AEROFLEX

3900 Series Digital Radio Test Set

HPD® Option Manual

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3900 Series

Digital Radio Test Set

HPD® Option Manual

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10200 West York / Wichita, Kansas 67215 U.S.A. / (316) 522-4981 / FAX (316) 524-2623

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Preface

Scope

This manual contains operational descriptions of the features contained in the 3900 Series HPD® Test System Options. Refer to the 3900 Series Operation Manual for information regarding general Test Set operation.

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 personnel familiar with the use of the 3900. Refer to the 3900 Series Operation Manual for information pertaining to Test Set operation.

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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Chapter 1

General Description

HPD® Option Overview

HPD®, High Performance Data, has been developed by Motorola to address the need for High Performance packet data operation on 700 and 800 MHz channels within the Narrowband 25 kHz bandwidth. The 3900 HPD® Options provide users with the ability to test High Performance Data systems. This manual describes features and functions specific to the 3900 Series HPD® Testing Option and HPD® Advanced Analysis Package. Refer to the 3900 Series Operation Manual for details regarding general operation of the Test Set.

HPD® can be configured for two modes of operation. When configured to operate in BR Mode the Test Set simulates Base Radio operation and is used to test the functionality of Motorola HPD® MSU's. When configured to operate in MSU Mode the Test Set simulates Mobile Subscriber Unit operation and is used to test the functionality of Motorola BR's.

HPD® Testing Option

The HPD® Testing Option (Motorola Part # R2091A) includes the following capabilities and features:

- Meter fields display measurement readings for the following parameters:
  - Signal Power
  - Frequency Error
  - EVM
  - Symbol Clock Error
  - Rx BER
  - Occupied Bandwidth
  - Burst Timing Error (when Receive Sync Mode is set to TDO)
  - Amplitude Imbalance
  - Phase Mismatch
  - Carrier Feed Through
- The user is able to define the following parameters:
  - The number of bursts over which readings are calculated.
  - Maximum frequency drift and Frequency profile period for transmitted signal.
  - Ability to include or exclude TDM Synchronization from the transmitted signal.
  - Modulation type, Sync Mode, Burst type and PSC of transmit and receive HPD® signals.
- Data I/O Port feature allows user(s) to configure signal files in XML format which can be transmitted to and from the 3900 Test Set.
- The EVM (Error Vector Magnitude) graph plots the average adjustment compensation values the Test Set applies to the received signal to match the signal to the expected points along the burst.
- The Constellation and Trajectory Tiles display visual representations of the received HPD® signal for QPSK, 16 QAM and 64 QAM modulation types.

HPD® Advanced Analysis Package

The HPD® Advanced Analysis Package (Motorola Part # R2092A) includes all features in the HPD® Testing Option as well as the following capabilities and features:

- Rx Bits Tile provides a readout of the bit blocks received in the HPD® data stream.
- Rx Time Display Tile shows the history of the frequency error, symbol clock error or power readings over a user defined span of time.
- Magnitude/Phase Error Tile shows magnitude and phase fluctuations of the received signal over a period of one burst.
- Eye Diagram Tile provides representations of the symbol pattern of the received frequency.
- Power Profile Display Tiles provide visual representation of the Full and Ramp power profile readings.
- I & Q Display Tile displays the I and Q patterns in the last received signal.

Installing HPD® Option

Refer to the section titled Install New License (Option) File in Chapter 3 of the 3900 Series Operation Manual for option installation procedures.

HPD® Option Status

Verifying HPD® Option Installation

To check the status of installed options:

1. Push the UTILS Key on the front panel of the 3900 twice.
2. Select Software Settings, License from the floating menu.

The License Tile displays a list of installed options, including the version and version date of each option (refer to Fig. 1-1). HPD® Testing Option is option 300; HPD® Advanced Analysis Package is Option 301. The option list varies according to the features installed on the Test Set. “Try before you buy” options have an expiration date.

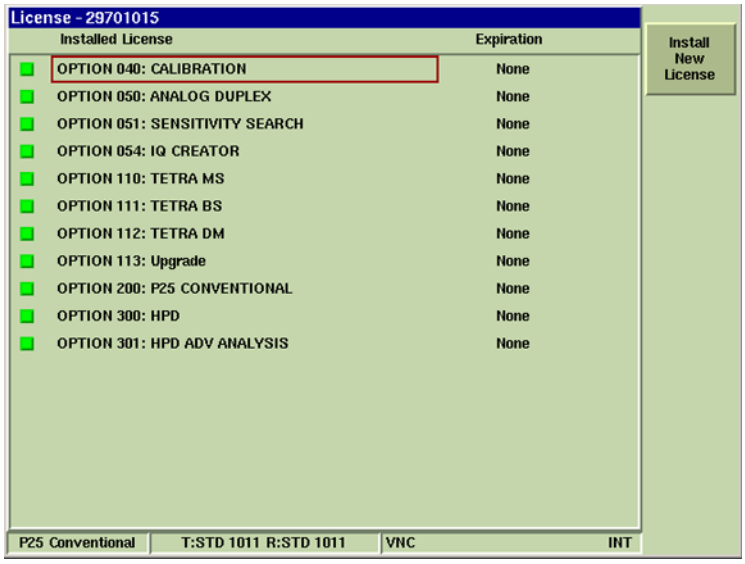


Fig. 1-1 3900 Software Upgrade Tile

Chapter 2

HPD® Basic System Operation

HPD® Tile Layout

This chapter describes the display Tiles found in the HPD® Testing Option package (Motorola Part #R2091A).

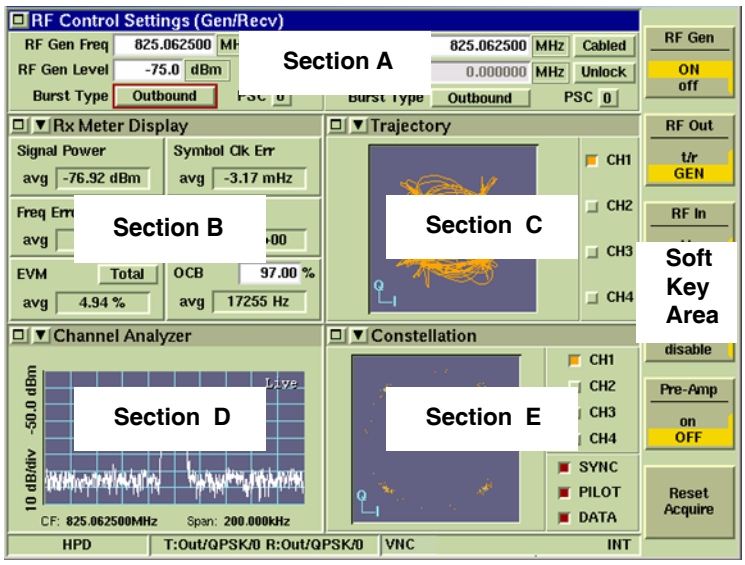


Fig. 2-1 HPD® Display Layout

- Section A of the HPD® User Screen always displays the RF Control Settings Tile when the Tiles are minimized.
- Sections B through E of the HPD® User Screen are configured using the Measurements Tile drop-down menu. Rx Meter Display Tiles are enabled in Section B through E when HPD® is first accessed or when Factory Default Settings have been restored.
- HPD® Test functions are selected from the drop-down menu located on the Tile menus on Sections B through E.
- HPD® 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.

NOTE

The Channel Analyzer and Spectrum Analyzer are asynchronous, swept analyzers, and are not synchronized with incoming HPD® signals. Inbound HPD® signals are on a 30 ms timeslot frame and appear discontinuous on the analyzer displays. Use Peak Hold to accumulate multiple sweeps to display an entire trace of the incoming HPD® signal.

Status Indicators

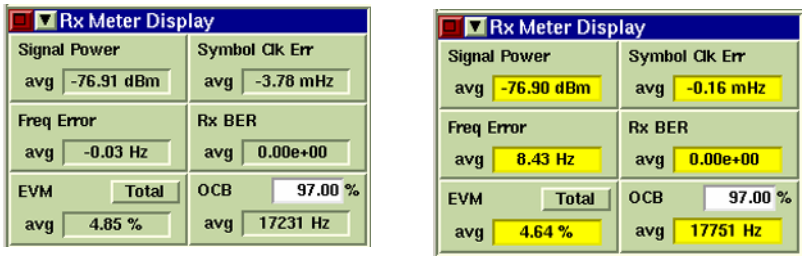
HPD® utilizes various status indicators to inform users of the activity being performed by the Test Set. Refer to Fig. 2-3 for location of the indicators on the User Screen.

Acquire Status Indicator

When the Test Set is attempting to acquire an incoming HPD® signal, a yellow **ACQ** indicator appears at the bottom of the User Screen. Meter fields turn GRAY to indicate invalid readings.

After an incoming HPD® signal is acquired, the **ACQ** indicator disappears and background of the meter display fields turns YELLOW, indicating that data is settling.

When data values have settled, the background of the meter display fields returns to BEIGE. Fig. 2-2 shows examples of data acquisition and data settled states on the Rx Meter Display Tile.



Data Acquisition - Beige Background Data Settling - Yellow Background

Fig. 2-2 HPD® Data Field Background Colors

Remote Access Indicator

The VNC (Virtual Network Computing) indicator at the bottom of the User Screen indicates when a user has established remote access to the Test Set. Refer to the section titled Remote Tile in Chapter 3 of the 3900 Series Operation Manual for information on Remote operation.

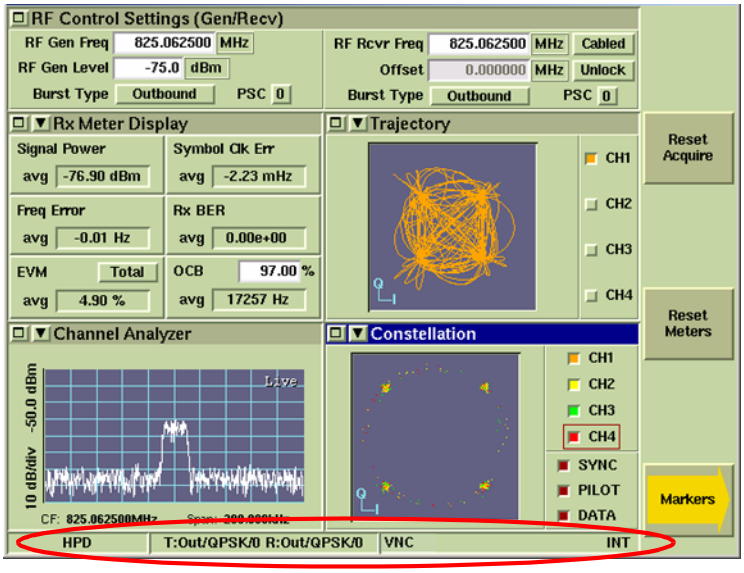


Fig. 2-3 HPD® Status Indicators

Tx/Rx Indicator

The Tx/Rx indicator provides information pertaining to the Transmit and Receive signal. In the example in Fig. 2-3, information is as follows:

Transmit Data		Receive Data	
Burst Type	Outbound	Burst Type	Outbound
Modulation Type	QPSK	Modulation Type	QPSK
PSC	0	PSC	0

INT/EXT Indicator

INT/EXT is the indicator for RF reference (Internal or External). The Internal/External RF Reference setting is selected from the Utilities menu. Refer to the 3900 Series Operation Manual for information on use of this feature.

RF Control Settings (Gen/Recv) Tile

RF Control Settings Tile

The RF Control Settings Tile is divided into two sections. The left side of the RF Control Settings Tile displays Transmit signal information. The right side of the RF Control Settings Tile displays information for the Received signal.

Fig. 2-5 shows the fields available on the RF Control Settings Tiles. The fields present on the Tile vary according to the selected parameters. For example, when Receive Burst Type is set to Inbound Random, the SAC, BKF, COS and LCM fields are not displayed.

Fig. 2-4 RF Control Settings Tile - Minimized View

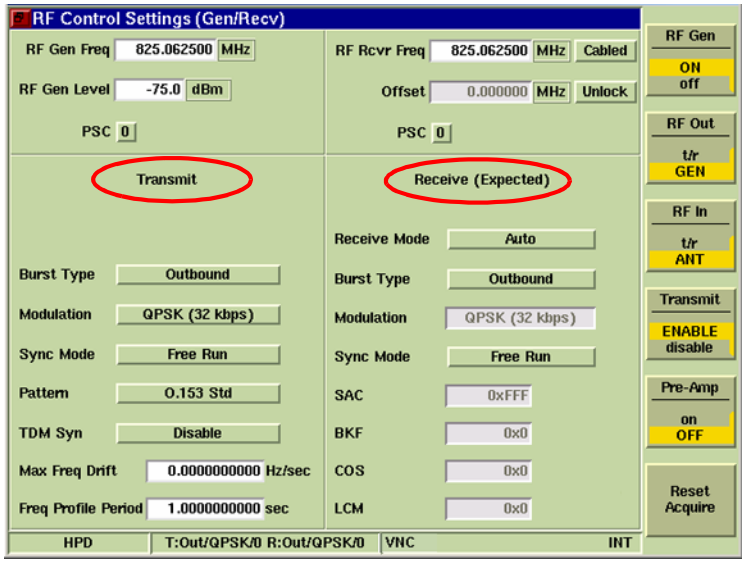


Fig. 2-5 RF Control Settings Tile - Maximized View

Field/Soft Key Definitions

RF Gen Freq

Displays the frequency being generated by the RF Generator. Editing the frequency value enables soft keys that select the frequency's unit of measure. Available units are GHz, MHz, kHz or Hz.

RF Gen Level

Indicates the output power level in dBm as defined by the user.

RF Rcvr Freq

Indicates the received frequency. Editing the frequency value enables soft keys that select the frequency's unit of measure. Available units are GHz, MHz, kHz or Hz.

Receiver Bandwidth Setting

Selects the receiver bandwidth used along the received HPD® signal path.

Cabled

Selects a Wideband IF Bandwidth, meaning that no filter is included in the received HPD® signal path. This setting is typically used for testing radios that are connected directly to the Test Set. Cabled is the default setting.

Off Air

Selects a Narrowband (30 kHz) IF Bandwidth filter to be included in the received HPD® signal path. This setting is typically used to reduce interference received when RF Carriers are present that are in close proximity to the receiver's tuned frequency.

Offset

When the Offset option button is set to Lock, changing the RF Gen Freq also changes the RF Rcvr Freq setting so that it is offset from the RF Generator frequency by the value specified in the Offset field.

When set to Unlock, a value can be entered independently for either the RF Gen Freq or RF Rcvr Freq. The Offset value indicates the RF Gen Freq minus the RF Rcvr Freq value.

PSC

Selects the Pilot and Sync Code to be received or transmitted in the HPD® signal. Available selections are 0 to 6.

Receive Mode

Selects the method of setting the Modulation field of the received signal. When AUTO is selected the 3900 matches the Modulation type to the modulation of the incoming signal. When MANUAL is selected the user selects the Modulation type of the received signal from the Modulation field.

