AEROFLEX

3900 Series
Digital Radio Test Set
P25 Option Manual

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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 3920Digital 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 3920Digital 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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Preface

Chapter 1 - Introduction

Contains general information about the capabilities of the 3900 P25 Option.

Chapter 2 - P25 Operation

Contains functional descriptions of the 3900 P25 Option Tiles.

Chapter 3 - P25 User Data I/O

Contains information about transferring P25 data that is in XML format to and from the Test Set.

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Appendix A

P25 Options List A-1

Chapter 1

Introduction to P25 Option

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 perform RF and modulation parametric tests on the Unit Under Test (UUT).;
- DES Encryption capability.

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 for performing Error Vector Magnitude measurements.

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

Supports encoding and decoding of Advanced Encryption Standard data exchanged between P25 radios.

Verifying P25 Option Installation

To check the status of installed options:

1. Power on Test Set.
2. Press the **UTILS Key** twice.
3. Select **Software Settings**, **License** from the floating menu.

The License Tile (refer to Fig. 1-1) displays a list of installed options, including the version and version date of each. The option list varies according to the features installed on the Test Set.

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.

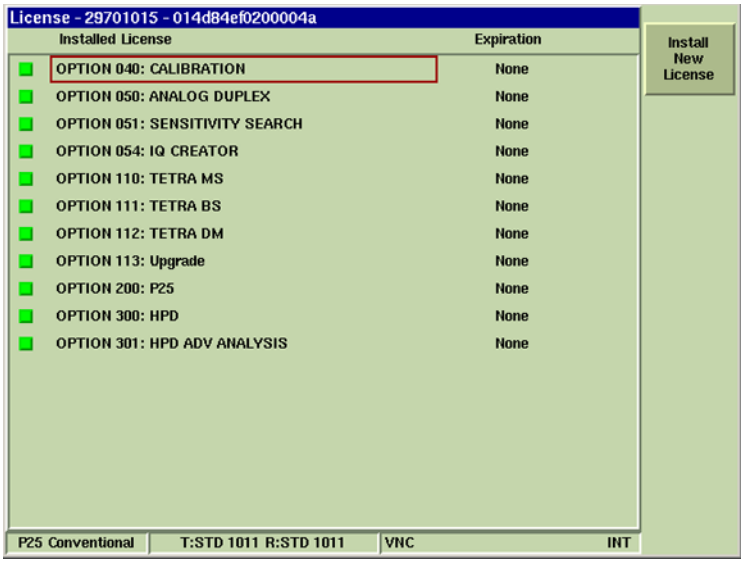

Fig. 1-1 3900 License Tile

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.

Chapter 2

P25 Software Operation

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 as well as features available with 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. These fields are notated with the clause **option enabled*. Refer to Appendix A, P25 Options List, for a description of P25 options.

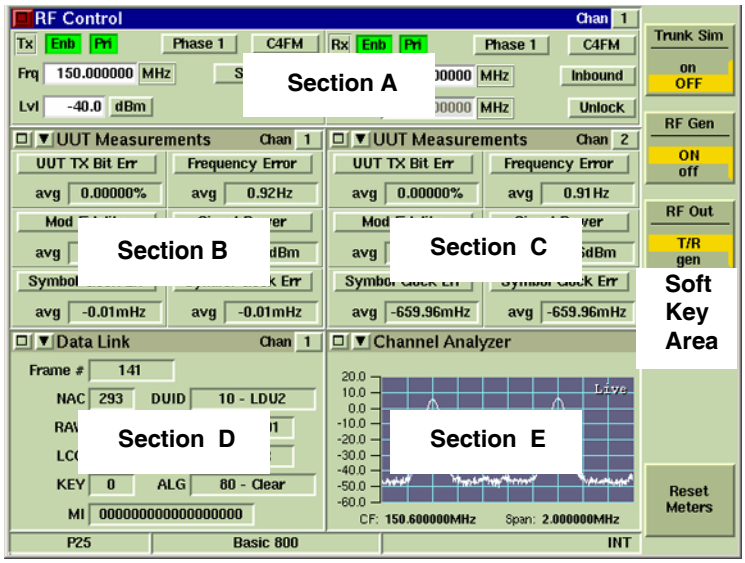

Fig. 2-1 P25 Display Layout

P25 System Tile Layout

The P25 User Screens can be configured according to 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.

RF Control Tile

P25 Option 390XOPT200 enabled.

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).

The P25 Base Option uses a single channel generator / receiver (CH1) configuration. The P25 Trunking Option utilizes two generator channels and two receiver channels (CH1 and CH2). To configure the RF Control Tile frequencies:

1. Select a primary channel (Pri toggle button) from which to establish a center frequency.
2. If desired, set secondary channel to any valid frequency. The secondary channel only transmits when it is within ±2.5 MHz of the center frequency (primary channel). A caution indicator is displayed if the secondary channel is set to an invalid frequency (refer to Fig. 2-3).
3. Enable Channel(s) as desired.
4. Turn [RF Gen] Soft Key to ON.

NOTE

Use the Primary Channel for obtaining test measurements.

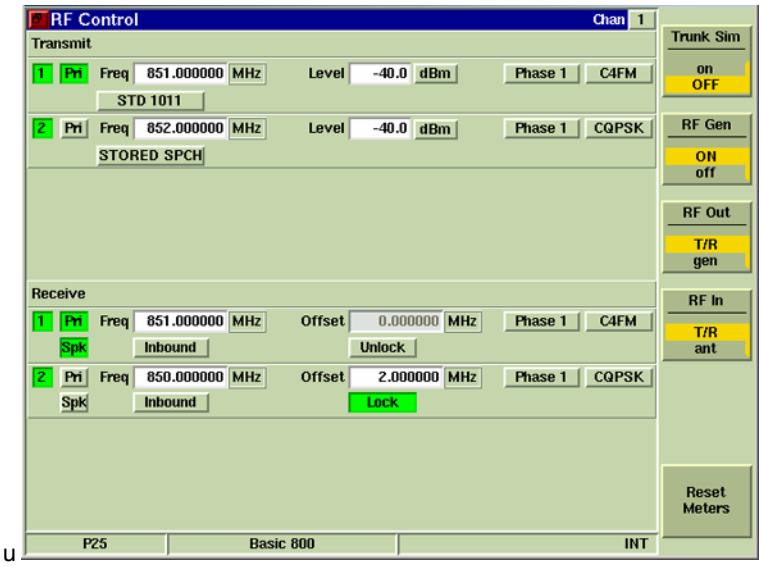

Fig. 2-2 P25 RF Control Tile

The 3900 P25 Trunking Option allows the user to configure Channel 1 and 2 to transmit and receive the same protocol with different modulation types, power levels and patterns selected on each channel as shown in Fig. 2-2.

Field/Soft Key Definitions

Chan (Channel)

Selects the channel data (Channel 1 or 2) that is visible on the minimized RF Control Tile.

Transmit Fields

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.

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.

Fig. 2-3 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.

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).

