



3900 Series Digital Radio Test Set P25 Option Manual

Issue-8

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3900 Series

Digital Radio Test Set

P25 Option Manual

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Preface

Scope

This manual contains information on how to use the 3900 P25 Option (390XOPT200). This manual is provided as an addition to the 3900 Series Operation Manual. Refer to the 3900 Series Operation Manual for information regarding functions and basic operation of the 3900 Radio Test Set.

Nomenclature Statement

The 3901, 3902 and 3920 Digital Radio Test Set is the official nomenclature for the test sets currently included in the 3900 Digital Radio Test Set Series. In this manual, 3900, unit or Test Set, refers to the 3901, 3902 and 3920 Digital Radio Test Sets unless otherwise indicated.

Intended Audience

This manual is intended for users familiar with P25 Systems and with the operation of the 3900.

Test Set Requirements

Refer to the 3900 Series Operation Manual for information on the following:

- Safety Precautions
- Power Requirements
- Platform Performance Data Specifications
- Repacking/Shipping Test Set

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Contents

Preface

Chapter 1 Introduction to P25 Options

Lists the capabilities of the 3900 P25 Option.

Chapter 2 P25 Base Software Option

Contains functional descriptions of the 3900 P25 Option.

Chapter 3 P25 Trunking Option

Contains functional description of the 3900 P25 Trunking Option.

Chapter 4 Miscellaneous P25 Options

Lists other available P25 Software Options.

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Chapter 1

Introduction to P25 Options

Functions and Capabilities

The 3900 Series P25 Options provide various features for testing P25 radios systems. The 3900 Series currently supports the following P25 test capabilities:

P25 Option 390XOPT200

P25 Option provides the following test features:

- P25 Base Radio simulation;
- Ability to lock/unlock paired generator and receiver frequencies;
- Ability to configure independent generator and receiver protocol;
- Internal AF Generators for audio modulation;
- Data Link Tile displays data from inbound voice packets;
- Ability to transmit P25 C4FM modulation waveforms;
- Ability to receive, demodulate and analyze P25 modulated signals;
- Ability to select Phase 1 or Analog Protocols;
- Ability to perform RF and modulation parametric tests on the Unit Under Test (UUT).
- Provides features for use of DES encryption on Trunked P25 Voice Channels.

P25 Trunking Option 390XOPT201

The 3900 Series P25 Trunking Option provides all of the features found in option 390XOPT200 plus the following:

- P25 Trunked Base Radio simulation;
- System Plan configuration for defining system information and Channel Plan data;
- Two Channel selection capability;
- P25 700 MHz, 800 MHz, UHF and VHF frequency band support.

P25 LSM Option 390XOPT204

The 3900 Series P25 LSM Option provides all of the features found in option 390XOPT200 plus the following:

- Ability to transmit Motorola® LSM waveforms;
- Enables the EVM Meter and supporting remote commands;
- Enables the Trajectory Tile;
- Enables Frequency and IQ Constellation Tile selection.

SmartNet™ / SmartZone™ Option 390XOPT207

The 3900 Series SmartNet™ / SmartZone™ Option provides all of the features found in option 390XOPT200 plus the following:

- Ability to emulate a repeater station operation (not locked to a specific 'test sequence' for the radio);
- Ability to 'find' and monitor a SmartNet™ / SmartZone™ control channel and then 'follow' the channel, the group or the individual unit;
- Full analog (FM) parametric tests and digital P25 mode tests;
- Various 800 and 900 MHz frequency band and VHF/UHF frequency band selection;
- Channel designation and frequency settings for 800 and 900 MHz band.

KVL Loader Option 390XOPT209

The KVL Keyloader Option adds the ability to enter encryption keys into the 3900 for DES and AES. Encryption keys may be loaded manually using either the front panel, external keypad, or the P25 Key Fill Device (KFD) interface protocol.

P25 Explicit Mode UHF/VHF Option 390XOPT212

The 3900 Series P25 Explicit Mode UHF/VHF Option provides all of the features found in option 390XOPT200 plus the following:

- Enables all bands for P25 Explicit Mode of operation.

P25 AutoTest II Option 390XOPT218

The 3900 Series P25 AutoTest II Option provides an interface to the Test Set's Autotest System and remote command functionality.

P25 AES Encryption Option 390XOPT240

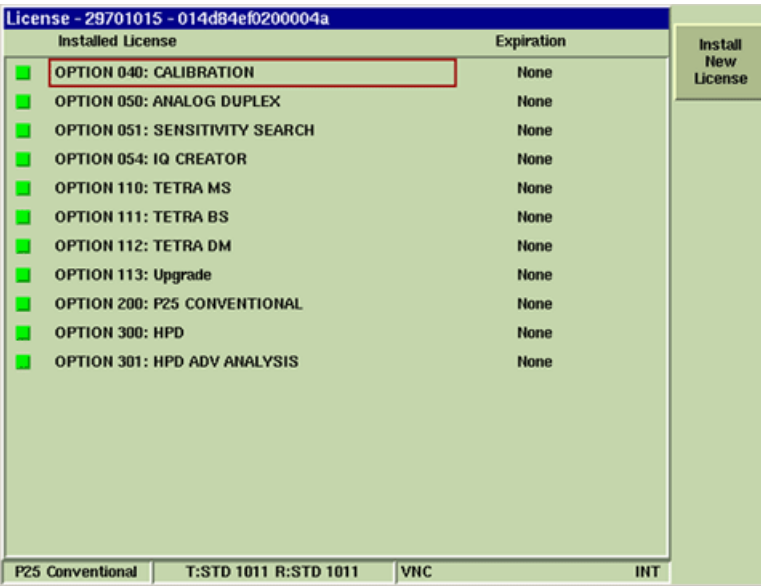
The P25 AES Encryption Option supports encoding and decoding of Advanced Encryption Standard data exchanged between P25 radios.

Verifying P25 Option Installation

To check the status of installed options while operating in Test Mode:

1. Push the UTILS Key twice to open Utility Menu.
2. Select Software Settings, License from the Utility menu.
3. The License Tile lists installed options, including the version and version date of each option (refer to example below).

The option list varies according to the features installed on the Test Set. P25 System is Option 200. If the option is not installed in the Test Set, refer to the 3900 Series Operation Manual for detailed information on installing a license file and performing software upgrades.



The screenshot shows a license tile window titled "License - 29701015 - 014d84ef0200004a". It contains a table with two columns: "Installed License" and "Expiration". The first row, "OPTION 040: CALIBRATION", is highlighted with a red box. To the right of the table is a button labeled "Install New License". At the bottom of the window, there are four status indicators: "P25 Conventional", "T:STD 1011 R:STD 1011", "VNC", and "INT".

Installed License	Expiration
OPTION 040: CALIBRATION	None
OPTION 050: ANALOG DUPLEX	None
OPTION 051: SENSITIVITY SEARCH	None
OPTION 054: IQ CREATOR	None
OPTION 110: TETRA MS	None
OPTION 111: TETRA BS	None
OPTION 112: TETRA DM	None
OPTION 113: Upgrade	None
OPTION 200: P25 CONVENTIONAL	None
OPTION 300: HPD	None
OPTION 301: HPD ADV ANALYSIS	None

Fig. 1-1 3900 License Tile

Installing P25 Option

Refer to the 3900 Series Operation Manual for instructions on installing options in the 3900.

Selecting P25

Refer to the 3900 Series Operation Manual for instructions on selecting test systems.

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Chapter 2

P25 Base Software Option

Introduction

The 3900 Series P25 Options provide users with the ability to test the operational capabilities of P25 Conventional and P25 Trunked radio systems. P25 Option 390XOPT200 is the basis from which all other P25 Test Options are developed and is referred to in this manual as the P25 Base Option. This option is required to operate all other P25 options.

This chapter provides an operational description of the P25 Base Option. Refer to Chapter 3, [P25 Trunking Option](#) and Chapter 4, [Miscellaneous P25 Options](#) for information on other P25 options.

Optional Fields

P25 display tiles contain some fields that are only available when specific P25 options are installed in the Test Set. Optional fields are described in other chapters in this manual.

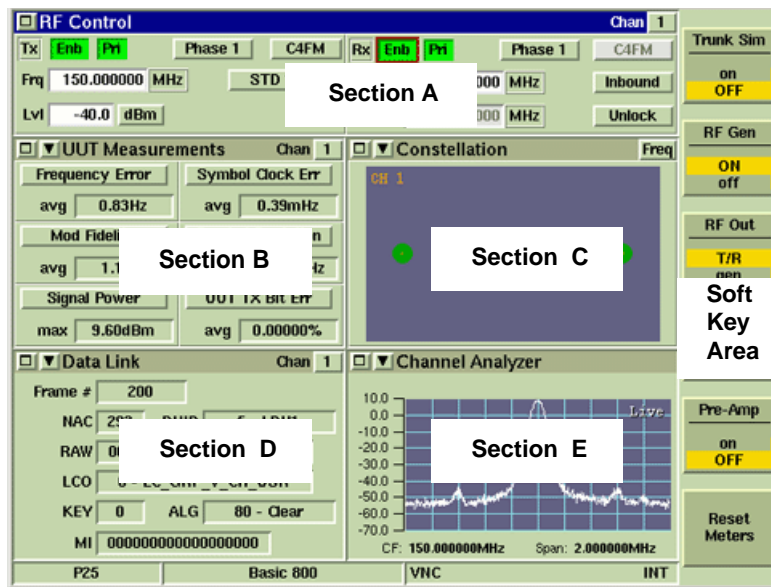


Fig. 2-1 P25 Display Layout

P25 System Tile Layout

The P25 User Screens can be configured for customized test requirements. Each section of the display is configured using the drop-down menu on the title bar of each tile.

- Section A of the P25 User Screen displays the RF Control Tile.
- Sections B through E of the P25 User Screen are configured using the drop-down menu on each tile.
- P25 includes access to the Channel Analyzer, Spectrum Analyzer and Oscilloscope. Use of the Channel Analyzer, Spectrum Analyzer and Oscilloscope are described in the 3900 Series Operation Manual.

Subject to Export Control, see Cover Page for details.

RF Control Tile

The RF Control Tile configures the Test Set for testing the physical layer of P25 radio systems and for testing P25 mobile radios operating in Conventional Mode. RF Control Tile fields must be configured according to the operating parameters of the Unit Under Test (UUT) to obtain valid test data.

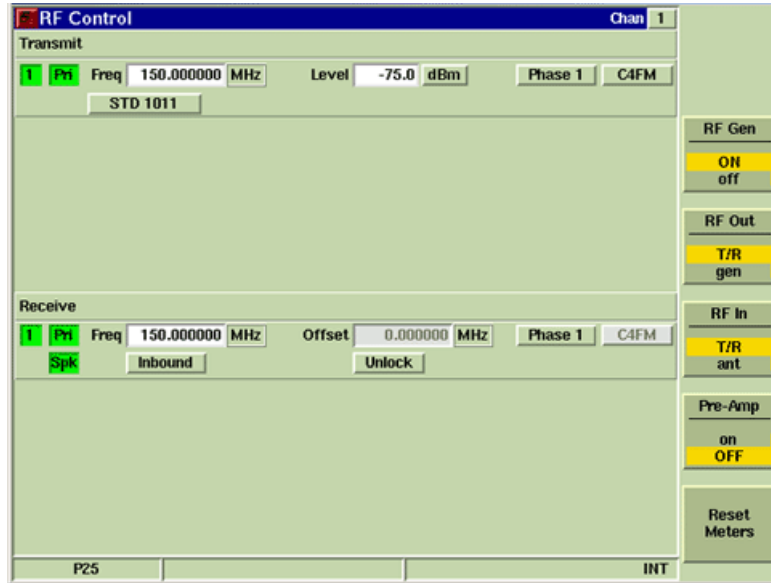


Fig. 2-2 P25 RF Control Tile

Transmit Field Definitions

1 / 2 Channel Toggle Buttons

Enables/disables the Channel to be used for the signal path.

Pri (Primary Channel)

Selects the channel as the primary frequency.

Freq (Frequency)

Defines carrier frequency of signal generated by the Test Set.

Level

Defines the output power level of Transmit signal.

Units (Level)

Selects the unit of measurement for Level readings.

Protocol

Selects the P25 Protocol of the signal generated by the Test Set. The P25 Base Option currently supports P25 Phase 1 (non-trunked) and Analog Protocols.

Modulation

This drop-down menu selects the Modulation type of the signal generated by the Test Set. Plot/graph traces vary based on the selected Modulation type. The Modulation types available depend on the Protocol type selected and the options installed in the Test Set.

Subject to Export Control, see Cover Page for details.

Pattern

Selects data or voice pattern to be generated by the Test Set. P25 patterns are derived from TIA-102.CAAA Specification. Pattern types include standard and non-standard P25 patterns, stored speech files and voice modulation. Available pattern types are dependent on the type of Protocol selected and the options installed in the Test Set.



Fig. 2-3 RF Control Tile Analog Protocol - Modulators

Receive Field Definitions

1 / 2 Channel Toggle Buttons

Enables/disables the Channel to be used for the signal path.

Pri (Primary Channel)

Selects the channel as the primary frequency. Selects the channel as the primary frequency.

Spk (Speaker)

Selects the channel that routes incoming audio signal to Test Set demodulators.

Freq (Frequency)

This field defines the receiver frequency. For accurate readings, this frequency should be set to the UUT transmit frequency.

Offset

When set to LOCK, changing the Receive or Transmit Frequency offsets the other frequency by the value specified in the Offset field. For example, setting the Receiver frequency to 150 MHz, with an offset of 2.5 MHz, results in the Transmit frequency updating to 152.5 MHz. Or, if the Transmit frequency is set to 150.0 MHz, with an Offset of 2.5 MHz, the Receive frequency updates to 147.5 MHz.

When set to UNLOCK, a value can be entered independently for either the Transmit Frequency or the Receiver Frequency.

Protocol

Selects the expected P25 Protocol of the received signal.

Modulation

The 3900 Receiver Modulation type in the P25 Base Option is system defined as C4FM and can not be changed by the user.

IF Bandwidth

Defines receiver bandwidth. 12.5 kHz is the typical bandwidth used on P25 systems. 25 kHz bandwidth is useful when a mobile radio is transmitting off frequency.

Inbound / Outbound Message

The Inbound/Outbound menu defines how the system processes signal data. When set to Inbound, the Test Set processes the signal as a mobile originated signal. When set to Outbound, the Test Set processes the signal as a mobile terminated signal. This parameter affects Trunking Simulation and XML data log.

Lock / Unlock

Locks / Unlocks frequency offset in relation to the Transmit and Receive frequencies.

Soft Key Definitions

RF Gen Soft Key

Selects and indicates the On/Off state of the RF Generator output from the Test Set. When the generator is disabled, an RF OFF indicator is shown on the Tile.

RF Out Soft Key

The RF Out Soft Key controls the RF Output signal routing. Select either the GEN (Generator) Connector or T/R Connector as RF Output port.

