3900 Series

Digital Radio Test Set

TETRA Option Manual

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Preface

SCOPE

This manual describes the use and applications of the 3900 TETRA Systems. Refer to the 3900 Series Operation Manual for information on use and operation of the Test Set.

NOMENCLATURE STATEMENT

The 3901, 3902, 3920 and 3920B 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, 3920 and 3920B Digital Radio Test Sets unless otherwise indicated.

INTENDED AUDIENCE

This manual is intended for users familiar with the use of TETRA Radios and TETRA 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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Chapter 1 - TETRA - General Information

1.1 INTRODUCTION

3900 TETRA Systems provide features for testing TETRA Trunked Mobile Radios and TETRA Base Stations. Mobiles and Base Stations with T1 Test capability can also be tested with the 3900 TETRA Systems. This manual describes how to use the Test Set to test the performance of mobiles and base stations designed to operate to TETRA specifications.

Each TETRA System functions as an independent test function, with no interchange of settings or configurations with other TETRA Systems or other Systems installed on the Test Set. An exception to this is the Channel Plan Function that allows User Defined Channel Plans to be created and saved to or recalled from any of the TETRA systems.

1.2 GENERAL INFORMATION

Manual testing is provided for the TETRA Mobile (MS and MS T1), TETRA Base Station (BS and BS T1) Modes and Direct Mode (DM).

Automatic testing is provided for the TETRA Mobile (MS) Mode.

Each TETRA Mode is provided with an individual Systems identity within the software structure of the Test Set. The modes enabled on a Test Set depend on the Options, or combination of Options pertinent to the Test Set.

The TETRA Systems provide the following test capabilities:

- On-channel transmitter measurements using standard or user-configured Channel Plans.
- Comprehensive modulation analysis with power profile, constellation, phase trajectory and vector error vs. time diagrams.
- Display of parameters and decoded data received from mobiles and base stations to aid diagnosis of system problems.
- Base station control channel simulation and signaling to provide effective network simulation, allowing mobile registration and call set-up to Test Set.
- Mobile Test Mode control using RF Loopback and T1 Signaling; and Audio Loopback, Test Sound and Silence Modes for mobile audio system testing.
- Mobile Test Mode using (TT) TETRA Test Mode.
- Uplink T1 Test Signal generator synchronized to base station down link frame structure supporting conformance testing of base station receivers.

1.3 TETRA CAPABILITIES

1.3.1 Transmitter Test

The 3900 tests the performance of transmitters in TETRA mobiles and TETRA base stations. Test capabilities are:

- Tx burst power
- Tx power level control (mobile only)
- Tx frequency error
- Tx burst timing (frame alignment) (mobile only)
- Modulation accuracy for peak and RMS vector error and residual carrier
- Burst profiles (transmitter output power versus time) (mobile only)
- Constellation, rotated vector and phase trajectory diagrams
- Vector error, magnitude and phase versus time displays
- Display of parameters and data received from mobiles and base stations

1.3.2 Receiver Tests

The signal generator within the Test Set produces the following signals:

- Simulated base station Main Control Channel (MCCH)
- Simulated base station Traffic Channel (TCH)
- T1 Test Signals Types 1, 2, 3, 4, 15 and 17 as defined in EN 300 394-1 for mobile testing
- RF Loopback and T1 Signaling Control of mobile Test Mode
- Synchronization to base station downlink frame structure for synchronized uplink T1 Type 7, 8, 9 and 10 signal generation for base station test.

1.4 TETRA MS SYSTEM

The 3900 tests the mobile operating in normal trunked mode. The TETRA MS System provides the following test capabilities:

- Base station simulation (MCCH, TCH/S, FACCH).
- Registration, group attachment and de-registration protocol.
- Call set-up, call maintenance and call clear-down protocol.
- Short Data Service (SDS) Message protocol.
- TETRA Test Mode (TT) registration and RF Loopback protocol.
- Transmitter measurements (i.e., burst power and timing, power profile, modulation accuracy, frequency error).
- Receiver measurements (BER, MER, RBER) on TCH/S using TT RF Loopback.
- Graphical displays of power profile and modulation.
- Capture and time stamping of mobile and test set protocol operations (1000 lines).
- Capture, demodulation and channel decoding of mobile transmissions (5000 bursts).

1.5 TETRA MS T1 SYSTEM

The 3900 tests the mobile using T1 Test Mode. The TETRA MS T1 System provides the following test capabilities:

- T1 Test signal generation (six types).
- T1 Test Mode control of mobile transmission, burst type, power level and RF Loopback.
- Transmitter measurements (i.e., burst power and timing, power profile, modulation accuracy, frequency error).
- Receiver measurements (BER, MER, PUEM) on T1 Test signals using T1 RF loopback.
- Graphical displays of power profile and modulation.
- Capture, demodulation and channel decoding of mobile transmissions (5000 bursts).

1.6 TETRA BS SYSTEM

The 3900 tests the base station operating in normal mode. The TETRA BS System provides the following test capabilities:

- Base station identification (MCC, MNC, BCC, LA).
- Frequency setting via Channel Plan. Channel Number or manually in Hz.
- Conversion of frequency to nearest equivalent Channel Number.
- Transmitter measurements (power, modulation accuracy, frequency error).
- Graphical displays of modulation.
- Direct RF connection to base station transmitter via T/R Connector.
- Off-air monitoring of base station transmitter via ANT Connector.
- Capture, demodulation and channel decoding of base station transmissions (5000 bursts).

1.7 TETRA BS T1 SYSTEM

The 3900 tests the base station using T1 Test Mode. The TETRA BS T1 System provides the following test capabilities:

- Base station identification (MCC, MNC, BCC).
- T1 Test signal generation (four types).
- Other test signal generation (18 Frame PRBS, Framed PRBS, Unframed PRBS).
- Optional synchronization to base station using sync pulse signal from base station.
- Optional automatic synchronization to base station using RF signal from base station.
- Optional automatic detection of required T1 Test Signal Type.
- Optional automatic detection of required scrambling code.
- Transmitter measurements (power, modulation accuracy, frequency error).
- Receiver measurements (BER, MER, PUEM) on T1 Test Signals using T1 RF loopback.
- Transmitter BER measurements on PRBS signals.
- Graphical displays of modulation.
- Capture, demodulation and channel decoding of base station transmissions (5000 bursts).

1.8 TETRA DM SYSTEM

The 3900 tests mobile direct mode call setup and parameters. The TETRA DM System provides the following test capabilities:

- Mobile to mobile tests.
- Transmitter measurements (burst power, power profile, burst timing, modulation accuracy, frequency error).
- Call set-up, call maintenance and call clear-down protocol.
- Short Data Service (SDS) Message protocol.
- Graphical displays of modulation, trajectory, constellation and power readings.
- History log of activity between mobile and Test Set.
- Graphical displays of power profile and modulation.
- Capture and time stamping of mobile and test set protocol operations (1000 lines).
- Capture, demodulation and channel decoding of base station transmissions (5000 bursts).
-

Chapter 2 - Common TETRA Operation

2.1 INTRODUCTION

This chapter describes TETRA System features that operate the same in all TETRA Systems.

NOTE	All instructions and key sequences are based on a unit operating in Test Mode unless otherwise indicated.

2.2 ACCESSING TETRA SYSTEMS

TETRA Systems are accessed from the Systems / Config menu. To select one of the TETRA systems while operating in Test Mode:

STEP	PROCEDURE

1. Press the CONFIG Key twice to access the Systems / Config menu.
2. Select Systems, TETRA from the systems menu.
3. Select the desired TETRA System from the expanded TETRA menu.
4. After a TETRA System is selected the Test Set loads the TETRA System, configured to the last used settings.

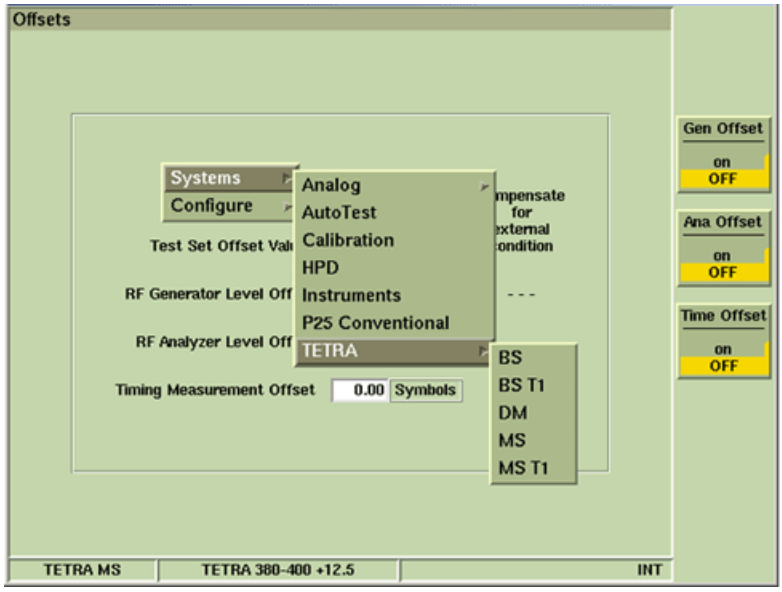

Fig. 2-1 TETRA System

NOTE	Menu contents vary according to the options installed in the Test Set.

2.3 TETRA DISPLAY MODES

The TEST Mode of the 3900 TETRA Systems has three Display Modes. Display modes are selected from the TEST floating menu.

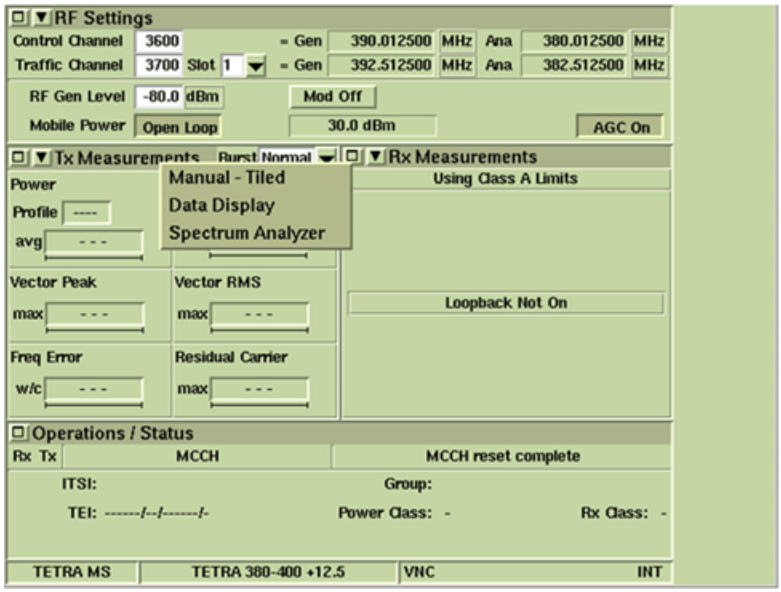

Fig. 2-2 TETRA Systems Test floating Menu

2.3.1 Manual - Tiled

Manual - Tiled Display Mode allows access to TEST mode functions. Tile configuration varies according to the TETRA system selected.

2.3.2 Data Display Mode

Data Display mode allows bursts of data passing between base stations and mobiles to be examined. The data is displayed as demodulated burst data after de-scrambling and channel decoding have occurred. Data Display Tile configuration is consistent throughout each TETRA system.

2.3.3 Spectrum Analyzer

Spectrum Analyzer display mode provides access to the Test Set's Spectrum Analyzer. Refer to the 3900 Series Operation Manual for information on the Spectrum Analyzer.

2.4 COMMON DISPLAY COMPONENTS

This section describes display components that are used through all TETRA Systems. Functionality of these components is consistent throughout each TETRA System unless otherwise noted.

2.4.1 Burst Types

The Burst drop-down menu selects the burst type. Menu options are dependent on the TETRA system selected.

2.4.2 Over n Bursts

The number of samples taken for each of the tests is set in the Over n Bursts numeric entry box within the results area for each test. The yellow status bar below the avg field indicates accumulation status.

The range for all the tests is 1 to 250. Default setting is 20.

2.4.3 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

2.4.4 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single or Repeat Soft Key is pressed.

2.4.5 Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Selecting ON with the Accumulate Soft Key starts the accumulation of traces.

Selecting OFF with the Accumulate Soft Key clears any accumulated traces and causes each trace to overwrite the previous trace.

2.4.6 Restart Soft Key

Clears any accumulated traces and starts a new accumulation. Setting the Accumulate Soft Key to ON displays this soft key.

2.5 CHANNEL PLANS

To test a mobile that is designed to use a standard TETRA Channel Plans, select the mobile's Channel Plan from the Channel Plan Tile. The correct Channel Plan configuration must be set up so the Rx and Tx frequencies and parameters of the Test Set correspond to those recognized by the mobile. The manufacturer or TETRA network operator supplying the mobile may need to be contacted to obtain this information.

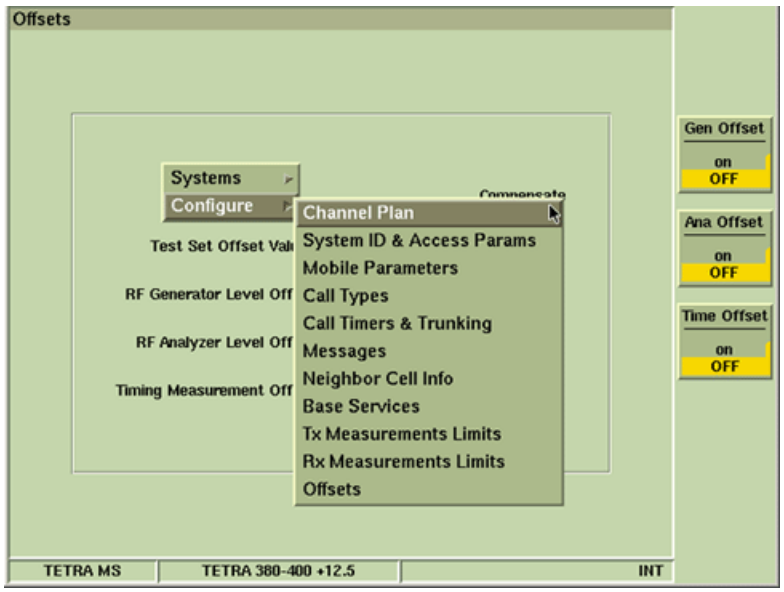

Fig. 2-3 Configuration Menu - Channel Plan Selected

2.5.1 Explanation of Channel Plans

The Channel Plan maps the uplink (MS Tx) frequency and the downlink (MS Rx) frequency to a Channel Number. A Channel Plan must be linked with a Channel Number because TETRA signaling protocol uses Channel Numbers rather than explicit frequencies to assign TETRA mobiles to frequency channels. Therefore, the mobile and base station (or the Test Set) map Channel Numbers must map to frequencies in the same manner. TETRA mobiles and base stations conforming to the TIP (TETRA Interoperability Profile) use the standard Channel Numbering scheme defined in ETSI TS 100 392-15. This Channel Numbering scheme is implemented in 3900 pre-defined Channel Plans.

Channel Numbers map to frequencies with a 25 kHz channel spacing, therefore the frequencies are integer multiples of 25 kHz, subject to a possible frequency offset. The Channel Plan also defines how TETRA channel frequencies are located (offset) within the frequency band. The 3900 supports the following options, as well as the less common 6.25 kHz offsets.

- If the channel boundaries are at integer multiples of 25 kHz, the center frequency is offset by +12.5 kHz from the frequency indicated by the Channel Number (Offset Channel Plan).
- If the channel center frequencies are at multiples of 25 kHz, the center frequency has zero offset from the frequency indicated by the Channel Number (Zero Offset Channel Plan).

2.5.2 Predefined Channel Plans

TETRA Systems contain a group of predefined Channel Plans that have been configured and saved according to TETRA frequency ranges. Predefined channel plans are selected from the Channel Plan drop down box.

System Information and Channel Block parameters are automatically configured when one of the 3900's standard predefined Channel Plans is selected.

System Information (Sys Info) parameters are used to supply information in the Test Set's control channel signal to tell the mobile about the Channel Plan.

Channel Block parameters tell the Test Set how to map Channel Numbers to frequencies.

When using one of the pre-defined Channel Plans, the Test Set configures all necessary parameters.

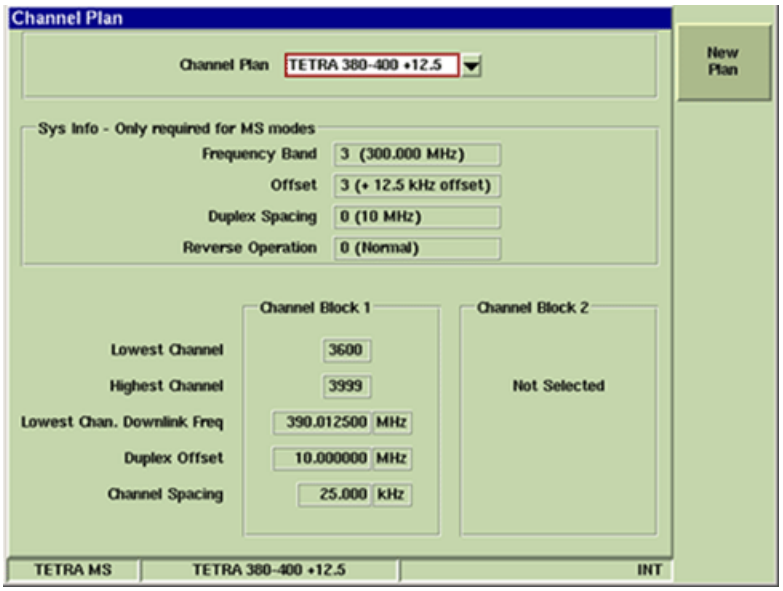

Fig. 2-4 Predefined TETRA Channel Plan Tile

2.5.3 Importing Channel Plans

The Utilities mode includes the File Management - TETRA feature which provides access to files that are common to all TETRA Systems, such as the Channel Plan files. Channel Plan files are imported or exported to and from a floppy disk or USB memory device via the File Management feature. Refer to the section titled File Management Tile in the 3900 Series Operation Manual for additional information on the use of the File Management feature.

To import a Channel Plan file when operating in Test Mode:

STEP	PROCEDURE
1.	Press the UTILS Key to access the Utilities menu.
2.	Select File Management from the Utilities menu.
3.	Connect a USB memory device containing the file in one of the 3900 USB ports.
4.	Select Import Soft Key to display the Save dialog box. Select the desired file.
5.	Select OK to import the file into the Test Set. File will now appear in TETRA Channel Plan menu.

2.5.4 Creating a New Channel Plan

The parameters described below are automatically configured when one of the 3900's standard predefined Channel Plans is selected. If the mobile does not conform to one of the pre-defined Channel Plans, a new Channel Plan with the details of the Channel Plan used by the mobile must be configured.

There are two aspects to the Channel Plan configuration:

- System Information (Sys Info) parameters are used to supply information in the Test Set's control channel signal to tell the mobile about the Channel Plan.
- Channel Block parameters tell the Test Set how to map Channel Numbers to frequencies.

When using one of the pre-defined Channel Plans, the Test Set configures all necessary parameters. When a new Channel Plan is created, the Sys Info parameters and the Channel Block parameters must be setup in a manner that the mobile under test understands. The Test Set intentionally does not create any links between the two sets of parameters, which allows full flexibility in defining a customized system; however this means that manually configured parameters must be set correctly.

Some TETRA radios have flexible RF architecture and are capable of setting their receiver and transmitter frequencies independently at any frequency within their supported frequency range, sometimes over an extended range covering more than one Channel Plan, e.g. 380 MHz to 430 MHz for both receiver and transmitter. Such mobiles typically obey all of the SYS INFO parameters, when possible. Other mobiles have fixed separate receiver and transmitter frequency ranges with a fixed duplex spacing; such mobiles may ignore some or all of the SYS INFO parameters.

2.5.4.A Sys Info Parameters

2.5.4.A.1 Frequency Band (Sys Info)

Specifies the reference frequency for the frequency band being used, range 0 to 15. For Channel Plans conforming to the ETSI standard (ETSI TS 100 392-15, this parameter specifies the 100 MHz block that contains the downlink frequencies. For example, for the 380 to 400 MHz band, the reference frequency is 300 MHz and thus the value of the Frequency Band (Sys Info) parameter is 3. The Test Set shows the ETSI standard interpretation of this parameter. For a proprietary Channel Numbering scheme, the correct value of this parameter may be zero or another irrelevant value.

2.5.4.A.2 Offset (Sys Info)

Specifies the channel center frequency offset, range 0 to 3. For Channel Plans conforming to the ETSI standard (ETSI EN 300 392-2, this parameter is interpreted as the following offsets from integer multiples of 25 kHz:

- 0 = No Offset
- 1 = +6.25 kHz
- 2 = -6.25 kHz
- 3 = +12.5 kHz

For example, if the center frequency of the first channel is 380.012500 MHz, the value of the Offset (SYS INFO) parameter is 3, indicating +12.5 kHz offset from 380.000000 MHz. The Test Set shows the ETSI standard interpretation of this parameter. For a proprietary Channel Numbering scheme, the correct value of this parameter may be zero or another irrelevant value.

2.5.4.A.3 Duplex Spacing (Sys Info)

Specifies the separation between the downlink (mobile Rx) frequency and the uplink (mobile Tx) frequency, range 0 to 7. For Channel Plans conforming to the ETSI standard (ETSI TS 100 392-15), the interpretation of this parameter is partly dependent on the value of the Frequency Band (Sys Info) parameter. Typical values used are:

- 0 (10 MHz) = 380 or 410 MHz systems
- 1 (45 MHz) = 800 or 870 MHz systems

The Test Set shows the ETSI standard interpretation of this parameter in conjunction with the frequency band, therefore, the Frequency Band (Sys Info) parameter is set before setting Duplex Spacing (Sys Info). For a proprietary Channel Numbering scheme, the correct value of this parameter may be zero or another irrelevant value.

Other values defined in the ETSI standard are:

0 Hz	7 MHz	30 MHz
1.6 MHz	8 MHz	36 MHz
4.5 MHz	10 MHz	39 MHz
5 MHz	18 MHz	45 MHz

2.5.4.A.4 Reverse Operation (Sys Info)

Specifies whether the uplink (mobile transmit) frequency is above or below the downlink (mobile receive) frequency, range 0 or 1. The Test Set shows the ETSI standard interpretation of the parameter. For a proprietary Channel Numbering scheme, the correct value of this parameter may be zero or another irrelevant value.

For Channel Plans conforming to the ETSI standard (ETSI EN 300 392-2), the interpretation of this parameter is:

0 (normal)

The uplink (mobile transmit) frequency is lower than the downlink (mobile receive) frequency, i.e., the duplex spacing is subtracted from the downlink frequency to obtain the uplink frequency

1 (reverse)

The uplink frequency is higher than the downlink frequency, i.e., the duplex spacing is added to the downlink frequency to obtain the uplink frequency.

2.5.4.B Channel Block 1 Parameters

Channel Block 1 parameters need to be defined when configuring TETRA System channel plans. Channel Block 2 parameters are not normally used and should be identified as Excluded.

2.5.4.B.1 Channel Block Included

Set this parameter to Included for Channel Block 1 to inform the Test Set that there is valid channel information in Channel Block 1.

2.5.4.B.2 Lowest Channel Number

Set this parameter to the lowest Channel Number used by the Channel Plan. This value normally corresponds to the channel that is the lowest frequency; however in a complicated Channel Plan, the lowest Channel Number is not necessarily the lowest frequency channel. Refer to the TETRA Performance Specifications located in the 3900 Platform Data Sheet for examples of Channel Numbers used in the pre-defined Channel Plans.

2.5.4.B.3 Highest Channel Number

Set this parameter to the highest Channel Number used by the Channel Plan. When a Channel Number is entered for the Control Channel or Traffic Channel, the Test Set only allows a number to be entered that is within the range of the Lowest Channel Number to Highest Channel Number.

2.5.4.B.4 Lowest Channel Downlink Frequency

This parameter establishes the mapping between Channel Numbers and frequencies for a New Channel Plan. Enter the downlink (mobile Rx) frequency that corresponds to the lowest Channel Number. The mobile Rx frequency entered must match the center frequency of the lowest numbered channel.

There is no link between the Sys Info Parameters and the Channel Block Parameters. If a Channel Plan uses an offset from the 25 kHz multiples, the offset value in Offset (Sys Info) and the offset in the Channel Block Lowest Channel Downlink Freq parameter must be set so the RF Generator frequency of the Test Set matches the mobile receiver frequency. For example, when using the lowest channel in TETRA 380-400 +12.5 with 12.5 kHz offset, enter 390.012500 MHz as the offset in the Channel Block Lowest Channel Downlink Freq parameter field.

NOTE	VIAVI 2968 TETRA Test Set users: The 3900 Test Set follows the ETSI standard in using the mobile Rx frequency as the basis of the calculation, whereas the VIAVI 2968 TETRA Test Set by established practice used the mobile Tx frequency.

2.5.4.B.5 Duplex Offset

Duplex Offset defines the link between the mobile Rx frequency and the mobile Tx frequency. The Test Set uses the duplex offset value to set its analyzer frequency to the mobile Tx frequency:

(mobile Tx frequency = mobile Rx frequency - Duplex Offset).

The Duplex Offset value is normally 10.000000 MHz or 45.000000 MHz. For example, for the lowest channel in TETRA 380-400 +12.5 (12.5 kHz offset):

mobile Tx frequency = (390.012500 MHz - 10.000000 MHz) = 380.012500 MHz.

A reverse Channel Plan can also be defined by entering a negative value for the Duplex Offset parameter. Remember that there is no link between the Sys Info Parameters and the Channel Block Parameters. If the Channel Plan uses reverse duplex, the REVERSE OPERATION (SYS INFO) parameter must be set to REVERSE and the Channel Block Duplex Offset parameter must be set to a negative value so that the Test Set sets its analyzer frequency (mobile Tx frequency) higher than its signal generator frequency (mobile Rx frequency).

2.5.4.B.6 Channel Spacing

This parameter defines how the Test Set calculates the mobile Rx frequency that corresponds to a particular Channel Number according to the formula:

mobile Rx frequency (channel n) =

(n - lowest Channel Number) x channel spacing + lowest channel downlink frequency

Normally this parameter is set to 25.000 kHz, TETRA channel spacing, so that each increment of the Channel Number increases the mobile Tx and Rx frequencies by 25 kHz. Reverse Channel Plans are defined by setting a negative channel spacing, so that incrementing the Channel Number reduces the mobile Tx and Rx frequencies.

2.5.4.C Channel Block 2 Parameters

Channel block 2 parameters are not normally used and should be set to Excluded so the Test Set disregards these settings.

If a Channel Plan contains a fragmented numbering scheme, this numbering scheme is defined using Channel Block 2. Typically a fragmented numbering scheme arises when additional channels are added to an existing Channel Plan at frequencies below the original lowest frequency. An example of this is GSM 900, where the original channels in the P-GSM band are numbered 1 to 124, and additional channels were later added (the E-GSM band below the P-GSM band) numbered 975 to 1023 and 0. Numbering fragmentation should not occur if the ETSI standard Channel Numbering scheme is used, since Channel Numbers 0000 to 4000 are defined as the bottom and top of a 100 MHz band, so all frequencies are covered.

NOTE	A TETRA system may have gaps in its allocation of frequency channels rather than being allocated as a contiguous block of spectrum, but a separate channel block does not need to be defined if the Channel Numbering includes the non-allocated channels. Separate non-contiguous channel blocks may be defined to instruct the Test Set to restrict the Control Channel and Traffic Channel selections to allocated channels.

2.5.5 Configuring a New Channel Plan

2.5.5.A Configure Parameters for a New Plan:

STEP	PROCEDURE

1. Press CONFIG Key to access the CONFIG Floating menu.
2. Select Channel Plan from the CONFIG Floating menu.
3. Press the New Plan Soft Key and the Channel Plan - New Tile is displayed. The Based On box selects an exiting Channel Plan as a template for the new plan. By using an existing Channel Plan that has parameters similar to the new plan, editing is kept to a minimum. The title of the plan currently selected is displayed in the Based On box.

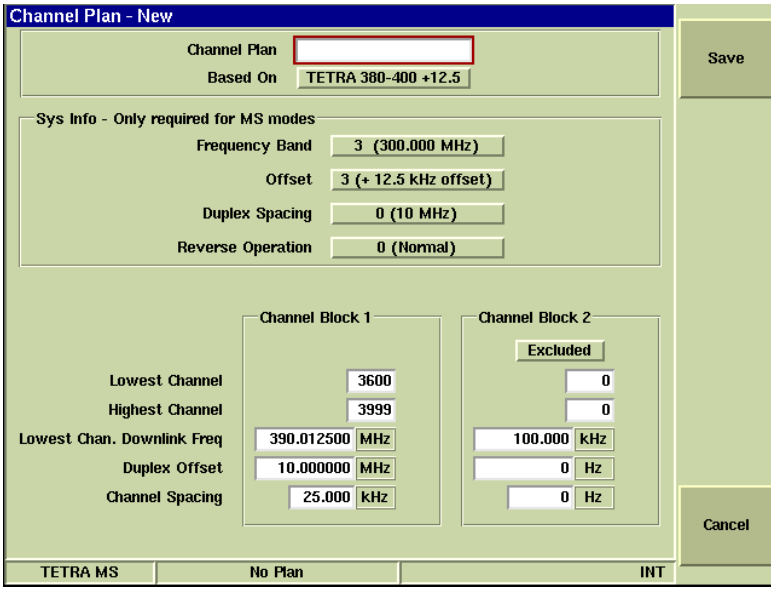

Fig. 2-5 Channel Plan - New

Fig. 2-5 shows the Channel Plan - New Tile before parameters new parameters have been entered. The Based On box selects an existing Channel Plan as a template for the new plan. By using an existing Channel Plan that has parameters similar to the new plan, editing is kept to a minimum. The title of the plan currently selected is displayed in the Based On box.

2.5.5.B Base New Plan on an Existing Plan:

STEP	PROCEDURE
1.	Select the existing plan from the Based On box drop down menu.
2.	Enter a title in the Channel Plan box to identify the new plan. The title must be unique and must not exceed 20 characters, including any spaces.
3.	Change the Sys Info parameters to the required settings.
4.	Change the Channel Block parameters as required.
5.	When the Channel Plan has been edited to the desired settings, press the Save Soft Key. The name of the new plan is displayed on the Information bar.

2.5.5.C Check Channel Plan configuration:

This check is completed on the TETRA MS TEST, RF Settings Tile where the RF Generator frequency and the RF Analyzer frequency is displayed for a given Channel Number.

STEP	PROCEDURE
1.	Set the lowest and highest Channel Numbers for the control channel.
2.	Verify that the Generator Frequency and Analyzer Frequency are set to the desired downlink and uplink frequencies.

2.5.6 New Channel Plan Examples

Refer to the example sequences below to configure three user defined Channel Plans.

2.5.6.A Example 1

The first example sets up a TETRA 380-400 -6.25 Channel Plan which is based on the TETRA 410-430 -6.25 Channel Plan, using the following parameters:

- TETRA 380-400 -6.25 Channel Plan
- Channels 3601 to 4000
- Down link 390.018750 to 399.993750 MHz
- Uplink 380.018750 to 389.993750 MHz

STEP	PROCEDURE
1.	Select the Channel Plan - New screen.
2.	On the Based On box drop down list select the TETRA 410-430 -6.25 Channel Plan.
3.	In the Channel Plan box, enter the title for the new plan, subject to the constraints mentioned earlier.

2.5.6.A.1 Sys Info Parameters

STEP	PROCEDURE
4.	On the Frequency Band drop down box select 3 (300 000 MHz).
5.	Verify that the Offset drop down box is set to 2 (-6.25 kHz offset).
6.	Verify that the Duplex Spacing drop down box is set to 0 (10 MHz).
7.	Verify that the Reverse Operation drop down box is set to 0 (Normal).

2.5.6.A.2 Channel Block 1 Parameters

STEP	PROCEDURE
8.	Edit the Lowest Channel box value to read 3601.
9.	Edit the Highest Channel box value to read 4000.
10.	Edit the Lowest Chan. Downlink Freq box value to read 390.018750 MHz.
11.	Verify that the Duplex Offset box value reads 10.000000 MHz.
12.	Verify that the Channel Spacing box value reads 25.000 kHz.

2.5.6.A.3 Channel Block 2 Parameters

STEP	PROCEDURE
13.	Verify that the Included / Excluded box is set to Excluded.
14.	When the Channel Plan is correctly configured, press the Save Soft Key. The name of the new plan is then displayed on the Information bar.

2.5.6.A.4 Check Channel Plan configuration:

This check is made on the TETRA MS TEST, RF Settings Tile where the RF Generator frequency and the RF Analyzer frequency is shown for a given Channel Number.

STEP	PROCEDURE
1.	Set the lowest and highest Channel Numbers for the control channel.
2.	Verify that the Generator Frequency and Analyzer Frequency are set to the desired downlink and uplink frequencies.

2.5.6.B Example 2

The second example sets up a TETRA 380-400 -6.25 Channel Plan which is based on the TETRA 380-400 +12.5 Channel Plan, using the following parameters:

- TETRA 380-400 -6.25 Channel Plan
- Channels 3601 to 4000.
- Down link 390.018750 to 399.993750 MHz.
- Uplink 380.018750 to 389.993750 MHz.

STEP	PROCEDURE
1.	Select the Channel Plan - New screen.
2.	On the Based On box drop down list select the TETRA 380-400 +12.5 Channel Plan.
3.	In the Channel Plan box, enter the title for the new plan, subject to the constraints mentioned earlier.

2.5.6.B.1 Sys Info Parameters

STEP	PROCEDURE
4.	Verify the Frequency Band drop down box is set to 3 (300 000 MHz).
5.	On the Offset drop down box select 2 (-6.25 kHz offset).
6.	Verify the Duplex Spacing drop down box is set to 0 (10 MHz).
7.	Verify the Reverse Operation drop down box is set to 0 (Normal).

2.5.6.B.2 Channel Block 1 Parameters

STEP	PROCEDURE
8.	Edit the Lowest Channel box value to read 3601.
9.	Edit the Highest Channel box value to read 4000.
10.	Edit the Lowest Chan. Downlink Freq box value to read 390.018750 MHz.
11.	Verify that the Duplex Offset box value reads 10.000000 MHz.
12.	Verify that the Channel Spacing box value reads 25.000 kHz.

2.5.6.B.3 Channel Block 2 Parameters

STEP	PROCEDURE
13.	Verify that the Included / Excluded box is set to Excluded.
14.	When the Channel Plan is correctly configured, press the Save Soft Key. The name of the new plan is then displayed on the Information bar.

2.5.6.B.4 Check Channel Plan configuration:

STEP	PROCEDURE
1.	Set the lowest and highest Channel Numbers for the control channel.
2.	Verify that the Generator Frequency and Analyzer Frequency are set to the desired downlink and uplink frequencies.

This check is made on the TETRA MS TEST, RF Settings Tile where the RF Generator frequency and the RF Analyzer frequency is shown for a given Channel Number.

2.5.6.C Example 3

The third example sets up a 460 MHz Channel Plan with 7 MHz duplex spacing with reverse operation. This is based on the TETRA 450-470 +12.5 Channel Plan. This plan uses the following parameters:

- 460 MHz Channel Plan
- Channels 2400 to 2519
- Down link 460.012500 to 462.987500 MHz
- Uplink to 467.012500 to 469.987500 MHz
- 7 MHz Duplex Spacing
- Reverse operation

STEP	PROCEDURE
1.	Select the Channel Plan - New screen.
2.	On the Based On box drop down menu select the TETRA 450-470 +12.5 Channel Plan.
3.	In the Channel Plan box, enter the title for the new plan, subject to the constraints mentioned earlier.

2.5.6.C.1 Sys Info Parameters

STEP	PROCEDURE
4.	Verify the Frequency Band drop down box verify is set to 4 (400 000 MHz).
5.	Verify the Offset drop down menu is set to 3 (+12.5 kHz offset).
6.	Verify the Duplex Spacing drop down box select 1 (7 MHz).
7.	Verify the Reverse Operation drop down box select 1 (reverse).

2.5.6.C.2 Channel Block 1 Parameters

STEP	PROCEDURE
8.	Verify that the Lowest Channel box value reads 2400.
9.	Edit the Highest Channel box value to read 2519.
10.	Verify that the Lowest Chan. Downlink Freq box value reads 460.012500 MHz.
11.	Edit the Duplex Offset box value to read -7.000000 MHz.
12.	Verify that the Channel Spacing box value reads 25.000 kHz.

2.5.6.C.3 Channel Block 2 Parameters

STEP	PROCEDURE
13.	Verify that the Included / Excluded box is set to Excluded.
14.	When the Channel Plan is correctly configured, press the Save Soft Key. The name of the new plan is then displayed on the Information bar.

2.5.6.C.4 Check Channel Plan configuration:

This check is made on the TETRA MS TEST, RF Settings Tile where the RF Generator frequency and the RF Analyzer frequency is shown for a given Channel Number.

STEP	PROCEDURE
1.	Set the lowest and highest Channel Numbers for the control channel.
2.	Verify that the Generator Frequency and Analyzer Frequency are set to the desired downlink and uplink frequencies.

2.5.7 Channel Plan Display Examples

Fig. 2-6 shows a new Channel Plan Tile ready to be created by setting the fields to the required settings and entering the new Channel Plan name.

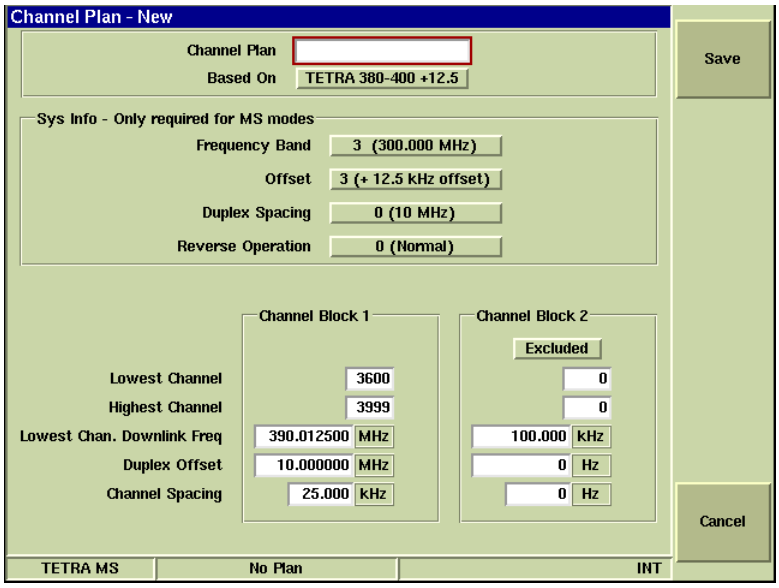

Fig. 2-6 Channel Plan - New - 380-400 +12.5

Fig. 2-7 shows the Channel Plan Tile from Fig. 2-6 after the Channel Plan has been saved with the name “New One.”.

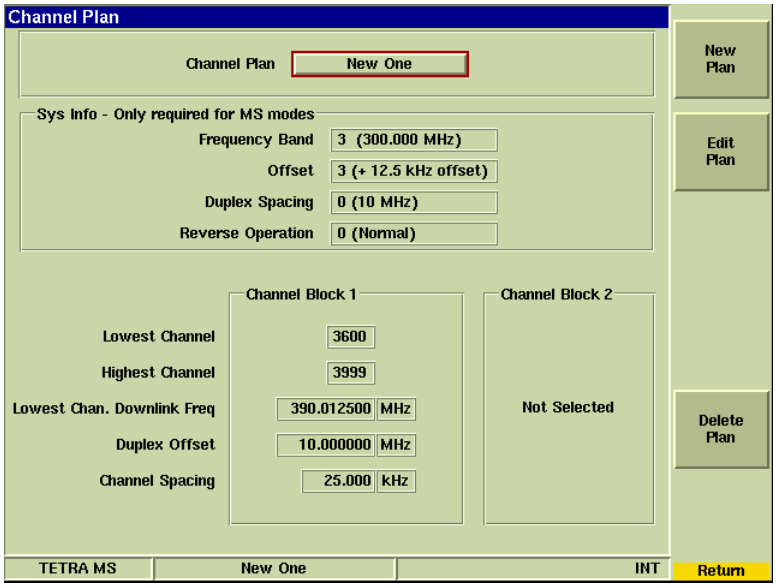

Fig. 2-7 New Channel Plan - Title New One

Fig. 2-8 shows the New One Channel Plan Tile (Fig. 2-7) ready to be edited. Editing the Channel Plan maintains the name, but the original Channel Plan configuration is lost.

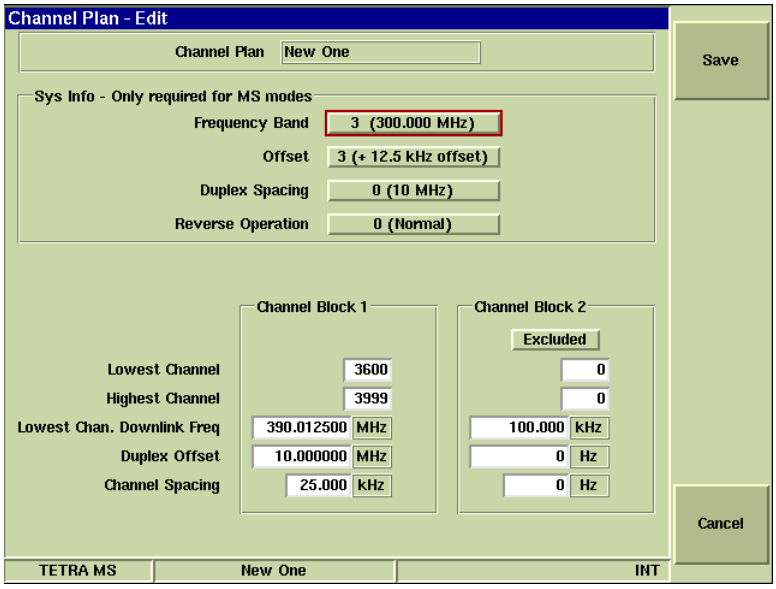

Fig. 2-8 Edit Channel Plan - Edit Tile with New One Ready to Edit

Fig. 2-9 shows the TEST display with **No Plan** (no Channel Plan) selected and the focus on the RF Settings tile. When **No Plan** is selected, the RF Generator and RF Analyzer frequency has to be set by absolute values and not by Channel Number.

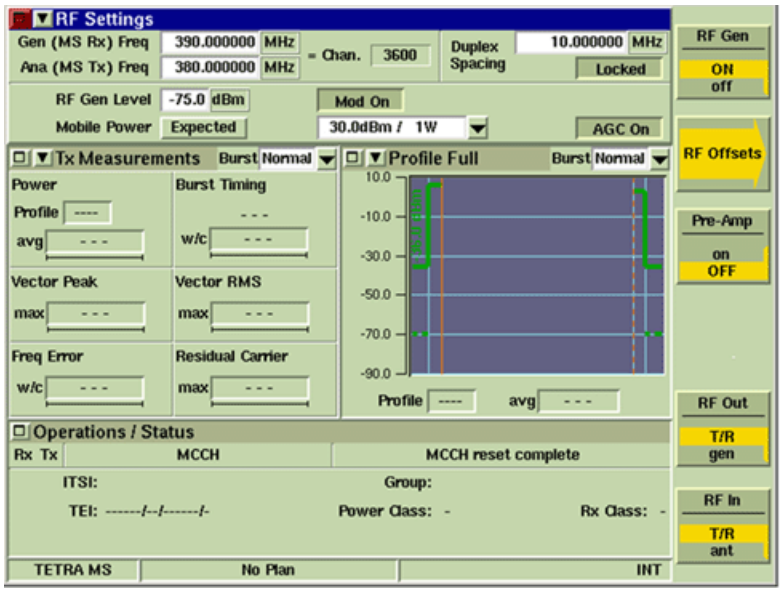

Fig. 2-9 RF Settings Tile - NO PLAN Selected

2.6 USING DATA DISPLAY MODE

2.6.1 Accessing Data Display Mode

Data Display Mode allows data bursts transmitted by base stations and mobiles to be examined. The data is displayed as demodulated burst data after de-scrambling and channel decoding have been performed.

To access Data Display Mode from Test Mode:

STEP	PROCEDURE

3. Press the TEST Key to open the Test Menu.
4. Highlight Data Display on the TEST floating menu and press the SELECT Key.
5. To return to the Manual Tiled mode, press the TEST Key display the TEST floating menu.
6. Highlight Manual Tiled and press the SELECT Key.

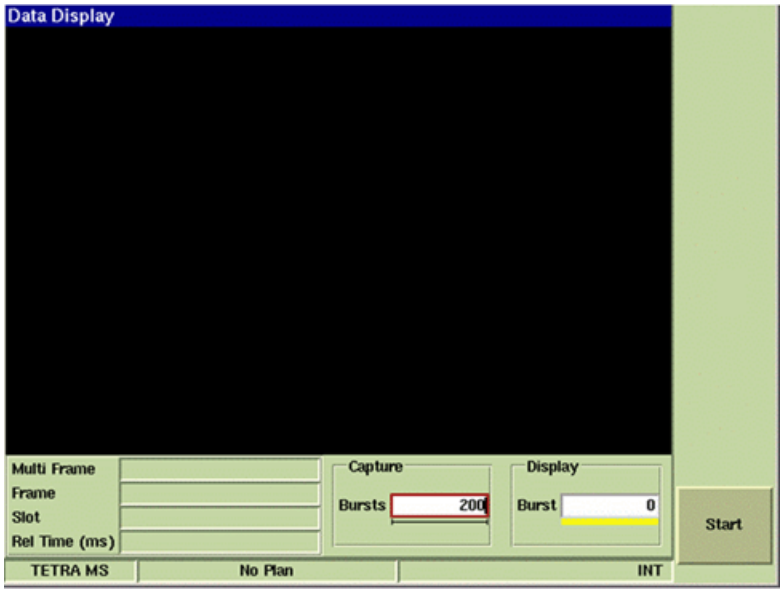

Fig. 2-10 Data Display Tile - Prior to Capture

When TETRA MS or TETRA MS T1 is active, Data Display captures uplink bursts.

When TETRA BS or TETRA BS T1 is active, Data Display captures downlink bursts.

When TETRA DM is active, Data Display captures Direct Mode bursts.

The Data Display Tile shows the data contained in the captured bursts. An example of a captured Data Display is shown in Fig. 2-11.

2.6.2 Capturing Data Displays

To start a data capture:

STEP	PROCEDURE

1. Press the Start Soft Key.
2. Specify the number of bursts to be captured in the Capture Bursts entry field. The bar graph below the capture indicates the progress of the capture.
3. Return to Manual - Tiled Display Mode while the Data capture is running. Return to Data Display Mode afterwards.

A capture is stopped at any time by pressing the Stop Soft Key. A progress bar shows the proportion of the capture that was completed when the capture was stopped.

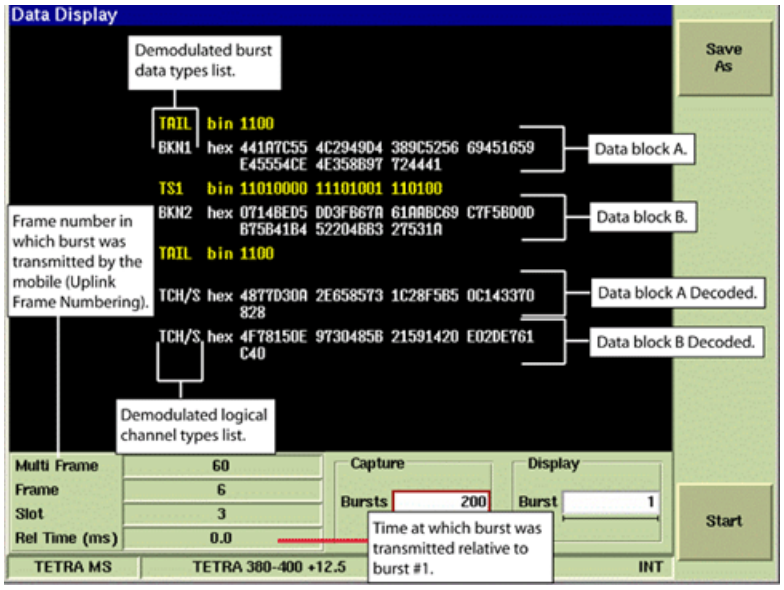

Fig. 2-11 TETRA MS Data Display Tile with Captured Data Bursts

The top part of the Tile displays demodulated burst data; the lower part displays the same data following de-scrambling and channel decoding.

The lower section of the Tile contains data fields that define the number of bursts to be captured. This section of the Tile also provides frame numbering information and a time stamp relative to the first captured burst.

The components of the demodulated burst data are indicated as either bin to identify binary data or hex to identify hexadecimal data. Demodulated Burst Data components are listed in the tables in the section titled Data Display File Format.

The identity of the specific burst displayed is shown on the display, with the Multi Frame, Frame and Slot numbers shown. The Rel Time (ms) value shows the time in milliseconds from the start of the capture until the start of the displayed burst.

The Display Burst readout box indicates the current captured burst that is displayed. By selecting this box and using the variable control, the compass keys, or by entering a value, the required burst is displayed.

Demodulated data is displayed in RED if it does not match the expected binary patterns for tail bits and training sequences.

Decoded data is displayed in RED if errors were detected in the data.

2.6.3 Data Display File Format

Save As allows captured data to be saved to the Test Set as a .csv or .txt file. The saved file can be exported via the Utilities File Management Tile.

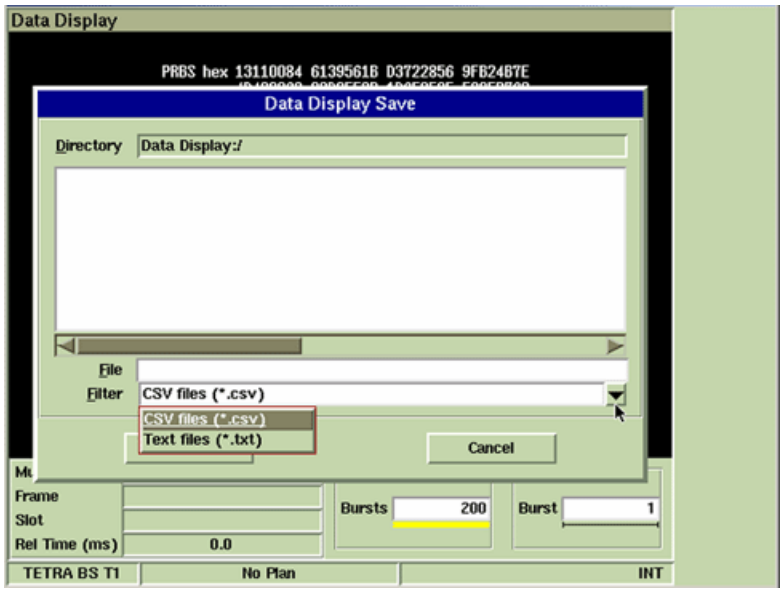

Fig. 2-12 Data Display Tile - File Drop-down Menu

2.6.3.A TXT File Format

TXT files are displayed in the following format:

Separator sequence of 80 =

Count = <number or burst starting at 1>

Multi-frame = <1 to 60 or blank if not synchronized>
This line is not present in TETRA DM.

Frame = <1 to 18 or blank if not synchronized>

Slot = <1 to 4 or blank if not synchronized> [subslot number SS1, SS2]

Rel_Time (ms) = <Time relative to start of capture of ms to nearest tenth>

Test_Mode = BS, DM, MS

Blank Line

Demodulated data as on screen, shown in gray scale. Errors shown with ERROR added to the end of the returned data.

