



**MOTOROLA**

TEST EQUIPMENT

**R-2670 FDMA Digital  
R2625 ASTRO 25  
Communications System Analyzer  
ASTRO 25 Trunking Option**

**OPERATOR'S MANUAL**

**Motorola Test Equipment Products**

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Project 25 is the creation of the Association of Public Safety Communications Officials (APCO). Project 25 brings together representatives of federal, state, and local government agencies. These agencies and other user organizations evaluate basic technologies in advanced land mobile radio to find solutions that best serve the needs of the public safety marketplace. The committee has encouraged participation by many international public safety organizations. The National Association of State Telecommunications Directors (NASTD), National Communications Systems (NCS), National Telecommunications & Information Agency (NTIA) and the Department of Defense (DOD) are all actively involved in the development of these user-driven standards.

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## Section I

### INTRODUCTION

#### 1-1 INTRODUCTION

This manual contains information for using the R-2670 FDMA Digital Communications System Analyzer with the ASTRO 25 Trunking Option and the R2625 ASTRO 25 Communications System Analyzer with the ASTRO 25 Trunking Option. The analyzer provides unique testing features for Project 25 trunking based communications equipment. All R-2600 series capabilities are retained with the Astro 25 trunking tests accessed via the LCD display, numeric keypad, screened defined softkeys, cursor movement keys and the optical tuning knob.

#### 1-2 CAPABILITIES

The ASTRO 25 Trunking Option is capable of generating and receiving a Project 25 signal. An ASTRO 25 signal relates to the Association of Public-Safety Communications Officials International (APCO) Project 25 digital standard Common Air Interface (CAI) signaling scheme in which a serial bit stream is encoded, mapped into one of four corresponding amplitudes, filtered digitally, and then modulated onto an RF carrier.

The ASTRO 25 Trunking Option simulates the functions of a Project 25 central controller by providing control channel and voice channel protocols to perform various tests. Features incorporated in this option include:

##### **Registration/Call Alert**

Registration/Call Alert tests the radio's ability to acquire and interpret the control channel being transmitted by the R-2670 or R2625. ID parameters are entered in the R-2670 or R2625 to match the radio's configuration. Successful registration verifies the radio's receiver as well as the configuration.

##### **Dispatch Voice**

Dispatch voice capability allows the user to verify the radio's transition from the control channel to the voice channel. In addition, receive and transmit voice capability can be verified.

##### **Call State Update**

Call sequence status is displayed in the form of a thermometer with numbers 1 through 12 representing the various call states. A textual message is also displayed below the thermometer to give an indication of call status.

##### **Baseband Audio Scope Display**

The display provides a clear graphic image of the audio baseband signal. The baseband signal is selectable at either the vocoder input in generate mode or the vocoder output in monitor mode.

#### 1-3 ABOUT THIS MANUAL

Section II, Operating Instructions, describe the various screens (displays) related to a Project 25 trunking test, and the cursor locations and fields within those screens. The operator is given instructions on setting up the screens for various tests, in order to become familiar with the inputs, outputs, and selections.

Section III, Applications, describe step by step instructions for the various tests supported by the analyzer.

Appendix A lists error and warning messages that may be encountered while performing tests.

## 2-4 ASTRO 25 TRUNK MODE

Select the ASTRO 25 TRUNK mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Use the **ASTRO 25 TRK** softkey to select the ASTRO mode. A screen similar to Figure 2.4 appears.

When the display zone "Mode:" is set to ASTRO 25 TRK, the R-2670 or R2625 will configure itself to generate and monitor Project 25 trunking signals.