RF In Soft Key

The RF In Soft Key controls the RF Input signal routing. Select either the T/R Connector or ANT (Antenna) Connector as the RF Input port.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

Audio Configuration Tile

The Audio Configuration Tile defines Audio modulator and AF generator parameters for use in testing Analog radio systems. Parameters can be defined separately for each modulator and AF generator. The Test Set is configured so that the user can simultaneously enable up to 3 modulators and 3 generators.

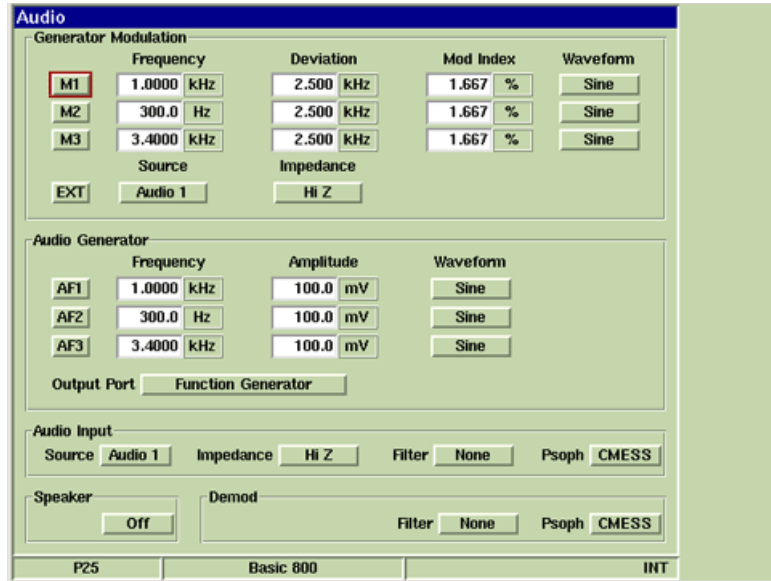


Fig. 2-4 P25 Audio Configuration Tile

Field Definitions

Modulation Generator Field Definitions

M1, M2, M3 Buttons

The Modulator buttons enable/disable each modulator. Modulators can be enabled in combination or individually.

EXT Toggle Button

The EXT Toggle Button enables/disables an external modulation source.

Frequency

Sets the frequency for each Modulation generator.

Deviation

Defines the Deviation for each generator when FM modulation is selected. When this value is defined, the Modulation Index value updates to display the value as a percent.

Mod (Modulation) Index

The Mod Index field defines the modulation level as a percent of the maximum deviation setting (150 kHz). When a Mod Index value is entered, the Deviation value updates to display the value in kHz. For example, when the Mod Index value is set to 100%, the Deviation value updates to 150 kHz, the maximum Deviation setting.

Waveform

Selects Waveform for each modulator.

Source

Selects the Audio input source.

Subject to Export Control, see Cover Page for details.

Impedance

External source can be set to un-terminated high impedance (Hi Z), or include a 600 Ohm termination (600 Ohms).

AF Generator Field Definitions

Configures the Test Set's internal audio generator.

AF 1, 2, 3

The AF1, AF2 and AF3 toggle buttons enable/disable corresponding audio generator.

Frequency

Sets the frequency for each AF generator. Frequency can be specified in kHz or Hz as defined by user.

Amplitude

Defines the amplitude for each AF Generator. Amplitude can be specified in V or mV as defined by user.

Waveform

Defines the Waveform for each AF Generator.

Output Port

Setting the Output Port to AF Out routes the output from the AF Generators to the FCTN GEN/ Demod Connector. Selecting Demod Out routes the demodulated audio signal to the FCTN/GEN Demod Out Connector.

Audio Input

Configures the Test Set's Audio Input parameters.

Source

Selects the Audio input source.

Impedance

External source can be set to un-terminated high impedance (Hi Z), or include a 600 Ohm termination (600 Ohms).

Filter

Selects a measurement filter to include in the measurement path.

Psoph

Selects CMESS or CCITT Psophometric weighting filter when the Psoph filter is selected from any of the Filter selection drop-down menus. Psoph filters are typically used for SINAD measurements, either Demod or Audio.

Speaker

Turns the Test Set's Loudspeaker On or Off.

Demod Input

Filter

Selects a measurement filter to include in the measurement path.

Psoph

Selects CMESS or CCITT Psophometric weighting filter when the Psoph filter is selected from any of the Filter selection drop-down menus. Psoph filters are typically used for SINAD measurements, either Demod or Audio.

Offsets Configuration Tile

The Offsets Configuration Tile allows users to define Generator (Tx) and Receiver (Rx) Level offsets.

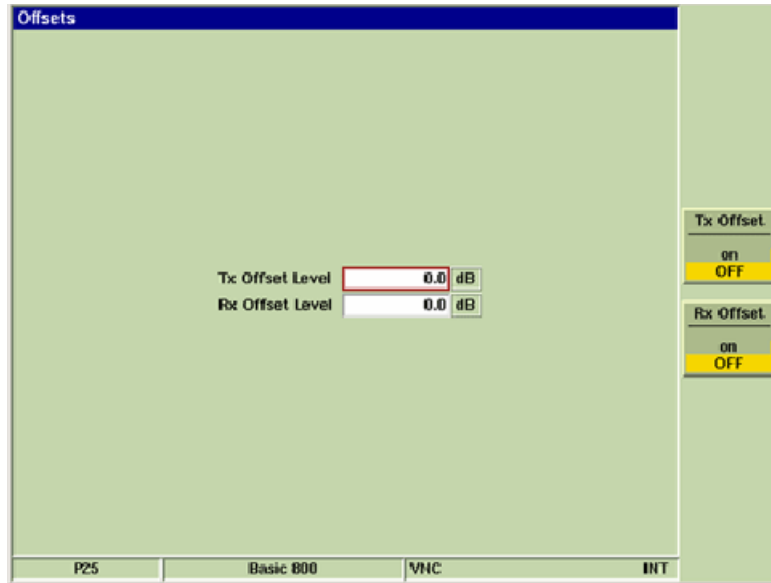


Fig. 2-5 Offsets Configuration Tile

Field / Soft Key Definitions

Tx Offset Level

Defines RF Generator Level Offset value.

Rx Offset Level

Defines Receiver Level Offset value.

Tx / Rx Offset Soft Keys

Enable / Disable defined Tx and Rx offset values.

UUT Measurements Limits Configuration Tile

The UUT Measurement Configuration Tile allows the user to define limits for UUT Measurements meter readings. Available measurements depend on the options installed in the Test Set.

Measurement	Upper Limit	Lower Limit	Units	Enabled/Disabled
Audio Distortion	0.00 %	0.00 %		Disabled
Audio Frequency	0.00 kHz	0.00 kHz		Disabled
Audio Level	0.00 V	0.00 V	V	Disabled
Audio SINAD	0.00 dB	0.00 dB		Disabled
Broadband Power	100 uW	100 uW	W	Disabled
Demod Distortion	0.00 %	0.00 %		Disabled

Fig. 2-6 UUT Measurements Limits Configuration Tile

Field / Soft Key Definitions

Disabled/Enabled

The Enable/Disable Toggle button turns defined limits on and off. Default values are applied if values are not defined by user.

Upper Limit

The UPPER LIMIT function sets a maximum acceptable reading for a specific measurement. When a measured level exceeds the enabled UPPER LIMIT, the Meter Bar and reading background on the Measurement Tiles turns RED.

When readings within enabled Upper and Lower limits the Meter Bar and reading background on the Measurement Tiles turns GREEN.

Lower Limit

When a measured level drops below the enabled LOWER LIMIT, the Meter Bar and reading background of the Measurement Tiles turns BLUE.

When readings within enabled Upper and Lower limits the Meter Bar and reading background on the Measurement Tiles turns GREEN.

Units

Units defines the unit of measurement for a specific measurement.

Averages

Specifies the number of bursts over which data is averaged for each measurement. Values can be set independently for each meter. If the Averages field is set to 50, the Test Set averages data over 50 samples.

Subject to Export Control, see Cover Page for details.

Set All Averages To Soft Key

Specifies the number of bursts over which data is averaged for each measurement. Values can be set independently for each meter. If the Averages field is set to 50, the Test Set averages data over 50 samples.

Up / Down Arrow Soft Key

There Up and Down Arrow Soft Keys navigate the measurements available on the UUT Measurements Limits Configuration Tile. The type of measurements available depends on the options installed in the Test Set.

Encryption Keys Configuration Tile

The Encryption Keys Configuration Tile allows the user to configure encryption parameters. The Test Set is configured with AES and DES Default encryption keys for industry standard testing. DES Encryption is included in the 3900 P25 Base Option (390XOPT200). P25 AES Encryption is an *option enabled feature.

	Reference Name	Key ID	Algorithm	
1	Default DES Key	0	DES-64 Bit	Edit
2	Default AES Key	0	AES-256 Bit	Edit
3	None	0	Clear	Edit
4	None	0	Clear	Edit
5	None	0	Clear	Edit
6	None	0	Clear	Edit
7	None	0	Clear	Edit
8	None	0	Clear	Edit
9	None	0	Clear	Edit
10	None	0	Clear	Edit
11	None	0	Clear	Edit
12	None	0	Clear	Edit
13	None	0	Clear	Edit
14	None	0	Clear	Edit
15	None	0	Clear	Edit
16	None	0	Clear	Edit

P25 Basic 800 INT

Fig. 2-7 P25 Encryption Keys Configuration Tile

Field / Soft Key Definitions

Reference Name

The Reference Name field is defined by the user to identify an encryption key. This field is not a required field, it has been provided to assist users in identifying specific encryption keys. The Test Set will still save encryption key data if this field is left blank.

Key ID

The Key Identifier is a 4 hex digit value ranging from 0 to 0xFFFF (0 to 65535).

Algorithm

Encryption Algorithm Identifier.

Edit

Pressing the Edit button accesses a display tile where the user can define encryption key parameters.

Key (Bytes 1-x)

Field defines the Encryption key value. The number of valid bytes depends on the selected Algorithm.

Apply Soft Key

Pressing the Apply Soft Key saves the Key ID configuration to the available list of Encryption Keys.

Clear Key Data Soft Key

The Clear Key Data Soft Key erases all key information for the selected encryption key. When Clear Key Data is pressed the Test Set opens a confirmation screen which requires that the user confirm the decision to delete the encryption key.

Cancel Soft Key

Pressing the Cancel Soft Key terminates the current function, returning to main Encryption Key Tile.

Validation Error Messages

When a duplicate Key ID is entered a Duplicate error icon is displayed. This error indicator remains until a unique Key ID is entered.

When invalid Key values are entered, an Invalid error icon is displayed. This error indicator remains until valid Key values are entered.

The screenshot shows the 'Encryption Keys' configuration window. At the top, the title bar reads 'Encryption Keys'. Below it, the 'Reference Name' field contains 'Default DES Key'. The 'Key ID' field contains '0' and is highlighted with a yellow 'Duplicate' error indicator. The 'Algorithm' field contains 'AES-256 Bit' and is highlighted with a red 'Invalid' error indicator. Below the algorithm field, there are two text input fields for 'Key (Bytes 1-16)' and 'Key (Bytes 17-32)'. On the right side of the window, there are two buttons: 'Clear Key Data' and 'Cancel'. At the bottom of the window, there is a status bar with three sections: 'P25', 'Basic 800', and 'INT'.

Fig. 2-8 Encryption Error Indicators

How to Create an Encryption Key

To create or edit an Encryption Key:

The screenshot shows the 'Encryption Keys' configuration window. The 'Reference Name' field is highlighted with a red border and contains the text 'Default DES Key'. Below this field is a green 'Valid' indicator. The 'Key ID' field contains the value '0', and the 'Algorithm' dropdown menu is set to 'DES-64 Bit'. Below these fields is another green 'Valid' indicator and the 'Key (Bytes 1-8)' field, which is currently empty. On the right side of the window, there are three buttons: 'Apply', 'Clear Key Data', and 'Cancel'. At the bottom of the window, there are three status indicators: 'P25', 'Basic 800', and 'INT'.

Fig. 2-9 Edit Encryption Key Parameters

1. Press one of the Edit buttons. Display changes as shown in example above.
2. Select Reference Name field and enter a name for the encryption key.
3. Enter Key ID value.
4. Select Encryption Algorithm Identifier.
5. Enter Key (Bytes 1-n) value. The Test Set was designed to display an “Invalid” indicator until a valid Key is entered.
6. Press Apply Soft Key when valid configuration is entered. When the Apply Soft Key is pressed, the display returns to the main Encryption Tile and the new Encryption Key ID appears in the list of encryption keys.

UUT Measurements Tile

The UUT Measurements Tile displays readings taken from the signal being transmitted by the UUT to the Test Set. The tile is divided into six sections, which display meters based on the P25 options installed in the Test Set. The drop-down menu in the upper left hand corner of each section allows the user to also select from the available list of meters. This tile can be selected on multiple sections of the P25 User Screen and each tile can be configured to display data from different channels and different meters.

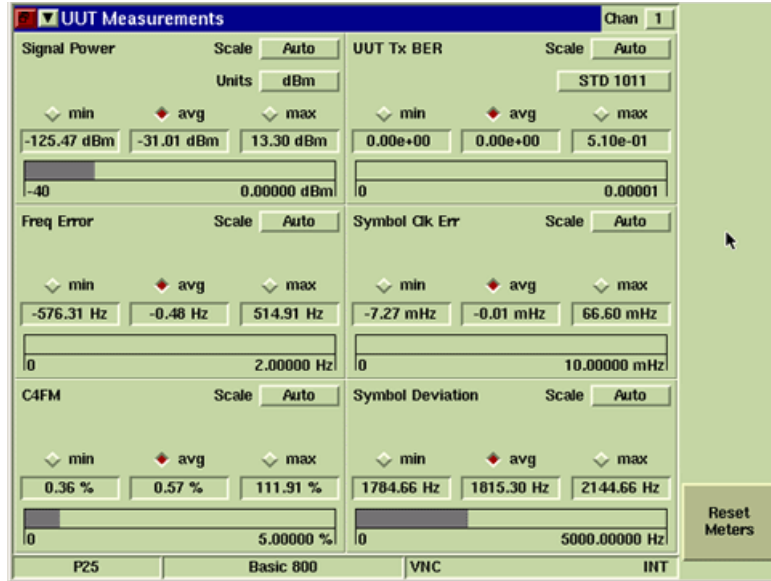


Fig. 2-10 UUT Measurements Tile

Measurement Meters

Broadband Power Meter

The Broadband Power Meter measures input power levels at the T/R Connector over a range of 100 mW to 125 W. The Broadband Power Meter is frequency independent which allows the user to measure and align transmitter power settings without adjusting the 3900's receiver frequency to match the transmitter frequency.

Frequency Error Meter

The Frequency Error Meter measures the frequency error of the incoming RF carrier signal. Frequency Error is calculated as the difference between the frequency of the received signal and the receive frequency defined for the 3900.

Modulation Fidelity Meter

The Mod Fidelity Meter measures P25 waveform Modulation Fidelity as indicated in the TIA-102.CAAA Specification. Desired measurement is equal to or less than 5% per TIA-102.CAAB Specification. Readings > 5% indicate the radio may require alignment or repair.