Modulation

Selects the modulation type to be transmitted by the Test Set. Available selections include QPSK, 16 QAM and 64 QAM. The Modulation types available in the drop-down menu are determined by the Burst Type selected. For example, Inbound Random burst patterns only enable QPSK modulation.

When Receive Mode is set to Manual, the Receiver Modulation type can be manually selected as QPSK, 16 QAM or 64 QAM.

Pattern

Selects the pattern to be generated. The O.153 Std pattern is a pseudorandom sequence based on ITU-T O.153 standard. The O.153 Std w/ 1% Err pattern is calibrated with a 1% bit error rate included in the pattern.

Sync Mode

Selects how the Test Set references timing in an HPD® signal. The Test Set always sends out a pulse at the beginning of Timeslot 0, regardless of the Sync Mode selected.

Free Run (Transmit and Receive Sync Mode)

When Free Run is selected the Test Set transmits and/or receives a continuous signal with all timeslots filled. There is no relationship between the timing of the Inbound Reserved and Outbound channels.

TDO (Receive Sync Mode)

The Test Set transmits an Outbound signal. Acquisition of the Inbound Reserved signal received from the MSU is based on the assumption that the Inbound Reserved signal is aligned with the Outbound signal as defined by HPD® Specifications (i.e., separated by the TDO value). When TDO is selected for Receive Sync Mode, Transmit Sync Mode automatically defaults to Free Run and vice versa.

The block diagram in Fig. 2-6 illustrates the signal path between the Test Set and the MSU when the Test Set is configured to receive the MSU's Inbound signal.

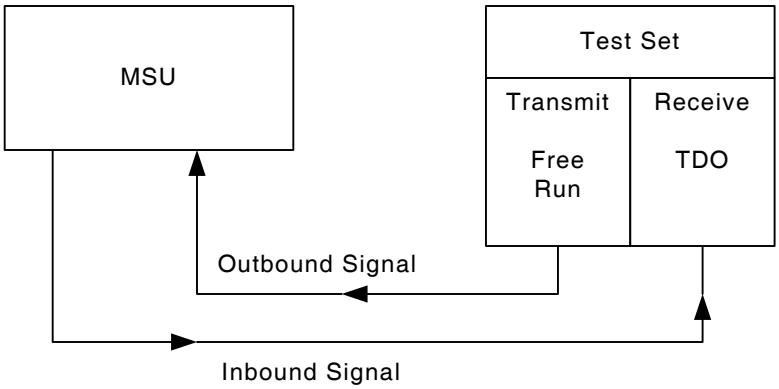


Fig. 2-6 TDO (Receive Sync Mode)

The RF Control Settings Tile Burst Type and Sync Mode parameters must be configured as follows to align the Test Set with the MSU signal:

Transmit Parameters		Receive Parameters	
Burst Type	Outbound	Burst Type	Inbound Reserved
Sync Mode	Free Run	Sync Mode	TDO

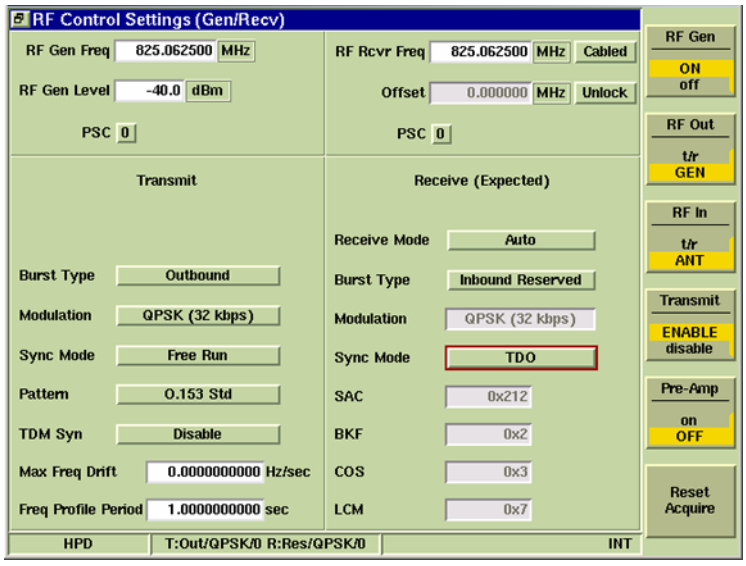


Fig. 2-7 RF Control Settings Tile - TDO (Receive Sync Mode)

TDO (Transmit Sync Mode)

The Test Set derives it's TDM Synchronization from the Outbound signal transmitted by the BR. The Inbound Reserved signal is transmitted by the Test Set as defined by HPD® Specifications (i.e., separated by the TDO value).

The block diagram in Fig. 2-8 illustrates the signal path between the Test Set and the BR when the Test Set is configured to receive and align itself to the BR's Outbound signal. When TDO is selected for Transmit Sync Mode, Receive Sync Mode automatically defaults to Free Run and vice versa.

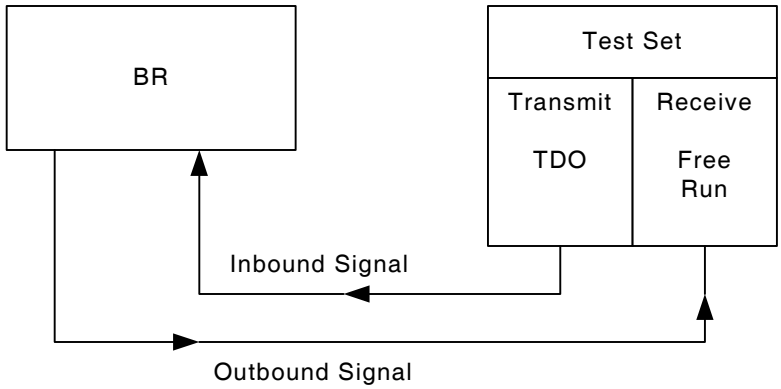


Fig. 2-8 TDO (Transmit Sync Mode)

The RF Control Settings Tile Burst Type and Sync Mode parameters must be configured as follows to align the Test Set with the BR's signal:

Transmit Parameters		Receive Parameters	
Burst Type	Inbound Reserved	Burst Type	Outbound
Sync Mode	TDO	Sync Mode	Free Run

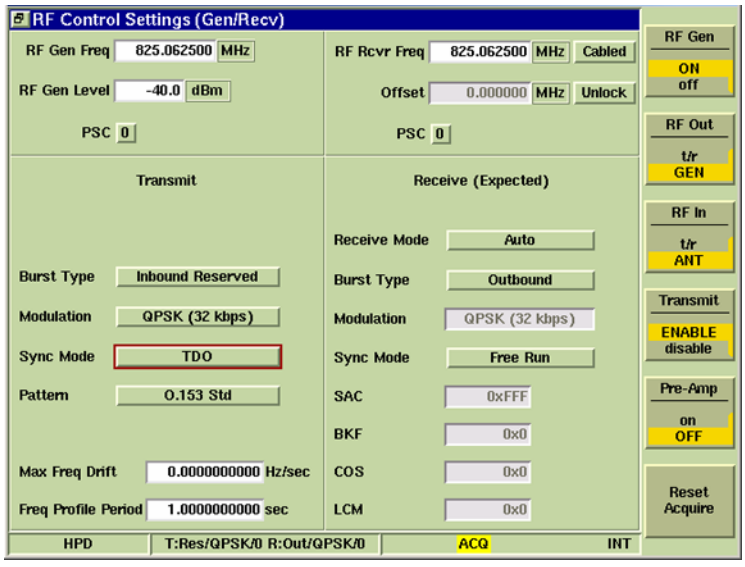


Fig. 2-9 RF Control Settings Tile - TDO (Transmit Sync Mode)

Burst Type

Burst Type defines the functionality of the 3900, enabling the test set to function as a BR or an MSU. BR mode allows the service monitor to simulate Base Radio operation. MSU mode allows the test set to simulate a mobile subscriber unit.

BR Simulation

To simulate BR operation set Burst Type fields as follows:

Transmit Mode: Outbound (signal is transmitted by BR)

Receive Mode: Inbound Reserved or Inbound Random (signal is being received from MSU)

MSU Simulation

To simulate MSU operation set the Burst Type fields as follows:

Transmit Mode: Inbound (signal is being received from MSU)

Receive Mode: Outbound (signal is being transmitted by the BR)

TDM Syn

Enables or disables TDM_SYNC in the BCCH (Broadcast Control Channel). This setting only applies to the Outbound Burst Type.

Max Freq Drift

Maximum Frequency Drift is the slope of the sine wave pattern when the Offset of the sine wave pattern is zero.

Freq Profile Period

The Frequency Profile Period is the period of the Sine wave.

SAC (Subscriber Access Code)

Display only field indicates the Subscriber Access Code in the header block of the received signal. Displayed in hexadecimal format.

BKF (Block Format)

Display only field indicates the Block Format in the header block of the received signal. Displayed in hexadecimal format.

COS (Coding Scheme)

Display only field indicates the Coding Scheme in the header block of the received signal. Data is displayed as a numeric value. Displayed in hexadecimal format.

00 = Test Pattern

01 = SAM Radio Channel Coding

LCM (Logical Channel Multiplexing)

Display only field indicates the Logical Channel Multiplexing in the header block of the received signal. Displayed in hexadecimal format.

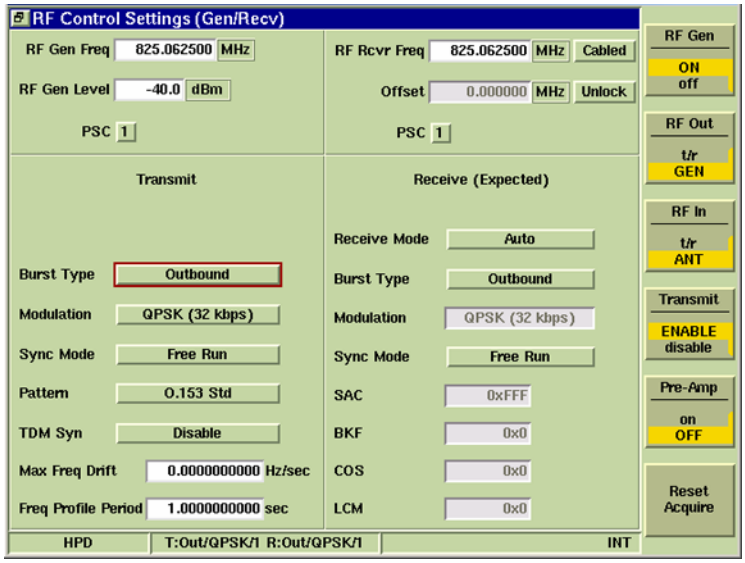


Fig. 2-10 RF Control Settings Soft Keys

[RF Gen] Soft Key

Turns the RF Generator ON or OFF. When the RF Generator is OFF, indicators appear at the top of the RF Control Settings Tile and in the Information Bar at the bottom of the Tile.

[RF Out] Soft Key

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

[RF In] Soft Key

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

[Transmit] Soft Key

Enables (starts) and disables (stops) HPD® signal transmission.

[Pre-Amp] Soft Key

Enables (ON) or Disables (OFF) the receiver Pre-Amp function. Refer to the 3900 Series Operation Manual for use of the Pre-Amp feature.

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

“Re-synchronizes” the test set with the incoming HPD® signal.

HPD® Configuration Tiles

Rx Measurements Limits Tile

The Rx Measurement Configuration Tile contains parameters that define Upper Limit and Lower Limit for meter readings.

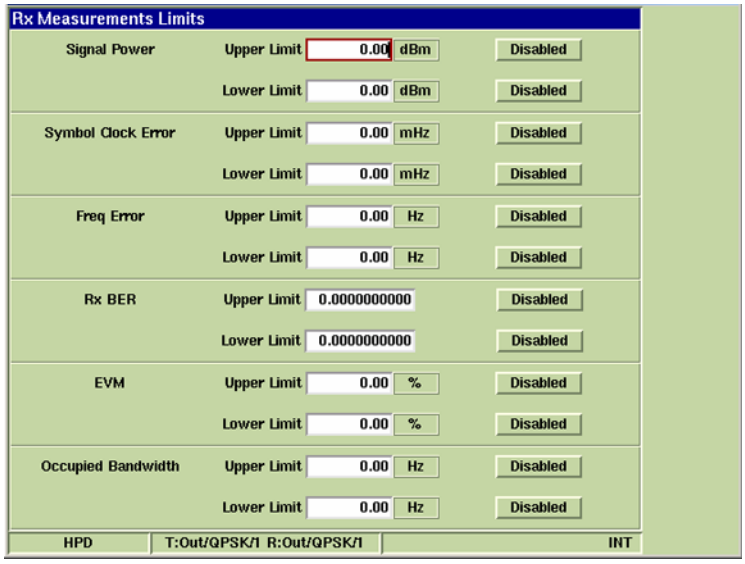


Fig. 2-11 Rx Measurements Configuration Tile

Field Definitions

Disable/Enable

Toggle button turns the limit indicators for the selected meter 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 Tiles turns **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 Tiles turns **BLUE**.

NOTE

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

I & Q Measurements Limits

The I & Q Measurements Limits Configuration Tile contains parameters that define Upper Limit and Lower Limit for meter readings on the maximized Constellation Tile.

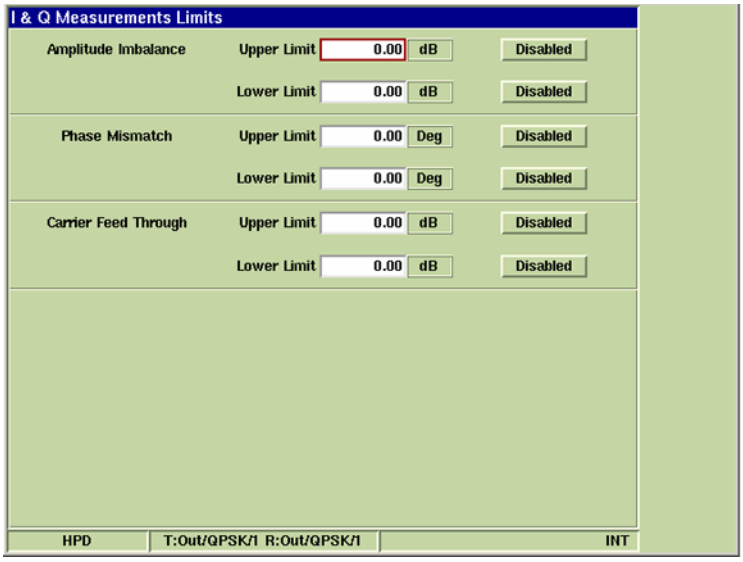


Fig. 2-12 I & Q Measurements Limits Configuration Tile

Field Definitions

Disable/Enable

Toggle button turns the limit indicators for the selected meter 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 Constellation 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 Constellation Tile turn **BLUE**.

NOTE

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

Decimation Configuration Tile

The Decimation Configuration Tile contains fields that define decimation values for all readings and display graphs. Selectable range for each reading is 10 to 10,000. Selecting 10 means that new data is available every 10th burst or time slot. Selecting 10,000 means new data is available every 10,000 bursts or time slots.

