VIAVI

CX300 ComXpert

Communication Service Monitor

NXDN Option Guide

Rev 000

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Notice

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The CX300 ComXpert Communications Service Monitor includes third party software licensed under the terms of separate open source software licenses. By using this software you agree to comply with the terms and conditions of the applicable open source software licenses. Software originated by VIAVI is not subject to third party licenses. Terms of the VIAVI Software License different from applicable third party licenses are offered by VIAVI alone.

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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Warranty information for this product is available on the VIAVI website at https://www.viavisolutions.com/en-us/warranty-information.

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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.

The authority to operate this equipment is conditioned by the requirements that no modifications be made to the equipment unless the changes or modifications are expressly approved by VIAVI.

> **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.
> - This transmitter must not be co-located in conjunction with any other antenna or transmitter.

Industry Canada Requirements

This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions: 1) This device may not cause interference; and, 2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: 1) l'appareil ne doit pas produire de brouillage; et, 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

EU WEEE and Battery Directives

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.

VIAVI has established a take-back processes in compliance with the EU Waste Electrical and Electronic Equipment (WEEE) Directive, 2012/19/EU, and the EU Battery Directive, 2006/66/EC.

Instructions for returning waste equipment and batteries to VIAVI can be found in the WEEE section of [VIAVI's Standards and Policies web page](#).

If you have questions concerning disposal of your equipment or batteries, contact the VIAVI WEEE Program Management team at WEEE.EMEA@VIAVISolutions.com.

EU REACH

Article 33 of EU REACH regulation (EC) No 1907/2006 requires article suppliers to provide information if a listed Substances of Very High Concern (SVHC) is present in an article above a certain threshold.

For information on the presence of REACH SVHCs in VIAVI products, see the Hazardous Substance Control section of [VIAVI's Standards and Policies web page](#).

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This product conforms with all applicable CE marking directives. Please see EU Declaration of Conformity for details.

EMC Directive Compliance

This product was tested and conforms to the EMC Directive, 2014/30/EU for electromagnetic compatibility.

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The China RoHS Materials Declaration is shipped with the product when required.

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This manual is a product of the VIAVI Technical Publications Department, issued for use with the CX300 ComXpert Communications Service Monitor. The PDF format of this manual is available on the VIAVI product website.

Go to: https://www.viavisolutions.com/en-us/resources/literature-library

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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.

- Phone: 1-844-GO-VIAVI
- Email: Techsupport.Avcomm@viavisolutions.com

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Record of Revisions

RECORD OF REVISIONS

REV.	DATE	ACCEPTANCE
000	June 2024	VIAVI

Preface

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

About this Manual

Scope of Manual

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

Intended Audience

This manual is intended for personnel who are familiar with NXDN 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 NXDN Option* effectively and efficiently.

Related Information

This is the CX300 ComXpert NXDN Option Guide *22163052*. 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 DMR Option Guide, 22163052, which provides information about the test and measurement functions found in the CX300 DMR options

- *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>`

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
- email: Techsupport.avcomm@viavisolutions.com

For the latest TAC information, go to:

https://www.viavisolutions.com/en-us/services-and-support/support/technical-assistance.

Conventions

Symbols and Markings

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

Table 2 Symbols and Markings

▷	**NOTE** 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.

Safety Definitions

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

Table 3 Safety Definitions

Term	Definition
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

CX300 NXDN option Overview

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

> **NOTE**
>
> Testing any transmitter function from a base station requires the use of a 40 dB 150 Watt high power attenuator.

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 a succinct overview of the unit, and to the CX300 Operation Manual for additional details.

The CX300 Next Generation Digital Narrowband (NXDN) software option provides various features for testing NXDN radio systems.

1.2   NXDN and NXDN Standard

The CX300 NXDN Test System is an optional test system developed by VIAVI to support the testing of digital two-way radio systems. The NXDN Test System has been developed according to technical specifications outlined in the NXDN Technical Specifications Part 1, Sub-Part A, B, C and D, V1.2.