Blank Line

Channel decodes as on screen, show in gray scale. Errors shown with ERROR added to the end of the returned data.

Blank Line

2.6.3.A.1 TXT File Example:

```
================================================================
Count = 1
Multi Frame = 31
Frame = 1
Slot = 1 (SSN2)
Rel Time (ms) = 0.0
Test mode = MS

TAIL bin 1100
CBK hex F312AB78 4D3FD94E 2A2AC
TSEXT bin 10011101 00001110 10011101 000011
CBK hex B688D33D 326C520D 2A09F
TAIL bin 1100

SCH/HU hex ERROR DECODING DATA
================================================================
Count = 2
Multi frame = 31
Frame = 16
Slot = 1 (SSN1)
Rel Time(ms) = 850.0
Test mode = MS

TAIL bin 1100
CBK hex F312AB78 4D3FD94E 2A2AC
TSEXT bin 10011101 00001110 10011101 000011
CBK hex B688D33D 326C524D 2A09F
TAIL bin 1100

SCH/HU hex 4096B438 44998C01 1002000
```

2.6.3.B CSV File Format

CSV files are displayed in the following format:

Test_mode,MN,FN,TN,SSN,Rel-time(ms),TS,RAMP_UP,RAMP_DOWN,NUM_BITS, RAW_DATA

where:

test_mode = BS, DM, MS

MN (Multi-frame Number = 1 to 60; 0 if TETRA DM is not applicable

FN (Frame Number) = 1 to 18

TN (Timeslot Number) = 1 to 4

NOTE In TETRA BS, BS T1 and DM, when the Test Set is not synchronized with the incoming signal the MN, FN and TN are 0.

SSN (Subslot Number) = SSN1
SSN2 for control bursts
SS both for all bursts except control bursts and two control bursts in a timeslot.

Rel_time (ms) = Time relative to start of capture in ms

TS (Training Sequence) = TS1, TS2, TSEXT and TSSYNC

RAMP_UP

0 = no ramp up at the beginning of burst, i.e., continuous with previous burst.

1 = Ramp up at beginning of burst

RAMP_DOWN

0 = No ramp down at end of burst, i.e., continuous with next burst.

1 = Ramp down at end of burst.

NUM_BITS Number of demodulated bits.

510 = Continuous burst in all modes

504 = Direct mode burst without ramp up, i.e., continuing from previous burst

476 = Direct mode burst without ramp down, i.e., continuing into next burst

470 = Discontinuous direct mode burst

432 = Discontinuous normal uplink burst

412 = Two control uplink bursts (stored back to back)

206 = Control uplink burst

RAW_DATA = Demodulated bits in hex

2.6.3.B.1 CSV File Example:

MS,31,1,1,SSN2,0.0,TSEXT,1,1,206,CF312AB784D3FD94E2A2AC9D0E9D0EDA234CF4C9B14834A827F0

MS,31,16,1,SSN1,850.0,TSEXT,1,1,206,CF312AB784D3FD94E2A2AC9D0E9D0EDA234CF4C9B14934A827F0

	Demodulated Burst Data Types Displayed
Indication	**Full Title and Comments**
	Blocks and Bits
BBK	Broadcast BlocK
BKN1	**B**loc**K** **N**umber **1**
BKN2	**B**loc**K** **N**umber **2**
CBK	**C**ontrol **B**loc**K** (in Control Burst)
FC	**F**requency **C**orrection bits
ISFC	**I**nter-**S**lot **F**requency **C**orrection (in Direct Mode)
P1	**P**re-amble **1** (in Direct Mode Normal Burst)
P2	**P**re-amble **2** (in Direct Mode Normal Burst)
P3	**P**re-amble **3** (in Direct Mode Synchronization Burst)
PA	**P**hase **A**djustment bits
PRBS	**P**seudo **R**andom **B**it **S**equence (BS T1 Unframed PRBS Operation)
SBK	**S**ynchronization **B**loc**K** (in Synchronization Burst)
TAIL	**TAIL** bits
	Training Sequences
TS1	**T**raining **S**equence **1** Normal training sequence, full slot usage
TS2	**T**raining **S**equence **2** Normal training sequence, half slot usage
TS3	**T**raining **S**equence **3** Inter-slot training sequence
TSEXT	**ex**tended **T**raining **S**equence (Control Burst)
TSSYNC	**sync**hronization **T**raining **S**equence (Synchronization Burst)

	Decoded Logical Channel Types Displayed
Indication	**Full Title and Comments**
	Channels
AACH	**A**ccess **A**ssignment **CH**annel
BNCH	**B**roadcast **N**etwork **CH**annel
BSCH	**B**roadcast **S**ynchronization **CH**annel
SCH/F	**F**ull slot **S**ignaling **CH**annel
SCH/H	**H**alf slot **S**ignaling **CH**annel (Direct Mode)
SCH/HD	**H**alf slot **S**ignaling **CH**annel (**D**own link)
SCH/HU	**H**alf slot **S**ignaling **CH**annel (**U**p link)
SCH/S	**S**ynchronization **S**ignaling **CH**annel (Direct Mode)
STCH	**ST**ealing **CH**annel
TCH/2.4	**2.4** kbit/s **T**raffic **CH**annel
TCH/4.8	**4.8** kbit/s **T**raffic **CH**annel
TCH/7.2	**7.2** kbit/s **T**raffic **CH**annel
TCH/S	**S**peech **T**raffic **CH**annel

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Chapter 3 - TETRA MS AutoTest Commands

3.1 INTRODUCTION

This chapter describes the AutoTest commands that can be used in conjunction with the TETRA MS System. Commands are grouped by functionality:

- Settings Commands for General, Initialization, and In-Call use.
- Test Commands, such as Power Level, Power Profile, etc.

The Setting Commands for each test are included under the Tile listing for the related Test Commands.

3.2 SETTINGS COMMANDS FOR GENERAL USE/INITIALIZATION

Command	Parameters	Default Value	Equivalent Tile
set_rf_ana_expected_level	<level> (in dBm) T/R: -40 to +55 ANT: -80 to 0 (in 5 dB steps)	T/R: 30 dBm ANT: -10 dBm	RF Settings Test
set_rf_ana_level_offset_enable	off | on	off	Offsets Config
set_rf_ana_level_offset_value	-40.0 to 40.0 (in dB)	0.0 dB	Offsets Config
set_rf_ana_port	tr | ant	tr	RF Settings Test
set_rf_gen_level	<level> (in dBm) T/R: -130 to -40 GEN: -130 to 0	T/R: -75 dBm GEN: -75 dBm	RF Settings Test
set_rf_gen_level_offset_enable	off | on	off	Offsets Config
set_rf_gen_level_offset_value	-40.0 to 40.0 (in dB)	0.0 dB	Offsets Config
set_rf_gen_port	tr | gen	tr	RF Settings Test
set_timing_offset_enable	off | on	off	Offsets Config
set_timing_offset_value	-999.99 to 999.99 (in symbols)	0.0 symbols	Offsets Config

3.3 SETTINGS COMMANDS FOR IN-CALL USE

Command	Parameters	Default Value	Equivalent Tile
set_idle_traffic_channel	transmission | message (trunking type) [facch | tch] (simplex traffic channel type)	message facch	Call Timers & Trunking Config
inc_rf_ana_closed_level	-30 to +30 (in 5 dB steps)	no default	RF Settings Test
set_rf_ana_control_mode	expected | open | closed	open	RF Settings Test

3.4 FIXED PARAMETERS

The large majority of TETRA MS parameters are controlled by the AutoTest programmer. However, within AutoTest, the following parameters have fixed values:

Parameter	Fixed Value	Tile
Group Call Hang Timer	30 sec	Call Timers & Trunking Config
Test Set Answer Mode	Auto	Call Timers & Trunking Config
Test Set Auto Answer Time	0 sec	Call Timers & Trunking Config
Test Set Auto Call Abort Time	0 sec	Call Timers & Trunking Config
Test Set Call Abort Mode	Auto	Call Timers & Trunking Config
Test Set Quiet Time	0 sec	Call Timers & Trunking Config
Test Set Transmit Mode	None	Call Timers & Trunking Config
Neighbor Cell - Broadcast	Not Supported	Neighbor Cell Info Config
BER Class 0 - Enable	Enabled	Rx Measurements Limits Config
BER Class 1 - Enable	Enabled	Rx Measurements Limits Config
BER Class 2 - Enable	Enabled	Rx Measurements Limits Config
MER - Enable	Enabled	Rx Measurements Limits Config
RBER Class 0 - Enable	Enabled	Rx Measurements Limits Config
RBER Class 1 - Enable	Enabled	Rx Measurements Limits Config
Burst Power - Enable	Enabled	Tx Measurements Limits Config
Burst Timing - Enable	Enabled	Tx Measurements Limits Config
Frequency Error - Enable	Enabled	Tx Measurements Limits Config
Power Profile - Enable	Enabled	Tx Measurements Limits Config
Residual Carrier - Enable	Enabled	Tx Measurements Limits Config
Vector Peak - Enable	Enabled	Tx Measurements Limits Config
Vector RMS - Enable	Enabled	Tx Measurements Limits Config
Conversation Type	Silence	Operations / Status Test
AGC	On	RF Settings Test
RF Gen Enable	On	RF Settings Test

3.5 REMOTE COMMAND TESTS

3.5.1 Power Level Tests

test_power_level_avg
test_power_level_max
test_power_level_min

3.5.1.A Summary

The test_power_level tests measure the average power during a burst. The measurement is taken over the middle of the burst measured at the symbol points through a TETRA filter. The power level (maximum, minimum or average, depending on which of the tests is selected) is measured over the number of bursts specified for this test by the set_power_samples command.

3.5.1.B Command Parameters

None

3.5.1.C Related Commands

Command	Parameters	Default Value	Equivalent Tile
set_power_class	1 | 1L | 2 | 2L | 3 | 3L | 4 | 4L	4	Mobile Parameters Config
set_power_class_usage	fixed | reported	reported	Mobile Parameters Config
set_power_level_limits	<Highest Upper> <Highest Lower> <Other Upper> <Other Lower> (in dB, all -9.9 to +9.9)	+2.0 dB -2.0 dB +2.5 dB -2.5 dB	Tx Meas Limits Config
set_power_samples	1 to 250	20	Tx Measurements Test
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)

3.5.1.D Results

If test completes...	Example
Within limits	Power Level Max, CH 964/3 PL04 +30.6 dBm (+xx.0/ -xx.0)
Limits exceeded	Power Level Avg, CH 964/3 PL04 +13.6 dBm (+xx.0/ -xx.0), FAIL
If test fails to complete...	**Example**
PTT timeout	Power Level Min, PTT not pressed, FAIL
Timeout	Power Level Avg, No bursts, FAIL
Not in call	Power Level Max, Not in a call, FAIL

NOTE

During a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**. When PTT is not pressed within the ptt_timeout period, the test fails.
While the test runs, a progress bar displays the accumulation of samples.

3.5.2 Power Profile Tests

test_power_profile

3.5.2.A Summary

The test_power_profile command checks the conformance of the mobile's burst power profile to user-definable mask limits.

The carrier must not exceed <High dBc Lead> on the leading edge, and it must not exceed <High dBc Trail> on the trailing edge. The carrier must be below the greater of <Low dBc> and <Low dBm> outside the burst.

The test is repeated at the mobile's minimum and maximum power level, assuming that the mobile is using open loop power control.

3.5.2.B Command Parameters

None

3.5.2.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_power_profile_limits	<Low dBc> <Low dBm> (both 0 to -99.9) <High dBc Lead> <High dBc Trail> (both -9.9 to 9.9)	-70 dBc -36 dBm +6 dBc +3 dBc	Tx Meas Limits Config
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)

3.5.2.D Results

If test completes...	Example
Within limits	Power Profile, CH3600/1 PL04 (-70.0/-36.0/+06.0/+03.0)
Limits exceeded	Power Profile, CH3600/1 PL04 (-70.0/-36.0/+06.0/+03.0), FAIL
If test fails to complete...	**Example**
PTT timeout	Power Profile, PTT not pressed, FAIL
Timeout	Power Profile, No bursts, FAIL
Not in call	Power Profile, Not in a call, FAIL

NOTE

During a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**. When PTT is not pressed within the ptt_timeout period, the test fails.

3.5.3 Burst Timing Tests

test_burst_timing_avg
test_burst_timing_wc

3.5.3.A Summary

The test_burst_timing commands measure the symbol timing of the bursts from the mobile, measured with respect to the signal transmitted by the Test Set.

The Tx timing error (worst case or average depending on which of the tests is selected) is measured over the number of bursts specified for this test by the set_burst_timing_samples command.

3.5.3.B Command Parameters

None

3.5.3.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_burst_timing_limit	0.01 to 9.99 (in symbols)	0.25 symbols	Tx Meas Limits Config
set_burst_timing_samples	1 to 250	20	Tx Measurements Test
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)

3.5.3.D Results

If test completes...	Example
Within limits	Test_Burst_Timing_Avg, CH3600/3 PL04 ±00.1 sym (00.3)
Limits exceeded	Test_Burst_Timing_WC, CH3600/3 PL04 +02.1 SYM (00.3), FAIL
If test fails to complete...	**Example**
PTT timeout	Test_Burst_Timing_Avg, PTT not pressed, FAIL
Timeout	Test_Burst_Timing_Avg, No bursts, FAIL
Not in call	Test_Burst_Timing_WC, Not in a call, FAIL

NOTE

During a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**. When PTT is not pressed within the ptt_timeout period, the test fails.
While the test runs, a progress bar displays the accumulation of samples.

3.5.4 Frequency Error Tests

test_freq_error_avg
test_freq_error_wc

3.5.4.A Summary

The test_freq_error commands determine the accuracy of the radio frequency transmitted by the mobile on the current traffic channel. The measurement made is the difference between the frequency of the signal received from the mobile and the receiver frequency of the Test Set. This measurement is taken over the middle of the burst measured at the symbol points through a TETRA filter.

The frequency error (worst case or average depending on which of the tests is selected) is measured over the number of bursts specified for this test by the **set_freq_error_samples** command.

3.5.4.B Command Parameters

None

3.5.4.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_freq_error_limit	1 to 999 (in Hz)	100 Hz	Tx Meas Limits Config
set_freq_error_samples	1 to 250	20	Tx Measurements Test
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)

3.5.4.D Results

If test completes...	Example
Within limits	Freq Error Avg, CH3600/1 PL04 ±023 Hz (100)
Limits exceeded	Freq Error WC, CH3600/1 PL04 ±128 Hz (100), FAIL
If test fails to complete...	**Example**
PTT timeout	Freq Error Avg, PTT not pressed, FAIL
Timeout	Freq Error Avg, No bursts, FAIL
Not in call	Freq Error WC, Not in a call, FAIL

NOTE

During a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**.
When PTT is not pressed within the ptt_timeout period, the test fails.
While the test runs, a progress bar displays the accumulation of samples.

3.5.5 Vector Error RMS Tests

test_vector_error_rms_avg
test_vector_error_rms_max

3.5.5.A Summary

The test_vector_error_rms commands measure the vector error of the received symbols with respect to the ideal symbol points for the burst. This measurement is taken over the middle of the burst measured at the symbol points through a TETRA filter. The RMS value is the root mean square of all the symbols.

The RMS Vector Error (worst case or average, depending on which of the tests is selected) is measured over the number of bursts specified for this test by the **set_vector_error_rms_samples** command.

3.5.5.B Command Parameters

None

3.5.5.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)
set_vector_error_rms_limit	0.1 to 99.9 (in %)	10%	Tx Meas Limits Config
set_vector_error_rms_samples	1 to 250	20	Tx Measurements Test

3.5.5.D Results

If test completes...	Example
Within limits	Vector Error RMS Test - Avg, CH3600/1 PL04 02.6% (10.0)
Limits exceeded	Vector Error RMS Test - Max, CH3600/1 PL04 15.9% (10.0, FAIL
If test fails to complete...	**Example**
PTT timeout	Vector Error RMS Test - Avg, PTT not pressed, FAIL
Timeout	Vector Error RMS Test - Avg, No bursts, FAIL
Not in call	Vector Error RMS Test - Max, Not in a call, FAIL

NOTE

When a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**. When PTT is not pressed within the ptt_timeout period, the test fails.
While the test runs, a progress bar displays the accumulation of samples.

3.5.6 Vector Error Peak Tests

test_vector_error_peak_avg
test_vector_error_peak_max

3.5.6.A Summary

The test_vector_error_peak_xxx commands measure the vector error of the received symbols with respect to the ideal symbol points for the burst. This measurement is taken over the middle of the burst measured at the symbol points through a TETRA filter. The RMS value is the root mean square of all the symbols.

The Peak Vector Error (average or maximum, depending on which of the tests is selected) is measured over the number of bursts specified for this test by the **set_vector_error_peak_samples** command.

3.5.6.B Command Parameters

None

3.5.6.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)
set_vector_error_peak_limit	0.1 to 99.9 (in %)	30%	Tx Meas Limits Config
set_vector_error_peak_samples	1 to 250	20	Tx Measurements Test

3.5.6.D Results

If test completes...	Example
Within limits	Vector Error Peak Test - Avg, CH3600/1 PL04 21.2% (30.0)
Limits exceeded	Vector Error Peak Test - Max, CH3600/1 PL04 38.9% (30.0), FAIL
If test fails to complete...	**Example**
PTT timeout	Vector Error Peak Test - Avg, PTT not pressed, FAIL
Timeout	Vector Error Peak Test - Avg, No bursts, FAIL
Not in call	Vector Error Peak Test - Max, Not in a call, FAIL

NOTE

During a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**. When PTT is not pressed within the ptt_timeout period, the test fails.
While the test runs, a progress bar displays the accumulation of samples.

3.5.7 Residual Carrier Tests

test_residual_carrier_avg
test_residual_carrier_max

3.5.7.A Summary

The test_residual_carrier commands determine the magnitude of the offset required to center the received symbols around the ideal symbol points.

The residual carrier error (average or maximum, depending on which of the tests is selected) is measured over the number of bursts specified for this test by the **set_residual_carrier_samples** command.

3.5.7.B Command Parameters

None

3.5.7.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)
set_residual_carrier_limit	0.1 to 99.9 (in %)	5%	Tx Meas Limits Config
set_residual_carrier_samples	1 to 250	20	Tx Measurements Test

3.5.7.D Results

If test completes...	Example
Within limits	Residual Carrier Test - Avg, CH3600/1 PL04 02.3% (05.0)
Limits exceeded	Residual Carrier Test - Max, CH3600/1 PL04 05.8% (05.0), FAIL
If test fails to complete...	**Example**
PTT timeout	Residual Carrier Test - Avg, PTT not pressed, FAIL
Timeout	Residual Carrier Test - Avg, No bursts, FAIL
Not in call	Residual Carrier Test - Max, Not in a call, FAIL

NOTE

During a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**. When PTT is not pressed within the ptt_timeout period, the test fails.
While the test runs, a progress bar displays the accumulation of samples.

3.5.8 Rx Meas - BER Tests

test_rx_meas_ber <rf gen level> [class0] [class1] [class2]

3.5.8.A Summary

The test_rx_meas_ber commands check the mobile receiver's bit error rate for Class 0, and/or Class 1 and/or Class 2 bits at the RF generator level specified.

The mobile is commanded to go into Loopback (BER) mode. (This may fail if the TT loopback protocol is not implemented in the mobile or if TT Test Mode has not been enabled.)

The result is averaged over the number of samples specified for this test by the **set_BER_class0_samples** and/or the **set_BER_class1_samples** and/or the **set_BER_class2_samples** command

3.5.8.B Command Parameters

Parameter	
<rf_gen_level>	In dBm.
[class0] [class1][Class2]	Optional list of sub-tests (Class 0, Class 1, Class 2, MER) to be included. By default (i.e. when none are listed), all three sub-tests are performed. For information, when more than one sub-test is specified, they are all tested simultaneously.

3.5.8.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_BER_class0_limits	<A> <B> <E> (each in %, 0.00001 to 99.99999)	4.27% 4.88% 4.27%	Rx Meas Limits Config
set_BER_class0_samples	1,000 to 10,000,000	15000	Rx Meas (BER) Test
set_BER_class1_limits	<A> <B> <E> (each in %, 0.00001 to 99.99999)	0.23% 0.23% 0.23%	Rx Meas Limits Config
set_BER_class1_samples	1,000 to 10,000,000	15000	Rx Meas (BER) Test
set_BER_class2_limits	<A> <B> <E> (each in %, 0.00001 to 99.99999)	0.23% 0.23% 0.23%	Rx Meas Limits Config
set_BER_class2_samples	1,000 to 10,000,000	15000	Rx Meas (BER) Test
set_level_change_wait	0 to 99 (in sec)	2 sec	AutoTest (No Tile)
set_rx_class	A | B | E	A	Mobile Parameters Config
set_rx_class_usage	fixed | reported	reported	Mobile Parameters Config

3.5.8.D Results

If test completes ...	Example
Results of required sub-tests	Rx BER, CH 964/3 RCA RF Gen Lev -115.0 dBm Class 0 1.02640% (4.27000), Class 1 6.12980% (0.23000), FAIL Class 2 0.05680% (0.23000)
If test fails to complete ...	**Example**
Timeout	Rx BER CH 964/3 RCA RF Gen Lev -115.0 dBm, No bursts, FAIL
Failed TCH	Rx BER CH 964/3 RCA RF Gen Lev -115.0 dBm, Not in a call, FAIL
Fail Duplex	Rx BER CH 964/3 RCA RF Gen Lev -115.0 dBm, Not a duplex call, FAIL
Loopback failure	Rx BER CH 964/3 RCA RF Gen Lev -115.0 dBm, No loopback, FAIL

NOTE

During a **Simplex** call when PTT is not already pressed, user is prompted **Please press PTT**. When PTT is not pressed within the ptt_timeout period, the test fails.
While the test runs, a progress bar displays the accumulation of samples.

3.5.9 Rx Meas - RBER Tests

test_rx_meas_rber <rf gen level> [mer] [class0] [class1]

3.5.9.A Summary

The test_rx_meas_rber command checks the mobile receiver's residual bit error rate for MER and/or Class 0 and/or Class 1 bits.

The mobile is commanded to go into Loopback (RBER) mode (this may fail if the TT loopback protocol is not implemented in the mobile or if TT Test Mode has not been enabled.)

The result is averaged over the number of samples specified for this test by the **set_RBER_mer_samples** and/or **set_RBER_class0_samples** and/or **set_RBER_class1_samples** commands.

3.5.9.B Command Parameters

Parameter	
<rf_gen_level>	In dBm.
[mer] [class0] [class1]	Optional list of sub-tests (MER, Class 0, Class 1) to be included. By default (i.e. when none are listed), all three sub-tests are performed. For information, when more than one sub-test is specified, they are all tested simultaneously.

3.5.9.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_level_change_wait	0 to 99 (in sec)	2 sec	AutoTest (No Tile)
set_MER_limits	<A> <B> <E> (each in %, 0.00001 to 99.99999)	0.045% 0.045% 0.045%	Rx Meas Limits Config
set_MER_samples	10 to 1,000,000	300	Rx Meas (RBER) Config
set_RBER_class0_limits	<A> <B> <E> (each in %, 0.00001 to 99.99999)	4.27% 4.88% 4.27%	Rx Meas Limits Config
set_RBER_class0_samples	1,000 to 10,000,000	15000	Rx Meas (RBER) Config
set_RBER_class1_limits	<A> <B> <E> (each in %, 0.00001 to 99.99999)	0.23% 0.23% 0.23%	Rx Meas Limits Config
set_RBER_class1_samples	1,000 to 10,000,000	15000	Rx Meas (RBER) Config
set_rx_class	A | B | E	A	Mobile Parameters Config
set_rx_class_usage	fixed | reported	reported	Mobile Parameters Config

3.5.9.D Results

If test completes ...	Example
Results of(required(sub-tests(	Rx RBER, CH 964/3 PLxx -115.0 dBm MER 0.00000% (0.04500) Class 0, 12.34567% (4.27000), FAIL Class 1, 0.12300% (0.23000)
If test fails to complete ...	**Example**
Timeout	Rx RBER, CH 964/3 PLxx -115.0 dBm, No bursts, FAIL
Failed TCH	Rx RBER, CH 964/3 PLxx -115.0 dBm, Not in a call, FAIL
Fail Duplex	Rx RBER, CH 964/3 PLxx -115.0 dBm, Not a duplex call, FAIL
Loopback failure	Rx RBER , CH 964/3 PLxx -115.0 dBm, No loopback, FAIL

NOTE

While the test runs, a progress bar displays the accumulation of samples.
When the test ends, the RF Gen Level is returned to its original value.
Failure of more than one RBER sub-test is counted as a single test failure in the overall Results Summary.

3.5.10 Registration Test

test_registration [test_mode]

3.5.10.A Summary

The test_registration command checks the ability of the mobile to Register (ITSI Attach) at Power on. If the mobile does not register within the specified Timeout period (default 30 seconds), the test exits.

Following ITSI attach registration, the Test Set waits for a specified period for the mobile to complete its group attachment process.

Optionally, the Test Set confirms that the mobile is in TT Test Mode.

3.5.10.B Command Parameters

Parameter	
[test_mode]	Optional parameter that confirms the mobile has performed an extended TT Test Mode registration.

3.5.10.C Related Script Commands

Command	Parameter	Default Value	Equivalent Tile
set_access_param	-53 to -23 dBm, (internally converted to nearest 2 dB step)	-45 dBm	System ID & Access Parameters Config
set_base_advanced_link	not_supported | supported	not_supported	Base Services Config
set_base_air_interface_encryption	not_available | available	not_available	Base Services Config
set_base_circuit_mode_data_service	not_supported | supported	not_supported	Base Services Config
set_base_migration	not_supported | supported	supported	Base Services Config
set_base_minimum_mode_service	never_used | may_be_used	never_used	Base Services Config
set_base_power_off_deregistration	not_required | required	required	Base Services Config
set_base_power_on_registration	not_required | required	required	Base Services Config
set_base_priority_cell	no | yes	yes	Base Services Config
set_base_reserved	not_available | available	not_available	Base Services Config
set_base_system_wide_services	not_supported | normal_mode	normal_mode	Base Services Config
set_base_tetra_packet_data_service	not_available | available	not_available	Base Services Config
set_base_tetra_voice_service	not_supported | supported	supported	Base Services Config

Command	Parameter	Default Value	Equivalent Tile
set_BCC	0 to 63	01	System ID & Access Parameters Config
set_channel_plan	<“plan_name”> (except no_plan)	“TETRA 380-400 +12.5”	Channel Plan Config
set_control_channel	0 to 4095 / Limits set by current Channel Plan	3600	RF Settings Test
set_group_attach_wait	0 to 99 (in sec)	25 sec	AutoTest - (No Tile)
set_GSSI	0 to 16777215	1	Mobile Parameters Config
set_GSSI_usage	fixed | reported	reported	Mobile Parameters Config
set_LA	0 to 16383	00001	System ID & Access Parameters Config
set_max_tx_level	15 to 45 (in dBm, internally converted to nearest 5 dB step)	30 dBm	System ID & Access Parameters Config
set_MCC	0 to 999	001	System ID & Access Parameters Config
set_min_rx_level_access	-125 to -50 (in dBm, internally converted to nearest 5dB step)	-125 dBm	System ID & Access Parameters Config
set_MNC	0 to 16383	00001	System ID & Access Parameters Config
set_registration_timeout	0 (no timeout) | 5 to 99 (in sec)	30 sec	AutoTest - (No Tile)
set_SSI	0 to 16777215	00000001	Mobile Parameters Config
set_SSI_usage	fixed | reported	reported	Mobile Parameters Config

3.5.10.D Results

If test completes...	Example
	Registration Test Mode 4 A ITSI: 400/00003/00742200 GSSI: 16777215 Selected
If test fails to complete...	**Example**
Time out	Registration Timeout 30 - No response, FAIL
Test Mode	Registration Test Mode not confirmed, FAIL

3.5.11 Place Calls From 3900 Test

test_testset_call <type> [check | nocheck]

3.5.11.A Summary

The test_testset_call command checks the ability of the mobile to receive a call from a Base Station.

The type of call is specified in the <type> text string, from the options shown. VIAVI recommends to use the **phone** type (if the mobile supports this type) to avoid the need to hold the PTT switch on the mobile during subsequent tests.

The default RF generator level for the test is -80 dBm; user can change value as needed. The mobile power (default level 9 for GSM, 5 for DCS 1800/PCS 1900, 9 for MULTI DCS/ MULTI PCS) and timing advance (default 0 bits) are as specified under Test Configuration.

3.5.11.B Command Parameters

Parameter	
<type>	group | private | phone | emergency | user
[check | nocheck]	Optional parameter to temporarily over-ride the effect of any preceding set_place_call_typecheck command

3.5.11.C Related Script Commands

Command	Parameter	Default Value	Equivalent Tile
set_emergency_call_params	group | individual simplex | duplex direct | hook <SSI>: 0 to 16777215	individual simplex direct 742200	Call Types Config
set_group_call_params	<PRI#>: 0 to 15 <SSI>: 0 to 16777215	00 742200	Call Types Config
set_phone_call_params	<PRI#>: 0 to 15 <ESN>: up to 24char ninc | inc	00 0143874220 0 inc	Call Types Config
set_place_call_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)
set_place_call_typecheck	no | yes	yes	AutoTest (No Tile)
set_private_call_params	simplex | duplex direct | hook <PRI#>: 0 to 15 <SSI>: 0 to 16777215	simplex hook 00 742200	Call Types Config
set_tch_timeslot	1 | 2 | 3 | 4	3	RF Settings Test
set_traffic_channel	0 to 4095 / Limits set by current Channel Plan	3700	RF Settings Test

Command	Parameter	Default Value	Equivalent Tile
set_user_call_params	group | individual simplex | duplex direct | hook <PRI#>: 0 to 15 <SSI>: 0 to 16777215 <ESN>: up to 24char, ninc | inc	individual duplex hook 00 16777186 742200 inc	Call Types Config

3.5.11.D Results

If test completes...	Example
Within limits	Test Set Call, GROUP CH 964/3 PL04 or Test Set Call, MODIFIED CH 964/3 PL04
Limits exceeded	Test Set Call, GROUP CH 964/3 PL04, FAIL or Test Set Call, MODIFIED CH 964/3 PL04, FAIL
If test fails to complete...	**Example**
Test Set already in a call	Test Set Call, Already in a call, FAIL
Call not answered	Test Set Call, Timeout 20 - No answer, FAIL
Type check	Test Set Call, Call modified Simplex>Duplex, FAIL
Protocol failures	Test Set Call, Call setup failed, FAIL
	Test Set Call, Call cleared down, FAIL

NOTE

When the mobile alerts (rings), the following Test Set prompt appears: **Please answer call**.
When mobile confirms acceptable call type as different from the type specified in the command, the call type is modified, and a fail result appears with the modification recorded, e.g. ***Simplex>Duplex.***

3.5.12 Place Calls From Mobile Test

test_mobile_call <type> [check | nocheck]

3.5.12.A Summary

The test_mobile_call command checks the ability of the mobile to place a call to a Base Station. The type of call is specified in the <type> text string, from the options shown.

3.5.12.B Command Parameters

Parameter	
<type>	group | private | phone | emergency
[check | nocheck]	Optional parameter to temporarily over-ride the effect of any preceeding set_place_call_typecheck command

3.5.12.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_place_call_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)
set_place_call_typecheck	no | yes	yes	AutoTest (No Tile)
set_tch_timeslot	1 | 2 | 3 | 4	3	RF Settings Test
set_traffic_channel	0 to 4095 / Limits set by current Channel Plan	3700	RF Settings Test

3.5.12.D Results

If test completes...	Example
	Mobile Call, GROUP, CH 964/3 PL04 Or Mobile Call, ACCEPTED, CH 964/3 PL04 SSI:1234567890 ESN:12345678
If test fails to complete...	**Example**
Test Set already in a call	Mobile Call, Already in a call, FAIL
Mobile does not place a call	Mobile Call, Timeout 20 - No call setup, FAIL
Type check	Mobile Call, Not a group call, FAIL
Protocol	Mobile Call, Call setup failed, FAIL

NOTE

At start of test, the following Test Set prompt appears: **Please place a <type> call from mobile**.
When call is placed, Test Set auto answers.
If type checking is selected, Test Set confines that mobile makes correct type of call and, if necessary, a failure is raised. Checks:

- Group: Confirm group call.
- Private: Confirm individual call, not to a Gateway SSI and no ESN.
- Phone: Confirm individual call, PSTN Gateway SSI and ESN are supplied.
- Emergency: Confirm priority = 15.

3.5.13 Call Cleardown From 3900 Test

test_testset_clear

3.5.13.A Summary

The test_testset_clear command checks the ability of the mobile to end a call on instruction from a Base Station.

3.5.13.B Command Parameters

None

3.5.13.C Results

If test completes...	Example
	Test Set Clear, Cleared down
If test fails to complete...	**Example**
Test Set not in a call	Test Set Clear, Not in a call, FAIL
Protocol	Test Set Clear, No response, FAIL

3.5.14 Call Cleardown From Mobile Test

test_mobile_clear

3.5.14.A Summary

The test_mobile_clear command checks the ability of the mobile to end a call.

3.5.14.B Command Parameters

Command	Parameters	Default Value	Equivalent Tile
	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)

3.5.14.C Results

If test completes...	Example
	Mobile Clear, Cleared down
If test fails to complete...	**Example**
Test Set not in a call	Mobile Clear, Not in a call, FAIL
Mobile does not clear call	Mobile Clear, Timeout - No response, FAIL
Protocol	Mobile Clear, No response, FAIL

NOTE

At start of test, the following Test Set prompt appears: **Please Clear Down call from mobile**.
If the message is ignored, the test times out.

3.5.15 Deregistration Test

test_deregistration

3.5.15.A Summary

The test_deregistration command checks the ability of the mobile to deregister from a base station after receiving the appropriate instruction.

3.5.15.B Command Parameters

None

3.5.15.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_deregistration_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)

3.5.15.D Results

If test completes...	Example
	Deregistration, Successful
If test fails to complete...	**Example**
Timeout	Deregistration, Timeout 20 - No response, FAIL

NOTE

At start of test, the following Test Set prompt appears: **Please Turn Off The Mobile Under Test**.
If the message is ignored, the test times out.

3.5.16 Speech Quality / Tone / Silence Test

test_audio <type>

3.5.16.A Summary

The Speech test is a subjective one in which the user is asked to judge the quality of the complete audio-radio-audio path by speaking into the microphone of the mobile and listening to the result from the ear piece or speaker (delay approx. 2 seconds).

The Tone and Silence tests inject either a test tone or silence into the radio's ear piece or speaker.

Some mobiles may not support speech when TT Test Mode has been selected, in which case this test should be disabled.

3.5.16.B Command Parameters

Parameter	
<type>	speech | tone | silence

3.5.16.C Related Script Commands

Command	Parameters	Default Value	Equivalent Tile
set_audio_test_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)
set_ptt_timeout	0 (no timeout) | 5 to 99 (in sec)	20 sec	AutoTest (No Tile)

3.5.16.D Results

If test completes...	Example
User selects "Pass"	Audio Speech, CH 964/3, -80.5 dBm
User selects "Fail"	Audio Speech, CH 964/3, -80.5 dBm, FAIL
If test fails to complete...	**Example**
User ignores "Pass/Fail" request	Audio Tone, Pass / Fail not selected, FAIL
Timeout (PTT press)	Audio Speech, PTT not pressed, FAIL
Timeout (PTT release)	Audio Tone, PTT not released, FAIL
Not in call	Audio Silence, Not in a call, FAIL

NOTE

During a Simplex call, when **Speech** selected and PTT is not pressed, user is prompted to **Please press PTT**. When PTT is pressed, user is prompted to **Please speak then release PTT**.
During a Simplex call, when **Tone** or **Silence** selected and PTT is pressed, user is prompted to **Please release PTT**.
During a Simplex call when the Test Set transmission starts, user is prompted to **Please listen to audio <type>** and select Pass or Fail.
At the end, the Test Set conversation reverts to the same type as before the test.

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Chapter 4 - Common TETRA Configuration Tiles

4.1 INTRODUCTION

TETRA MS and BS Systems use Configuration Tiles that contain TETRA Base Station and Mobile parameters. The base station and mobile parameters can be configured to suit specific test requirements. These parameters must be set correctly on the Test Set in order to test a TETRA Mobile radio. This chapter describes the Configuration Tiles for TETRA BS, BS T1, MS and MS T1 Systems. Tile descriptions are listed in the order that they appear on the Configuration Menu.

TETRA MS and BS Configuration Tile layout and parameter functions are similar throughout these TETRA System, however, the parameters are separate and specific to each TETRA System. For example, changes made on a TETRA MS Offsets Configuration Tile do not affect the parameters on the TETRA BS Offsets Configuration Tile.

The examples provided in this chapter include screen shots from the TETRA MS System. The layout of TETRA MS Tiles may vary from other TETRA Systems; however, unless otherwise noted, field functionality is the same for each system.

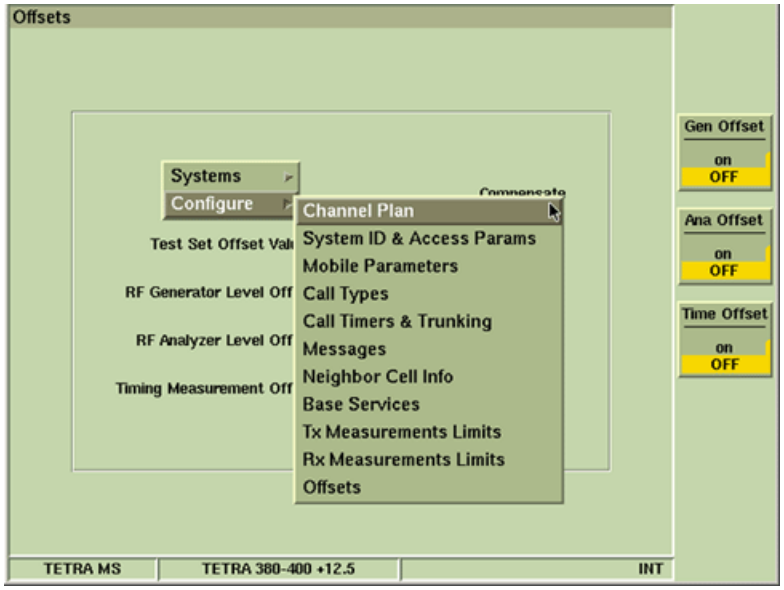

Fig. 4-1 TETRA MS Configuration Menu

4.2 AF MEASUREMENTS/LIMITS

The AF Measurements/Limits Configuration Tile sets parameters used when making Audio measurements in TETRA MS and BS Systems.

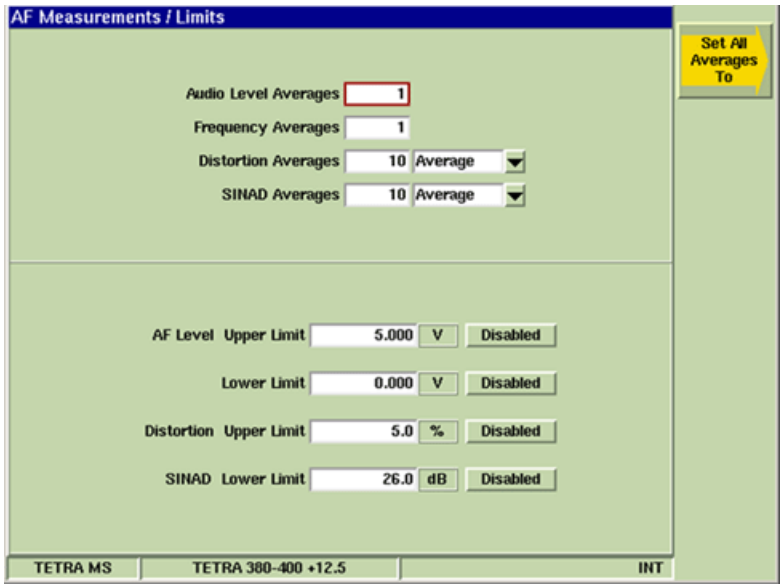

Fig. 4-2 TETRA MS AF Measurements/Limits Configuration Tile

4.2.1 Field/Soft Key Definitions

4.2.1.A Measurement Averages

Range Value fields define the number of readings over which data is acquired to calculate average measurement readings for Audio Level, Frequency, Distortion and SINAD measurements.

Distortion and SINAD measurements allow users to select Average or Worst Case parameters from the drop-down menu. When Average is selected, the Range Value field defines the number of readings that calculated to determine the average Distortion and SINAD reading. When Worst Case is selected, the Distortion or SINAD reading on the Audio Tile reflects the reading which most greatly exceeds the defined parameters. The Range Value field is not applicable when Worst Case is selected.

4.2.1.B Upper/Lower Limits

The AF Limits fields allow Upper and Lower measurement limits to be set for AF measurements. When a measurement limit is enabled, the limits are indicated on the Audio Tile.

4.2.1.C AF Level - Upper / AF Level - Lower Limits

Specifies the upper and lower limit for AF Level measurements in V.

4.2.1.D Distortion - Upper Limit

Specifies the upper limit for Distortion measurements as a percent.

4.2.1.E SINAD - Lower Limit

Specifies the lower limit for SINAD measurements as a percent.

4.2.1.F Set All Averages To Soft Key

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

4.3 BASE SERVICES CONFIGURATION TILE

The Base Services Tile provides access to all of the Base Services System Information parameters. This Tile is specific to the TETRA MS System.

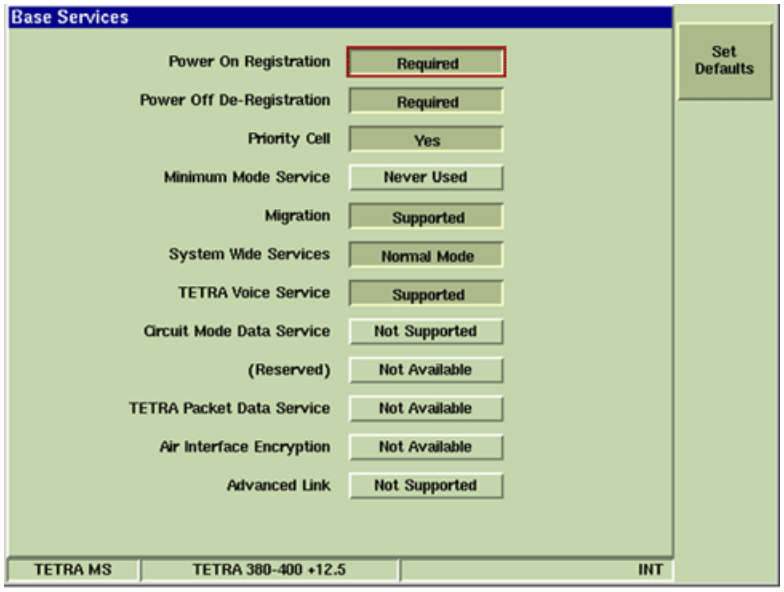

Fig. 4-3 TETRA MS Base Services Configuration Tile

Base Services System Information parameters, including default settings and available options, are shown in the following table:

Parameter	Default	Options
Power on registration	Required	Not required, Required
Power off de-registration	Required	Not required, Required
Priority cell	Yes	No, Yes
Minimum mode service	Never used	Never used, May be used
Migration	Supported	Not supported, Supported
System wide services	Normal mode	Not supported, Normal mode
TETRA voice service	Supported	Not supported, Supported
Circuit mode data service	Not supported	Not supported, Supported
(Reserved)	Not available	Not available, Available
TETRA Packet Data Service	Not available	Not available, Available
Air interface encryption	Not available	Not available, Available
Advanced link	Not supported	Not supported, Supported

4.3.1 Field Definitions

4.3.1.A Power On Registration

Indicates if a mobile is required to perform ITSI Attach Registration when it is powered on. Parameter should be set to Required.

4.3.1.B Power Off De-Registration

Indicates if a mobile is required to perform ITSI detach de-registration when it is powered off. Parameter should be set to Required.

4.3.1.C Priority Cell

Indicates if a mobile should select this 'cell' in preference to non-priority cells. Parameter should be set to Yes.

4.3.1.D Minimum Mode Service

Indicates if there is a possibility of the base station MCCH being replaced by a Traffic Channel in Frames 1-17 and a MMCC in Frame 18. The Test Set does not use Minimum Mode so this parameter should be set to Never Used.

4.3.1.E Migration

Indicates if the base station supports registration attempts by a mobile belonging to a different network (different MCC or MNC values). Parameter should be set to Supported.

4.3.1.F System Wide Services

Indicates whether the base station is operating normally or whether it is temporarily in Fallback Mode. When in Fallback Mode the base station is unable to communicate with the rest of the TETRA Network. Parameter should be set to Normal Mode.

Setting this parameter to Not Supported may cause the mobile to indicate Local Area Service or Fallback. The mobile may not attempt operations requiring connections outside the local cell such as telephone calls.

4.3.1.G TETRA Voice Service

Indicates if the base station supports speech calls using the TETRA codec. Parameter should be set to Supported.

4.3.1.H Circuit Mode Data Service

Indicates if the base station supports Circuit Mode Data Calls. The Test Set does not support Circuit Mode Data Calls so this parameter should be set to Not Supported.

4.3.1.I (Reserved)

This parameter is reserved for future definition in the TETRA standard. Parameter should be set to Not Available.

4.3.1.J TETRA Packet Data Service

This parameter indicates if the base station supports the TETRA Packet Data Service. The Test Set does not support packet data so this parameter should be set to Not Available.

4.3.1.K Air Interface Encryption

Indicates if the base station supports Air Interface Encryption. The Test Set does not support Air Interface Encryption so this parameter should be set to Not Available.

Setting this parameter to Available may cause the mobile to wait before registering in order to receive the associated security class and cipher key information broadcasts.

4.3.1.L Advanced Link

Indicates if the base station supports Advanced Link Service which is required for packet data. The Test Set does not support Advanced Link Service so this parameter should be set to Not Available.

4.4 BS PARAMETERS CONFIGURATION TILE

The BS Parameters Tile informs the Test Set of the Power Class and Receiver Class of the base station under test. This Tile is specific to the TETRA BS and BS T1 Systems. The TETRA BS Parameters Configuration Tile is limited to the Power Class field.

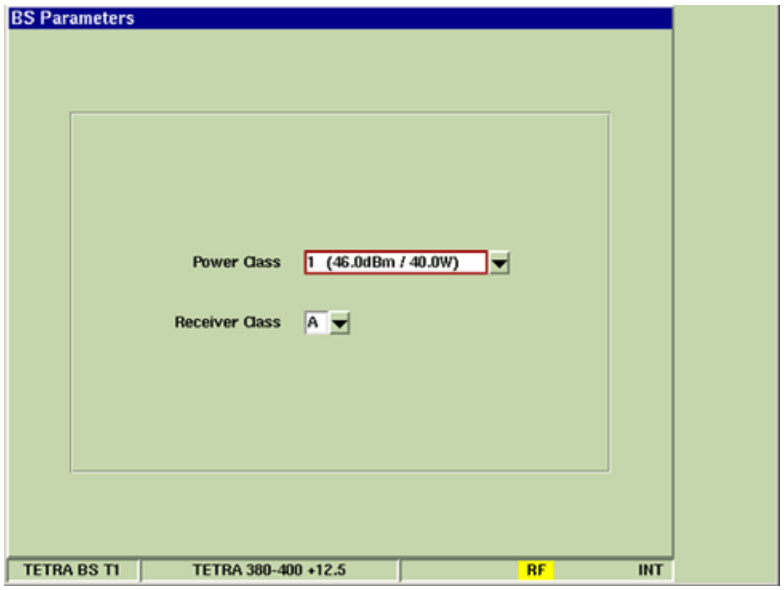

Fig. 4-4 TETRA BS T1 BS Parameters Configuration Tile

4.4.1 Field Definitions

4.4.1.A Power Class

Indicates the Power Class of the base station. The parameter is used by the Test Set to determine the power level expected from the base station, i.e. the limits for the Tx Power bar graph, if this is enabled. This field limits the maximum power level measured and determines the limits used for the Tx Power Level test.

4.4.1.B Receiver Class

Indicates the receiver class of the base station, indicating the base station's receiver sensitivity. The parameter is used by the Test Set to decide which limits (A or B) to use for the BER, MER and PUEM bar graphs.

4.5 CALL TIMERS & TRUNKING CONFIGURATION TILE

Call Timers & Trunking parameters are set from the Call Timers & Trunking Tile. These parameters control Test Set behavior during a call. Some of these parameters only apply to simplex calls. The Call Timers & Trunking Configuration Tile is specific to the TETRA MS System.

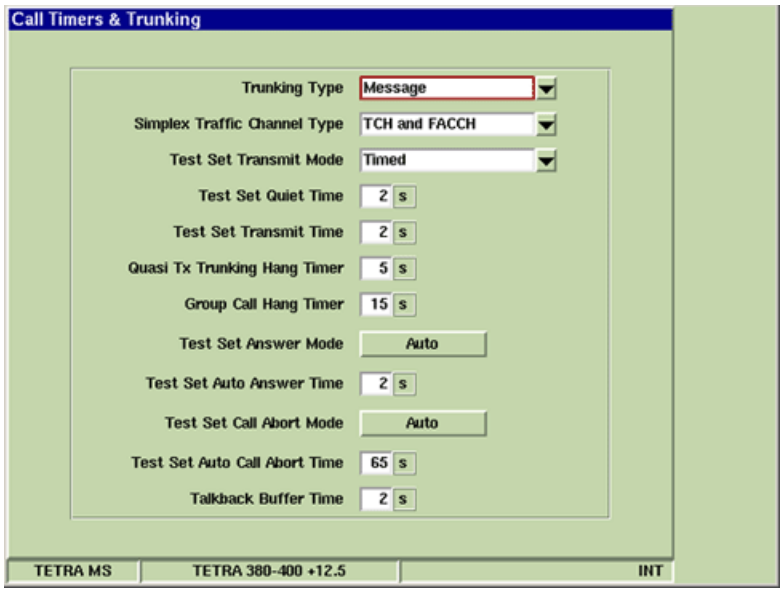

Fig. 4-5 TETRA MS Call Timers & Trunking Configuration Tile

4.5.1 Field Definitions

4.5.1.A Trunking Type

The Trunking Type determines the channel assignment during quiet periods in a simplex call.

4.5.1.A.1 Message

Mobile is allowed to stay on the Traffic Channel, which becomes an FACCH. Default Trunking Type is Message.

4.5.1.A.2 Transmission

Mobile is assigned back to MCCH.

4.5.1.A.3 Quasi-transmission

Mobile is allowed to stay on the Traffic Channel, which becomes an FACCH, but returns to MCCH when the Quasi-Transmission Trunking (QTT) hang timer expires.

NOTE	Some terminals may only support QTT for individual (private) calls, not for group calls. If the terminal being tested does not support QTT in a group call, set the Group Call Hang Timer to expire earlier than the Quasi Tx Trunking Hang Timer; as an alternative select a different Trunking Type.

4.5.1.B Simplex Traffic Channel Type

During a simplex call, the mobile under test is either receiving traffic on a downlink traffic channel or transmitting traffic on an uplink traffic channel. The Simplex Traffic Channel Type determines the configuration of the corresponding uplink or downlink channel when the mobile is receiving or transmitting.

4.5.1.B.1 DL and UL TCH

Both the uplink and downlink channels are always configured as traffic channels during active speech periods. This configuration matches the situation on a real base station when one or more mobiles participating in the call are present in the same cell, and the base station is relaying the traffic from the uplink to the downlink channel. When the mobile under test is receiving on the downlink channel, the uplink channel is assumed to be in use by the transmitting mobile. If the mobile under test needs to send signaling to the base station (e.g., to request transmit permission or to end the call) it can only do so by waiting for Frame 18.