Signal Power Meter

The Signal Power Meter is a tuned power meter that indicates the amount of RF Energy that is contained within the 3900'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 can be measured at the T/R or ANT Connector. The T/R Connector provides measurements from -60 to +51 dBm. The ANT Connector provides the ability to measure levels from +10 to -100 dBm.

Drop-down menu selects unit of measurement as dBm or Watts. When Watts is selected and the reading falls below 100 mW, the meter background turns GRAY, indicating the reading may be inaccurate. If this occurs, switch the unit of measurement to dBm to obtain an accurate reading.

Symbol Clock Error Meter

The Symbol Clock Error Meter measures the 4800 baud symbol clock of the incoming P25 signal. Symbol Clock Error measurements should not exceed +/-48 mHz per TIA-102.CAAA Specification.

Symbol Deviation Meter

The Symbol Deviation Meter measures the symbol deviation accuracy of a P25 signal per TIA-102.CAAA and TIA-CAAB Specifications. Symbol Deviation measurements should be >1620 and <1980 Hz per the above referenced specifications.

UUT Tx BER Meter

The UUT Tx BER Meter compares an incoming P25 symbol data to a standard pattern to determine errors in signal processing.

The P25 Base Option currently supports STD 1011, STD CAL, STD SILENCE, STD INTFR, STD BUSY, STD IDLE, and STD 511 (.153) patterns as defined in TIA-CAAA Specification.

NOTE

BER is calculated over the entire data packet, not just the voice data. Use Standard P25 Patterns for accurate BER measurements.

Audio / Demod Meters

The Audio and Demod meters are enabled when Analog protocol is selected on the Tx and Rx signals.

Audio / Demod Distortion Meters

The Audio Distortion Meter measures the amount of audio distortion a radio receiver may add to an audio signal during the demodulation process. The Demod Distortion Meter measures the amount of audio distortion created by a radio transmitter when an audio signal is modulated.

Audio Frequency Meter

The Audio Frequency Meter measures the frequency of the audio signal received at the Test Set's selected input connector (i.e., Audio 1 or MIC Connector).

Demod Frequency Meter

The Demod Frequency Meter measures the frequency of the demodulated signal received at the Test Set's selected input connector (i.e., Audio 1 or MIC Connector).

FM Deviation Meter

The FM Deviation Meter measures the amount of deviation present on an FM Modulated RF Signal received by the 3900. FM Deviation measurements are only valid when Analog Protocol is selected.

Audio Level Meter

The Audio Level Meter measures the amplitude and audio signal received at the Test Set's selected input connector (i.e., Audio 1 or MIC Connector).

Audio / Demod Sinad Meter

The AF Sinad Meter measures the receive quality of a radio receiver. The Modulation Sinad Meter measures the sinad of a transmitter.

Inband Power Meter

The Inband Power Meter indicates the total power measurement of the selected channel in the received RF Signal. Analog Protocol must be selected to enable this meter.

RF Error Meter

The RF Error Meter indicates the difference (frequency error) between the received RF signal and the defined receive frequency.

RF Error measurements are only valid when Analog Protocol is selected.

Field / Soft Key Definitions

min/avg/max Reading Indicators

These radio buttons select the reading displayed on the bar graphs and the reading displayed when the UUT Measurements Display Tile is minimized.

Selecting min displays the lowest recorded reading.

Selecting avg displays the average of all recorded readings over the period of defined bursts (default setting).

Selecting max displays the highest recorded reading.

Meter Bar

The METER BAR is a single, linear indicator that provides a visual measurement reading based on a user defined scale. Upper and lower limit indicators are set on the UUT Measurement Configuration Tile. Refer to the section titled UUT Measurements Limits Configuration Tile for more information on Upper and Lower Limits.

Scale

The scale of the bar graph is selected from the Scale drop-down menu. Available settings are Auto-ranging (Auto) or a fixed value. The selected scale value is displayed below the bar graph.

Reset Meters Soft Key

The Reset Meters Soft Key stops, clears, and re-starts the acquisition of data for the data display fields.

Constellation Tile

The Constellation plot displays the signal Constellation points of the received P25 signal which allows the user to evaluate the signal for distortion and noise. The green plot circles indicate the expected location of plot clusters.

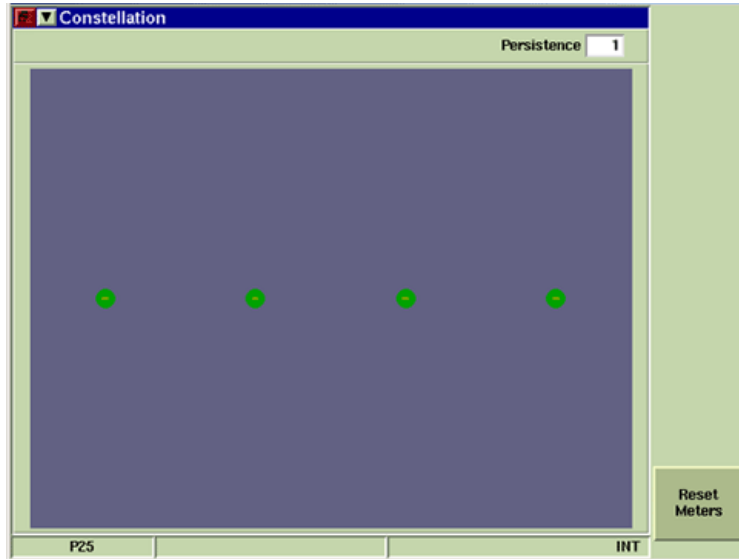


Fig. 2-11 Constellation Tile - CQPSK Modulation

Field / Soft Key Definitions

Persistence

Specifies how many trace plots are shown simultaneously on the display field. Selectable range is 1 to 10. Selecting 1 means that only one burst or time slot is displayed on the display field. Selecting 10 means the last 10 bursts or time slots are displayed simultaneously on the display field.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

Eye Diagram Tile

The Eye Diagram Display Tile shows the eye diagram of the received P25 signal. The format of the signal displayed changes according to various P25 parameters such as Protocol and Modulation type.

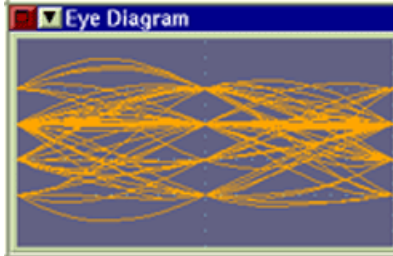


Fig. 2-12 Eye Diagram Tile - Minimized View - 2 Symbols

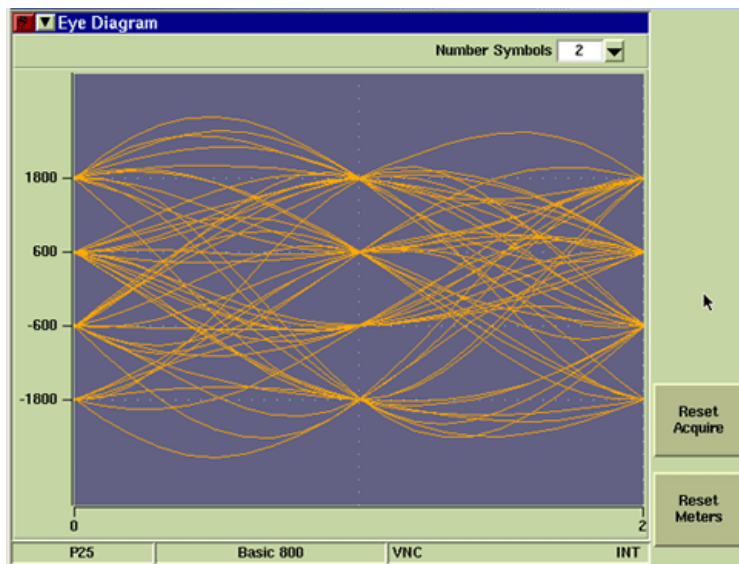


Fig. 2-13 Eye Diagram Tile - Maximized View - 4 Symbols

Field Definitions

Number Symbols

Defines the horizontal scale of the display field. Fig. 2-12 shows a trace with the Number Symbols field set to 2; Fig. 2-13 shows the Number Symbols field set to 4. Lowering the number or symbols shows more detail of the signal pattern.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

Distribution Tile

The Distribution Tile shows a histogram of the number of times a frequency occurs along the P25 signal at the symbol time.

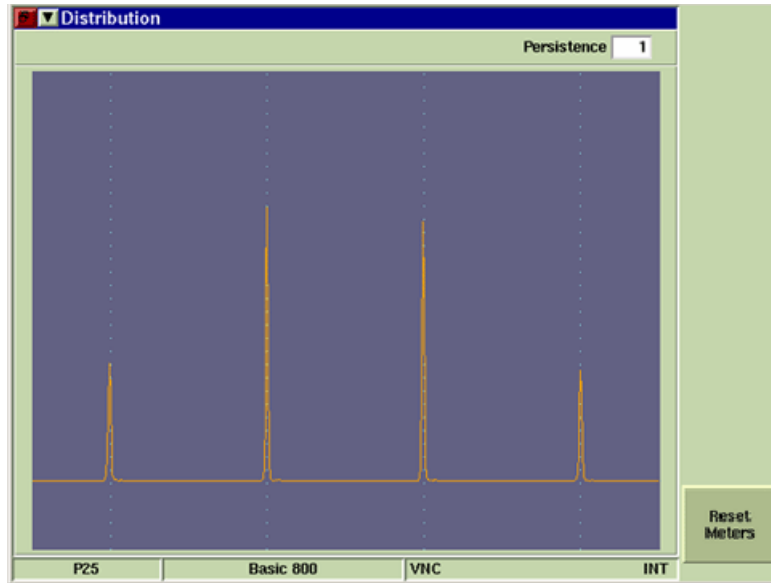


Fig. 2-14 Distribution Tile - Maximized View

Field Definitions

Persistence

Specifies how many trace plots are shown simultaneously on the display field. Selectable range is 1 to 10. Selecting 1 means that only one burst or time slot is displayed on the display field. Selecting 10 means the last 10 bursts or time slots are displayed simultaneously on the display field.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

Data Link Measurement Tile

The Data Link Measurement Tile displays digital data contained in the signal received from the UUT on a voice channel. This tile can be selected on multiple sections of the P25 User Screen and each tile configured to display data from different channels.

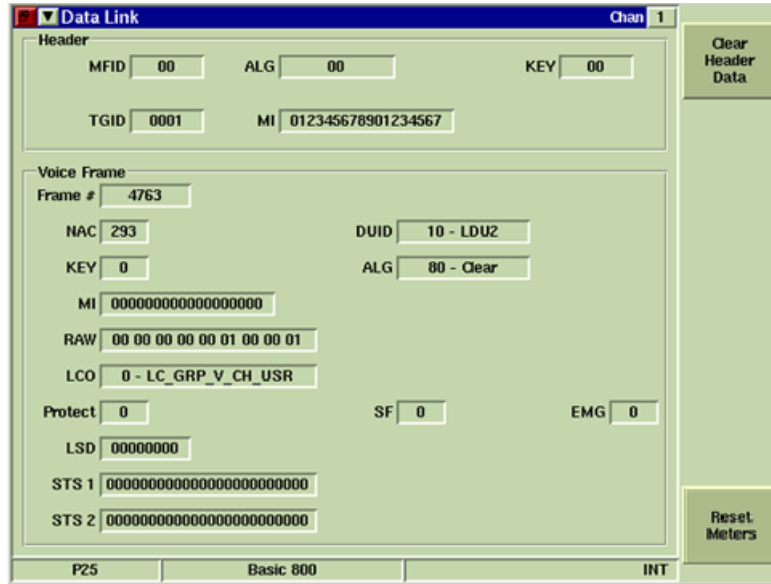


Fig. 2-15 Data Link Measurements Tile

Header Data Field Definitions

The Header Data section of the Data Link Measurement Tile displays header data received from the UUT. Field content can be cleared and reset by pressing the Clear Header Data Soft Key.

MFID

Displays Manufacturer Identification number received from UUT. This value reflects the MFID for customized protocols. P25 Standard is 00. Any value other than 00 reflects a specific manufacturer message.

ALG

Displays the Encryption Algorithm Identifier received from UUT.

Key

Displays the Encryption Key Identifier received from UUT.

TGID

Displays the Talk Group Identification number received from UUT.

MI

Displays the Message Identifier received from UUT.

Voice Frame Data Field Definitions

Frame

Internal number Test Set assigns to the data to show relative time and activity of signal. This value is not a requirement of TIA specifications and not part of the over-the-air protocol.

NAC

Displays the Network Access Code received from UUT per TIA-102.AABB Specification. The System ID is equivalent to the NAC.

DUID

Displays the Data Unit Identifier received from UUT.

ALG

Displays the Encryption Algorithm Identifier received from UUT.

KEY

Displays the Encryption Key Identifier received from UUT.

MI

Displays the Message Identifier received from UUT.

RAW

Displays raw symbols logged from UUT.

LCO

Displays the Logic Control Opcode received from UUT.

P

Displays the Protected bit value for the encrypted voice data.

0 = Clear (Default)

1 = Encrypted

SF

Displays the State Flag identifier received from UUT.

EMG

Emergency status received from UUT.

LSD

Displays the Low Speed Data.

STS 1

Status bits for LDU1.

STS 2

Status bits for LDU2.

Clear Header Data Soft Key

Clears and updates Data Link Header fields.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

Power Over Time Tile

The Power Over Time Tile displays the power measurement of the received signal over a specified period of time. This measurement provides an indication of the transmitter's stability.

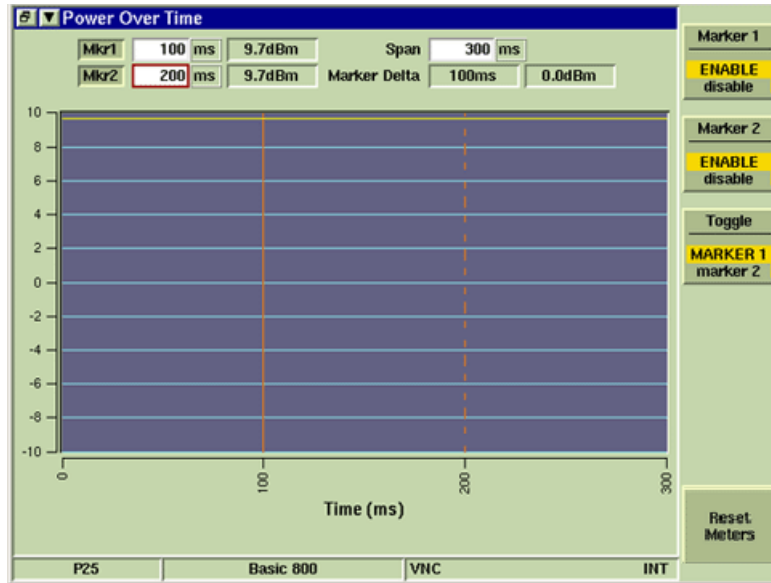


Fig. 2-16 Power Over Time Tile

Field / Soft Key Definitions

Mkr 1 / Mkr 2

The Mkr1 and Mkr2 toggle buttons enable Marker 1 and Marker 2. Markers must be enabled to edit the Marker position fields. Status and functionality of these toggle buttons is linked to the Marker 1 and Marker 2 Soft Keys.