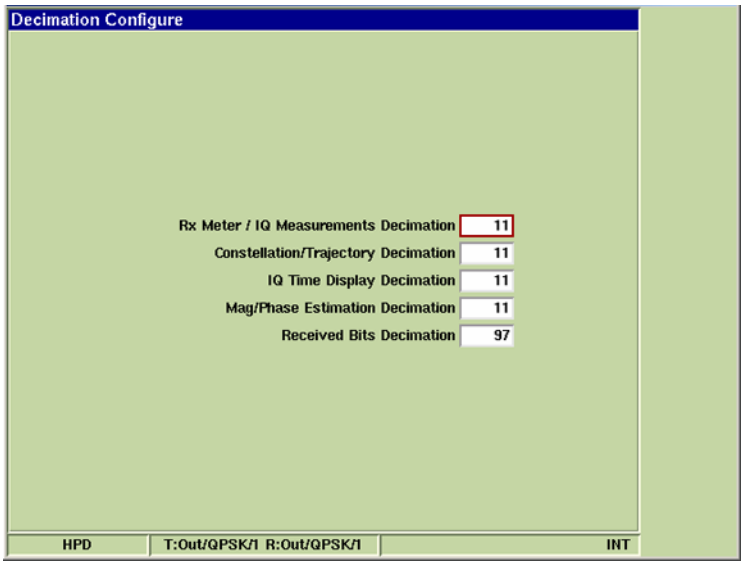


Fig. 2-13 Decimation Configuration Tile

Field Definitions

Rx Meter/IQ Measurements Decimation

Specifies the rate at which meter measurement readings are available to the user interface.

Constellation/Trajectory Decimation

Specifies the rate at which I & Q readings are available to the user interface for the Constellation Tile, Trajectory Tile and Eye Diagram Tile plot fields.

IQ Time Display Decimation

Specifies the rate at which I & Q readings are available to the user interface for the I & Q Display Tile graphs and Profile Full Tile and Profile Ramps Tile. This field is only available when the HPD® Advanced Analysis feature is installed in the Test Set.

Mag/Phase Estimation Decimation

Specifies the rate at which magnitude and phase readings are available to the user interface for the Magnitude/Phase Estimation Tile. This field is only available when the HPD® Advanced Analysis feature is installed in the Test Set.

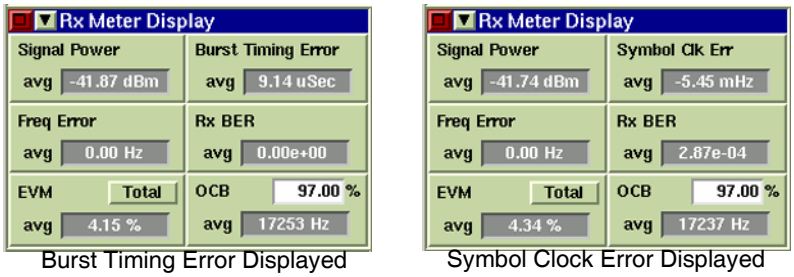
Received Bits Decimation

Specifies the rate at which received bits data is available to the user interface for the Rx Bits Tile. This field is only available when the HPD® Advanced Analysis feature is installed in the Test Set.

HPD® Rx Measurement Tiles

Rx Meter Display Tile

The Rx Meter Display Tile shows measurement results pertaining to the received HPD® signal. Parameters configured on this Tile update the parameters on other HPD® Measurement Tiles. Fig. 2-15 shows the maximized display, which provides a wider range of data than the minimized Tile and contains radio buttons that select the readings to be shown on the minimized Tile, Meter Bar and bar graph.



Burst Timing Error Displayed Symbol Clock Error Displayed

Fig. 2-14 Rx Meter Display - Minimized View

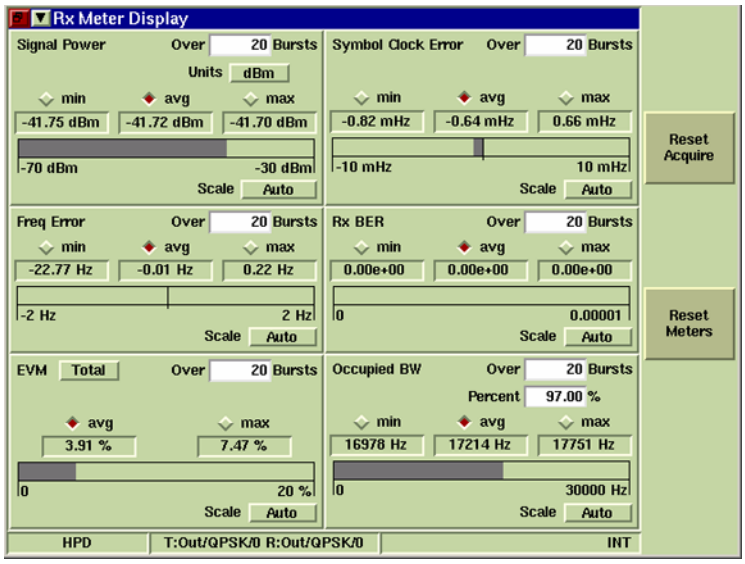


Fig. 2-15 Rx Meter Display - Maximized VIew

Field/Soft Key Definitions

Signal Power

Indicates power of the received signal. Drop-down menu selects unit of measurement as dBm or W. When the 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.

Frequency Error

Indicates frequency error of the received signal.

EVM

Indicates the Error Vector Magnitude reading of the received signal.

Symbol Clock Error

Indicates the Symbol Clock Offset between the Test Set and the transmitter.

Burst Timing Error

Indicates Timing Offset between the expected and received signal. This meter is only visible when Receive Sync Mode field on the RF Control Settings (Gen/Recv) Tile is set to TDO.

Rx BER

Indicates Bit Error Rate (BER) readings of signal.

Occupied Bandwidth

Indicates Occupied Bandwidth readings of signal.

Over *n* Bursts

Specifies the number of bursts over which data is averaged for each measurement. Values can be set independently for each meter. If the Bursts field is set to 20 (default value) it means the Test Set averages data over 20 bursts.

min/avg/max Reading Indicators

These radio buttons select the reading displayed when the Rx Meter Display Tile is minimized.

Selecting min displays the lowest recorded reading. Pressing the [Reset Meters] Soft Key resets this value.

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

Selecting max displays the highest recorded reading. Pressing the [Reset Meters] Soft Key resets this value.

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 Rx Measurement Configuration Tile. Refer to section titled I & Q Measurements Limits and Rx Measurements Limits Tile for more information on Upper and Lower Limits.

Scale

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. Fig. 2-16 shows an example of the Symbol Clock Error Meter with different scale settings selected.

Fig. 2-16 Rx Meter Display - Symbol Clock Error Meter Scale Adjustments

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

Constellation Tile

The Constellation plot displays the signal Constellation points of the received HPD® signal. The Amplitude Imbalance, Phase Mismatch and Carrier Feed Through meters measure signal impairments that occur as a result of imbalances between I & Q signal components.

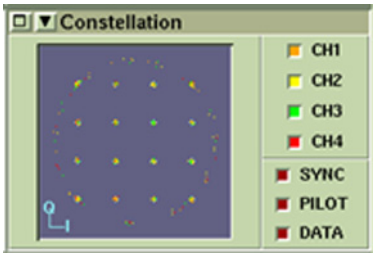


Fig. 2-17 Constellation Tile - Minimized View

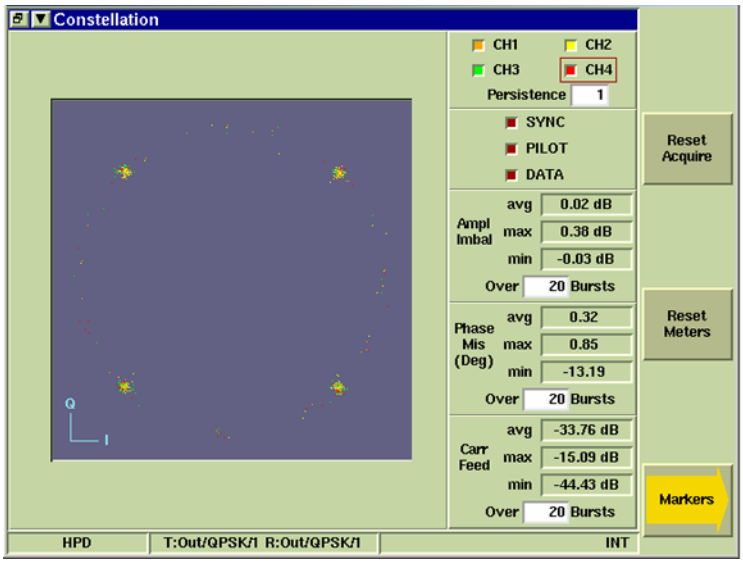


Fig. 2-18 Constellation Tile - Maximized View

Field/Soft Key Definitions

Channel Tick Boxes

The CH1 through CH4 tick buttons select channel(s) to be displayed on the plot field. More than one channel can be enabled. When enabled the tick buttons show the color used to display the selected channel(s).

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.

SYNC/PILOT/DATA

Selecting these tick boxes displays SYNC, PILOT and DATA indicators on the display field. User may enable the PILOT, SYNC and DATA indicators in any combination. The system does not allow all tick buttons to be disabled. For example, if PILOT, SYNC and DATA are enabled, the PILOT and SYNC tick buttons can be deselected, however, the DATA tick button can not be disabled (the least active button can not be deselected).

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

[Markers] Soft Key

The [Markers] Soft Key opens a soft key sub-menu that allows the user to enable and configure markers on the graph field.

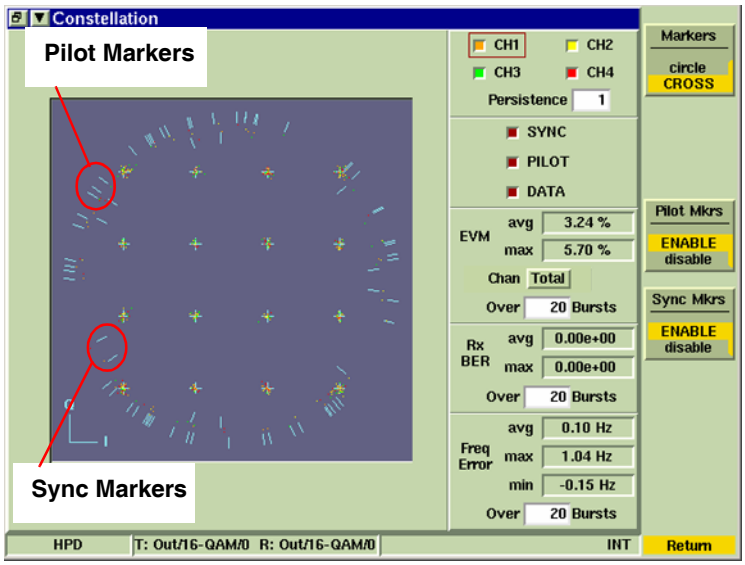


Fig. 2-19 Constellation SYNC and PILOT Markers Enabled

[Markers Cross/Circle]

Soft key selects either CROSS or CIRCLE symbol indicators for the display field. This soft key is accessed by pressing the [Markers] Soft Key.

[Pilot Markers]

Enables (ON) and disables (OFF) Pilot markers on the Constellation display field. The Pilot markers are located on the outer circle of the example provided in Fig. 2-19. This soft key is accessed by pressing the [Markers] Soft Key.

[SYNC Markers]

Enables (ON) and disables (OFF) Sync markers on the Constellation display field. The Sync markers are located on the inside circle of the example provided in Fig. 2-19. This soft key is accessed by pressing the [Markers] Soft Key.

Trajectory Tile

The Trajectory plot displays a visual representation of the received samples. The graph allows up to four channels to be displayed simultaneously. The minimized view in Fig. 2-20 shows all channels enabled; the maximized view in Fig. 2-21 shows only Channel 1 enabled.

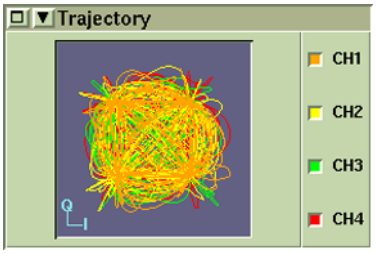


Fig. 2-20 Trajectory Tile - Minimized View

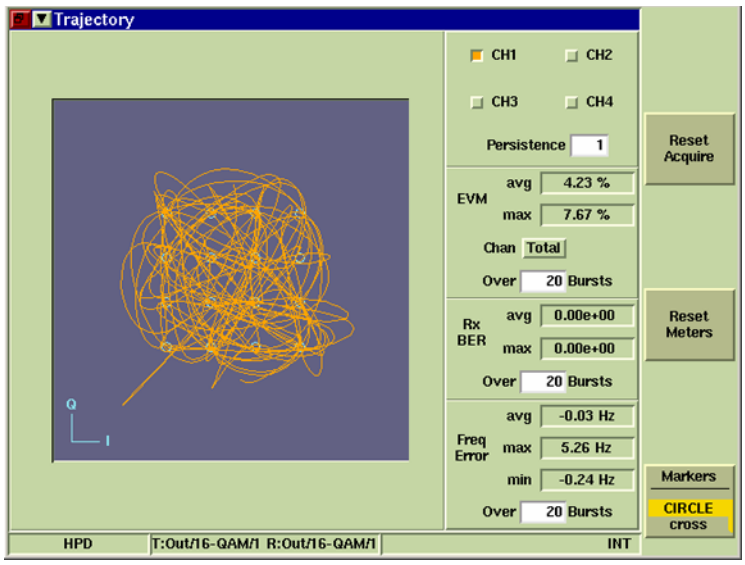


Fig. 2-21 Trajectory Tile - Maximized View

Field Definitions

Channel Tick Boxes

The CH1 through CH4 tick buttons select channel(s) shown on the display field. More than one channel can be enabled. When enabled the tick buttons show the color used to display the selected channel(s).

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

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

“Re-synchronizes” the test set with the incoming HPD® signal.

[Markers Cross/Circle] Soft Key

Soft key selects either CROSS or CIRCLE symbol indicators for the display field.

Error Vector Magnitude Tile

The Error Vector Magnitude (EVM) graph plots the average adjustment compensation values the Test Set applies to the received signal to match the signal to the expected points along the burst. Error Vector Magnitude (EVM) is a measure of the difference between the actual signal and an ideal signal. The difference measured between signals is calculated as a percent and plotted on the graph on a symbol by symbol basis.

