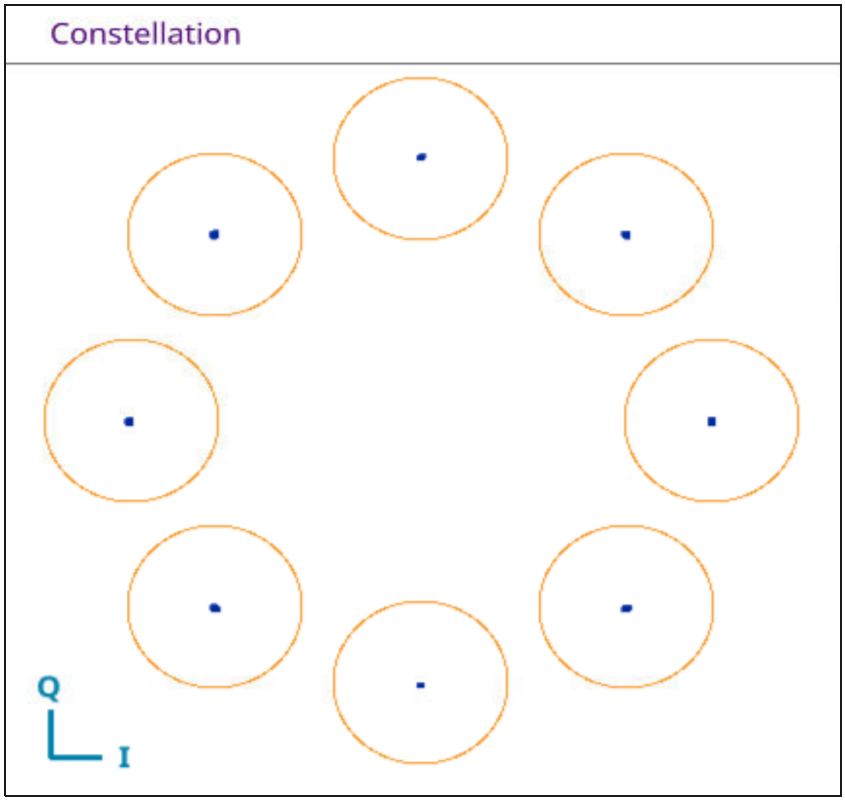

Figure 2-1 TETRA MS Constellation Plot - Example 1

A perfect signal would display a single dot in the center of each of the circles. In reality, there is usually a line in each of the circles that shows the spread of deviation for each symbol. A wider line translates into a larger mod fidelity reading. The line may extend outside of the circle, which indicates very poor Magnitude Error, or that the symbol deviation is too large or too small.