Span

Span sets the length of time (horizontal scale) over which the power measurement is displayed.

Marker Delta

When both markers are defined and enabled the Delta field indicates the difference between the position and power measurement at each point on the signal.

Marker 1/Marker 2 Soft Key

The Marker 1 and Marker 2 Soft Keys enables or disables markers displayed on the graph field. Markers can also be enabled using the Mkr1 and Mkr2 toggle buttons. The Marker 1 and Marker 2 Soft Key status is linked to the Mkr1 and Mkr2 toggle buttons.

Toggle Marker Soft Key

The Toggle Marker Soft Key focuses on an enabled marker. The Toggle Marker Soft Key also controls the marker readings displayed at the top of a minimized tile. Each press of this Soft Key changes the source of the measurements through Mkr1, Mkr2 and Delta readouts.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

Simulator Tile

The P25 Simulator Tile allows the user to simulate the effect of a radio by using the 3900 to talk to the unit under test. During simulation, the 3900 serves as the Virtual Mobile (VM) which is configured to talk to a unit under test.

When the Test Set is operating in non-trunking mode, the fields on the Simulator Tile set basic call parameters.

When the Test Set is operating in trunking mode or SmartNet™/SmartZone™ protocol is selected (*option enabled), the fields on the Simulator Tile set additional call parameters.



Fig. 2-17 P25 Simulator Tile

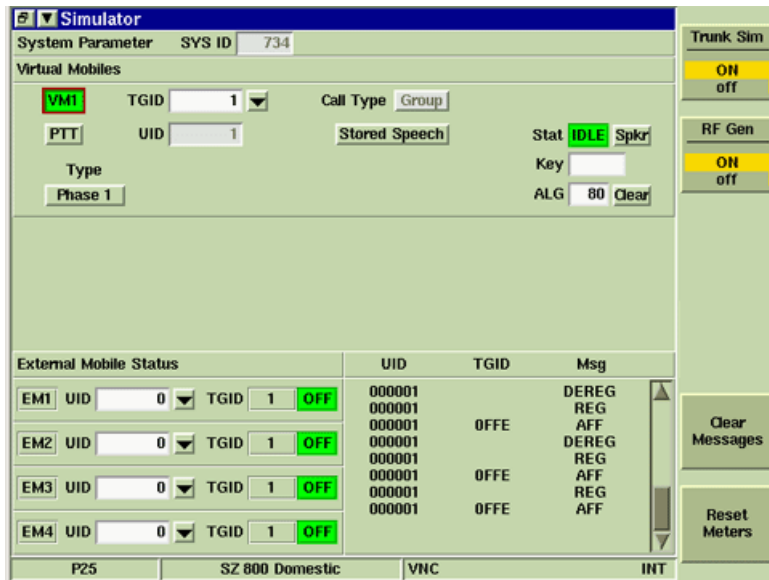


Fig. 2-18 P25 Trunking Simulator Tile

Subject to Export Control, see Cover Page for details.

System Parameter

NAC

The NAC field defines the Network Access Code used by the Test Set Simulator.

Virtual Mobile Field Definitions

VM1

When the P25 Trunking Simulator is enabled (Trunking Sim Soft Key is in ON state), the VM1 indicator updates to a toggle button. Enabling the VM1 toggle button simulates powering on an external radio which initiates radio registration and affiliation with the Test Set. This functionality is enabled when the P25 Trunking Option is installed.

PTT (Push to Talk)

Enabling the Push to Talk toggle button keys the virtual radio and begins transmission.

TGID

Defines the Virtual Mobile's Talk Group Identifier as a six hex digit value. Range is 0x0 to 0xFFFFFFFF.

UID

Defines the Virtual Mobile's Encryption Key Identifier as a four hex digit value. Range is 0x0 to 0xFFFF.

Call Type

The Test Set currently only supports Group Calls. Additional call support is planned for a future release.

Pattern

The Pattern drop-down menu selects the audio source used by the Virtual Mobile.

VM Call Status Indicator

The Call Status Indicator displays the virtual mobile's call status.

OFF

OFF indicates that the Virtual Mobile is not enabled.

IDLE

IDLE indicates the Virtual Mobile is attempting to locate a control channel and send a registration request.

REG

REG indicates that the Virtual Mobile has registered with the Test Set.

AFF

AFF indicates that the Virtual Mobile has affiliated with the Test Set.

CALL

CALL indicates that the Virtual Mobile is participating in a call.

Key

Defines the Virtual Mobile's Encryption Key Identifier as a four hex digit value. Range is 0x0 to 0xFFFF.

ALG

Defines the Virtual Mobile's Encryption Algorithm Identifier as a two hex digit value. Range is 0x0 to 0xFF.

(Radio) Type

The Radio Type drop-down menu selects the type of radio participating in the call. This drop-down menu is only available when the SmartNet™ / SmartZone™ Option is installed.

Radio Flags

Refer to [SmartNet™ / SmartZone™ Radio Flags](#) for a description of these toggle buttons.

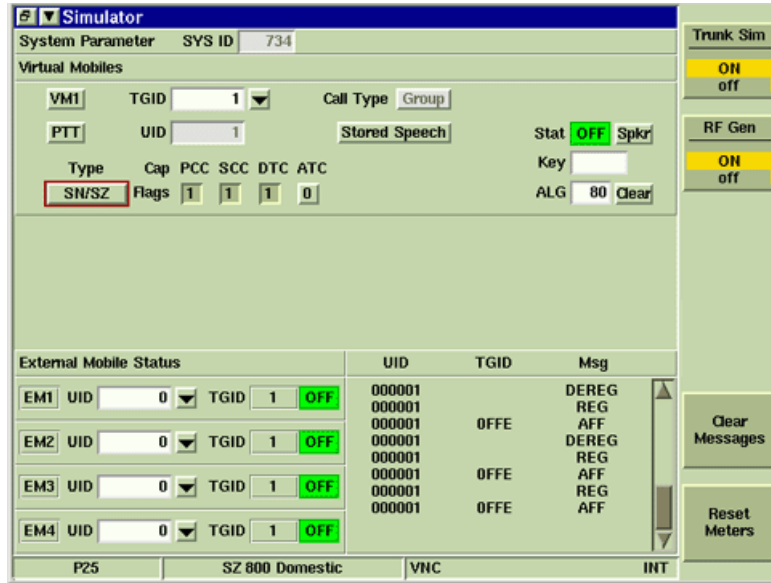


Fig. 2-19 SmartNet™ / SmartZone™ Simulator Tile

External Mobile Field Definitions

The External Mobile parameters allow the user to configure the Test Set to monitor up to four external mobile radios. These fields are enabled when the P25 Trunking Option is installed.

EM1

EM label indicates the External Mobile (1, 2, 3 or 4) for which the data applies.

UID

Defines the External Mobile's User Identifier as a six hex digit value. Range is 0x0 to 0xFFFFFFFF.

TGID

Displays the External Mobile's Talk Group Identifier in six hex digit format within range of 0x0 to 0xFFFFFFFF.

Call Status Indicator

The Call Status Indicator displays the External Mobile's call status.

OFF

OFF indicates that the External Mobile is not enabled.

REG

REG indicates that the External Mobile has registered with the Test Set.

AFF

AFF indicates that the External Mobile has affiliated with the Test Set.

CALL

CALL indicates that the External Mobile is participating in a call.

Subject to Export Control, see Cover Page for details.

Call Logging Field

The Call Logging field displays the registration, affiliation and deregistration of external mobile radios. These fields are enabled when the P25 Trunking Option is installed.

UID

Unit Identification of the External Mobile.

TGID

Talk Group Identifier of the External Mobile.

MSG

The Logging messages are the registration and affiliation messages sent by the External Mobile.

REG

REG indicates that the External Mobile has sent registration message to the Test Set.

AFF

AFF indicates that the External Mobile has sent affiliation message to the Test Set.

DEREG

DEREG indicates that the External Mobile has sent a deregistration message to the Test Set.

Soft Key Definitions

Trunk Sim Soft Key

Enables/disables Trunked Mode Simulator. When the Trunking Simulator is enabled, the Test Set reconfigures the transmit and receive parameters on the RF Control Tile based on the parameters defined on the Trunking Control Tile.

This soft key is enabled when the P25 Trunking or SmartNet™ / SmartZone™ Option is installed in the Test Set.

RF Gen Soft Key

Selects and indicates the On/Off state of the RF Generator output from the Test Set. When the generator is disabled, an RF OFF indicator is shown on the Tile.

Clear Messages Soft Key

Clears message data in Call Logging Field.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

Configuring Test Simulations

Configuring Conventional Test Simulation

To configure the Test Set for Base Station Simulation for evaluating a Conventional P25 mobile radio:

1. Power on Test Set and select P25 System.
2. Restore Test Set to Factory Defaults, Settings and GUI restore option.
3. Connect Antenna Connector on UUT to Test Set T/R Connector with coaxial cable.
4. Configure Test Set Measurements Tiles to display Simulator Tile, UUT Measurements Tile, Data Link Tile and Channel Analyzer.

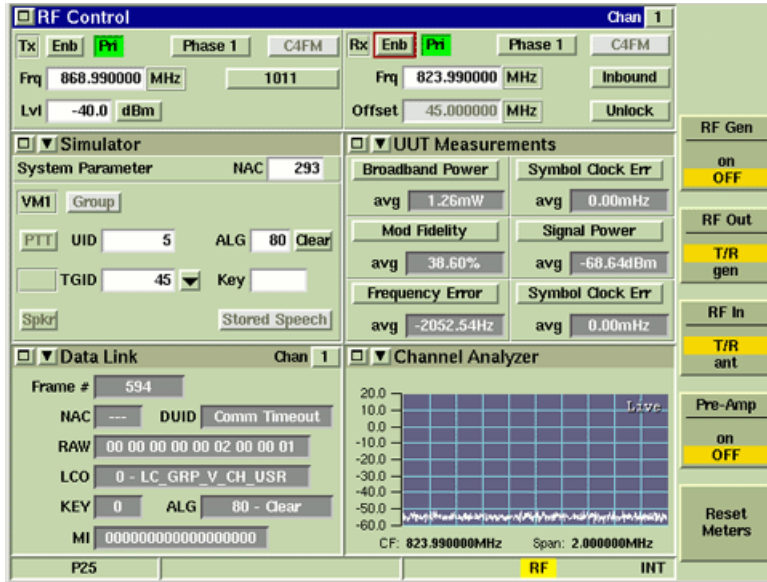


Fig. 2-20 Conventional Base Simulation Tile Layout

5. Select RF Control Tile. Set RF Out and RF In Soft Keys to TR.
6. Set Test Set Transmit frequency to match UUT Receive frequency. Example uses 868.99.
7. Set Test Set Receive frequency to match UUT Transmit frequency. Example uses 823.99.
8. Verify Gen Level is at default value of -40 dBm.
9. Verify Offset is in default state (Unlocked).
10. Set Test Set Transmit Pattern to a non-standard pattern (Voice, 1011, or Silence). Example uses 1011.
11. Select Simulator Tile. Set NAC value to match radio programming. Example uses 293.
12. Set UID to any valid non-zero value. Example uses 5.
13. Set TGID to any valid non-zero value. Example uses 45.
14. Select RF Control Tile. Enable Tx and Rx Channel. Set RF Gen Soft Key to ON.

Subject to Export Control, see Cover Page for details.

- Power on UUT. Verify selected tone (Pattern) is being transmitted on radio. Some radios display the UID of the received call. If UUT has this functionality, verify UID on radio matches UID defined on Test Set Simulator Tile.

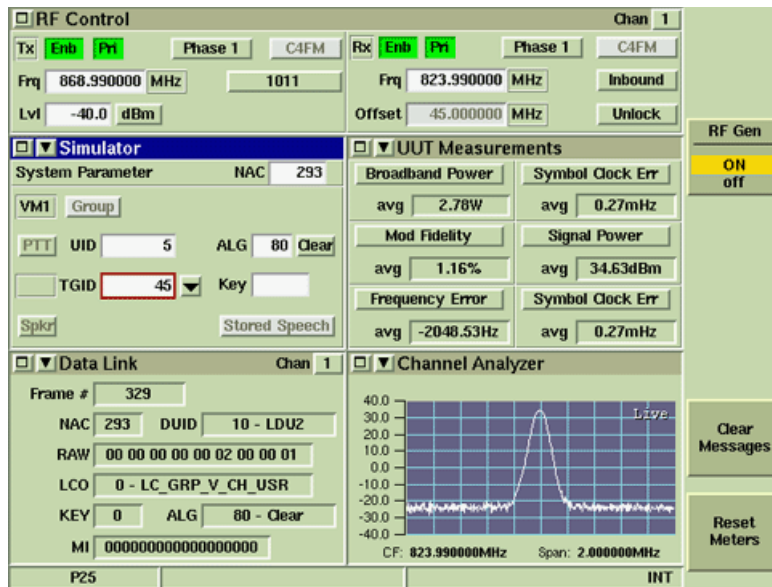


Fig. 2-21 Conventional Base Simulation Call Data

- Key Radio to obtain readings on Test Set.

Configuring Trunked Base Station Simulation

The following UUT parameters must be known when configuring Base Station Simulation:

- UUT System ID
- UUT WACN
- UUT Base Frequency
- First Control Channel Frequency in UUT scan list
- UUT Channel Spacing value
- UUT Tx Offset value

To configure the Test Set for Base Station Simulation for evaluating a Trunked P25 mobile radio:

1. Power on Test Set and select P25 System.
2. Restore Test Set to Factory Defaults, Settings and GUI restore option.
3. Connect Antenna on UUT to Test Set T/R Connector with coaxial cable.
4. Select System Plan Configuration Tile. Select or configure a system plan appropriate to the network programming of the UUT.

Channel ID	Base Frequency	Bandwidth (kHz)	Transmit Offset	Channel Space
1	851.006250 MHz	12.50	-45.000000 MHz	6.250 kHz
2	0 Hz	12.50	0 Hz	0 Hz
3	0 Hz	12.50	0 Hz	0 Hz
4	0 Hz	12.50	0 Hz	0 Hz
5	0 Hz	12.50	0 Hz	0 Hz
6	0 Hz	12.50	0 Hz	0 Hz
7	0 Hz	12.50	0 Hz	0 Hz
8	0 Hz	12.50	0 Hz	0 Hz

Fig. 2-22 Configure P25 System Plan

5. Select the Data Link and Trunking Control Tile on two of the measurement tiles.
6. Select Channel 2 on the Data Link Tile.

7. Select the Simulator Tile on the other two measurement tiles. Select VM View on one of the Simulator Tiles and Log View on the other Simulator Tile.