1.3   CX300 NXDN Option Features and Capabilities

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

- Ability to lock/unlock paired generator and receiver frequencies
- Ability to receive, demodulate and analyze NXDN modulated signals
- Ability to perform RF and modulation parametric tests on the Unit Under Test (UUT)
- Ability to select NXDN or Analog Protocols
- Distribution, Constellation and Eye Diagram graph plots
- Variety of UUT measurements including Bit Error Rate, Signal Power, Slot Power Frequency Error, Symbol Clock Error, Symbol Deviation and FSK Error
- Power Profile Over Time, Profile Full and Profile Ramps Display Tiles
- Spectrum Analyzer, Channel Analyzer and Oscilloscope available within the NXDN Test System

1.4   Verifying NXDN Option Installation

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

1.4.1   Factory Installed Option

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

1.4.2 Post Production Option

When a NXDN 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.
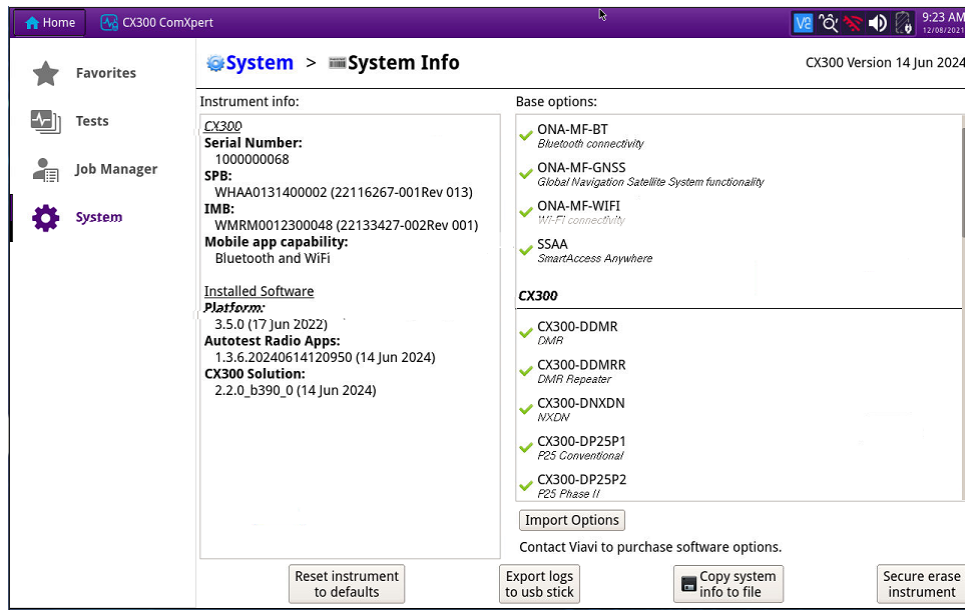
Figure 1-1 System Info Screen

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.
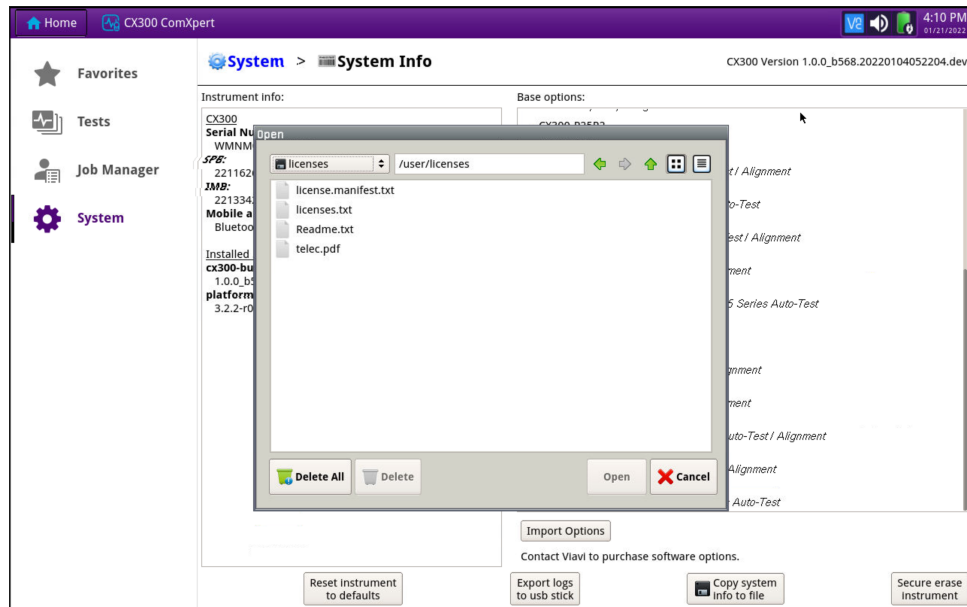
Figure 1-2 Import Options Selected