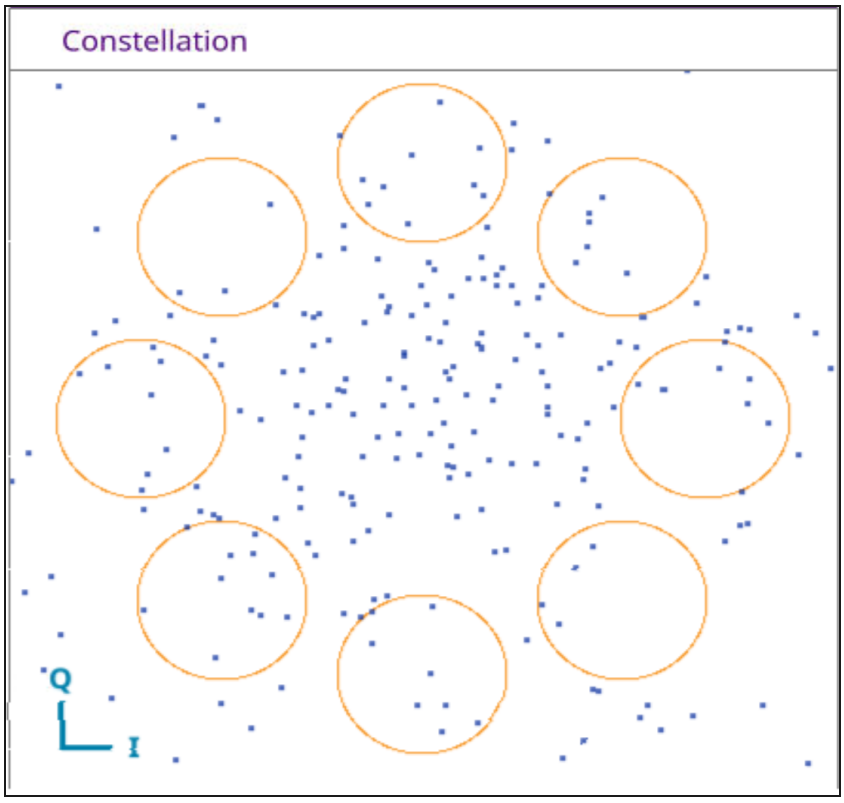

Figure 2-2 TETRA MS Constellation Plot - Example 2

2.3 Audio Controls and Signal Routing

The audio signal routing, volume, and squelch settings of the CX300 are configured on the **Audio Controls window**. The **Audio Controls window** is used to configure settings such as speaker routing, the signal source for performing noise measurements and the Oscilloscope input signal.

The **Audio Controls window** is displayed by selecting the **Audio Controls button** from the **Quick Access Toolbar**.

Refer to the *CX300 ComXpert Communication Service Monitor Operation Manual* for detailed information about the audio controls and signal routing settings.

2.4 Frequency List Controls and Settings

The Frequency List tool allows users to define frequency list tables which can easily be loaded and applied via the CX300 UI.

Refer to the *CX300 ComXpert Communication Service Monitor Operation Manual* for additional information about this function.

2.5 Normalize

The Normalize function performs a series of internal measurements and corrections to reduce measurement inaccuracies which may occur due to environmental conditions such as temperature change. Normalize optimizes various performance parameters, including carrier leakage, IQ gain and balance, Third Order Intercept (IP3), and level correction.

Refer to the *CX300 ComXpert Operation Manual* for additional information about this function.

3

TETRA Calls and Measurements

This chapter provides task-based instructions for using the CX300 ComXpert to perform key TETRA tests and measurements. This chapter describes how to use the CX300 in the following test scenarios.

- Testing TETRA MS Transceiver 3-2
  - TETRA Transceiver Test Description 3-2
  - Equipment Needed 3-2
  - Hardware Setup Diagram 3-2
  - Configuring the CX300 Test Set 3-3
  - Testing TETRA Transmitter. 3-4
  - Testing TETRA Receiver. 3-5
- TETRA Receiver Sensitivity Test. 3-5
  - TETRA Receiver Sensitivity Description 3-5
  - Equipment Needed 3-5
  - Test Setup. 3-6
  - Configuring the CX300 Test Set 3-6
  - Performing the TETRA Receiver Sensitivity Test 3-6

3.1 Testing TETRA MS Transceiver

3.1.1 TETRA Transceiver Test Description

The following instructions guide the user through an objective TETRA Transmitter Test and a subjective TETRA Receiver Test. It is not necessary to control the UUT through the UUT OEM tuner or programming software for this test.

3.1.2 Equipment Needed

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

- CX300 ComXpert Test Set
- RF Coaxial Cable and adapters

3.1.3 Hardware Setup Diagram

Connect the CX300 and UUT as shown in Figure 3-1, and then proceed to the next section.

Figure 3-1 TETRA Transceiver Test Setup Diagram

3.1.4 Configuring the CX300 Test Set

1. Select the CX300 ComXpert Tab.
2. Select Communications Test on the **Mode Pane**.
3. Select TETRA on the Measure Pane.
4. Click the **Done** button.
5. Select the **RF Generator** menu.
    a. Set the RF Generator port to **RF Duplex.**
    b. Set the RF Generator Frequency state to Off.
    c. Set the RF Generator Frequency to match the UUT Receiver Frequency.
    d. Set the Modulation to TETRA **MST1**.
    e. Set the RF Generator Level to -80 dBm.
6. Set the **Modulation menu**.
    a. Select UUT Type (BST1 or MST1).
7. Set the **RF Receiver menu**.
    a. Set the RF Receiver Port to **RF Duplex**.
    b. Set the RF Receiver Frequency to match the UUT transmit frequency.
    c. Set the AGC Mode to **AUTO**.
8. Set the **TETRA Demod menu**.
    a. Select UUT Type (BST1 or MST1).
9. Select the Signal Power meter on the **Meter tile.**
10. Select TETRA Measurements on the **Meter/Data tile.**

3.1.5 Testing TETRA Transmitter

1. Record and compare the TETRA Measurements to Table 3-1.
2. If no further testing required, proceed to next step. If not proceed to Testing the TETRA Transmitter.
3. Disconnect and power **OFF** the UUT.