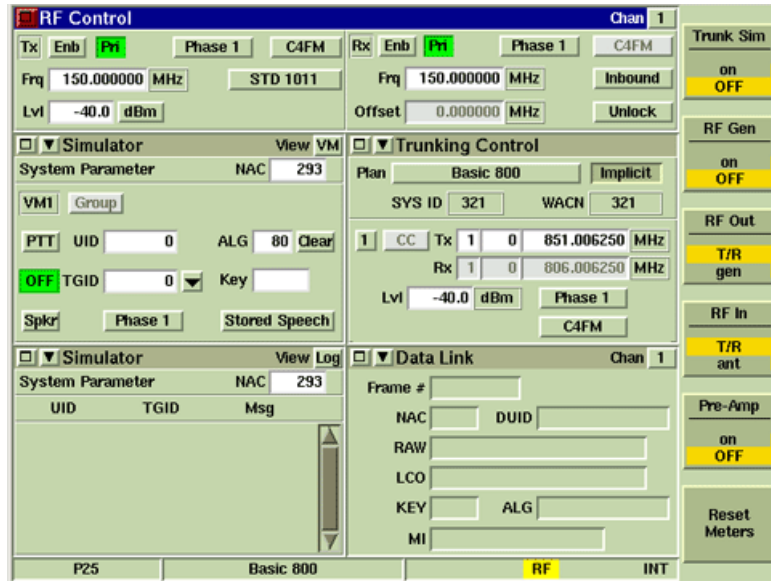


Fig. 2-23 Trunking Base Simulation Tile Configuration

8. Select and maximize Trunking Control Tile. Set Control Channel Frequency to match first frequency of scan list. Example uses 860.775 MHz. Control Channel Number updates when frequency is entered.
9. Set Voice Channel Number to value approximately 20 above or below the Control Channel Number. Example uses 1583. Minimize Trunking Control Tile.



Fig. 2-24 Trunking Base Simulation Trunking Control Tile

10. Set Trunk Sim Soft Key to ON. RF Control Tile Tx and Rx Frequency fields update to Trunking Control Tile values and RF Gen Soft Key updates to ON.

Subject to Export Control, see Cover Page for details.

11. Simulator Tile updates according to call registration and affiliation process.

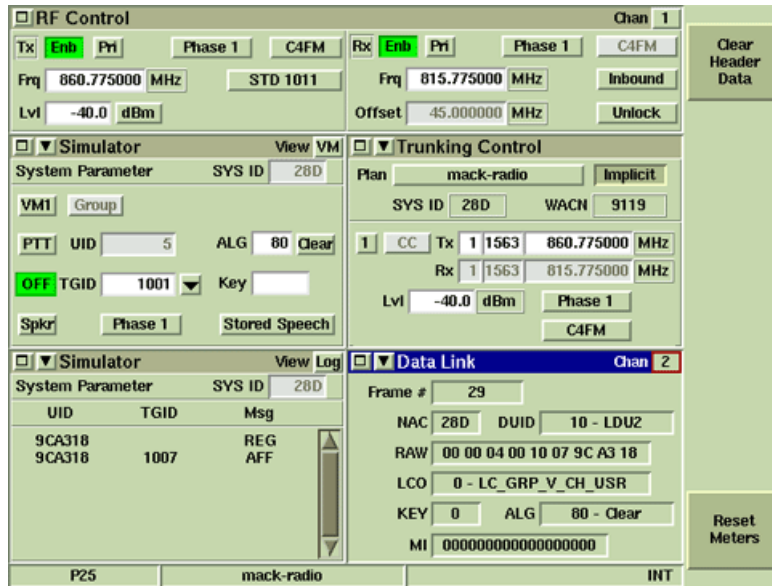


Fig. 2-25 Trunking Base Simulation - Mobile Call Registration

To Call Mobile from Test Set

1. Maintain current call setup.
2. Select Simulator Tile. Set UID to an arbitrary value. Example uses 5.
3. Set TGID to match UUT network programming (value reported on Simulator Tile). Example uses 1007.

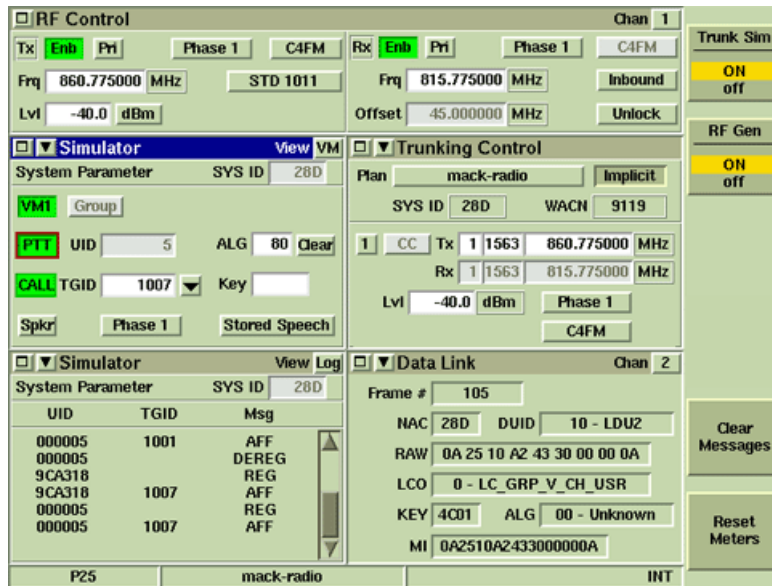


Fig. 2-26 Trunking Base Simulation - Call to Mobile

4. Enable VM1 toggle button and PTT function. UUT emits Stored Speech or Voice Pattern being generated by the Test Set.

Subject to Export Control, see Cover Page for details.

Chapter 3

P25 Trunking Option

Introduction

This chapter provides a functional description of P25 Trunking Option (390XOPT201). The P25 Trunking Option requires installation of P25 System Option, 390XOPT200.

The P25 Trunking Option provides the user with features necessary to test Trunked P25 radios and systems. P25 Trunking Option includes all of the features found in the P25 System Option plus the following:

- P25 Trunked Base Radio simulation;
- System Plan configuration for defining system information and Channel Plan data;
- Two Channel selection capability;
- P25 700 MHz, 800 MHz, UHF and VHF frequency band support.

When the P25 Trunking Option is installed, additional display tiles and fields are enabled to provide the user with the ability to configure the Test Set to test Trunked P25 radios and systems.

Two Channel Capability

The P25 Trunking Option enables two transmit and receive signals on the RF Control Tile. Each channel can be configured to different parameters such as frequency, modulation and protocol. When both channels are enabled, the secondary channel must be within +/- 2.5 MHz of the primary channel (center frequency).

The Pri toggle button indicates which channel is selected as the Primary Channel. The example below shows Channel 1 selected as the primary channel.

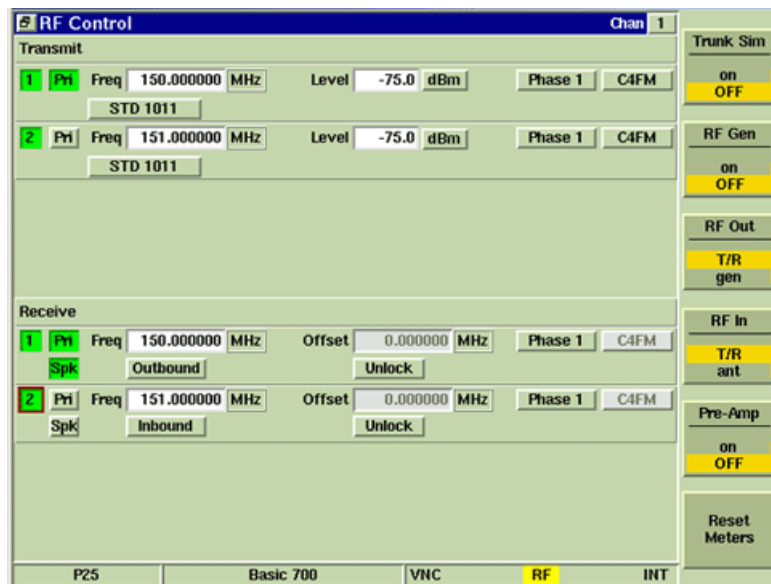



Fig. 3-1 Primary Channel Indication

Subject to Export Control, see Cover Page for details.

P25 Trunking Option

When a user enables both channels and the secondary channel frequency is more than 2.5 MHz from the primary channel frequency, an invalid condition occurs and the system is unable to complete the function. When this condition occurs, the Channel Toggle Button of the inactive channel turns ORANGE to indicate the invalid condition.

The example below shows an example of this invalid condition. In the example, Channel 1 is enabled as the primary channel and is set to 851.00 MHz. The user has attempted to enable Channel 2 as the secondary channel, with the frequency set to 150.00 MHz. The following indicators have been triggered:

-  Indicates secondary channel frequency is more than 2.5 MHz from primary channel.
- Orange button indicates system can not enable the channel because it is more than 2.5 MHz from primary channel.

In this example, to enable Channel 2, the user must perform either of the following:

- Select Channel 2 as the primary channel (Channel 1 will be disabled).
- Change Channel 2 frequency to within ± 2.5 MHz of Channel 1 frequency (Channel 1 will remain enabled).

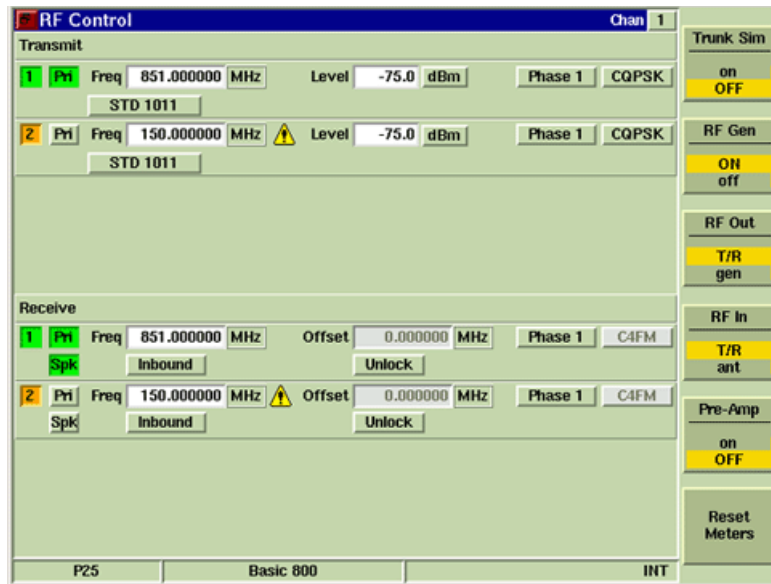


Fig. 3-2 Channel 2 - Invalid Parameter

RF Control Tile

The P25 Trunking Option enables the following fields on the RF Control Tile:

Pri (Primary Channel)

The Pri toggle button selects the channel as the generator center frequency. When Channel 1 is selected as the primary channel, traces are displayed in ORANGE on all plot/graph fields and a CH 1 indicator is displayed when a valid signal is being displayed. When Channel 2 is selected as the primary channel, traces are displayed in YELLOW on all plot/graph fields and a CH 2 indicator is displayed when a valid signal is being displayed. The Primary Channel should be used for obtaining test measurements.

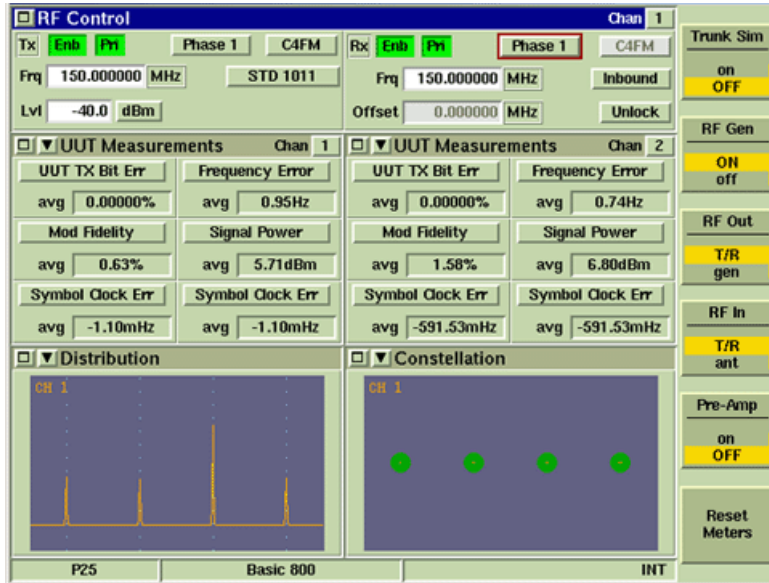


Fig. 3-3 Channel 1 Primary - Traces are ORANGE

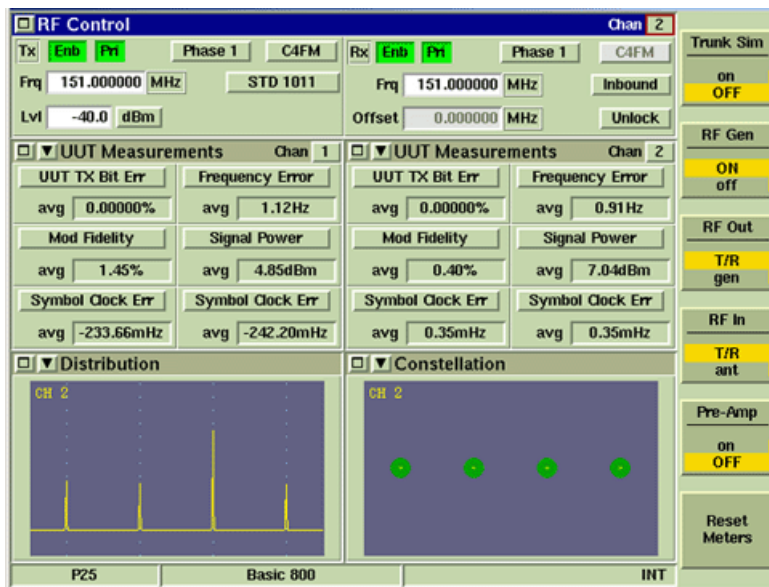


Fig. 3-4 Channel 2 Primary - Traces are YELLOW

Subject to Export Control, see Cover Page for details.

Chan (Channel)

The Chan drop-down menu selects the channel data (Channel 1 or 2) that is visible when the RF Control Tile is minimized.

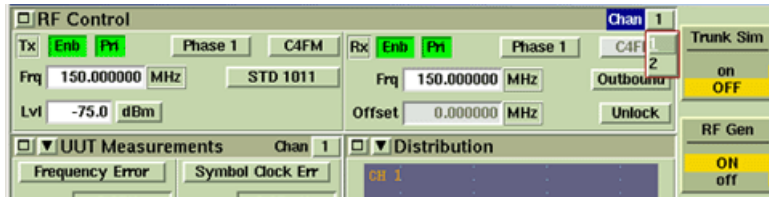


Fig. 3-5 Minimized RF Control Tile - Select Channel

1 / 2 Channel Toggle Buttons

The 1 / 2 Channel Toggle Buttons enable/disable a Channel to be used for the transmit path. Both channels can be enabled at the same time, however, the secondary channel frequency must be within +/- 2.5 MHz of the primary channel frequency.