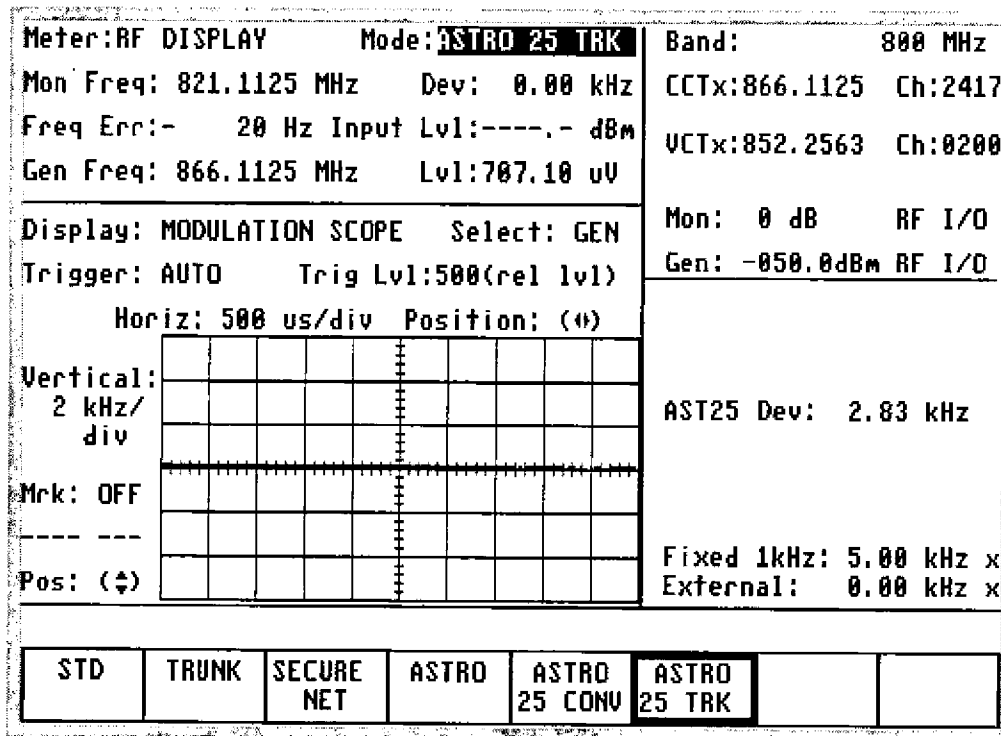


Figure 2-4 Astro 25 Mode Screen

Upon selection of the ASTRO 25 Trunk mode, specific tests are accessed by pressing the **more** softkey in the "Meter" field. Two softkey selections are available in this field: **REG/CAL ALERT** (registration call alert) and **DISPTCH VOICE** (dispatch voice). See Figure 2-5. A description of each of the tests as well as the screens associated with the tests is included in the following sections.

### 2-4.1 Registration Call Alert

This test verifies that the radio under test is capable of registering and receiving a call alert from the R-2670 or R2625 that is simulating fixed site base station.

### 2-4.2 Dispatch Voice

This test verifies control channel to voice channel transitions as well as transmit and receive voice capabilities.

Softkey selection of the test is available once the ASTRO 25 Trunk mode has been entered. See Figure 2-5. In order to execute a test, various parameters specific to the radio under test must be entered. A screen description, including parameter definitions is contained in Section 2-4.

Meter: <b>REG/CALL ALERT</b> Mode: ASTRO 25 TRK		Band: 800 MHz
MACN ID: 00001 H	SYSTEM ID: 001 H	CCTx: 866.1125 Ch: 2417
WUID: 000001 H	WGID: 0001 H	UCTx: 863.5063 Ch: 2000
RFSS ID: 01 H	SITE ID: 01 H	Mon: 0 dB RF I/O
Seq:		Gen: -050.0dBm RF I/O
Status: -----		
MACN ID: ----- H	SYSTEM ID: --- H	
UID: ----- H	GID: ---- H	
WUID: ----- H	WGID: ---- H	AST25 Dev: 2.83 kHz
		Fixed 1kHz: 0.00 kHz x
		External: 0.00 kHz x
<b>REG/CAL ALERT</b>	<b>DISPTCH VOICE</b>	
		start test
		more

Figure 2-5 Registration Call Alert Meter Selection

### 2-4.3 Astro 25 Trunking Screens

Upon selection of REG/CAL ALERT or DISPATCH VOICE, the screen zones defined in Section 2-3 will display parameters associated with Project 25 trunking. Parameters associated with REG/CAL ALERT and DISPTCH VOICE are identical, therefore the screens look identical until the **start test** softkey is pressed. Upon test initiation, the screens differ for each test only in the call sequence diagram and message prompts. The following sections define the Project 25 parameters associated with each display zone

#### 2-4.3.1 Display Zone

The display zone consists of two main sections User Input Parameter Section and the Result Section. The User Input Section consists of various Ids that must be entered by the user. These Ids match the Ids contained within the radio so that a communication link can be established between the R-2670 or R2625 and the radio. The result section consists of parameters received from the radio under test. Some of the parameter definitions are identical to those in the Input Parameter Section.