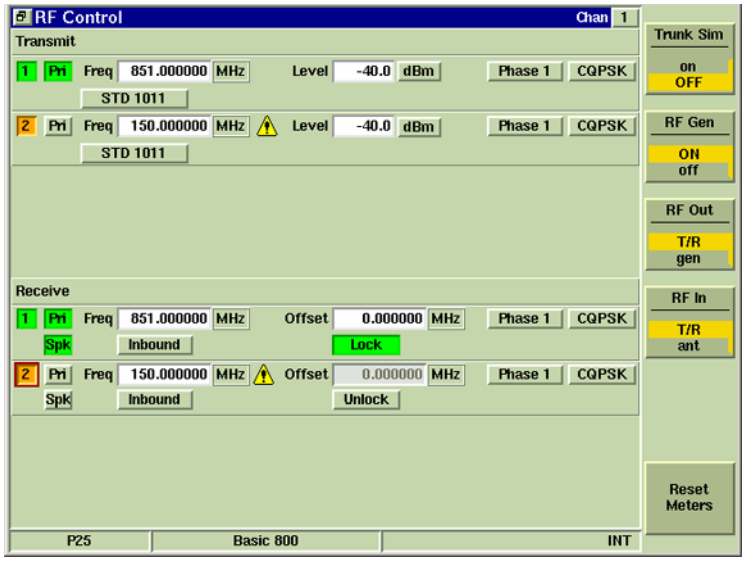

Fig. 2-3 Channel 2 - Invalid Parameter

Pri (Primary Channel)

The Pri 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.

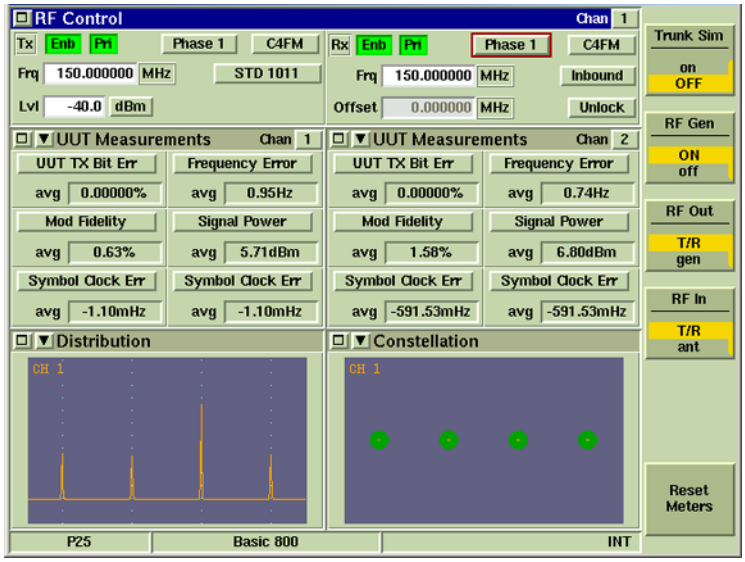

Fig. 2-4 Channel 1 Primary - Traces are ORANGE

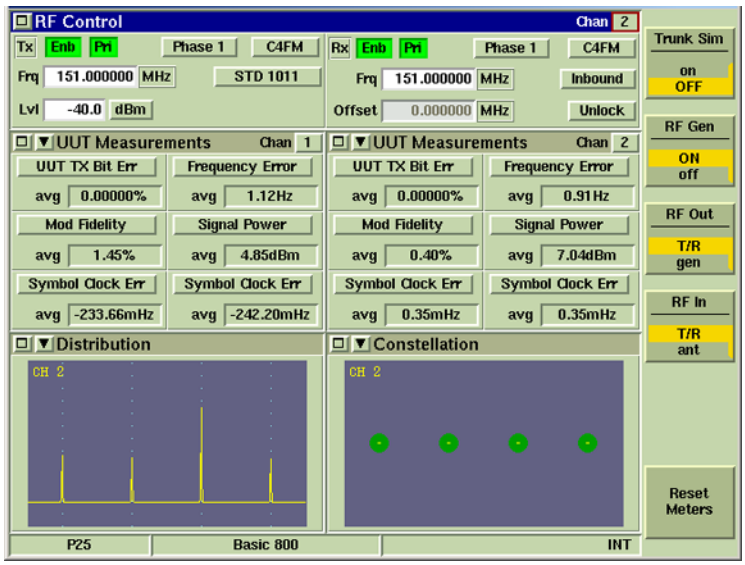

Fig. 2-5 Channel 2 Primary - Traces are YELLOW

Frq (Frequency)

Defines carrier frequency of the signal generated by the Test Set.

Level

Defines the output power level of the 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 Protocol.

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. The examples below show Modulation Accuracy Tiles for LSM (Fig. 2-6), C4FM (Fig. 2-7) and CQPSK (Fig. 2-8) modulations.

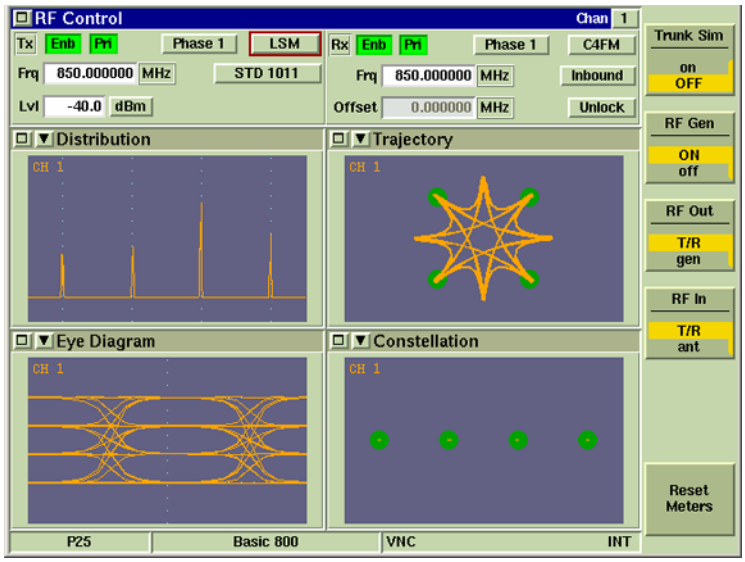

Fig. 2-6 LSM Modulation - Modulation Accuracy Plots

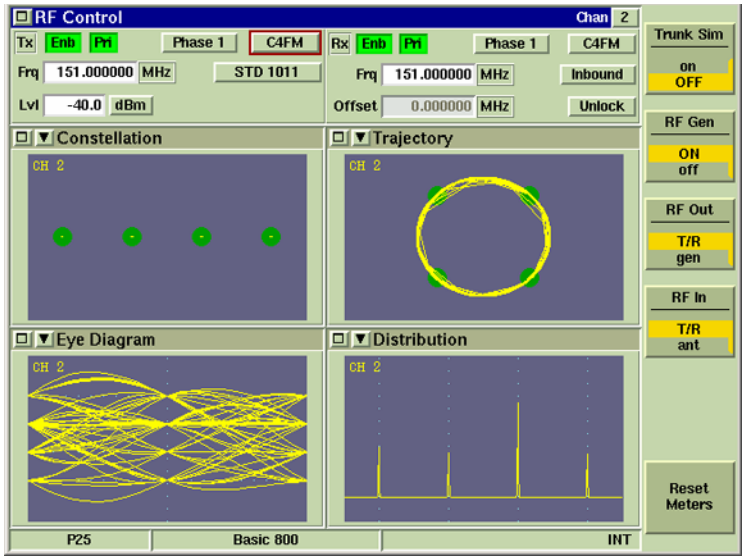

Fig. 2-7 C4FM Modulation - Modulation Accuracy Plots

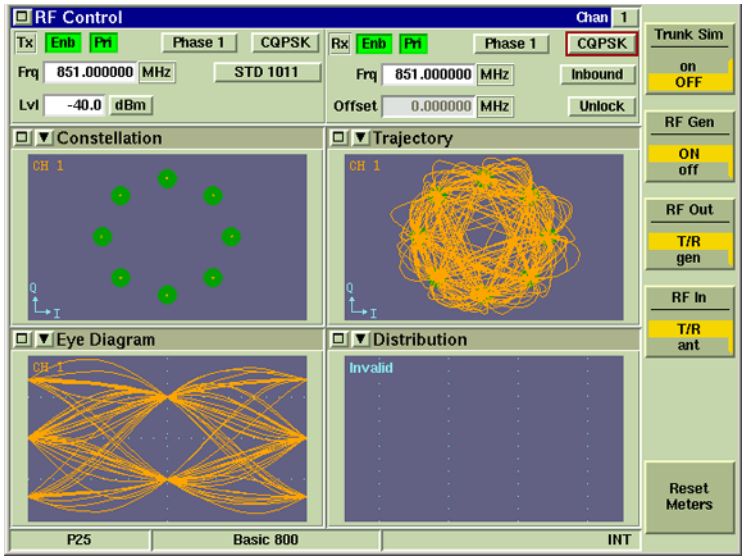

Fig. 2-8 CQPSK Modulation - Modulation Accuracy Plots

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.