Trunking Control Tile

The Trunking Control Tile configures the Test Set for testing the operational parameters of a P25 Trunked radio system. Channels are activated when the Trunking Simulator is enabled (Trunk Sim Soft Key is ON). When Trunking Simulation is activated, call parameters are copied from the Trunking Control Tile to the RF Control Tile.

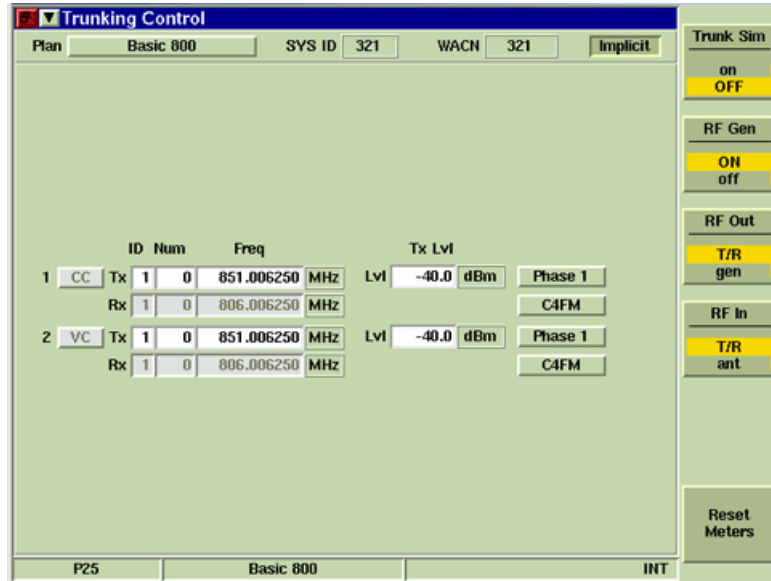


Fig. 3-6 Trunking Control Tile

Field/Soft Key Definitions

Plan

Selects the System Plan to be used when testing the UUT. Custom System Plans can be defined and saved using the [System Plan Configuration Tile](#).

Sys ID

Indicates System ID associated with the selected System Plan. The Sys ID is currently equivalent to the NAC. This field is system specific and must match the UUT.

WACN

Indicates Wide Area Communications Network identifier of the selected System Plan. This field is system specific and must match the UUT.

Implicit Message Format

When Implicit mode is selected the mobile uses Implicit message formats (single-block messages) to determine the channel / frequency pair to use to access the network.

CC (Control Channel)

The CC Tx and Rx fields define the ID, Number and Frequency for the Tx and Rx Control Channels. Either the ID and Number or the ID and Frequency must be defined in order for the Test Set to populate data fields based on the System Plan selected on the System Plan Configuration Tile. CC Rx fields are display only when Implicit mode is selected.

VC (Voice Channel)

The VC Tx and Rx fields define the ID, Number and Frequency for the Tx and Rx Voice Channels. Either the ID and Number or the ID and Frequency must be defined in order for the Test Set to populate data fields based on the System Plan selected on the System Plan Configuration Tile. VC Rx fields are display only when Implicit mode is selected.

ID / NUM

ID and Num (Number) fields define the frequency according to the System Plan defined on the System Plan Configuration Tile. ID and Frequency fields define the Number according to the System Plan defined on the System Plan Configuration Tile.

Freq (Frequency)

Frequency fields are defined by selecting the ID/Num fields or be entering the values manually.

Lvl (Level)

Defines the default RF Power Level for the Control Channel and Voice Channel.

Protocol

Selects the P25 protocol to be used for each channel. P25 Phase 1 and Analog are the protocol types currently supported by the P25 Base Option. Other protocol types are *option enabled.

Trunk Sim Soft Key

Enables/disables Trunked Mode Simulator. When the Trunking Simulator is enabled, the Test Set reconfigures the transmit and receive parameters on the RF Control Tile based on the parameters defined on the Trunking Control Tile.

RF Gen Soft Key

Selects and indicates the On/Off state of the RF Generator output from the Test Set. When the generator is disabled, an RF OFF indicator is shown on the Tile.

RF Out Soft Key

The RF Out Soft Key controls the RF Output signal routing. Select either the GEN (Generator) Connector or T/R Connector as RF Output port.

RF In Soft Key

The RF In Soft Key controls the RF Input signal routing. Select either the T/R Connector or ANT (Antenna) Connector as the RF Input port.

Reset Meters Soft Key

The Reset Meters Soft Key clears and resets the meter readings.

System Plan Configuration Tile

The System Plan Configuration Tile allows the user to define parameters for testing Trunked P25 systems. Once a plan has been defined and saved, all parameters associated with the plan are recalled when the plan is selected on the Trunking Control Tile.

The System Plan Configuration Tile also allows users to select one of the pre-defined system plans which can be customized to meet specific test scenarios, then saved as a new file for future testing. Saved files can be imported to and exported from the Test Set using the Utility File Management Tile.

Channel ID	Base Frequency	Bandwidth (kHz)	Transmit Offset	Channel Space
1	851.006250 MHz	12.50	-45.000000 MHz	6.250 kHz
2	0 MHz	12.50	0 MHz	0 kHz
3	0 MHz	12.50	0 MHz	0 kHz
4	0 MHz	12.50	0 MHz	0 kHz
5	0 MHz	12.50	0 MHz	0 kHz
6	0 MHz	12.50	0 MHz	0 kHz
7	0 MHz	12.50	0 MHz	0 kHz
8	0 MHz	12.50	0 MHz	0 kHz

Fig. 3-7 P25 System Plan Configuration Tile - Hexadecimal Format

Field/Soft Key Definitions

System Plan

Allows user to select desired System Plan. Use the Edit Soft Key to customize pre-defined System Plans. Refer to section titled [How to Configure a System Plan](#) for instructions on how to create a custom plan.

Type

Identifies/defines System Plan as a P25 System Plan or SmartZone Band Plan when the SmartZone Option is installed in the Test Set. This field is display only unless the user is editing the current system or band plan.

Sys ID

Defines the System Identifier per TIA-102.AABB Specification. The System ID is equivalent to the NAC.

WACN ID

Defines Wide Area Access Network Identifier.

Base Parameters

Base Parameters must be configured for the Test Set to simulate a base station.

RFSS ID

Defines RF Subsystem Identifier for Outbound Channel.

Site ID

Defines Site Identifier.

Ann Grp Addr

Defines Announcement Group Address.

Local Reg Area

Defines Local Registration Area.

SVC Class

Defines Service Class.

Active Net

Defines Active Network value.

Loc/Glob Affil

Selects Local or Global Affiliation.

Group Affil

Defines the Group Affiliation status sent when a radio attempts to affiliate with the Test Set.

- 0 = Accept (Default)
- 1 = Fail
- 2 = Deny
- 3 = Refused

Registration

Defines the Registration Value sent when a radio attempts to register.

- 0 = Accept (Default)
- 1 = Fail
- 2 = Deny
- 3 = Refused

WGID Mapping

Selects method for obtaining Working Group Identifier. This value is currently automatically selected by Test Set.

WUID Mapping

Sets Bandwidth for each channel within the selected Channel ID.

Protected

Defines the Protected bit value for the encrypted control data.

- 0 = Clear (Default)
- 1 = Encrypted

Channel Plan Parameters

Each physical channel in a system is identified by a unique Channel ID / Channel Number pair. The channel plan is the basis for calculating frequencies from ID / Number pairs. The channel plan is not related to the mobile radio scan lists which the mobile uses to find active control channels.

Channel ID

Lists Channel Identifier.

Base Frequency

Sets starting frequency for calculating channel numbers.

Bandwidth

Sets Bandwidth for each channel within the selected Channel ID.

Transmit Offset

Sets Offset value of the transmit frequency from the receiver frequency for each channel within the selected Channel ID.

Channel Space

Defines spacing between each channel within a given Channel ID.

Soft Keys

Edit Soft Key

The Edit Soft Key allows the user to create and save custom System Plans. Pressing the Edit Soft Key changes System Plan data fields to an editable state and enables additional soft key functions.

Display Soft Key

The Display Soft Key selects Decimal or Hexadecimal format to display data field content. Refer to Fig. 3-7 for example of hexadecimal format; refer to Fig. 3-8 for an example of decimal format.

The screenshot shows the 'System Plan' configuration window. At the top, the 'System Plan' is set to 'Basic 800', 'Type' is 'P25', 'SYS ID' is '801', and 'WACN' is '801'. Below this, there are several input fields for 'Base' parameters: RFSS ID (1), Site ID (1), Ann Grp Addr (1), Loc Reg Area (1), SVC Class (60), Active Net (1), Loc/Glob Affil (0: Local), Group Affil (0: Accept), Registration (0: Accept), WUID Mapping (Auto), and Protected (Clear). A 'Display' soft key is visible on the right, with 'DEC' selected and 'hex' unselected. The main part of the screen is a 'Channel Plan' table with 8 rows. The first row is populated with values: Channel ID 1, Base Frequency 851.006250 MHz, Bandwidth 12.50 kHz, Transmit Offset -45.000000 MHz, and Channel Space 6.250 kHz. The remaining rows (2-8) have empty fields. At the bottom, there are soft keys for 'P25', 'Basic 800', 'RF', and 'INT'. A downward arrow soft key is also present on the right side.

Channel ID	Base Frequency	Bandwidth (kHz)	Transmit Offset	Channel Space
1	851.006250 MHz	12.50	-45.000000 MHz	6.250 kHz
2	0 MHz	12.50	0 MHz	0 kHz
3	0 MHz	12.50	0 MHz	0 kHz
4	0 MHz	12.50	0 MHz	0 kHz
5	0 MHz	12.50	0 MHz	0 kHz
6	0 MHz	12.50	0 MHz	0 kHz
7	0 MHz	12.50	0 MHz	0 kHz
8	0 MHz	12.50	0 MHz	0 kHz

Fig. 3-8 System Plan - Decimal Display Format

Arrow Up/Down Soft Key

The Up and Down Arrow Soft Keys navigate the Channel Plan data fields.

Save Soft Key

Pressing the Save Soft Key saves current System Plan Configuration to the Test Set's internal database. A saved System Plan can later be recalled for future use. Pre-configured System Plans are reconfigured to factory default parameters when the Restore Factory Defaults procedure is performed.

Cancel Soft Key

When configuring plan parameters, pressing Cancel Soft Key aborts all unsaved changes.

How to Configure a System Plan

The P25 System includes default System Plans that can be used as templates from which to create custom plans. All fields are display only until the Edit Soft Key is pressed.

To edit an existing System Plan:

1. Select a plan from System Plan menu.
2. Press Edit Soft Key. Screen updates to editable fields as shown in example below.
3. Enter plan name in Name field.
4. Make desired changes to various system parameters.
5. Press Save Soft Key.

System Plan					
Name		SYS ID	321	WACN ID	321
Base					
RFSS ID	1	Site ID	1	Ann Grp Addr	1
Loc Reg Area	1	SVC Class	3C	Active Net	1
Loc/Glob Affil	0: Local	Group Affil	0: Accept	Registration	0: Accept
WGID Mapping	Auto	WUID Mapping	Auto	Protected	Clear
Channel Plan					
Channel ID	Base Frequency	Bandwidth (kHz)	Transmit Offset	Channel Space	
1	851.006250 MHz	12.50	-45.000000 MHz	6.250 kHz	
2	0 Hz	12.50	0 Hz	0 Hz	
3	0 Hz	12.50	0 Hz	0 Hz	
4	0 Hz	12.50	0 Hz	0 Hz	
5	0 Hz	12.50	0 Hz	0 Hz	
6	0 Hz	12.50	0 Hz	0 Hz	
7	0 Hz	12.50	0 Hz	0 Hz	
8	0 Hz	12.50	0 Hz	0 Hz	
P25 Basic 800 VNC INT					

Fig. 3-9 Edit System Plan

When configuring plan parameters, pressing Cancel Soft Key aborts all unsaved changes. The Utilities File Management Tile allows saved plans to be imported to and exported from the Test Set.

Chapter 4

Miscellaneous P25 Options

Introduction

This chapter provides a functional description of P25 System Options that add to the functionality of P25 Base Option (390XOPT200) and P25 Trunking Option (390XOPT201).

Refer to Appendix A for information on option dependencies.

P25 LSM Option 390XOPT204

The P25 LSM Option provides features required to test Motorola® Linear Simulcast Modulation. P25 LSM Option includes all of the features found in the P25 System Option plus the following:

- Ability to transmit Motorola® LSM waveforms;
- Enables the EVM Meter and supporting remote commands;
- Enables the Trajectory Tile;
- Enables Frequency and IQ Constellation Tile selection.

LSM Modulation Selection

LSM measurements are enabled by selecting LSM as the Transmit Modulation Type.

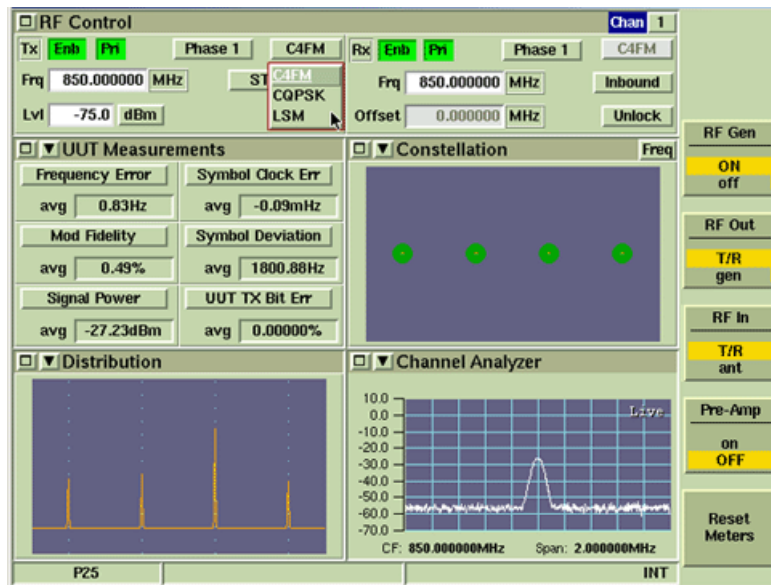
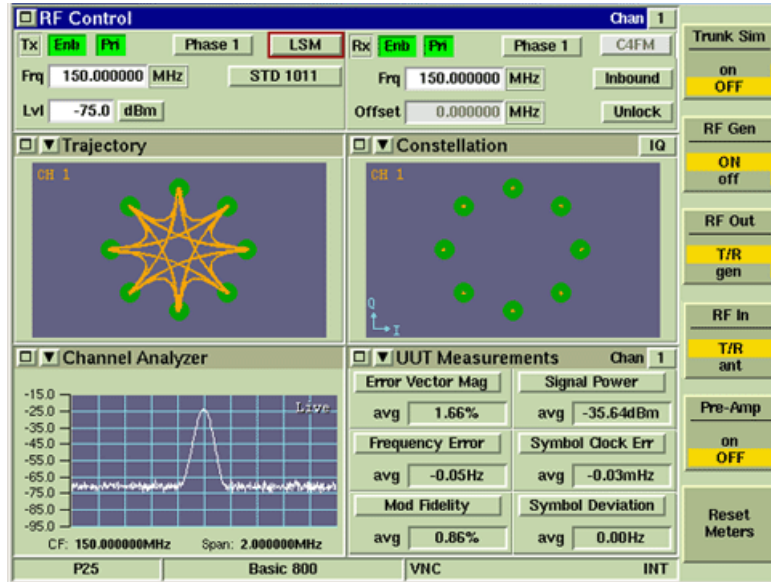


Fig. 4-1 Selecting LSM Modulation

Subject to Export Control, see Cover Page for details.