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.

1.5   NXDN Test Modes

NXDN provides several test modes for the purpose of evaluating the transmit and receive performance of a NXDN 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:

*   Radio Test Mode
*   Auto Test Mode

1.5.1   Radio Test Mode

Radio Test mode supports full duplex, Transmit, and Receive capabilities, providing simultaneous access to RF Generator and RF Receiver functions. Radio test mode is typically used for manual testing of subscriber or infrastructure equipment.

1.5.2   AutoTest Mode

AutoTest Mode used to automatically test a large library of OEM radios to OEM specifications. This feature provides test reports to document the results and automated alignment to keep radio operation optimal.

1.6   Accessing NXDN 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** (Receive Test, Transmit Test or Duplex Test).

3.   Select **NXDN** from the **Measure Pane**.

4.   Perform one of the following to load NXDN:

   •   Press the **NXDN** button again.

   •   Select the **Done Button**.

1.7   NXDN User Interface Layout

The NXDN User Interface (UI) uses the same layout, methods of navigation, and control used in the CX300 Analog 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.

2

NXDN Test and Measurement Functions

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

> **NOTE**
>
> Testing any transmitter function from a base station requires the use of a 40 dB 150 Watt high power attenuator.

2.1   NXDN Generate and Receive Functions

The CX300 provides the user with an RF Generator that provides a signal source of known parameters and control settings menu.

> **NOTE**
>
> The availability of generate and receive functions is based on the selected test mode of operation. See "NXDN Test Modes", section 1.5, on page 1 - 5.

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   NXDN Modulation Controls and Settings

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

Table 2-1 NXDN Modulation Controls and Settings

Control/Setting	Description
Mod Type	This setting selects the type of modulation applied to the outgoing signal. Selections vary according to the NXDN options available on the test set.
Pattern	This setting selects the data or voice pattern to be generated by the test set. Pattern types include standard and non-standard NXDN patterns. Available pattern types are depend on the type of **Protocol** selected and the options installed in the test set. NXDN has been developed according to technical specific actions outlined in ETSI TS 102 361- 1, V1.4.1.
Color Code	Field displays the Color Code the Test Set receives from the UUT.

Table 2-1 NXDN Modulation Controls and Settings (Continued)

Control/Setting	Description
Call ID	Field displays the Call ID the Test Set receives from the UUT.
Slot	The Slot Power Meters indicate measurements for Slot 1 and Slot 2 of the NXDN signal.
Priority	This setting defines the relative importance attributed to the signal.
Emergency	This is the status indicator which determines if this service is to be specially processed as an emergency service. • **0** = Non-emergency - indicates the normal processing status. • **1** = Emergency - indicates special processing required
Radio ID	User Selectable
All Call	User Selectable
NOTE:	The Call ID is user selectable UNLESS the user selects "All Call" which sets the field to 16777215
Mode	DIRECT (for Portables and Mobiles), SYNC Mode is selected for Repeaters only

2.1.3 Analog Modulation Controls and Settings

The CX300 contains three internal modulation generators and an external modulation source. Analog modulation controls and settings are configured from the **Analog 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 of Analog 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 NXDN Meters