Table 3-1 Testing TETRA Phase 1 Transceiver

Measurement	Lower Limit	Target	Upper Limit
RF Frequency Error (ppm)		0	1
Symbol Rate Error (ppm)		0	10
Magnitude Error (%)		0	5
Symbol Deviation (Hz)	1620	1800	1980
(Signal Power		(Radio Specific)	

3.1.6 Testing TETRA Receiver

1. Select the RF Generator menu.
   a. Set the Generator state to On.
2. Verify an audible tone is present at the UUT Receiver speaker.
3. Lower the RF Generator output level until the audio begins to sound unstable. This is a subjective receiver sensitivity of the TETRA Receiver. A more formal test is described in section 3.1.4, on page 3-3.
4. If no further testing is to be conducted, disconnect and power **OFF** the UUT.

3.2 TETRA Receiver Sensitivity Test

3.2.1 TETRA Receiver Sensitivity Description

Receiver sensitivity is a determination of the level of the signal that produces the standard in the receiver. The TIA standard measurement is performed by generating the standard test pattern and then reducing the level of the RF signal.

3.2.2 Equipment Needed

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

- CX300 ComXpert Test Set
- RF Coaxial Cable and adapters
- UUT OEM tuner or programming software (if required - see note below)

3.2.3 Test Setup

1. Connect the CX300 and UUT as shown in Figure 3-2, and then proceed to the next section.

Figure 3-2 TETRA Receiver Sensitivity Test Setup Diagram

3.2.4 Configuring the CX300 Test Set

1. Configure the CX300 as described in section 3.1.4, on page 3-3.
2. Select the **TETRA Mod menu.**

3.2.5 Performing the TETRA Receiver Sensitivity Test

1. Select the **RF Generator menu**.
   a. Set the UUT OEM for testing TETRA Receiver Sensitivity / RX.
2. Adjust the RF Generator output level until the UUT control software Rx meter displays 5%, or in test scenarios where the radio calculates and report its own Rx, until the UUT reports.
3. Record the RF Generator output level.
4. If no further testing is to be conducted, disconnect and power Off the UUT.

4

TETRA MST1 and BST1 Systems

This chapter explains the procedures and features for testing TETRA Mobiles in MST1 and BST1 Test Modes.

- TETRA MST1 System 4-2
  - MST1 Test Mode 4-2
- TETRA BST1 System 4-4
  - BST1 Test Mode 4-4
- Audio Controls 4-6

4.1 TETRA MST1 System

4.1.1 MST1 Test Mode

Some TETRA Mobiles have the capability to receive and transmit T1 Test Signals. When in T1 Test Mode, the mobile may respond to instructions over the air interface, or it may require a separate control program.

The TETRA MS T1 system produces the T1 Test Signals required for receiver testing and performs measurements on the signals transmitted by the TETRA Mobile for conformance testing.

The following steps may need to be performed to use T1 Test Mode to test a mobile:

- The Test Set MCC value may need set to 001 and the MNC value to 00001 so the mobile recognizes these special test values
- An access code may need to be entered on the mobile or an external configuration/control application may need to be used to place the mobile into T1 Test Mode. Refer to the mobile manufacturer for information on using T1 Test Mode and T1 loopback (if supported)

In the example shown in Figure 4-1, for **Modulation**, **MST1** is selected.