EVM Meter

The EVM Meter provides a measurement of how far symbol points are from an expected location.



EVM Meter Enabled

Trajectory Tile

The Trajectory Tile provides a visual representation of the received P25 signal. The Trajectory Tile can be used in combination with the Constellation Tile to evaluate modulation accuracy. The green markers on the plot field indicate the expected location of intersect points along the signal.

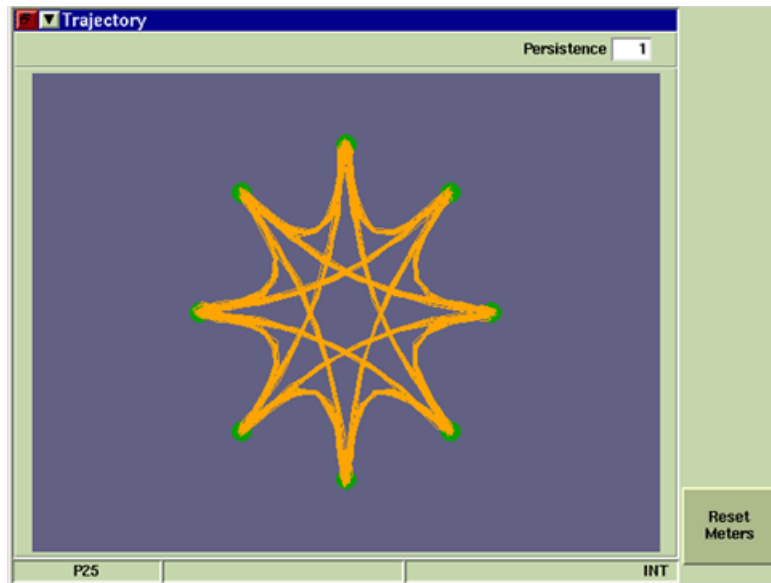


Fig. 4-2 Trajectory Tile

Subject to Export Control, see Cover Page for details.

Frequency and IQ Constellation Tile

The LSM Option enables the ability to configure the Constellation Tile to display either the Frequency domain or the IQ domain of the P25 signal. The example below shows the display configured to show both the Frequency and IQ Constellation plots of the same signal.

Frequency Constellation Plot

The Frequency Constellation plot represents the frequency domain of the P25 signal. The Frequency Constellation plot shows the demodulated frequency of the P25 signal following internal signal processing.

IQ Constellation Plot

The IQ Constellation plot represents the IQ domain of the P25 signal. The IQ Constellation plot shows the P25 signal before it is demodulated and processed.

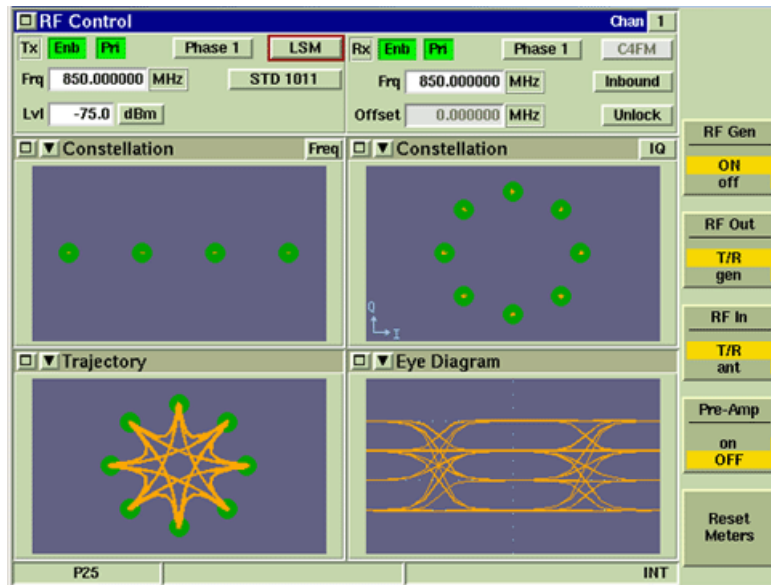


Fig. 4-3 Frequency and IQ Constellation Tiles

XML Logger Option 390XOPT206

Introduction

The P25 User Data I/O Port allows XML formatted information, referred to in this manual as XML files, to be relayed to and from a remote PC location and a Test Set. Each XML file contains processing instructions, a timestamp, and MAC header and MAC data blocks. When the PC and Test Set are connected, the Test Set sends any valid received P25 data to the PC in XML format. The PC receives the XML file, which can be saved to a file, edited and re-transmitted to the Test Set, or deleted.

Received XML files can be viewed by either a text editor or a customer developed Viewing Application.

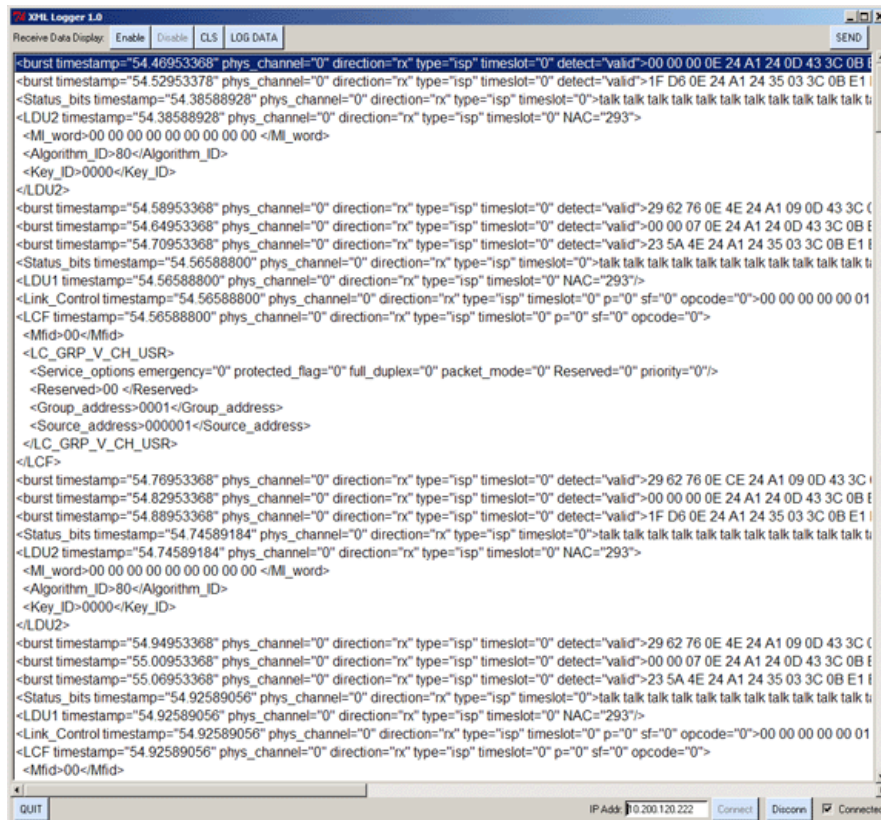


Fig. 4-4 XML Viewing Application - Logged Data

Viewing Application

The following information is necessary to develop an internal viewing application:

- The Test Set Raw Data Service is 'listening' on TCP socket number 2222.
- The Test Set's IP address can be configured and accessed from the Network Utility Tile. Refer to the 3900 Series Operation Manual for use of this feature.
- Netcat application for transferring XML commands to and from the Test Set. Netcat is available at <http://www.vulnwatch.org/netcat/>.

Connecting Equipment

To use the User Data I/O Port, the PC and the Test Set must be operating on the same local network via an Ethernet cable. Once equipment is connected, XML files can be transmitted to and from the PC and the Test Set. In this configuration, the Test Set functions as a TCP socket “server” and the users PC application functions as a TCP “client.” The port number used by the Test Set is 2222.

NOTE

The TCP socket on the PC should be opened in “blocking” mode so that XML data is not lost when it is sent to the Test Set. PC processing speed must be sufficient to allow it to accept the incoming data burst stream of XML lines.

P25 XML Command Structure

This section describes P25 XML commands and command formatting instructions. This section is intended for users familiar with XML and therefore only describes XML commands specific to the P25 Data I/O Port feature.

The P25 RF / Trunking Control Tile must be configured with the same settings defined in the XML command script prior to sending or receiving XML data.

<burst></burst>

The <burst> tag has the following attributes:

timestamp

The timestamp command is an 8 digit hexadecimal number representing:

- On data sent to the Test Set: the time of transmission of the data in the burst.
- On data received from the Test Set: the time of reception of the burst.

The timestamp is optional on commands sent to the Test Set. It is present on data loads received from the Test Set

Times are all referenced from the first bit of the burst. They are relative to an arbitrary value, so timestamps should only be used is to compute the times between bursts in the same capture.

Timestamp resolution is 20 nsec, meaning a burst at 00000010 and a burst at 00000020 are 320 nsec apart (20 HEX - 10 HEX is 16 decimal, x 20 ns timestamp resolution is 320 nsec).

phys_channel

This command specifies the channel (0 or 1) being transmitted or received.

- 0 = Channel 1
- 1 = Channel 2

direction

This command specifies whether the signal is being transmitted (tx) or received (rx).

detect

The field is used with receive only signals. Command indicates if received signal is valid or invalid.

type

Indicates if data is an inbound service packet (isp) or outbound service packet (osp).

timeslot

Indicates which timeslots in a TDMA system a specific data element is sent or received.

The command is skipped when it is received in a non-TDMA mode system or when command is not applicable to command usage.

Filter Parameters

<LogFilter></LogFilter>

The user may specify what types of information are to be sent from the Test Set by using the <LogFilter> tag. This tag requires using the parameter “phys_channel”, which has the same meaning as the “phys_channel” of the <burst> tag.

The <LogFilter> tag requires using all of the following sub-tags, each of which is a boolean value (0/1 on/off true/false):

<Environment></Environment>

The Environment tag controls the logging of Test Set configuration changes, such as received frequency, transmit frequency, etc.

<Raw></Raw>

Raw controls the logging of raw octets received.

<Protocol_Raw></Protocol_Raw>

Protocol_Raw controls the logging of raw protocol data (after decoding from the raw data stream but without interpretation).

<Protocol_Cooked></Protocol_Cooked>

Protocol_Cooked controls the logging of protocol data with the data parsed into a more legible format.

<Voice></Voice>

Voice controls logging of the voice data as sent to the vocoder.

Example:

```
<LogFilter phys_channel="1">
  <Environment>0</Environment>
  <Raw>0</Raw>
  <Protocol_Raw>0</Protocol_Raw>
  <Protocol_Cooked>0</Protocol_Cooked>
  <Voice>0</Voice>
</LogFilter>
```

NOTE

The following example DOES NOT WORK: it is missing some of the required subtags:

```
<LogFilter phys_channel="1">
  <Environment>0</Environment>
  <Raw>0</Raw>
</LogFilter>
```