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

2.2.1 Meter Controls and Settings

NXDN supports a variety of analog and NXDN meters. The controls and settings described in this section are found throughout various analog and NXDN 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   NXDN Demod Controls and Settings

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

NXDN demodulation controls and settings are configured from the **NXDN 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 2-4 for a description of the controls and settings that are available for NXDN Demod Meters. NXDN Demod Meters also contain the following demodulation controls and setting:

Table 2-2 Screen Name Controls and Settings

Control/Setting	Description
Demod Type (FM, NXDN)	This setting selects the type of modulation to the incoming signal. Selections vary according to the NXDN options available on the test set.
Demod Audio Filter	The NXDN supports the following filters:
	• HP: A high-pass filter (HP) passes signals with a frequency higher than a selected cutoff frequency.
	• LP: A low-pass filter (LP) passes signals with a frequency lower than a selected cutoff frequency.
	NOTE:
	• The NXDN test pattern defines the reference used for the TX BIT Error Rate measurement.
	• Bit Error Rate (BER) is a measure of the number of bit errors that occur in a given number of bit transmissions.
Pattern	This setting selects the NXDN test pattern of the receive signal.

2.2.4   Analog Demod Meter

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

Analog demodulation controls and settings are configured from the **Analog 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 Analog Demod meters, controls, and settings.

2.2.5   RF Error Meter

The **RF Error Meter** indicates the difference (frequency error) between the received RF signal and the defined receive frequency. **RF Error Meter** controls and settings are configured from the **RF 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 2-4 for a description of the controls and settings supported for the **RF Error 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 2-4.

2.2.7   FSK Error Meter

The FSK Error Meter measures rms deviation error at the symbol deviation points of the signal. FSK Error is measured over 60 ms and is expressed as the percentage of the deviation. FSK Error should not exceed 5%. Outbound traffic (signal generated by BR) contains 144 symbols at 4800 symbols per second; inbound traffic (signal generated by mobile) contains 288 symbols at 9600 symbols per second.

Figure 2-1 FSK Error

2.2.8   Symbol Deviation Meter

The Symbol Deviation Meter measures the deviation of the NXDN signal at symbol time, normalized to the 1050 Hz symbol point when receive rate is 4800 symbols per second; 2400 Hz symbol point when receive rate is 9600 symbols per second. Symbol Deviation is measured over 60 ms. Outbound traffic (signal generated by BR) contains 144 symbols at 4800 symbols per second; inbound traffic (signal generated by mobile) contains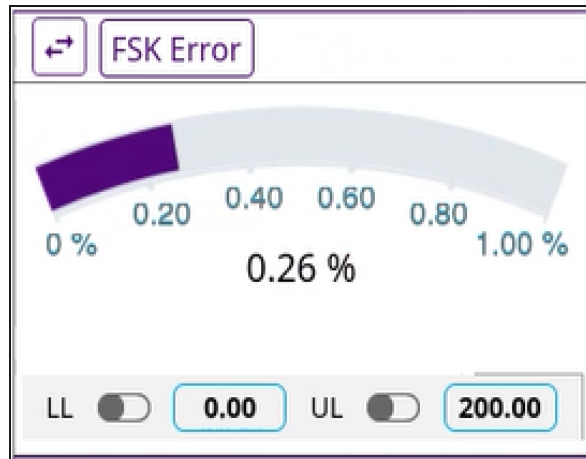 288 symbols at 9600 symbols per second. Symbol deviation measurements should be >945 and <1155 for rate of 4800 symbols per second and >2160 and <2640 for rate of 9600 symbols per second.
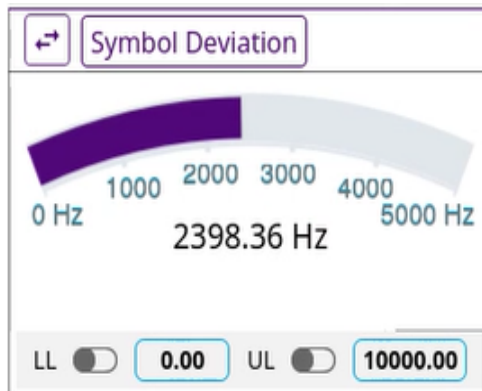
Figure 2-2 Symbol Deviation Meter