4.5.1.B.2 TCH and FACCH

During active speech periods, either the uplink or the downlink channel is configured as a Traffic Channel; the other channel is configured as FACCH. This configuration matches the situation on a real base station when the other mobile(s) participating in the call are not present in the same cell as the mobile under test. When the mobile under test is receiving on the downlink channel, the uplink channel is configured as FACCH and is available for immediate signaling without waiting for Frame 18.

4.5.1.C Test Set Transmit Mode

Test Set Transmit Mode allows users to select the Test Set behavior on a simplex call when the mobile is not transmitting. Options are:

4.5.1.C.1 None

The Test Set does not automatically simulate another user transmitting when the mobile under test is not transmitting. Press the PTT button on the mobile at any time to request transmission or the user can manually simulate another user transmitting. Group calls are subject to the Group Call Hang Timer setting.

4.5.1.C.2 Timed Mode

When the PTT button of the mobile under test is released, the Test Set waits for the Test Set Quiet Time period. During the Quiet Time period the mobile's PTT button may be pressed again to request transmission. If the mobile's PTT button is not pressed, the Test Set simulates another user talking for the Test Set Transmit Time period, after which it reverts to Quiet Mode. During Quiet Mode the mobile's PTT button may be pressed again to request transmission. In a group call, the maximum duration of Quiet Mode is determined by the Group Call Hang Timer period. When the Group Call Hang Timer expires, the Test Set automatically clears down a group call. The Transmit Mode default setting is Timed.

4.5.1.C.3 Continuous Mode

When the PTT button of the mobile under test is released, the Test Set immediately simulates another user talking for an indefinite length of time. Depending on the mobile, it may be possible to interrupt the other user and request to transmit by pressing the mobile's PTT button again. To keep the mobile receiver open during a simplex call, set Test Set Transmit Mode to Continuous or select None and manually control Test Set transmission. Timer values do not apply when Continuous Mode is selected.

4.5.1.D Test Set Quiet Time

Defines the period for which the Test Set waits after the mobile's PTT button is released before simulating another user talking in Timed Mode. Range is 0 to 30 s. Default setting is 2 s.

4.5.1.E Test Set Transmit Time

Defines the period for which the Test Set simulates another user talking in Timed Mode. Range is 1 to 30 s. Default setting is 2 s.

4.5.1.F Quasi Tx-Trunking Hang Timer

Determines the period for which the Test Set monitors the Traffic Channel in a Quiet State (FACCH) before returning the mobile to the MCCH. This parameter only applies to QTT. Range is 1 to 30 s. Default setting is 5 s.

4.5.1.G Group Call Hang Timer

Defines the maximum quiet period in group call, in Timed Mode or when mode is set to None, after which the Test Set automatically clears down the group call. Range is 1 to 30 s. Default setting is 15 s.

NOTE	The Hang Timer value should be longer than the Test Set Quiet Time period, otherwise a group call is cleared down before the Test Set has an opportunity to simulate another user talking.

4.5.1.H Test Set Answer Mode

When a Hook Signaling Call is set up from the mobile to the Test Set, the Test Set enters the Alerting State, representing the period when the calling party is waiting for the called party to answer the call. If the Test Set Answer Mode is set to Auto, the Test Set automatically simulates the called party answering the call after the Test Set Auto Answer Time. If the Test Set Answer Mode is set to Manual, the Test Set only answers the call if the Answer Soft Key is pressed; however, it is possible to simulate the called party rejecting the mobile originated call by pressing the Reject Soft Key.

NOTE	Test Set Answer Mode should be set to Auto so user can set up and clear down calls on the mobile from within a Measurement Tile without having to return to the Operations/Status Tile to answer the call.

4.5.1.I Test Set Auto Answer Time

Sets the time the Test Set waits during the Alerting State of a mobile originated hook signaling call before automatically answering the call. When the call is answered it enters the conversation state on the traffic channel. During this time a Called Party Alerting tone should be heard from the mobile, and the user has the option of manually answering or rejecting the call if a sufficiently long Auto Answer Time has been set. If the Auto Answer Time has been set with a time of 0 s, mobile originated calls go straight into conversation without a delay. This parameter only applies when Test Set Answer Mode is set to Auto. Range is 0 to 30 s. Default setting is 2 s.

4.5.1.J Test Set Call Abort Mode

When a Hook Signaling Call is set up from the Test Set to the mobile, the mobile enters the Alerting State and the Test Set waits for the user to answer the call on the mobile. If Test Set Call Abort Mode is set to Auto, the Test Set automatically simulates the calling party hanging up if the call is not answered within the Test Set Auto Call Abort Time. If Test Set Call Abort Mode is set to Manual, the Test Set does not automatically abort the call; the call is manually aborted by pressing the Abort Soft Key.

4.5.1.K Test Set Auto Call Abort Time

Sets the time the Test Set waits during the mobile Alerting State of a mobile terminated hook signaling call before automatically aborting the call (simulating the calling party hanging up). If the Test Set's Auto Call Abort Time has been set to a sufficiently long time, the mobile may reject the unanswered call before the Test Set automatically aborts it. This parameter only applies when the Test Set Call Abort Mode is set to Auto. Range is 1 to 300 s. Default setting is 65 s.

4.5.1.L Talkback Buffer Time

When the mobile is transmitting, the incoming speech is recorded in the Talkback Buffer. The contents of the Talkback Buffer are replayed for subsequent transmission from the Test Set to the mobile. Range is 1 to 30 s.

When set to 2 s, the last 2 s of incoming speech are recorded and replayed repeatedly during the simplex Test Set transmission. During duplex operation, the last 2 s of incoming speech are continuously re-transmitted with a delay of 2 s.

4.6 CALL TYPES CONFIGURATION TILE

The Call Types Configuration Tile defines parameters for the selected Call Type. A Call Type is selected from the Call Type drop-down menu, which displays the associated Tile. Each Call Type opens a specific display Tile.

Parameters can be configured for each call type: some parameters for some call types are pre-configured. Parameters that can be edited are displayed in a numeric entry box or a drop-down selection box as appropriate. This Tile is specific to the TETRA MS System.

NOTE	Not all combinations of call type options are valid. If an invalid combination is selected the call may fail.

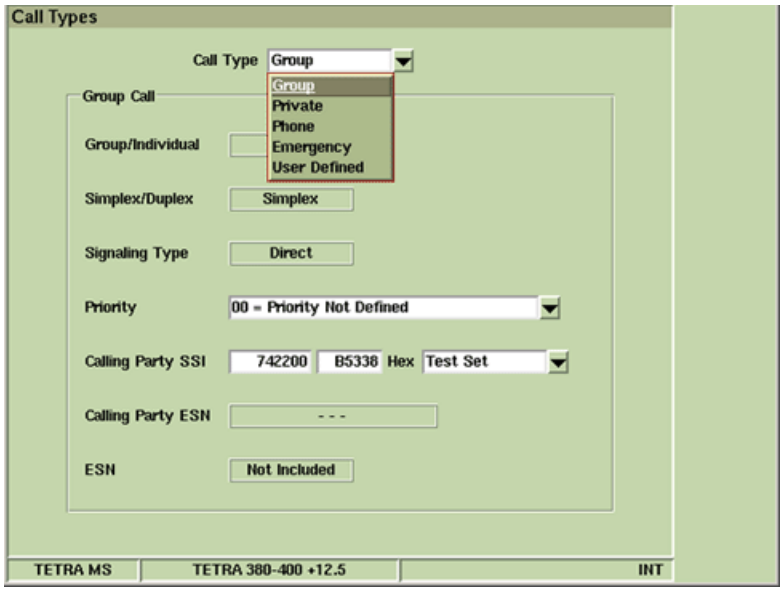

Fig. 4-6 TETRA MS Call Type Drop-down Menu

4.6.1 Group Call

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Group Call	Pre-defined value
Simplex/Duplex	Simplex Call	Pre-defined value
Signaling Type	Direct	Pre-defined value
Priority	00	00 to 15
Calling Party SSI	742200 (Test Set)	00000000 to 16777215
ESN	Not Included	Pre-Defined value

4.6.2 Private Call

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Individual Call	Pre-defined value
Simplex/Duplex	Simplex Call	Simplex Call, Duplex Call
Signaling Type	Hook	Direct, Hook
Priority	00	00 to 15
Calling Party SSI	742200 (Test Set)	00000000 to 16777215
ESN	Not Included	Pre-Defined value

4.6.3 Phone Call

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Individual Call	Pre-defined value
Simplex/Duplex	Duplex Call	Pre-defined value
Signaling Type	Hook	Pre-defined value
Priority	00	00 to 15
Calling Party SSI	16777184 (PSTN gateway)	Pre-defined value
Calling Party ESN	01438742200	0 to 999999999999999999999999 Up to 24 digits
ESN	Included	Included, Not included

4.6.4 Emergency Call

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Individual Call	Individual Call, Group Call
Simplex/Duplex	Simplex Call	Simplex Call, Duplex Call
Signaling Type	Direct	Direct, Hook
Priority	15	Pre-defined value
Calling Party SSI	742200 (Test Set)	00000000 to 16777215
ESN	Not Included	Pre-Defined value

4.6.5 User Defined

User Defined call types allow user to define the following parameters per call requirement:

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Individual Call	Individual Call, Group Call
Simplex/Duplex	Duplex Call	Simplex Call, Duplex Call
Signaling Type	Hook	Direct, Hook
Priority	00	00 to 15
Calling Party SSI	16777186 (PABX gateway)	00000000 to 16777215
Calling Party ESN	01438742200	0 to 999999999999999999999999 Up to 24 digits
ESN	Included	Included, Not included

4.7 CHANNEL PLAN CONFIGURATION TILE

TETRA signaling protocol uses Channel Numbers rather than explicit frequencies to assign TETRA Mobiles to frequency channels. TETRA Systems use Channel Plans to map the uplink (MS Tx) frequency and the downlink (MS Rx) frequency to these Channel Numbers. TETRA Mobiles and Base Stations conforming to TIP (TETRA Interoperability Profile) use the standard Channel Numbering scheme as defined in ETSI TS 100 392-15. The 3900 pre-defined Channel Plans follow this Channel Numbering scheme.

A User Defined Channel Plan created and saved in any of the TETRA Systems is available for selection in all of the TETRA Systems.

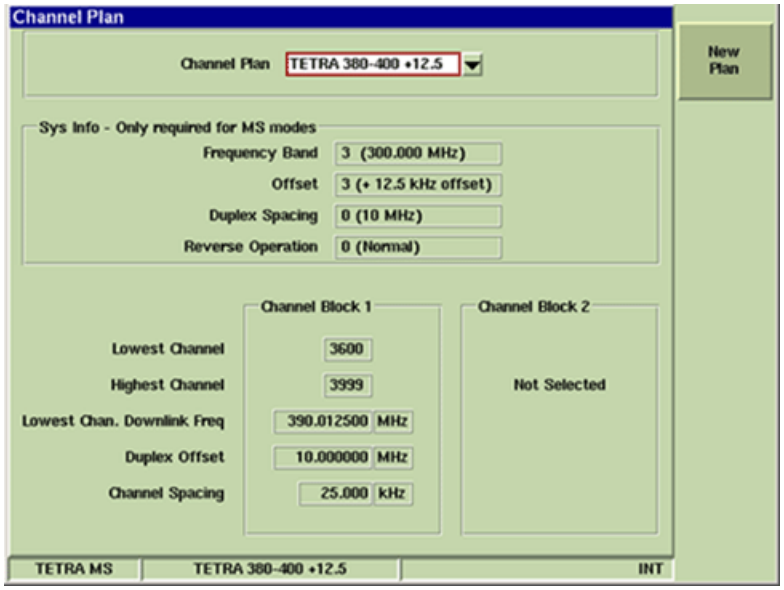

Fig. 4-7 TETRA MS Channel Plan Configuration Tile

4.7.1 TETRA MS T1

Configuring Channel Plans for TETRA MS T1 is similar to configuring those for TETRA MS, with the following noted exceptions:

- TETRA MS T1 System does not use channel assignments, therefore, a Channel Plan does not need to be selected. Use Channel Numbers (with a Channel Plan) or select No Plan to enter RF Generator and RF Analyzer frequencies.
- When using a Channel Plan, the carrier number and related parameters are included in the T1 signal.
- When No Plan is selected, these parameters are set to Zero. The Channel Plan on the 3900 may need to be set to No Plan according to mobile functionality.
- A User Defined Channel Plan created and saved in a TETRA System is available for selection in ALL of the TETRA Systems.
- The mobile may require the Test Set to use a different Channel Plan in TETRA MS T1 Test Mode than is used in TETRA MS mode, or it may require the use of No Plan.

4.7.2 TETRA BS and BS T1

Configuring Channel Plans for TETRA BS and BS T1 is similar to configuring those for TETRA MS, with the following noted exceptions:

- The Test Set RF Analyzer frequency must be set to match the frequency of the base station transmitter. This setting may be entered either explicitly in Hz or by using a Channel Number.
- If a Channel Number is used, the Channel Plan selected must match the one used by the base station, so that the Channel Number entered corresponds to the frequency of the base station transmitter.
- As an alternative, the Test Set can be set to the BS Tx frequency by selecting No Plan on the Channel Plan Configuration Tile.

NOTE	The Spectrum Analyzer can be used to identify the frequency of the Base station transmitter if it is not known. Refer to the 3900 Series Operation Manual for information on using the Spectrum Analyzer.

4.8 MESSAGES CONFIGURATION TILE

The Messages Configuration Tile is configured to meet the requirements of the message type to be used for testing. Tile layout and parameters vary according to the Message Type selected. This section describes the parameters on each type of Message Tile.

4.8.1 Status Message Tile

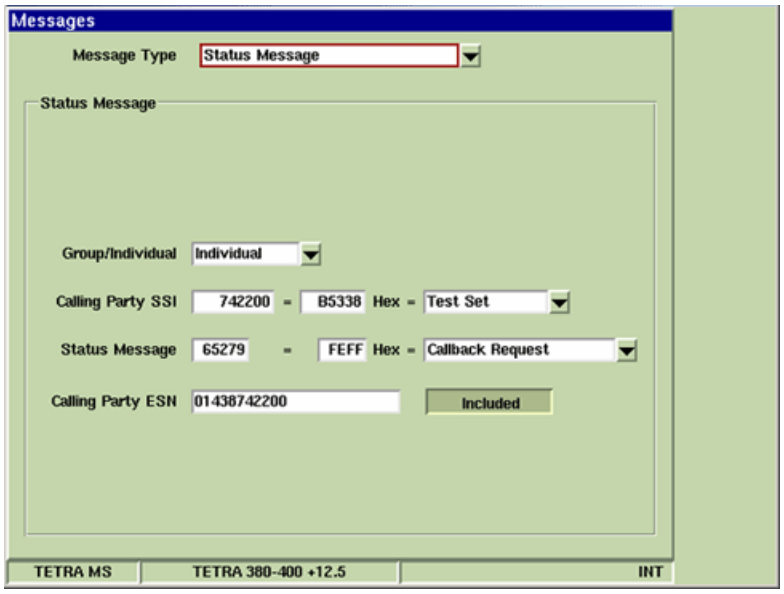

Fig. 4-8 TETRA MS Status Message Tile

4.8.1.A Field Definitions

4.8.1.A.1 Group/Individual

Selects the addressing of the status message sent. Options are Group Message or Individual Message. Default setting is Individual Message.

4.8.1.A.2 Calling Party SSI

Selects a Calling Party SSI within the range 00000000 to 16777215 for the status message. Enter decimal, HEX or select from the available drop-down menu. Default setting is 742200 (Test Set).

4.8.1.A.3 Status Message

Enters a status message within the range 0000 to FFFF HEX. Enter decimal, HEX or select from the drop-down menu. Default setting is FEFF HEX (CALLBACK). This parameter is defined on the Status Message Configuration Tile.

4.8.1.A.4 Calling Party ESN

This field defines the Calling Party ESN.

ESN characteristics:

- Limited to 24 digits/characters.
- Formatted like a telephone number, (e.g. 01438742200).
- ESN permitted characters are 0123456789*# and +.

4.8.1.A.5 Included/Excluded

Selects whether or not the ESN Type 3 optional element is Included in or Excluded from the message.

4.8.2 SDS Type 1, 2 & 3 Messages Configuration Tile

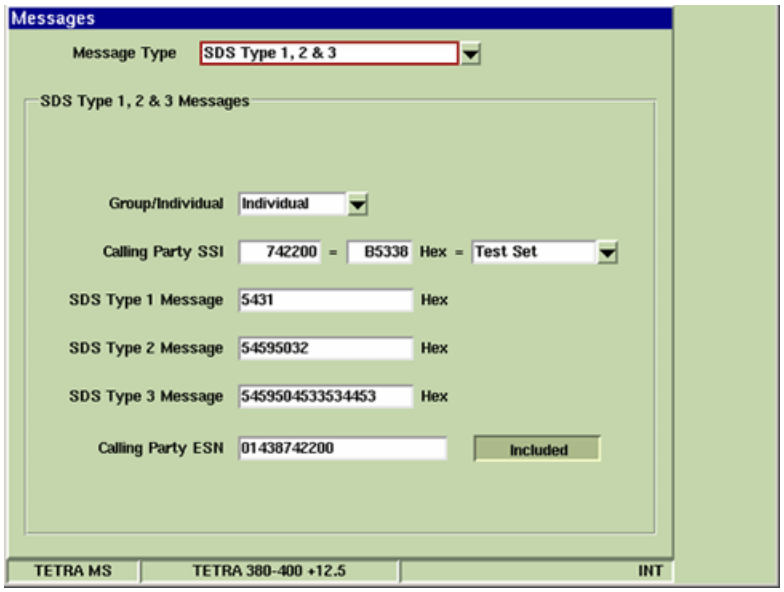

Fig. 4-9 TETRA MS SDS - Type 1, 2 and 3 Message Tile

4.8.2.A Field Definitions

4.8.2.A.1 Group/Individual

Selects the addressing applied to sent SDS Type 1, 2 and 3 messages. Options are Group Message or Individual Message. Default setting is Individual Message.

4.8.2.A.2 Calling Party SSI

Selects a Calling Party SSI within the range 00000000 to 16777215 for SDS Type 1, 2 and 3 messages. Enter decimal, HEX or select from the available drop-down menu. Default setting is 742200 (Test Set).

4.8.2.A.3 Priority

Sets priority level assigned to message.

- 0 = Normal (Default)
- 1 = High
- 2 = Pre-emptive
- 3 = Emergency

4.8.2.A.4 SDS Type 1 Message

Sets the SDS Type 1 message. Range is 0000 to FFFF HEX. Default setting is 5431 HEX (ASCII T1).

4.8.2.A.5 SDS Type 2 Message

Sets the SDS Type 2 message. Range is 00000000 to FFFFFFFF HEX. Default setting is 54595032 HEX (ASCII TYPE2).

4.8.2.A.6 SDS Type 3 Message

Sets the SDS Type 3 message. Range is 00000000 00000000 to FFFFFFFF FFFFFFFF HEX. Default setting is 54595045 33534453 HEX (ASCII TYPE3SDS).

4.8.3 SDS Type 4 - SDS-TL Text Message

Use Type 4 SDS-TL Text Messages to send a text message to a mobile and to configure the Test Set to handle the SDS Transport Layer (SDS-TL) protocol operations.

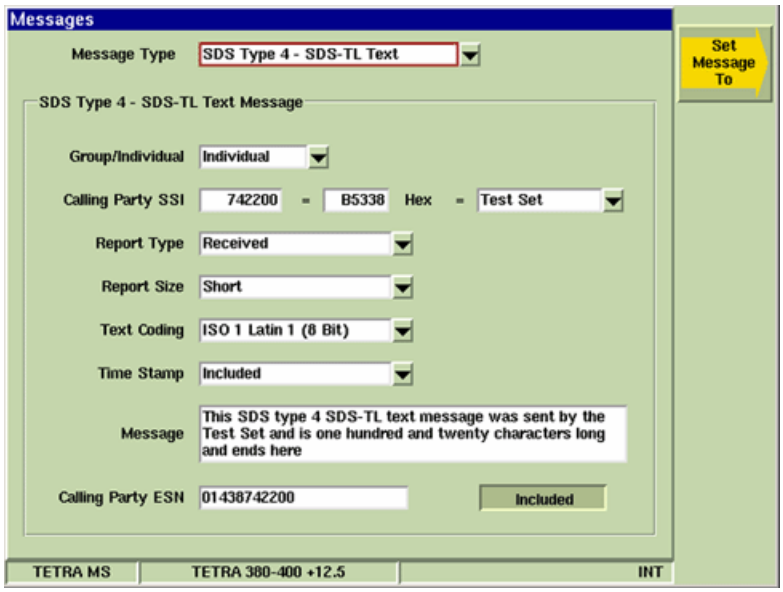

Fig. 4-10 TETRA MS SDS Type 4 - SDS-TL Text Message Tile

4.8.3.A Field/Soft Key Definitions

4.8.3.A.1 Group/Individual

Selects the addressing of the sent SDS-TL Text Message. Options are Group Message or Individual Message. Default setting is Individual Message.

4.8.3.A.2 Calling Party SSI

Allows a Calling Party SSI to be entered. Range is 00000000 to 16777215 for the SDS-TL text message. The user can enter decimal, HEX or select from the drop-down menu.

4.8.3.A.3 Report Type

Requests the type of report sent by the mobile in response to the SDS-TL Text Message. Options are None, Received, Consumed or Received and Consumed. Default setting is None.

The mobile may not send the type of report requested or any report. The mobile should not send a report if the requested report type is None.

4.8.3.A.4 Report Size

Requests either a Short Report from the mobile (Status Message) or a Standard Report (SDS-TL Standard Report). Default setting is Short.

The mobile may not send a report or it may not send the size of report requested. A report is not sent when the requested report type is None.

4.8.3.A.5 Text Coding

Selects if the text message is sent to the mobile in standard 8-bit TETRA compatible text coding or 7-bit GSM compatible text coding. Options are 7-bit (GSM) or 8-bit Latin (TETRA). Default setting is 8-bit Latin (TETRA).

Some mobiles may not be capable of receiving 7-bit coded text messages.

4.8.3.A.6 Time Stamp

Selects if a time stamp is included in the text message sent to the mobile. Options are Included or Not Included. Default setting is Not Included.

> **NOTE** Time stamping information consists of month, day, hours, minutes, and is obtained from the Test Set real time clock. The real time clock is set from the Utilities menu, I/O Settings, Clock Tile. If a mobile displays a year, it has been obtained from its own internal calendar: it is not part of the SDS-TL time stamp information.

4.8.3.A.7 Message

Message field can be edited to create custom message.

4.8.3.A.8 Calling Party ESN

An ESN is required when the Test Set simulates an SDS Message made to a mobile through a PSTN Gateway, (e.g., conventional landline or mobile number).

ESN characteristics:

- Limited to 24 digits/characters.
- Formatted like a telephone number (e.g. 01438742200).
- ESN permitted characters are 0123456789*# and +.

4.8.3.A.9 Included/Excluded

Selects whether or not the ESN Type 3 optional element is Included in the message. Pressing one of the soft keys after a message is edited replaces the edited message with the message applicable to the soft key.

4.8.3.A.10 Set Message To Soft Key

Opens a soft key sub-menu that selects from the following pre-defined messages:

4.8.3.A.11 Long Default Message Soft Key

This SDS type 4 SDS-TL Text Message was sent by the Test Set and is one hundred and twenty characters long and ends here.

4.8.3.A.12 Medium Size Message Soft Key

A medium length SDS-TL 66 character message sent from the Test Set.

4.8.3.A.13 Short Message Soft Key

A short SDS-TL Message.

4.8.4 Type 4 Simple Text Messages Configuration Tile

Use Type 4 SDS-TL Text Messages to send a text message to a mobile and to configure the Test Set to handle the SDS Transport Layer (SDS-TL) protocol operations.

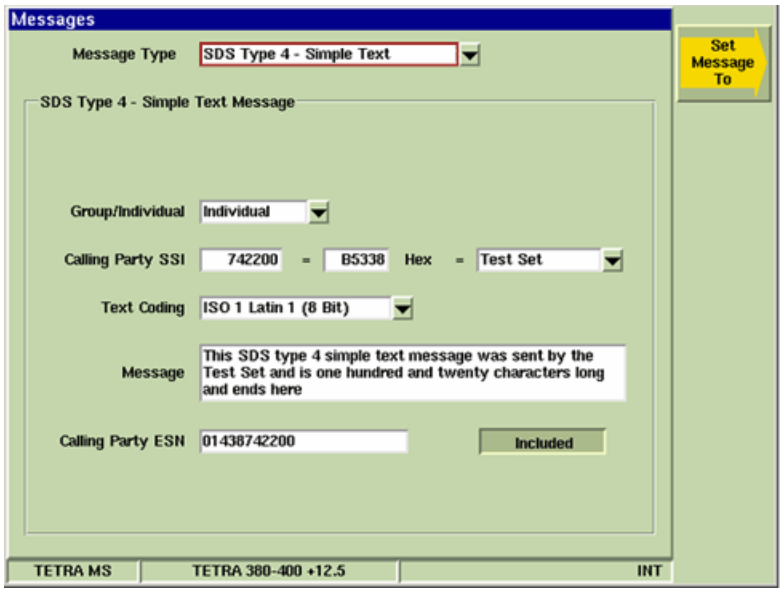

Fig. 4-11 TETRA MS Type 4 Simple Text Message Tile

4.8.4.A Field/Soft Key Definitions

4.8.4.A.1 Group/Individual

Selects the addressing of the Simple Text Message sent. Options are Group Message or Individual Message. Default setting is Individual Message.

4.8.4.A.2 Calling Party SSI

Allows a Calling Party SSI to be entered. Range is 00000000 to 16777215 for the simple text message. Enter decimal, HEX or select from the drop-down menu.

4.8.4.A.3 Text Coding

Selects whether the text message is sent to the mobile in standard 8-bit TETRA compatible text coding or in 7-bit GSM compatible text coding. Options are 7-bit (GSM) or 8-bit Latin (TETRA). Default setting is 8-bit Latin (TETRA).

NOTE	Some mobiles may not be capable of receiving 7-bit coded text messages.

4.8.4.A.4 Message

Message field can be edited to create custom message.

4.8.4.A.5 Calling Party ESN

An ESN is required when the Test Set simulates an SDS Message made to a mobile through a PSTN Gateway, (e.g., conventional landline or mobile number).

ESN characteristics:

- Limited to 24 digits/characters.
- Formatted like a telephone number (e.g. 01438742200).
- ESN permitted characters are 0123456789*# and +.

4.8.4.A.6 Included/Excluded

Selects whether or not the ESN Type 3 optional element is Included in the message.

4.8.4.A.7 Set Message To Soft Key

Opens a soft key sub-menu that selects from the following pre-defined messages:

4.8.4.A.8 Long Default Message Soft Key

This SDS type 4 simple text message was sent by the Test Set and is one hundred and twenty characters long and ends here.

4.8.4.A.9 Medium Size Message Soft Key

A medium length simple 66 character message sent from the Test Set.

4.8.4.A.10 Short Message Soft Key

A short SDS-TL Message.A short simple message.

4.8.5 Type 4 HEX Message Configuration Tile

Use Type 4 HEX Messages to define the Type 4 SDS data sent, including any headers.

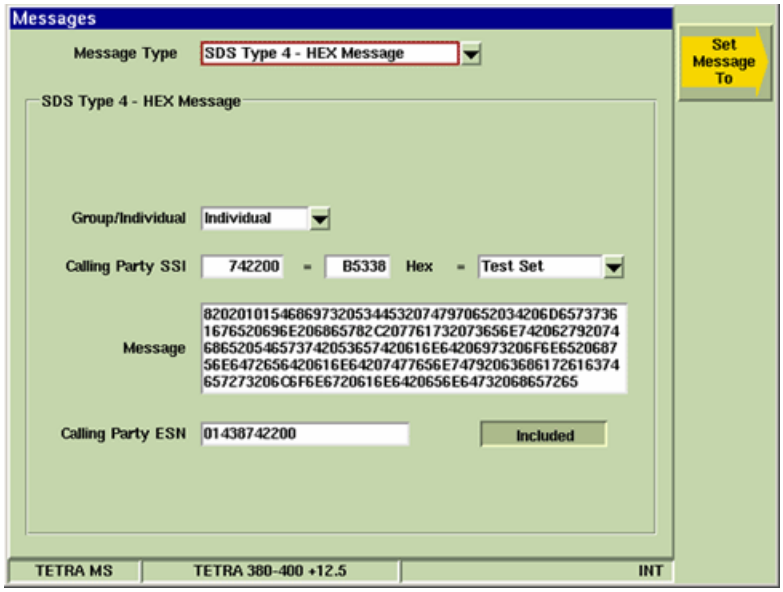

Fig. 4-12 TETRA MS Type 4 - HEX Message Tile

4.8.5.A Field/Soft Key Definitions

4.8.5.A.1 Group/Individual

Selects the addressing of the Type 4 HEX Message sent. Options are Group Message or Individual Message. Default setting is Individual Message.

4.8.5.A.2 Calling Party SSI

Allows a Calling Party SSI to be entered. Range is 00000000 to 16777215 for the selected message type. Enter decimal, HEX or select from the drop-down menu.

4.8.5.A.3 Message

Message field can be edited to create custom message.

4.8.5.A.4 Calling Party ESN

An ESN is required when the Test Set simulates an SDS Message made to a mobile through a PSTN Gateway, (e.g. conventional landline or mobile number.

ESN characteristics:

- Limited to 24 digits/characters.
- Formatted like a telephone number (e.g. 01438742200).
- ESN permitted characters are 0123456789*# and +.

4.8.5.A.5 Included/Excluded

Select whether or not the ESN Type 3 optional element is Included in the message.

4.8.5.A.6 Set Message To Soft Key

Opens a soft key sub-menu that selects from the following pre-defined messages:

4.8.5.A.7 Long Default Message Soft Key

8202010154686973205344532074797065203420 6D6573736167652069 6E206865782C20 7761732073656E74206279207468652054657374205365742061 6E64206973206F6E6520 68756E6472656420616E64207477656E747920636861726163746572732 06C6F6E672061 6E6420656E64732068657265

This HEX message decodes to:

82020101 Hex

followed by

This SDS type 4 message in hex, was sent by the Test Set and is one hundred and twenty characters long and ends here.

This SDS type 4 message in hex, was sent by the Test Set and is one hundred and twenty characters long and ends here.

4.8.5.A.8 Medium Size Message Soft Key

8202010141206D656469756D206C656E6774682036372068657820636861726163746572 206D6573736167652073656E742066726F6D207468652054657374205365 74

This HEX message decodes to:

82020101 Hex

followed by

A medium length 67 hex character message sent from the Test Set.

4.8.5.A.9 Short Message Soft Key

8202010141207368 6F727420686578206D657373616765

This HEX message decodes to:

82020101 Hex

followed by

A short hex message.

4.8.6 Type 4 Other SDS-TL Message Configuration Tile

Use Type 4 Other SDS-TL messages to define custom application data content, but use the Test Set to handle the SDS Transport Layer (SDS-TL) protocol processes.

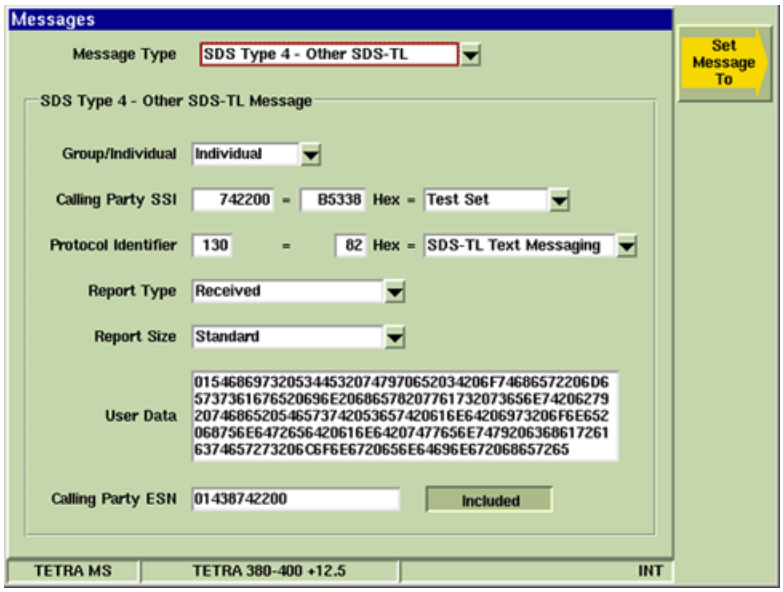

Fig. 4-13 TETRA MS SDS Type 4 - Other SDS - TL Message Tile

The following parameters are relevant to SDS Type 4 - Other SDS-TL Messages.

4.8.6.A Field/Soft Key Definitions

4.8.6.A.1 Group/Individual

Selects the addressing of Type 4 Other SDS-TL Messages sent. Options are Group Message or Individual Message. Default setting is Individual Message.

4.8.6.A.2 Calling Party SSI

Allows a Calling Party SSI to be entered. Range is 00000000 to 16777215 for the Type 4 Other SDS-TL message. Enter decimal, HEX or select from the drop-down menu.

4.8.6.A.3 Protocol Identifier

Selects the application protocol for the message data. Select from one of the ETSI defined values in the drop-down menu, or enter a custom value in decimal or HEX. Default setting is 130/82 HEX/SDS-TL Text Message.

4.8.6.A.4 Report Type

Requests the type of report sent by the mobile in response to the SDS-TL Message. Options are None, Received, Consumed or Received and Consumed. Default setting is None.

The mobile may not necessarily send the type of report requested or any report. However, the mobile should not send a report if the requested report type is None.

4.8.6.A.5 Report Size

Requests either a Short Report from the mobile (Status Message) or a Standard Report (SDS-TL Standard Report). Short Reports are allowed only for text messages. Default setting is Standard.

4.8.6.A.6 Calling Party ESN

An ESN is required when the Test Set simulates an SDS Message made to a mobile through a PSTN Gateway (e.g. conventional landline or mobile number).

ESN characteristics:

- Limited to 24 digits/characters.
- Formatted like a telephone number (e.g. 01438742200).
- ESN permitted characters are 0123456789*# and +.

4.8.6.A.7 Included/Excluded

Selects whether or not the ESN Type 3 optional element is Included in the message.

4.8.6.A.8 User Data

The User Data field can be edited to create custom messages appropriate to the application protocol specified in the Protocol Identifier.

4.8.6.A.9 Set Message To Soft Key

Opens a soft key sub-menu that selects from several pre-defined text messages. The text messages are applicable to the default protocol identifier. Pressing one of the soft keys after a message is edited replaces the edited message with the message applicable to the soft key.

4.8.6.A.10 Long Default Message Soft Key

01546869732053445320747970652034206F74686572206D6573736167652069 6E206865782077617320736 56E74206279207468652054657374205365742061 6E64206973206F6E652068756E6472656420616E64207477656E74792063686172616374657273206C6F6E6720656E64696E672068657265

This HEX message decodes to:

01 Hex (indicates 8-bit coding)

followed by

This SDS type 4 other message in hex was sent by the Test Set and is one hundred and twenty characters long ending here.

4.8.6.A.11 Medium Size Message Soft Key

0141206D656469756D206C656E6774682053445334203636206368617261637465722 06D65737361676520736 56E742066726F6D207468652054657374205365 74

This HEX message decodes to:

01 Hex (indicates 8-bit coding)

followed by

A medium length SDS4 66 character message sent from the Test Set.

4.8.6.A.12 Short Message Soft Key

01412073686F72742053445334206D657373616765

This HEX message decodes to:

01 Hex (indicates 8-bit coding)

followed by

A short SDS4 message.

4.9 MOBILE PARAMETERS CONFIGURATION TILE

The Mobile Parameters Tile allows changes to be made to the mobile radios's SSI, GSSI, Power Class and Receiver Class. These parameters are specific to TETRA MS and MS T1 Systems.

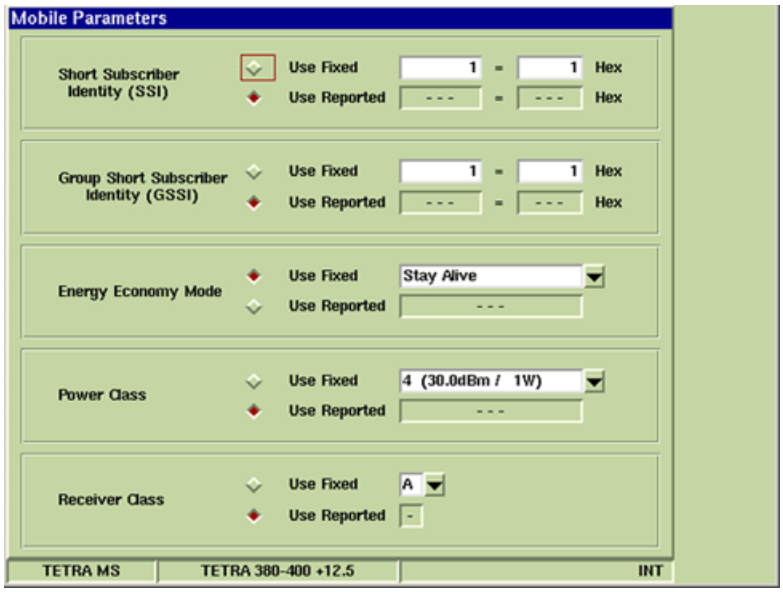

Fig. 4-14 TETRA MS Mobile Parameters Configuration Tile

4.9.1 Field Definitions

4.9.1.A Short Subscriber ID (SSI)

The Short Subscriber Identity is used by the Test Set to make calls or send messages to the mobile. The reported value is automatically updated when a mobile registers with the Test Set. To use a manually entered value, select Use Fixed and enter the desired values in the data fields.

4.9.1.B Group Short Subscriber ID (GSSI)

The Group Short Subscriber Identity is used by the Test Set to make a group call or send a group addressed message to the mobile. The reported value is automatically updated when the mobile informs the Test Set it has selected a group. If the mobile does not select a group, this parameter defaults to the last group selected. When a mobile has attached multiple groups, select Use Fixed and entering values in the data fields to set this value manually.

4.9.1.C Energy Economy Mode (EEM)

EEM parameters define how the Test Set configures the energy economy mode used to communicate with the mobile. The TETRA MS Protocol History Tile displays the requested energy economy mode. The Operations/Status Tile provides soft keys that select the energy economy mode requested by the Test Set.

The Fixed setting allows the Test Set to over ride the EEM requested by the mobile during call registration. The Use Reported setting forces the Test Set to accept the EEM requested by the mobile.

EEM parameters are option enabled with TETRA MS option 390XOPT114, TETRA Energy Economy Mode.

4.9.1.D Power Class

The Power Class of the mobile is used by the Test Set to determine the maximum power level expected from the mobile. The Power Class of the mobile is used to indicate the accuracy of the Test Set's estimation of the mobile power level displayed. When limits are enabled the Power Class decides the Pass/Fail limits for the Tx Power measurement and bar graph.

If the mobile has completed an extended TT Test Mode registration the reported value is updated to the value received from the mobile. If the mobile does not support TT Test Mode registration, select Use Fixed and enter the fixed value.

NOTE	During Openloop Power Control, a TETRA Mobile has a tolerance of ± 4 dB on its RSSI measurement which dictates the transmit power level step used. Therefore, the mobile may be transmitting on a higher or lower level than the power level step estimated by the Test Set. However, the mobile should not transmit at a level higher than its power class, or higher than the TxPWR _MAX_CELL parameter, nor lower than 15 dBm.

4.9.1.E Receiver Class

The Receiver Class of the mobile indicates the mobile's receiver sensitivity. The Receiver Class setting is used by the Test Set to determine the limits used for Rx BER/ RBER/MER Measurements.

When the mobile has completed an extended TT Test Mode registration, the reported Receiver Class is updated to the value received from the mobile. When the mobile does not support TT Test Mode registration, select Use Fixed and manually enter a fixed value.

4.9.2 TETRA MS T1

TETRA MS T1 Mobile Parameters are similar to the TETRA MS with the exception that TETRA MS T1 mobile parameters are limited to Power Class and Receiver Class. Functionality of these fields is identical to TETRA MS.

4.10 NEIGHBOR CELL INFO CONFIGURATION TILE

The 3900 supports Neighbor Cell Broadcast function which is used to inform the mobile about base stations in cells adjoining the cell currently serving the mobile. The parameters required for Neighbor Cell testing are configured on this Tile. This Tile is specific to the TETRA MS System.

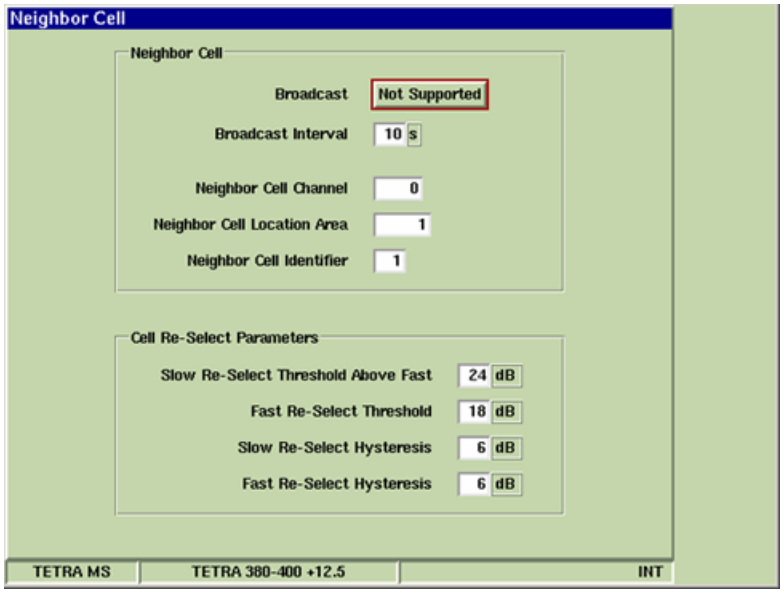

Fig. 4-15 TETRA MS Neighbor Cell Configuration Tile

4.11 OFFSETS CONFIGURATION TILE

The Offsets Configuration Tile allows user to offset the RF Generator Output Level, RF Analyzer Input Level and Timing Measurement Delay to compensate for external devices or conditions.

The indicated value of the RF Generator Output Level and RF Analyzer Input Level can be offset so that these values relate to the levels at the RF Connection of the radio under test, allowing for cable losses, external attenuators or other devices. If RF Offsets have been set for the RF Generator and/or the RF Analyzer, these can be individually included or excluded using the Gen Offset or Ana Offset Soft Key. A warning indicator appears beside a measurement when an offset has been applied, as shown in the example below.

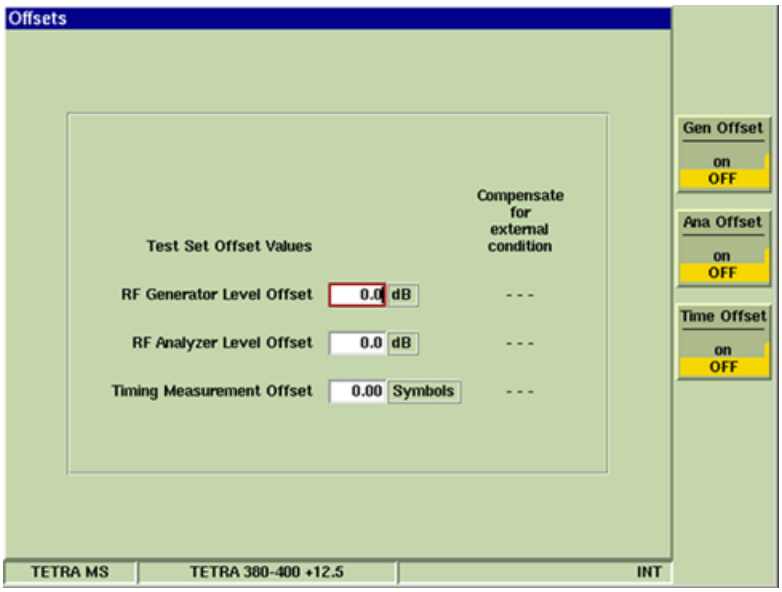

Fig. 4-16 TETRA MS Offsets Configuration Tile

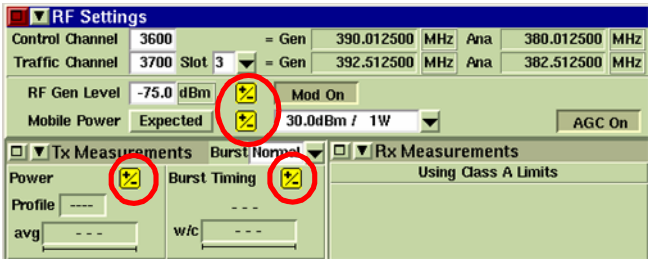

Fig. 4-17 Offset Warning Symbols

4.11.1 Field/Soft Key Definitions

4.11.1.A Test Set Offset Values

Fields define Offset values for specified parameter. A defined Offset is not active until it is enabled using the appropriate soft key.

4.11.1.B Gen Offset Soft Key

Enables/Disables a defined RF Generator Level Offset value.

4.11.1.C Ana Offset Soft Key

Enables/Disables a defined RF Analyzer Level Offset value.

4.11.1.D Timing Offset Soft Key

Enables/Disables a defined Timing Measurement Offset value. The Timing Measurement Delay offset compensates for an external timing delay (for example, when using a fading simulator) or a deliberate timing advance applied by a mobile.

The indicated value of the RF Generator Output Level and RF Analyzer Input Level can be offset so that these values relate to the levels at the RF Connection of the radio under test, allowing for cable losses, external attenuators or other devices. If RF Offsets have been set for the RF Generator and/or the RF Analyzer, these can be individually included or excluded using the Gen Offset or Ana Offset Soft Key.

4.12 RX MEASUREMENT LIMITS CONFIGURATION TILE

The parameters on this Tile set the Pass/Fail limits for Rx Measurements.

The limits set on the Rx Measurements Limits Configuration Tile are applied to the BER or RBER/MER measurements of the Speech Traffic Channel using TT Loopback. Three sets of limits are provided, applicable to the three different TETRA Receiver Classes (A, B and E.). The Receiver Class of the mobile under test is specified on the Mobile Parameters Configuration Tile as shown in the example below.

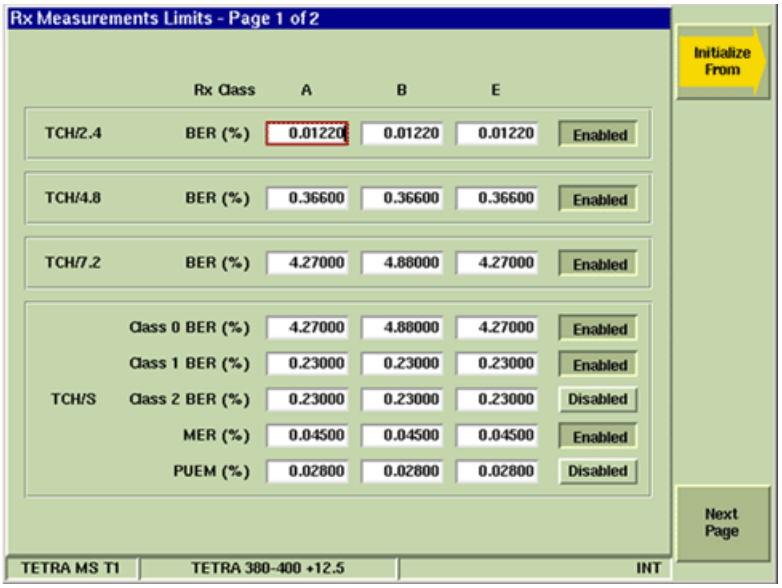

Fig. 4-18 TETRA MS T1 Rx Measurement Limits Configuration Tile - (Page 1 of 2)

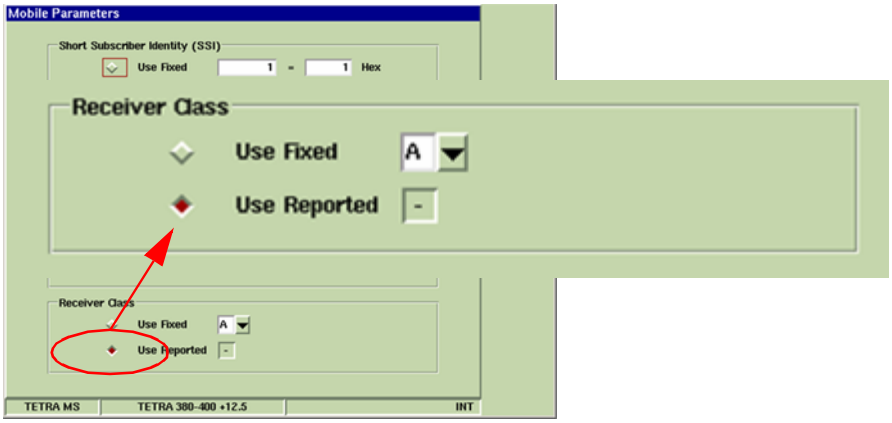

Fig. 4-19 Receiver Class - Mobile Parameters Configuration Tile

Receiver Class limits currently being used are flagged on the Rx Measurements Tile as shown in the example below. The Option Buttons enable/disable parameters (or groups of parameters). Receiver Class is set on the Mobile Parameters Configuration Tile.

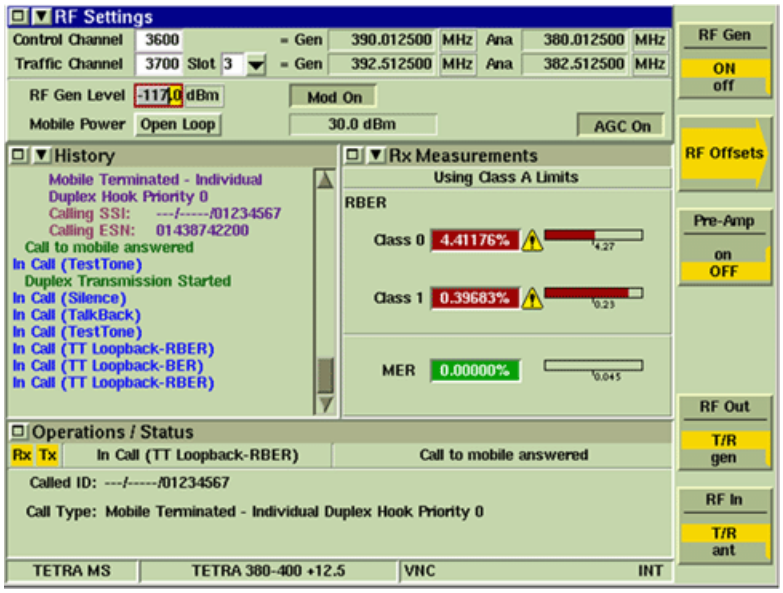

Fig. 4-20 TETRA MS Rx Measurement Tile - Example Limits Shown

4.12.1 Field/Soft Key Definitions

4.12.1.A Initialize From Soft Key

Press the Initialize From Soft Key, followed by either the Static or Dynamic Soft Key to initialize the limits to the default settings you. This action resets ALL limits on the Tile to the default values for the selected Burst type (for example Normal).

Two sets of default Pass/Fail limits are available for initializing the settings. These values are based on the ETSI specification for testing equipment using static signal conditions, and different limits for testing using equipment to reproduce dynamic signal conditions.

4.12.1.B Next Page / Previous Page Soft Key

Soft keys toggle between Rx Measurements Configuration Tiles 1 and 2.