Example XML File

The following is an example of a transmitted or received xml file:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE P25_log_data PUBLIC "-//Aeroflex/P25_log_data/1.0/EN"
"http://ftp.ifrsys.com/wowbaggr/p25_log.dtd" >
<P25_log_data>
<LogFilter phys_channel="1">
<Environment>0</Environment>
<Raw>1</Raw>
<Protocol_Raw>0</Protocol_Raw>
<Protocol_Cooked>0</Protocol_Cooked>
<Voice>0</Voice>
</LogFilter>
<burst timestamp="FFFFFFF" phys_channel="0" direction="tx" type="isp" timeslot="0">01 02 03
04 05 06 07 08 09 01 02 03 04 05 06 07 08 09 01 02 03 04 05 06 07
08 09 01 02 03 04 05 06 07 08 09 01 02 03 04 05 06 07 08 09 01 02
03 04 05 06 07 08 09
</burst>
</P25_log_data>
```

P25 SmartNet™ / SmartZone™ Option 390XOPT207

The 3900 SmartNet™ / SmartZone™ Option provides test features necessary to test SmartNet™ / SmartZone™ radios and systems. The SmartNet™ / SmartZone™ Option includes the following features:

- Two Channel selection capability;
- Ability to emulate a repeater station operation (not locked to a specific 'test sequence' for the radio);
- Ability to 'find' and monitor a SmartNet™ / SmartZone™ control channel and then 'follow' the channel, the group or the individual unit;
- Full analog (FM) parametric tests and digital P25 mode tests;
- Various 800 and 900 MHz frequency band and VHF/UHF frequency band selection;
- Channel designation and frequency settings for 800 and 900 MHz band.

Selecting SmartNet™ / SmartZone™ Protocol

When the SmartNet™ / SmartZone™ Option is installed, the feature is enabled by selecting SmartNet™ / SmartZone™ Protocol on the RF Control Tile.

When SmartNet™ / SmartZone™ is selected as the Protocol the Modulation type updates to FMFSK (FM Frequency Shift Keying).

Refer to section titled [RF Control Tile](#) in Chapter 2 for a description of the RF Control Tile.

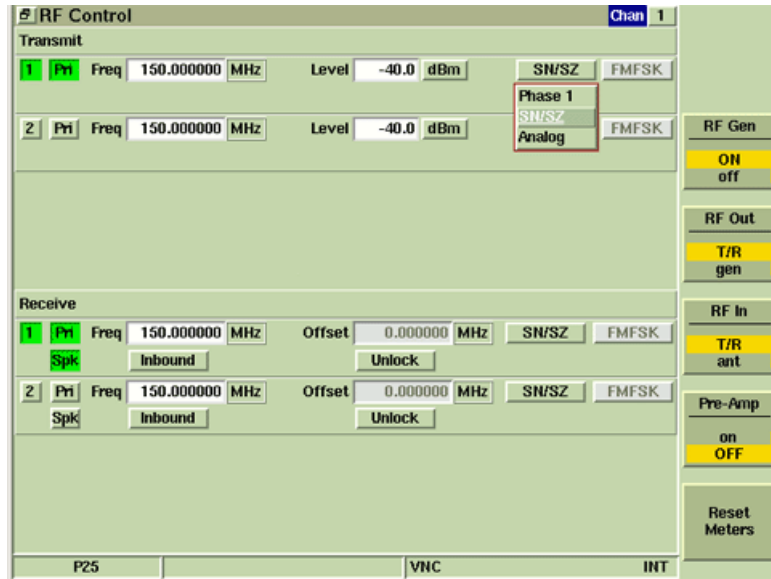


Fig. 4-5 Selecting SmartNet™ / SmartZone™ Protocol

SmartNet™ / SmartZone™ Band Plan Configuration

The P25 SmartNet™ / SmartZone™ System Option includes several pre-configured band plans which allow the user to quickly configure the Test Set to UUT system plan requirements. Users can select one of the pre-configured band plans to test a radio operating on one of the allocated SmartNet™ / SmartZone™ band plans, or they can configure a customized plan to test a radio operating on non-allocated channel plans.

The screenshot shows the 'System Plan' configuration window. The 'System Plan' dropdown is set to 'SZ 800 Domestic' and the 'Type' is 'SN/SZ'. The 'SYS ID' is '734'. Under the 'Base' section, 'Site ID' is '1' and 'Bandplan' is 'BP 800 DOMESTIC'. The 'Connect Tone' is '105 Hz'. Various other options like 'Auto Affiliate', 'All Secure Down', 'Tx Deviation', etc., are set to their default values. The 'Channel Plan' section is currently empty.

Fig. 4-6 SmartNet™ / SmartZone™ System Plan Configuration Tile

The screenshot shows the 'System Plan' configuration window with the 'Bandplan' set to 'BP_OTHERBAND'. The 'Channel Plan' section is populated with a table:

Channel Plan	Count	Chan Spacing	Start Freq	Stop Freq
1	0	5 kHz	800.000000 MHz	800.000000 MHz
2	0	5 kHz	800.000000 MHz	800.000000 MHz
3	0	5 kHz	800.000000 MHz	800.000000 MHz

Fig. 4-7 SmartNet™ / SmartZone™ Otherband Configuration

Subject to Export Control, see Cover Page for details.

SmartNet™ / SmartZone™ Radio Flags

Radio flags are enabled when SNSZ is selected from the Radio Type drop down menu on the RF Control Tile. The radio flags provide the ability to set the radio capabilities for different channel types.

Refer to section titled [Simulator Tile](#) in Chapter 2 for a description of the other fields on the Simulator Tile.

The screenshot shows the 'Simulator' window with the following configuration:

- System Parameter: SYS ID 734
- Virtual Mobiles: VM1 TGID 1, Call Type Group, PTT UID 1, Stored Speech, Stat OFF, Spkr, Key, ALG 80 Clear.
- Type: Cap PCC SCC DTC ATC
- SN/SZ Flags: 1 1 1 0
- External Mobile Status Table:

EM	UID	TGID	Msg
EM1	0	1	DEREG
			REG
			AFF
EM2	0	1	DEREG
			REG
			AFF
EM3	0	1	DEREG
			REG
			AFF
EM4	0	1	DEREG
			REG
			AFF
- Bottom status: P25, SZ 800 Domestic, VNC, INT

Fig. 4-8 Enabled SmartNet™/SmartZone™ Radio Flags

PCC (Phase 1 Control Channel)

When PCC is enabled, the Virtual Mobile searches for APCO-P25 Phase 1 Control Channels.

SCC (SmartNet™/SmartZone™ Control Channel)

When SCC is enabled, the Virtual Mobile searches for SmartNet™/SmartZone™ Control Channels.

DTC (Digital Traffic Channel)

When DTC is enabled, the Virtual Mobile is capable of operating on a Digital Traffic Channel.

ATC (Analog Traffic Channel)

When ATC is enabled, the Virtual Mobile is capable of operating on an Analog Traffic Channel (narrow-band, FM, with low-speed data). Implementation of this feature is planned for a future release.

SmartNet™ / SmartZone™ Deviation Meter

HSD Deviation Meter

SmartNet™/SmartZone™ signals use a High Speed Data Digital Control Channel. The HSD Deviation Meter measures the FM deviation on the SmartNet™/SmartZone™ High Speed Data Digital Control Channel. The HSD Deviation Meter is only available when SNSZ Protocol and FMFSK Modulation are selected on the Rx Channel.

KVL Loader Option (390XOPT209)

The KVL Keyloader Option adds the ability to enter encryption keys into the 3900 for DES and AES. Encryption keys may be loaded manually using either the front panel, external keypad, or the P25 Key Fill Device (KFD) interface protocol.

Automatic Loading

The KVL Keyloader option includes a cable for connecting the 3900 Test Connector to the KVL-3000 Plus™.

The KVL-3000 Plus™ may be set to load keys as is done for a radio, but instead the 3900 receives the key for checking the radio in secure mode. Refer to the KVL-3000 Plus™ User's Guide (68P81131E16-A) for more information about KVL device, and for details about how key loading is performed. Use the "ASTRO 25" mode of operation on the KVL device with the 3900. KVL ASN Mode is only supported with Option 20.

Manual Loading

Manual Key loading is configured using the Encryption Keys Configuration Tile.

P25 Explicit Mode VHF / UHF 390XOPT212

The P25 Explicit Mode UHF / VHF Option enables all bands for P25 Explicit message format mode of operation.

Selecting Explicit Message Format

Explicit Message Format is selected on the Trunking Control Tile. The message format indicator updates from an indicator field to a toggle button when the P25 Explicit Mode option is installed in the Test Set. Explicit Message Format is selected using this toggle button.



Fig. 4-9 Selecting Message Format Mode of Operation

Implicit Message Format

Implicit message format is typically used in frequency bands that use fixed channel assignments such as the 800 MHz Band, therefore, when Implicit Mode is selected the Receive parameters are system defined based on channel assignments.

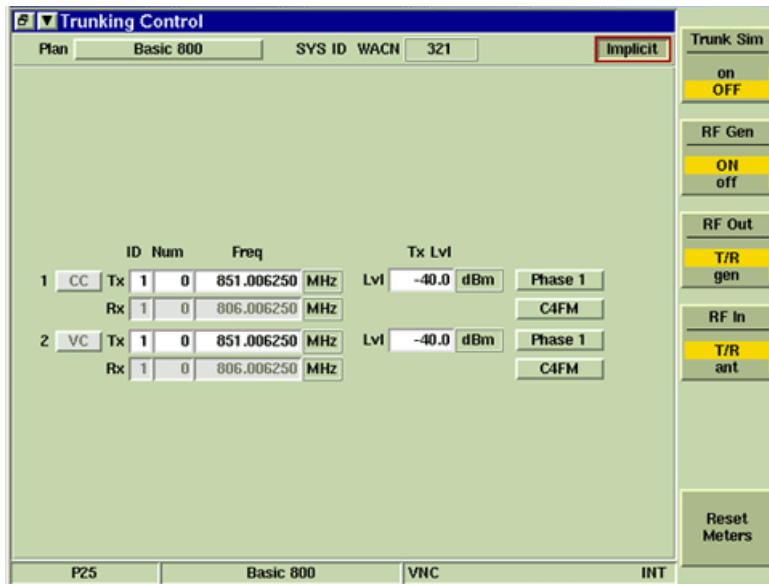


Fig. 4-10 Implicit Message Format Selected

Explicit Message Format

Explicit message format allows the user to configure Transmit and Receive parameters to test a radio operating on un-assigned channels. When Explicit Mode is selected, the user can manually configure Control Channel and Voice Channel Receive ID, Number and Frequency.

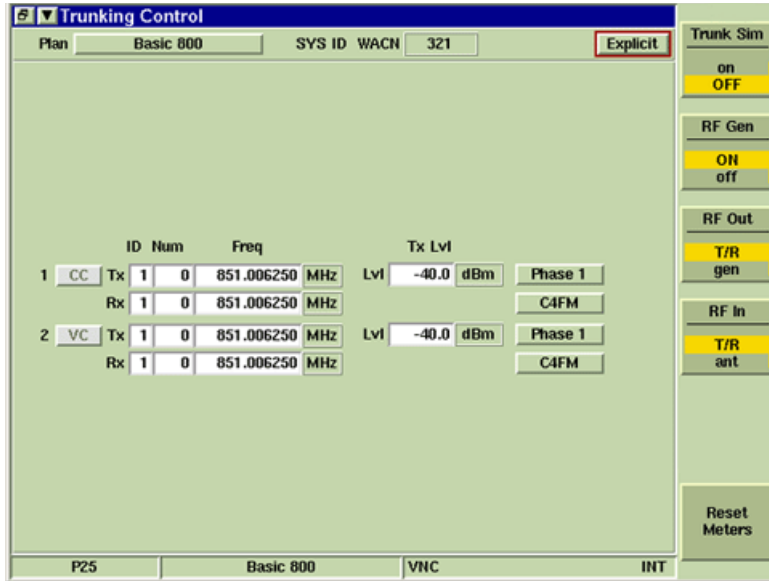


Fig. 4-11 Explicit Message Format Selected

P25 AutoTest II 390XOPT218

The 3900 Series P25 AutoTest II Option provides an interface to the Test Set's Autotest System and remote command functionality.

Refer to the 3900 Series Operation Manual for information on using the AutoTest II System.

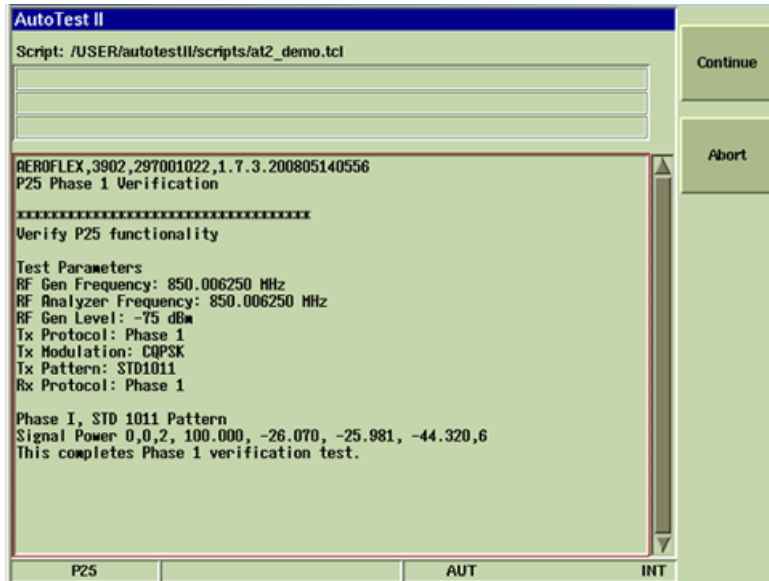


Fig. 4-12 P25 AutoTest II Example Script

Subject to Export Control, see Cover Page for details.

P25 AES Encryption 390XOPT240

The P25 AES Encryption Option supports encoding and decoding of Advanced Encryption Standard data exchanged between P25 radios.

Selecting AES Encryption

AES Encryption format is selected from the ALG drop-down menu on the Simulator Tile.

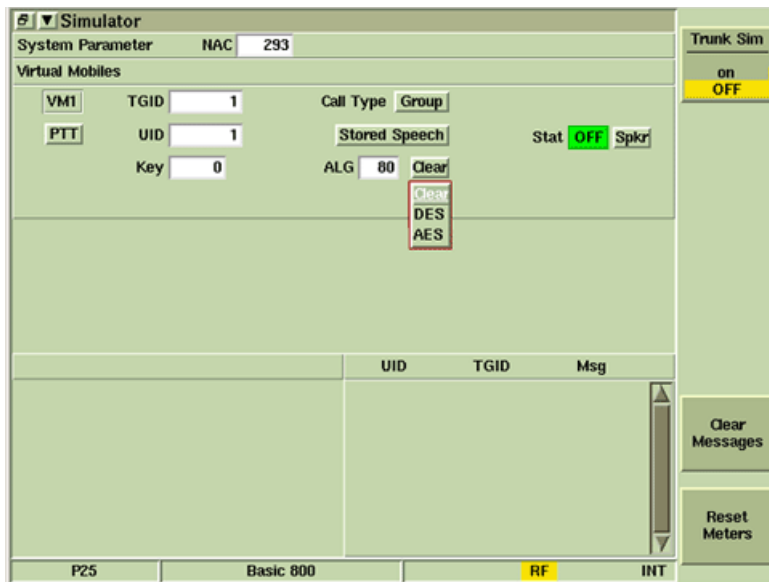


Fig. 4-13 AES Selection (Simulator Tile)

AES Encryption Keys

AES encryption keys are defined on the Encryption Keys Configuration Tile. Refer to [Encryption Keys Configuration Tile](#) for information on configuring encryption keys.

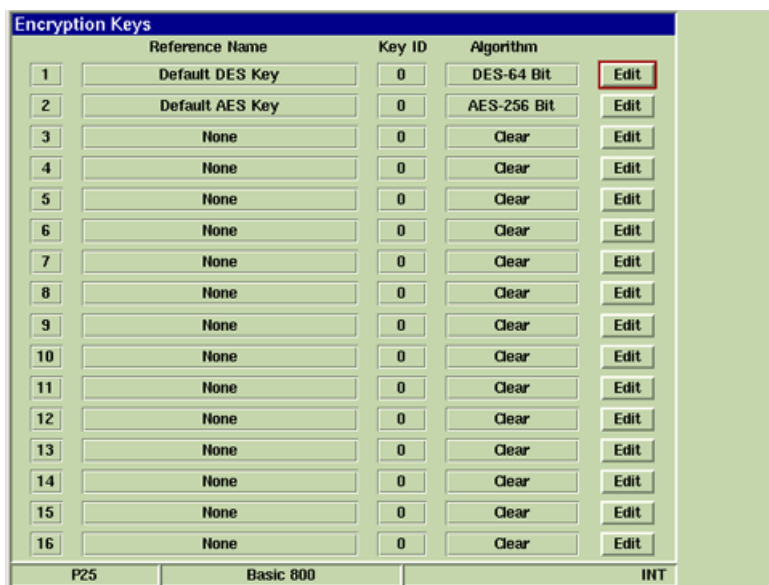


Fig. 4-14 AES Encryption Key Configuration

Subject to Export Control, see Cover Page for details.

Appendix A

Measurement Meter Dependencies

The UUT Measurement Meters available in the 3900 P25 Option depend on the options installed in the Test Set and the type of Protocol and Modulation selected on the RF Control Tile.

The following table shows the option required (in addition to P25 Base Option) and the protocol and modulation type that must be selected to enable and/or obtain valid meter measurements.

Rx Protocol	Analog	Phase 1	SNSZ	Requires Option #
Audio Distortion	x			
Audio Frequency	x			
Audio Level	x			
Audio Sinad	x			
Broadband Power	x	x	x	
EVM		x		390XOPT204
Demod Distortion	x			
Demod Frequency	x			
Demod Sinad	x			
Frequency Error		x	x	
FM Deviation	x			
HSD Deviation			x	390XOPT207
Inband Power	x			
Mod Fidelity		x		
RF Error	x			
Signal Power		x	x	
Symbol Clock Error		x		
Symbol Deviation		x		
UUT Tx BER		x		

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