The User Input section of the display zone consists of various parameters that must be entered by the user. These parameters must match the configuration set in radio codeplug. The radio codeplug is read using Radio Service Software (RSS). The parameters are defined below.

WACN ID – Wide Area Communication Network ID

SYSTEM ID – System ID

WUID – Working Unit IDentity

WGID – Working Group IDentity

RFSS ID – RF Sub-System ID

SITE ID – Site ID

The middle of the display zone contains a field named SEQ. This area of the display,

which correspond to a frequency range of 851.0063 to 876.5938 MHz respectively.

also known as a thermometer will update the user as to the state of the call sequence. Refer to Appendix A for a description of the status thermometer signaling events for each test sequence.

The bottom portion of the display zone contains those parameters received from the radio under test. The parameters received from the radio are defined below.

WACN ID – Wide Area Communication Network ID

SYSTEM ID – System ID

WUID – Working Unit ID

WGID Working Group ID

UID

GID

#### 2-4.3.2 RF Zone

This zone contains general RF information specifically related to the Astro 25 trunk mode of operation. Channel selection for both the control channel and the voice channel is made in this zone. The RF zone provides for user selection of the channels and frequencies. A description of each of the fields contained within the RF Zone is included below.

Band – This entry allows the user to select the RF Band for a particular test.

CCTx –Control Channel Generate Frequency

This parameter allows the user to enter the control channel frequency in MHz.

Ch Control Channel Number

This parameter allows the user to enter the control channel number. The 800 MHz band allows for channel numbers 0 to 4095

VCTx – Voice Channel Generate Frequency



This parameter allows the user to enter the voice channel generate frequency in MHz.

#### Ch Voice Channel Number

This parameter allows the user to enter the voice channel number. The 800 MHz band allows for channels 0 to 4095 which correspond to a frequency range of 851.0063 to 876.5938 respectively.

#### Mon

This field allows the user to select the attenuation and port for the received signal. Attenuation is softkey selectable and can be set to 0, 20, or 40dB. The port is softkey selectable to RF I/O or ANT.

#### Gen

This field allows output level setting and generate port selection. The output level can be entered using the keypad or the tuning knob. The port is softkey selectable to Gen Out or ANT. The output level varies based on the generate port selection as follows:

Gen out 0 - -80dB

RF/IO -50 – 130dB

### 2-4.3.3 Audio Zone

This zone contains baseband audio controls and level setting.

AST25 Dev – This field allows the user to set the Astro 25 generate signal deviation. The deviation range is 0 – 5kHz.

Fixed 1kHz – This field allows a fixed 1KHz to be enabled and the amount of modulation, measured in kHz deviation, to be adjusted.

External – This field allows an external input to be enabled and the amount of modulation, measured in kHz deviation, to be adjusted. The external input selection includes both the BNC labeled: EXT MOD IN and the MIC (microphone input).

## 2-5 TEST SETUP

### Connecting a Radio

Use a 50 ohm BNC cable and an N to BNC adapter to connect from the RF I/O port of the R-2670 or R2625 analyzer to the antenna port of the radio as shown in Figure 2-6.

### CAUTION

*When in Monitor mode, adjust the squelch to where the LED indicator for squelch just turns off or is closed. When the signal from the radio is present, the squelch LED will illuminate indicating that squelch has been detected and there is a signal present.* CAUTION

*Observe the input power ratings and warnings of the analyzer to insure that no damage occurs to the analyzer.*