2.2.9   Symbol Clock Error Meter

The **Symbol Clock Error Meter** measures the 4800 baud symbol clock of the incoming NXDN signal. Symbol clock error measurements should not exceed ± 48 mHz per *ETSI TS 102 361 Specification*.

Symbol Clock Error Meter controls and settings are configured from the **Symbol Clock 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 2-4 for a description of the controls and settings supported for the **Symbol Clock Error Meter**.

2.2.10 Bit Error Rate Meter

Bit Error Rate (BER) is a measure of the number of bit errors that occur in a given number of bit transmissions. BER measurements are essential to diagnosing NXDN system coverage problems and avoiding critical loss of communications.

The NXDN BER Meter evaluates a radios transmit BER performance by comparing incoming NXDN symbol data to a standard pattern to determine errors in signal processing. Supported patterns are defined in accordance with the TIA-CAAA Specification.

See section 2.2.1, "Meter Controls and Settings", on page 2-4 for a description of the controls and settings supported for the Bit Error Rate Meter.

> **NOTE**
>
> BER is calculated over the entire data packet, not just the voice data. Use Standard NXDN Patterns for accurate BER measurements.

2.2.11 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 FSK Error results.

2.2.12 Constellation Plot

The **Constellation Plot** shows a graph of the measured deviation for each of the symbols. The plot contains four circles that indicate the ideal location for each of the measured deviations. These circles identify the location (from left to right) for deviation:

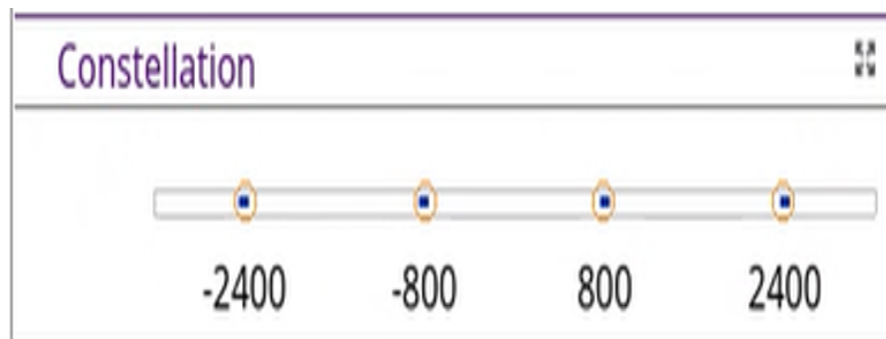*   -1944 Hz
*   -648 Hz
*   +648 Hz
*   +1944 Hz

Figure 2-3 Example of Constellation Plot

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. The circle should be interpreted as the not a pass fail indication of the FSK Error.