4.12.1.C BER Class 0 (Rx Class A, B and E)

These limits are applied to the BER measurements performed on the Class 0 (unprotected) bits in the TETRA speech frame when a duplex call is in progress and the mobile under test is performing BER TT Loopback (if supported). Different limits can be set for different classes of receiver performance (A, B or E); the Test Set applies the appropriate limit according to the Receiver Class parameter on the Mobile Parameters Configuration Tile.

4.12.1.D BER Class 1 (Rx Class A, B and E)

These limits are applied to the BER measurements performed on the Class 1 (protected) bits in the TETRA speech frame when a duplex call is in progress and the mobile under test is performing BER TT Loopback (if supported). Different limits can be set for different classes of receiver performance (A, B or E); the Test Set applies the appropriate limit according to the Receiver Class parameter on the Mobile Parameters Configuration Tile.

4.12.1.E BER Class 2 (Rx Class A, B and E)

These limits are applied to the BER measurements performed on the Class 2 (highly protected) bits in the TETRA speech frame when a duplex call is in progress and the mobile under test is performing BER TT Loopback (if supported). Using BER TT Loopback, errors in the Class 2 bits do not result in erasure of the speech frame; therefore, the Bit Error Rate can be measured rather than the Message Erasure Rate on these bits. Different limits can be set for different classes of receiver performance (A, B or E); the Test Set applies the appropriate limit according to the Receiver Class parameter on the Mobile Parameters Configuration Tile.

4.12.1.F RBER Class 0 (Rx Class A, B and E)

These limits are applied to the RBER measurements performed on the Class 0 (unprotected) bits in the TETRA speech frame when a duplex call is in progress and the mobile under test is performing RBER TT Loopback (if supported). Speech frames that result in Message Erasure are excluded from the RBER Class 0 measurement. Different limits can be set for different classes of receiver performance (A, B or E); the Test Set applies the appropriate limit according to the Receiver Class parameter on the Mobile Parameters Configuration Tile.

4.12.1.G RBER Class 1 (Rx Class A, B and E)

These limits are applied to the RBER measurements performed on the Class 1 (protected) bits in the TETRA speech frame when a duplex call is in progress and the mobile under test is performing RBER TT Loopback (if supported). Speech frames that result in Message Erasure are excluded from the RBER Class 1 measurement. Different limits can be set for different classes of receiver performance (A, B or E); the Test Set applies the appropriate limit according to the Receiver Class parameter on the Mobile Parameters Configuration Tile.

4.12.1.H MER (Rx Class A, B and E)

These limits are applied to the MER measurements performed on the Class 2 (highly protected) bits in the TETRA speech frame when a duplex call is in progress and the mobile under test is performing RBER TT Loopback (if supported). Using RBER TT Loopback, any errors in the Class 2 bits result in erasure of two complete speech frames, therefore, Message Erasure Rate can be measured rather than the Bit Error Rate on these bits. When a message erasure occurs, all data bits for all 3 bit classes for two speech frames are erased. Different limits can be set for different classes of receiver performance (A, B or E); the Test Set applies the appropriate limit according to the Receiver Class parameter on the Mobile Parameters Configuration Tile.

4.12.2 TETRA MS T1 Rx Measurements Limits Configuration Tile

The TETRA MS T1 Rx Measurements Limits Configuration Tile is similar to the TETRA MS Rx Measurements Limits Configuration Tile with the following exceptions:

- The Rx Measurements Limits Configuration Tile sets the error pass limits for different T1 Signal Types and the relevant receiver class. Columns A, B and E relate to the limits applicable to the receiver class selected on the Mobile Parameters Configuration Tile.
- The rows (TCH/2.4,TCH/4.8, TCH/7.2, TCH/S, AACH, SCH/F, SCH/HD and BSCH) relate to the limits applicable to the T1 Signal Type selected from the T1 Type drop-down menu on the Control Tile.

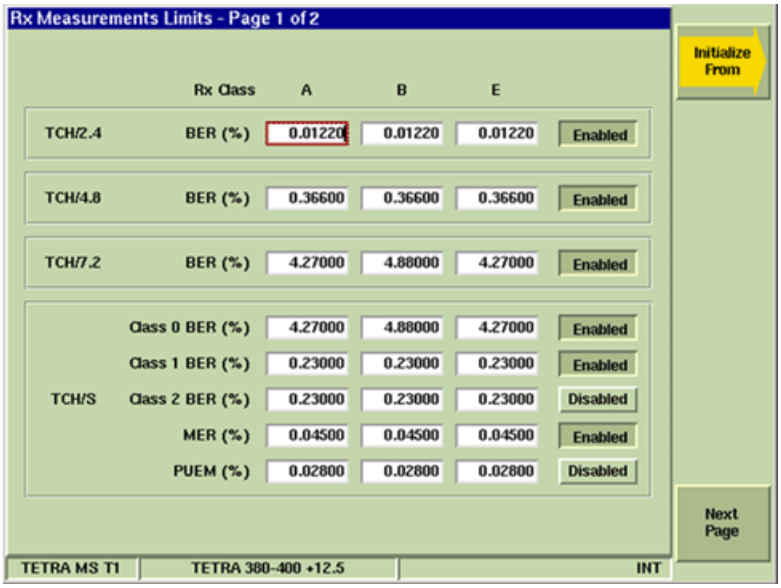

Fig. 4-21 TETRA MS T1 Rx Measurements Limits Configuration Tile

4.12.3 TETRA BS T1 Rx Measurements Limits Configuration Tile

The TETRA BS T1 Rx Measurements Limits Configuration Tile is similar to the same Tile found in TETRA MS T1 with the following exceptions:

- The Rx Measurements Limits Configuration Tile sets the error pass limits for different T1 Signal Types and the relevant receiver class. Columns A, B and E relate to the limits applicable to the receiver class selected on the Mobile Parameters Configuration Tile.
- The rows (TCH/2.4,TCH/4.8, TCH/7.2, TCH/S, AACH, SCH/F, SCH/HD and BSCH) relate to the limits applicable to the T1 Signal Type selected from the T1 Type drop-down menu on the Control Tile.

4.13 SYSTEM ID & ACCESS PARAMETERS CONFIGURATION TILE

The parameters on the System ID & Access Parameters Configuration Tile define the way the mobile behaves with respect to the RF Level received from the Test Set. Default values are suitable for most mobiles.

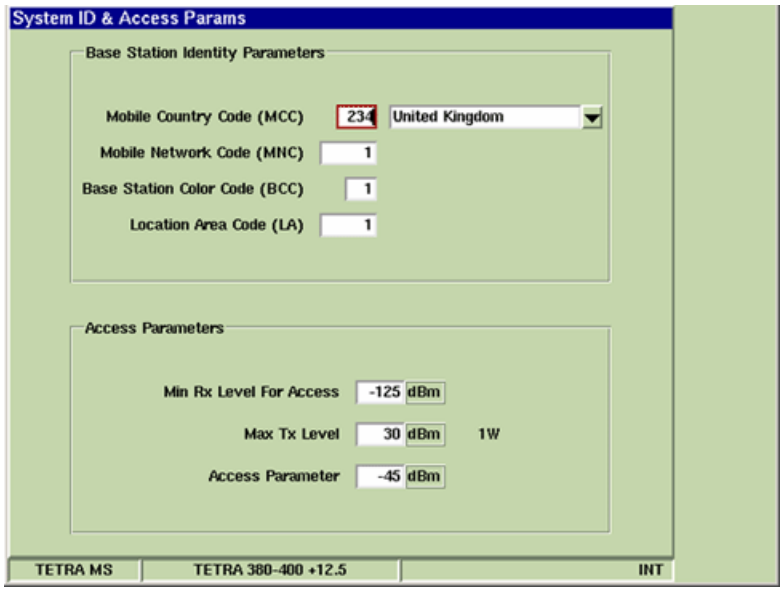

Fig. 4-22 TETRA MS System ID & Access Parameters Configuration Tile

4.13.1 Field Definitions

4.13.1.A Base Station Identity Parameters

The correct MCC and MNC must be set to allow the mobile to recognize the downlink signaling from the Test Set. Contact the manufacturer or TETRA Network Operator supplying the mobile to obtain this information.

4.13.1.A.1 Mobile Country Code (MCC)

Sets the MCC sent to the mobile in the Broadcast Synchronization Information. The MCC Text drop-down menu selects an MCC by name if the MCC is known. Range is 0 to 999 (decimal). To test a mobile using TETRA Test Mode (TT), set the MCC to 001, otherwise set the MCC to the code appropriate for the mobile under test.

4.13.1.A.2 Mobile Network Code (MNC)

Sets the MNC sent to the mobile in the Broadcast Synchronization Information. Range is 0 to 16383 (decimal). To test a mobile using TETRA Test Mode (TT), set the MNC to 00001, otherwise set the MNC to the code appropriate for the mobile under test.

4.13.1.A.3 Base Color Code (BCC)

Sets the BCC sent to the mobile in the Broadcast Synchronization Information. Range is 0 to 63 (decimal).

NOTE	Setting the BCC to 0 causes the scrambling sequence for all logical channel types to be generated with an all zeros scrambling seed for the BSCH, regardless of the values of MCC and MNC. Some TETRA terminals do not support BCC value 0.

4.13.1.A.4 Location Area (LA)

Sets the LA sent to the mobile in the System Information. Range is 1 to 16383 (decimal).

4.13.1.B Access Parameters

The parameters on the System ID & Access Parameters Configuration Tile define the way the mobile behaves with respect to the RF Level received from the Test Set. Default values are suitable for most mobiles.

4.13.1.B.1 Min Rx Level For Access

Defines the minimum RF Generator Level the mobile accepts before it attempts to register with the Test Set. The Minimum Rx Level value should be set to a value lower than the RF Generator Level to ensure registration (e.g. -125 dBm). Valid range is -125 to -50 dBm, in 5 dB steps. Default setting is -125 dBm.

The RF Generator Level also affects the behavior of the mobile when performing cell re-selection.

For additional information, refer to section titled Neighbor Cell Broadcast, Cell Selection, Cell Re-Selection and Call Restoration in Chapter 5, TETRA MS System.

4.13.1.B.2 Max Tx Level

Defines the maximum power level the mobile is permitted to transmit when using Openloop Power Control (link control). Default setting is 30 dBm.

4.13.1.B.3 Access Parameter

The Access Parameter is used by the mobile, along with the measurement of the mobile's received RF Level (the Test Set's RF Generator Level), to determine the power level transmitted when using Openloop Power Control (link control). The default value is -45 dBm, which should achieve +30 dBm transmission by a mobile when RF Generator Level is set to -75 dBm. The Access Parameter is also used by the Test Set to adjust its input attenuation to suit the estimated mobile power level.

4.13.2 TETRA MS T1 System ID & Access Parameters Config Tile

Configuring System ID and Access Parameters for TETRA MS T1 is similar to configuring those for TETRA MS, with the following noted exceptions:

- Base Station Identity Parameters, i.e. MCC, MNC and BCC may or may not require specific test values for System ID & Access Parameters. Refer to the mobile manufacturer for information on using T1 Test Mode and T1 Loopback.
- TETRA MS T1 does not contain a Location Area (LA) Parameter.

4.13.3 TETRA BS System ID Configuration Tile

Configuring System ID Parameters for TETRA BS is similar to configuring those for TETRA MS, with the following noted exceptions:

- TETRA BS is limited to Base Station Identity Parameters.
- The Identity Details of the Base Station (MCC, MNC, and BCC) are normally transmitted within the base station signal. Station ID parameters obtained from the base station signal are shown on the Operations/Status Tile.
- Identity Details are obtained automatically from the Base station under test by selecting the Update - Automatic feature on the TETRA BS System ID Configuration Tile. These values are selected manually when Update - Manual is selected.
- Measurements performed on the base station transmitter are unaffected by the settings on the TETRA BS System ID Configuration Tile. The base station identity only needs set correctly for the purpose of decoding System Information in the base station signal, or for decoding the content of the demodulated data captured and displayed when Data Display Mode is selected.

4.13.4 TETRA BS T1 System ID and Sync Configuration Tile

Configuring System ID Parameters for TETRA BS T1 is similar to configuring those for TETRA BS, with the exception that TETRA BS T1 includes Base Station Identity Parameters and Base Station Sync Parameters.

4.13.4.A Field Definitions

4.13.4.A.1 Base Station Sync

The Test Set must be synchronized with the frame structure of the base station signal to test a base station using TETRA BS T1. Base Station Sync settings control parameters associated with the synchronization function.

4.13.4.A.2 Mode

Auto

When Auto mode is selected, synchronization is achieved by locking the Test Set to the base station signal.

Pulse

When Pulse mode is selected, synchronization is achieved by a physical connection to the Test Set's Sync I/O connector on the rear panel.

4.13.4.A.3 Auto Sync Path Offset

The Auto Sync Path Offset controls the timing offset between the downlink frame structure and the Test Set's T1 Uplink Signal. Positive values advance the timing of the Test Set signal, causing it to be generated earlier; negative values delay the timing of the Test Set signal relative to the Base station downlink frame structure.

4.13.4.A.4 Sync Pulse Offset

The Sync Pulse Offset controls the timing offset between the sync pulse from the base station pulse and the Test Set's T1 Uplink Signal. Range is 0 to 1.02 seconds in 1 second increments.

4.13.4.A.5 Sync Pulse Edge

The Sync Pulse Edge parameter selects whether timing is referenced to the rising or falling edge of the base station's synchronization pulse.

4.14 TX MEASUREMENTS LIMITS CONFIGURATION TILE

The Tx Measurements Tile defines Pass/Fail limits that are applied to measurements on the Tx Measurements, Modulation Accuracy and Power Profile Tiles. The limits shown on the Tx Measurement bar graphs are also obtained from the Tx Measurements Limits settings.

The limits applicable to the Normal Burst Type are set independently from those applicable to the Control Burst Type. The Tile for each burst type is opened by selecting Normal or Control in the Burst drop-down menu. The Toggle Buttons Enable/Disable parameters (or groups of parameters).

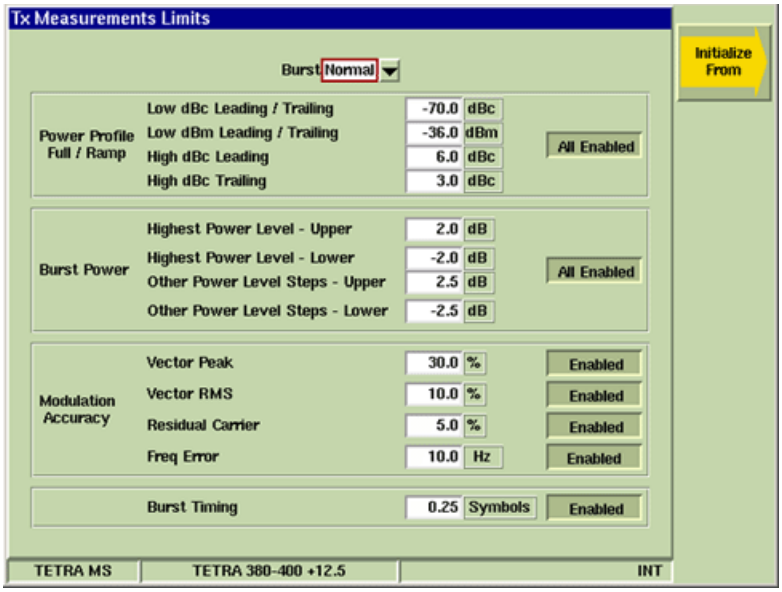

Fig. 4-23 TETRA MS Tx Measurement Limits Configuration Tile

4.14.1 Field/Soft Key Definitions

4.14.1.A Burst Type

A separate set of limits is set for each Burst Type. These limits are applied to the measurements made from the active Measurements Tiles, in conjunction with the Burst Type selection drop-down menu on any active Measurement Tiles. The Burst Type for which the limits are being set is selected from the Burst drop-down menu. Default setting is TS1+2.

The limits set for TS1+2 bursts are applied to bursts of either type if TS1+TS2 is selected on a measurement screen. These values can be different from either the TS1 or the TS2 limits. The Test Set measures bursts of the selected type(s) and disregards other burst types.

4.14.1.B Initialize From Soft Key

Press the Initialize From Soft Key, followed by either the Normal or Extreme Soft Key to initialize the limits to the Default values. This action resets ALL of the limits to the default values for the selected Burst type.

Two sets of default Pass/Fail limits are available for initializing the settings. These default limits are based on the ETSI specification for testing equipment to be used under normal environmental temperature and humidity conditions, and less stringent limits for use under extreme conditions.

4.14.1.C Burst Timing

Specifies the limit for the Burst Timing measurement on the Tx Measurements Test Tile. The parameter specifies a symmetrical limit that is applied to positive and negative timing errors (e.g. a value of 0.25 symbol sets the upper limit to +0.25 symbol and the lower limit to -0.25 symbol. The limit is applied with respect to the expected timing on the uplink, which is determined by the timing of the downlink signal generated by the Test Set.

4.14.1.D Power Profile Leading / Trailing Indicators

Fig. 4-24 shows the limit points indicated on the Power Profile Full Tile.

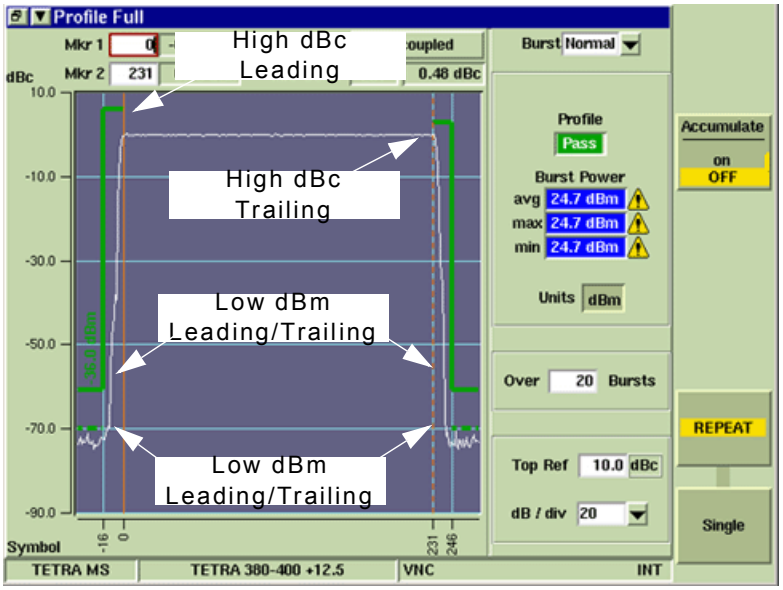

Fig. 4-24 TETRA MS Power Profile Full Tile - Limit Points Shown

4.14.1.D.1 Low dBc Leading/Trailing

This indicator specifies the upper limit of the Power Profile mask for the periods before ramp-up and after ramp-down (before t1 and after t3 in the ETSI specification) when the mobile transmitter must be inactive (Lmin in the ETSI specification). This limit is a relative level specified in dBc, where 0 dBc is defined as the actual power measured in the useful part of the burst (t2 in the ETSI specification). The Test Set only applies this limit if the limit is higher in absolute level terms than the alternative limit parameter Low dBm Leading/Trailing. To apply a dBc limit only, set the Low dBm limit to -99.9 dBm.

4.14.1.D.2 Low dBm Leading/Trailing

This indicator specifies the same upper limit as the Low dBc Leading/Trailing parameter as an absolute level specified in dBm. The Test Set applies this limit if the limit is higher in absolute level terms than the alternative limit parameter Low dBc Leading/Trailing.

These two parameters allow the Test Set to conform to the ETSI specification for the power profile when they are initialized from the Normal or Extreme limits. Using the ETSI specified parameters, Low dBc Leading/Trailing is set to -70.0 dBc and Low dBm Leading/Trailing is set to -36.0 dBm.

When the mobile power level measured by the Test Set is +34.0 dBm or higher, -70.0 dBc equates to -36.0 dBm or higher and the dBc limit is applied.

When the mobile power level measured by the Test Set is less than +34.0 dBm, -70.0 dBc equates to less than -36.0 dBm and the dBm limit is applied. To apply a dBm limit only, set the Low dBc limit to -99.9 dBc.

4.14.1.D.3 High dBc Leading

This indicator specifies the upper limit of the power profile mask for the ramp-up period (t1 in the ETSI specification). This limit is a relative level specified in dBc, where 0 dBc is defined as the actual power measured in the useful part of the burst (t2).

4.14.1.D.4 High dBc Trailing

This indicator specifies the upper limit of the power profile mask for the ramp-down period (t3 in the ETSI specification). This limit is a relative level specified in dBc, where 0 dBc is defined as the actual power measured in the useful part of the burst (t2).

4.14.2 Tx Measurements Upper and Lower Limits

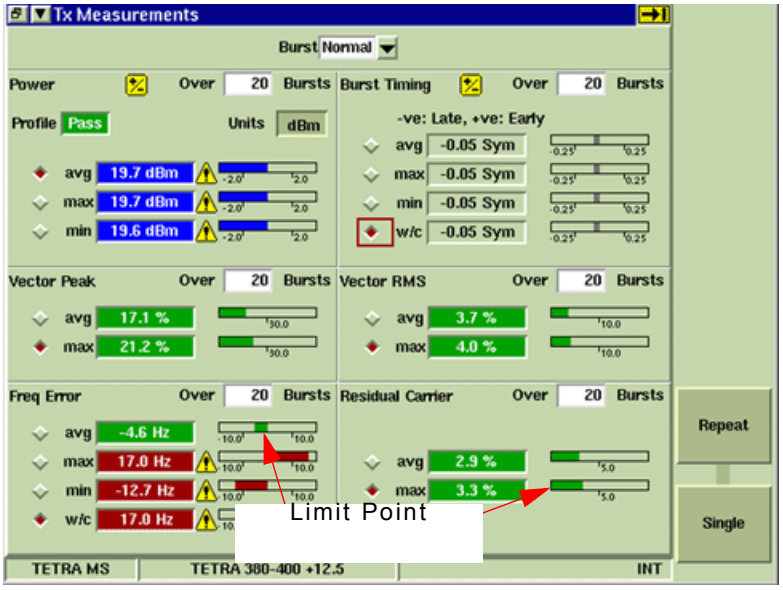

Fig. 4-25 TETRA MS Tx Measurements Tile - Limit Points Shown

4.14.2.A Highest Power Level - Upper

Specifies the upper limit for the burst power measurement. This limit is a relative level specified in dBc, where 0 dBc is defined as the nominal power level. This parameter is applicable to the mobile's highest power level as defined by the Power Class parameter on the Mobile Parameters Configuration Tile. The Test Set applies this upper limit when it is expecting the mobile to be transmitting at its highest power level, otherwise it applies the Other Power Level Steps - Upper limit.

4.14.2.B Highest Power Level - Lower

Specifies the lower limit for the burst power measurement, and it is applied when the Highest Power Level - Upper limit is applied. Separate upper and lower limits allow user to define asymmetric limits with respect to the nominal power, e.g. +3.0 dB and -4.0 dB.

4.14.2.C Other Power Level Steps - Upper

Specifies the upper limit for the burst power measurement. This limit is a relative level specified in dBc, where 0 dBc is defined as the nominal power level. This parameter is applicable to all power level steps except for the mobile's highest power level as defined by the Power Class on the Mobile Parameters Configuration Tile drop-down menu.

The Test Set applies this upper limit when it is expecting the mobile to be transmitting at a power level step below its highest power level, otherwise it applies the Highest Power Level - Upper limit. This limit is applied to the power level that the Test Set is expecting the mobile to be using, which cannot always be predicted correctly. Therefore, the Test Set may indicate that the Burst Power measurement is outside the limits for a particular power level step because the mobile is using a higher or lower power level step than the one that the Test Set is expecting.

4.14.2.D Other Power Level Steps - Lower

Specifies the lower limit for the burst power measurement. This lower limit is applied when the Other Power Level Steps - Upper limit is applied. Separate upper and lower limits allow user to define asymmetric limits with respect to the nominal power.

4.14.3 Modulation Accuracy Limits

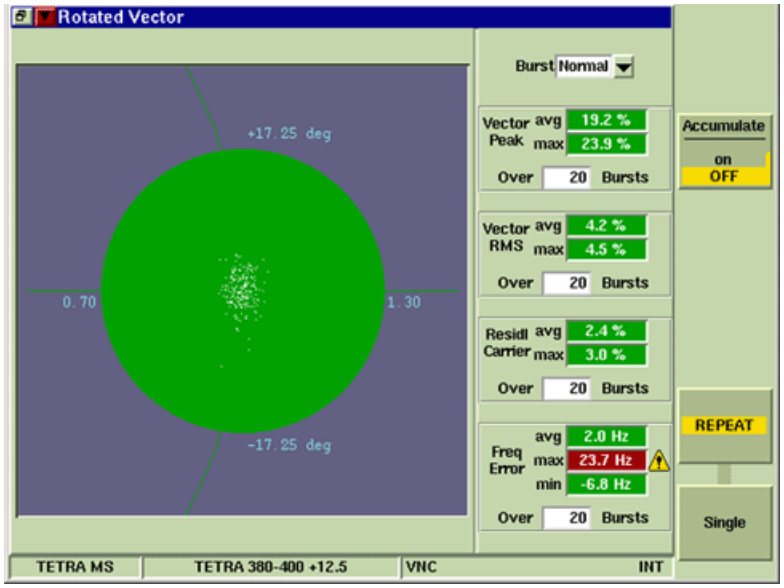

Fig. 4-26 TETRA MS Rotated Vector Tile - Peak Limit Shown

4.14.3.A Vector Peak

Specifies the upper limit for the Peak Vector Error measurement. This limit applies not only to the numerical display on the Tx Measurements Tile, but also to all of the Modulation Accuracy graphical display Tiles (except for the Phase Trajectory Tile).

Vector Peak sets the size of the limit circles around the symbol points on the Constellation and Rotated Vector Tiles and sets the position of the limit lines on the graphs of the Vector Error, Magnitude Error and Phase Error Tiles. On the Rotated Vector Tile, the display is automatically scaled to fit the specified limit. The example above shows the Rotated Vector Tile with the Vector Peak limit circle.

4.14.3.B Vector RMS

Specifies the upper limit for the RMS Vector Error measurement. This limit applies only to the numerical display of RMS Vector Error on the Tx Measurements Tile (which is repeated on the maximized Modulation Accuracy Tiles). This limit does not affect the appearance of graphical displays.

4.14.3.C Residual Carrier

Specifies the upper limit for the Residual Carrier Vector Error measurement. It is applicable to the numerical display of Residual Carrier on the Tx Measurements Tile and the maximized Modulation Accuracy Tiles. This limit does not affect the appearance of the graphical displays.

4.14.3.D Freq Error

Specifies the limit for the Frequency Error measurement. It is applicable to the numerical display of Frequency Error on the Tx Measurements Tile and the maximized Modulation Accuracy Tiles. This limit does not affect the appearance of the graphical displays.

Freq Error specifies a symmetrical limit that is applied to positive and negative frequency errors, e.g. a value of 100 Hz sets the upper limit to +100 Hz and the lower limit to -100 Hz. The limit is applied with respect to the RF Analyzer frequency.

4.14.4 TETRA BS and BS T1

TETRA BS and BS T1 Tx Measurement Limits are similar to the TETRA MS with the following exceptions:

- The Burst Power measurement has separate upper and lower limits, so that asymmetric limits can be set, e.g. +3 dB /- 4 dB with respect to the nominal power level.
- The modulation accuracy measurements have upper limits only.
- The upper and lower limits for the burst power measurement are applied with respect to the Base Station Power Class value set on the BS Parameters Configuration Tile.

Chapter 5 - TETRA MS System

5.1 INTRODUCTION

The 3900 TETRA MS System provides features for testing TETRA Mobiles in normal operating mode. Mobiles with T1 Test capability can be tested using the TETRA MS T1 System.

The TETRA MS System provides the following test capabilities:

- Base station simulation (MCCH, TCH/S, FACCH).
- Registration, group attachment and de-registration protocol.
- Call set-up, call maintenance and call clear-down protocol.
- Short Data Service (SDS) Message protocol.
- TETRA Test Mode (TT) registration and RF Loopback protocol.
- Transmitter measurements.
- Receiver measurements (BER, MER, RBER) on TCH/S using TT RF Loopback.
- Graphical displays of power profile and modulation.
- Capture and time stamping of mobile and Test Set protocol operations (1000 lines).
- Capture, demodulation and channel decoding of mobile transmissions (1000 bursts).

This chapter describes TETRA MS TEST Tiles. Refer to Chapter 4, Common TETRA Configuration Tiles for use of TETRA MS Configuration Tiles.

5.2 TETRA MS TILE LAYOUT

Fig. 5-1 shows TETRA MS System in Manual - Tiled display mode, with the Tiles minimized.

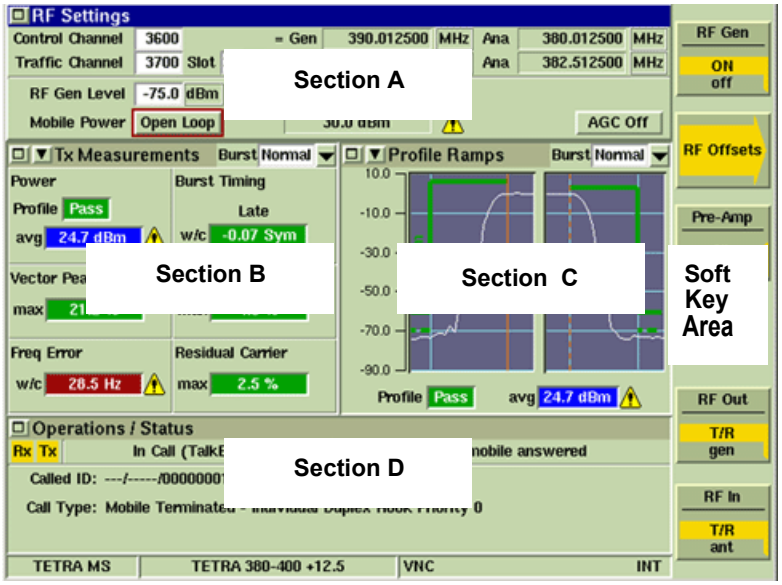

Fig. 5-1 TETRA MS System Display - Tiles Minimized View

Each section of the screen is used to display specific Tiles:

- The RF Settings Tile is only available in Section A.
- Sections B and C can be configured to display Measurement Tiles, Protocol Tiles, the Oscilloscope, Channel Analyzer and Audio Tile. Tiles can be displayed simultaneously in Sections B and C.
- Section D always shows the Operations/Status Tile.
- The Information Bar at the bottom of the Tile displays the operating System title and other information operational information.

The soft keys displayed on the right side of the display are relevant to the Tile currently active. In Fig. 5-1, focus is on the Tile in Section A, the RF Settings Tile. The Information bar at the bottom of the Tile shows the current operating System title (TETRA MS) selected and the Channel Plan set to TETRA 380-400 +12.

5.3 AUDIO TILE

The TETRA System Audio Tile is a combination of the functionality found on the Analog Duplex AF Generators and AF Analyzers Tiles. Audio Tile functionality allows a user to measure and evaluate audio signals while operating within TETRA Systems. Functionality is identical to the fields found in the Analog Duplex System.

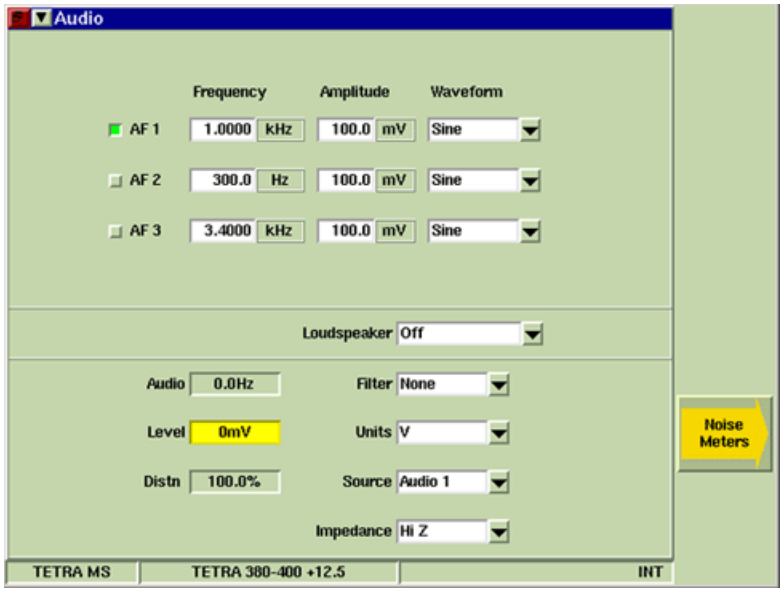

Fig. 5-2 TETRA MS Audio Tile - Maximized View

5.3.1 AF Generator Field Definitions

5.3.1.A Frequency

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

5.3.1.B Amplitude

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

5.3.1.C Waveform

Defines the Waveform for each AF Generator. Select from Sine or Square. The selected value (Sine or Square) is displayed on the minimized Tile beside the Amplitude field.

5.3.1.D Radio Buttons

The buttons to the left of each AF Generator frequency settings field turn each generator ON or OFF.

5.3.1.E Output Level Warning

A warning indicator is displayed if the sum of the active AF Generator levels is set to exceed 5 V.

5.3.1.F Loudspeaker

Selects the signal sent to the internal loud speaker. This menu is accessible when the Audio Tile is maximized.

5.3.2 AF Analyzer Field/Soft Key Definitions

5.3.2.A Audio Freq

Displays the averaged frequency of the Audio input signal.

5.3.2.B Level

Displays the averaged level of the Audio input signal. When V is selected from the Units drop-down menu, a scale indicator is displayed next to the Level reading.

5.3.2.C Distn/SINAD

Displays the measured noise level on the Audio input signal, using the modulation signal applied to the Test Set RF Output Connector as the reference. The desired noise measurement (Distortion or SINAD) is selected from the Noise Meters Soft Key sub-menu.

5.3.2.D Filter

Selects a measurement filter to include in the measurement path.

5.3.2.E Units

Selects the unit of measure as V, dBm or dBr for the Level reading. Available value is limited by selected audio input Source. For example, the Balanced audio input source can be set to either dBm or dBr: V is not available as an option. When V is selected, a scaling value indicator (mV) is displayed beside the Level reading in the Level field.

5.3.2.F Source

Selects Audio 1 and 2 IN Connectors, Balanced or MIC/ACC Connector as Audio Input. Balanced (Audio 1 and Audio 2 inputs) can be used with a center pin to center pin, two banana plug to BNC adapters.

5.3.2.G Impedance

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

5.3.2.H Noise Meters Soft Key

Opens a soft key sub-menu that allows measurement option to be selected to be displayed on the Audio Tile for Modulation Distortion and AF Distortion measurement.

Refer to the 3900 Series Operation Manual for additional information on configuring Noise Meters Soft Key.

5.4 BURST TILE

The Burst Tile provides a graphic representation of the TETRA signal in the active timeslot. When a TETRA signal is received, a color-coded, horizontal band is generated from right to left on the Burst Tile. The Burst Tile can be selected from the drop-down menu on the Measurements Tiles or on the RF Settings Tile .

NOTE	The Burst Tile is intended to provide an indication of the activity present in the TETRA signal. Use Data Display Mode for a detailed view of signal content.

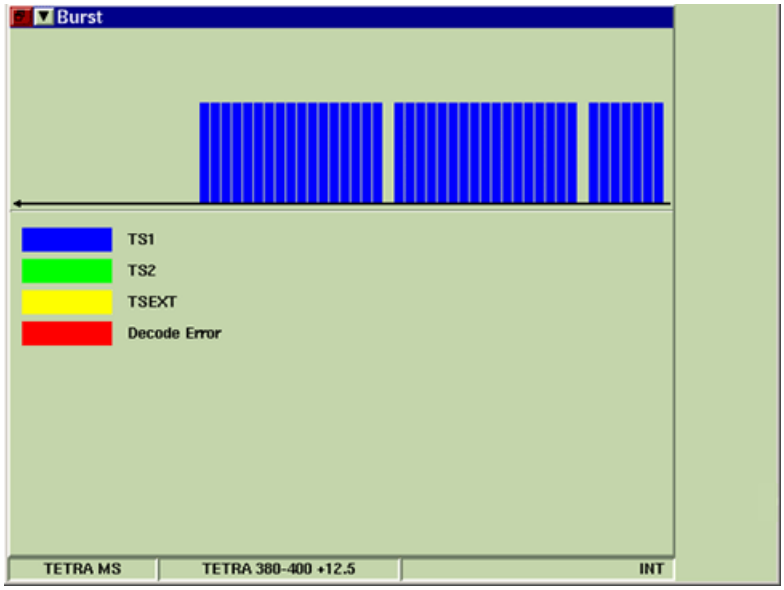

Fig. 5-3 TETRA MS Burst Tile - RF Settings Tile location

The Burst Tile uses color-coding to represent various burst types present in TETRA systems. The color-coding allows for quick identification of the information received across the signal.

TETRA MS uses the following color-coding to identify burst types:

	Represents a TS1 burst.
	Represents a TS2 burst.
	Represents a TSEXT burst. Appears as a complete bar when present.
	Represents protocol decode failure. Occupies the bottom third of bar when present.

Fig. 5-4 shows an example of a TETRA signal that contains the following characteristics:

- TS1 bursts shown in dark blue
- TS2 bursts shown in green
- TSEXT bursts shown in yellow

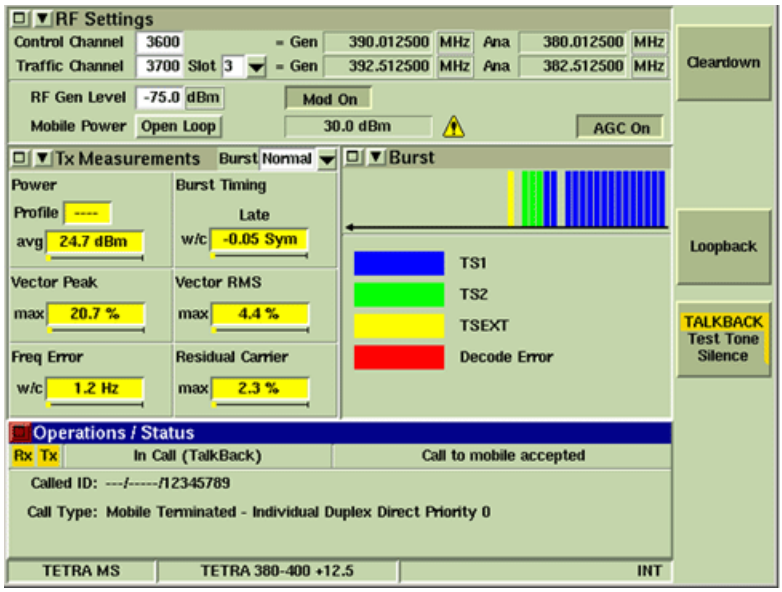

Fig. 5-4 TETRA MS Burst Tile - Measurement Tile location

5.5 MODULATION ACCURACY TILES

5.5.1 Constellation Tile

The Constellation Tile shows the spread of symbol points for a burst and gives a visual representation of whether the deviations are phase or magnitude related. Limit circles may be displayed as shown in this example. The constellation point circle is pushed into an oval when an I/Q imbalance is present. The measurement results displayed when the Tile is maximized are the same as the results displayed on the Tx Measurements Tile.

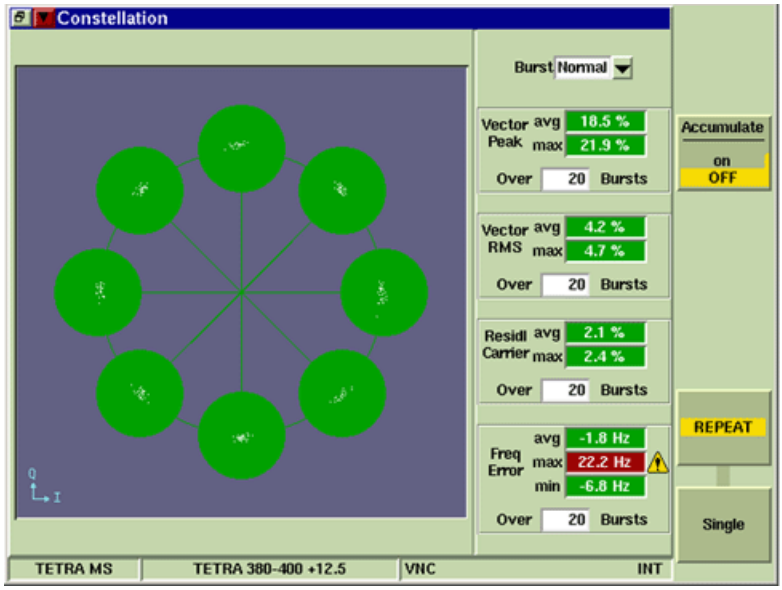

Fig. 5-5 TETRA MS Constellation Tile - Maximized View

5.5.2 Soft Key Definitions

5.5.2.A Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.5.2.B Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.5.2.C Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.5.3 Magnitude Error Tile

Magnitude Error is the amount by which the signal differs from the magnitude of the ideal signal. It is expressed as a positive or negative percentage of the magnitude of the ideal signal. The Magnitude Error Tile displays the magnitude error for each symbol for a whole burst without considering any phase error that may be present. Increasing magnitude error with time may indicate power supply problems. Errors at start or end of burst may indicate ramp-up or ramp-down problems. The measurement results displayed when the Tile is maximized are the same as the results displayed on the Tx Measurements Tile.

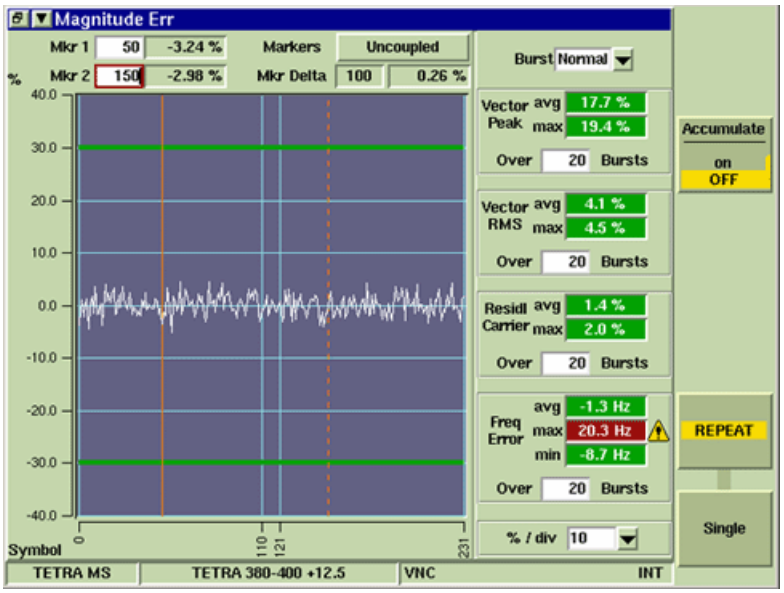

Fig. 5-6 TETRA MS Magnitude Error Tile - Maximized View

5.5.4 Soft Key Definitions

5.5.4.A Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.5.4.B Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.5.4.C Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.5.5 Phase Error Tile

Phase Error is the amount by which the signal leads or lags from the ideal signal. The reading is expressed as a positive (anti-clockwise movement) or negative (clockwise movement) angle. The Phase Error Tile displays the phase error for each symbol for an entire burst without considering any magnitude error that may be present. Large variations at the start of the burst may indicate oscillator settling problems. Variations during the burst may be due to oscillator control issues. The measurement results displayed when the Tile is maximized are the same as the results displayed on the Tx Measurements Tile.

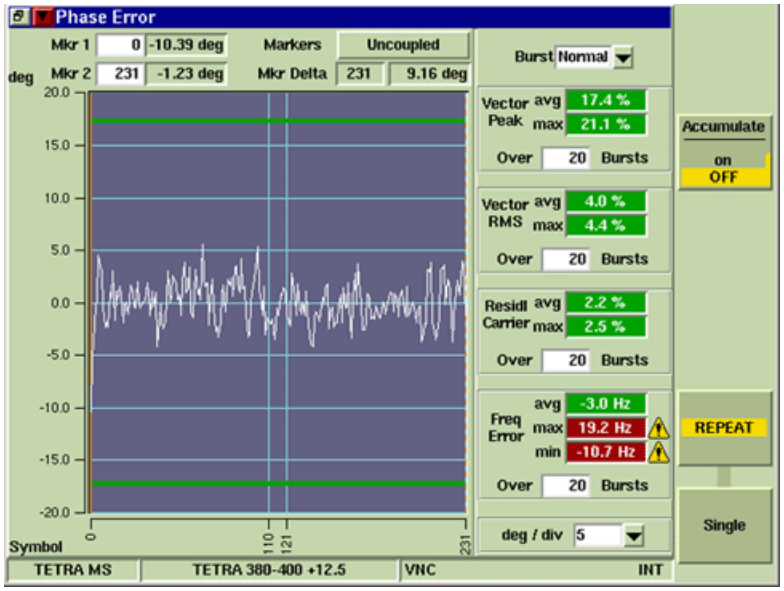

Fig. 5-7 TETRA MS Phase Error Tile - Maximized View

5.5.6 Soft Key Definitions

5.5.6.A Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.5.6.B Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.5.6.C Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.5.7 Rotated Vector Tile

The Rotated Vector Tile is based on the Constellation Tile. The eight segments present on the Constellation Tile are rotated so that the ideal vectors overlay each other, displaying a larger representation. Once again a limit circle may be displayed, in this case set to 30%. As in the Constellation diagram in the example above, phase and magnitude can be observed. The spread of values along the unit circle line indicates Phase problems. The spread of values horizontally indicates Magnitude problems. The measurement results displayed when the Tile is maximized are the same as the results displayed on the Tx Measurements Tile.

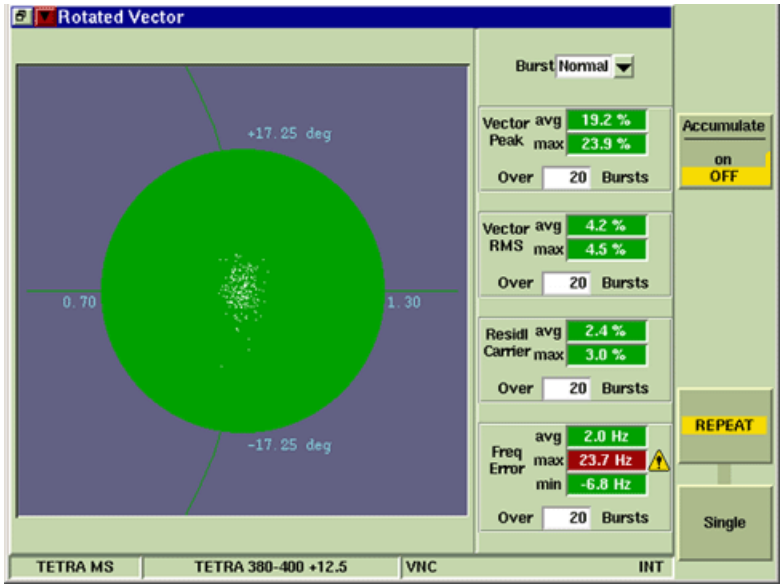

Fig. 5-8 TETRA MS Rotated Vector Tile - Maximized View

5.5.8 Soft Key Definitions

5.5.8.A Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.5.8.B Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.5.8.C Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.5.9 Trajectory Tile

The Trajectory Tile displays the actual carrier transitions (phase and amplitude) during the burst. It shows the power deviations and the targeting onto the symbol points. Compression of the carrier, indicated by squashed outer loops, incorrect filtering, indicated by signal spread at the constellation points and non-linearities can be evaluated with this Tile. The measurement results displayed when the Tile is maximized are the same as the results displayed on the Tx Measurements Tile.

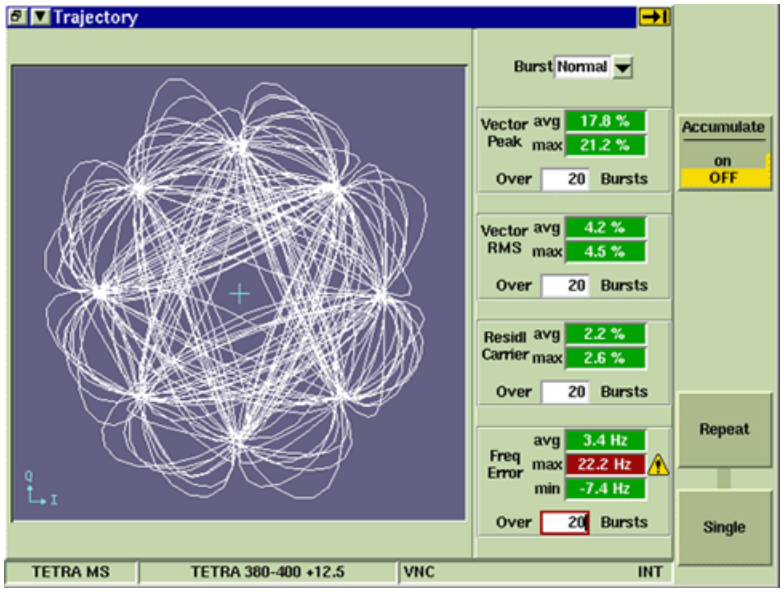

Fig. 5-9 TETRA MS Trajectory Tile - Maximized View

5.5.10 Soft Key Definitions

5.5.10.A Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.5.10.B Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.5.10.C Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.5.11 Vector Error Tile

The Test Set displays the vector error for each symbol point for an entire burst. All of the vector errors across a burst are analyzed to produce the RMS and Peak Vector Error readings for the burst. The measurement results displayed when the Tile is maximized are the same as the results displayed on the Tx Measurements Tile.

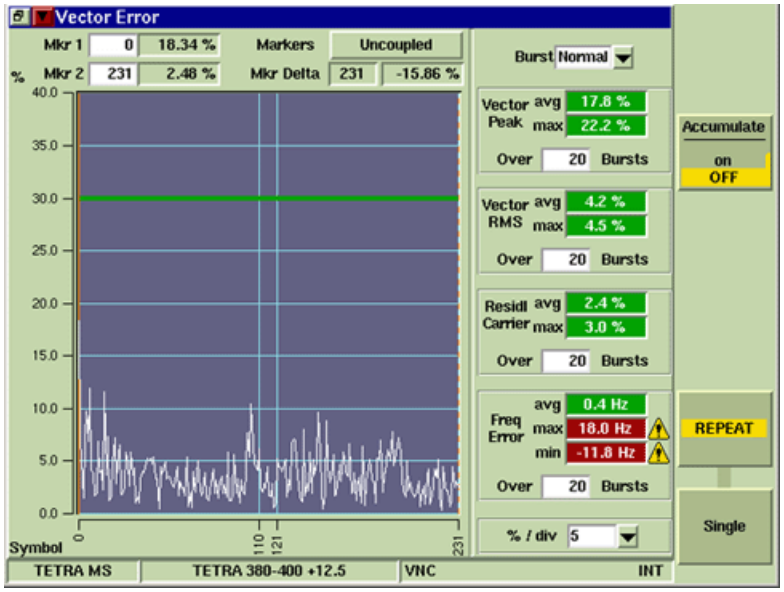

Fig. 5-10 TETRA MS Vector Error Tile - Maximized View

5.5.12 Soft Key Definitions

5.5.12.A Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.5.12.B Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.5.12.C Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.6 OPERATIONS/STATUS TILE

The Operation/Status Tile accesses call placement and message functions. The Tile is Protocol State dependent, with the soft keys provided to make calls, select call types and other functions. The Tile shows the state of the Test Set in relation to a mobile under test. Tile data shows:

- Identity of the mobile, group or groups to which it is attached and similar information.
- The State of any calls in progress and any special test states in use are displayed.
- Calls to the mobile under test are initiated from this Tile.
- SDS Text Messages to the mobile under test are set up from the Operations/ Status Tile.
- Displays Text Messages that are received from the mobile under test.