Receive Fields

1 / 2 Channel Toggle Buttons

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

Pri (Primary Channel)

Selects the channel as the receiver center frequency.

Spk (Speaker)

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

Frq (Frequency)

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

Inbound/Outbound

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.

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

Selects Modulation Type of received signal. The Modulation types available depend on the Protocol type selected.

Lock / Unlock

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

[RF Gen] Soft Key

Turns RF Generator ON or OFF. When the RF Generator is OFF, an indicator appears in the Information Bar at the bottom of the display tile.

[RF Out] Soft Key

Selects the T/R Connector or GEN (Generator) Connector for the RF Output.

[RF In] Soft Key

Selects the T/R Connector or ANT (Antenna) Connector for Receiver Input.

[Reset Meters] Soft Key

Clears and resets the meter readings.

Configuration Tiles

P25 Configuration Tiles define parameters required when testing P25 radio systems.

Audio Configuration Tile

The Audio Configuration Tile defines Audio modulator and AF generator parameters. 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.

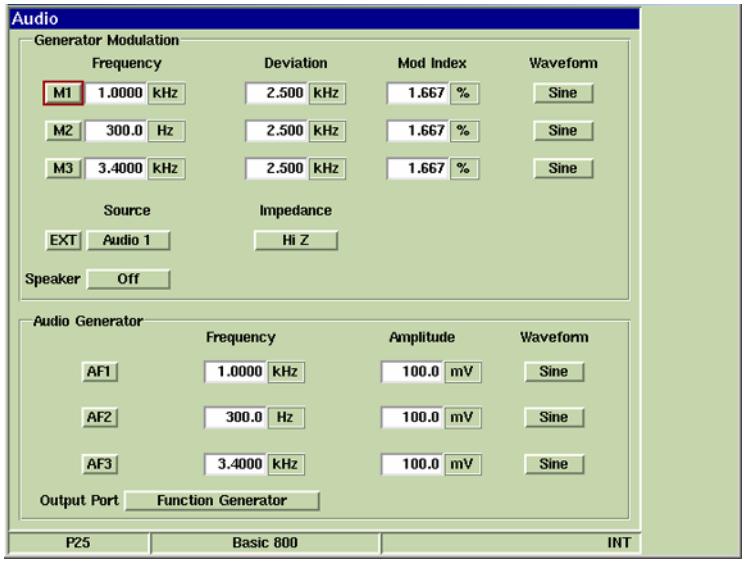

Fig. 2-9 P25 Audio Configuration Tile

Field/Soft Key Definitions

Modulation Generator Fields

M1, M2, M3 Buttons

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

EXT Button

The EXT button enables/disables an external modulation source.

Frequency

Sets the frequency for each Modulation generator.

Deviation

Defines the Deviation for each generator when FM 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 external input source.

Impedance

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

Speaker

Turns the Test Set's Loudspeaker On or Off.

AF Generator Fields

Configures the Test Set's internal audio generator.

AF 1, 2, 3

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.

Offsets Configuration Tile

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

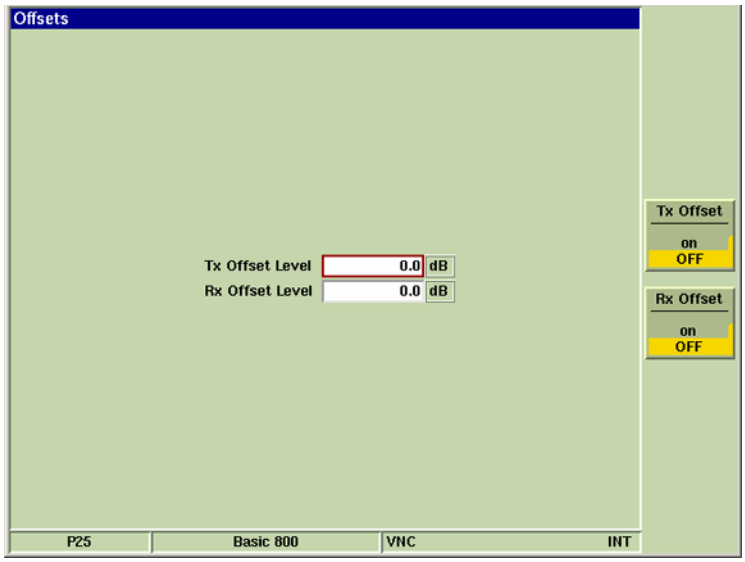

Fig. 2-10 Offsets Configuration Tile

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.

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 allows users to select one of the pre-defined system plans, or they can customize any of the pre-defined System Plans to meet specific test scenarios, then save the system plan 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.

NOTE

The System Plan Configuration Tile is **option enabled* with the P25 Trunking Option (390XOPT201).

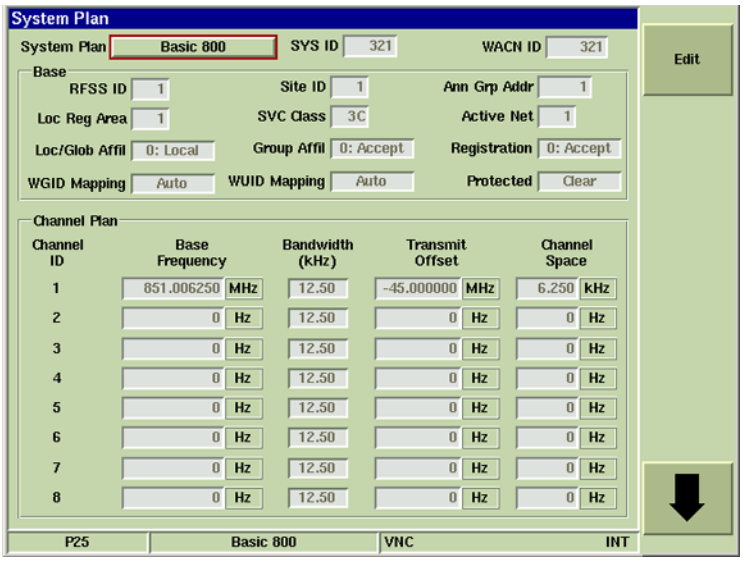

Fig. 2-11 P25 System Plan Configuration Tile

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 Configure a System Plan for instructions on how to create a custom 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. Currently Automatically selected by Test Set.

WUID Mapping

Selects method for obtaining Working Unit Identifier. Currently Automatically selected by Test Set.

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. The Test Set stores up to 16 configured channels in a System Plan file.

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.

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 configure a customized System Plan:

1. Select a plan from System Plan menu.
2. Press [Edit] Soft Key. Screen updates to editable fields as shown in Fig. 2-12.