2.2.13 Distribution Plot

The **Distribution Plot** shows not only the deviation of each of the symbols, but also the relative number of occurrences of each of the deviations. The **Distribution Plot** shows a wide range of parameters associated with Magnitude Error. The horizontal axis is the frequency deviation of the signal at symbol time and the vertical axis shows the number of times the deviation occurred. The vertical dotted lines indicate the ideal deviation points (from left to right) of:
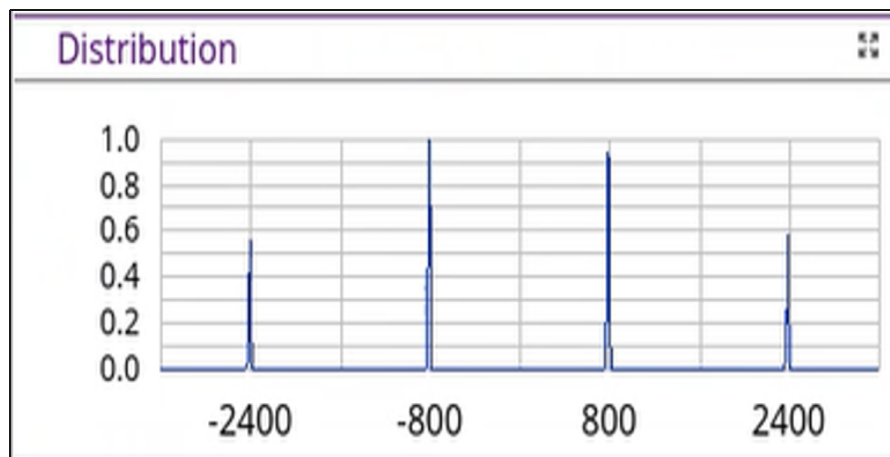
- -1944
- -648
- +648
- +1944

Figure 2-4 Example Distribution Plot

A perfect signal would be represented by a single line superimposed on top of each of the dashed lines. If the distribution plot is shifted wider than the location of the dashed lines, the plot indicates a symbol deviation greater than 1800 Hz. Conversely, a plot that is narrower than the dashed lines would indicate a symbol deviation less than 1800 Hz.

2.2.14 Eye Diagram

The **Eye Diagram** shows a graph of the demodulated signal at all points. The symbol deviation versus time. The horizontal scale represents time, the vertical scale indicates the deviation. The four horizontal dashed lines represent the deviations at the symbol points and are deviations of (from bottom to top):
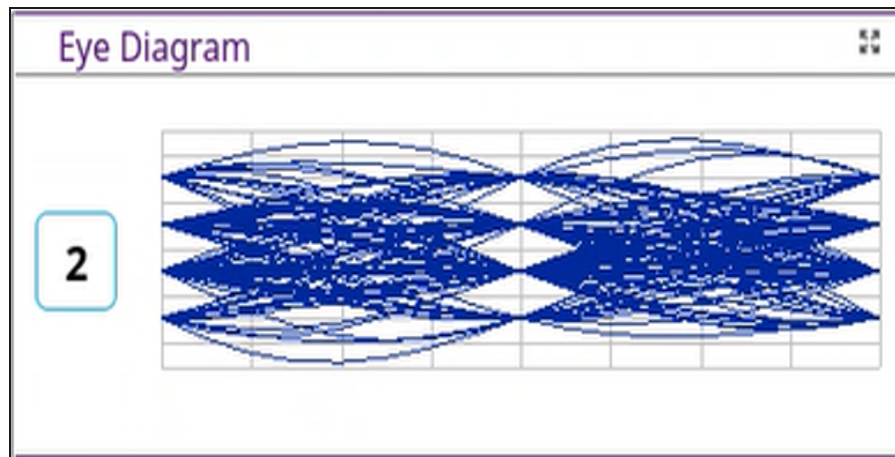
- -1944 Hz
- -648 Hz
- +648 Hz
- +1944 Hz

Figure 2-5 Example Eye Diagram

The center vertical dashed line and the start and stop of the graph are the locations at which the graph intersects a symbol point. An ideal NXDN signal presents as the lines crossing through the point at which the vertical and horizontal dashed lines intersect. As Magnitude Error becomes larger, or symbol deviation becomes wider or narrower, the plot of the symbol deviation passes below and/or above the dashed lines.

Table 2-3 Eye Diagram Controls and Settings

Control/Setting	Description
Symbol Count Button	The Symbol Count button selects the number of symbols

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.

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3

NXDN Measurements

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

> **NOTE**
>
> Testing any transmitter function from a base station requires the use of a 40 dB 150 Watt high power attenuator.

3.1 Testing NXDN Phase 1 Transceiver

3.1.1 NXDN Transceiver Test Description

The following instructions guide the user through an objective NXDN Transmitter Test and a subjective NXDN 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 NXDN 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 NXDN 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 NXDN.

    e. Set the RF Generator Level to -80 dBm.