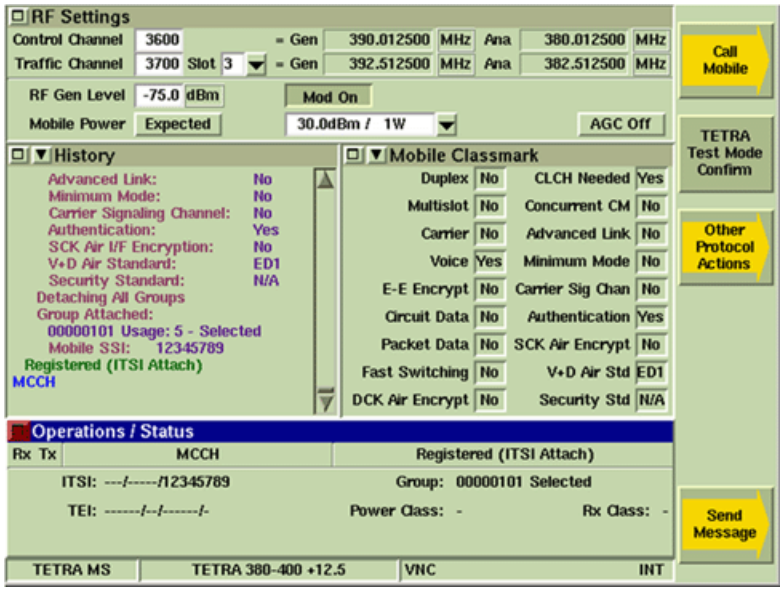

Fig. 5-11 TETRA MS Operations/Status Tile - Normal Registration

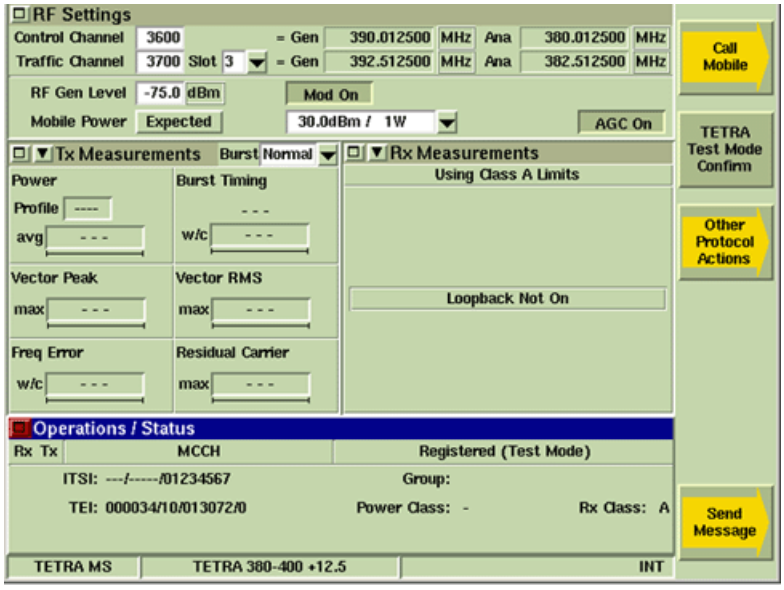

Fig. 5-12 TETRA MS Operations/Status Tile - TT Test Mode Registration

5.6.1 Field/Soft Key Definitions

5.6.1.A Mode, Events and Messages

The Operations/Status Tile shows the current TETRA Test Mode of the Test Set and the current action. SDS Messages and information about them are shown on the bottom line of the Tile.

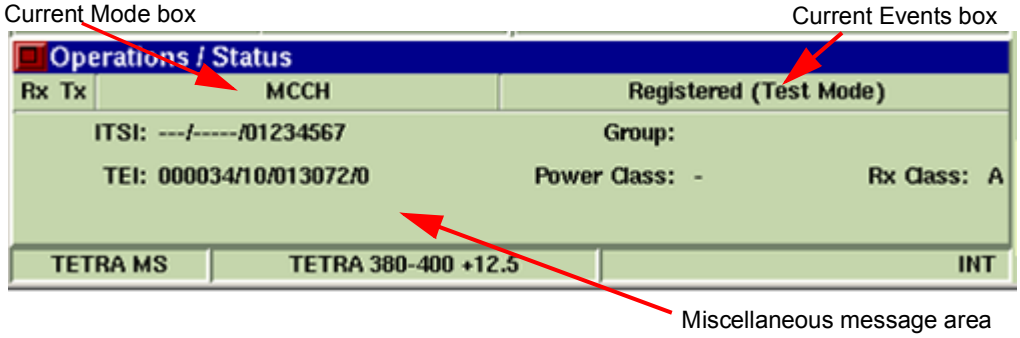

Fig. 5-13 TETRA MS Operations/Status Tile - Information Areas

5.6.1.B Call Mobile Soft Key

Opens a soft key sub-menu that allows user to initiate a call to the mobile.

5.6.1.C TETRA Test Mode Confirm Soft Key

Sends a TETRA Test Mode Confirm command to the mobile under test. This function should be used in conjunction with a mobile that supports TETRA Test Mode (TT).

Mobiles may differ in their implementation of TT Mode, but typically the following operations need to be performed:

STEP	PROCEDURE
1.	Select the System ID & Access Parameters Configuration Tile and set MCC to 1 and MNC to 1 (test values).
2.	Configure the mobile to enable TETRA Test Mode. (Refer to the manufacturer for details.)
3.	Wait for the mobile to register to the Test Set (ITSI Attach). The mobile may refrain from attaching groups in this mode.
4.	Press the TETRA Test Mode Confirm Soft Key within 30 s of enabling TETRA Test Mode on the mobile, but not before the mobile has registered.

The mobile sends the TETRA Test Mode Confirm response, including its TEI (TETRA Equipment Identity), Power Class and Receiver Class.

The mobile remains in TETRA Test Mode which may be subject to a time limit, e.g. 5 minutes, or it may remain in TETRA Test Mode until the mobile is switched off. If the mobile does not receive the TETRA Test Mode Confirm command within 30 s of TETRA Test Mode being enabled, the TT mode is invalid and the mobile reverts to normal mode.

The Test Set indicates Registered (Test Mode) and displays the TEI, Power Class and Receiver Class values reported by the mobile. The Power Class and Receiver Class reported values are also updated on the Mobile Parameters Configuration Tile, and may be used for limit checking in manual or automatic testing.

Receiver BER/MER measurements can now be performed on the mobile by setting up a duplex call and commanding it into Loopback mode.

5.6.1.D Other Protocol Actions Soft Key

Opens a soft key sub-menu that access additional protocol functions.

5.6.1.D.1 Commanded Registration

Commands the mobile tore-attach its groups and to re-register with its full ITSI (MCC/MNC/SSI) and Mobile Classmark. It is not normally necessary to perform this operation: this information is obtained during registration (ITSI attach).

Following a Reset to MCCH operation (see below) the Commanded Registration function is likely to fail, since the Test Set has no knowledge of the mobile's SSI address. However, if the correct SSI address is entered as a Use Fixed value on the Mobile Parameters Configuration Tile, the mobile should respond to Commanded Registration and update the information.

NOTE	This command is for re-registration only, and cannot normally be used to force a mobile to register to the Test Set if it has not already done so.

5.6.1.D.2 Reset to MCCH

Forces the Test Set to generate the MCCH if it is not already doing so. Pressing this soft key resets (deletes) the Test Set's knowledge of the reported mobile information (ITSI, groups, Classmark, TEI, Power Class, Receiver Class), so an attempt to place a call or send a message from the Test Set to the mobile is likely to fail unless the mobile is powered off and on to initiate another registration.

Normally the Test Set resets (deletes) its knowledge of the reported mobile information automatically when the mobile is powered down and de-registers from the Test Set. If the mobile has not de-registered (for example it has been disconnected from the Test Set without being powered down first), pressing the Reset to MCCH Soft Key resets the Test Set mobile information display. Protocol History is also reset if Clear Mode Auto is selected.

5.6.1.E Energy Economy Mode Soft Key

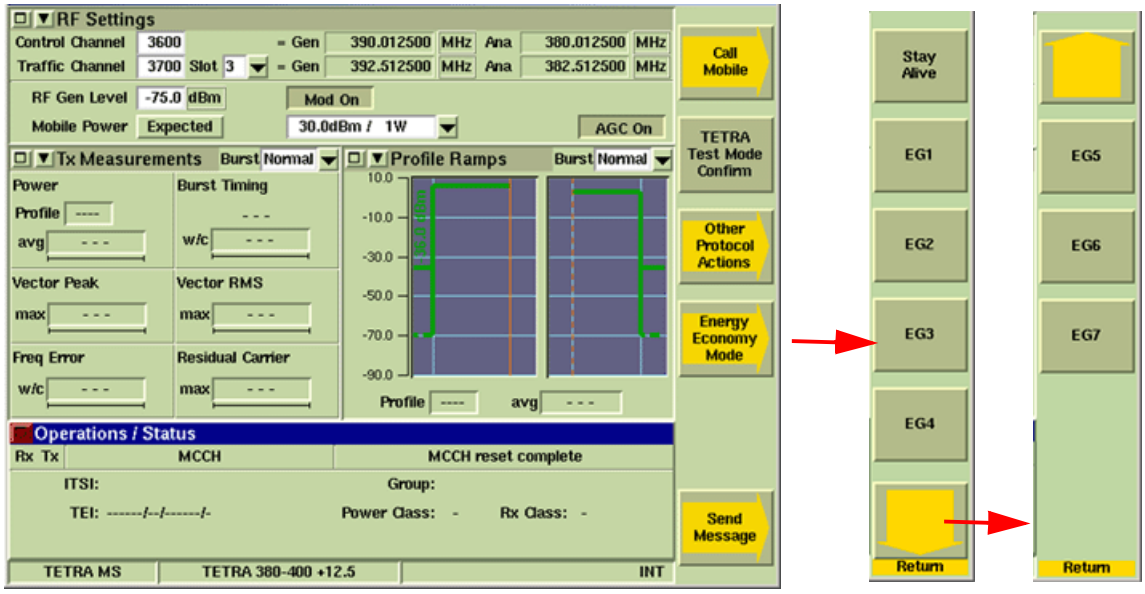

Fig. 5-14 Energy Economy Mode Soft Key Sub-menus

This soft key is only available when option 390XOPT114, TETRA Energy Economy Mode, is installed in the Test Set. Pressing this soft key opens a soft key sub-menu that provides the user with the ability to request that the mobile change the energy economy mode being used. The mobile must acknowledge the Test Set's request to change energy economy mode before the change takes effect.

NOTE	The Mobile may respond to Test Set's request to change EEM with a different EEM than the one requested by the Test Set. Also, the Mobile can request a new EEM at any time when Use Reported is selected on the Mobile Parameters Configuration Tile.

5.6.1.F Send Message Soft Key

Opens a soft key sub-menu that allows user to send a Status Message or an SDS message to the mobile.

5.7 POWER MEASUREMENTS TILES

5.7.1 Profile Full Tile

The Profile Full Tile shows in graphic form, the profile of the signal bursts that make up the signal from a TETRA Mobile. The ramp-up, middle and ramp-down of the burst are shown, with a profile mask defining the acceptable signal levels over the burst period.

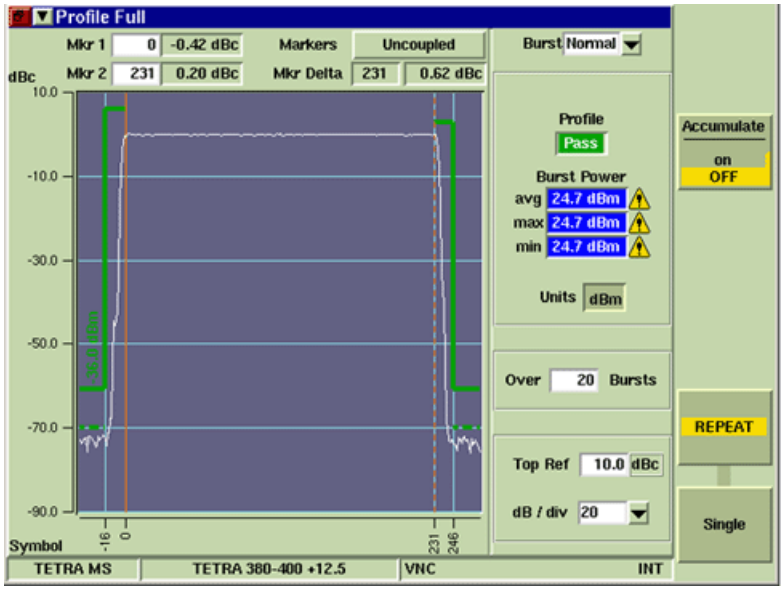

Fig. 5-15 TETRA MS Power Profile Full Tile - Maximized View

5.7.1.A Field/Soft Key Definitions

5.7.1.A.1 Graph Axes

The X axis is calibrated in Symbol Points over the Ramp Up and Ramp down periods and the Y axis is calibrated in dBc.

For a Normal burst, the X axis range is 300 symbols, covering from symbol -35 to symbol 265.

For a Control burst, the X axis range is 150 symbols, covering from symbol -24 to symbol 126.

Each Normal burst has a duration of 231 symbols and Control bursts have a duration of 103 symbols.

The Ramp Up and Ramp Down limit profiles are shown on the Profile Full Tile.

Refer to the sections in this chapter titled Profile Full Tile and Profile Ramps Tile.

5.7.1.A.2 Power Measurement

The displayed mask limits, which are the Pass/Fail criteria for the Power Profile Measurement, are configured in the Tx Measurements Limits Configuration Tile. If these limits are set to Disabled, the mask is not displayed and the profile Pass/Fail assessment is not performed.

The average of the power measurements of the middle of the burst is shown in the avg box.

5.7.1.A.3 Burst Power Results

The results of the Tx Burst Power measurements are shown when the Tile is maximized. These results are the same as the results displayed on the Tx Measurements Tile, but without the bar graphs or radio buttons.

5.7.1.A.4 Top Ref

Sets the top of scale of the Y axis.

5.7.1.A.5 dB / div

Sets the span of the sections along the Y axis.

5.7.1.A.6 Over n Bursts

The Over n Bursts setting affects the displayed Power Profile, Pass/Fail assessment and Burst Power measurement. The Power Profile is averaged over the Number of Bursts specified, which usually smooths out the noise, reducing the peak level of the power profile during the periods when the mobile's transmitter is inactive. If a stringent level for the Low dBc limit is specified, e.g. -70 dBc, it may be necessary to average the profile over a large number of bursts, e.g. 200, to produce a fair assessment of the performance of the mobile transmitter under test.

5.7.1.A.7 Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.7.1.A.8 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.7.1.A.9 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.7.2 Profile Ramps Tile

The Profile Ramps Tile shows a graphic form of the profile of the Rise and Fall Ramps of the signal bursts from a TETRA Mobile. The profile mask defines the acceptable signal levels over the rise and fall periods.

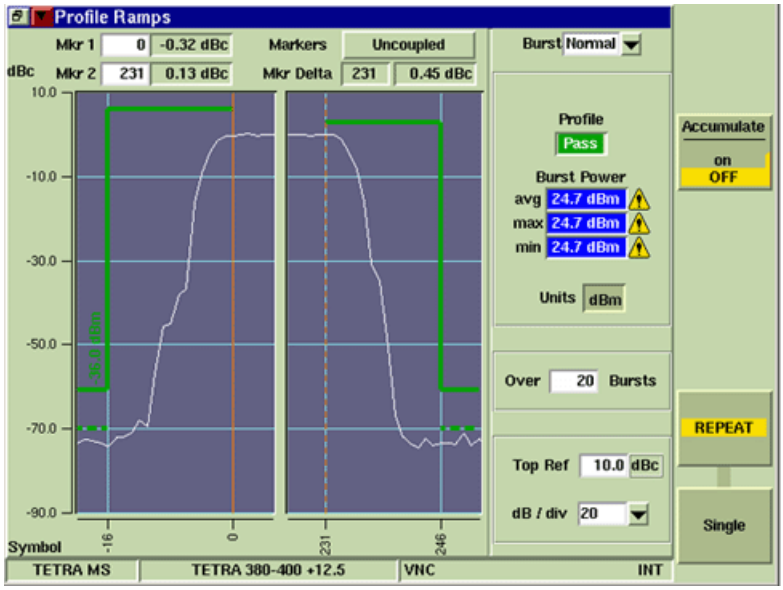

Fig. 5-16 TETRA MS Power Profile Ramps Tile - Maximized View

5.7.2.A Field/Soft Key Definitions

5.7.2.A.1 Burst Power Results

The results of the Tx Burst Power measurements are shown when the Tile is maximized. These results are the same as the results displayed on the Tx Measurements Tile, but without the bar graphs or radio buttons.

5.7.2.A.2 Top Ref

Sets the top of scale of the Y axis.

5.7.2.A.3 dB / div

Sets the span of the sections along the Y axis.

5.7.2.A.4 Over n Bursts

The Over n Bursts setting affects the displayed Power Profile, Pass/Fail assessment and Burst Power measurement. The Power Profile is averaged over the Number of Bursts specified, which usually smooths out the noise, reducing the peak level of the power profile during the periods when the mobile's transmitter is inactive. If a stringent level for the Low dBc limit is specified, e.g. -70 dBc, it may be necessary to average the profile over a large number of bursts, e.g. 200, to produce a fair assessment of the performance of the mobile transmitter under test.

5.7.2.A.5 Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.7.2.A.6 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.7.2.A.7 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.7.3 Profile Frame Tile

The Profile Frame Tile shows a graphic form of the power profile of the inactive and active slots of a TETRA frame. Whereas the Profile Ramps Tile shows a profile of the Rise and Fall Ramps of a single burst, the Power Frame Tile shows a profile mask of the signal levels over an entire TETRA frame. TETRA MS T1 Power Profile Frame only transmits in Timeslot 1.

NOTE

TETRA MS T1 Power Profile Frame only transmits in Timeslot 1.

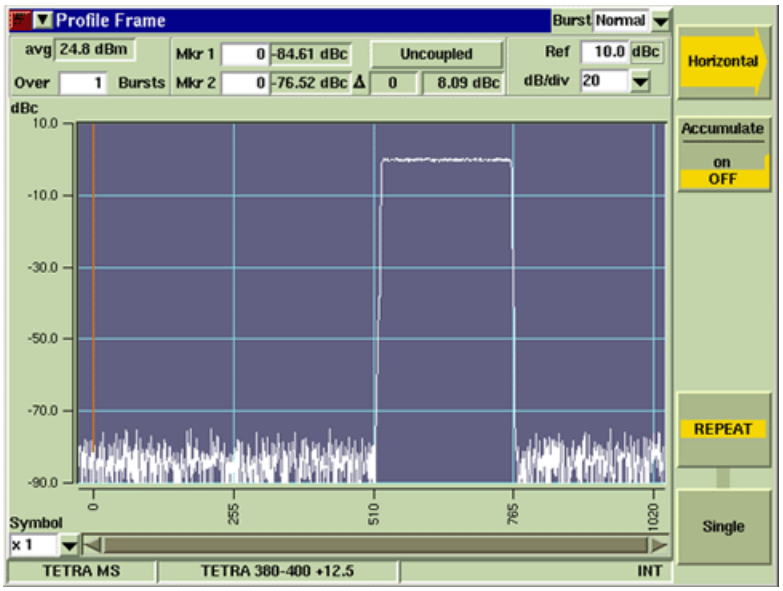

Fig. 5-17 TETRA MS Power Profile Frame Tile Maximized View

5.7.3.A Field/Soft Key Definitions

5.7.3.A.1 Horizontal Axis Zoom Control

The Horizontal Axis Zoom Control drop-down menu located at the bottom left of the Tile selects the length of horizontal axis that is displayed. Selecting x1 displays the entire horizontal axis; selecting x2 displays half of the horizontal axis.

This menu is linked to the Expand and Contract Horizontal soft keys. When the Expand/ Contract soft keys are used to adjust the horizontal axis, the value in the Horizontal Axis Zoom Control field is updated accordingly.

5.7.3.A.2 Horizontal Scroll Bar

The Horizontal Scroll bar allows user to scan left and right along the length of the horizontal axis.

5.7.3.A.3 Horizontal Soft Key

The Horizontal Soft Key accesses additional soft keys to configure horizontal display parameters.

5.7.3.A.4 Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Setting the Accumulate Soft Key to ON starts the accumulation of traces.

Setting the Accumulate Soft Key to OFF clears any accumulated traces and causes each trace to overwrite the previous trace.

5.7.3.A.5 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

5.7.3.A.6 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

5.8 PROTOCOL TILES

Protocol Tiles provide information relating to registration, call processing and messaging operations performed by the mobile and the Test Set. This information is available whether or not the Protocol Tiles were displayed during the protocol operations.

5.8.1 Protocol Mobile Classmark Tile

The mobile under test provides its Classmark information when it registers to the Test Set. The Classmark is a set of flags by which the mobile indicates its capabilities to a base station. These flags are shown in an abbreviated format on the minimized version of the Tile; with fuller descriptions available on the maximized view of the Tile.

> **NOTE** The Simplex/Duplex indication relates to the mobile's ability to perform RF transmission and reception simultaneously, not to simplex/duplex calls; therefore, it is common for a mobile that supports duplex calls to indicate Simplex in its Classmark. Refer to ETSI EN 300 392-2 16.10.5 if exact definition of the Classmark information is required.

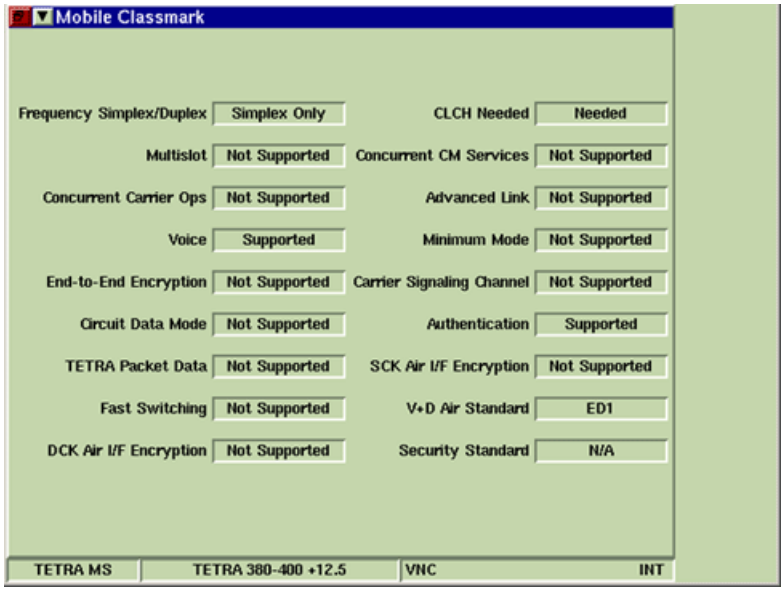

Fig. 5-18 TETRA MS Protocol Mobile Classmark Tile - Maximized View

5.8.2 Protocol Groups Tile

If the mobile under test has attached multiple groups, the groups can be viewed in the Groups Tile. The minimized view of the Groups Tile allows user to select the format of the group numbers. The View Decimal/Hex Soft Key selects decimal or hexadecimal format to display group numbers. The maximized Tile displays group numbers in decimal and hexadecimal format. The class of usage of each group is also shown, e.g. Normal Priority, Low Priority, Selected. When group modification operations are made to the mobile (attach, detach, change of class of usage, change of selected group) the Groups Tile is updated accordingly.

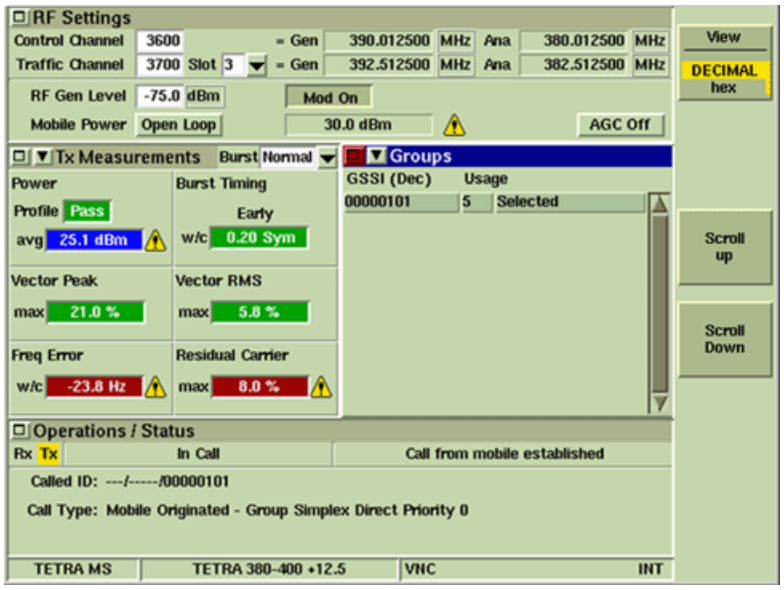

Fig. 5-19 TETRA MS Protocol Groups Tile - Minimized View

5.8.2.A View Soft Key

This toggle button changes the display of data from Decimal format to Hexadecimal format.

5.8.3 Protocol History Tile

The Protocol History Tile records all information displayed in the Operations/Status Tile. This information is useful when multiple operations have produced information that has appeared and been overwritten. The Protocol History Tile also records the Operations/ Status Tile information when that Tile is not visible. For some operations, more detailed information is shown in Protocol History than is displayed in the Operations/Status Tile.

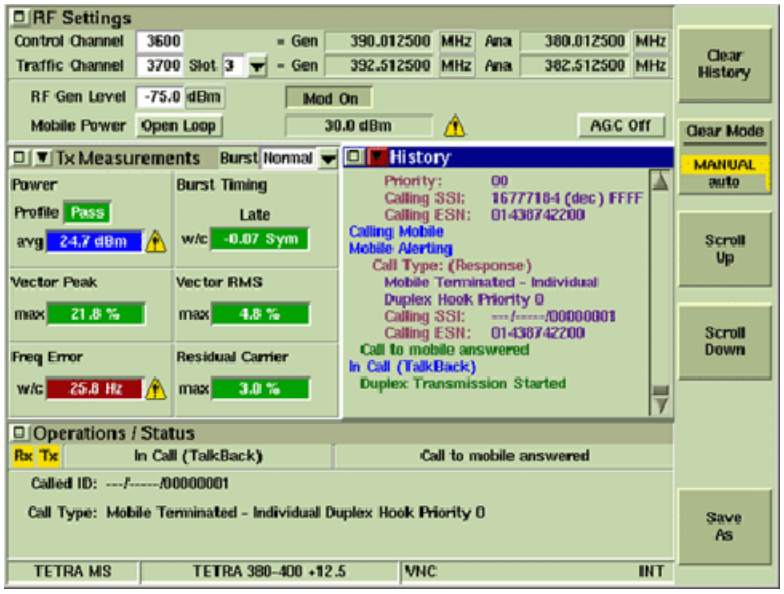

Fig. 5-20 TETRA MS Protocol History Tile - Minimized View

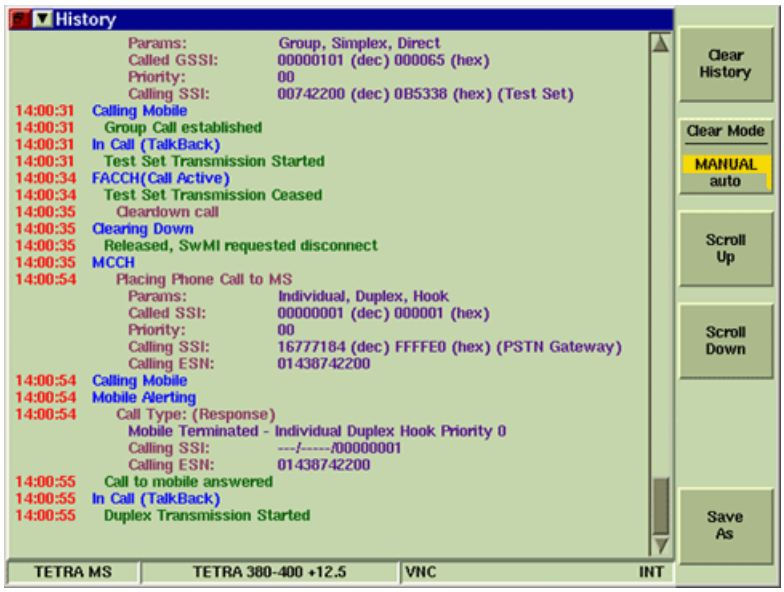

Fig. 5-21 TETRA MS Protocol History Tile - Maximized View

5.8.4 Soft Key Definitions

5.8.4.A Clear History Soft Key

Clears the information already recorded in the protocol history. If Clear Mode Soft Key is set to Auto, the information already recorded by the Test Set is cleared automatically each time a mobile registers with the Test Set.

5.8.4.B Clear Mode Soft Key

Defines how logged data is cleared. When set to Manual, logged data is cleared by pressing the Clear History Soft Key. When set to Auto, logged data is cleared when a new mobile registers with the Test Set.

5.8.4.C Save As Soft Key

Saves a text file to the Test Set's hard drive that can be exported via the File Management Tile feature.

5.8.4.D Timing Soft Key

Timestamp information is shown in the maximized view of the Protocol History Tile. The timestamp can display real time (Timing = ABSOLUTE) or the time relative to the first entry in the history (Timing = ELAPSED). If the real time shown is incorrect, press the UTILS Key to access the Test Set's Hardware Settings, Time & Date Tile and make the necessary adjustments.

5.9 RF SETTINGS TILE

The RF Settings Tile is used to set the Control Channel, Traffic Channel and other parameters used for testing the mobile. The configuration of the RF Settings Tile depends on the Channel Plan selected and whether or not the Test Set is participating in a call. Refer to examples below for examples of RF Setting Tile configuration.

Refer to section titled Channel Plans in Chapter 2 for information about configuring Channel Plans.

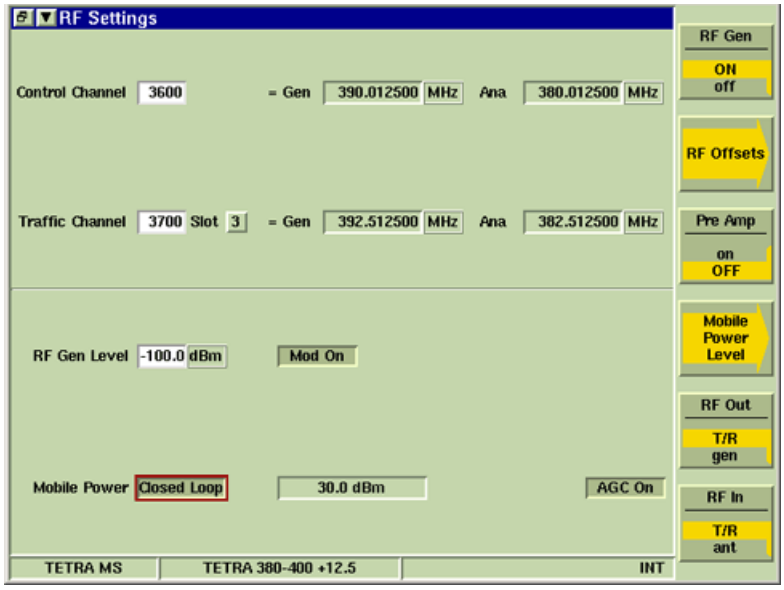

Fig. 5-22 TETRA MS RF Settings Tile - Channel Plan Selected

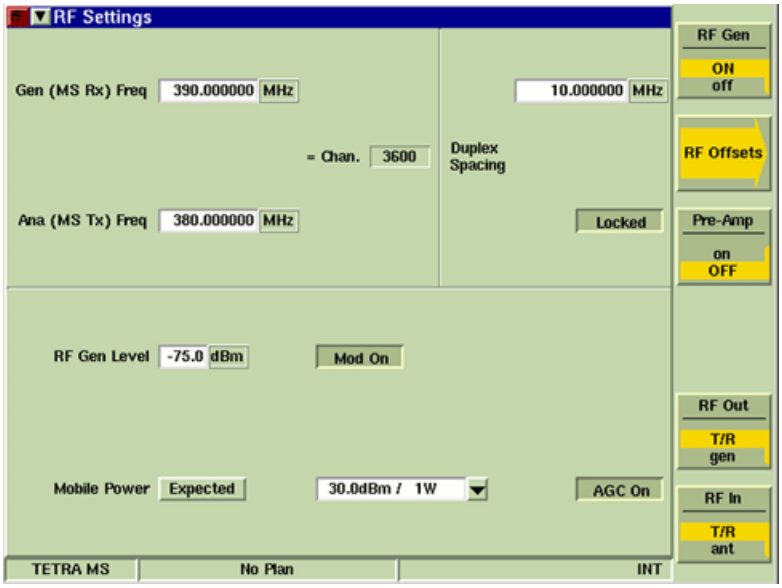

Fig. 5-23 TETRA MS RF Settings Tile - No Channel Plan Selected

5.9.1 Field/Soft Key Definitions

5.9.1.A Control Channel

When No Plan is selected on the Channel Plans Configuration Tile, this field specifies a Channel Number that sets the frequency of the Test Set's RF Generator and RF Analyzer when on the control channel.

Enter the required Channel Number in the settings box and press the ENTER Key. The RF Generator and RF Analyzer frequencies are displayed in the boxes to the right of the Control Channel Number.

NOTE	When No Plan is selected from the Channel Plan drop-down menu, the RF Generator Frequency and Analyzer Frequency specify the receiver and transmitter frequencies of the mobile under test in Hz. It is not normally possible to perform call set-up with a mobile if No Plan is selected. The Control Channel can be set to any value permitted by the selected Channel Plan. The Timeslot for the Control Channel is always Timeslot 1.

Verify Control Channel is set within the range that the mobile can receive, or to one of the specific values that the mobile recognizes if the mobile does not scan all channels of the band. The manufacturer or TETRA Network Operator supplying the mobile may need to be contacted to obtain this information.

5.9.1.B Traffic Channel and Timeslot

When No Plan is selected on the Channel Plan Configuration Tile, this field sets the Test Set's RF Generator Frequency and Analyzer Frequency when on a Traffic Channel (a call has been established). This value can be set to any value permitted by the selected System Type.

Enter the required Channel Number in the settings box and press the ENTER Key. The RF Generator Frequency and Analyzer Frequency are displayed in the boxes to the right of the Control Channel Number. The Timeslot for the Traffic Channel can be set to a value between 1 and 4. Verify that the value of the Traffic Channel is within the mobile's range.

5.9.1.B.1 Handoff

The Traffic Channel Number and timeslot can also be changed during a call. The Test Set sends a command to the mobile to instruct it to handoff to the new channel; the Test Set then changes to the new Channel Number and/or timeslot. This procedure can be used to check the RF performance of the mobile at different frequencies (Channel Numbers) without needing to Cleardown the call and set up another call. The Handoff instruction is recorded in the Protocol History Tile and the Operations/Status Tile.

NOTE	The ability to handoff during a call depends on the mobile's capabilities. The TETRA handoff protocol does not involve any form of acknowledgement from the mobile, so it is not possible for the Test Set to determine whether the handoff has been successful. Check to see that the Tx Measurements Tile indicates that transmitted bursts are being received from the mobile on the new Traffic Channel.

5.9.1.C RF Generator Frequency

When No Plan is selected on the Channel Plan Configuration Tile, this field is visible to allow user to set the RF Generator frequency for the downlink channel. The Channel Number closest in frequency to the specified value is displayed in the Chan. field.

5.9.1.D Analyzer Frequency

When No Plan is selected on the Channel Plan Configuration Tile, this field allows user to set the RF Analyzer frequency for the uplink channel. The Channel closest in frequency to the entered value is displayed in the = Chan. field.

5.9.1.E Duplex Spacing

This button is available when No Plan is selected on the Channel Plans Configuration Tile, and Locked is selected on the Duplex Spacing Locked/Unlocked option button.

If Channel Plan field is set to No Plan and the Locked/Unlocked option button is set to Unlocked, this field shows the Duplex Spacing between the downlink and the uplink channels.

If the Locked/Unlocked option button is set to Locked, changing the setting in this box also changes the setting of the Analyzer Freq setting so that it is offset from the RF Generator Frequency setting by the value specified in the Duplex Spacing setting box.

If set to Locked, a new value for either RF Generator Frequency or Analyzer Frequency can be entered and the other parameter is updated automatically to maintain the duplex spacing.

5.9.1.F RF Generator Level

The RF Generator Level parameter can be set to any value within the output range of the Digital Signal Generator. The default setting is -75 dBm.

Refer to the 3900 Platform Specifications operating parameters of the T/R Connector and GEN (Generator) Connector.

NOTE	If an RF Generator level offset is applied, the set output range is shifted by the amount of the Offset.

5.9.1.G Mobile Power

Defines the manner in which the Test Set adjusts parameters to manage the power level of the mobile. When the Test Set is not participating in a call Open Loop or Expected can be selected. When the Test Set is participating in a call Open Loop or Closed Loop can be selected.

5.9.1.H Open Loop

When Open Loop is selected, the Test Set sets its input gain to a value appropriate for the output expected from the mobile when the signal is received at the current RF Generator Level setting.

5.9.1.I Closed Loop

When Closed Loop is selected, a soft key sub-menu is displayed to allow user to configure the Test Set to instruct the mobile to change its power output in 5 dB increments.

5.9.1.J Expected

Allows the approximate power expected to be received from the mobile to be entered manually.

5.9.1.K Mod (Modulation)

Includes (ON) or Excludes (OFF) modulation on the carrier signal.

5.9.1.L AGC (Automatic Gain Control)

When AGC is turned ON, the Test Set adjusts the input gain to optimize the accuracy of power measurements.

5.9.1.M RF Gen Soft Key

Controls the status of the RF Signal Generator output.

5.9.1.N Pre-Amp Soft Key

The 3900 is equipped with an internal 15 dB broadband amplifier that affects the T/R Connector and ANT (Antenna) Connector. When Pre-Amp is turned ON, the 3900 has a typical noise figure of -9 dB leading to a noise floor level of approximately -140 dBm in the Spectrum Analyzer (RBW = 300 Hz) and approximately -126 dBm for the Inband Power Meter (IF = 6.25 kHz). Using the Pre-Amp feature increases the sensitivity of the 3900.

NOTE	When Pre-Amp is used, special attention is required; it is a broadband amplifier and could lead to saturation or compression problems in the receiver chain if the signal of interest is very low, but a strong out of band signal is present.

5.9.1.O RF Offsets Soft Key

Opens a soft key sub-menu that selects to Include or Exclude any set Analyzer or Generator Offset.

5.9.1.P RF Out Soft Key

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

5.9.1.Q RF In Soft Key

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

5.10 RX MEASUREMENTS TILE

The Receiver Sensitivity of the mobile may be tested using a BER measurement in which PRBS frames sent to the mobile by the Test Set are returned to it by the RF transmission from the mobile. The Test Set then compares the data that it received with the data that it sent. This requires the mobile to be in a special mode in which it sends back all the traffic frames that it receives. This mode may be enabled with the Test Set and mobile in T1 Test Mode, or with the Test Set and mobile in TT Loopback Mode.

In TETRA MS, mobile receiver testing is performed on the speech Traffic Channel using TT Loopback Mode after a mobile has performed a Test Mode Registration and a duplex call has been set up. Mobile receiver testing for other types of channels is supported by the TETRA MS T1 System using T1 Loopback Mode with the mobile in T1 Test Mode.

NOTE	T1 Test Mode or TT Loopback Mode may not be supported by mobile under test.

The Rx Measurements Tile shows the results of BER, RBER and MER measurements made on the receiver of the mobile under test. The mobile must support the TETRA Test Mode (TT) RF Loopback function to use this feature. It may be necessary to perform a Test Mode Registration before the RF Loopback function can be used.

After a mobile that supports TT Loopback has performed a Test Mode Registration (if required), it is necessary to set up a duplex call from or to the mobile, and to command the mobile into Loopback Mode (either BER TT Loopback or RBER TT Loopback). When a duplex call with Loopback enabled is not configured, the Rx Measurements Tile indicates Loopback Not On and does not show any measurements as shown in the example below.

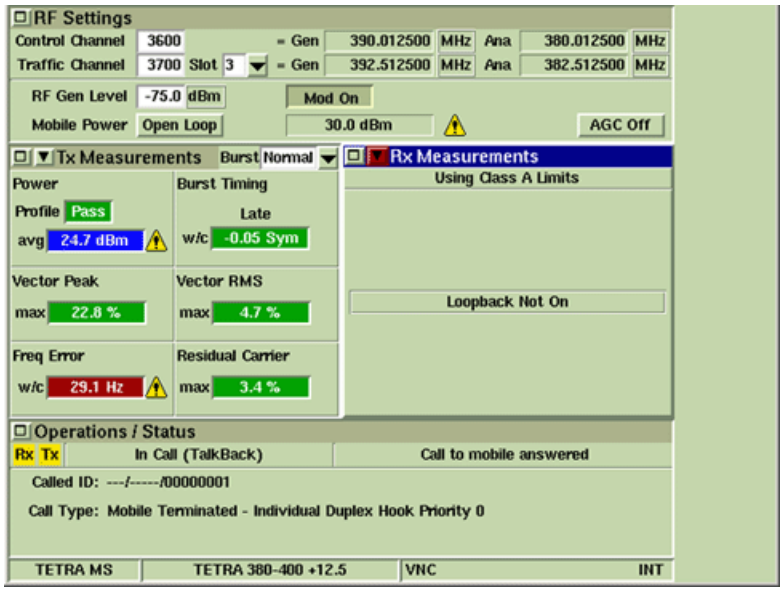

Fig. 5-24 TETRA MS Rx Measurements Tile - Loopback OFF

When the mobile is performing BER TT Loopback, the Rx Measurements Tile shows the BER results for the three different classes of bits in the TETRA speech frame. Class 0 bits have no protection and are likely to result in non-zero BER measurements at a higher RF Generator Level than the Class 1 and Class 2 bits, which have some error correction capability.

When the mobile is performing RBER TT Loopback, the Rx Measurements Tile shows the RBER results for the Class 0 and Class 1 bits in the TETRA speech frame, and the MER result for the Class 2 bits. In RBER TT Loopback, when the mobile detects errors in the Class 2 bits, it erases two complete speech frames and indicates this erasure in the Loopback data. Therefore, the RBER results for the Class 0 and Class 1 bits do not include any speech frames in which Class 2 bit errors resulted in erasure.

TETRA Mobile receivers are specified as one of three receiver performance classes (A, B or E) with different BER/MER performance requirements. Different limits can be set for the different Receiver Classes. The Test Set applies the limits according to the Receiver Class specified in the Mobile Parameters Configuration Tile. If the mobile has performed Test Mode registration, it may be possible to obtain the Receiver Class automatically (if set to Use Reported). The Rx Measurements Tile indicates which set of limits it is using.

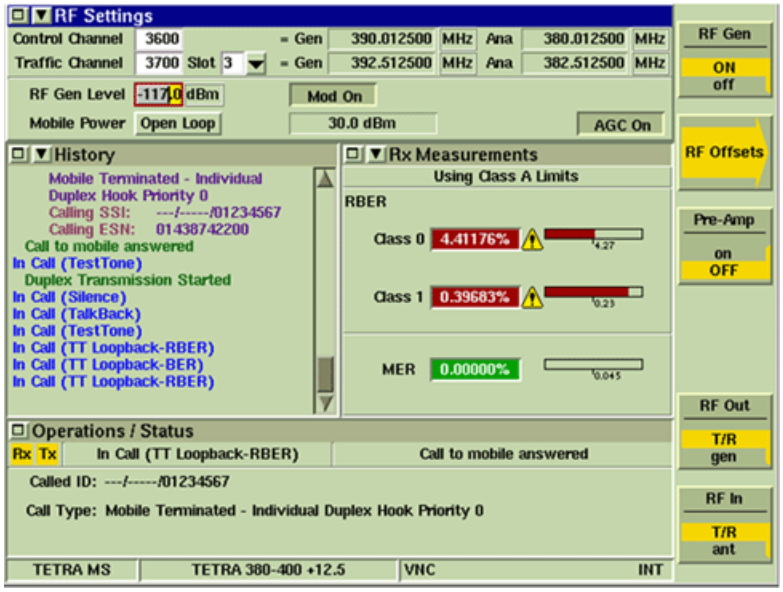

Fig. 5-25 TETRA MS Rx Measurements Tile - Minimized View

The maximized Rx Measurements Tile allows the sample size to be specified for each measurement. To the right of the sample size is an indication of the time taken to acquire the specified number of samples in the format hh:mm:ss. The maximized Tile also indicates the total number of bits (or messages) acquired and the number of bits (or messages) that were in error. This function helps locate infrequent, discrete error events.

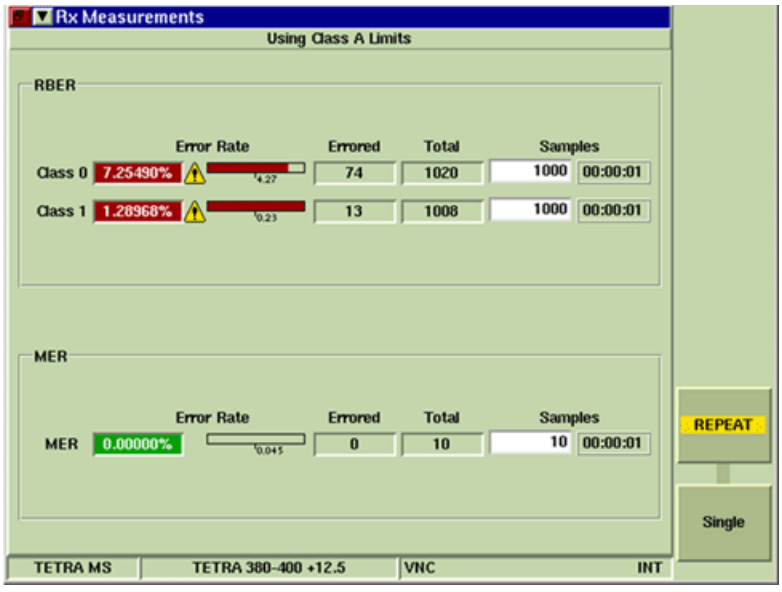

Fig. 5-26 TETRA MS Rx Measurements Tile - Maximized View

5.11 TX MEASUREMENTS TILE

During registration, call set up, or while transmitting during a call, the mobile transmits bursts to the Test Set allowing the transmitter RF parameters to be measured. These parameters are displayed on the Tx Measurements Tile, or they may be viewed in detail on any of the Power Measurements Tiles or Modulation Accuracy Tiles.

> **NOTE** Measurements can only be made on bursts with a valid training sequence.

The Burst Type selection configures each Tile for making measurements on only one type of burst (Normal or Control). Duplex call set-up is recommended, if supported by the mobile, because it avoids the need to hold the mobile's PTT button ON. Simplex calls may also be subject to limited transmission periods due to autonomous call timers or transmit timers within the mobile. The Tx Measurements Tile shows the results of measurements made to the signal received from the mobile under test. The results are given in numeric and graphical form.

The results are given in numeric and graphical form. Fig. 5-27 shows the minimized Tile grouped on the display; Fig. 5-28 shows the Tile in maximized view.

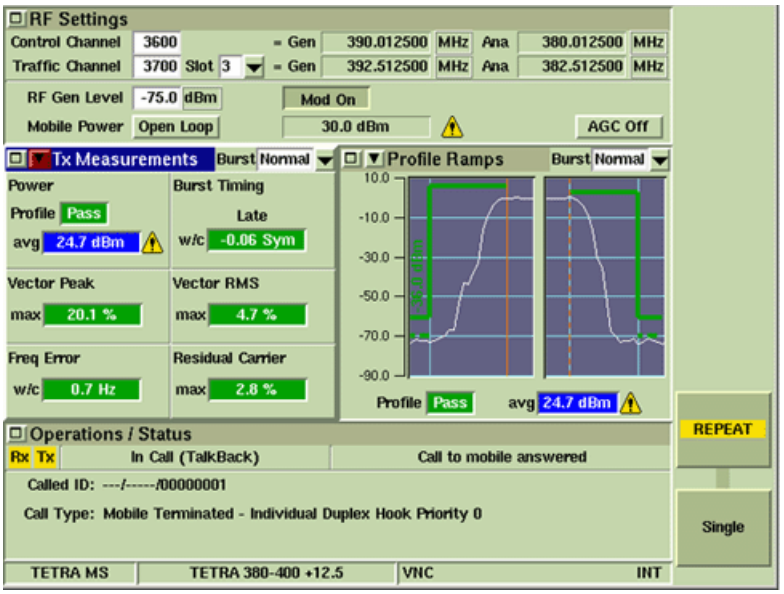

Fig. 5-27 TETRA MS Tx Measurement Tile - Minimized View

5.11.1 Field Definitions

5.11.1.A Power

The Power Measurement shows the average power during the measured burst. This measurement is taken over the usable part of the burst (all modulation symbols SN0 ~ SNmax) measured at the symbol points through a TETRA filter (Root Nyquist, a = 0.35).

Available units of measurement are dBm or W.

5.11.1.B Burst Timing

The Burst Timing, or frame alignment measurement, shows the symbol timing of the mobile's bursts measured with respect to the Test Set signal.

The units of measurement are Symbols with a range of -9.99 to +9.99. A positive value indicates a burst that is early with respect to the Test Set signal.

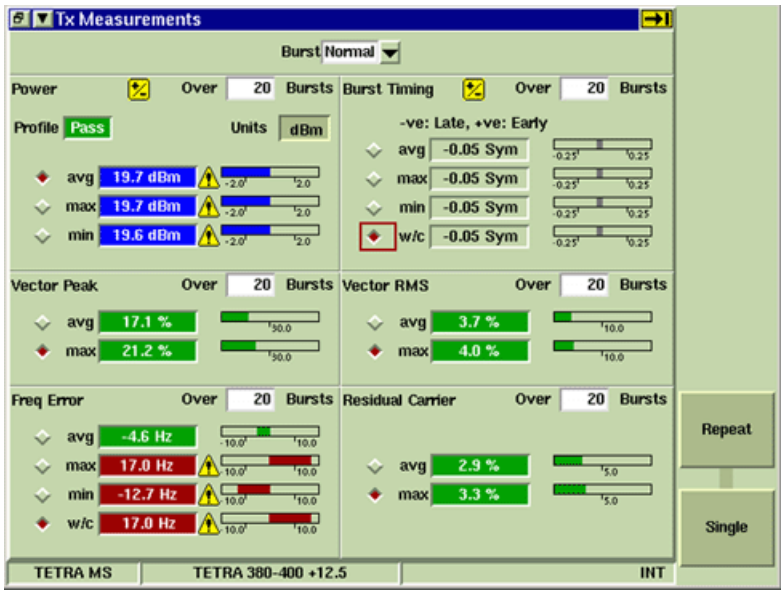

Fig. 5-28 TETRA MS Tx Measurement Tile - Maximized View

5.11.1.C Vector Errors

The Vector Error Measurements show the vector error of the received symbols with respect to the ideal symbol points for the burst. These measurements are taken over the usable part of the burst, measured at the symbol points through a TETRA filter. The measurements are expressed as a percentage of the mean amplitude.

5.11.1.C.1 Vector Peak

The Vector Peak measurement is the vector error of the symbol with the highest error.