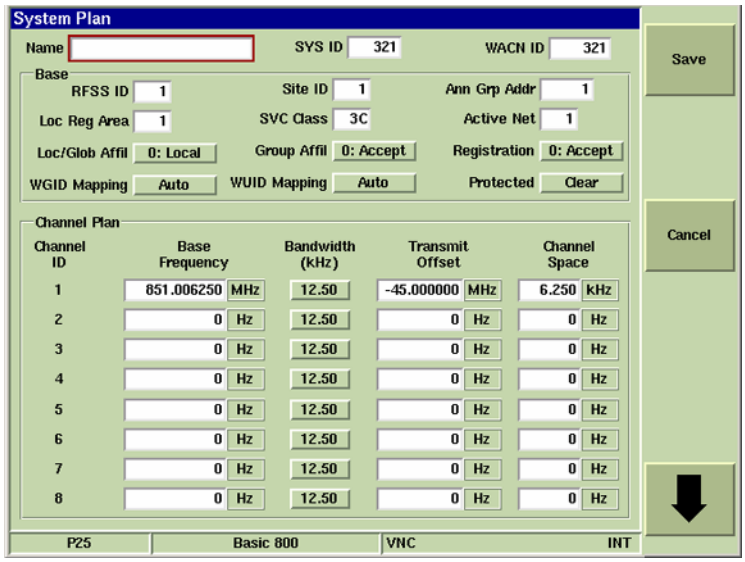

Fig. 2-12 Edit System Plan

3. Enter plan name in Name field.
4. Make desired changes to various system parameters.
5. Press [Save] Soft Key.

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.

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.

Field Definitions

Chan (Channel)

Selects the channel for which parameters are to be configured. Using the Lock button allows user to apply defined values to all channels.

Disabled/Enabled

Turns defined limits for selected measurement ON or OFF.

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 Tile turn **RED**.

Lower Limit

The LOWER LIMIT function sets a minimum acceptable reading for a specific measurement. When a measured level drops below the enabled LOWER LIMIT, the Meter Bar and reading background of the measurement Tile turn **BLUE**.

NOTE

When readings are within the enabled Upper and Lower limits, the Meter Bar and reading background turn **GREEN**.

Units

Selects the unit of measurement for applicable 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.

[Set All Averages To] Soft Key

Opens a soft key sub-menu that selects the number (sample rate) used to calculate all UUT measurement averages.

[Page 1/2/3] Soft Key

Displays limit settings for additional measurement meters.

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 a standard P25 feature. P25 AES Encryption is an **option enabled* feature.

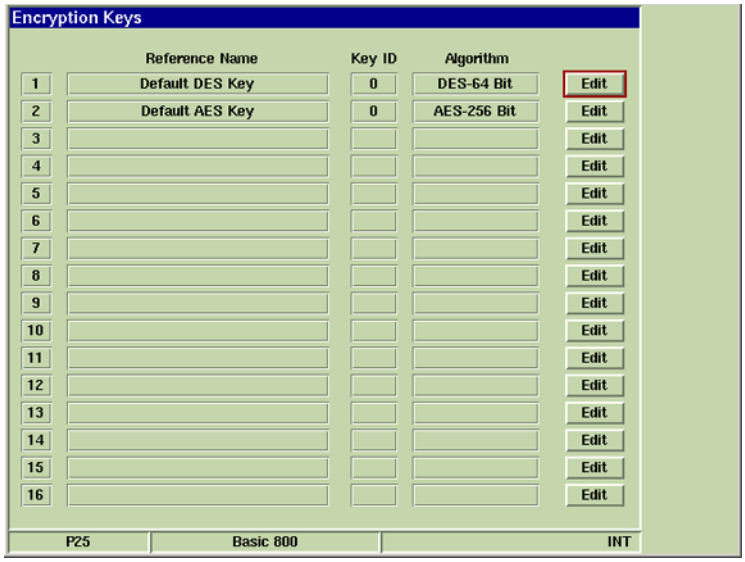

Fig. 2-13 P25 Encryption Keys Configuration Tile

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 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 Edit accesses a display tile (refer to Fig. 2-16) where the user can define encryption key parameters.

Validation

The Validation field displays various status indicators pertaining to the defined encryption key.

Key (Bytes 1-8)

Field defines the Encryption key value.

[Done] Soft Key

Pressing [Done] saves defined encryption parameters to the Test Set's internal memory and returns the display to the main Encryption Key Configuration Tile. If the Key (Bytes) field does not contain the minimum number of characters for the selected Algorithm type, **Key too short** is displayed in the Validation field (refer to Fig. 2-14) when the [Done] Soft Key is pressed.

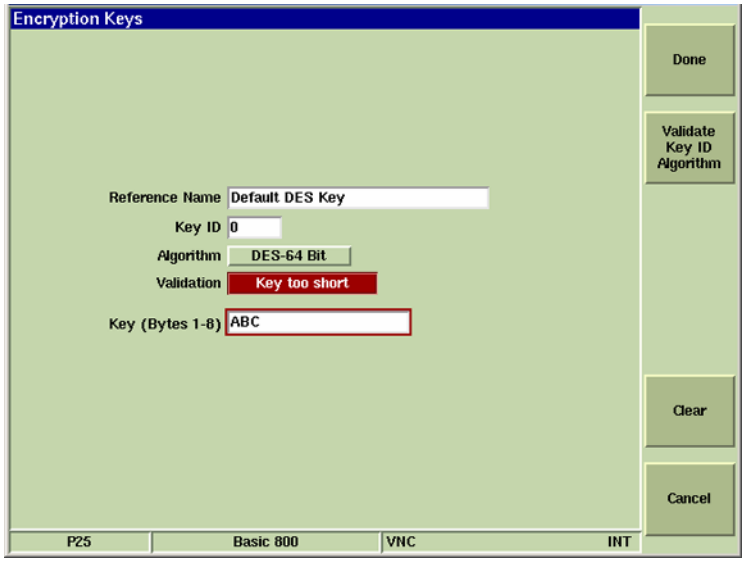

Fig. 2-14 Key (Bytes) Too Short

[Validate Key ID Algorithm] Soft Key

The [Validate Key ID Algorithm] Soft Key compares the entered Key ID and Algorithm pair with existing encryption keys to make sure the pair is not already defined under another Reference Name. If the Key ID and Algorithm pair are already defined, **Duplicate** is displayed in the Validation field. If the Key ID and Algorithm pair do not already exist, Passed is displayed in the Validation field (refer to Fig. 2-15).

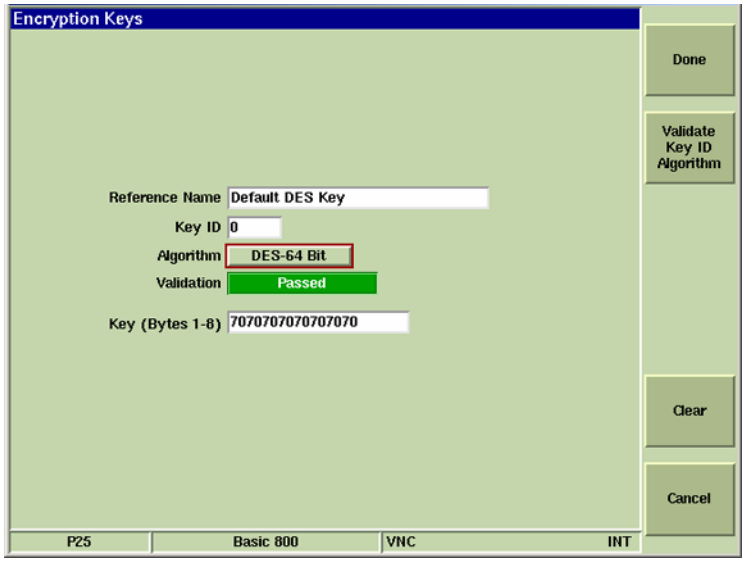

Fig. 2-15 Encryption ID Validation PASSED

[Clear] Soft Key

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

[Confirm] Soft Key

The [Confirm] Soft Key is displayed when the [Clear] Soft Key is pressed. User must press [Confirm] to clear encryption content.