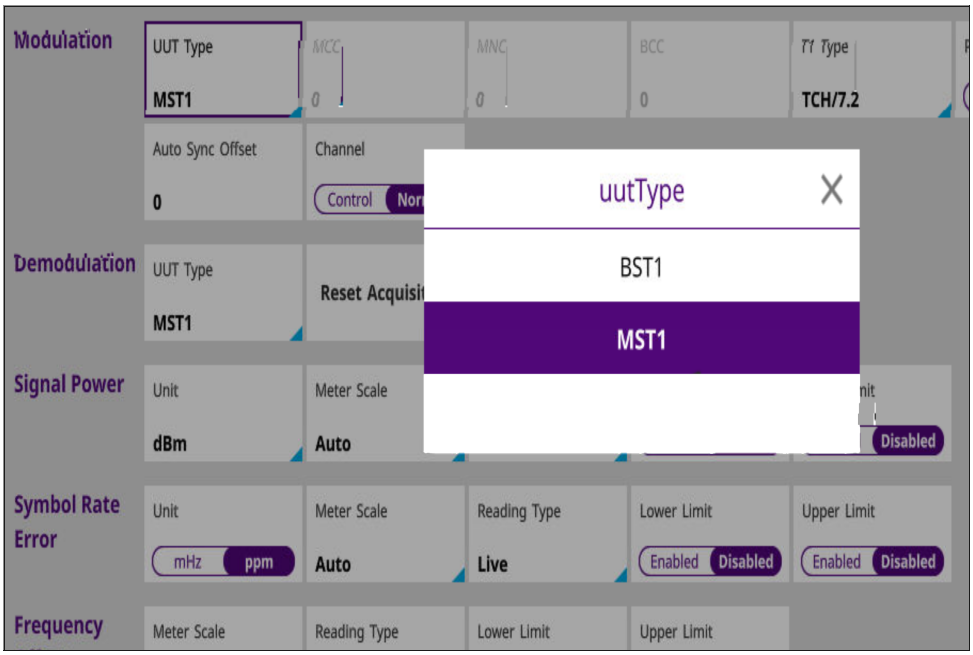

Figure 4-1 Modulation MST1 Selected Example

The TETRA MS System provides features for testing TETRA Mobiles in normal operating mode. Mobiles with T1 Test capability can be tested using the TETRA MST1 System.

The TETRA MST1 System provides the following test capabilities:

- Base station simulation
- Transmitter measurements
- Graphical displays of power profile and modulation
- Modulation and Demodulation

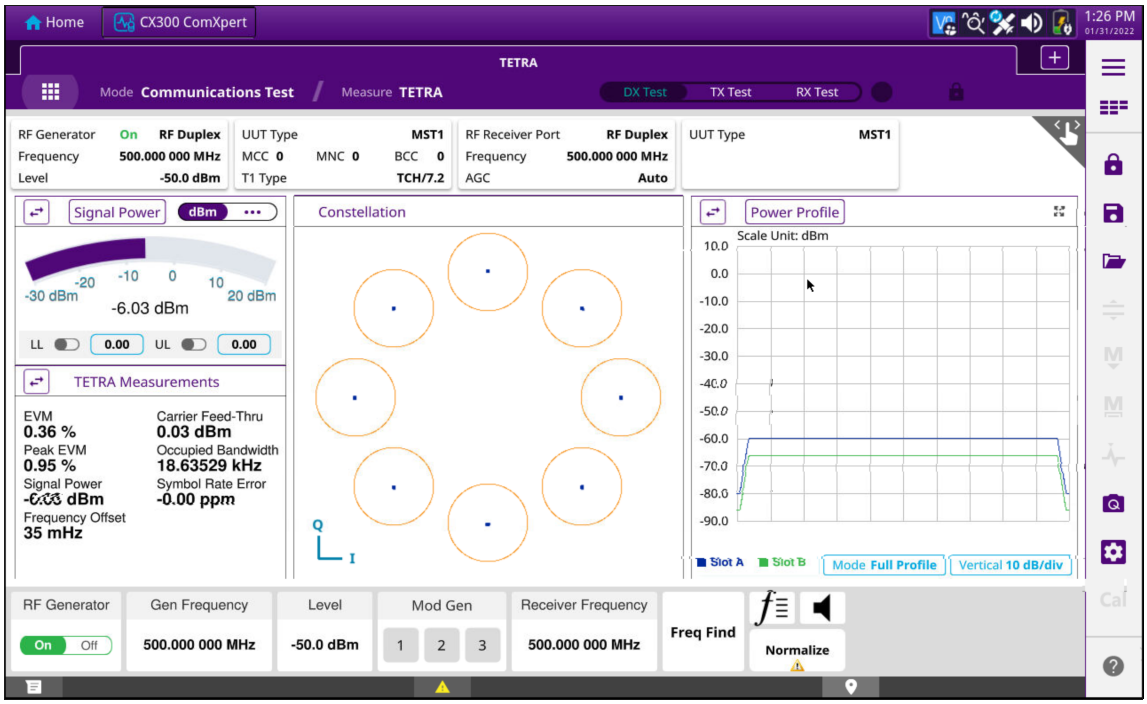

Figure 4-2 TETRA MST1 System Display - Example Only

4.2 TETRA BST1 System

4.2.1 BST1 Test Mode

The TETRA BST1 System is intended to be used for testing base station transmitters and/or receivers operating in T1 Test Mode. Limited testing with proprietary test modes is also possible.