5.11.1.C.2 Vector RMS

The Vector RMS measurement is the root mean squared of all the symbols.

5.11.1.C.3 Residual Carrier

The Residual Carrier measurement is the mean residual carrier magnitude.

5.11.1.D Freq Error

The Freq Error measurement shows the difference between the frequency of the received signal and the analyzer frequency of the Test Set. This measurement is taken over the usable part of the burst measured at the symbol points through a TETRA filter.

5.11.1.E Results

The results of the measurements are shown numerically and as bar graphs when Tile is maximized. The results of measurements are presented as different criteria for different tests, to give the most appropriate measurements. The results are obtained by making measurements on all of the symbols over the range of the number of samples (bursts) specified for the test. These criteria are listed below.

avg	Average value of all of the samples measured.
max	Maximum value of the burst that produced the highest result from the number of samples measured.
min	Minimum value of the burst that produced the lowest result from the number of samples measured.
w/c	Worst Case value of the burst that produced the lowest or highest result from the number of samples measured.

5.12 MOBILE REGISTRATION

Registering a mobile with the Test Set indicates that the frequency and system parameters in the Test Set correspond to the mobile's operating parameters. In addition, mobile registration allows the Test Set to capture the Short SSI and the selected GSSI of the mobile which are required to set up a call to the mobile. The SSI and GSSI can be also be configured manually on the Mobile Parameters Configuration Tile.

To register the Mobile:

1. Select Base Services from the TETRA MS Configuration menu.
2. Set the Power On Registration and Power Off De-registration parameters to Required. This sets the relevant System Information parameters to command the Mobile to register at power-on and de-register at power-off.

The mobile should register automatically when it is powered on and locates the simulated base station signal from the Test Set. This may take as long as 30 seconds from power-on. Upon registration, the SSI of the mobile and its selected GSSI are displayed. The reported SSI and GSSI parameters are found on the Mobile Parameters Configuration Tile. These parameters are updated to the values received from the mobile.

The mobile may attach group identities during or after registration, and may subsequently change the selected GSSI. These parameters can be viewed in detail on the Protocol Groups Tile.

If the mobile does not register with the Test Set and the initial configuration parameters have been set correctly, failure to register may be because the RF Generator Level of the Test Set is insufficient for the mobile. Adjusting the Test Set's RF Generator Level setting on the RF Settings Tile may correct the problem; however, this may affect the power level chosen by the mobile.

Failure to register may also be because the signal transmitted by the mobile is outside the capture range of the Test Set's receiver. The Test Set is not able to predict the power level the mobile will use, since this depends on the power class of the mobile and whether it transmits at its maximum power or uses open loop power control to decide the power level to use. Adjusting the Mobile Power setting on the RF Settings Tile to the level the mobile is expected to use.

The Mobile should automatically de-register when it is powered down.

NOTE	The Other Protocol Functions/Commanded Registration function can only be used to request information from a mobile that is already registered to the Test Set. If the mobile does not register with the Test Set at power on, pressing Power On Registration does not cause the mobile to register with the Test Set.

5.12.1 Registration Information

The mobile provides information to the Test Set during registration. The extent of this information depends on the type of registration requested. Some of the mobile's information is displayed on the Operations/Status Tile, other information pertaining to the mobile is displayed on Tiles specific to the information.

Only the ITSI, GSSI and class mark information are displayed unless an extended (TT Test Mode) registration has taken place.

5.12.1.A ITSI

The Individual TETRA Subscriber Identity, displayed in decimal not hexadecimal, consisting of the Mobile Country Code (MCC), Mobile Network Code (MNC) and the Short Subscriber Identity (SSI). The MCC and MNC are only sent during a commanded registration.

5.12.1.B TEI

TETRA Equipment Identity is the mobile's hardware serial number, consisting of the Type Approval Code (TAC), Final Assembly Code (FAC), Serial Number (SNR) and Spare Digit (SPR). This information is only displayed if an extended (TT Test Mode) registration has taken place.

5.12.1.C GSSI

The Group Short Subscriber Identity for the selected group (Class of Usage 5) is displayed in decimal or as No Group Selected. If an additional group is attached (Class of Usage other than 5) or a group is detached, it is displayed separately.

Some Mobiles may attach multiple additional groups, in which case the Test Set displays only the most recent attached or detached groups beside the selected group. All attached groups (up to 40) can be displayed on the Protocol Groups Tile.

Each attached group is shown in decimal and HEX.

The class of usage of each group is also shown, e.g. Selected, Normal Priority, Low Priority.

Changing a currently selected group, altering the priority of a group, detaching a group or attaching a group updates the displayed list of groups accordingly.

5.12.1.D Power Class

Defines the mobile's maximum power level. This parameter is displayed only if an extended (TT Test Mode) registration has taken place. If the mobile does not report its power class correctly, select the correct Used Fixed on the Power Class section of the Mobile Parameters Configuration Tile and enter the correct Power Class value. Refer to the table in the section titled Mobile Transmitter Power Levels for mobile transmitter power levels.

5.12.1.E Mobile Transmitter Power Levels

Control Level	Nominal Output Power	Comments
MS PL1	45 dBm / 31.6 W	Power Class 1 Max Power
MS PL1L	42.5 dBm / 17.8 W	Power Class 1L Max Power
MS PL2	40 dBm / 10 W	Power Class 2 Max Power
MS PL2L	37.5 dBm / 5.62 W	Power Class 2L Max Power
MS PL3	35 dBm / 3.16 W	Power Class 3 Max Power
MS PL3L	32.5 dBm / 1.78 W	Power Class 3L Max Power
MS PL4	30 dBm / 1 W	Power Class 4 Max Power
MS PL4L	27.5 dBm / 562 mW	Power Class 4L Max Power
MS PL5	25 dBm / 316 mW	
MS PL6	20 dBm / 100 mW	
MS PL7	15 dBm / 31.6 mW	

5.12.2 Receiver Class

Defines the receiver performance of the mobile. Receiver Classes are A, B or E.

The parameter is only displayed when extended (TT Test Mode) registration has taken place.

If the mobile does not report its Receiver Class correctly, select Use Fixed in the Receiver Class section of the Mobile Parameters Configuration Tile and enter the correct Receiver Class value.

5.12.3 Class Mark Information

The Mobile's Class Mark information is obtained during registration and is displayed on the Mobile Class Mark Tile. This Tile is accessed from the TEST Floating Menu by selecting Protocol, then Mobile Classmark.

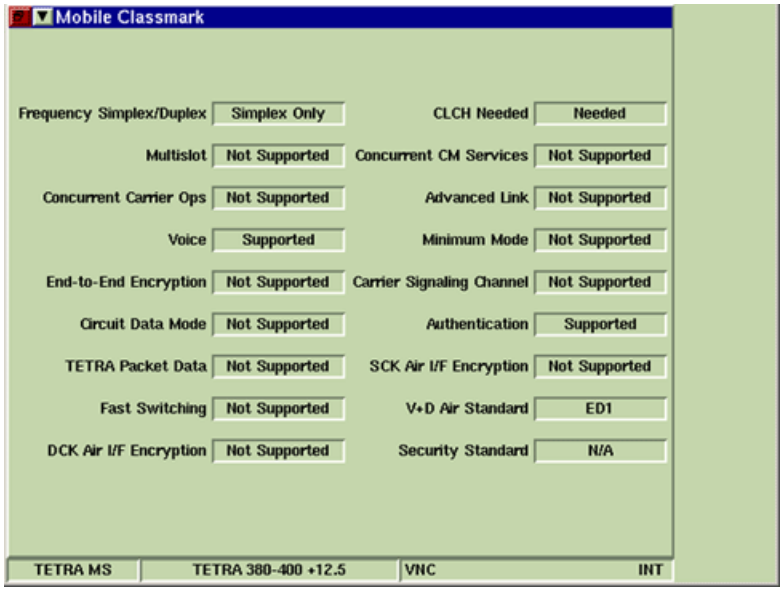

Fig. 5-29 TETRA MS Mobile Classmark Tile - Maximized View

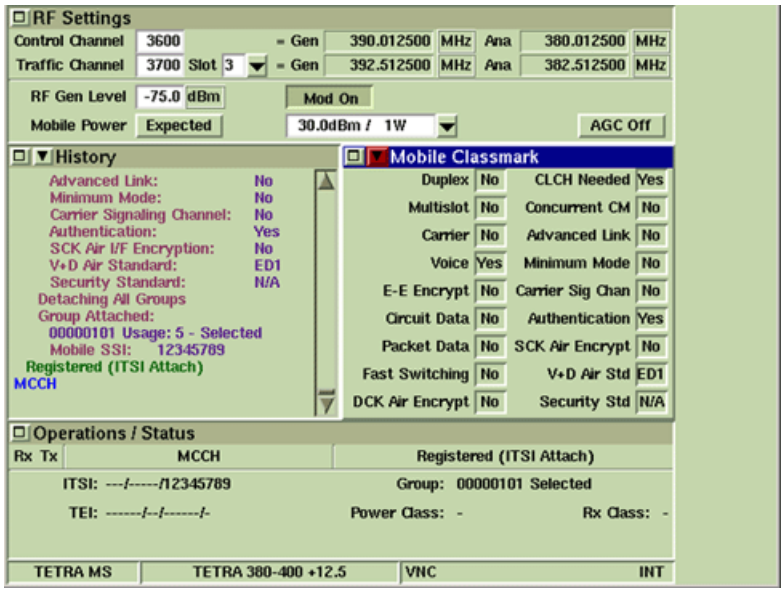

Fig. 5-30 TETRA MS Mobile Classmark Tile - Minimized View

5.13 SETTING UP CALLS TO AND FROM THE MOBILE

The Test Set supports group calls, private calls, phone and emergency type calls, and simplex and duplex calls. Not all TETRA Mobiles support all of these call types. TETRA Mobiles from different manufacturers may differ in their implementation of certain call functions, and may not necessarily be fully compatible with the Test Set for all of these call types. The Test Set is compatible with mobiles conforming to the TETRA MoU Interoperability Profile (TIP core services).

5.13.1 Mobile Originated Calls

To set up Mobile-Originated Calls, the relevant call type is selected on the mobile; user operations on the mobile cause signaling to be sent to the Test Set to set up a call. The 3900 supports the following Mobile-Originated Call types:

- Group Call
- Private Call (Individual Call)
- Telephone Call (PSTN, PABX or ISDN Call)
- Emergency Call

5.13.1.A Mobile Originated Group Call

A Mobile Originated Group Call has the following characteristics:

- Call is addressed to a group of TETRA users (point-to-multipoint)
- Simplex call only
- Direct set-up only
- Automatic cleardown by network

The following operations are necessary to initiate a group call from the mobile to the Test Set. This procedure may vary depending on the mobile's functionality.

STEP	PROCEDURE

1. Select the Operations/Status Tile on the Test Set.
2. Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
3. Verify mobile has attached a selected Group ID (GSSI) to the Test Set.
4. Verify mobile's selected Group ID (GSSI) is not No Group.
5. Verify mobile is in Group Mode, if it has a mode selection.
6. Verify mobile's display shows no dialed digits.
7. Press and hold the mobile's PTT switch.

The Operations/Status Tile indicates the type of call initiated, the call's status and the called Group ID (GSSI).

The mobile is initially transmitting. Depending on the mobile, it may be possible to cleardown the call from the mobile; otherwise the call can be cleared from the Test Set. The Test Set clears the call automatically after the Hang Timer expires if the mobile and Test Set are not transmitting.

NOTE	TETRA Mobiles set up group calls to a pre-selected group of TETRA users: therefore a number does not need to be dialed when initiating a group call. A TETRA Mobile selects the required group or No Group. The selected group is attached and indicated on the Test Set when registration is performed. When the group selection is altered the new selected group is attached and indicated on the Test Set. TETRA Mobiles can only set up group calls when a selected group is attached to the Test Set.

5.13.1.B Mobile Originated Private Call (Individual Call)

A Mobile Originated Private Call has the following characteristics:

- Call is addressed to an individual TETRA user (point-to-point)
- Can be simplex or duplex call
- Can be direct set-up or hook signaling

The ability to originate a simplex or duplex private call depends on the mobile under test and its program configuration. The use of direct set-up or hook signaling typically depends on the mobile configuration, but may be affected by user selection of Loud Mode (speaker) or Discreet Mode (ear piece) on the mobile. Use of duplex may automatically switch the mobile to use the ear piece instead of the speaker. The exact procedure depends on the mobile under test, but normally the following operations are necessary to initiate a private call from the mobile to the Test Set.

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
3.	Verify mobile is in Private Mode, if it has a mode selection.
4.	Key a valid called party individual SSI into the mobile.
5.	Perform the indicated operation according to the type of call in progress.
Simplex Call	
	If configured for direct set-up, press and hold the mobile's PTT switch.
Simplex Call	
	If configured for hook signaling, press and release the mobile's PTT switch.
Duplex Call	
	Press the mobile's key marked SEND (handset up) or Y (yes) or OK.
For Simplex Hook or Duplex Calls	
	Test Set may require user to press Answer or Reject soft key on the Test Set to answer the call.

The Operations/Status Tile indicates the type of individual call initiated, the call's status and the called ID (SSI). The SSI may differ from the dialed number, e.g. the mobile may add the dialed number to a base address. For a simplex call, the mobile is initially transmitting (direct set-up) or receiving (hook signaling). For a duplex call, the mobile is transmitting and receiving, and PTT operation is not required. The call can be cleared down from either the mobile or the Test Set.

NOTE	The mobile may be configured to only accept numbers within a certain limited range as valid SSI values for a private call. If unsure of what is acceptable, try a number that is close to the mobile's own SSI; e.g. alter the least significant digit. For some mobiles it may be necessary to prefix the SSI or make a menu selection to indicate that the number is a TETRA individual subscriber ID - refer to the mobile's operating instructions.

5.13.1.C Mobile Originated Telephone Call (PSTN Call or PABX Call or ISDN Call)

A Mobile Originated Telephone Call has the following characteristics:

- Call is addressed to an individual telephone user (point-to-point)
- Called user is accessed via the PSTN, PABX or ISDN gateway on the TETRA Network
- Normally duplex call for both users, but can be simplex call for the TETRA user
- Normally hook signaling for both users, but can be direct set-up for the TETRA user
- DTMF overdial for end-to-end signaling

The ability to originate a telephone call depends on the mobile under test and its program configuration. The use of direct set-up or hook signaling depends on the mobile configuration, but may be affected by user selection of Loud Mode (speaker) or Discreet Mode (ear piece) on the mobile. Use of duplex may automatically switch the mobile to use the ear piece instead of the speaker. The exact procedure depends on the mobile under test, but normally the following operations are necessary to initiate a telephone call from the mobile to the Test Set.

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
3.	Verify mobile is in Telephone Mode, if it has a mode selection.
4.	Key a valid called party telephone number into the mobile (refer to note below).
5.	Press the mobile's key marked SEND (handset up) or Y (yes) or OK, or if the mobile has none of these keys, briefly press and release PTT.

Simplex Hook or Duplex calls:

Test Set may require user to press Answer or Reject soft key on the Test Set to answer the call.

The Operations/Status Tile indicates the type of individual duplex hook signaling call initiated, the call's status and the called ID (SSI) of the TETRA Network's PSTN, PABX or ISDN gateway is shown, along with the telephone number of the called user on the PSTN, PABX or ISDN (the External Subscriber Number or ESN). For a duplex call, the mobile is transmitting and receiving, and PTT operation is not required. It may be possible to send DTMF signaling during a duplex telephone call. The call can be cleared down from either the mobile or the Test Set.

NOTE	The mobile may be configured to only accept numbers within a certain limited range as valid ESN values for a telephone call. If unsure of what is acceptable, try a number that is valid in the PSTN of the country for which the TETRA Mobile is configured, for example ten digits starting with zero. For some mobiles it may be necessary to prefix the ESN or make a menu selection to indicate that the number is a PSTN telephone number - refer to the mobile's operating instructions. For PABX calls, valid ESN values may be different, for example four digits not starting with zero.

5.13.1.D Mobile Originated Emergency Call

A Mobile Originated Emergency Call has the following characteristics:

- Call can be addressed to either an individual TETRA user or a group of TETRA users
- May be addressed to special emergency SSI (e.g. 16777214)
- Can be simplex or duplex call
- Can be direct set-up or hook signaling
- Emergency priority level 15, i.e., Pre-emptive Priority level 4

The ID of the called user(s) and the type of call that is set up are normally pre-programmed and are dependent on the configuration of the mobile for the requirements of a particular TETRA Network.

The mobile may be configured to recognize an emergency call as a special case and behave differently, for example by displaying EMERGENCY and over-riding the user setting of the volume control, or by activating the mobile's microphone and transmitter without requiring the user to press the PTT.

The following operations are necessary to initiate an emergency call from the mobile to the Test Set. Set up may vary depending on the mobile's functionality.

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
3.	Press the mobile's red emergency button (may need to press and hold the button briefly).

The Operations/Status Tile indicates the type of call initiated, the call's status and the called user ID (SSI or GSSI). For a simplex call the mobile may initially be transmitting or receiving depending on the configuration. It may or may not be possible to cleardown an emergency call from the mobile; normally the call can be cleared from the Test Set. An emergency group call is be cleared down automatically by the Test Set after expiry of the Hang Timer.

5.13.1.E Mobile Originated Call in Alerting State: Call Accept and Call Reject

When a hook signaling call is set up from the mobile to the Test Set, the Test Set enters the Alerting state, representing the period when the calling party is waiting for the called party to answer the call. During this period a called party alerting tone should be heard from the mobile. The Test Set can be configured to respond during the alerting state via the options in the Call Timers & Trunking Configuration Tile.

When the Test Set Answer Mode is set to Auto, the Test Set automatically simulates the called party answering the call after the defined Test Set Auto Answer Time (range 0 to 30 s). The call then enters the conversation state on the Traffic Channel. If Auto Answer is set with a time of 0 s, mobile originated calls go straight into conversation without delay, and a called party alerting tone may not be heard from the mobile.

When Test Set Answer Mode is set to Manual, the Test Set only answers the call if the Answer soft key is pressed. If the call is not answered, the mobile is likely to time out after a pre-set period and the Test Set indicates Released, expiry of mobile timer. The 3900 can also be configured to simulate the called party rejecting the mobile originated call by pressing the Reject soft key during the alerting state. The Answer and Reject soft keys can also be used with Test Set Answer Mode set to Auto if to set a long Test Set Auto Answer Time.

5.13.2 Mobile Terminated Calls

The following Mobile-Terminated Call Types are supported:

- The Mobile Terminated Message types supported by the Test Set are described in this section.

5.13.2.A Setting Up a Mobile Terminated Call

To set up mobile terminated calls:

STEP	PROCEDURE

1. Select the Operations/Status Tile on the Test Set.
2. Press the Call Mobile Soft Key.
3. Select the required call type by pressing the appropriate soft key. Configure the required parameters for the desired call type.

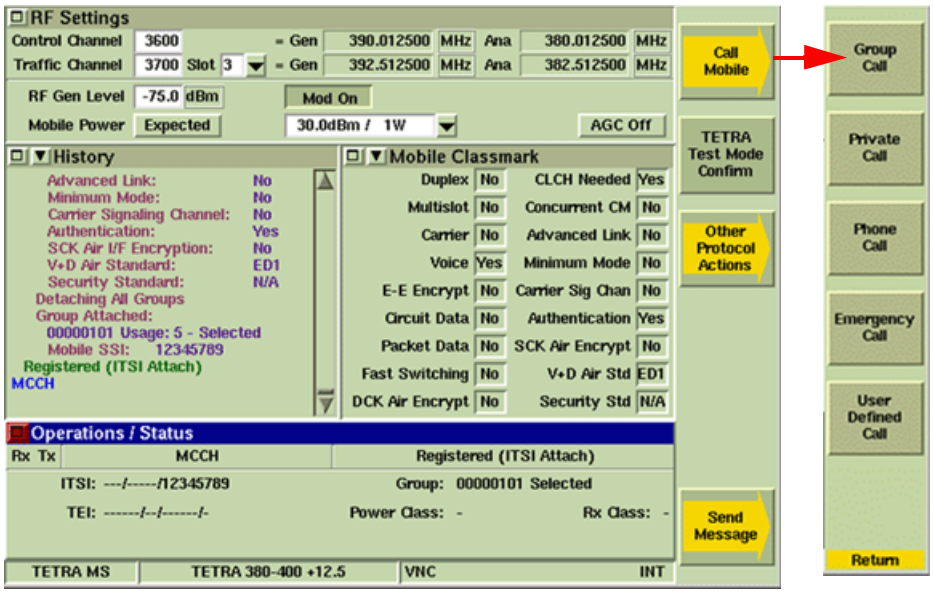

Fig. 5-31 TETRA MS Operations/Status Tile - Call Mobile Soft Keys

5.13.2.B Mobile Terminated Group Call

A Mobile Terminated Group Call has the following characteristics:

- Call is addressed to a group of TETRA users (point-to-multipoint).
- Simplex call only.
- Direct set-up only.
- Automatic cleardown by network.

The following configuration should be checked before setting up a group Call for the first time.

STEP	PROCEDURE
1.	Select the Call Types Configuration Tile and select Group in the Call Type field.
2.	Set the Priority as required. (Typically 00 = Priority Not Defined.)
3.	Set the Calling Party SSI as required.

The following operations are necessary to initiate a group call from the Test Set to the mobile. Set up may vary depending on the mobile's functionality.

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
3.	Verify mobile has attached a selected Group ID (GSSI) to the Test Set.
4.	Verify mobile's selected Group ID (GSSI) is not No Group.
5.	Verify mobile is in Group Mode, if it has a group selection.
6.	Do not alter the value of GSSI in the Mobile Parameters Configuration Tile (refer to Note 1 below).
7.	Press the Call Mobile Soft Key, then the Group Call Soft Key on the Operations/ Status Tile. No action is required on the mobile to answer the call, as it is direct set-up.

The Operations/Status Tile indicates the type of call initiated, the call's status and the called Group ID (GSSI). The mobile is initially receiving. It is normally possible for the mobile to leave but not to cleardown the group call, as it is not the call owner; the call can be cleared down from the Test Set.

The Test Set automatically clears down the call after expiry of the Group Call Hang Timer if the mobile and Test Set are not transmitting.

NOTE 1 Mobile terminated group calls are addressed to the Group ID (GSSI) value shown on the Mobile Parameters Configuration Tile, which is updated with the selected Group ID at registration or when a new group is selected on the mobile. If the mobile has attached other Group ID (GSSI) values in addition to the selected Group ID, it may be able to receive calls addressed to these groups. This depends on whether the mobile has been configured to scan for calls to other attached groups. In this case, the GSSI value in the Mobile Parameters Configuration Tile can be changed to one of the other Group ID values to test this behavior. TETRA

NOTE 2 Unlike an individual call, a group call is addressed to multiple mobiles that do not acknowledge the call set-up. Therefore, as the Test Set is not expecting an acknowledgement from the mobile, the Test Set always goes into conversation on the TCH whether or not there is a mobile under test that recognizes the Group ID.

5.13.2.C Mobile Terminated Private Call (Individual Call)

A Mobile Terminated Private Call has the following characteristics:

- Call is addressed to an individual TETRA user (point-to-point)
- Can be simplex or duplex call
- Can be direct set-up or hook signaling

The following configuration must be completed and verified before a call is initiated:

STEP	PROCEDURE
1.	Select the Call Types Configuration Tile and select Private in the Call Type field.
2.	Set Simplex or Duplex as required.
3.	Set the Signaling Type to Direct or Hook as required.
4.	Set the Priority box as required. Typically 00 = Priority Not Defined.
5.	Set the Calling Party SSI as required (refer to Note 1).

The ability to receive a simplex or duplex private call depends on the mobile under test and its program configuration. The ability to accept direct set-up or hook signaling depends on the mobile configuration, but may be affected by user selection of Loud Mode (speaker) or Discreet Mode (ear piece) on the mobile - a direct set-up call may be modified by the mobile under test to hook signaling.

The following operations are necessary to initiate a private call from the Test Set to the mobile. Set up may vary depending on the mobile's functionality.

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed). Do not alter the value of SSI in the Mobile Parameters Configuration Tile (refer to Note 1).
3.	Press the Call Mobile Soft Key on the Test Set, followed by the Private Call Soft Key.
4.	Perform the indicated operation according to the type of call in progress.

5.13.2.C.1 Simplex, direct set-up

No action is required on the mobile to answer the call.

5.13.2.C.2 Simplex, hook signaling

Press and hold the mobile's PTT switch to answer the call (refer to Note 2).

5.13.2.C.3 Duplex, hook signaling

Press the mobile's key marked SEND (handset up) or Y (yes) or OK to answer the call, or if the mobile has none of these keys, briefly press and release PTT (refer to Note 2).

The Operations/Status Tile indicates the type of individual call initiated, the call's status and the called ID (SSI). For a simplex call, the mobile is initially receiving (direct set-up) or transmitting (hook signaling). For a duplex call, the mobile is transmitting and receiving, and PTT operation is not required. The call can be cleared down from either the mobile or the Test Set.

NOTE 1 Mobile terminated private (individual) calls are addressed to the user ID (SSI) shown in the Mobile Parameters Configuration Tile, which is updated with the mobile's SSI at registration. TETRA Mobiles ignore individual calls addressed to other users.

NOTE 2 For some mobiles it may be necessary to select Private Mode before answering an individual call.

5.13.2.D Mobile Terminated Telephone Call (PSTN Call)

A Mobile Terminated Telephone Call has the following characteristics:

- Called TETRA user is accessed via the gateway (PSTN) from the external PSTN
- Normally duplex call for both users, but can be simplex call for TETRA user
- Hook signaling only
- DTMF overdial for end to end signaling

The following configuration must be completed and verified before a call is initiated:

STEP	PROCEDURE
1.	Select the Call Types Configuration Tile and in the Call Type box select Phone.
2.	Set the Priority as required. (Typically 00 = Priority Not Defined.)
3.	Set the CALLING PARTY ESN as required (refer to Note 3).

The ability to receive a simplex or duplex private call depends on the mobile under test and its program configuration. The ability to accept direct set-up or hook signaling depends on the mobile configuration, but may be affected by user selection of Loud Mode (speaker) or Discreet Mode (ear piece) on the mobile - a direct set-up call may be modified by the mobile under test to hook signaling.

The following operations are necessary to initiate a private call from the Test Set to the mobile. Set up may vary depending on the mobile's functionality.

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
3.	Do not alter the SSI value on the Mobile Parameters Configuration Tile. Refer to Note 1.
4.	Press the Test Set's Call Mobile Soft Key, followed by the Phone Call Soft Key.
5.	Press the mobile's key marked SEND (handset up) or Y (yes) or OK to answer the call, or if the mobile has none of these keys, briefly press and release PTT (refer to Note 4).

The Operations/Status Tile indicates the type of individual call initiated, the call's status and the called ID (SSI). Since this is a Duplex call, PTT operation is not required. It may be possible to send DTMF signaling during a duplex telephone call. The call can be cleared down from either the mobile or the Test Set.

NOTE 1	Mobile terminated telephone calls are addressed to the user ID (SSI) shown in the Mobile Parameters Configuration Tile, which is updated with the mobile's SSI at registration. TETRA Mobiles ignore individual calls addressed to other users, i.e. different SSI values.
NOTE 2	For some mobiles it may be necessary to select Phone Mode before answering a telephone call.
NOTE 3	If the Calling Party ESN matches a phone number entry stored in the mobile's directory, the mobile should display the name associated with the phone number as the calling party ID.
NOTE 4	Some mobiles are only capable of simplex operation and may change the duplex call to simplex or reject the duplex call. Press and hold the mobile's PTT switch to answer a simplex call.
NOTE 5	For mobile terminated telephone calls via a PABX or ISDN gateway, use User Defined call type and select the appropriate gateway as the calling party SSI.

5.13.2.E Mobile Terminated Emergency Call

A Mobile Terminated Emergency Call has the following characteristics:

- Call can be addressed to an individual TETRA user or a group of TETRA users
- Can be simplex or duplex call
- Can be direct set-up or hook signaling
- Emergency priority level 15, i.e. Pre-emptive Priority level 4

The following configuration must be completed and verified before a call is initiated:

STEP	PROCEDURE
1.	Select the Call Types Configuration Tile. Select Emergency from the Call Type drop-down menu.
2.	Set Group/Individual as required.
3.	Set Simplex/Duplex as required.
4.	Set the signaling Type to Direct or Hook as required.
5.	Set the Calling Party SSI as required.

The mobile may be configured to recognize an emergency call as a special case and behave differently, for example by displaying EMERGENCY and over-riding the user setting of the volume control, or by activating the mobile's microphone and transmitter without requiring the user to press the PTT.

The following operations are necessary to initiate an emergency call from the Test Set to the mobile. Set up may vary according to the mobile's functionality.

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
3.	roup call: Verify mobile has attached a selected Group ID (GSSI) to the Test Set.
4.	Group call: Verify mobile's selected Group ID (GSSI) is not NO GROUP. Do not alter the value of SSI or GSSI on the Mobile Parameters Configuration Tile.
5.	Press the Test Set Call Mobile Soft Key, followed by the Emergency Call Soft Key.
6.	Perform the indicated operation according to the type of call in progress.

Perform the indicated operation according to the type of call in progress.

5.13.2.E.1 Simplex, Direct Set-up

No action is required on the mobile to answer the call.

5.13.2.E.2 Simplex, Hook Signaling

Press and hold the mobile's PTT switch to answer the call.

5.13.2.E.3 Duplex, Hook Signaling

Press the mobile's key marked SEND (handset up) or Y (yes) or OK to answer the call, or if the mobile has none of these keys, briefly press and release PTT.

For a simplex call, the mobile initially receives (direct set-up) or transmits (hook signaling). For a duplex call, the mobile is transmitting and receiving, and PTT operation is not required. The ability to cleardown the emergency call from the mobile depends on the mobile. The call can be cleared down from the Test Set. An emergency group call is cleared down automatically by the Test Set on expiry of the hang timer.

5.13.2.F Mobile Terminated User Defined Call

A Mobile Terminated User Defined Call allows all mobile terminated call parameters to be set to the user's requirements. It can be used to define call types that are not covered by the four pre-defined call types (i.e., a simplex telephone call) or to provide an additional call type (i.e., a private duplex call when the pre-defined private call type is set to simplex).

The following configuration should first be carried out to define the required call type.

STEP	PROCEDURE
1.	Select the Call Types Configuration Tile. Select User Defined in the Call Type drop-down menu.
2.	Set Individual/Group as required.
3.	Set Simplex/Duplex as required.
4.	Set Signaling Type to DIRECT or HOOK as required.
5.	Set the Priority as required.
6.	Set the Calling Party SSI as required.
7.	Set the Calling Party ESN as required.
8.	Set ESN to Not Required if Calling Party ESN is not to be sent.

To configure the Test Set:

STEP	PROCEDURE
1.	Select the Operations/Status Tile on the Test Set.
2.	Press the Test Set Call Mobile Soft Key, followed by the User Defined Call Soft Key.
3.	Answer the call as required by the call type.

5.13.2.G Mobile Terminated Call in Alerting State: Caller ID, Call Modification, Call Reject and Call Abort

When a mobile terminated hook signaling call has been initiated from the Test Set to the mobile, the mobile is in the Alerting state, waiting for the call to be answered on the mobile. During this time the Operations/Status Tile indicates Mobile Alerting. The Test Set supplies a calling user ID to the mobile, as configured for the call type, and the mobile may show this number if it has caller ID display capability. It is also possible to be in this state if a direct set-up call has been initiated from the Test Set to the mobile, and the mobile performs Call Modification to a hook signaling call by indicating to the Test Set that it is in the Alerting state. There are six possible mobile and Test Set actions available during the Alerting state:

- The call is answered using the mobile's PTT switch (for a simplex call) or the mobile's key marked SEND (handset up) or Y (yes) or OK (for a duplex call). The Operations/Status Tile indicates In Call status.
- The mobile can auto-answer the call if it has this capability. This depends on the mobile's setting of Loud Mode (speaker) or Discreet Mode (ear piece), if applicable.
- Call can be auto-rejected by using the mobile's key marked END (handset down) or C (clear). The Test Set indicates MCCH/Call Rejected on the Operations/Status Tile.
- Call can be auto-rejected if the mobile has this capability and if it is not answered before expiry of the mobile's call set-up timer (typically 20 to 60 s duration). The Test Set indicates Call To Mobile Not Answered on the Operations/Status Tile.
- A call can be aborted using the Test Set Abort Call soft key, simulating the calling user abandoning the call (hanging up) when the called user does not answer. This may cause the mobile to indicate that there has been a missed call.
- The Test Set automatically aborts the call after 65 s if there is no answer or reject action.

5.13.2.H Mobile Terminated Call: Call Type, Call Modification and Call Rejection by Mobile

Any combination of Call Type parameters can be set in the Call Types Configuration Tile with the Call Type field set to User Defined. These parameters are used to determine the type of mobile terminated call that is set up from the Test Set to the mobile when the Call Mobile and User Defined Call soft keys are pressed. Some parameter combinations are invalid (for example Group with Duplex or Hook), and a TETRA Mobile does not necessarily support every valid combination of call type parameters.

When a non-supported call type is set-up, the mobile may modify the call to a type it does support. If this occurs the Test Set indicates the actual call type that is now taking place. Alternatively, the mobile may reject the call set-up, indicating that it does not support the service requested; in this case the Test Set indicates MCCH/Call To Mobile Rejected on the Operations/Status Tile.

5.14 PTT OPERATION

During a simplex call on a TETRA Network, only one user at a time may talk (transmit). Mobile users indicate their wish to talk by holding or releasing the PTT switch on the TETRA Mobile. The PTT switch does not directly control the mobile's transmitter - signaling is sent to the base station requesting or relinquishing permission to transmit.

5.15 SIMPLEX CALLS ON TEST SET

The Call Timers & Trunking Configuration Tile, Trunking Type parameter selects Transmission or Quasi-transmission as the Message Type for simplex calls. This setting is only effective when Conversation Mode is used in connection with the Call Timers & Trunking Configuration Tile. The Test Set Trunking Mode selection applies to Mobile Originated Calls as well as Mobile Terminated Calls.

The Call Timers & Trunking Configuration Tile, Transmit Mode parameter selects None, Timed, or Continuous as the Transmit Mode.

> **NOTE** The Test Set Transmit Mode parameter is only effective when the Test Set Trunking Type is set to Transmission Trunking. During Message Trunking and QTT, the Test Set Transmit Mode is Continuous regardless of the setting.

The following Test Set behaviors apply to Simplex Calls when the Test Set Transmit Mode is set to None and Trunking Mode is set to Transmission Trunking:

- When the mobile's PTT is released, the Test Set indicates Mode:MCCH Call Active and TxRx and the mobile is returned to the MCCH.
- PTT requests can be made by the mobile, but the Test Set does not simulate another user talking. If no PTT requests are made during a Group Call, the Test Set automatically clears down the call on expiry of the Group Call Hang Timer.
- The following Test Set behaviors apply to Simplex Calls when the Test Set Transmit Mode is set to Timed and Trunking Mode is set to Transmission Trunking:
- When the mobile's PTT is released, the Test Set indicates Mode:MCCH Call Active and TxRx and the mobile is returned to the MCCH.
- PTT requests can be made by the mobile, otherwise the mobile simulates another user talking on expiry of the Test Set Quiet Time. The Test Set indicates Mode:Conversation and TxRx. The Test Set simulates the other user releasing PTT on expiration of the Test Set Transmit Time.
- PTT requests can be made by the mobile. If no PTT requests are made during a group call, the Test Set automatically clears down the call on expiration of the Group Call Hang Timer.

The following Test Set behaviors apply when the Test Set Transmit mode is set to Continuous, whether the call is mobile originated or mobile terminated:

- When the mobile's PTT is released, the Test Set indicates TxRx. The Test Set immediately indicates to the mobile that another user has been granted transmit permission, and the mobile under test receives the audio on the Traffic Channel (Silence, Test Tone or Talk-back). The mobile under test continues to receive the audio on the Traffic Channel until either the PTT is pressed or the call is cleared down. In the case of Message Trunking with Conversation Mode Talk-back, previously stored speech is continuously replayed. When the mobile's PTT is pressed, the Test Set indicates TxRx and the mobile's transmitter is turned ON.

5.16 DTMF OVERDIAL

During a duplex telephone call, some mobiles are able to indicate DTMF signaling to communicate with automated equipment connected to the PSTN. This capability depends on the mobile's configuration and may be a user defined option in the mobile's settings menu.

If enabled, pressing any of the keys 0 to 9,*, # on the mobile's keypad causes these digits to be sent to the Test Set which displays, e.g., DTMF:123456789*0#. The mobile may be configured to indicate a DTMF tone for as long as the key is pressed, in which case the Test Set shows the digit in inverse video until the key is released.

5.17 SELECTION OF TRUNKING MODE

During a simplex call on a TETRA Network, only one user at a time may talk (transmit). Other users wishing to talk (transmit) may make transmission requests either before or after the user with permission to transmit has finished talking. Depending on the relative priorities of the users, a transmit request may either interrupt the transmitting user or be queued pending the end of transmission. When the transmitting user ceases transmission, another user granted permission to transmit or the call is silent (no user transmitting).

The Trunking Mode defines the system behavior when no user is transmitting. In the case of Message Trunking, the mobiles in the call remain assigned to the Traffic Channel until the call is cleared down. In the case of Transmission Trunking, the mobiles in the call are returned to the MCCH, with a Traffic Channel being assigned each time permission to transmit is granted. In the case of QTT, the mobiles remain on the Traffic Channel for a short period and are changed to the MCCH if no PTT requests are made within the QTT Hang Timer Period.

5.18 CALL CLEARDOWN

A call from the Test Set can always be cleared down using the Cleardown Soft Key. It is also often possible to cleardown a call from the mobile, depending on the mobile configuration and the type of call. The method for clearing down depends on the mobile. For a Mobile Originated or Mobile Terminated Group Call, the Test Set automatically clears down the call when the Call Hang Timer (Transmission Trunking, Timed or No Transmission) has expired.

NOTE	If an attempt is made to cleardown a Mobile Terminated Group Call from the mobile, this does not cleardown the call on the Test Set, as the mobile does not send any signaling to the Test Set in this case. The mobile simply leaves the Traffic Channel (TCH) and return to the MCCH. However, since the Test Set is still in Conversation Mode on the Traffic Channel, the mobile does not find the MCCH until the Cleardown Soft Key is pressed, which causes the Test Set to return to Mode: MCCH.

5.19 TRANSMIT / RECEIVE INDICATORS

An icon on the Operations/Status Tile indicates the current state of the mobile transmitter and the Test Set RF Generator. This is shown and explained in the examples.

When a simplex call has been set up on the Test Set, holding the mobile's PTT switch pressed requests transmit permission; the Test Set grants transmit permission to the mobile, the mobile then turns on its transmitter, and the Test Set indicates RxTx. Releasing the mobile's PTT switch relinquishes the transmit permission; the mobile turns off its transmitter and the Test Set indicates RxTx or RxTx. Refer to the following section titled Selection of Trunking Mode. PTT operation does not apply to duplex calls, since the mobile's transmitter and receiver are both active during the call (the Test Set indicates RxTx.)

NOTE	For simplex calls, mobiles are normally configured with a transmit timer, typically of one minute duration. If the PTT switch is held pressed for longer than this period, the mobile autonomously ceases transmission as if the user had released the PTT switch. To avoid transmission time-out when testing a TETRA Mobile, VIAVI recommends setting up a duplex call (if possible) to examine the mobile transmitter measurements in detail. Using duplex also avoids the need to hold the mobile's PTT switch pressed during transmitter measurements.

Fig. 5-32 Operations/Status Tile - Rx/Tx State Icon

5.19.1 Quiet Indicator

Neither the Test Set or mobile is transmitting. This may be CALL ACTIVE or either FACCH (Message Trunking) or MCCH (Transmission Trunking) or NO CALL in progress (on MCCH).

5.19.2 Transmit Indicator

Tx Indicator means the mobile is transmitting to the Test Set in a simplex call.

5.19.3 Receive Indicator

Rx Indicator means the mobile is receiving a simplex call being transmitted by the Test Set.

5.19.4 Duplex Indicator

Rx / Tx Indicators mean the mobile and Test Set are both transmitting.

5.20 STATUS AND SHORT DATA (SDS) MESSAGES

5.20.1 Mobile Originated Status and Short Data (SDS) Messages

For Mobile Originated Messages, the relevant Message Type is selected on the mobile by the user. The Mobile Originated Message Types supported by the Test Set are described in this section.

5.20.2 Status Messages

Status Messages are displayed on the Operations/Status Tile in the Current Events box and in the Miscellaneous message area, as shown in Fig. 5-33. The messages that are displayed in these areas are mentioned throughout the remainder of the Status and Short Data (SDS) Messages section.

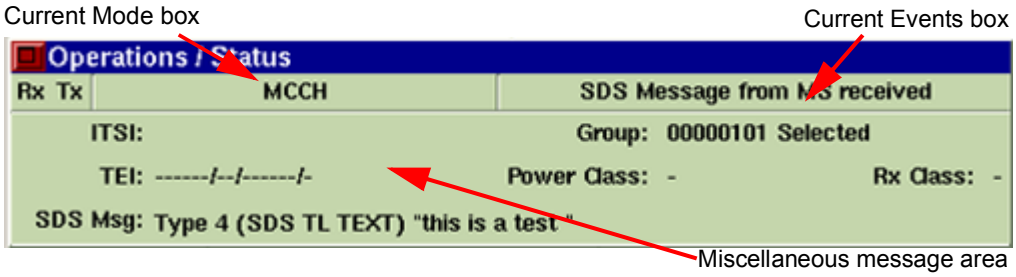

Fig. 5-33 TETRA MS Operations/Status Tile - Status Message Areas

5.20.2.A Mobile Originated Status Message

A Mobile Originated Status Messages has the following characteristics:

- 16-bit number with pre-defined meaning.
- Message is addressed to an individual TETRA user or a group of TETRA users.

The ability to originate a Status Message depends on the mobile under test and its program configuration.

The following operations are necessary to send a Status Message from the mobile to the Test Set. Set up may vary according to mobile functionality.

STEP	PROCEDURE
1.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2.	Verify Test Set is in MCCH mode or that it is in a call.
3.	Select STATUS using the mobile's soft keys and menu functions.
4.	Select a pre-coded Status Message or enter a status number on the mobile.
5.	Enter or select an individual or group message destination address on the mobile.
6.	Send the Status Message by pressing the appropriate key on the mobile.

The mobile may indicate that the Status Message has been successfully sent. The Test Set indicates on the Operations/Status Tile the numerical value of the Status Message (in hexadecimal and decimal), and the type of Status Message that has been received, in the format shown below.

In the Miscellaneous message area:

Status Msg: xxxx, (ddddd), ccccccccccc

With x being HEX digits, d being decimal digits and c being text characters making up the message type text. The destination SSI or GSSI of the Status Message is shown by selecting the green envelope icon.

Status Messages within the range of 8000 - EFFF HEX (32768 - 61439) are defined by network operators or user applications. Other Status Message values are for system use. Some of these values have standard defined meanings as shown in the following table:

5.20.2.A.1 Displayed Status Values

HEX Value	Decimal Value	Text Indicated by Test Set	Explanation
0000	0	EMERGENCY STATUS	May precede an emergency call
0001	1	RESERVED FOR TETRA	Base station fall back
0002 to 7BFF	2 to 31743	RESERVED FOR TETRA	Reserved for future definition in the TETRA standard.
7C00 to 7CFF	31744 to 31999	TEXT PROTOCOL 000 to TEXT PROTOCOL 255	SDS-TL message number nnn was not understood by the receiving MS
7D00 to 7DFF	32000 to 32255	TEXT MEM FULL 000 to TEXT MEM FULL 255	Text message number nnn could not be stored by the receiving MS
7E00 to 7EFF	32256 to 32511	TEXT RECEIVED 000 to TEXT RECEIVED 255	Text message number nnn received by the MS
7F00 to 7FFF	32512 to 32767	TEXT CONSUMED 000 to TEXT CONSUMED 255	Text message number nnn read by the MS user
8000 to EFFF	32768 to 61439	RESERVED FOR USER	Values defined by user applications
F000 to FDFF	61440 to 65023	RESERVD FOR SYSTEM	Reserved for future system definition
FE00	65024	GENERAL STATUS ACK	Status Message received by MS
FE01	65025	GENERAL STATUS NO ACK	Negative acknowledgement. (SwMI error code)
FE02	65026	NOT AUTHORISED	SwMI error code
FE03	65027	UNKNOWN ADDRESS	SwMI error code
FE04	65028	NO DESTINATION	SwMI error code
FE05	65029	DEST NOT REACHABLE	SwMI error code
FE06	65030	UNAUTH DESTINATION	SwMI error code
FE07	65031	DESTINATION BUSY	SwMI error code
FE08	65032	VALUE OUT OF RANGE	Status Message received by MS outside the range of defined values
FE09 to FE1F	65033 to 65055	RESERVD FOR SYSTEM	Reserved for future definition of system error codes
FE20 to FEEF	65056 to 65263	RESERVD FOR SYSTEM	Reserved for future definition
FEF0	65264	TX INHIBIT ON	RF sensitive area use
FEF1	65265	TX INHIBIT OFF	RF sensitive area ended
FEF2 to FEF5	65266 to 65269	RESERVD FOR SYSTEM	Reserved for future system definition
FEF6	65270	NORMAL AL CALL REQ	MS requests system to set up an ambience listening call
FEF7	65271	EMERG AL CALL REQ	MS requests system to set up an emergency ambience listening call
FEF8	65272	SCANNING OFF	MS is not scanning groups
FEF9	65273	SCANNING ON	MS is scanning groups
FEFA	65274	ENTRY REQUEST	MS wants to be a member of a group
FEFB	65375	RESERVD FOR SYSTEM	Reserved
FEFC	65276	URGENT CALLBACK	Urgent call-back request
FEFD	65277	SELECTIVE ALERT	Notification of important call
FEFE	65278	RESERVD FOR SYSTEM	reserved
FEFF	65279	CALLBACK REQUEST	Call-back request

5.20.2.B Mobile Originated Short Data (SDS) Message

A Mobile Originated Short Data Messages has the following characteristics:

- Type 1: 16-bit number
- Type 2: 32-bit number
- Type 3: 64-bit number
- Type 4: variable length Text Message or other SDS-TL application
- Message is addressed to an individual TETRA user or a group of TETRA users

The ability to originate a Status Message depends on the mobile under test and its program configuration.

The following operations are necessary to send a Status Message from the mobile to the Test Set. Set up may vary according to mobile functionality.

STEP	PROCEDURE

1. Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2. Verify Test Set is in MCCH mode or that it is in a call.
3. Select STATUS using the mobile's soft keys and menu functions.
4. Select a pre-coded Status Message or enter a status number on the mobile.
5. Enter or select an individual or group message destination address on the mobile.
6. Send the Status Message by pressing the appropriate key on the mobile.

The mobile may indicate that the Status Message has been successfully sent. The Test Set indicates on the Operations/Status Tile the numerical value of the Status Message (in hexadecimal and decimal), and the type of Status Message that has been received, in the format shown below.

In the Miscellaneous message area:

Status Msg: xxxx, (ddddd), ccccccccccc

With x being HEX digits, d being decimal digits and c being text characters making up the message type text. The destination SSI or GSSI of the Status Message is shown by selecting the green envelope icon.

Status Messages within the range of 8000 - EFFF HEX (32768 - 61439) are defined by network operators or user applications. Other Status Message values are for system use. Some of these values have standard defined meanings as shown in the following table:

5.20.2.C Type 1, 2 and 3 Messages

The Test Set indicates the numerical value (in hexadecimal) and the type of short data message that has been received. Short data message types are indicated as follows:

- SDS Msg: Type 1 xxxx (4 HEX characters).
- SDS Msg Type 2 xxxxxxxx (8 HEX characters).
- SDS Msg Type 3 xxxxxxxxxxxxxxxx (16 HEX characters).

The destination SSI or GSSI of the SDS message is shown by selecting the yellow envelope icon.

5.20.2.D Type 4 Messages

SDS Type 4 Messages are of variable length and use the SDS Transport Layer (SDS-TL) protocol to identify their content and request delivery reports. All SDS Type 4 Messages should contain at least a minimal 8-bit Protocol identifier as specified in ETSI EN 300 392-2 Clause 29.

The Test Set provides a minimal single line display of the form SDS Msg: Type 4 (xxx) xxxxxx when any SDS type 4 Message is received. Select the yellow envelope icon to display the full message content.

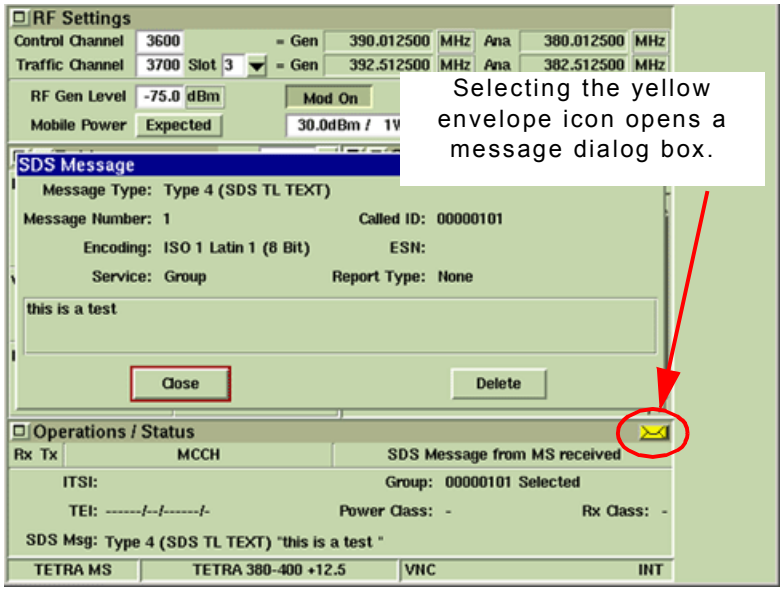

Fig. 5-34 TETRA MS - SDS Message Tile

5.20.2.D.1 Message Type

Indicates whether the message is identified as an SDS-TL Text Message. (INDIVIDUAL) or (GROUP) whether the message is sent to an SSI or a GSSI.

For other SDS-TL Message Types the SDS-TL protocol identifier is shown as a HEX value.

5.20.2.D.2 Coding Scheme

Indicates whether the text message was sent using 8-bit TETRA standard coding or 7-bit GSM compatible coding.

5.20.2.D.3 Report Request

Indicates the report type requested by the mobile (received, consumed or none). The Test Set sends the requested report type as a short report.

5.20.2.D.4 Message Number

Identification number of the message. The Test Set includes this number in the message report (if requested).

The Message Text box shows the text message sent by the mobile, up to 160 characters. For non-text messages this box shows up to 80 HEX bytes of data sent by the mobile.

5.20.2.D.5 Called ID

Shows the SSI (individual) or GSSI (group) to which the message was sent.

5.20.3 Mobile Terminated Status and Short Data (SDS) Messages

The Mobile Terminated Message types supported by the Test Set are described in this section.