[Cancel] Soft Key

[Cancel] terminates the current function, returning to previous Encryption Key Tile.

To Configure an Encryption Key:

1. Press one of the Edit buttons. Display changes as shown in example below.

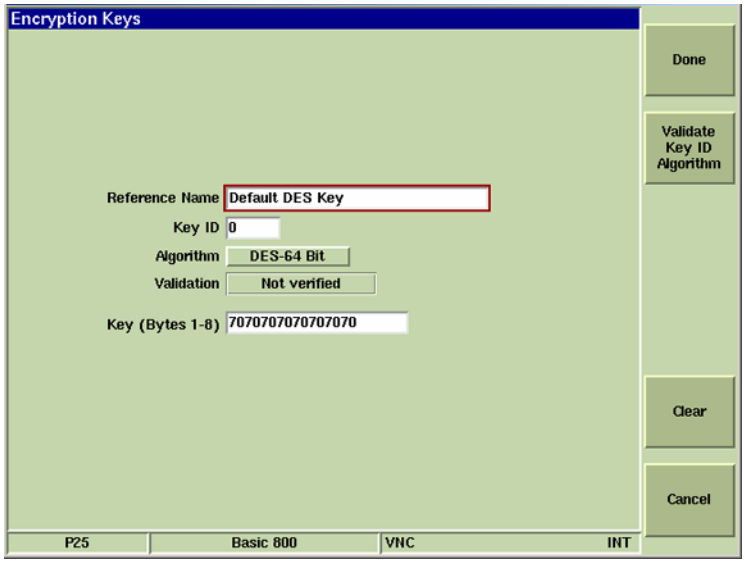

Fig. 2-16 Edit Encryption Key Parameters

2. Select Reference Name field and enter a name for the encryption key.
3. Enter Key ID value.
4. Select Encryption Algorithm Identifier.
5. Press [Validate Key ID Algorithm] Soft Key.
6. Verify Passed is displayed in the Validation field.
7. Enter Key (Bytes 1-8) value.
8. Press [Done] Soft Key.

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. The drop-down menu in the upper left hand corner of each section allows the user to select from the available list of meters. The meters that are available depends on the options installed in the Test Set.

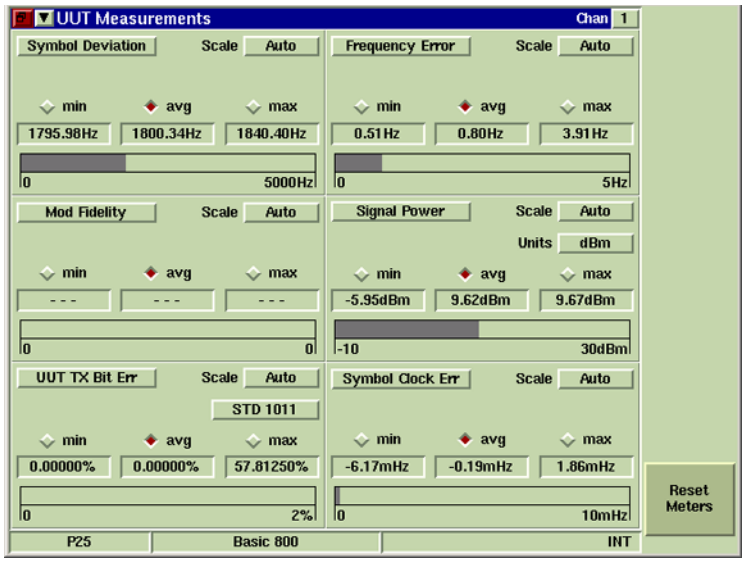

Fig. 2-17 UUT Measurements Tile

Display Configuration

The UUT Measurements Tile can be selected on any of the four Measurements Tiles. The example below shows the display configured to show measurements for both Channel 1 and Channel 2. Some measurements are only available when a channel is selected as the Primary Receive channel.

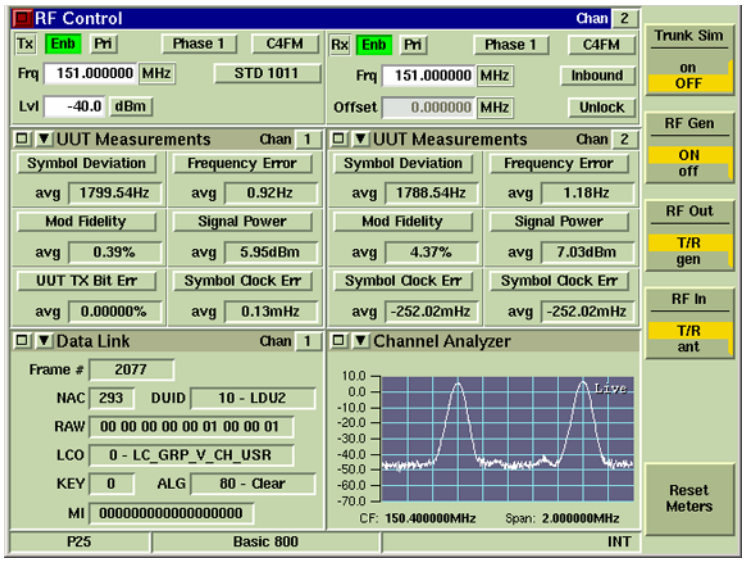

Fig. 2-18 UUT Measurements Tile - Configured for Two Channels

Field/Soft Key Definitions

Chan (Channel)

Selects the channel data being displayed on the UUT Measurements Tile.

min/avg/max Reading Indicators

These radio buttons select the reading displayed on the bar graphs and when the UUT Measurements 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 information on Upper and Lower Limits.

Scale

SCALE is a user defined field which defines the display of the METER BAR. User selection is made from a drop-down box offering the choice of Auto (default value) or a fixed value. The available range is specific to the referenced reading.

[Reset Meters] Soft Key

Clears and resets the meter readings.

Measurement Meters

The drop-down menu on each section of the UUT Measurements Tile selects the type of meter to be displayed in that section. Menu contents are based on the selected protocol and the options installed in the Test Set.

Broadband Power Meter

Indicates broadband power measurement of signal.

EVM (Error Vector Magnitude) Meter

Indicates the Error Vector Magnitude measurement for CQPSK modulation. This meter is **option enabled* and only visible when Receive modulation is set to CQPSK and Transmit is set to LSM.

Frequency Error Meter

Indicates frequency error of the received signal.

Modulation Fidelity Meter

Indicates the Modulation Fidelity reading of the received signal.

Signal Power Meter

Indicates power of the received signal. 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

Indicates the Symbol Clock Offset between the Test Set and transmitter for C4FM Modulation.

Symbol Deviation Meter

Indicates the average deviation of the received C4FM waveform.

UUT Tx BER Meter

Indicates Bit Error Rate (BER) readings of signal being sent by the UUT to the Test Set. The received pattern must match the transmitted pattern to perform BER measurements.

NOTE

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

Modulation Accuracy Tiles

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 format of the signal displayed changes according to various P25 parameters. The green circles on the plot field indicate expected location of plot clusters. The examples below show the Constellation Tile showing signal points for C4FM and CQPSK Modulation.