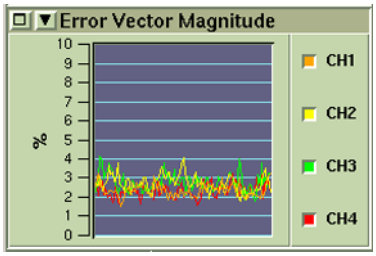


Fig. 2-22 Error Vector Magnitude - Minimized View

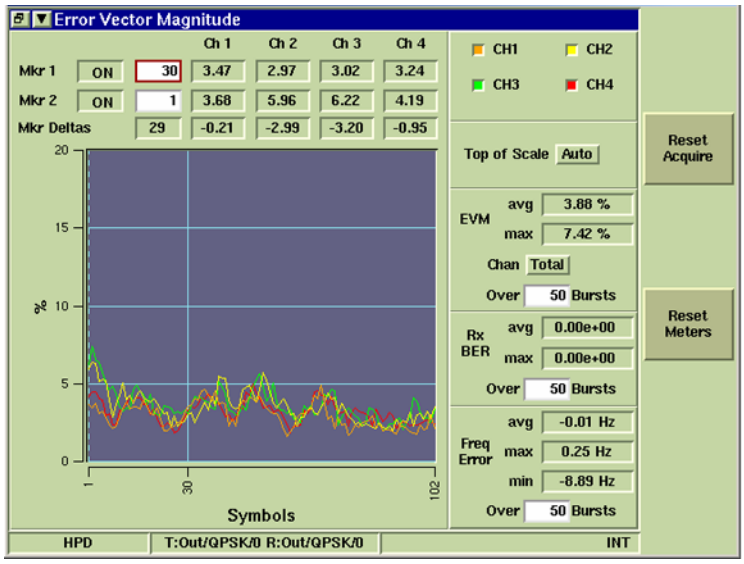


Fig. 2-23 Error Vector Magnitude - Maximized View

Field Definitions

Mkr 1 and Mkr 2

ON/OFF

Enables (ON) or Disables (OFF) vertical markers on the display field.

Horizontal Position

The white data field to the right of the ON/OFF button indicates the marker's location along the display field's horizontal scale. The markers can be placed at any point along the horizontal scale.

EVM Reading

The field to the right of the Horizontal Position field indicates the EVM reading at the marker's position for each enabled channel (CH1 through CH4). This field is read only and can not be altered by the user. The value is indicated as a percentage and is only displayed for enabled channels.

Mkr Deltas

The Mkr Deltas fields contain data only when both markers are enabled. The first field indicates the marker horizontal delta between Mkr 1 and Mkr 2. The second through fifth field indicates the difference in EVM reading between Mkr 1 and Mkr 2. These fields are read only and can not be altered by the user.

Channel Tick Boxes

The CH1 through CH4 tick buttons select channel(s) shown on the display field. More than one channel can be enabled. When enabled the tick buttons indicate the color used to display the selected channel(s).

Graph Scale

Vertical

The vertical scale of the EVM field is indicated as a percent value. The highest value is defined by the Top of Scale drop down menu. Default value is Auto.

Horizontal

The horizontal scale is indicated in symbols as defined by the number of symbols contained in the selected channel. Symbol ranges vary based on the Burst Type selected on the RF Control Settings (Gen/Recv) Tile selected and the Channel being displayed. When multiple channels are selected the Symbol range shown reflects the largest range required.

Burst Type	Range Channel 1 and 4	Range Channel 2 and 3
Inbound Random	1 to 20	1 to 21
Inbound Reserved	1 to 92	1 to 94
Outbound	1 to 102	1 to 102

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

“Re-synchronizes” the test set with the incoming HPD® signal.

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Chapter 3

HPD® Advanced Analysis Features

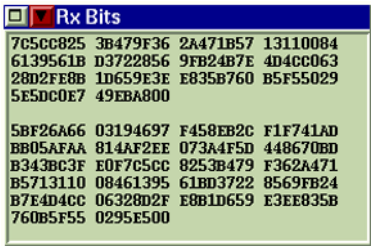
Introduction

This chapter describes the features found in the Advanced HPD® Analysis Package (Motorola Part # R2092A). These optional features provide the user with the following capabilities:

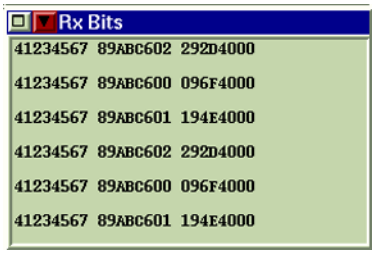
- Rx Bits Tile provides a readout of the bit blocks received in the HPD® data stream.
- Rx Time Display Tile shows the history of the frequency error, symbol clock error or power readings over a user defined span of time.
- Magnitude/Phase Estimation Tile shows magnitude and phase fluctuations of the received signal over a period of one burst.
- Eye Diagram Tile provides representations of the symbol pattern of the received frequency.
- Profile Full Tile and Profile Ramps Tile provide visual representations of the Full and Ramp power profile readings.
- I & Q Display Tile displays the I and Q patterns in the last received signal.

Rx Bits Tile

The Rx Bits Tile provides a visual representation of the bits received in the HPD® data stream. The data is displayed as hexadecimal characters grouped in an 8 character word format. When the Test Set receives a signal, the bit fields log data according to the position of the data in the burst stream, starting with bit "0" and continuing until the Test Set stops receiving a signal.



Inbound Reserved / Outbound Burst Types



Inbound Random Burst Type

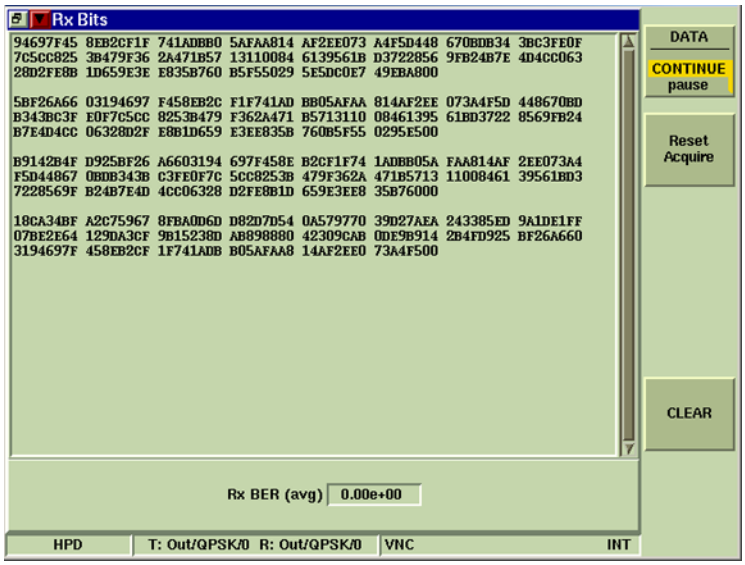


Fig. 3-1 Received Bits Tile - Maximized and Minimized View

Field/Soft Key Definitions

Receive Bits Field

Displays bit blocks acquired from the received HPD® signal. Correctly received bits are displayed as **BLACK** hexadecimal characters; bit errors are displayed as **RED** hexadecimal characters.

Rx BER (avg)

Displays the average BER reading.

[Data] Soft Key

The [DATA] soft key PAUSES the live feed of received bit data packets. Pressing [CONTINUE] resumes the display of received bit data packets. Bit data packets transmitted when [Pause] is selected are **not** recovered when [Continue] is selected.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

[Clear] Soft Key

Clears acquired bit data from data field.

Rx Time Display Tile

The Rx Time Display Tile shows the history of the frequency error, power readings and symbol clock error or burst timing error readings over a user defined span of time.

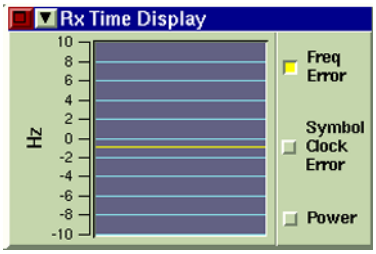


Fig. 3-2 Rx Time Display - Minimized View

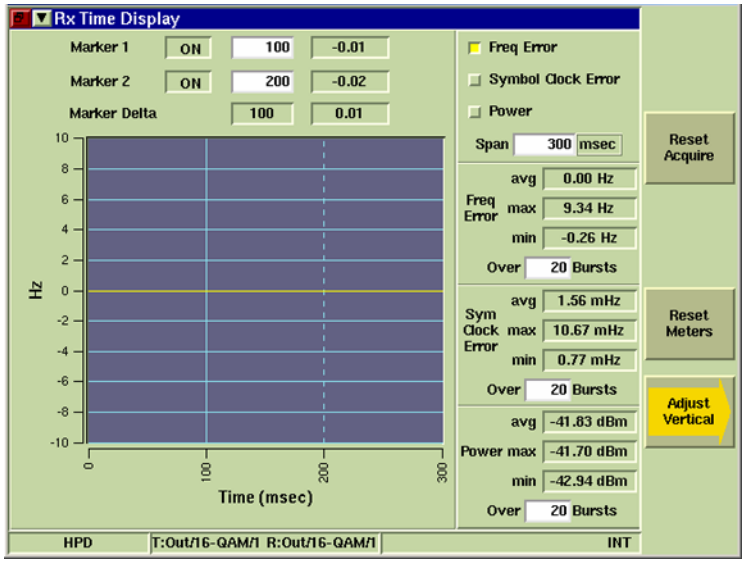


Fig. 3-3 Rx Time Display - Maximized View

Field/Soft Key Definitions

Marker 1/Marker 2

ON/OFF

Enables (ON) or disables (OFF) vertical markers on the display field.

Horizontal Position

The white data field to the right of the ON/OFF button indicates the marker's location along the display field's horizontal scale. The markers can be placed at any point along the horizontal scale.

Measurement Reading

Indicates the current measurement reading at the marker's position. This field is read only and cannot be edited.

Marker Delta

The first field indicates the difference between Marker 1 and Marker 2 locations. The second field indicates the difference in measurement readings between Marker 1 and Marker 2 locations. These fields are read only and can not be edited. Marker Delta fields only contain data when both markers are enabled.

Span

Defines the period of time over which the selected reading is plotted on the display field. Valid span setting depends on the decimation rate selected in the Rx Meter FIeld on the Decimation Configuration Tile and the signal burst type.

Graph Scale

Horizontal

The graph's horizontal scale is defined by the Span setting. The Test Set automatically adjusts the defined Span setting to the closest valid value according to the signal burst type being received.

Vertical

The graph's vertical scale unit of measurement is defined by the reading displayed on the graph field. Fig. 3-4 shows the Frequency Error reading selected for display and the associated vertical scale indicated in Hz. Symbol Clock Error is indicated in mHz; Power readings are indicated in dBm.

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

[Adjust Vertical] Soft Key

The [Adjust Vertical] soft key opens a soft key sub-menu as shown in Fig. 3-4. The sub-menu soft keys adjust the position and range of the vertical scale.

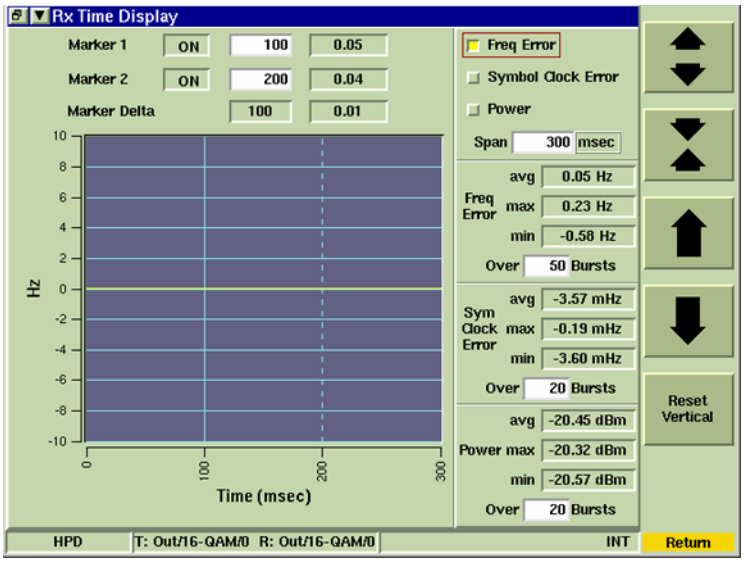


Fig. 3-4 Rx Time Display - Vertical Soft Keys

[Reset Vertical] Soft Key

Centers trace vertically on graph field. This soft key is helpful in locating a trace when it is not visible on the graph field. This soft key is access by pressing the [Adjust Vertical] Soft Key.

Magnitude/Phase Estimation Tile

The Magnitude/Phase Error Tile shows magnitude and phase fluctuations of the received signal over a period of one burst.

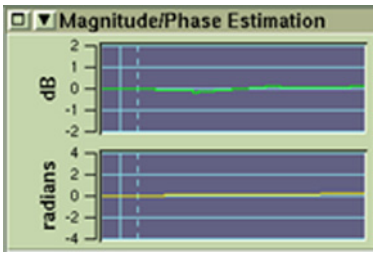


Fig. 3-5 Magnitude/Phase Estimation Tile - Minimized View

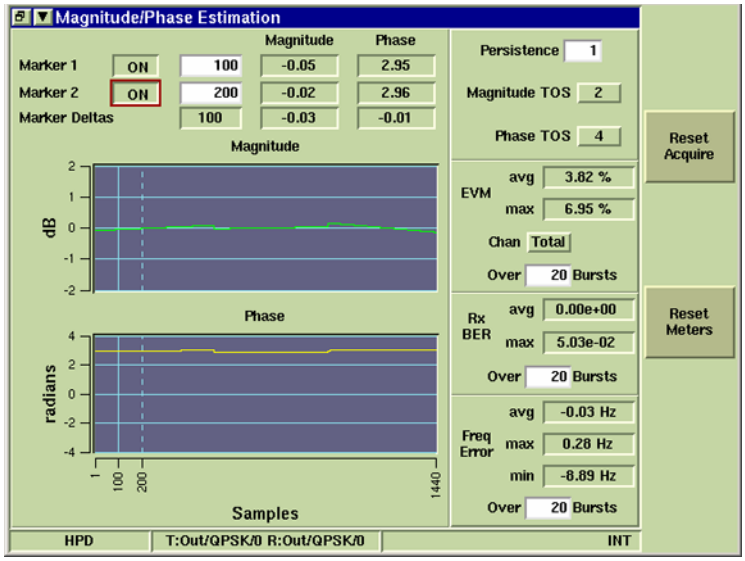


Fig. 3-6 Magnitude/Phase Estimation Tile - Maximized View

Field/Soft Key Definitions

Marker 1/Marker 2

ON/OFF

Enables (ON) or disables (OFF) vertical markers on the display field.

Horizontal Position

The white data field to the right of the ON/OFF button indicates the marker's location along the display field's horizontal scale. The markers can be placed at any point along the horizontal scale.

Magnitude/Phase

When markers are enabled these fields indicate the readings on the Magnitude and Phase graph fields at set marker locations. These fields are system defined and can not be edited.

Marker Deltas

The field on the left indicates the difference between Marker 1 and Marker 2 locations on the graph. The middle field indicates the difference in Magnitude readings between Marker 1 and Marker 2 locations on the graph. The field on the right indicates the difference in Phase readings between Marker 1 and Marker 2 locations on the graph. These fields are read only and can not be edited. The Marker Deltas fields only contain data when both markers are enabled.