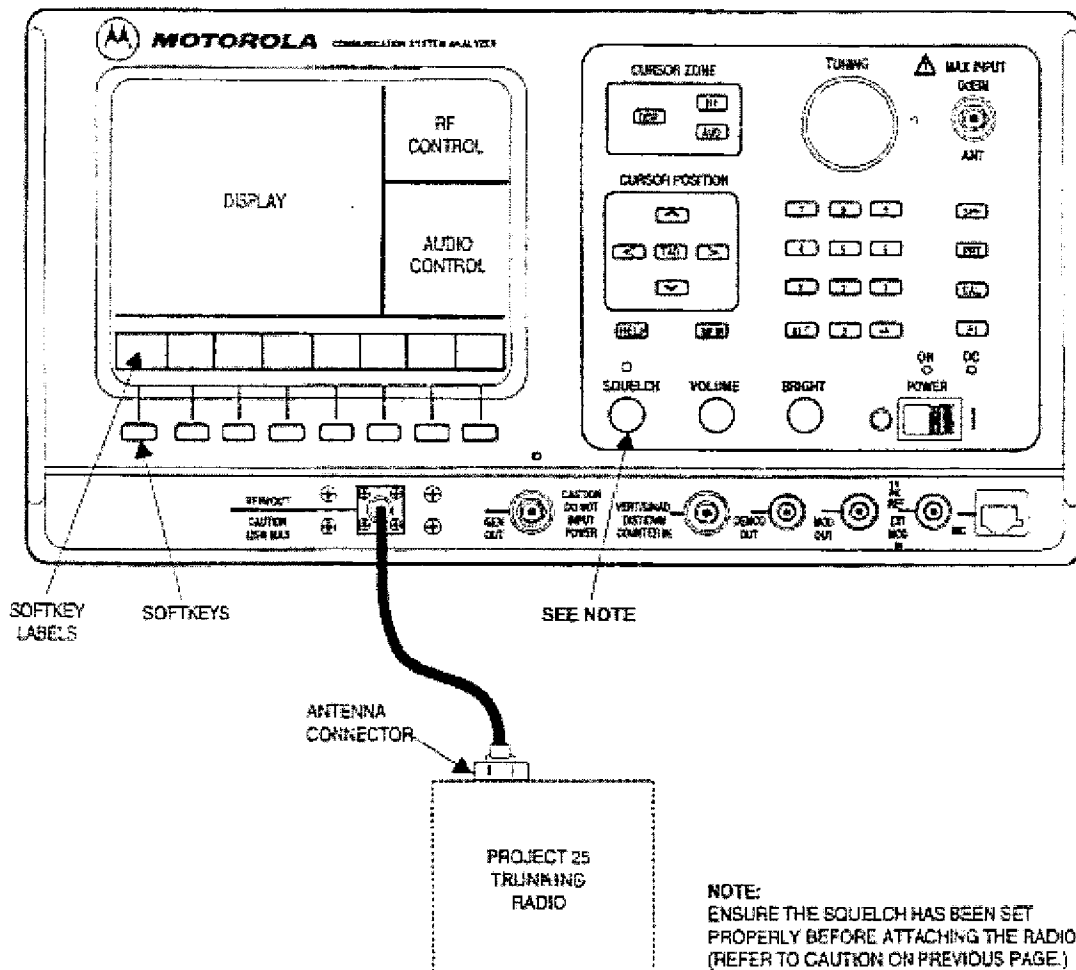


Figure 2-6. Test Setup

## Section III

# APPLICATIONS

### 3-1 PROJECT 25 TRUNK RADIO TESTING

This section of the manual contains information on testing of Project 25 trunked radio using the R-2670 FDMA Digital Communications System Analyzer or R2625 with the Astro 25 Trunk option. Two types of tests are defined: Registration/Call Alert and Dispatch Voice.

#### 3-1.1 Registration/Call Alert

Select the **ASTRO 25 TRUNK** mode by placing the cursor in the "Mode" field in the Display Zone located at the top of the screen. Use the **ASTRO 25 TRK** softkey to select the mode.

Move the cursor to the "Meter" field by pressing the **TAB** key. Press the **REG/CAL ALERT** softkey to select the Registration Call Alert test.

Enter the parameters listed below. If the parameters are not known, the radio codeplug must be read using Radio Service Software (RSS). Note that WACN ID and SYSTEM ID are required for communication with the radio under test. The remaining parameters are optional unless the radio has been configured for specific modes of operation.

WACN ID

SYSTEM ID

WUID

WGID

RFSS ID

SITE ID

Press the **RF** Cursor Zone hardkey to move to the RF zone. Press the **800 MHz** softkey to select the 800 MHz band. Move the cursor to the "CCTx

field and enter either the control channel transmit frequency or the channel number.

Set the monitor attenuation and port selection. Suggested port selection is RF I/O with 20 dB attenuation.

Set the generator attenuation and port selection. Suggested port selection is RF I/O with -50 dB for the level setting.