When testing a base station transmitter, the Test Set is expecting to receive a T1 Test Signal from the base station under test. The frequency of the expected signal is determined by the Analyzer Frequency setting. When testing a base station receiver, the Test Set must be synchronized to the frame structure of the base station under test, either by analyzing the signal from the base station transmitter, or by receiving a synchronization pulse from the base station receiver. The frequency of the generated signal is determined by the Generator Frequency setting.

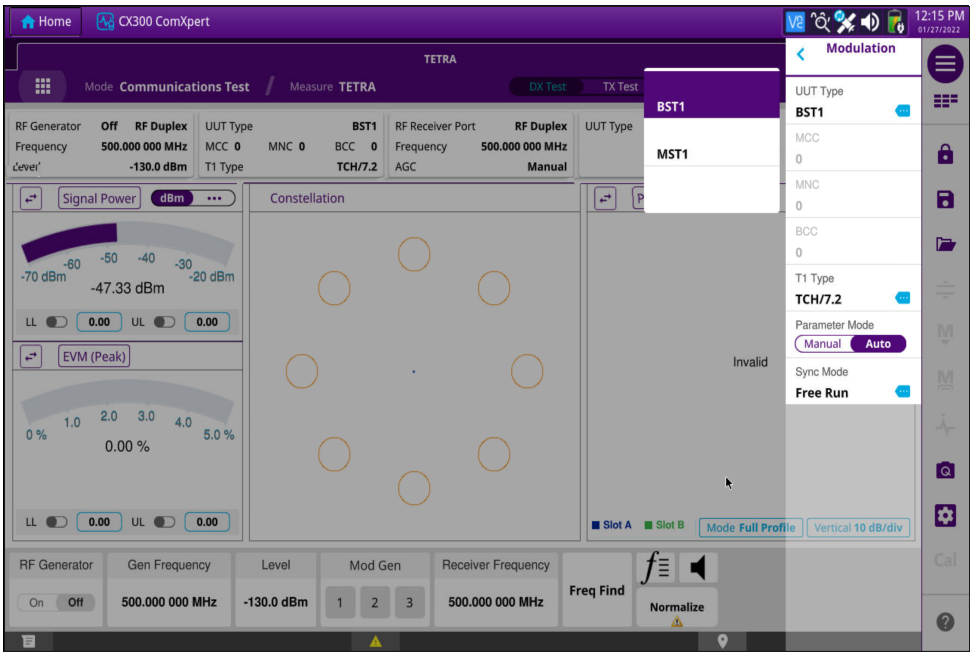

Figure 4-3 Modulation BST1 Selected - Example Only

The CX300 TETRA BS System provides features for testing TETRA Base Station Transmitters in their normal operating mode. Base Station transceivers with T1 Test capability can be tested using the TETRA BST1 System.

The TETRA BST1 System provides the following test capabilities:

- Base station identification (MCC, MNC, BCC)
- T1 Test signal generation
- Optional synchronization to base station using sync pulse signal from base station
- Transmitter measurements (power, modulation accuracy, frequency error)
- Graphical displays of modulation
- Modulation and Demodulation