Persistence

Specifies the number of I and Q plots shown simultaneously on the display field. 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.

Magnitude TOS (Top of Scale)

Defines the highest value on the vertical scale of the Magnitude display field. Fig. 3-6 and Fig. 3-7 show examples of how adjusting the TOS value changes the display.The example screens below show one Tile with the TOS set to 2, the other is set to 10.

Phase TOS (Top of Scale)

Defines the highest value of the vertical scale of the Phase display field.

Graph Scale

Magnitude Graph

Vertical

The vertical scale of the magnitude graph is defined by the Magnitude TOS (Top of Scale) field. Default range is -2 to +2 dBm.

Horizontal

The horizontal scale of the Magnitude graph is system defined based on the number of symbols present in one burst.

Phase Graph

Vertical

The vertical scale of the Phase graph is defined by the Phase TOS (Top of Scale) field. Default range is -4.0 to 4.0 radians.

Horizontal

The horizontal scale of the phase graph is system defined based on the number of symbols present in one burst.

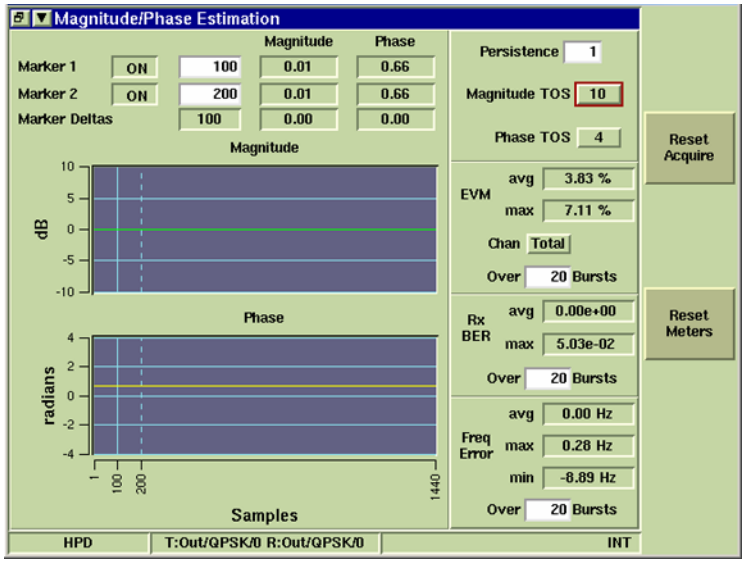


Fig. 3-7 Magnitude TOS (10 dBm)

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

Eye Diagram Tile

The Eye Diagram Display Tile shows the eye diagram of the received signal.

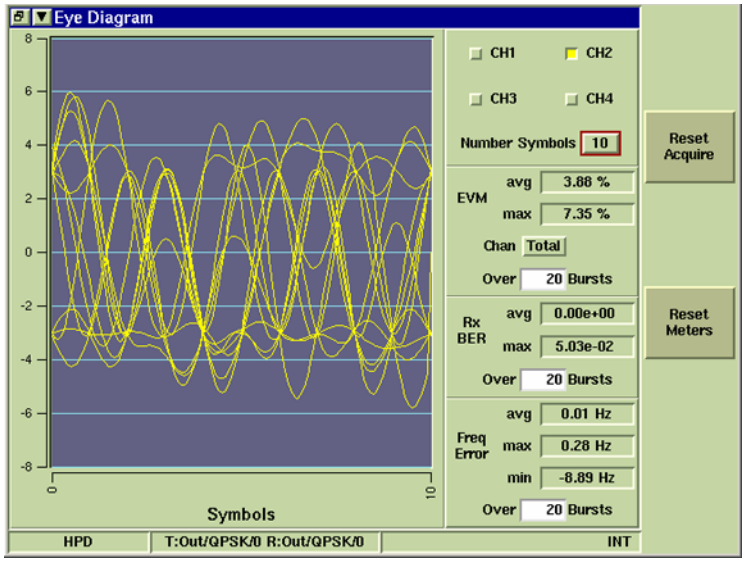


Fig. 3-8 Eye Diagram Tile - Maximized View

Field Definitions

Channel Tick Boxes

CH1 through CH4 tick boxes select the channel displayed on the graph field. Only one channel can be enabled at any given time. When enabled, the tick buttons indicate the color used to display the selected channel.

Graph Scale

Vertical

The vertical scale represents the I & Q positions of the Rx signal at specific points in time. The vertical scale is system defined at -8 to +8.

Horizontal

The horizontal scale is indicated in symbols as defined by the Number Symbols field. A smaller scale setting results in a more detailed trace display.

Number Symbols

Defines the horizontal scale of the display field. The example screens show how adjusting the horizontal scale changes the appearance of the trace on the graph field. Fig. 3-8 shows a trace with the Number Symbols field set to 10. Lowering the number or symbols shows more detail of the signal pattern.

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

“Re-synchronizes” the test set with the incoming HPD® signal.

I & Q Display Tile

The I & Q Display Tile shows the I and Q patterns in the last received signal over a period of time.

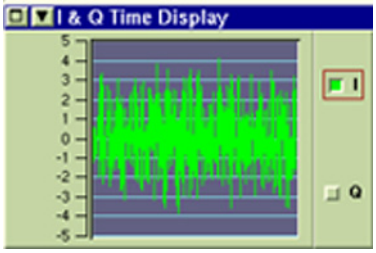


Fig. 3-9 I & Q Display Tile - Minimized View

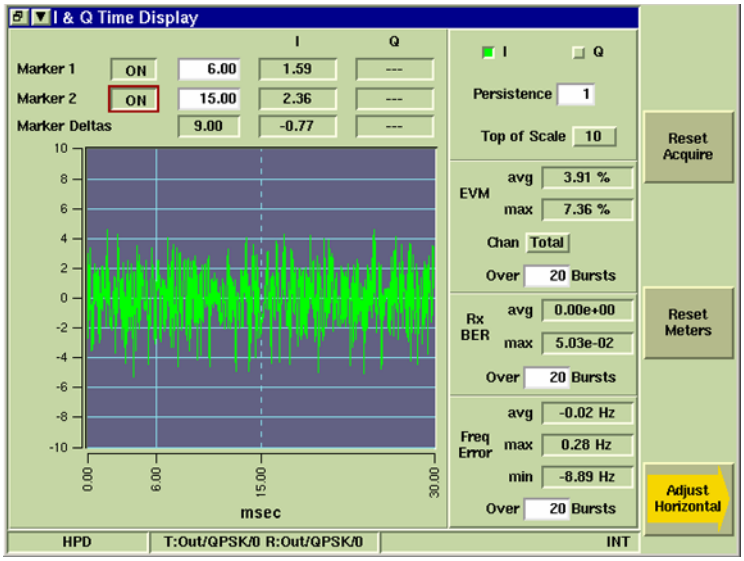


Fig. 3-10 I & Q Display Tile - Maximized View

Field/Soft Key Definitions

Marker 1/Marker 2

ON/OFF

Enables (ON) or disables (OFF) vertical markers on the display field.

Horizontal Position

The white data field to the right of the ON/OFF button indicates the marker's location along the display field's horizontal scale. The markers can be placed at any point along the horizontal scale.

I and Q Fields

Indicates the readings at I and Q points at marker location. Data is only present in these fields when the parameter is enabled by the I and Q tick boxes. These fields are read only and can not be edited.

Marker Deltas

The field on the left indicates the difference between Marker 1 and Marker 2 locations. The next two fields indicate the difference in readings between Marker 1 and Marker 2 locations for the I and Q points on the graph field. These fields are read only and can not be edited. The Marker Delta fields only contain data when both markers are enabled.

I and Q Tick Buttons

Tick buttons enable (ON)/ disable (OFF) the I and Q points on the graph field. When enabled, the tick buttons indicate the color used to display the selected pattern.

Top of Scale

The I & Q Display Tile automatically centers the signal trace at "0" on the vertical scale. TOS defines the highest value of the vertical scale. When a value is selected, the corresponding negative value is displayed at the bottom of the graph. Fig. 3-10 shows an example with the TOS set to 10; Fig. 3-11 shows an example with the TOS set to 5.

Graph Field

Vertical Scale

The vertical scale represents the I & Q positions of Rx signal at points in time. Value is defined by the Top of Scale field. Default range -10 to +10.

Horizontal Scale

The horizontal scale of the I & Q Time Display field is indicated in ms (msec). Default range for a single Outbound burst or Inbound Reserved burst is 0 to 30 ms (msec). Default range for a single Inbound Random burst is 0 to 10 ms (msec). The [Adjust Horizontal] Soft Key opens a soft key sub-menu that adjusts the position and range of the graph's horizontal scale.

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

[Adjust Horizontal] Soft Key

The [Adjust Horizontal] Soft Key opens a soft key sub-menu as shown in Fig. 3-11. The additional soft keys adjust the position of the horizontal scale and the appearance of the signal trace on the graph. The smallest range setting is 2 ms (msec).

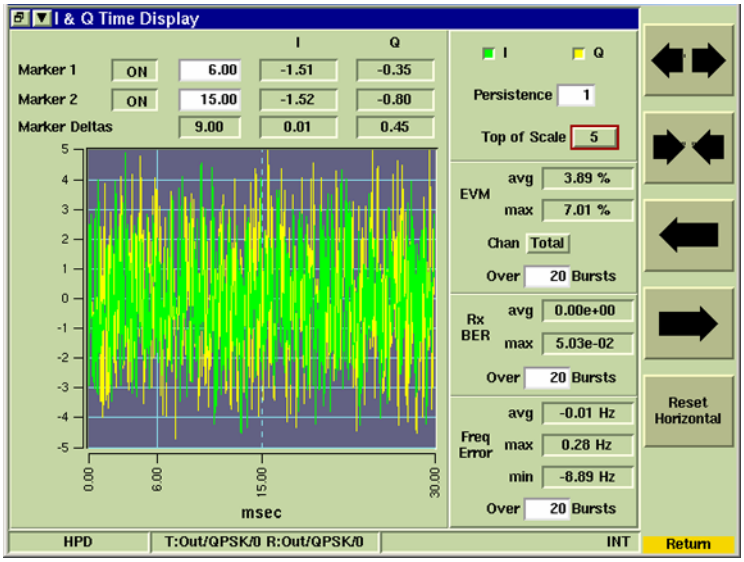


Fig. 3-11 I & Q Display Adjust Horizontal Soft Key Sub-menu

[Reset Horizontal] Soft Key

Resets the horizontal scale to default range of the burst type. This soft key is accessed by pressing the [Adjust Horizontal] Soft Key.

Profile Full Tile

The Profile Full Tile displays the complete profile of the signal's power reading over a period of one burst.

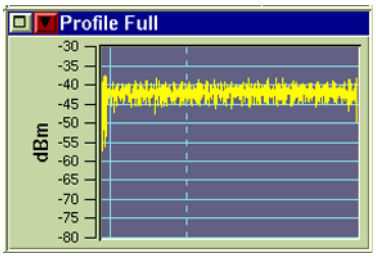


Fig. 3-12 Profile Full - Minimized View

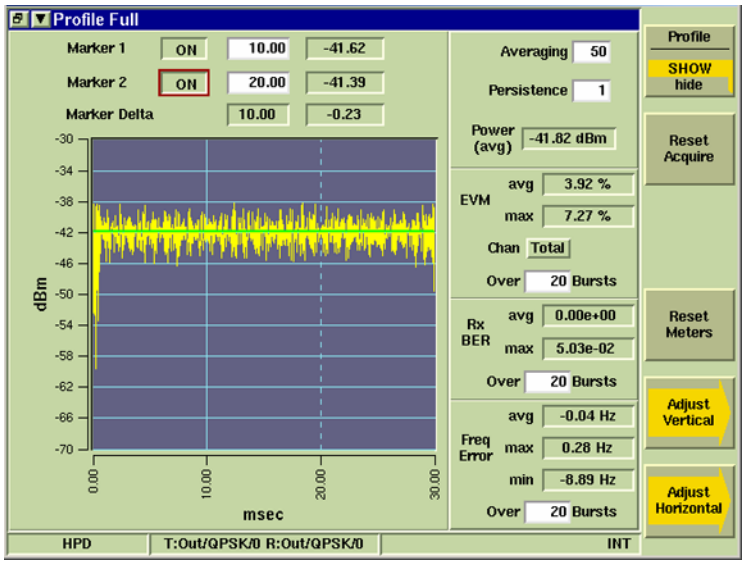


Fig. 3-13 Profile Full - Maximized View

Field/Soft Key Definitions

Marker 1/Marker 2

ON/OFF

Enables (ON) or disables (OFF) vertical markers on the display field.

Horizontal Position

The white data field to the right of the ON/OFF button indicates the marker's location along the display field's horizontal scale. The markers can be placed at any point along the horizontal scale.

Power Reading

The field to the right of the Horizontal Position field indicates the Power reading at the marker's position.

Marker Deltas

The field to the left indicates the difference between Marker 1 and Marker 2 locations. The second field indicates the difference in Power reading between Marker 1 and Marker 2 locations. These fields are read only and can not be edited. The Marker Delta fields only contain data when both markers are enabled.

Averaging

Defines the number of bursts measured to calculate average meter readings. Changes made to this field do not affect the Over *n* Bursts setting on the Rx Meter Display Tile.

Persistence

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

Graph Scale

Vertical Scale

The vertical scale of the graph field is indicated in dBm. The [Adjust Vertical] Soft Key opens a soft key sub-menu that adjusts the positioning and range of the graph's vertical scale. The smallest available range span is 20.0 dBm.

Horizontal Scale

The horizontal scale of the Profile Full graph field is indicated in ms (msec). Default range for a single Outbound burst or Inbound Reserved burst is 0 to 30 ms (msec). Default range for a single Inbound Random burst is 0 to 10 ms (msec). The [Adjust Vertical] Soft Key opens a soft key sub-menu that adjusts the positioning and range of the graph's horizontal scale.

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

[Profile] Soft Key

[Profile Show/Hide] turns the profile trace ON/OFF. When SHOW is selected, as in Fig. 3-14, a **GREEN** profile appears on the display indicating the expected pattern of the signal. The minimized view in Fig. 3-12 shows the Profile trace in the HIDE state (no profile trace is displayed).