5.20.3.A Mobile Terminated Status Message

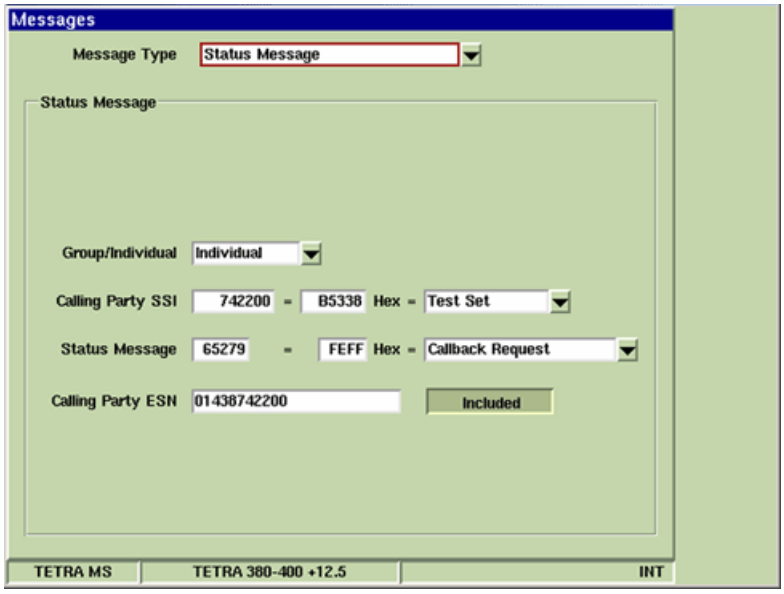

Fig. 5-35 TETRA MS Status Message Configuration Tile

A Mobile Terminated Status Message has the following characteristics:

- 16-bit number with pre-defined meaning.
- Message is addressed to an individual TETRA user or a group of TETRA users

The following operations are necessary to send a Status Message from the Test Set to the mobile. Set up may vary according to the mobile's functionality.

STEP	PROCEDURE

1. Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2. Verify Test Set is in MCCH mode.
3. Select the Messages Configuration Tile and select Status Message from the Message Type drop-down menu.
4. Set the following parameters as required:

- Individual or Group
- Calling Party SSI
- Status Message value
- Calling Party ESN value (if required)
- Included or Not Included

5. Select the Operations/Status Tile on the Test Set and press the Send Message Soft Key followed by the Status Message Soft Key.

The mobile may indicate that the Status Message has been received and the message and calling party address should be displayed. The Test Set indicates on the Operations/ Status Tile that the message has been sent and the numerical value of the Status Message (in hexadecimal and decimal), in the format shown below.

In the Current Events box:

Sending Status Message to MS

followed by:

Status Message from MS received or Status/SDS sent to MS failed

In the Miscellaneous message area:

Status Msg: FE00, (65024) General Status Acknowledge

Full details are recorded in the Protocol History Tile.

5.20.3.B Mobile Terminated Short Data (SDS) Message Types 1, 2 and 3

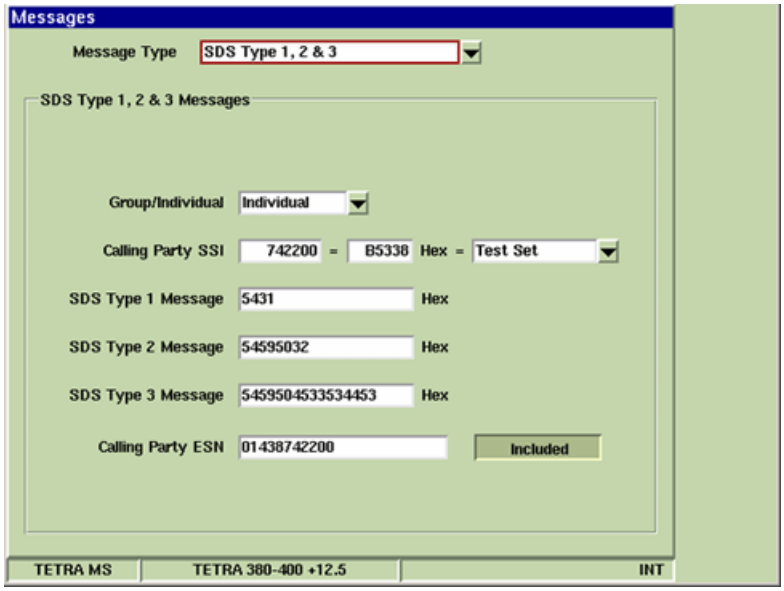

Fig. 5-36 TETRA MS SDS Types 1, 2, and 3 Message Tile

Mobile Terminate Short Data Message Types have the following characteristics:

- Type 1: 16-bit number
- Type 2: 32-bit number
- Type 3: 64-bit number
- Message is addressed to an individual TETRA user or a group of TETRA users

The ability to receive a Short Data Message depends on the mobile under test and its program configuration. Type 4 is more commonly supported than Types 1, 2 and 3.

The following operations are necessary to send a Short Data Message from the Test Set to the mobile. Set up may vary according to the mobile's functionality.

STEP	PROCEDURE

1. Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2. Verify Test Set is in MCCH mode.
3. Select the Messages Configuration Tile and select SDS Type 1, 2 & 3 from the Message Type drop-down menu.
4. Set the following parameters as required:
   - Individual or Group
   - Calling Party SSI
   - SDS Type 1, 2 or 3 Message
   - Calling Party ESN value (if required)
   - Included or Not Included
5. Select the Operations/Status Tile on the Test Set and press the Send Message Soft Key.
6. Press the Type 123 SDS Messages Soft Key followed by either the SDS Type 1 Message or SDS Type 2 Message or SDS Type 3 Message Soft Keys.

STEP	PROCEDURE

The mobile may indicate that the SDS Message has been received and the message and calling party address should be displayed. The Test Set indicates on the Operations/ Status Tile that the message has been sent.

In the Current Events box.

Sending SDS Type 1 Msg to MS (or Type 2 or Type 3)

followed by:

Status/SDS sent to MS

Full details are recorded in the Protocol History Tile.

5.20.3.C Mobile Terminated Short Data (SDS) Message Type 4 - SDS-TL Text Message

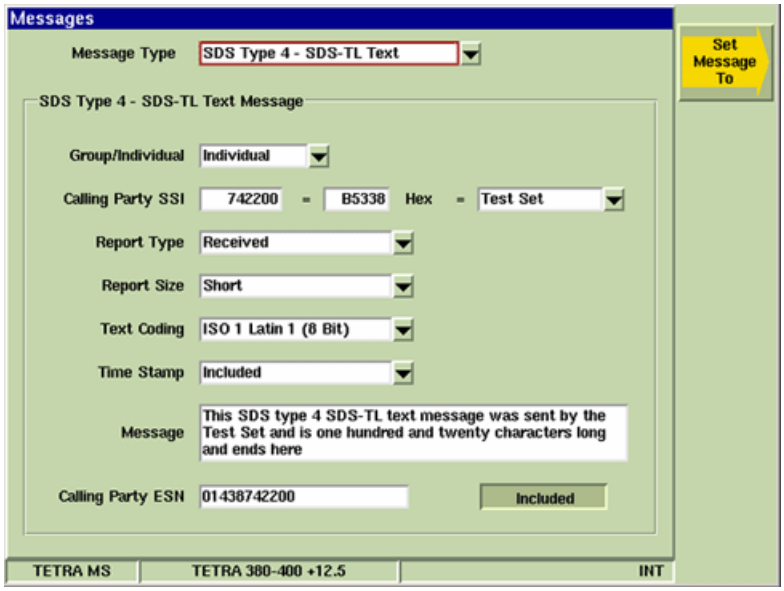

Fig. 5-37 TETRA MS SDS Type 4 - SDS-TL Text Message Tile

A Mobile Terminated Short Data Message Type 4 - SDS - TL has the following characteristics:

- Variable length text message
- SDS-TL header identifies message content
- SDS-TL delivery reports may be requested
- Message is addressed to an individual TETRA user or a group of TETRA users

The ability to receive a type 4 short data message depends on the mobile under test and its program configuration. Some mobiles may not be capable of receiving 7-bit coded messages.

The following operations are necessary to send a short data message from the Test Set to the mobile. Set up may vary according to the mobile's functionality.

STEP	PROCEDURE

1. Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2. Verify Test Set is in MCCH mode.
3. Select the Messages Configuration Tile and select SDS Type 4 - SDS-TL Text Message from the Message Type drop-down menu.
4. Set the following parameters as required:

- Individual or Group
- Calling Party SSI
- Report Type
- Report Size
- Text Coding
- Time Stamp
- Calling Party ESN value (if required)
- Included or Not Included

5. Edit message or set it to one of the pre-defined messages.
6. Set Report Type to request a report from the mobile if required when the message is received and/or read by the user ('consumed').
7. Set Report Size to Short (short report) or Standard (standard report) as required.

STEP	PROCEDURE

8. Set Text Coding to 8-bit or 7-bit as required.
9. Set Time Stamp to Required or Not Required.
10. The text message box initially shows a pre-defined Text Message of 120 characters in length. Focus on the message box and press SELECT to enter a custom text message or press Set Message To, then Long Default Message, Short Message or Medium Size Message.
11. Select the Operations/Status Tile and press the Send Message Soft Key, followed by the Type 4 SDS-TL Text Msg Soft Key.

The mobile may indicate that the SDS Message has been received and the message and calling party address and time stamp (if included) should be displayed. The Test Set indicates on the Operations/Status Tile that the message has been sent.

In the Current Events box:

Sending SDS-TL Type 4 Msg to MS

followed by (for example):

SDS std report from MS received

Full details are recorded in the Protocol History Tile.

5.20.3.D Mobile Terminated Short Data (SDS) Message Type 4 - Simple Text Message

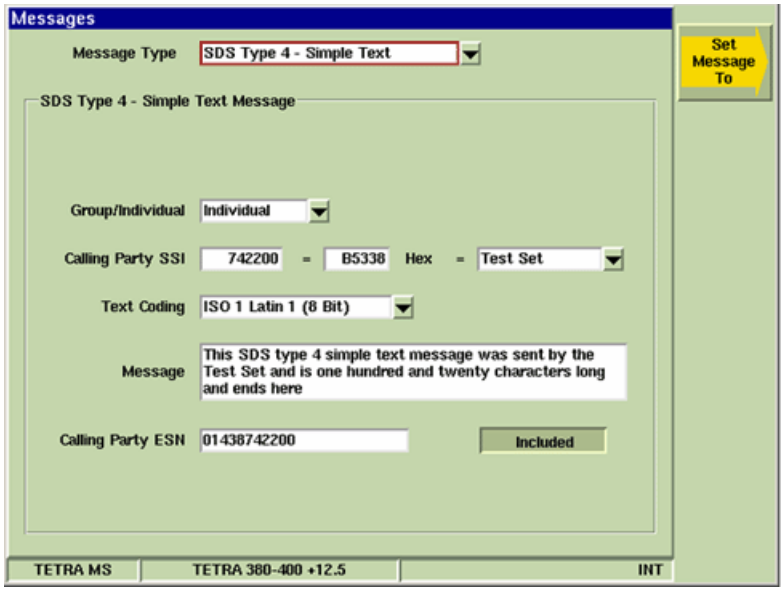

Fig. 5-38 TETRA MS SDS Type 4 - Simple Text Message Tile

A Mobile Terminated Short Data Message Type 4 - Simple Text Message type has the following characteristics:

- Variable length text message
- SDS-TL header identifies message content
- SDS-TL delivery reports may not be requested
- Message is addressed to an individual TETRA user or a group of TETRA users

The ability to receive a Type 4 Short Data Message depends on the mobile under test and its program configuration. Some mobiles may not be capable of receiving 7-bit coded messages.

The following operations are necessary to send an SDS from the Test Set to the mobile. Set up may vary according to the mobile's functionality.

STEP	PROCEDURE
1.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2.	Verify Test Set is in MCCH mode.
3.	Select the Messages Configuration Tile and select SDS Type 4 - Simple Text Message from the Message Type drop-down menu.
4.	Set the following parameters as required:
•	Individual or Group
•	Calling Party SSI
•	Text Coding
•	Calling Party ESN value (if required)
•	Included or Not Included
5.	Edit message or set it to one of the pre-defined messages. The text message box initially shows a pre-defined text message of 120 characters in length. Focus on the message box and press SELECT Key to enter a custom text message.

STEP	PROCEDURE

6. Select the Operations/Status Tile and press the Send Message Soft Key, followed by the Type 4 SDS Simple Text Msg Soft Key.

The mobile may indicate that the SDS Message has been received and the message and calling party address should be displayed. The Test Set indicates on the Operations/ Status Tile that the message has been sent.

In the Current Events box.

Sending SDS Type 4 Simple Msg to MS

followed by:

Status/SDS sent to MS

Full details are recorded in the Protocol History Tile.

5.20.3.E Mobile Terminated Short Data (SDS) Message Type 4 - Hex Message

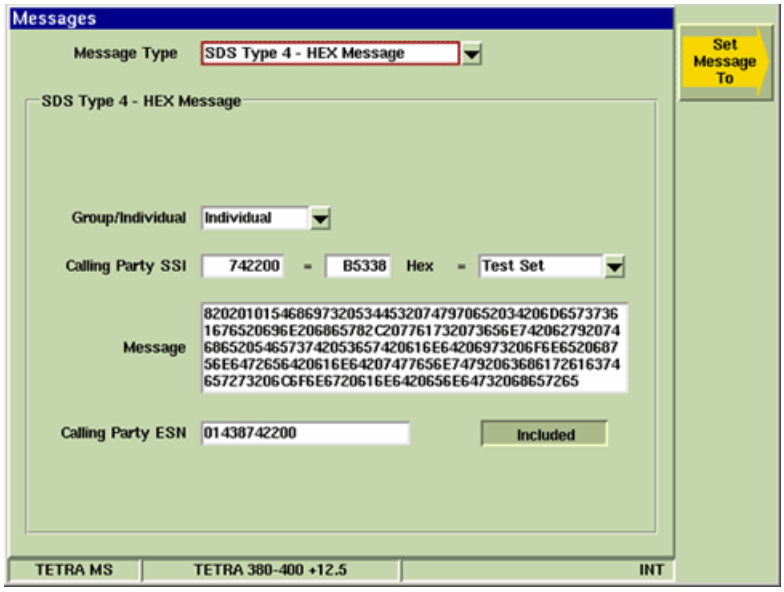

Fig. 5-39 TETRA MS SDS Type 4 - Hex Message Tile

A Mobile Terminated Short Data (SDS) Message Type 4 - Hex Message has the following characteristics:

- Variable length user application data
- SDS-TL header not sent - include in message data if required or use SDS-TL other
- SDS-TL delivery reports not requested - include request in message data if required or use SDS-TL other
- Message is addressed to an individual TETRA user or a group of TETRA users

The ability to receive a Type 4 Short Data Message depends on the mobile under test and its program configuration.

The following operations are necessary to send an SDS from the Test Set to the mobile. Set up may vary according to the mobile's functionality.

STEP	PROCEDURE
1.	Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2.	Verify Test Set is in MCCH mode.
3.	Select the Messages Configuration Tile and select SDS Type 4 - Hex Message from the Message Type drop-down menu.
4.	Set the following parameters as required:
•	Individual or Group
•	Calling Party SSI
•	Calling Party ESN value (if required)
•	Included or Not Included
5.	Set the HEX message data as required. Normally the first byte should be an SDS-TL protocol identifier.
6.	The message box initially contains the HEX data equivalent of an 8-bit text message with no report request and no time stamp. Use the DATA keypad to enter custom data in HEX.

STEP	PROCEDURE

7. Select the Operations/Status Tile and press the Send Message Soft Key, followed by the Type 4 HEX Msg Soft Key.

The mobile may indicate that the SDS Message has been received and you should be able to read the message and see the calling party address. The Operations/Status Tile indicates that the message has been sent.

In the Current Events box.

Sending SDS-TL Type 4 Hex Msg to MS

followed by:

SDS/Status sent to MS.

Full details are recorded in the Protocol History Tile.

Use this message type for other types of messages, including user applications.

NOTE	The HEX data should be an even number of HEX digits, representing an integer number of bytes (octets) of data. The data entered is the SDS Type 4 Message content starting with the SDS-TL protocol identifier as defined in ETSI EN 300 392-2 Clause 29. The Test Set calculates the SDS data length from the number of octets of the data, and generates the remaining protocol necessary to send the data to the mobile.

5.20.3.F Mobile Terminated Short Data (SDS) Message Type 4 - Other SDS-TL Message

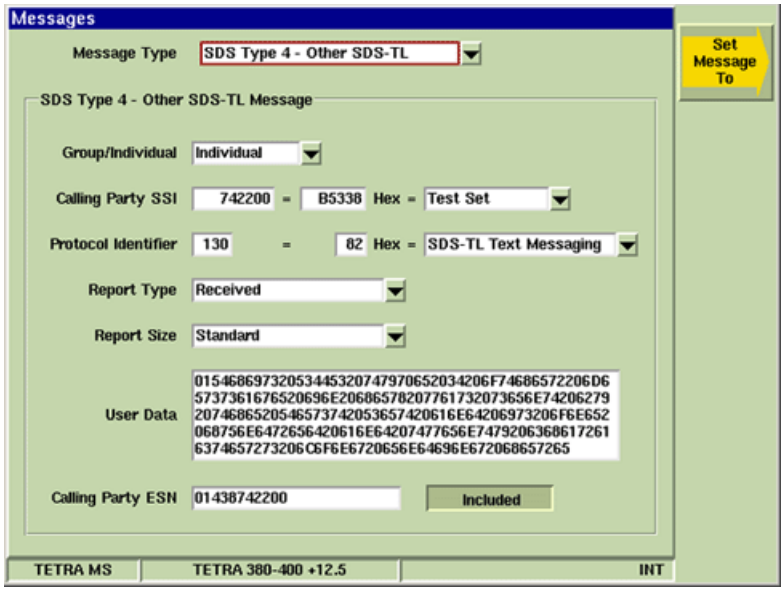

Fig. 5-40 TETRA MS SDS Type 4 - Other SDS-TL Message Tile

A Mobile Terminated Short Data Message Type 4 has the following characteristics:

- Variable length user application data
- SDS-TL Header identifier message control
- SDS-TL Header delivery reports may be requested
- Message is addressed to an individual TETRA user or a group of TETRA users

The ability to receive a Type 4 Short Data Message depends on the mobile under test and its program configuration.

The following operations are necessary to send an SDS from the Test Set to the mobile. Set up may vary according to the mobile's functionality.

STEP	PROCEDURE

1. Verify mobile has registered to the Test Set (SSI or full ITSI displayed).
2. Verify Test Set is in MCCH mode.
3. Select the Messages Configuration Tile and select SDS Type 4 - Other SDS-TL Text Message from the Message Type drop-down menu.
4. Set the following parameters as required:
   - Individual or Group
   - Calling Party SSI
   - Protocol Identifier
   - Report Type
   - Report Size
   - User data
   - Calling Party ESN value (if required)
   - Included or Not Included
5. Select the Operations/Status Tile and press the Send Message Soft Key, followed by the Type 4 SDS-TL Other Msg Soft Key.

STEP	PROCEDURE

The mobile may indicate that the SDS Message has been received and the message and calling party address should be displayed. The Test Set indicates on the Operations/ Status Tile that the message has been sent:

In the Current Events box:

Sending SDS-TL OtherMsg to MS

Status/SDS sent to MS

Status/SDS sent to MS failed

NOTE	HEX data should be an even number of HEX digits, representing an integer number of bytes (octets) of data. The data entered on the SDS-TL user application control is defined by the Protocol Identifier selected. The Test Set calculates the SDS data length from the number of octets of the data, and generates the remaining protocol necessary to send the data to the MS.

5.21 NEIGHBOR CELL BROADCAST, CELL SELECTION, CELL RE-SELECTION AND CALL RESTORATION

On an active TETRA Network, a TETRA Mobile continually monitors the signal strength of neighboring base stations (cells) to determine whether it would obtain better service from another base station (cell). This monitoring operation is performed when the mobile is idle on the MCCH and when the mobile is engaged in a call on a Traffic Channel. The mobile uses information transmitted by its current base station (serving cell) to identify the frequencies on which to monitor neighbor cells; this information (the Neighbor Cell Broadcast) also enables the mobile to make decisions about the signal level conditions under which it should attempt to obtain better service (perform Cell Re-selection). The mobile may also use this information when first turned on to determine the most suitable base station on which to register (perform Initial Cell Selection). If the mobile is engaged in a call when it performs Cell Re-selection, it also performs Call Restoration signaling on the new base station (cell) in order to continue with the call. There are a number of different types of Cell Re-selection which are used according to the mobile's call involvement and its monitoring capabilities.

The Cell Re-selection Operations supported by the Test Set are described in this section.

NOTE	Two Test Sets are needed to test the mobile's ability to perform the Cell Re-selection Operations. Each Test Set simulates a separate TETRA base station (cell), using different carrier frequencies, as in a real TETRA Network. The RF inputs and outputs of the two Test Sets are combined so that the mobile can receive signals generated by each Test Set, and so that each Test Set can receive signals transmitted by the mobile.

5.21.1 Configuration for Cell Re-Selection Tests

The equipment required for these tests is as follows:

- Two 3900 Series Radio Test Sets
- 6 dB Power Splitter (3-port, 2-way resistive divider, 50 ohm) rated for mobile transmit power
- 50 ohm attenuator rated for mobile transmit power (only if necessary to protect splitter)
- Connecting cables

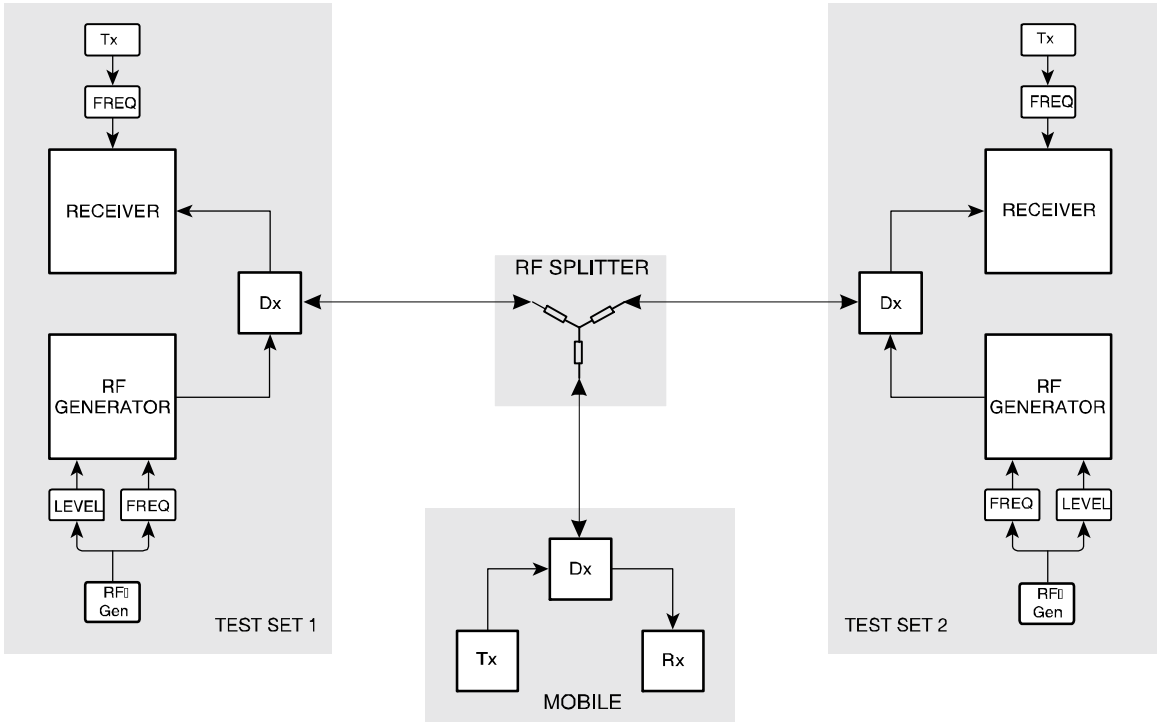

Fig. 5-41 Cell Re-selection Radio Test Set-up

STEP	PROCEDURE
1.	Use the power splitter and connecting cables to connect the mobile to both Test Sets via the power splitter.
2.	Connect the RF port of each Test Set (normally the T/R Connector) to a port on the splitter, and connect the mobile under test to the third port on the splitter.
3.	Select TETRA MS System on each Test Set.
•	The mobile receives signals generated by each Test Set, subject to 6 dB loss. Each Test Set receives signals transmitted by the mobile, subject to 6 dB loss. The Test Sets can compensate for this loss, so that the displayed values for signal generator level and mobile transmitter power correspond to the levels at the mobile's antenna connection.
4.	Select the Offsets Configuration Tile to set offset values of -6.0 dB for the Test Set RF Generator and the Test Set RF Analyzer (negative values indicate a loss, positive values indicate a gain).
5.	Set Gen Offset Soft Key and Ana Offset Soft Key to ON.
6.	To use an attenuator to protect the splitter, connect it between the splitter and the mobile's antenna connection.

STEP	PROCEDURE
7.	If calibrated loss figures are available for the connecting cables, mobile antenna connection adaptor, attenuator (if required) or other hardware, these values should be included in the offset values.
8.	Verify following Parameters are set up as follows on both Test Sets:
9.	Select the same Channel Plan Configuration Tile. Set a Channel Plan that suits the mobile under test. If this is a user defined Channel Plan, ensure that it is defined identically on each Test Set.
10.	Select the RF Settings Tile. Select the Control Channel field and enter different Control Channel Numbers for each Test Set, preferably spaced at least four channels (100 kHz) apart. Depending on the mobile, it may be necessary to ensure that at least one of the Control Channels corresponds to a channel that the mobile is configured to use for initial cell selection.
11.	Select the RF Settings Tile. Select the Traffic Channel field and enter different Traffic Channel Numbers for each Test Set, which can vary from the Control Channel Numbers and on any timeslots.
12.	Select the System ID & Access Parameters Configuration Tile and enter the following:
•	MCC on each Test Set, select the same MCC value, which must match the MCC value expected by the mobile under test.
•	MNC on each Test Set, select the same MNC value, which must match the MNC value expected by the mobile under test.
•	BCC can be set to any value (although 00 is best avoided) and does not need to be the same on each Test Set.
13.	Select different LA values for each Test Set. The actual values are arbitrary, but they must be different in order to simulate different cells.
14.	Min Rx Level for access on each Test Set must be set to the same value. This parameter is used in conjunction with the Cell Re-selection parameters in the Neighbor Cell Broadcast; therefore the value selected is based on the testing being performed. The suggested initial value for this parameter is -105 dBm.
15.	Max Tx Level on each Test Set must be set to the same value. The actual value to use depends on the testing to be performed. If the 6 dB power splitter (or attenuator) is not capable of handling the full transmit power class of the mobile, verify the Max Tx Level parameter is set to a safe value to avoid damaging the splitter. The suggested initial value for this parameter is 30 dBm.
16.	Access Parameter on each Test Set must be set to the same value. The actual value to use depends on the testing to be performed. The suggested initial value for this parameter is -33 dBm.
17.	Select the Base Services Configuration Tile on each Test Set. Set Power On Registration and Power Off De-Registration to Required and verify that the rest of the parameters are set to the same state on each Test Set.
18.	Select the Neighbor Cell Configuration Tile and configure information as needed (refer to the following section).
19.	Select the Call Timers & Trunking Configuration Tile and set the Trunking Type and other parameters as required on each Test Set.
20.	Select the Call Types Configuration Tile and set the Call Types field and set as required on each Test Set.

5.21.2 Neighbor Cell Broadcast

Neighbor Cell Broadcast is a message that is generated periodically (every 4 s to 30 s) by each Test Set on both the MCCH and the Traffic Channel. This message contains the information about the other Test Set (cell), which allows the mobile to locate and monitor the signal level of the other Test Set (cell). The message also contains the parameters necessary for the mobile to make Cell Re-selection decisions, in conjunction with the Minimum Rx level for Access Parameter, based on the signal levels of the two Test Sets (cells).

5.21.2.A Neighbor Cell

5.21.2.A.1 Broadcast

Select Supported to allow the Test Set to generate the Neighbor Cell Broadcast Message.

5.21.2.A.2 Broadcast Interval

This value is arbitrary, and controls how often the Test Set generates the Neighbor Cell Broadcast message. The suggested value for this parameter is 10 s.

5.21.2.A.3 Neighbor Cell Channel

Select the Channel Number of the MCCH that is set up on the other Test Set. This enables the mobile to tune its receiver to the correct frequency for monitoring and scanning the other Test Set.

5.21.2.A.4 Neighbor Cell Location Area

Select the LA that is set up on the other Test Set. This enables the mobile to recognize the other Test Set as a valid neighbor cell to which it should register when performing Cell Re-selection.

5.21.2.A.5 Neighbor Cell Identifier

This value is arbitrary, and is only used in Type 2 Cell Re-selection for the mobile to indicate which of a number of neighbor cells it has selected. The suggested value for this parameter is 1 on each Test Set.

5.21.2.B Cell Re-select Parameters

5.21.2.B.1 Slow Re-Select Threshold Above Fast

Sets the threshold level for judging the serving cell (the Test Set that the mobile is currently using) to be relinquishable (see ‘C1 and C2 values’ below).

The suggested initial value for this parameter is 18 dB, setting the fast threshold level at (-105 dBm + 18dB) = -87 dBm.

5.21.2.B.2 Fast Re-Select Threshold

Sets the threshold level for judging the serving cell (the Test Set that the mobile is currently using) to be improvable (see ‘C1 and C2 values’ below). This parameter defines the additional threshold above the Fast Threshold.

The suggested initial value for this parameter is 24 dB, setting the slow threshold level at (-105 dBm + 18 dB + 24 dB) = -63 dBm.

5.21.2.B.3 Slow Re-Select Hysteresis

Sets the threshold level for judging the neighboring cell (other Test Set) at a level better than the serving cell (the Test Set the mobile is currently using) when the serving cell is improvable (refer to C1 and C2 values below). Suggested initial value for this parameter is 6 dB.

5.21.2.B.4 Fast Re-Select Hysteresis

Sets the threshold level for judging the neighboring cell (other Test Set) to be better than the serving cell (the Test Set mobile is currently using) when the serving cell is relinquishable (refer to C1 and C2 values below). Suggested initial value for this parameter is 6 dB.

5.21.3 C1 and C2 Values

In an active TETRA Network, the mobile is required to scan the serving cell (base station it is currently using) and measure the signal level (RSSI value). The difference between the RSSI value and the Min Rx Level For Access parameter is known as ‘C1’. The mobile is also required to monitor neighboring cells and calculate the difference between the RSSI value and the Min Rx Level For Access parameter for each neighbor cell; this value is known as ‘C2’. The mobile uses the C1 and C2 values in conjunction with the Cell Re-selection parameters (Fast Threshold, Fast Hysteresis, Slow Threshold, Slow Hysteresis) to make Cell Re-selection decisions.

- Serving cell relinquishable: (C1 < Fast Threshold) AND (C2 > (C1 + Fast Hysteresis)). Using the suggested values, this would be satisfied with the currently used Test Set RF Generator Level below -87 dBm and the other Test Set RF Generator Level at least 6 dB higher.
- Serving cell improvable: (C1 < Slow Threshold) AND (C2 > (C1 + Slow Hysteresis)). Using the suggested values, this would be satisfied with the currently used Test Set RF Generator Level below -63 dBm and the other Test Set RF Generator Level at least 6 dB higher.
- Cell usable: (C1 > (Fast Threshold + Fast Hysteresis)). Using the suggested values, this would be satisfied with the Test Set RF Generator Level above -81 dBm.
- Initial cell selection: (C1 > 0). Using the suggested values, this would be satisfied with the Test Set RF Generator Level above -105 dBm.
- Radio link failure: (C1 < 0). Using the suggested values, this would be satisfied with the Test Set RF Generator Level below -105 dBm.

The mobile’s Cell Re-selection decision also takes into account whether the neighboring cells offer a better of service than the serving cell.

- If the service levels are the same in each cell, which is the case with the two Test Sets, the mobile should perform Cell Re-selection if the serving cell is improvable.
- If the service level in the neighboring cell is worse, the mobile should only perform Cell Re-selection if the serving cell is relinquishable.
- If the service level in the neighboring cell is better, the mobile should perform Cell Re-selection if the neighboring cell is usable.
- For additional information on Cell Re-selection refer to EN 300 392-2 sub-clauses 18.3.4 to 18.3.4.7.5, 18.5.4 and 23.7.1 to 23.7.5.2.3. During testing, the mobile may provide a diagnostic display indicating its calculated C1 and C2 values - refer to the mobile manufacturer or supplier to access this information.

For additional information on Cell Re-selection refer to EN 300 392-2 sub-clauses 18.3.4 to 18.3.4.7.5, 18.5.4 and 23.7.1 to 23.7.5.2.3. During testing, the mobile may provide a diagnostic display indicating its calculated C1 and C2 values - refer to the mobile manufacturer or supplier to access this information.

NOTE	The values of C1 and C2 are further reduced if the value of the ‘Maximum Tx level’ parameter is greater than the mobile’s maximum power capability. The descriptions in this manual assume that the ‘Maximum Tx level’ parameter is set equal to or less than the mobile’s maximum power capability, so that C1 and C2 are only dependent on the RSSI values and the ‘Minimum Rx level for access’ parameter. Some mobiles may be configured to continue operating when C1<0.

5.21.4 Initial Cell Selection

The mobile is allowed to initially select any suitable cell that has a positive C1 value, i.e. the received signal level is greater than the Minimum Rx Level For Access parameter. If the mobile does not search the frequency band for suitable channels, it may select the Test Set generating the MCCH on one of its pre-defined channels and initially ignore the other Test Set, even if the other Test Set is generating the MCCH at a higher level. To test initial cell selection, ensure that both Test Sets are generating MCCH, set the RF Generator Level on each Test Set as required, and switch on the mobile. The mobile makes its initial cell selection of one of the Test Sets, which indicates Registered (ITSI Attach). If the mobile initially ignored the Test Set with the higher signal level, it may subsequently perform undeclared Cell Re-selection if the conditions are satisfied.

5.21.5 Undeclared Cell Re-Selection

When the mobile is registered on one cell (Test Set) and is idle on the MCCH, (i.e. not engaged in a call) it is required to monitor the neighboring cells (other Test Set) to determine whether Cell Re-selection conditions are satisfied. If this is the case, it performs undeclared Cell Re-selection to the selected neighbor cell (other Test Set). No signaling is sent to the serving cell (the currently used Test Set), i.e. it does not declare its intention of leaving the serving cell. The mobile performs roaming location updating signaling on the selected neighbor cell (other Test Set), i.e. it is registering in the new location area that is indicated by the neighbor cell (other Test Set). To test undeclared Cell Re-selection, ensure that both Test Sets are generating MCCH, and that the mobile is registered on one of the Test Sets. Set the RF Generator Level on the Test Sets as required to satisfy the conditions for Cell Re-selection and wait for the mobile to decide to perform undeclared Cell Re-selection. The other Test Set indicates Registered (Roaming Location Update).

5.21.6 Unannounced Cell Re-selection and Call Restoration

When the mobile is engaged in a call on one cell (Test Set) it must continue to monitor the neighboring cells (other Test Set) to determine whether Cell Re-selection conditions are satisfied. The type of Cell Re-selection depends on whether or not the serving cell (the currently used Test Set) needs to know that the mobile is leaving the serving cell. If the mobile is engaged in a group call and it is not transmitting (i.e. it is one of a number of mobiles that are receiving) then the serving cell does not need to be notified, i.e. the mobile does not need to announce that it is performing Cell Re-selection.

To test unannounced Cell Re-selection:

STEP	PROCEDURE
1.	Set up a group call on the currently used Test Set with the mobile receiving, and Verify other Test Set is generating MCCH.
2.	Set the RF Generator Levels on the Test Sets as required to satisfy the conditions for Cell Re-selection and wait for the mobile to decide to perform unannounced Cell Re-selection.
3.	The other Test Set indicates Call Type: Restored Individual Call or Call Type: Restored Group Call. The mobile is receiving the group call on the other Test Set and can continue with its normal operations. Recommend setting both Test Sets to Test Tone and Test Set Transmit Mode to Continuous to observe the duration of the break and re-establishment of the audio path.

NOTE In the case of unannounced Cell Re-selection, the original Test Set does not know that the mobile has performed Cell Re-selection, and remains in conversation on the Traffic Channel. Press Clear down Soft Key on the original Test Set to return it to generating MCCH after the mobile has performed unannounced Cell Re-selection to the other Test Set.

5.21.7 Announced Type 3 Cell Re-Selection and Call Restoration

When the mobile is engaged in a call on one cell (Test Set) it must continue to monitor the neighboring cells (other Test Set) to determine whether Cell Re-selection conditions are satisfied. The type of Cell Re-selection depends on whether or not the serving cell (the currently used Test Set) needs to know that the mobile is leaving the serving cell. If the mobile is engaged in a private call or a phone call, or it is transmitting in a group call, then the serving cell needs to be notified, i.e. the mobile needs to announce that it is performing Cell Re-selection.

5.21.7.A To test announced Cell Re-selection:

STEP	PROCEDURE
1.	Set up a private call or a phone call on the currently used Test Set, or a group call with the mobile transmitting, and Verify other Test Set is generating MCCH.
2.	Set the RF Generator Level on the Test Sets as required to satisfy the conditions for Cell Re-selection and wait for the mobile to decide to perform announced Cell Re-selection. The currently used Test Set indicates Mobile Re-Selected Cell (Type 3)/ MCCH.
3.	The other Test Set indicates Call Type: Restored Individual Call or Call Type: Restored Group Call. The mobile continues with the call on the other Test Set and can continue with its normal operations. It is recommended to set both Test Sets to Conversation Mode Test Tone so that the duration of the break and re-establishment of the audio path can be observed. When the mobile announces Cell Re-selection, the Test Set automatically returns to MCCH generation.

5.21.8 Announced Type 2 Cell Re-Selection and Call Restoration

The procedure for testing Announced Type 2 Cell Re-selection is the same as for Type 3, the difference being due to the capability of the mobile under test, Type 2 being an optional requirement for TETRA Mobiles. A Type 2 capable mobile performs background scanning of the intended neighbor cell (other Test Set) while it is engaged in the call on the serving cell (the currently used Test Set), and has acquired the necessary synchronization and system information from the neighbor cell (other Test Set) before announcing Cell Re-selection of the identified neighbor cell on the serving cell. The currently used Test Set indicates Mobile Re-Selected Cell (Type 2) in this case. The break in the audio path should be shorter for a type 2 re-selection, which can be observed by setting both Test Sets to Test Tone.

5.22 ANALYSIS OF SIGNALING MESSAGES

The Protocol History Tile records the events and associated parameters during signaling operations, including timestamp information. This information can be used to check the configuration of a mobile under test, particularly the values of any fixed numbers for call set-up or the duration of timers. This information is presented at a high level corresponding to actions on the mobile and the Test Set, so you do not need to be a TETRA protocol expert to understand it. Use of the Protocol feature is described under the section titled Protocol Tiles.

A detailed low-level record of the information transmitted by the mobile under test can be obtained by using Using Data Display Mode. After initiating a Data Display capture, return to Manual Tiled Display Mode to perform the required signaling operations. When signaling operations are complete, return to Data Display Mode to stop the capture and view the data when required.

Refer to section titled Using Data Display Mode in Chapter 2, Common TETRA Operation for information on various TEST Display Modes.

5.23 MOBILE AUDIO TESTING

Audio performance testing allows for a subjective test of the audio performance of a mobile and may be used to confirm correct operation of the audio components within it. It is also a useful aid to fault diagnosis to audio components within the mobile.

Audio performance testing is achieved in the Test Set by storing speech received from the mobile and sending it back to the mobile after a 2 s delay (sometimes referred to as Talkback or Speech Loopback).

In a duplex call, speech is continuously fed back to the mobile's ear piece; sounds entering the mobile's microphone should be heard from the mobile's ear piece after a delay of 2 s.

In a simplex call, sounds entering the mobile's microphone while the PTT is pressed should be heard from the mobile's speaker when the PTT is released; this is best achieved by speaking into the mobile's microphone briefly, then immediately releasing the PTT. The last 2 s of stored speech are sent to the mobile repeatedly, if the Test Set Transmit Mode is Continuous, to simulate a continuing transmission from another mobile.

The Test Set can send a Test Tone to the mobile, which is useful in ascertaining whether a fault is in the audio input or audio output section of the mobile if the talkback test fails. The Test Set can also send Silence to the mobile, useful in locating the source of noise in the audio system.

5.23.1 Selecting the Audio Signal

When a call has been established, the audio signal can be set to one of the Audio Test Modes; Talkback, Test Tone or Silence.

5.23.1.A Talkback Test Tone

Selects each of the following audio modes:

5.23.1.A.1 Talkback Mode

Speech frames produced by the signal from the mobile microphone are returned after a 2 second delay, to be output from the mobile's speaker.

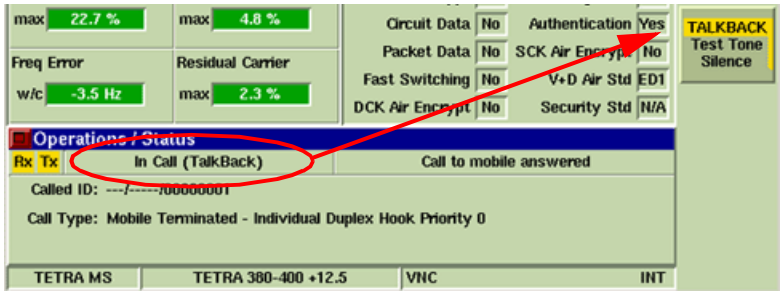

Fig. 5-42 Audio Test - Talkback Mode Selected

5.23.1.A.2 Test Tone Mode

Test Tone speech frames are sent to the mobile. This encoded representation of a 1 kHz signal is provided as an aid to checking the audio output and speaker of the mobile, and represents an audio level approximately 12 dB below the theoretical maximum output level. Speech Codecs in TETRA radios are not optimized for steady tones, and you may detect some fluctuation in level when played through the radio's ear piece or speaker.

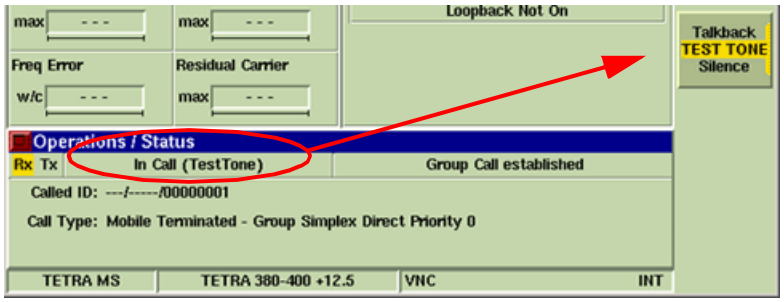

Fig. 5-43 Audio Test - Test Tone Selected

NOTE	Speech Codecs in TETRA radios are not optimized for steady tones, and you may detect some fluctuation in level when played through the radio's ear piece or speaker.

5.23.1.A.3 Silence Mode

Silence speech frames are sent to the mobile.

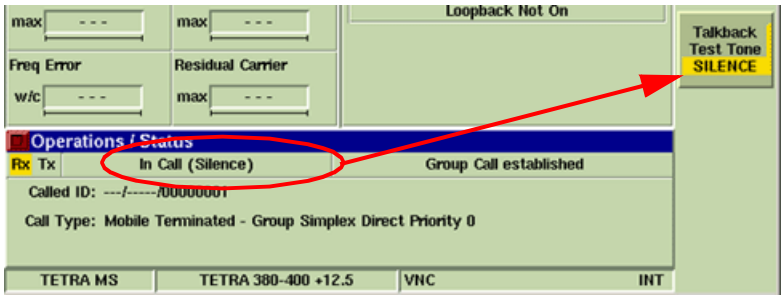

Fig. 5-44 Audio Test - Silence Mode Selected

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Chapter 6 - TETRA MS T1 System

6.1 INTRODUCTION

The 3900 TETRA MS T1 System provides features for testing TETRA Mobiles in T1 Test Mode. The TETRA MS T1 System provides the following test capabilities:

- TETRA MS T1 System provides the following test capabilities:
- T1 Test Signal generation (six types).
- T1 Test Mode control of mobile transmission, burst type, power level and RF Loopback.
- Transmitter measurements (burst power, power profile, burst timing, modulation accuracy, frequency error).
- Receiver measurements (BER, MER, PUEM) on T1 Test Signals using T1 RF Loopback.
- Graphical displays of power profile and modulation.
- Capture, demodulation and channel decoding of mobile transmissions (5000 bursts).

This chapter describes TETRA MS T1 TEST Tiles.

Refer to Chapter 4, Common TETRA Configuration Tiles for use of TETRA MS T1 Configuration Tiles.

Refer to Chapter 5, TETRA MS System for use of the Modulation Accuracy Tiles, Power Profile and Protocol Tiles.

6.1.1 T1 Test Mode

Some TETRA Mobiles have the capability to receive and transmit T1 Test Signals. When in T1 Test Mode, the mobile may respond to instructions over the air interface, or it may require a separate control program.

The TETRA MS T1 system produces the T1 Test Signals required for receiver testing, and performs measurements on the signals transmitted by the TETRA Mobile for conformance testing as defined in ETSI EN 300 394-1.

The following steps may need to be performed to use T1 Test Mode to test a mobile:

- The Test Set MCC value may need set to 001 and the MNC value to 00001 so the mobile recognizes these special test values.
- NO PLAN may need to be selected on the Channel Plans Configuration Tile rather than a TETRA Channel Plan.
- An access code may need to be entered on the mobile or an external configuration/control application may need to be used to place the mobile into T1 Test Mode. Refer to the mobile manufacturer for information on using T1 Test Mode and T1 loopback (if supported).

6.1.2 TETRA MS T1 Tile Layout

The Display Mode provides a display screen divided into three sections. The example below shows TETRA MS T1 in Manual - Tiled Display Mode with the Tiles minimized.

Each section of the screen is used to display certain types of Tiles:

- Section A always shows the Control Tile.
- Sections B and C can be configured to display Measurement Tiles, Protocol Tiles, the Oscilloscope, Channel Analyzer and Audio Tile. Tiles can be displayed simultaneously in Sections B and C.
- The Information Bar at the bottom of the Tile displays various titles and other information.

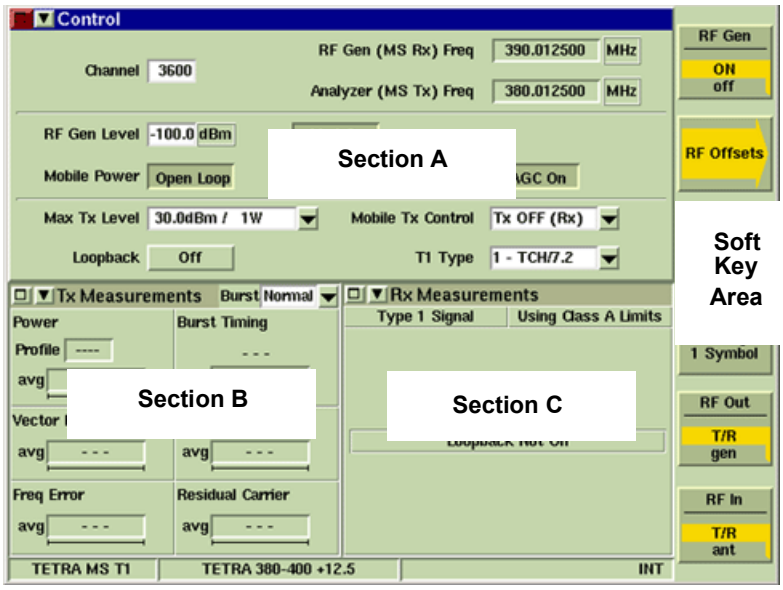

Fig. 6-1 TETRA MS T1 System Display - Minimized View

Fig. 6-1 shows the Control Tile selected (Section A). The soft keys displayed are relevant to the Control TIle. The Information Bar displays the System title TETRA MS T1 and indicates that NO PLAN has been selected for the Channel Plan. Refer to Chapter 2, section titled Channel Plans for information about configuring Channel Plans.

6.2 BURST TILE

The Burst Tile provides a graphic representation of the TETRA signal in the active timeslot. When a TETRA signal is received, a color-coded, horizontal band is generated from right to left on the Burst Tile. The Burst Tile can be selected from the drop-down menu on the Measurements Tiles as shown in Fig. 6-2, or from the drop-down menu on the Control TIle as shown in Fig. 6-3.

NOTE	The Burst Tile is intended to provide an indication of the activity present in the TETRA signal. Use Using Data Display Mode for a detailed view of signal content.

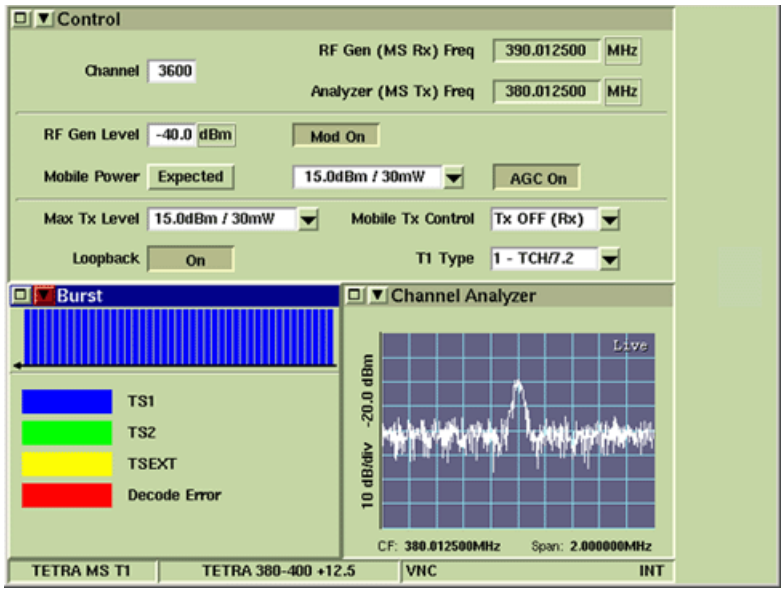

Fig. 6-2 TETRA MS T1 Burst Tile - Measurements Tile location

The Burst Tile uses color-coding to represent various burst types present in TETRA systems. The color-coding allows for quick identification of the information received across the signal.

TETRA MS T1 uses the following color-coding to identify burst type:

	Represents a TS1 burst.
	Represents a TS2 burst.
	Represents a TSEXT burst. Appears as a complete bar when present.
	Represents protocol decode failure. Occupies the bottom third of bar when present.

Fig. 6-2 and Fig. 6-3 provide examples of a TETRA signal that contains TS1 bursts.

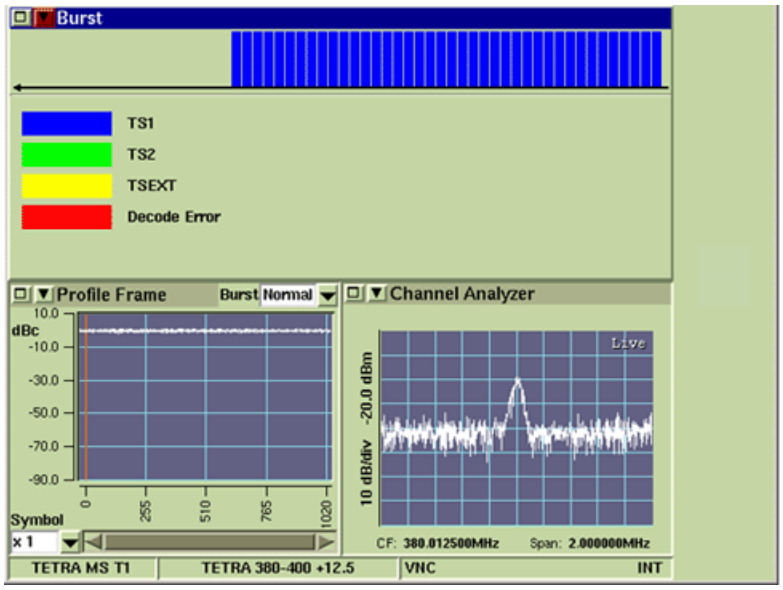

Fig. 6-3 TETRA MS T1 Burst Tile - Control Tile location

6.3 CONTROL TILE

The Control Tile allows RF Parameters of the Test Set to be set to the values required for the mobile under test. The Control Tile also provides control of the operation of the mobile for mobiles that respond to control information in the T1 signal. The required parameters depend on whether a Channel Plan with Channel Numbers is being used or if No Plan is selected and frequencies are entered manually.