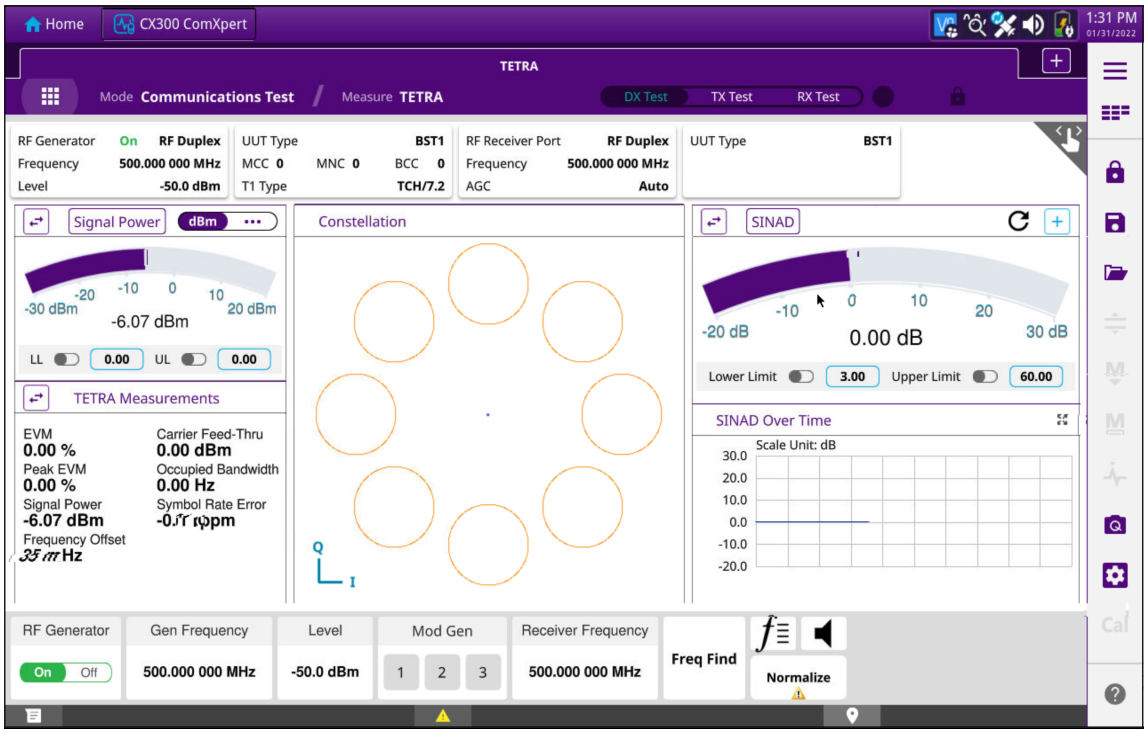

Figure 4-4 TETRA BST1 System Display - Example Only

4.3 Audio Controls

The TETRA System Audio Controls is a combination of the functionality found on the Duplex AF Generators and AF Analyzers. Audio functionality allows a user to measure and evaluate audio signals while operating within TETRA Systems. Functionality is identical to the fields found in the Duplex System.

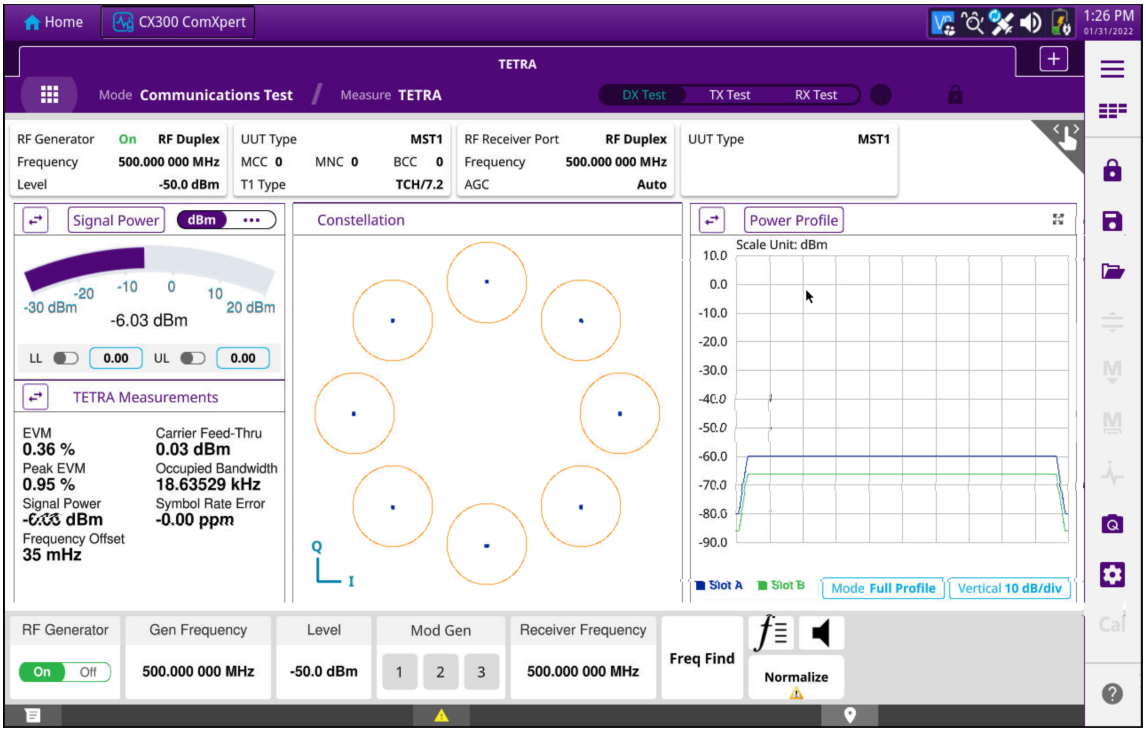

Figure 4-5 Audio Controls Selected - Example Only

Audio Controls Button

When the Audio Controls Button is selected on the **Device Status Bar**, the Audio Controls Screen will appear. See examples shown in Figure 4-5 and Figure 4-6.