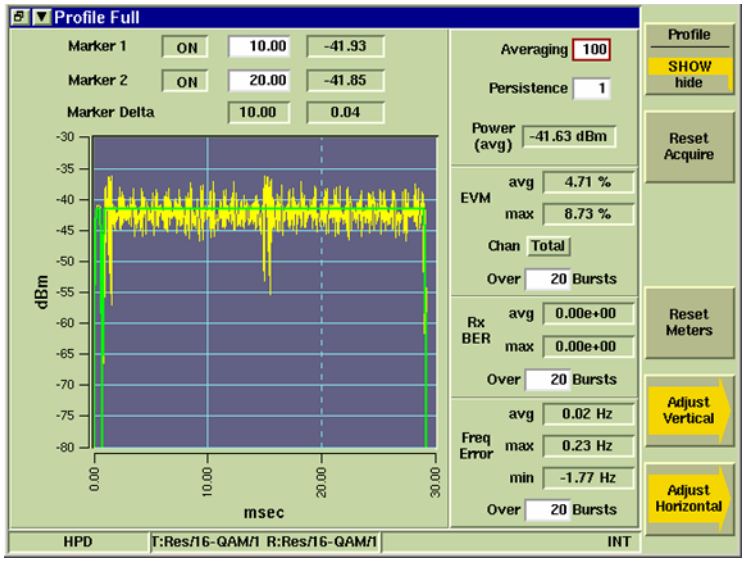


Fig. 3-14 Power Full - Profile SHOW Enabled

[Adjust Vertical] Soft Key

The [Adjust Vertical] soft key opens a soft key sub-menu as shown in the example below. The sub-menu soft keys adjust the position of the Vertical Scale and appearance of the signal on the graph. Scale is adjusted in increments of 10 dBm.

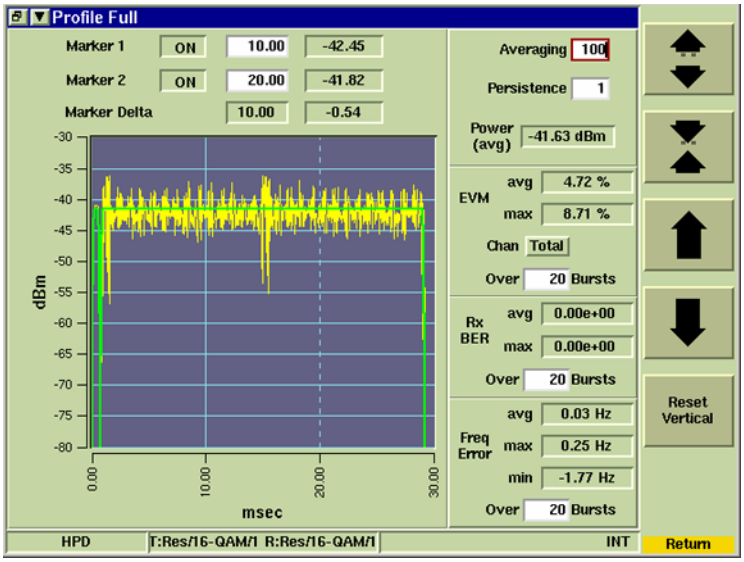


Fig. 3-15 Power Full Adjust Vertical Soft Key Sub-menu

[Reset Vertical] Soft Key

Resets all vertical values to default values and centers trace pattern vertically on the graph field. This soft key is accessed by pressing the [Adjust Vertical] Soft Key

[Adjust Horizontal] Soft Key

[Adjust Horizontal] soft key opens a soft key sub-menu that allows users to adjust the position and range of the graph's horizontal scale. This feature can be used to focus on specific time spans of the burst, such as the first two ms (msec) or the last 5 ms (msec) of the burst. Fig. 3-16 shows the first two ms (msec) of the burst displayed on the graph.

The largest range setting for Outbound and Inbound Reserved signal is 0 to 30 ms. The largest rage setting for Inbound Random signals is 0 to 10 ms. The smallest available range setting is 2 ms.

[Reset Horizontal] Soft Key

Resets the horizontal scale to default range of the burst type. This soft key is accessed by pressing the [Adjust Horizontal] Soft Key.

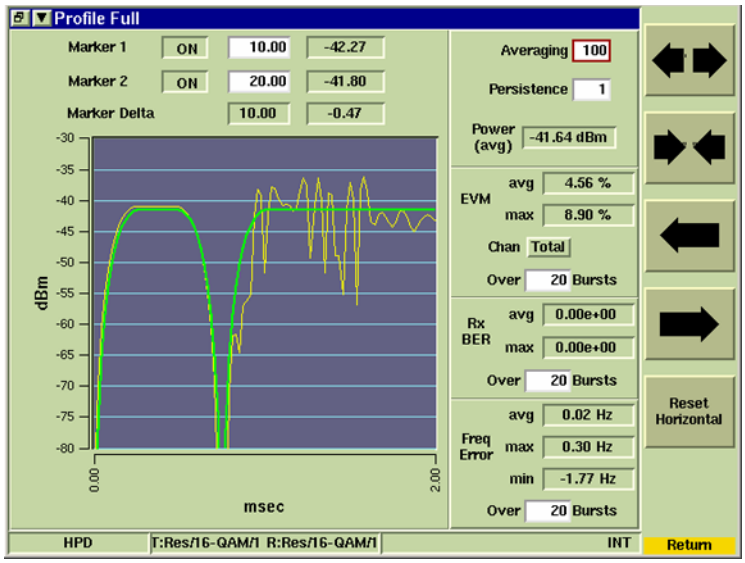


Fig. 3-16 Power Full - First two ms (msec) of Burst

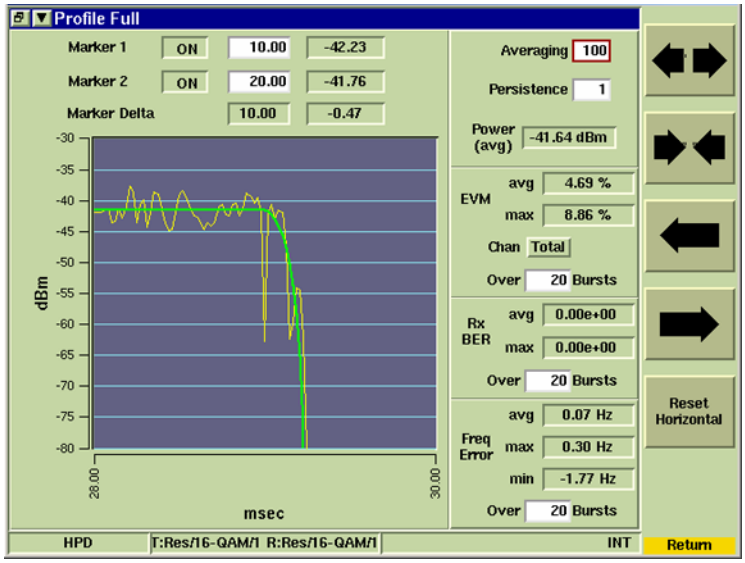


Fig. 3-17 Power Full - Last two ms (msec) of Burst

Profile Ramps Tile

The Profile Ramps Tile displays the ramp profile of the signal's power reading over a period of one burst. The left side of the field provides a detailed view of the first 2 ms (msec) of the burst. The right side of the field provides a detailed view of the last 2 ms (msec) of the burst. The maximized view in Fig. 3-18 shows the Profile Ramps Tile with the SHOW Profile feature selected.

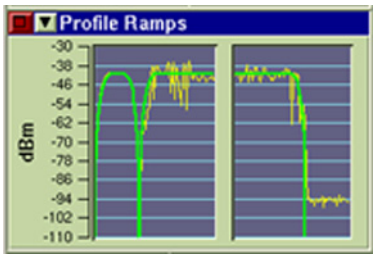


Fig. 3-18 Power Ramps - Minimized View

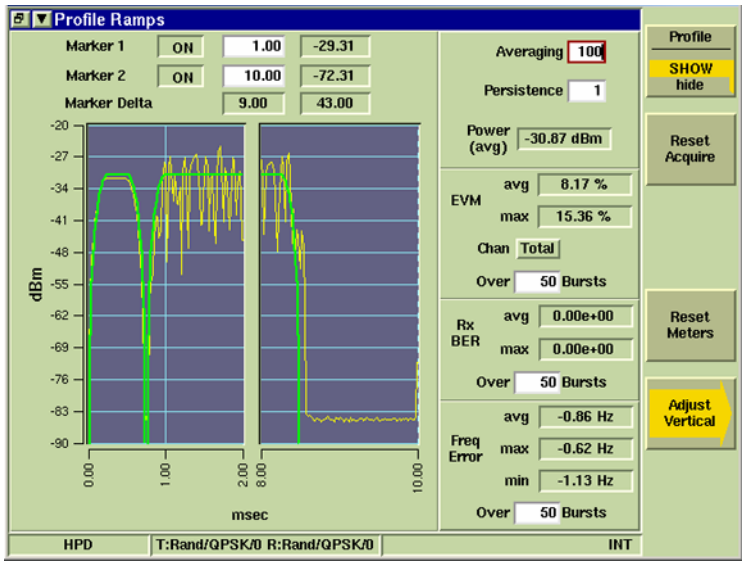


Fig. 3-19 Power Ramps - Maximized View

Field/Soft Key Definitions

Marker 1/Marker 2

ON/OFF

This button allows users to Enables (ON) or Disables (OFF) vertical markers on the display field.

Horizontal Marker Position

The white data field to the right of the ON/OFF button defines the marker's location along the graph field's horizontal scale. Markers can be placed at any point within the available time range for each side of the graph field. The range on the left side of the graph field is 0 to 2.0 ms (msec), the first two ms (msec) of the burst. The range on the right side of the graph field is 28 to 30 ms (msec) for Outbound and Inbound Reserved signals and 8 to 10 ms (msec) for Inbound Random signals, the last two ms (msec) of the burst.

Power Reading

The field to the right of the Horizontal Marker Position field indicates the Power reading at the marker's position.

Marker Deltas

The first field indicates the difference between Marker 1 and Marker 2 locations. The second field indicates the difference in Power readings between Marker 1 and Marker 2 locations. These fields are read only and can not be edited. The Marker Delta fields only contain data when both markers are enabled.

Averaging

Defines the number of bursts measured to calculate average trace data values. Changes made to this field do not affect the Over *n* Bursts setting on the Rx Meter Display Tile.

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 is displayed simultaneously on the display field.

Graph Scale

Vertical Scale

The vertical scale of the graph field is indicated in dBm. The [Adjust Vertical] Soft Key opens a soft key sub-menu that adjusts the positioning and range of the graph's vertical scale.

Horizontal Scale

The horizontal scale of the graph field is indicated in ms (msec). The left field range is 0 to 2 ms (msec); the right field range is 28 to 30 ms (msec) or 8 to 10 ms (msec) depending on the burst type. Marker indicators appear along the horizontal axis when markers are enabled.

[Profile Show/Hide] Soft Key

The [Profile Show/Hide] soft key turns the profile trace ON/OFF. When SHOW is selected, a **GREEN** profile appears on the display indicating the expected pattern of the signal.

[Reset Meters] Soft Key

Stops, clears, and re-starts the acquisition of data for the data display fields.

[Reset Acquire] Soft Key

"Re-synchronizes" the test set with the incoming HPD® signal.

[Adjust Vertical] Soft Key

The [Adjust Vertical] soft key opens a soft key sub-menu as shown in Fig. 3-16. The sub-menu soft keys adjust the position of the Vertical Scale of the graph. The smallest available range span is 30 dBm. Scales is adjusted in increments of 10 dBm.

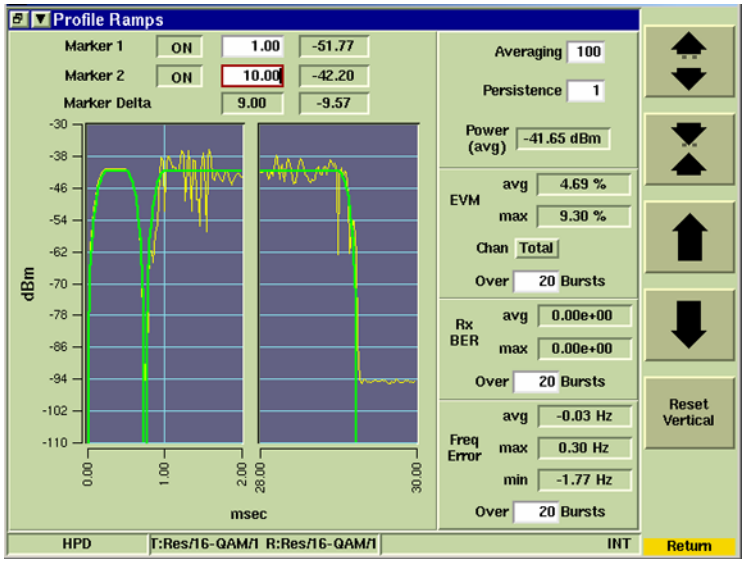


Fig. 3-20 Power Ramps - Adjust Vertical Soft Keys Sub-menu

[Reset Vertical] Soft Key

Resets all vertical values to default values and centers trace pattern vertically on the graph field. This soft key is accessed by pressing the [Adjust Vertical] Soft Key

Chapter 4

HPD® User Data I/O Port

Introduction

The HPD® 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 HPD® 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 only be viewed when a viewing application has been installed on the PC.

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.

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 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.

HPD® XML Command Structure

This section describes HPD® XML commands and command formatting instructions. This section is intended for users familiar with XML and therefore only describes XML commands specific to the Test Set HPD® Option.

To establish a baseline, the first <burst> definition in the XML file should include <type>, <modulation>, <mhbk> and <mdbk> information.

<burst> </burst>

This command indicates the beginning and end of each burst.

The following configuration rules must be followed or the burst is not transmitted:

- If <type> or <modulation> appear in the <burst> definition, <mhbk> and <mdbk> must also be included in the <burst> definition.
- If <type> is INBOUND RANDOM, <modulation> must be defined as QPSK.

<type> </type>

This command specifies the mode of the signal being transmitted or received:

INBOUND RESERVED
INBOUND RANDOM
OUTBOUND

<modulation> </modulation>

This command specifies the type of modulation being transmitted or received:

QPSK
16QAM
64QAM

<timestamp> </timestamp>

The timestamp field is optional for each burst transmission. This value can be user defined as an ASCII hex string with a maximum of 8 characters. The burst is sent immediately if this field is "FFFFFFFF".

<mhbk> </mhbk>

The field is comprised of a stream of ASCII hex characters which compile the MAC Header Block of the burst.

MHBK data should be input as a ASCII hex string. Bit lengths are defined in the following table according to specified modulation and signal type:

SIGNAL TYPE	MODULATION TYPE	BIT LENGTH
Outbound	QPSK	120 bits
Outbound	16 QAM	120 bits
Outbound	64 QAM	120 bits
Inbound Reserved	QPSK	96 bits
Inbound Reserved	16 QAM	96 bits
Inbound Reserved	64 QAM	96 bits
Inbound Random	QPSK	Does not contain a MHBK.

<mdbk> </mdbk>

The field is comprised of a stream of ASCII hex characters which compile the MAC Data Block of the burst.

MDBK data should be input as a ASCII hex string. Bit lengths are defined in the following table according to specified modulation and signal type:

SIGNAL TYPE	MODULATION TYPE	BIT LENGTH
Outbound	QPSK	696 bits
Outbound	16 QAM	1392 bits
Outbound	64 QAM	2088 bits
Inbound Reserved	QPSK	648 bits
Inbound Reserved	16 QAM	1296 bits
Inbound Reserved	64 QAM	1944 bits
Inbound Random	QPSK	164 bits

<skip> </skip>

When <skip> is used in the command structure the burst is not transmitted for that time slot.