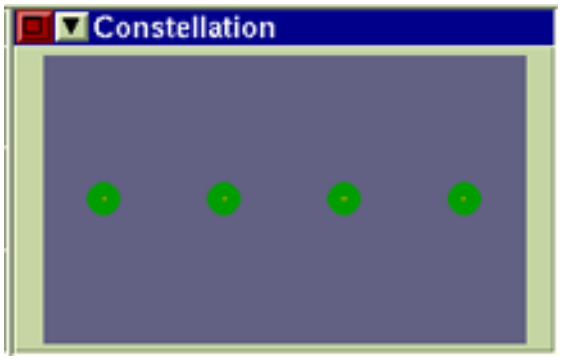

Fig. 2-19 Constellation Tile - C4FM Modulation

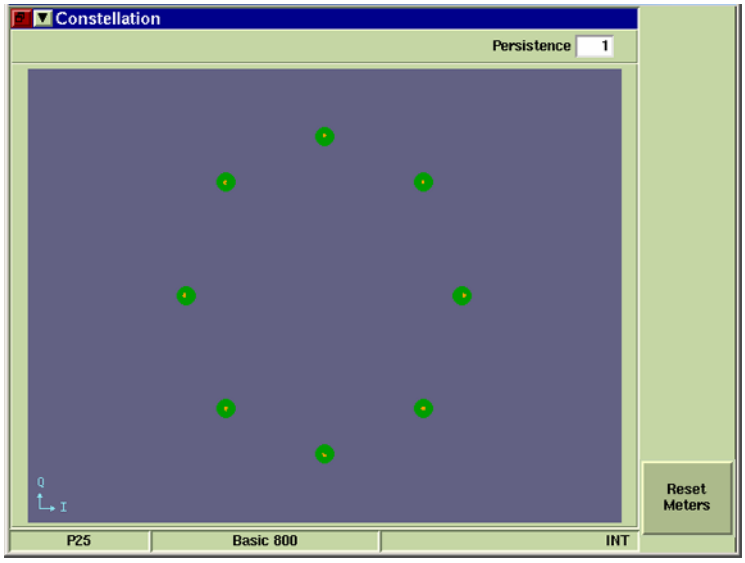

Fig. 2-20 Constellation Tile - CQPSK Modulation

Field/Soft Key Definitions

Persistence

Specifies how many trace plots are shown simultaneously on the display field. Selecting 1 means that only one slot is displayed on the graph field. Selecting 10 means the last 10 slots are displayed simultaneously on the graph field.

[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.

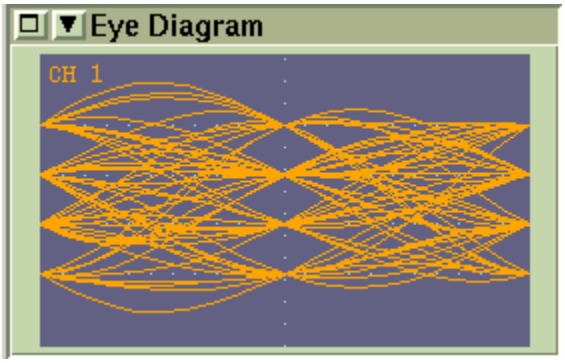

Fig. 2-21 Eye Diagram Tile - Minimized View - 2 Symbols

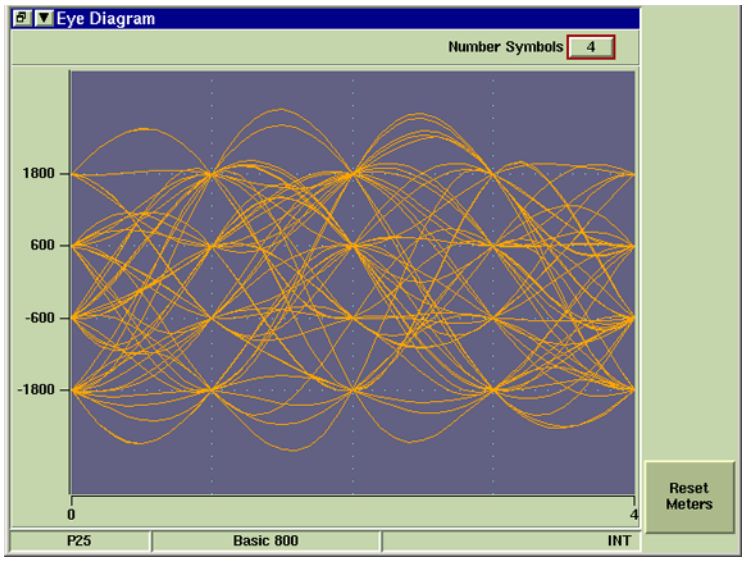

Fig. 2-22 Eye Diagram Tile - Maximized View - 4 Symbols

Field Definitions

Number Symbols

Defines the horizontal scale of the display field. Fig. 2-21 and Fig. 2-22 provide examples showing how adjusting the Number Symbols field changes the appearance of the trace on the graph field. Fig. 2-21 shows a trace with the Number Symbols field set to 2; Fig. 2-22 shows the Number Symbols field set to 4. Lowering the number or symbols shows more detail of the signal pattern.

[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. CPQSK Modulation types are invalid on this measurement tile.

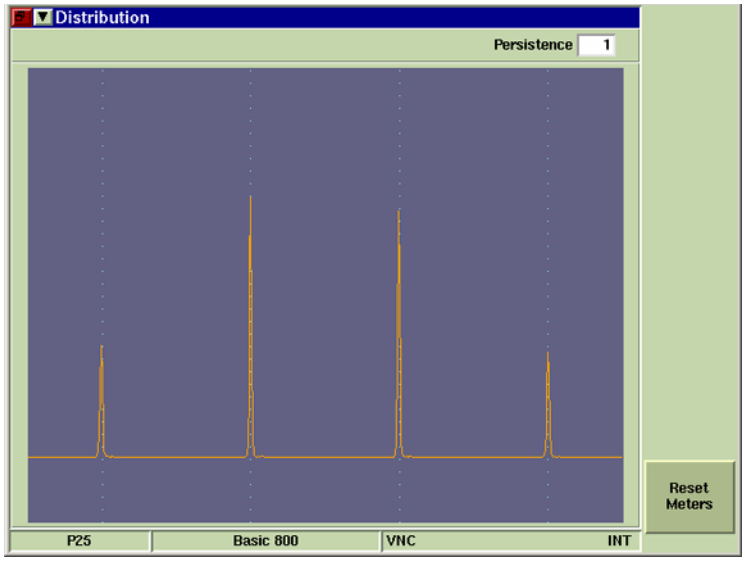

Fig. 2-23 Distribution Tile - Maximized View

Field Definitions

Persistence

Specifies how many trace plots are shown simultaneously on the display field. Selecting 1 means that only one slot is displayed on the graph field. Selecting 10 means the last 10 slots are displayed simultaneously on the graph field.

[Reset Meters] Soft Key

Clears and resets the meter readings.

Trajectory Tile

The Trajectory plot 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 indicate the expected location of intersect points along the signal.