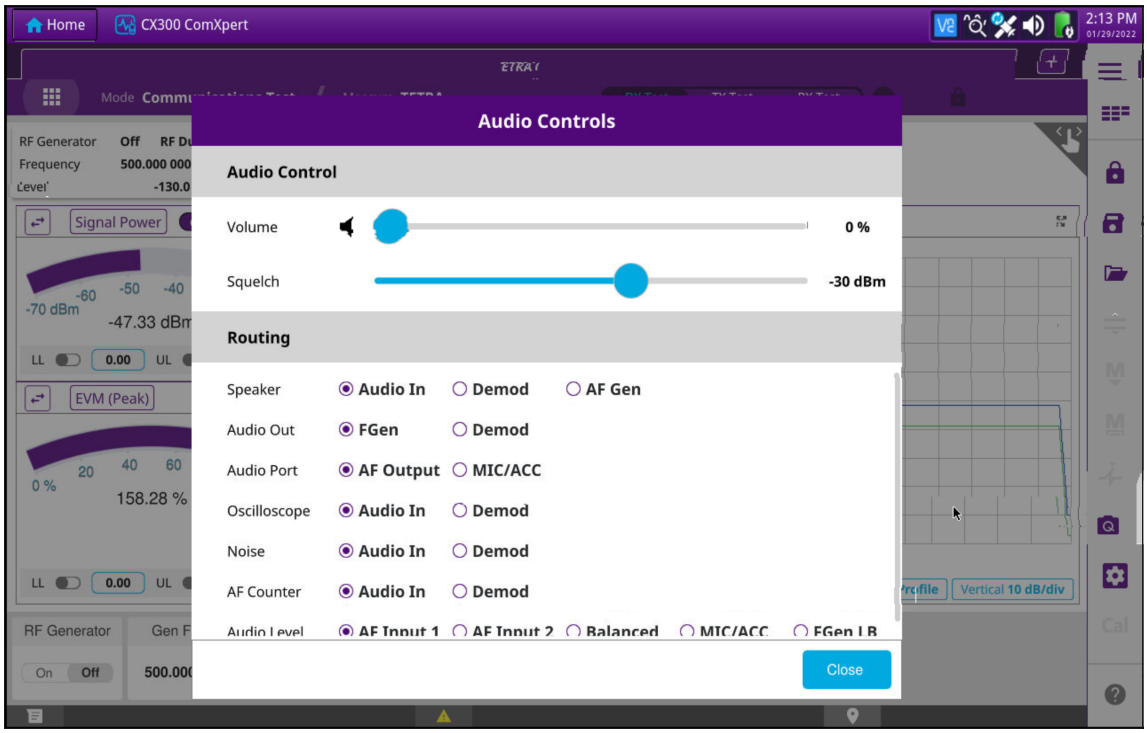

Figure 4-6 Audio Controls Selected - Example Only

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A

Terms and Acronyms

A - B

ACC — accessory

AES — Advanced Encryption Standard

AF — Audio Frequency

AGC — Automatic Gain Control

Avg — average

BER — Bit Error Rate

C - D

dBm — decibel milliwatts

DES — Data Encryption Standard

DEST ID — Destination Identifier

DUT — Device Under Test

F - L

FM — Frequency Modulation

GUI — Graphic User Interface

HP — High Pass in relation to High Pass filter

kHz — kilohertz

LP — Low Pass in relation to Low Pass Filter

M - N

mHz — millihertz

MHz — megahertz

MIC — microphone

Mod — Modulation

NAC — Network Access Code

P - T

RF — Radio Frequency

RMS — Root Mean Square

SCCB — Secondary Control Channel Broadcast

Sym Dev — Symbol Deviation —

TETRA — Digital Mobile Radio (TETRA) Test System

U - Z

TGID — Talk Group Identifier

UUT — Unit Under Test

WACN — Wide Area Communications Network

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