<sync> </sync>

Sync indicates the external sync pulse is not transmitted at the beginning of the burst.

Chapter 5

HPD® Acceptance Test

Introduction

The HPD® Acceptance Test procedure is used to verify that 3900 HPD® software is functioning within factory specifications. Before beginning this procedure, complete the Installation Instructions described in section titled Installation in Chapter 2 of the 3900 Series Operation Manual. Refer to the section titled Test Set Operation in the 3900 Series Operation Manual for information on use and operation of the Test Set.

The HPD® Acceptance Test procedure utilizes the Test Set's internal loopback feature, allowing the unit to generate and receive an HPD® signal.

Required Equipment

MBNC to MBNC cable

Test Procedure

1. Power on Test Set.
2. Verify no error messages are displayed during the boot-up process.
3. Connect one end of MBNC to MBNC cable to Test Set GEN (Generator) Connector. Connect other end to Test Set ANT (Antenna) Connector.
4. Select **Systems**, **HPD** from the Systems Floating menu.
5. When HPD® is first selected, HPD® System Tiles appear as shown in Fig. 5-1. If HPD® has previously been used Tile layout may vary.

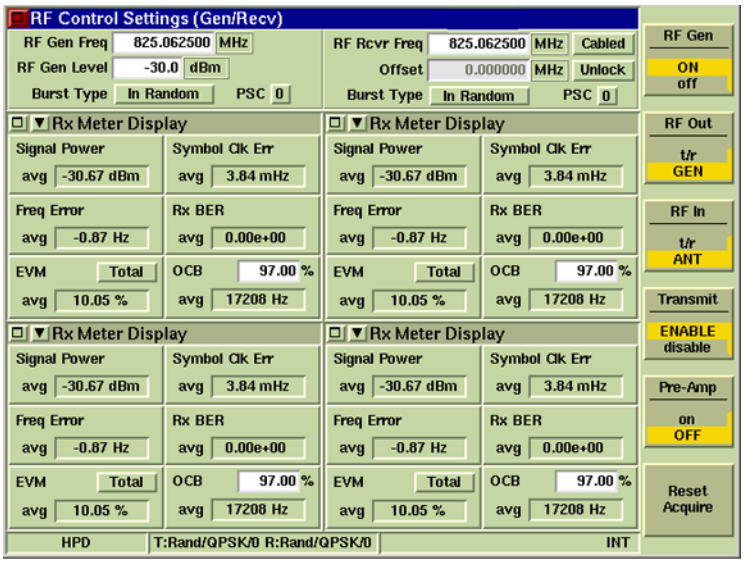


Fig. 5-1 HPD® Factory Default Display Tile

6. Maximize the **RF Control Settings Tile** and configure the following fields:
   - Set the **RF Gen Freq** and **RF Rcvr Freq** to **851.0625 MHz**.
   - Set the **RF Gen Level** to **-40 dBm**.
   - **Offset** in **Unlock** state.
   - Set to **Cabled**.
   - Set the Tx and Rx **PSC** to **1**.
   - Set **Receive Mode** to **Auto**.
   - Set Tx and Rx **Burst Type** to **Outbound**.
   - Set Tx **Modulation** to **QPSK (32 kbps)**.
   - Set Tx and Rx **Sync Mode** to **Free Run**.
   - Set **Pattern** to **O.153 Std**.
   - Set **TDM Syn** to **Disable**.
   - Set **Max Freq Drift** to **0.000000 Hz/sec**.
   - Set **Freq Profile Period** to **1.000000 sec**.

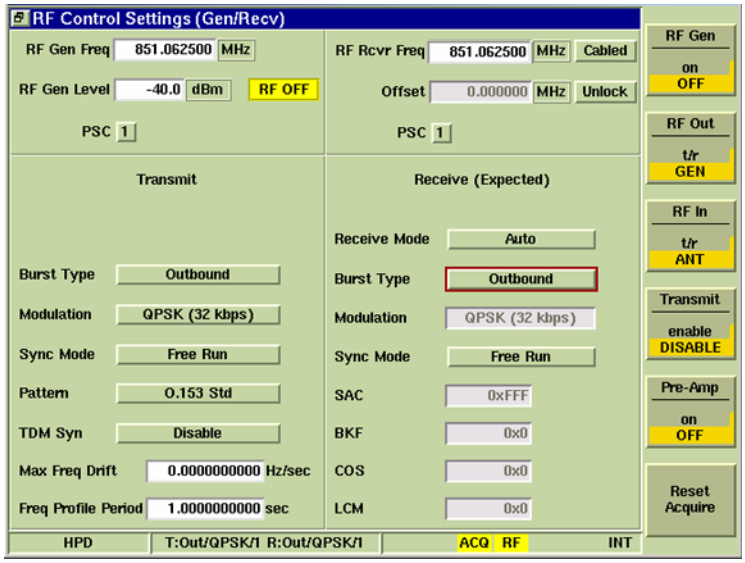


Fig. 5-2 HPD® Measurement Tiles

7. Minimize **RF Control Settings Tile**.

8. Select the Constellation, Error Vector Magnitude and Trajectory Tiles on three of the Measurement Tiles (refer to Fig. 5-3). **Invalid** is displayed in the upper left hand corner of these three display Tiles until a channel is enabled.

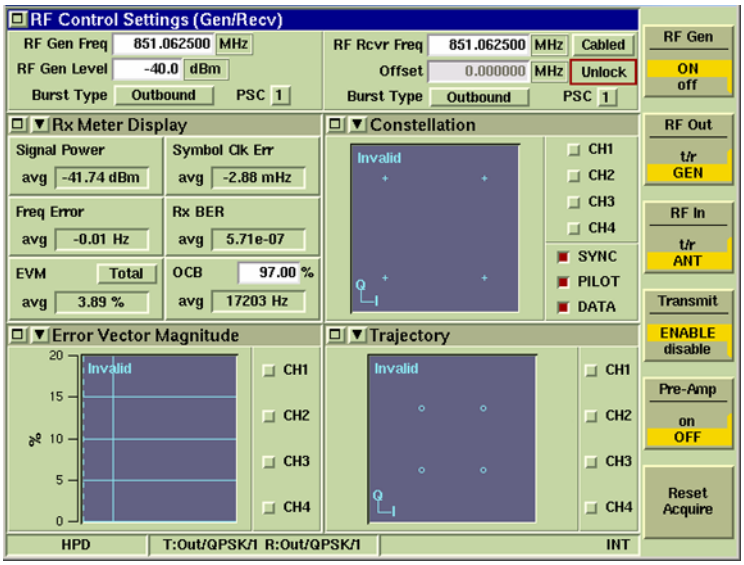


Fig. 5-3 RF Control Settings Soft Keys Enabled

9. Select **RF Control Settings Tile**.
10. Set **[RF Out] Soft Key** to **GEN**.
11. Set **[RF In] Soft Key** to **ANT**.
12. Set **[Transmit] Soft Key** to **Enable**.
13. Set **[RF Gen] Soft Key** to **ON**.
14. Wait while Test Set acquires signal and accumulates data. Press **[Reset Acquire] Soft Key** if needed.
15. Verify data displayed on Information Bar reads **T:Out/QPSK/1 R: Out/QPSK/1**.
16. Maximize **Rx Meter Display Tile** to view measurement readings.
17. Record the following readings from the **Rx Meter Display Tile**:
    - Signal Power: avg and max.
    - Frequency Error: min, avg and max.
    - EVM: avg and max.
    - Rx BER: avg and max.
18. Minimize the **Rx Meter Display Tile**. Verify the average readings recorded in Step 17 match the following data fields on the **RF Control Settings Tile**:
    - Signal Power = RF Gen Level (± 1 dBm plus cable loss).
    - Freq Error = RF Gen Offset (± 1 Hz).
    - Rx BER is 0.0 (± < 1%).

19. Select and maximize the **Constellation Tile**. Enable CH1 through CH4.
20. Verify the **Constellation Tile** displays a QPSK signal as shown in Fig. 5-4.

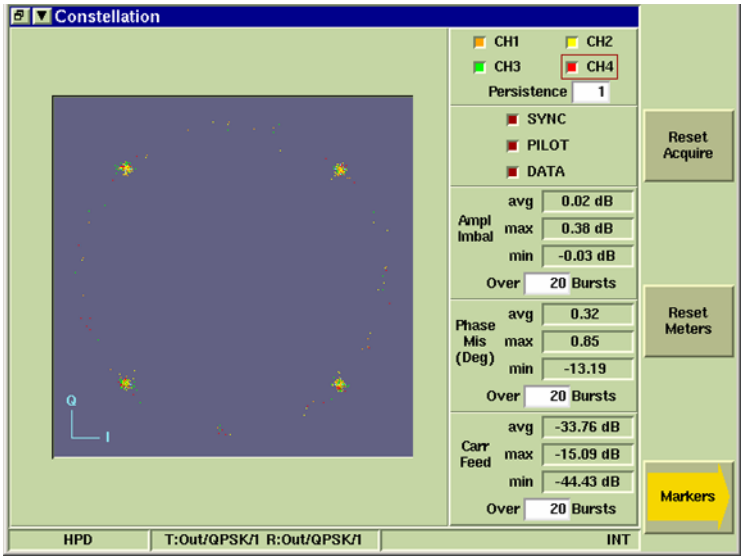


Fig. 5-4 Constellation Tile - QPSK Signal

21. Minimize the **Constellation Tile** and maximize the **Trajectory Tile**.
22. Enable CH1 through CH4.
23. Verify the following measurements match the readings recorded in Step 17:
    - EVM: avg and max.
    - Rx BER: avg and max.
    - Freq Error: min, avg and max.
24. Minimize **Trajectory Tile** and maximize **Error Vector Magnitude Tile**. Enable CH1 through CH4.
25. Verify the following measurements match the readings recorded in Step 17:
    - EVM: avg and max.
    - Rx BER: avg and max.
    - Freq Error: min, avg and max.
26. Minimize **Error Vector Magnitude Tile** and maximize the **RF Control Settings Tile.** Change Transmit **Modulation** to **16 QAM (64 kbps)**. Press **[Reset Acquire] Soft Key** if needed.

27. Minimize **RF Control Settings Tile** and verify **Constellation Tile** displays a 16 QAM signal as shown in Fig. 5-5.

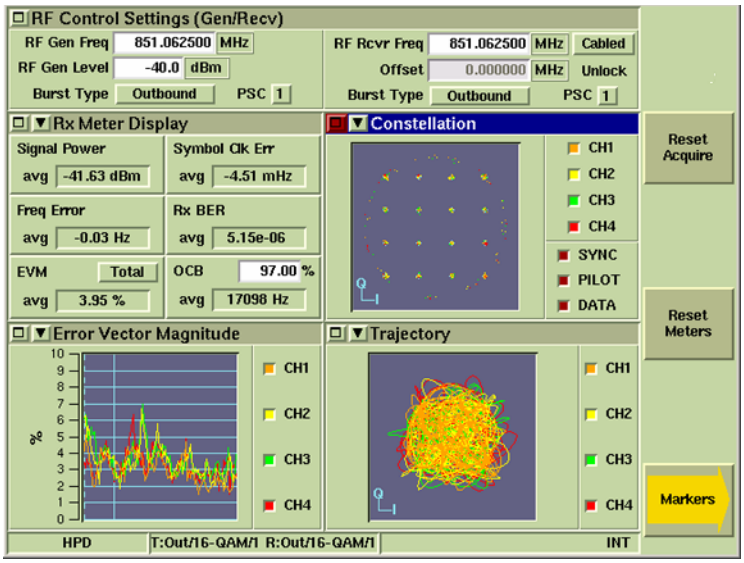


Fig. 5-5 Constellation Tile - 16 QAM Signal

28. Maximize **RF Control Settings Tile** and change Transmit **Modulation** to **64 QAM (96 kbps)**. Press **[Reset Acquire] Soft Key** if needed.

29. Minimize **RF Control Settings Tile** and verify **Constellation Tile** displays a 64 QAM signal as shown in Fig. 5-6.

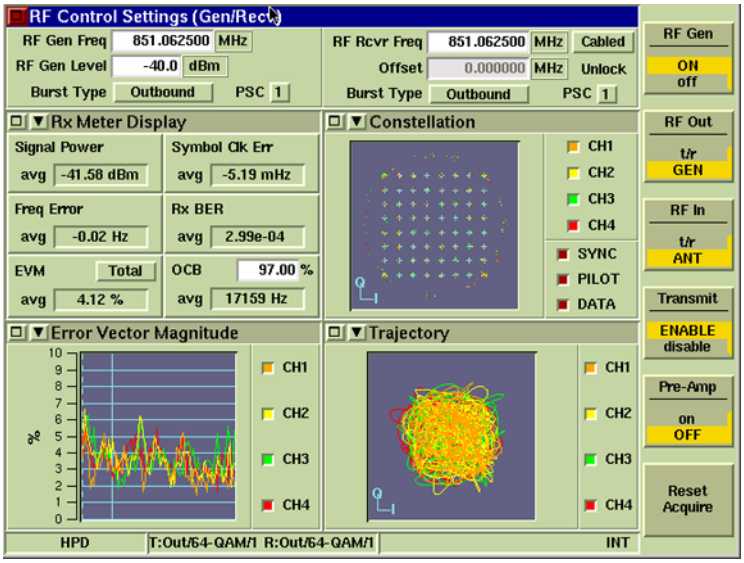


Fig. 5-6 Constellation Tile - 64 QAM Signal

30. Maximize the **RF Control Settings Tile** and change the **Pattern** to **O.153 Std w/1% Err**. Press **[Reset Acquire] Soft Key** if needed.