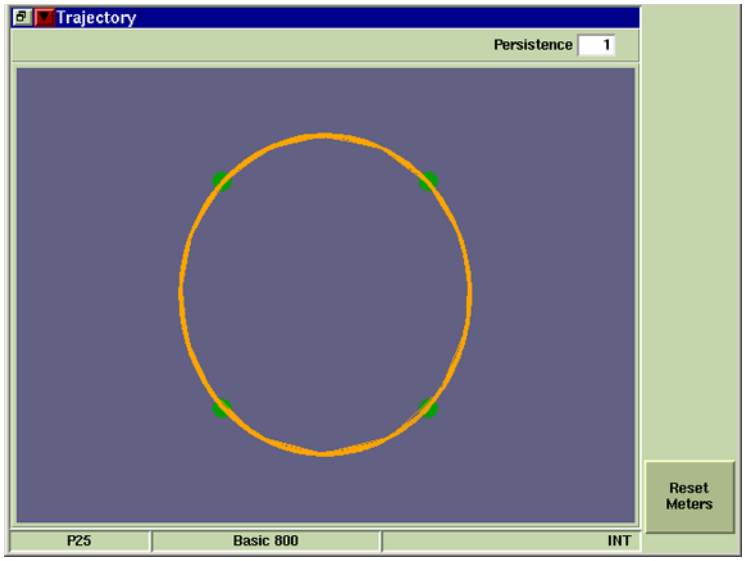

Fig. 2-24 Trajectory Tile - C4FM Modulation

Field/Soft Key Definitions

Persistence

Specifies how many trace plots are shown simultaneously on the display field. Selecting 1 means that only one slot is displayed on the graph field. Selecting 10 means the last 10 slots are displayed simultaneously on the graph field.

[Reset Meters] Soft Key

Clears and resets the meter readings.

P25 Protocol Tiles

Trunking Control Tile

P25 Trunking Option 390XOPT201 enabled.

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.

To configure the Trunking Control Tile frequencies:

1. Select the Trunking Control Tile.
2. Select a System Plan from the Plan name drop-down menu.
3. Verify desired Implicit / Explicit mode is selected (if option is enabled).
4. Enter Control Channel frequency and desired power level.
5. Enter Voice Channel frequency and desired power level.
6. Set [Trunk Sim] Soft Key to ON.

After the Test Set is configured, key the unit under test to generate measurement and test data.

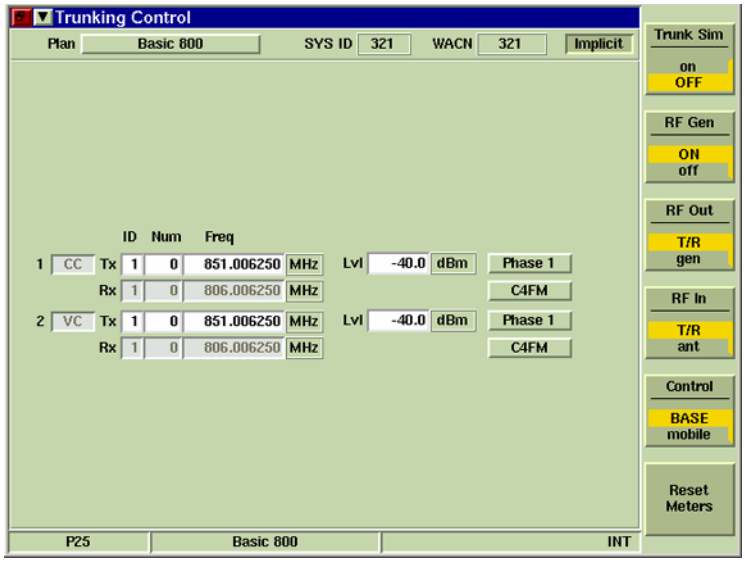

Fig. 2-25 Trunking Control Tile

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.

Message Format

The Implicit / Explicit toggle button selects whether the simulator uses Implicit or Explicit message format data fields. Implicit message format is the standard format used within the P25 system. Explicit message format is **option enabled*.

Implicit

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.

Explicit

When Explicit mode is selected the mobile uses Explicit message formats (multi-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 is the protocol type 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

Turns RF Generator ON or OFF. When the RF Generator is OFF an indicator appears in the Information Bar at the bottom of the display tile.

[RF Out] Soft Key

Selects the T/R Connector or GEN (Generator) Connector for the RF Output.

[RF In] Soft Key

Selects the T/R Connector or ANT (Antenna) Connector for Receiver Input.

[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.

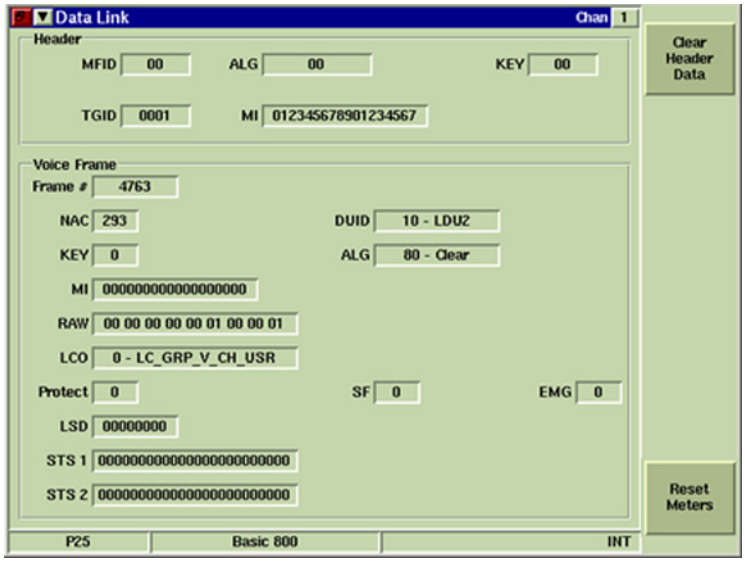

Fig. 2-26 Data Link Measurements Tile

Field/Soft Key Definitions

The fields on this tile are read-only and can not be edited by the user.

Chan (Channel)

Selects the channel data being displayed on the Data Link Tile.

Header Data

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

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

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 the External Mobile (EM), or 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, the fields on the Simulator Tile set radio parameters for several call parameters.

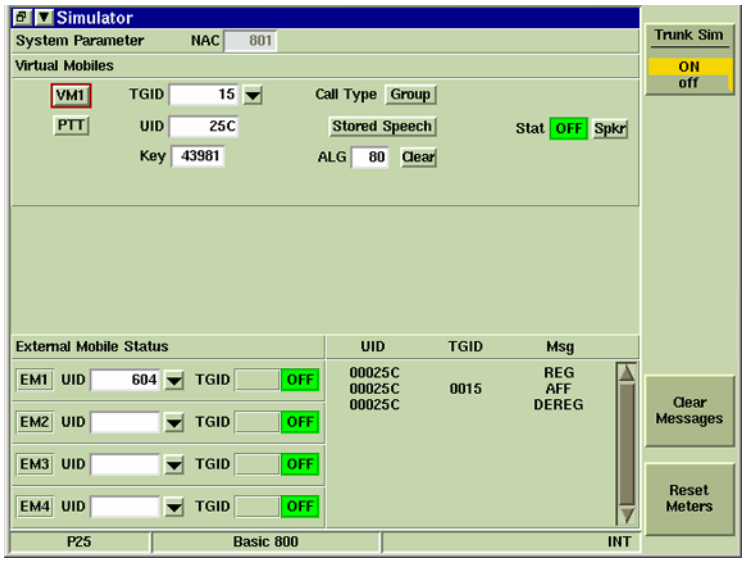

Fig. 2-27 P25 Simulator Tile

The minimized view of the Simulator Tile can be configured to display External Mobile Parameters (EM View), Logged Data (Log View) or Virtual Mobile Parameters (VM View).