6. Set the **NXDN Mod menu**.

    a. Set the Pattern to 1031.

    b. Set the NAC to match the UUT Receive NAC.

    c. Set the TGID to match the TGID or the UUT Receiver.

7. Set the **NXDN Demod 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 RF Receiver Demodulation Type to NXDN.

    d. Set the AGC Mode to **AUTO**.

8. Set the **NXDN Demod menu**.

    a. Set the NXDN Demond BER Pattern to Framesync.

9. Select the Signal Power meter on the **Meter tile.**

10. Select NXDN Measurements on the **Meter/Data tile.**

3.1.5 Testing NXDN Transmitter

1. Key the UUT Transmitter.

2. Record and compare the NXDN Measurements to Table 3-1.

3. Un-key the UUT Transmitter.

4. If no further testing required, proceed to next step. If not proceed to Testing the NXDN Transmitter.

5. Disconnect and power **OFF** the UUT.

Table 3-1 Testing NXDN (2400 Hz Transceiver)

Measurement	Lower Limit	Target	Upper Limit
RF Frequency Error (ppm)	0	(Radio Specific)	1
Symbol Clock Error (ppm)	-10 (ppm)	0	10 (ppm)
FSK Error (%)	NA	0	5(%)
Symbol Deviation (Hz)	2160	2400	2640
(Signal Power)	NA	(Radio Specific)	NA
BER (%)	NA	0	3

3.1.6 Testing NXDN 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 NXDN Receiver. A more formal test is described in .

4. If no further testing is to be conducted, disconnect and power **OFF** the UUT.

3.2 NXDN Receiver Sensitivity Test

3.2.1 NXDN Receiver Sensitivity Description

Receiver sensitivity is a determination of the level of the signal that produces the standard bit error rate (BER) in the receiver. The ETSI standard specifies the standard bit error rate to be 5%. This measurement is performed by generating the standard test pattern and then reducing the level of the RF signal until the number of bit errors in the receiver, as a percentage of the total number of bits transmitted, is 5%.

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)

> **NOTE**
>
> BER may be measured in different manners depending on the radio manufacturer. Most radios have a built-in BER measurement that takes the detected bit stream from the received signal and compares it with the standard test pattern. This measurement may be displayed on the radio or in the UUT OEM tuner or programming software. Other radios have a bit detector output and an external BER detector measures the bit error rate.
>
> If necessary, switch the receiver under test to test mode to perform a bit error rate test.

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 NXDN 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 **NXDN Mod menu.**

   a. Set the pattern to the standard test pattern prescribed by the UUT OEM for testing NXDN Receiver Sensitivity / RX BER.

3.2.5   Performing the NXDN Receiver Sensitivity Test

1. Select the **RF Generator menu**.

   a. Set the UUT OEM for testing NXDN Receiver Sensitivity / RX BER.

2. Adjust the RF Generator output level until the UUT control software Rx BER meter displays 5%, or in test scenarios where the radio calculates and report its own Rx BER, until the UUT reports a BER of 5%.

3. Record the RF Generator output level.

4. If no further testing is to be conducted, disconnect and power Off the UUT.

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   **NXDN —** Digital Mobile Radio (NXDN) Test System

dBm — decibel milliwatts

DES — Data Encryption Standard

DEST ID — Destination Identifier

DUT — Device Under Test

E - L   **ETSI —** European Telecommunications Standards Institute

FM — Frequency Modulation

FFT — Fast Fourier Transform

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

O - S   **OEM —** original equipment manufacturer

RF — Radio Frequency

PMR — professional mobile radio or private mobile radio

RMS — Root Mean Square

SCCB — Secondary Control Channel Broadcast

Sym Dev — Symbol Deviation

U - Z   **TGID —** Talk Group Identifier

UI — User Interface

USB — Universal Serial Bus

UUT — Unit Under Test

WACN — Wide Area Communications Network

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NXDN Option Guide

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