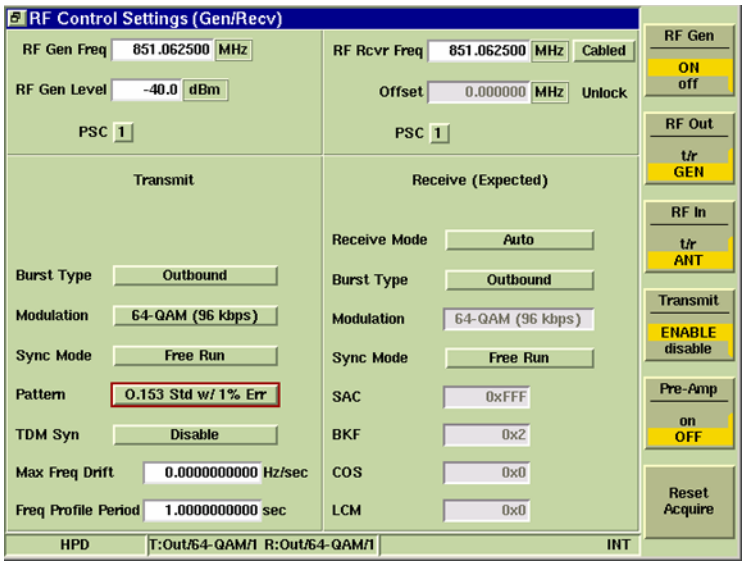


Fig. 5-7 RF Control Settings Tile - Pattern Selection

31. Minimize **RF Control Settings Tile**. Verify Rx BER reading on **Rx Meter Display Tile** is ~1.00e-02.

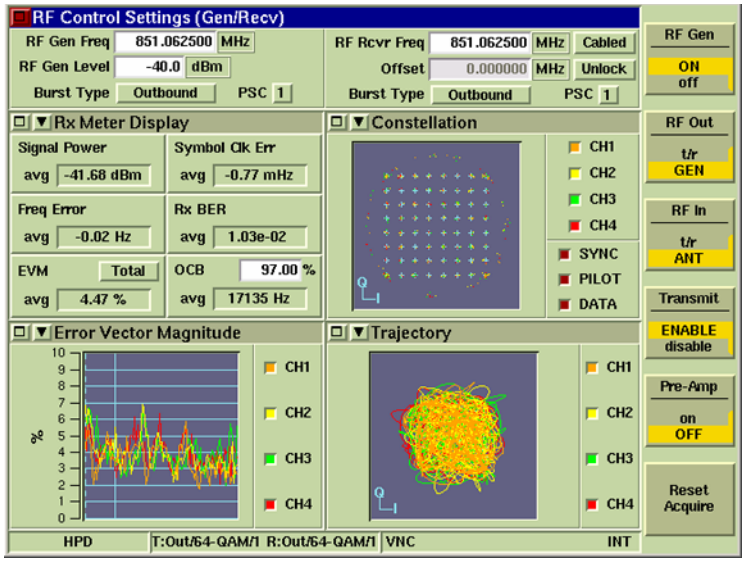


Fig. 5-8 RF Control Settings Tile - Rx BER Measurement

This completes the HPD® Acceptance Test. If the Test Set did not pass any of these verification steps contact Aeroflex Customer Service.

Chapter 6

HPD® Test Applications

Introduction

This chapter provides instructions on configuring the Test Set to perform basic measurements on the HPD® BR and MSU. Test Setup may vary according to the hardware configuration of the BR and MSU being tested.

HPD® BR Functionality Test Procedure

This procedure is used to measure RF Output Power, Frequency Accuracy and BER of the Base Radio. This procedure also provides EVM, Symbol Clock Error and Occupied Bandwidth readings.

Test Setup

1. Connect BR Output to Test Set T/R Connector. Connect Test Set 10 MHz reference to BR Ext Freq Ref.
2. Configure BR parameters to transmit to the Test Set.

Configure Test Set

3. Power on Test Set. Select **Systems**, **HPD** from the floating menu.
4. Maximize the RF Control Settings screen (refer to Fig. 6-1) and configure the following RF Rcvr (Receiver) fields:
   - Set **RF Rcvr Freq** to match BR frequency.
   - Set **Offset** to **UNLOCK**.
   - Set **Receiver Bandwidth** to Cabled / Off Air as desired.
   - Set **Receive** PSC to match PSC of BR.
   - Set **Receive Mode** to **Auto**.
   - Set **Burst Type** to **Outbound**.
   - Verify **Sync Mode** defaults to **Free Run** when Outbound Burst Type is selected.
   - Verify **[Pre Amp] Soft Key** is OFF.
5. Set **[RF In] Soft Key** to **T/R**.
6. Set **[RF Gen] Soft Key** to **OFF**.
7. Set **[Transmit] Soft Key** to **DISABLE**.

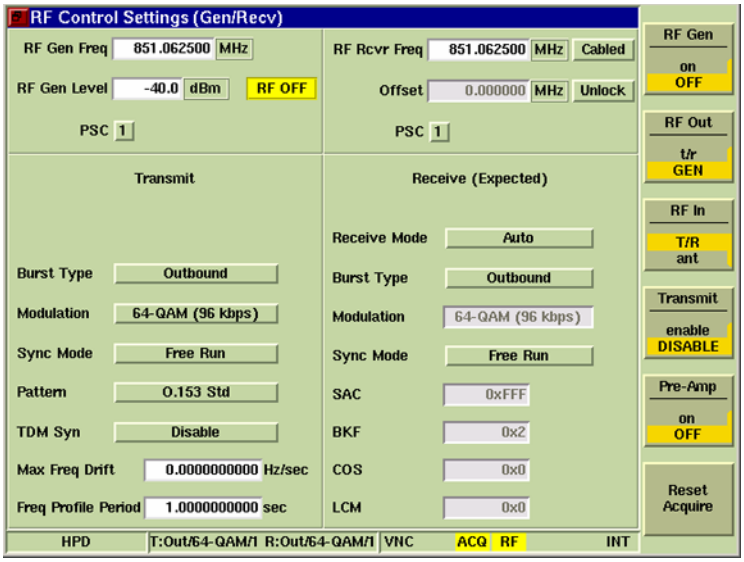


Fig. 6-1 Configure RF Control Settings - BR Functionality Test

8. Minimize the **RF Control Settings Tile**. Maximize the **Rx Meter Display Tile.**
9. Define the number of bursts over which the test should average readings for each desired measurement.

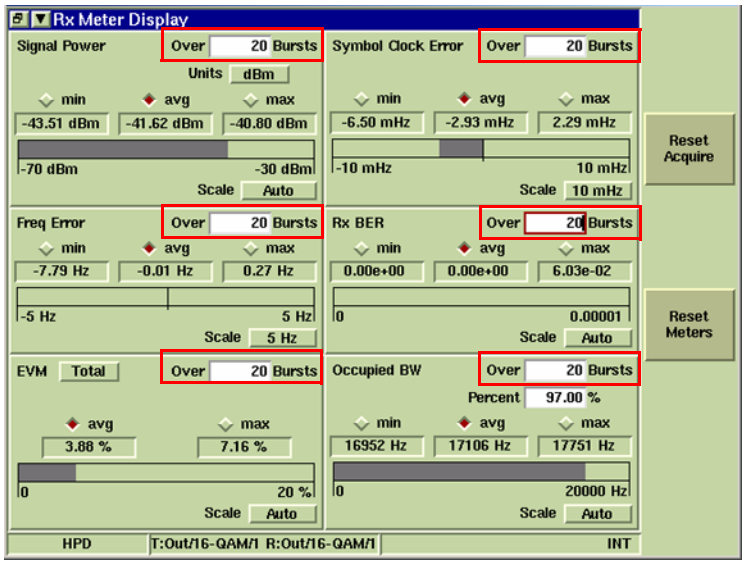


Fig. 6-2 Configure Rx Meter Fields - BR Functionality Test

10. Key the BR to transmit signal from BR to Test Set.
11. Record desired data from the **Rx Meter Display Tile**.

HPD® MSU Functionality Test Procedure

This procedure is used to measure RF Output Power, Frequency Accuracy and BER of the Mobile Subscriber Unit. This procedure also provides EVM, Symbol Clock Error and Occupied Bandwidth readings. The Test Set simulates BR functionality during this test and should be configured accordingly.

Test Setup

1. Connect MSU Tx Port to Test Set T/R Connector.
2. Connect Test Set GEN (Generator) Connector to MSU Rx Port.
3. Configure MSU to operate in Full Duplex Mode.

Configure Test Set

4. Power on Test Set. Select **Systems**, then **HPD** from the floating menu.
5. Maximize the **RF Control Settings Tile** and configure the following:

Transmit Fields:

- Set **RF Gen Freq** to match MSU frequency.
- Set **RF Gen Level** to desired value.
- Set the **Receive PSC** to match the PSC of the MSU.
- Set **Burst Type** to **Outbound**.
- Set **Modulation** to match MSU modulation type.
- Select desired **Pattern**.
- Set **TDM Syn** to **Disable**.

Receive Fields

- Set **Offset** to **UNLOCK**.
- Set **RF Rcvr Freq** to match MSU frequency.
- Set **PSC** to match MSU PSC.
- Set **Receive Bandwidth** to Cabled / Off Air as desired.
- Set **Receive Mode** to **Auto**.
- Set **Burst Mode** to **Inbound** (Reserved or Random to match MSU).
- Set **Sync Mode** to **Free Run** or **TDO** as desired.

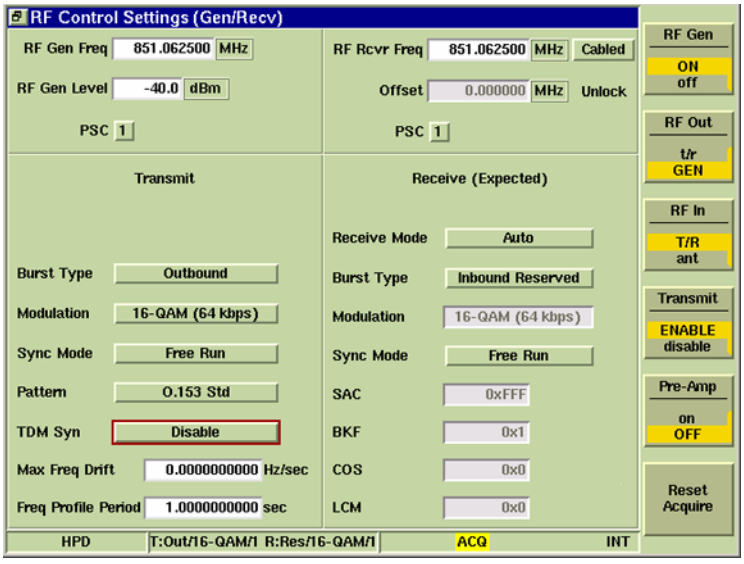


Fig. 6-3 Configure RF Control Settings - MSU Functionality Test

6. Set [**RF In] Soft Key** to **T/R**.
7. Set [**RF Out] Soft Key** to **GEN**.
8. Set [**RF Gen] Soft Key** to **ON**.
9. Set [**Transmit] Soft Key** to **ENABLE**.
10. Minimize the **RF Settings COntrol Tile**. Maximize the **Rx Meter Display Tile**.
11. Define the number of bursts over which the test should average readings for each desired measurement.

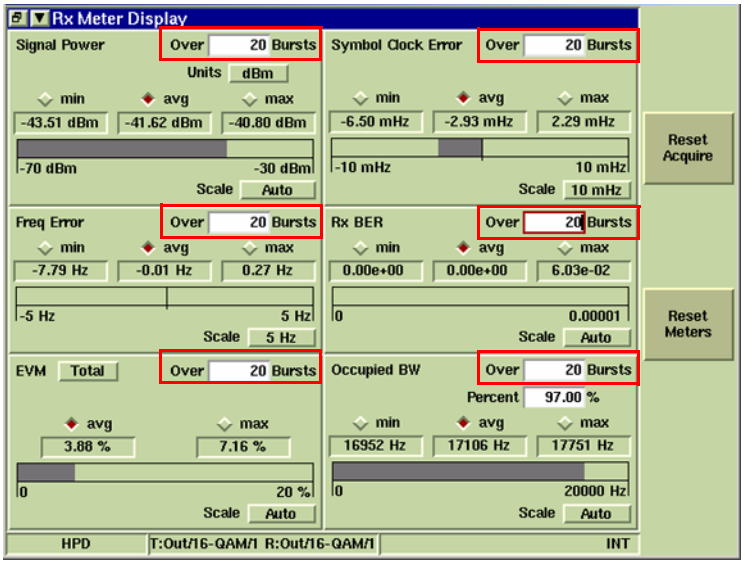


Fig. 6-4 Configure Rx Meter Fields - MSU Functionality Test

12. Transmit signal from MSU to Test Set.
13. Record the desired data from the **Rx Meter Display Tile**.

Appendix A

HPD® Terms and Acronyms

ACQ	Acquire Status Indicator
avg	Average reading
BER	Bit Error Rate
BKF	Block Format
BR	Base Radio
CH	Channel
CONFIG	Configuration
COS	Coding Scheme
EXT	External
EVM	Error Vector Magnitude
freq	Frequency
GEN	Generate
GHz	Giga Herts
HPD®	High Performance Data®
Hz	Hertz
I/O	Input / Output
Inbound	Burst type sent from Mobile Subscriber Unit to Base Radio
INT	Internal
kHz	kilo Hertz
LCM	Logical Channel Multiplexing
max	Maximum reading
MHz	Mega Hertz
min	Minimum reading
Mod	Modulation
ms	Millisecond
MSU	Mobile Subscriber Unit
Out	Outbound Signal
Outbound	Burst type sent from Base Radio to Mobile Subscriber Unit
PSC	Pilot Sync Code
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
Ran	Random Inbound Signal
Res	Reserved Inbound Signal
RF	Radio Frequency
Rx / Rcvr	Receive
SAC	Subscriber Access Code
SAM	Scalable Adaptive Modulation
TDO	Time Division Offset
TOS	Top of Scale

Tx	Transmit
UTILS	Utilities
VNC	Virtual Network Client / Virtual Network Computing

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Appendix B

Contact Information

For information on purchasing HPD® Software Option, contact Motorola:

CONTACT:	Motorola Parts Call Center	
	Telephone:	(800) 422-4210, ext 6883
	Hours of Operation	Monday through Friday 7 am to 7 pm CST

HPD® Option Numbers	HPD® Testing Option	Motorola Part # R2091A
	HPD® Advanced Analysis Package	Motorola Part # R2092A
	HPD® Testing Suite (R2091A and R2092A)	Motorola Part # R2093A

For technical support, contact Motorola:

CONTACT:	Motorola System Support Center	
	Telephone:	(800) 221-7144
	Hours of Operation	24 hours a day / 7 days a week

For issues relating to use of the 3900, contact the Aeroflex Sales Support Department:

CONTACT:	Aeroflex Sales Support Department 10200 West York Street Wichita, KS 67215	
	Telephone:	(800) 835-2350 (Dial Option 4)
	FAX:	(316) 529-5330
	Email:	techsupport@aeroflex.com

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CHINA / Shanghai	Tel: [+86] (21) 5109 5128	Fax: [+86] (21) 5150 6112
FINLAND	Tel: [+358] (9) 2709 5541	Fax: [+358] (9) 804 2441
FRANCE	Tel: [+33] 1 60 79 96 00	Fax: [+33] 1 60 77 69 22
GERMANY	Tel: [+49] 8131 2926-0	Fax: [+49] 8131 2926-130
HONG KONG	Tel: [+852] 2832 7988	Fax: [+852] 2834 5364
INDIA	Tel: [+91] 80 51150 4501	Fax: [+91] 80 5115 4502
KOREA	Tel: [+82] (2) 3424 2719	Fax: [+82] (2) 3424 8620
SCANDINAVIA	Tel: [+45] 9614 0045	Fax: [+45] 9614 0047
SPAIN	Tel: [+34] (91) 640 11 34	Fax: [+34] (91) 640 06 40
UK / Burnham	Tel: [+44] (0) 1628 604455	Fax: [+44] (0) 1628 662017
UK / Cambridge	Tel: [+44] (0) 1763 262277	Fax: [+44] (0) 1763 285353
UK / Stevenage	Tel: [+44] (0) 1438 742200	Fax: [+44] (0) 1438 727601
	Freephone: 0800 282388	
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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven, customer-focused.