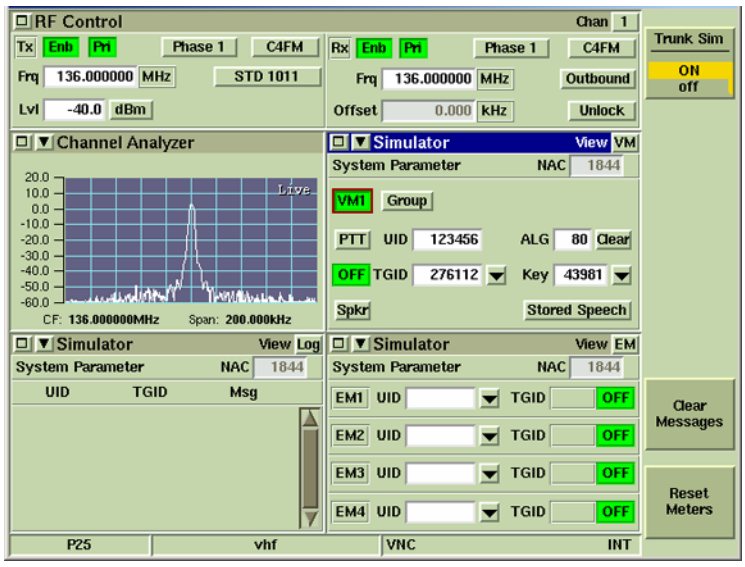

Fig. 2-28 P25 Simulator Tile - Minimized View Options

System Parameter

NAC

Network Access Code of Virtual Mobile. When operating in non-trunking mode, the NAC is user defined. When Trunking Simulator is ON, the NAC value is system generated as a combination of the WACN and System ID.

Virtual Mobile Field Definitions

VM1

This toggle button enables the Virtual Mobile. The toggle button appears as a label until Trunking Simulation is enabled (ON).

PTT (Push to Talk)

Enabling the Push-to-Talk (PTT) toggle button keys the virtual radio and begins continuous transmission.

TGID

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

UID

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

Call Type

This button defines the type of call being simulated by the Virtual Mobile. P25 Simulator currently supports Group calls.

Pattern

This menu defines the voice pattern being transmitted by the Virtual Mobile.

Stat

The Call Status indicator displays the Virtual Mobile's call status.

Spkr

Toggle button turns Test Set speaker on and off.

Key

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

ALG

Defines the Virtual Mobile's Encryption Algorithm Identifier as a two digit hex value. DES encryption is available as a standard feature; AES encryption support is **option enabled*.

Range is 0x0 to 0xFF.

External Mobile Field Definitions

The Simulator Tile allows the user to monitor four external mobiles.

UID

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

TGID

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

Call Status Indicator

The Call Status Indicator is located to the right of the TGID field. The Call Status Indicator displays the external mobile's call status.

REG

External Mobile has registered with the Test Set.

AFF

External Mobile has affiliated with the Test Set.

Call Logging Field

The Call Logging Field displays external mobiles registration, affiliation and deregistration activity.

UID

Unit Identification of the External Mobile.

TGID

Talk Group Identifier of the External Mobile.

MSG

Message type sent by the External Mobile and decoded by Test Set.

REG

External Mobile has sent a registration message to the Test Set.

AFF

External Mobile has sent an affiliation message to the Test Set.

DEREG

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.

[Clear Messages] Soft Key

Clears message data in Call Logging Field

[Reset Meters] Soft Key

Clears and resets the meter readings.

P25 Power Measurements

Power Over Time Tile

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

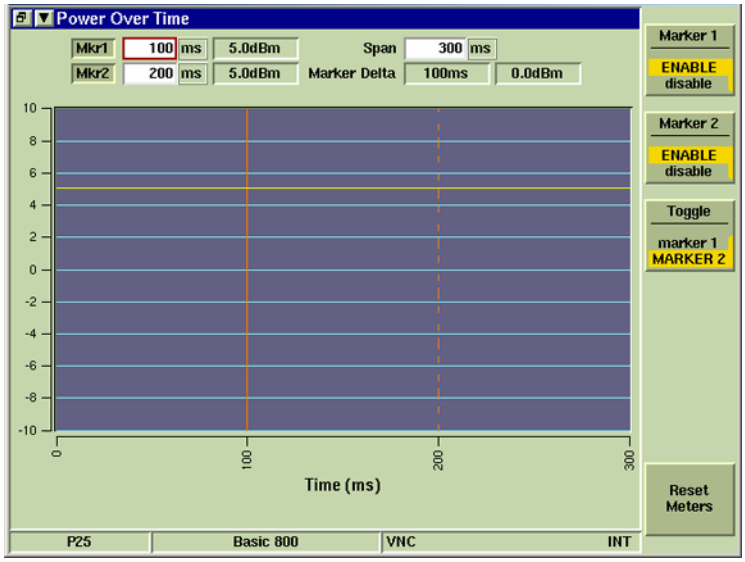

Fig. 2-29 Power Over Time Tile

Field/Soft Key Definitions

Mkr1 / Mkr2

Enable (ON) or disable (OFF) vertical markers on the plot field.

Marker Position

The data fields to the right of the Mkr1 and Mkr2 toggle buttons define marker positions.

Power Measurement

The data fields beside each marker position field indicate the power reading at the signal point.

Marker Delta

The Marker Delta fields indicate the difference between Marker 1 and Marker 2 positions and the difference in the Power reading between these points. The Marker Delta fields only contain data when both markers are enabled.

Span

Span sets the length of time (horizontal scale) over which the power measurement is displayed. Maximum Span setting is 24,000 ms.

[Marker 1/Marker 2] Soft Key

Enable (ON) or disable (OFF) vertical markers on the plot field.

[Toggle Marker] Soft Key

The [Toggle Marker] Soft Key changes and indicates marker focus. When the Power Over Time Tile is minimized, pressing this soft key also changes the marker reading displayed at the top of the tile.

[Reset Meters] Soft Key

Clears and resets the meter readings.

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Chapter 3

P25 User Data I/O Port

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.

NOTE

Received XML files can be viewed by either a text editor or a customer developed Viewing Application. This is an **option enabled* feature.

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 the following sub-tags (all sub-tags MUST be present), 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:

```
<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="FFFFFFFF" 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 0607 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>
```

Appendix A

P25 Options List

P25 Options

The following table identifies P25 Options currently available in the 3900.

System	Features Provided	Option #	Special Notes
P25	Provides the ability to transmit and receive P25 modulated signals and to perform RF and modulation measurements on P25 radios and systems.	390XOPT200	Includes Vocoder Option (390XOPT216)
Trunking	Provides features for testing all bands of Trunked P25 radios and systems.	390XOPT201	**Requires** 390XOPT200
P25 DES Encryption	Supports encoding and decoding of Data Encryption Standard data exchanged between P25 radios.	390XOPT202	Included in 390XOPT200
LSM	Provides features for testing Motorola® Linear Simulcast Modulation and enables EVM Meter.	390XOPT204	**Requires** 390XOPT200
XML Logger	The P25 XML Logger allows XML formatted information to be relayed to and from a remote PC location and a Test Set.	Contact Aeroflex Sales Department	**Requires** applicable P25 Options **Requires** XML Viewing Application
Explicit Mode VHF / UHF	Enables all bands for P25 Trunking Explicit Mode of operation.	390XOPT212	**Requires** 390XOPT200 and 390XOPT201
P25 AutoTest II	The AutoTest II Option provides an interface between the Test Set's AutoTest System and remote command functionality.	390XOPT218	**Requires** applicable P25 Option.
P25 800 MHz Bands	Supports P25 radio and system testing in 800 MHz frequency band.	390XOPT221	Included in 390XOPT201
P25 700 MHz / UHF / VHF Bands	Supports P25 radio and system testing in 700 MHz, UHF and VHF frequency bands.	390XOPT222	Included in 390XOPT201
P25 AES Encryption	Supports encoding and decoding of Advanced Encryption Standard data exchanged between P25 radios.	390XOPT240	**Requires** 390XOPT200.
P25 Trunked Base Station Simulator	Provides P25 Trunked Base Station functionality for testing P25 mobile radios.	390XOPT244	Included in 390XOPT201

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