Press the **AUD** Cursor Zone hardkey to move the Audio zone.

Set the **ASTRO 25** deviation. The default and suggested deviation is 2.83 kHz.

Connect the radio under test to the RF I/O port as shown in Figure 2-6.

Press the **DISP** Cursor Zone hardkey to move to the Display zone. Move the cursor to the "Meter" field and press the **start test** softkey to begin the test.

Observe the user prompts displayed above the row of softkeys. Turn radio on as directed by the prompt.

Follow the call sequence by looking at the sequence thermometer in the middle of the screen. The status below the sequence thermometer gives a textual description of the Call State. For a description of all call states, refer to Appendix A.

If the call is successful, the thermometer will reach 8 and the test is completed. The bottom portion of the Display Zone will exhibit those parameters received from the radio.

#### 3-1.2 Dispatch Voice

Select the **ASTRO 25 TRUNK** mode by placing the cursor in the "Mode" field in the Display Zone located

at the top of the screen. Press the **ASTRO 25 TRK** softkey to select the mode.

Move the cursor to the “Meter” field by pressing the **TAB** key. Press the **DISPTCH VOICE** softkey to select the Dispatch Voice test.

Enter the parameters listed below. If the parameters are not known, the radio codeplug must be read using Radio Service Software (RSS). Note that WACN ID and SYSTEM ID are required for communication with the radio under test. The remaining parameters are optional unless the radio has been configured for specific modes of operation.

WACN ID

SYSTEM ID

WUID

WGID

RFSS ID

SITE ID

Press the **RF** Cursor Zone hardkey to move to the RF zone. Press the **800 MHz** softkey to select the 800 MHz band. Move the cursor to the “CCTx” field and enter either the control channel transmit frequency or the channel number. Move the cursor to the “VCTx” field and enter either the voice channel transmit frequency or the channel number

Set the monitor attenuation and port selection. Suggested port selection is RF I/O with 20 dB attenuation.

Set the generator attenuation and port selection. Suggested port selection is RF I/O with –50 dB for the level setting.

Connect the radio under test to the RF I/O port as shown in Figure 2-6.

Press the **AUD** Cursor Zone hardkey to move the Audio zone.

Set the ASTRO 25 deviation. The default and suggested deviation is 2.83 kHz.

Move the cursor to the “external” field. Set the deviation. Press the **TAB** key to move to

the switch selection. Press the **CONT** softkey to turn on the external port (microphone).

Press the **DISP** Cursor Zone hardkey to move to the Display zone. Move the cursor to the “Meter” field and press the **start test** softkey to begin the test.

Observe the user prompts displayed above the row of softkeys. Turn radio on as directed by the prompt. Perform actions specified by user prompts throughout the remainder of the test.

Follow the call sequence by looking at the sequence thermometer in the middle of the screen. The status below the sequence thermometer gives a textual description of the Call State. For a description of all call states, refer to Appendix A.

Upon completion of the test, the sequence thermometer will reach 11. Press the **stop test** softkey to complete the test (state 12). The bottom portion of the Display Zone will exhibit those parameters received from the radio.

## APPENDIX A

### Sequence Descriptions

#### Test Sequence Code Description for Registration/Call Alert Test

Code	Call Status
1	Idle Control Channel
2	Registration Request Received
3	Registration Response Sent
4	Grp. Affiliation. Request Received
5	Grp. Affiliation. Response Transmitted
6	Call Alert Request Transmitted
7	Call Alert Response Received
8	Test Complete

#### Test Sequence Code Description for Dispatch Voice Test

Code	Call Status
1	Idle Control Channel
2	Registration Request Received
3	Registration Response Sent
4	Grp. Aff. Request Received
5	Grp. Aff. Response Transmitted
6	Group Voice Request Received
7	Group Voice Channel Grant Sent
8	Receive Voice Data
9	Transmit Voice Mic Off
10	Transmit Voice Mic On
11	Transmit Voice Mic Off (On)
12	Test Complete
13	

#### Registration Call Alert/Dispatch Voice Error Messages

Error
Test Terminated by User
Timeout – Test Halted

## APPENDIX B

### 800MHZ Band Details

Channel Type	Frequency Range	Channel Number	Frequency Offset
Control Channel/Voice Channel	851.0063 – 876.6000	0 - 4095	45 MHz