Refer to section titled Channel Plans in Chapter 2 for information about configuring Channel Plans.

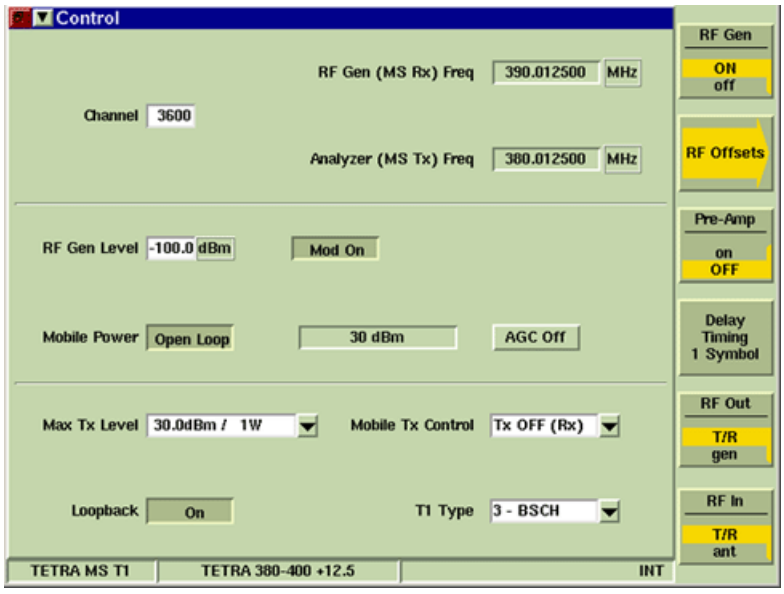

Fig. 6-4 TETRA MS T1 Control Tile - Soft Keys

6.3.1 Field/Soft Key Definitions

6.3.1.A Channel

Enabled when a Channel Plan is selected.

Enter a Channel Number that is within the range defined by the Channel Plan. Verify that the mobile is set up to receive a T1 Signal on the same channel as the one generated by the Test Set. The Test Set displays the corresponding mobile Rx and Tx Frequencies.

6.3.1.B Mobile Rx Frequency

Field is enabled when No Plan Selected (Without Channel Plan).

The mobile Rx Frequency is the T1 frequency generated by the Test Set. This parameter should be set to the T1 frequency the mobile is expecting to receive from the Test Set. The Test Set displays the nearest equivalent Channel Number. If Duplex Spacing is Locked, this parameter updates automatically when the mobile Tx Frequency parameter is changed.

6.3.1.C Mobile Tx Frequency

Field is enabled when No Plan Selected (Without Channel Plan).

The Mobile Tx Frequency should be set to the frequency at which the mobile transmits. If the Duplex Spacing is Locked this parameter updates automatically when the mobile Rx Frequency parameter is changed.

6.3.1.D Duplex Spacing

The effect of this parameter depends on the status of the Locked/Unlocked button.

6.3.1.D.1 Locked

The Duplex Spacing parameter is a setting that controls the frequency differential between the Test Set RF Generator frequency (the mobile Rx frequency) and the Test Set RF Analyzer frequency (the mobile Tx frequency). For example, Duplex Spacing is set to 10 MHz, the Test Set RF Analyzer frequency is automatically set 10 MHz lower than the Test Set RF Generator frequency. Negative values represent a reverse duplex configuration, in which event the Test Set RF Analyzer frequency is higher than the Test Set RF Generator frequency.

6.3.1.D.2 Unlocked

The Duplex Spacing parameter is a reading of the frequency difference between the mobile Rx Frequency and the Mobile Tx Frequency, provided for information. The mobile Rx Frequency and the mobile Tx Frequency are set independently.

NOTE	When No Plan is selected, these parameters only control the frequencies of the Test Set's Signal Generator and Signal Analyzer. No frequency information is included in the T1 signal. A Channel Plan should be used if the mobile uses the T1 Signal to control its transmitter frequency.

6.3.1.E With or Without a Channel Plan

6.3.1.E.1 RF Gen Level

When Channel Plan is set to No Plan, the RF Gen Level field is visible to allow user to set the RF Generator frequency for the downlink channel. The Channel Number closest in frequency to the specified value is displayed in the Chan.(Channel) field.

6.3.1.E.2 Max Tx Level

Sets the maximum power level at which a mobile is permitted to transmit when using Mobile Link Control (open loop power control). (This is the MS_TXPWR_MAX_CELL parameter in system information.) Range is 15 to 45 dBm, in 5 dB steps.

This settings box is a replication of the one on the System ID & Access Parameters Configuration Tile. Mobiles in T1 Mode can use this parameter to set their power directly. Refer to ETSI EN 300 394-1.

NOTE	Some mobiles may use a proprietary control program to set the transmit level and may disregard the Max Tx Level parameter in the Test Set T1 signal.

6.3.1.F Mobile Tx Control

Instructs the mobile to transmit Normal bursts, Control bursts or to set to Rx Only Mode (Tx Off).

NOTE	Some mobiles may use a proprietary control program to set the transmit level and may disregard the Max Tx Level parameter in the Test Set mobile Tx Control setting.

6.3.1.G Loopback

The Loopback button controls the Loopback Mode of the mobile in T1 Test Mode (if supported in the mobile). With Loopback ON, the mobile loops back the bursts received from the Test Set, allowing a BER measurement to be made. This option affects the Loopback parameter in the T1 BNCH/T information as shown in the following table.

Loopback Setting	Loopback Parameter
OFF	0 = off
ON	1 = on

6.3.1.H T1 Type

The following are the available T1 Signal Types:

6.3.1.H.1 Type 1 (TCH/7.2)

TCH/7.2 A T1 Type 1 Signal is generated.

Frames 1 to 17 of the TN1 carry O.153 PRBS data, coded as TCH/7.2, indicated in BNCH/T T1 burst type.

6.3.1.H.2 Type 2 (SCH/F)

SCH/F A T1 Type 2 Signal is generated.

Frames 1 to 17 of the TN1 carry O.153 PRBS data, coded as SCH/F, indicated in BNCH/T T1 burst type.

6.3.1.H.3 Type 3 (BSCH + SCH/HD)

BSCH + SCH/HD A T1 Type 3 Signal is generated.

Frames 1 to 17 of the TN1 carry two streams of O.153 PRBS data; one coded as BSCH, the other as coded as SCH/HD, indicated in BNCH/T T1 burst type.

6.3.1.H.4 Type 4 (TCH/2.4)

TCH/2.4 A T1 Type 4 Signal is generated.

Frames 1 to 17 of TN1 carry O.153 PRBS data, coded as TCH/2.4, indicated in BNCH/T T1 burst type.

6.3.1.H.5 Type 15 (TCH/S)

TCH/S A T1 Type 15 Signal is generated.

Frames 1 to 17 of TN1 carry O.153 PRBS data, coded as TCH/S, indicated in BNCH/T T1 burst type.

6.3.1.H.6 Type 17

TCH4.8 A T1 Type 17 Signal is generated.

Frames 1 to 17 of TN1 carry O.153 PRBS data, coded as TCH/4.8, indicated in BNCH/T T1 burst type.

Each T1 Signal Type contains a separate stream of O.153 PRBS data in the AACH. These options affect the T1 Burst Type parameter in the T1 BNCH/T information as shown in the following table. This parameter automatically sets the T1 Signal Type parameter in the Rx Measurements Tile.

Mobile Tx Control	Tx ON Parameter	Tx Burst Type Parameter
OFF	0 = off	0 = NUB
NORMAL	1 = on	0 = NUB
CONTROL	1 = on	1 = CB

6.3.1.I RF Gen Soft Key

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

6.3.1.J RF Offsets Soft Key

Opens a soft key sub-menu that selects to Include or Exclude any set Analyzer or Generator Offset.

6.3.1.K RF Out Soft Key

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

6.3.1.L RF In Soft Key

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

6.3.1.M Delay Timing 1 Symbol Soft Key

Delays the timing of the T1 Test Signal by 1 symbol each time the key is pressed. This feature is used in conjunction with the timing error measurement to perform the mobile Frame Alignment Performance Test specified in ETSI EN 300 394-1.

NOTE	Generation of a faded T1 Signal (TU50 or HT200) requires the use of an external propagation simulator.

6.4 RX MEASUREMENTS TILE

The Rx Measurements Tile displays the results of various error rate measurements performed using T1 Loopback. The measurements performed depend on the mobile receiving the T1 Signal generated by the Test Set and the information sent from the mobile back to the Test Set. The Signal Type is selected on the Control Tile from the T1 Type drop-down menu. Applicable limits (A, B or E) are selected on the Mobile Parameters Configuration Tile.

The minimized view of the Rx Measurements Tile shows the tile as it appears when Loopback function is OFF. The maximized view of the Rx Measurements Tile shows the tile as it appears when Loopback function is ON, enabling additional measurement parameters. The number of BER/MER/ measurements displayed when the Loopback function is ON depends on the T1 signal type selected on the Control Tile.

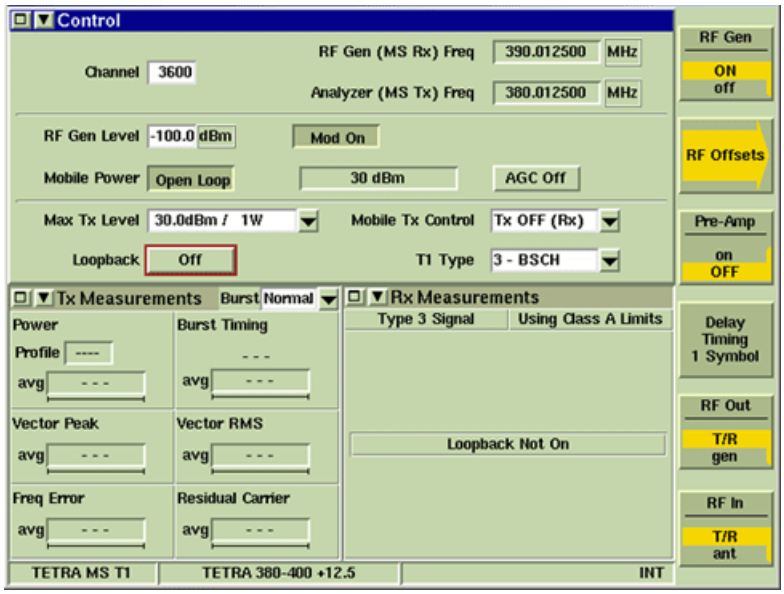

Fig. 6-5 TETRA MS T1 Rx Measurements Tile - Minimized View (Loopback OFF)

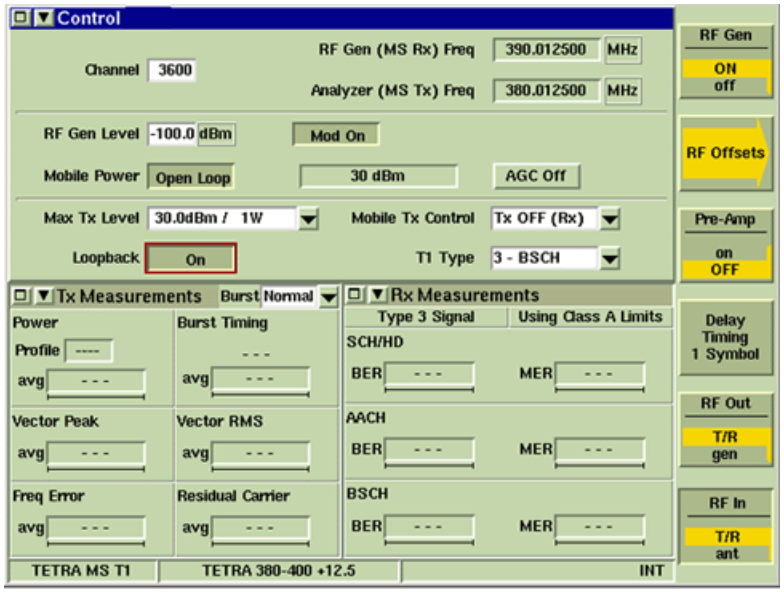

Fig. 6-6 TETRA MS T1 Rx Measurements Tile - Minimized View (Loopback ON)

6.4.1 Mobiles that Do Not Support T1 Loopback

If the mobile does not support T1 Loopback Mode, receiver BER testing may still be possible using the standard signals generated by the Test Set. If the mobile is able to output its received data on a test connector, the received data can be fed to and measured on a separate BER meter. Alternatively, some mobiles are able to measure their own BER internally.

6.4.2 Field Definitions

6.4.2.A PUEM Measurements

PUEM (Probability of Undetected Erroneous Measurement) is a conformance type measurement that tests the capability of the mobile's error detection. Messages that are returned to the Test Set with one or more bits in error should also indicate message error in the appropriate error flag. If the Test Set receives a returned message containing bit errors without the error flag being set, this counts as an Undetected Erroneous Message.

6.4.2.B Bar Graphs

A bar graph is included for each measurement.

6.4.2.C Count of Total Bits

A numeric box displays the total number of bits analyzed for each measurement.

6.4.2.D Count of Bit Errors

A numeric box displays the total number of incorrect bits identified for each measurement.

6.4.2.E Sample Sizes

Settings boxes to allow sample sizes to be set are provided for each measurement.

6.4.2.F Sample Time

A numeric box displays the time required for the selected number of samples to accumulate. Sample Time is displayed in HH:MM:SS format.

6.4.2.G Available Signal Types

The following table lists the signal types available, the tests that are run on each signal type, what data is looped back by the mobile to the Test Set and the specific measurements performed for each call type.

Signal Type	Tests Run	Mobile Loops Back	Measurements Made
Type 1 (TCH7.2 + AACH)	TCH7.2	TCH7.2 PRBS only	BER
Type 2 (SCH/F + AACH)	SCH/F + AACH	SCH/F PRBS + error flag AACH PRBS + error flag	BER, MER, PUEM BER, MER, PUEM
Type 3 (BSCH + SCH/HD + AACH)	BSCH SCH/HD AACH	BSCH PRBS + error flag SCH/HD PRBS + error flag AACH PRBS + error flag	BER, MER, PUEM BER, MER, PUEM BER, MER, PUEM
Type 4 (TCH2.4 + AACH)	TCH2.4 AACH	TCH2.4 PRBS only AACH PRBS + error flag	BER BER, MER, PUEM
Type 15 (TCH/S + AACH)	TCH/S AACH	TCH/S PRBS + error flag AACH PRBS + error flag	BER0, BER1, BER2, MER, PUEM BER, MER, PUEM
Type 17 (TCH4.8 + AACH)	TCH/4.8 AACH	TCH4.8 PRBS only AACH PRBS + error flag	BER BER, MER, PUEM

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Chapter 7 - TETRA BS System

7.1 INTRODUCTION

The 3900 TETRA BS System provides features for testing TETRA Base Station Transmitters in their normal operating mode. Base Station transceivers with T1 Test capability can be tested using the TETRA BST1 System.

This chapter describes TETRA BS TEST Tiles.

Refer to Chapter 4, Common TETRA Configuration Tiles for use of TETRA MS T1 Configuration Tiles.

Refer to Chapter 5, TETRA MS System for use of the Audio TIle and Modulation Accuracy Tiles.

The TETRA BS System provides the following test capabilities:

- Base station identification (MCC, MNC, BCC, LA).
- Frequency setting via Channel Plan, Channel Number or manually.
- Conversion of frequency to nearest equivalent Channel Number.
- Transmitter measurements (power, modulation accuracy, frequency error).
- Graphical displays of modulation.
- Direct RF connection to BS transmitter via T/R Connector.
- Off-air monitoring of BS transmitter via ANT (Antenna) Connector.
- Capture, demodulation and channel decoding of base station transmissions (5000 bursts).

7.2 TETRA BS DISPLAY LAYOUT

The Manual - Tiled Display Mode provides a display screen divided into four quadrants. Fig. 7-1 shows TETRA BS with Manual - Tiled Display Mode selected and the Tiles minimized.

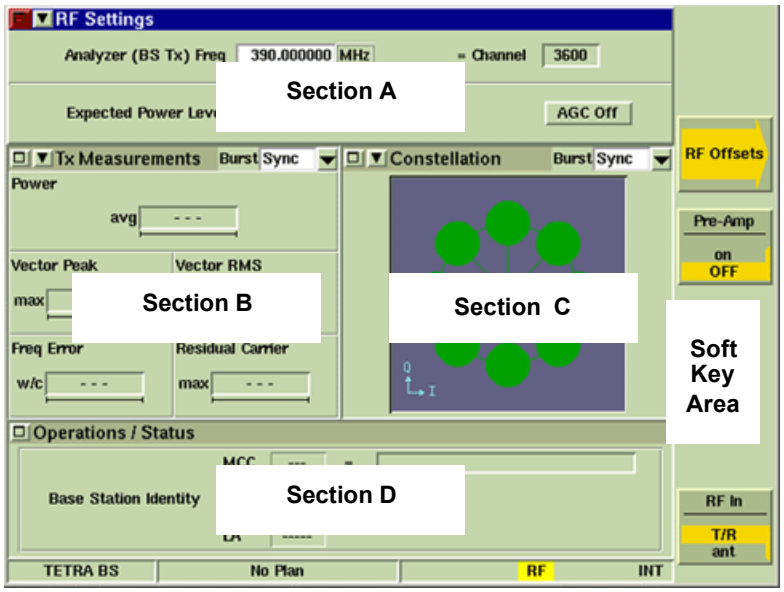


Fig. 7-1 TETRA BS System Display - Minimized Views

Each section of the screen is used to display certain types of Tiles:

- Section A always shows the RF Settings Tile.
- Sections B and C can be configured to display Measurements Tiles, the Oscilloscope, Channel Analyzer and Audio Tile. Tiles can be displayed simultaneously in Sections B and C if required.
- Section D always shows the Operations/Status Tile.
- The information bar at the bottom of the Tile shows the currently operating System and the selected Channel Plan.

Fig. 7-1 shows the RF Settings Tile (Section A) selected. The soft keys displayed are relevant to the RF Settings Tile. The Information bar displays the operating System title (TETRA BS) and indicates that NO PLAN has been selected for the Channel Plan.

7.3 BURST TILE

The Burst Tile provides a graphic representation of the TETRA signal in the selected timeslot. When a TETRA signal is received, a color-coded, horizontal band is generated from right to left on the Burst Tile. The Timeslot drop-down menu selects the timeslot to be monitored. The Burst Tile can be selected on the Measurements Tiles or the RF Settings Tile.

NOTE	The Burst Tile is intended to provide an indication of the activity present in the TETRA signal. Use Using Data Display Mode for a detailed view of signal content.

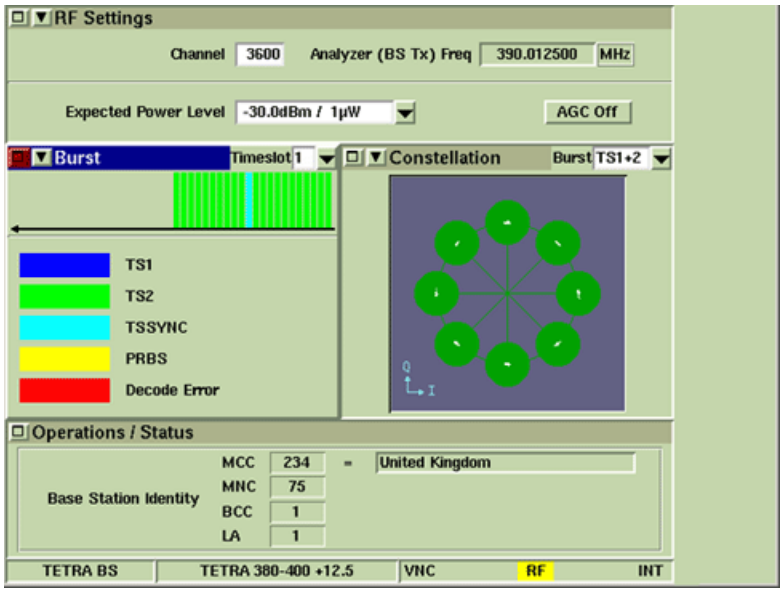


Fig. 7-2 TETRA BS Burst Tile - Measurements Tile location

The Burst Tile uses color-coding to represent various burst types present in TETRA systems. The color-coding allows for quick identification of the information received across the signal.

TETRA BS uses the following color-coding to identify burst type:

	Represents a TS1 burst.
	Represents a TS2 burst.
	Represents a TSSYNC burst.
	Represents a PRBS burst. Appears as a complete bar when present.
	Represents protocol decode failure. Occupies the bottom third of bar when present.

Fig. 7-2 and Fig. 7-3 show a TETRA signal that contains TS2 and TSSYNC bursts.

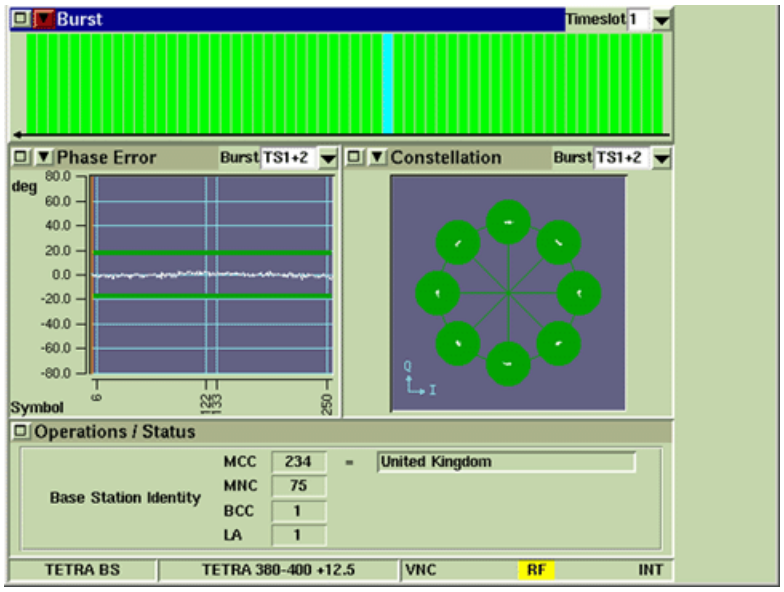


Fig. 7-3 TETRA BS Burst Tile - RF Settings Tile location

7.4 OPERATIONS/STATUS TILE

The Operations/Status Tile shows the System Identity details of the base station under test. The identity information is decoded from the RF signal produced by the base station.

The MCC, MNC and BCC values are always updated to the values decoded from the base station RF signal, regardless of the Update Manual/Automatic setting on the TETRA BS System ID Configuration Tile. The LA value can only be decoded from the base station RF signal if the MCC/MNC/BCC parameters on the System ID Configuration Tile are correctly configured to match the scrambling parameters used by the base station. This is normally achieved by setting the Update parameter to Automatic; however, the System ID parameters may need to be set manually if the base station is operating in a test mode where it does not broadcast the correct System ID parameters.

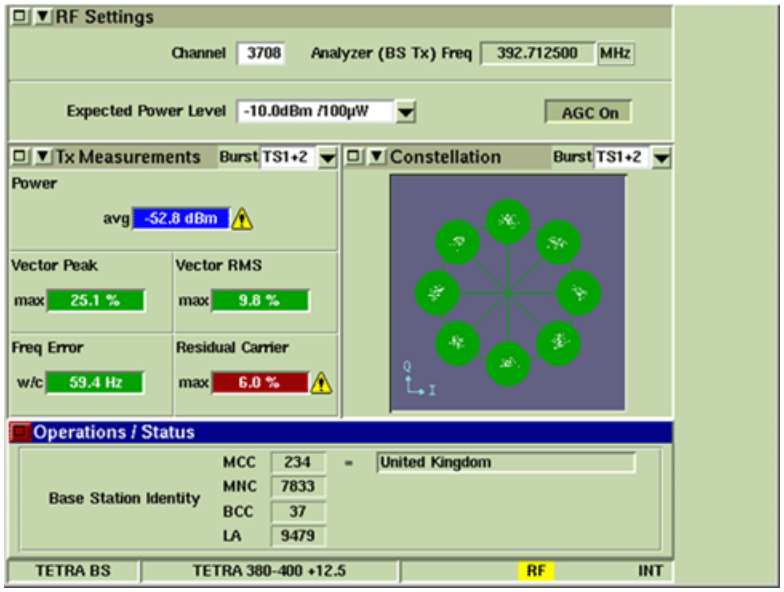


Fig. 7-4 TETRA BS Operations/Status Tile - Minimized View

base station under test.

7.5 TX MEASUREMENTS TILE

The Tx Measurements Tile is accessed from the drop-down menu on any of the TETRA BS Measurement Tiles. The Tx Measurement Tiles show the results of measurements made to the signal produced by the base station under test. The results are indicated in numeric and graphical form. The example below shows the Tx Measurements Tile in maximized view.

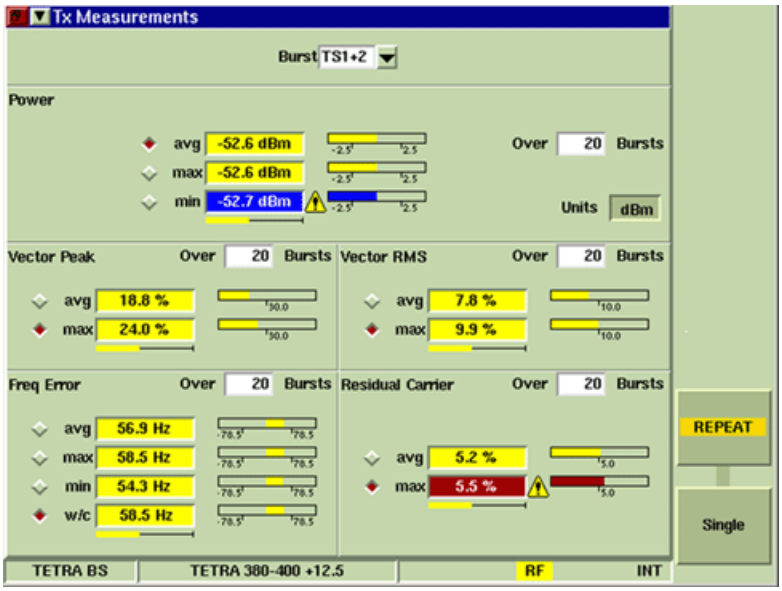


Fig. 7-5 TETRA BS Tx Measurements Tile - Maximized View

7.5.1 Field/Soft Key Definitions

7.5.1.A Burst

The Burst drop-down menu at the top of the Tx Measurements Tile selects the type of burst or bursts on which the measurements are made. Burst options are:

Listed as	Details of Burst
TS1+2	Normal burst with Training Sequence Type 1 and Normal burst with Training Sequence Type 2
TS1	Normal burst with Training Sequence Type 1
TS2	Normal burst with Training Sequence Type 2
Sync	Synchronization burst.
PRBS	Psuedo Random Bit Sequence burst with no Training Sequence

Base stations may periodically use the second half of a normal burst (with training sequence 2) or a sync burst for linearization. During this period the base station signal is not explicitly defined and these types of bursts may appear as measurement failures. Set the Burst Type to TS1 to eliminate this possibility. Setting the Burst Type to TS2, TS1+2 or Sync does not guarantee that the Test Set will capture bursts containing linearization, since these are valid burst types for normal operation. To capture only bursts containing linearization, set the base station to T1 Test Mode and select TETRA BS T1 on the Test Set.

7.5.1.B Over n Bursts

The number of samples taken for each of the tests is set in the Over n Bursts numeric entry box within the results area for each test. The yellow status bar below the avg field indicates accumulation status.

The range for all the tests is 1 to 250. Default setting is 20.

7.5.1.C Measurement Limits

The measurement Pass/Fail limits, defined on the Tx Measurements Limits Configuration Tile, allow user to set different Pass/Fail limits for each burst type.

7.5.1.D Results

The maximized Tx Measurements Tile shows measurements results numerically and as bar graphs. The results of measurements are presented as different criteria for different tests. The results are obtained by making measurements on all of the symbols in each burst over the number of bursts specified for the test. These criteria are listed below.

avg	Average value of all of the samples measured.
max	Maximum value of the burst that produced the highest result from the number of samples measured.
min	Minimum value of the burst that produced the lowest result from the number of samples measured.
w/c	Worst Case value of the burst that produced the lowest or highest result from the number of samples measured.

While the Test Set is acquiring and compiling measurement results, the maximized and minimized measurement Tiles show a progress bar below each numeric measurement field. The measurement results show the average, maximum, minimum or worst case thus far based on the incomplete measurement data. The progress bars disappear when the specified number of bursts have been measured.

7.5.1.E Power

The Power Measurement shows the average power reading during the measured burst. This measurement is taken from the usable part of the burst (all modulation symbols SN0 ~ SNmax) measured at the symbol points through a TETRA filter (Root Nyquist, a = 0.35).

The units of measurement is indicated in dBm or W.

7.5.1.F Vector Errors

The Vector Error Measurements show the vector error of the received symbols with respect to the ideal symbol points for the burst. These measurements are obtained from the usable part of the burst, measured at the symbol points through a TETRA filter. The measurements are expressed as a percentage of the mean amplitude level.

7.5.1.F.1 Vector Peak

The Vector Peak Measurement is the vector error of the symbol with the highest error.

7.5.1.F.2 Vector RMS

The Vector RMS Measurement is the root mean squared of the vector error of all the symbols.

7.5.1.F.3 Residual Carrier

The Residual Carrier Measurement is the mean residual carrier magnitude.

7.5.1.G Freq Error

The Freq Error Measurement shows the difference between the frequency of the base station signal and the Analyzer frequency (of the Test Set. This measurement is obtained from the usable part of the burst measured at the symbol points through a TETRA filter.

7.5.1.H Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

7.5.1.I Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

7.6 RF SETTINGS TILE

The RF Settings Tile is used to configure settings for the Test Set RF Input parameters to be used for testing the Base Station. Required parameters that must be configured do not depend on whether or not a Channel Plan is selected.

Refer to section titled Channel Plans in Chapter 2 for information about configuring Channel Plans.

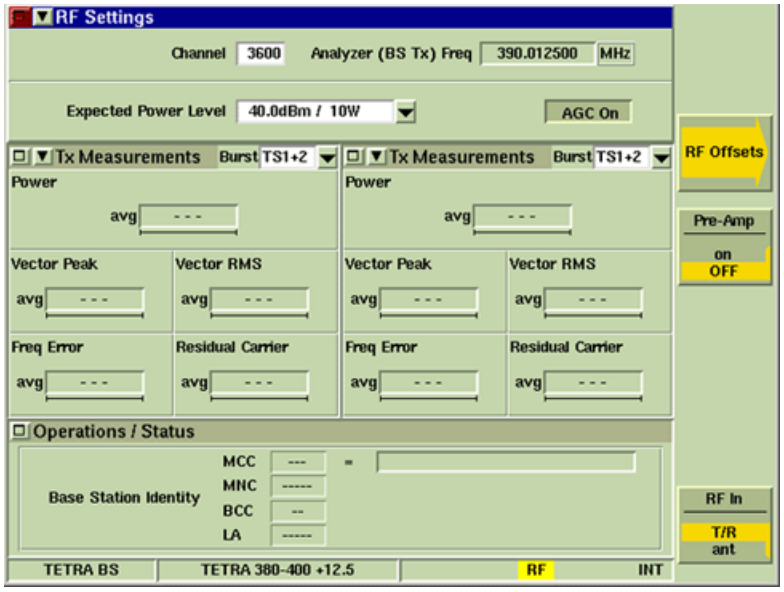


Fig. 7-6 TETRA BS RF Settings Tile - Channel Plan Selected

7.6.1 Field/Soft Key Definitions

7.6.1.A Channel and Analyzer (BS Tx) Freq

When a Channel Plan is selected, this parameter sets the frequency of the RF analyzer within the Test Set to that of the channel to be used by specifying a Channel Number.

Enter the required Channel Number in the Channel Settings field and press the ENTER button. The input center frequency of the Test Set RF Analyzer is displayed in the Analyzer (BS Tx) Freq field.

7.6.1.B Analyzer (BS Tx) Freq and Channel

When No Plan is selected, this parameter sets the center frequency of the RF Analyzer within the Test Set. Enter the required Frequency in the Analyzer Freq Settings field and press the ENTER button. The Channel Number closest to that frequency is displayed in the Channel field.

7.6.1.C Expected Power Level

Specifies an expected power input level for the Test Set. The RF Analyzer attenuators must be set to the values required for this input level. The range of values available for selection at any time depends on which RF input connection is selected and the value of any RF input offset that is set. The defined Power Level is overridden when the AGC is enabled (ON).

7.6.1.D AGC On/Off

The Expected Power Level setting is overridden by the AGC facility if the AGC Button is set to the ON state. With the AGC set to ON, the Test Set optimizes the gain of the RF analyzer to provide the best resolution to the measurements made to the signal.

7.6.1.E RF Offsets Soft Key

Opens a soft key sub-menu that selects to Include or Exclude any set Analyzer or Generator Offset.

7.6.1.F Pre-Amp Soft Key

The 3900 is equipped with an internal 15 dB broadband amplifier that affects the T/R Connector and ANT (Antenna) Connector. When Pre-Amp is turned ON, the 3900 has a typical noise figure of -9 dB leading to a noise floor level of approximately -140 dBm in the Spectrum Analyzer (RBW = 300 Hz) and approximately -126 dBm for the Inband Power Meter (IF = 6.25 kHz). Using the Pre-Amp feature increases the sensitivity of the 3900.

NOTE	When Pre-Amp is used, special attention is required; it is a broadband amplifier and could lead to saturation or compression problems in the receiver chain if the signal of interest is very low, but a strong out of band signal is present.

7.6.1.G RF In Soft Key

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

Chapter 8 - TETRA BS T1 System

8.1 INTRODUCTION

The 3900 TETRA BS T1 System provides features for testing TETRA Base Station transceivers operating in T1 Test Mode. Base Station transmitters can be tested in their normal operating mode using TETRA BS.

This chapter describes TETRA BS T1 TEST Tiles.

Refer to Common TETRA Configuration Tiles for use of TETRA MS T1 Configuration Tiles.

Refer to TETRA MS System for use of the Audio TIle and Modulation Accuracy Tiles.

The TETRA BS T1 System provides the following test capabilities:

- Base station identification (MCC, MNC, BCC).
- T1 Test Signal generation (four types).
- Other test signal generation (18 Frame PRBS, Framed PRBS, Unframed PRBS).
- Optional synchronization to base station using sync pulse signal from base station.
- Optional automatic synchronization to base station using RF signal from base station.
- Optional automatic detection of required T1 Test Signal Type.
- Optional automatic detection of required scrambling code.
- Transmitter measurements (power, modulation accuracy, frequency error).
- Receiver measurements (BER, MER, PUEM) on T1 Test Signals using T1 RF Loopback.
- Transmitter BER measurements on PRBS Signals.
- Graphical displays of modulation.
- Capture, demodulation and channel decoding of base station transmissions (5000 bursts).

8.2 TETRA BS T1 DISPLAY LAYOUT

The 3900 TETRA BS T1 System is intended to be used for testing base station transmitters and/or receivers operating in T1 Test Mode as defined in ETSI EN 300 394-1. Limited testing with proprietary test modes is also possible.

When testing a base station transmitter, the Test Set is expecting to receive a T1 Test Signal from the base station under test. The frequency of the expected signal is determined by the Channel or Analyzer Frequency setting on the Control Tile. When testing a base station receiver, the Test Set must be synchronized to the frame structure of the base station under test, either by analyzing the signal from the base station transmitter, or by receiving a synchronization pulse from the base station receiver. The frequency of the generated signal is determined by the Channel or Generator Frequency setting on the Control Tile.

The Manual - Tiled Display Mode provides a display screen divided into three sections. The example below shows TETRA BS T1 with Manual - Tiled Display Mode selected and with the Tiles minimized.

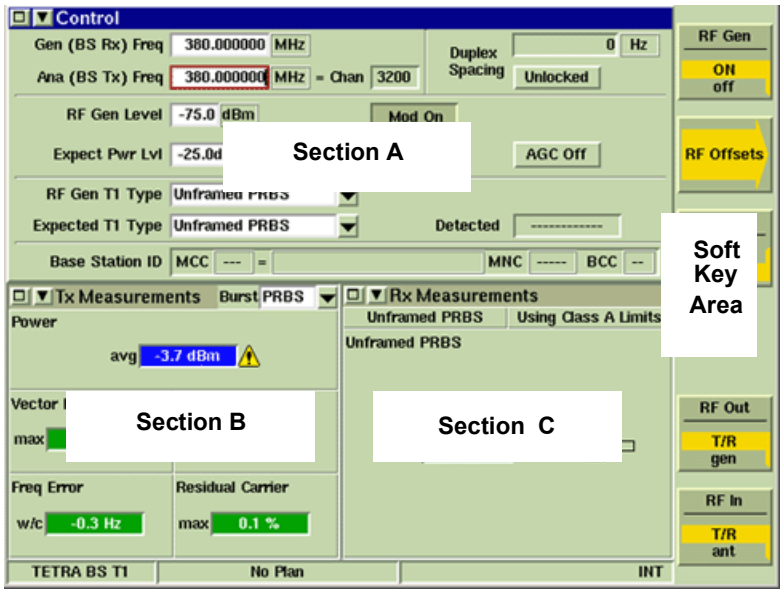


Fig. 8-1 TETRA BS T1 System Display - Minimized Tiles

Each section of the screen is used to display certain types of Tiles:

- Section A always shows the Control Tile.
- Sections B and C can be configured to display Measurements Tiles, the Oscilloscope, Channel Analyzer and Audio Tile. Tiles can be displayed simultaneously in Sections B and C if required.
- Section D is the information bar and displays various titles and other information.

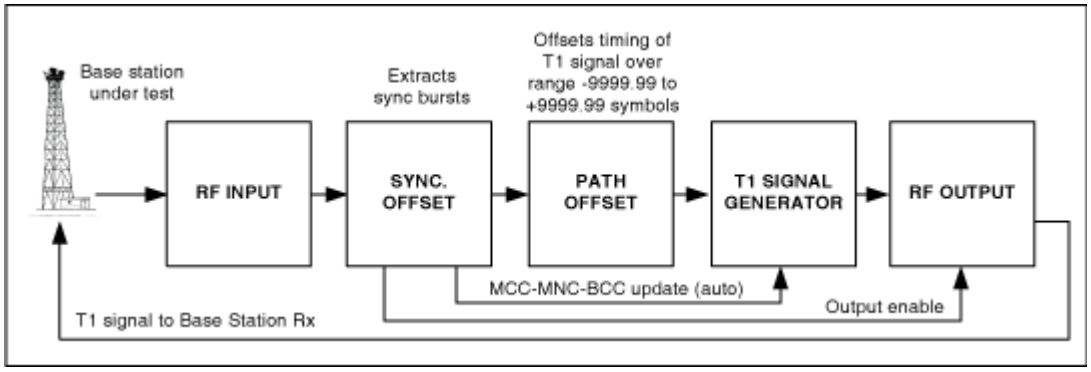
Fig. 8-1 shows the Control Tile selected (Section A). The soft keys displayed are relevant to the Control Tile. The Information Bar displays the operating System title (TETRA BS T1) and indicates that NO PLAN has been selected for the Channel Plan.

8.3 T1 TESTING

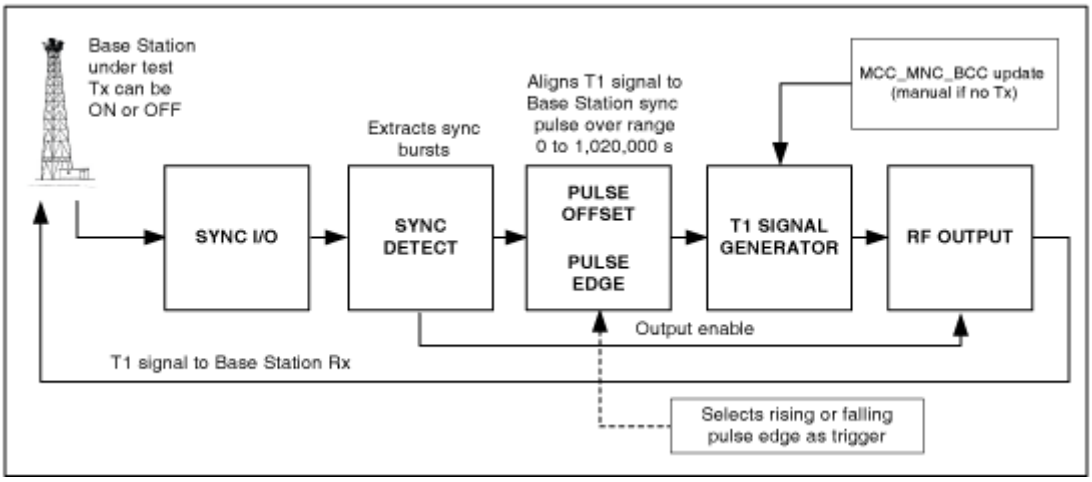
8.3.1 Synchronization

The T1 Test System provides RPBS Signals (T1 Type 7, TCH/7.2 Uplink) which allow BER tests to be carried out on the receiver of the base station under test. The Test Set must be synchronized to the base station frame structure to perform BER testing, so that the transmitted signal is sent in the correct timeslot and frames and within the specified alignment limits.

The Test Set has two synchronization modes, Auto and Pulse. Select the required mode using the Mode button on the Base Station Sync area of the TETRA BS T1 System ID and Sync Configuration Tile. A description of the two modes is provided below. A block diagram has been provided in the illustration below for reference.



AUTO MODE



PULSE MODE

Fig. 8-2 Diagram of Sync to Base Station - Auto and Pulse Modes

8.3.2 Auto Synchronization Mode

The downlink signal from the Base Station under test is fed to the RF input of the Test Set. The SYNC bursts from this signal are used to establish the current position in the downlink frame structure. The signal generated by the Test Set is automatically timed to provide correct synchronization with the base station.

> **NOTE** When Automatic is selected on the Base Station Identity Parameters area of the TETRA BS T1 System ID and Sync Configuration Tile, the T1 Uplink Signal generated by the Test Set automatically uses the MCC-MNC-BCC values captured in the sync burst for scrambling.

The Auto Sync Path Offset parameter controls the time offset between the downlink frame structure and the T1 Uplink Signal from the Test Set within the range -9999.99 symbols to +9999.99 symbols. Positive values advance the timing of the Test Set signal, causing the signal to be generated earlier; negative values delay the timing of the Test Set signal relative to the base station downlink frame structure.

8.3.3 Pulse Synchronization Mode

A synchronization pulse is fed from the base station by physical connection to the Sync BNC connector on the rear of the Test Set. The base station does not need to be transmitting to carry out testing using the Pulse Mode. The signal generated by the Test Set is timed to provide correct synchronization with the base station synchronization pulse.

> **NOTE** The T1 Signal generated by the Test Set must use the same MCC-MNC-BCC values for scrambling as the base station under test. If there is no base station Tx signal, these values must be entered manually on the TETRA BS T1 System ID and Sync Configuration Tile.

The Sync Pulse Offset parameter represents the offset between the start of frame 1, timeslot 1 of the base station's downlink frame structure and the synchronization pulse. For example, a value of 10 ms indicates that the base station's synchronization pulse occurs 10 ms after the start of frame 1, timeslot 1 of the base station's downlink frame structure. The Sync Pulse Edge parameter selects whether timing is referenced to the rising or falling edge of the base station's synchronization pulse. Range is 0 to 1,020,000 ms.

8.3.4 Pulse Specification

The signal applied to the Sync BNC Connector on the rear of the Test Set should conform to the specifications shown below.

Logic 1 Level	+3.85 to +5.00 V (max)†
Logic 0 Level	0 (min)† to 1.35 V
Pulse Width	> 1.0 µs
Pulse Polarity	Rising or Falling
Input Resistance	10 k Ohm ± 5%

> **CAUTION** THE VOLTAGE ON THIS CONNECTOR SHOULD AT NO TIME EXCEED +5.0 V OR BE ALLOWED TO GO NEGATIVE.

8.4 BURST TILE

The Burst Tile provides a graphic representation of the TETRA signal in the selected timeslot. When a TETRA signal is received, a color-coded, horizontal band is generated from right to left on the Burst Tile.

The Timeslot drop-down menu selects the timeslot to be monitored. Unframed PRBS does not contain protocol timing, eliminating the presence of numbered timeslots. When the Expected T1 Type is set to Unframed PRBS, the Burst Tile shows a quarter of the data received instead of specific Timeslots. The functionality of the Timeslot drop-down menu changes to select which quarter of data to display, and the field turns yellow to indicate that it is not applicable to a timeslot.

NOTE	The Burst Tile is intended to provide an indication of the activity present in the TETRA signal. Use Using Data Display Mode for a detailed view of signal content. When the Expected T1 Type is set to Unframed PRBS, the Test Set is unable to detect training sequences in a TETRA signal. As a result, bursts are not displayed on the Burst Tile, Data Display Tile or Tx Measurements Tile and the Burst field on all Tx Measurements Tile turns yellow for all selections except PRBS.

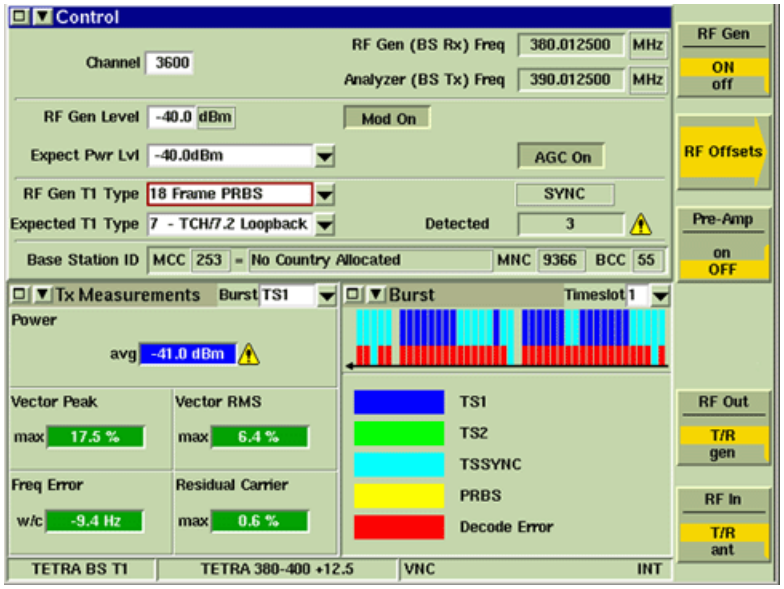


Fig. 8-3 TETRA BS T1 - Burst Tile Measurements Tile location

The Burst Tile uses color-coding to represent various burst types present in TETRA systems. The color-coding allows for quick identification of the information received across the signal.

TETRA BS T1 uses the following color-coding to identify burst type:

	Represents a TS1 burst.
	Represents a TS2 burst.
	Represents a TSSYNC burst.
	Represents a PRBS burst. Appears as a complete bar when present.
	Represents protocol decode failure. Occupies the bottom third of bar when present.

Fig. 8-3 and Fig. 8-4 provide examples of TETRA signals that contains the following:

- Protocol decode errors in red
- TSSYNC bursts in light blue
- TS1 bursts in dark blue

The Burst Tile can be selected from the drop-down menu on the Measurement Tiles as shown in Fig. 8-3, or from the drop-down menu on the Control Tile as shown in Fig. 8-4.

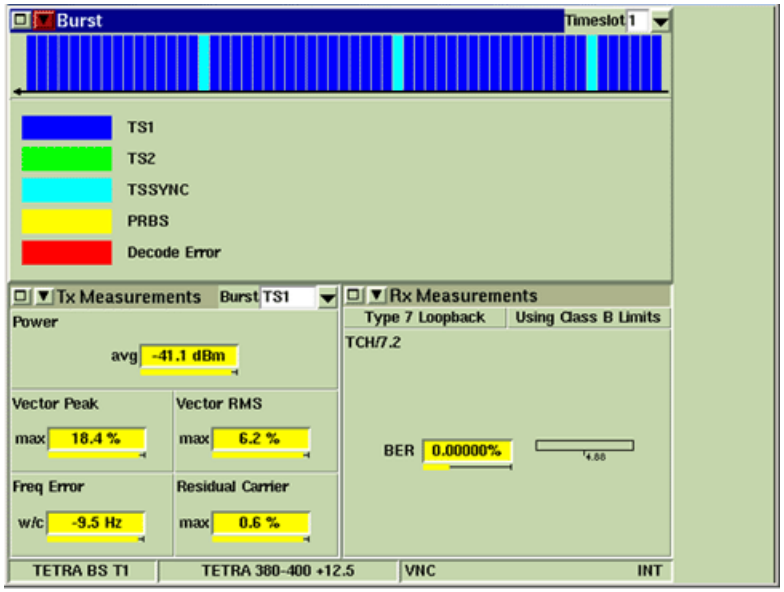


Fig. 8-4 TETRA BS T1 - Burst Tile Control Tile location

8.5 CONTROL TILE

The following parameters must be set on the BS T1 Control Tile whether or not a Channel Plan is selected.

Refer to Chapter 4, Channel Plan Configuration Tile, for information on configuring Channel Plans.

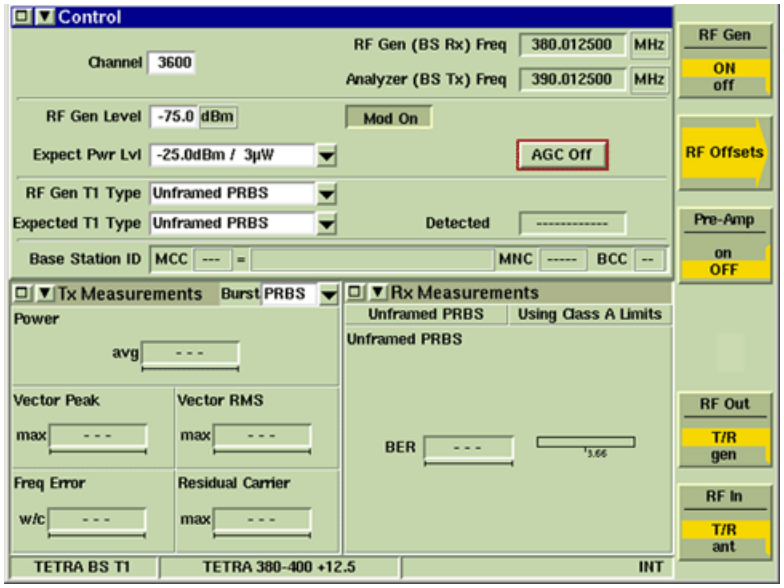


Fig. 8-5 TETRA BS T1 Control Tile - Channel Plan Selected

8.5.1 Field/Soft Key Definitions

8.5.1.A Channel Number

Sets the frequency of the RF Analyzer and the RF Generator within the Test Set to that of the Channel to be used by specifying a Channel Number when a Channel Plan is selected. Enter the required Channel Number in the Channel settings box and press the ENTER key. The output frequency of the Test Set RF Generator is shown in the Gen (BS Rx) Freq field and the input center frequency of the Test Set RF Analyzer is shown in the Ana (BS Tx) Freq field.

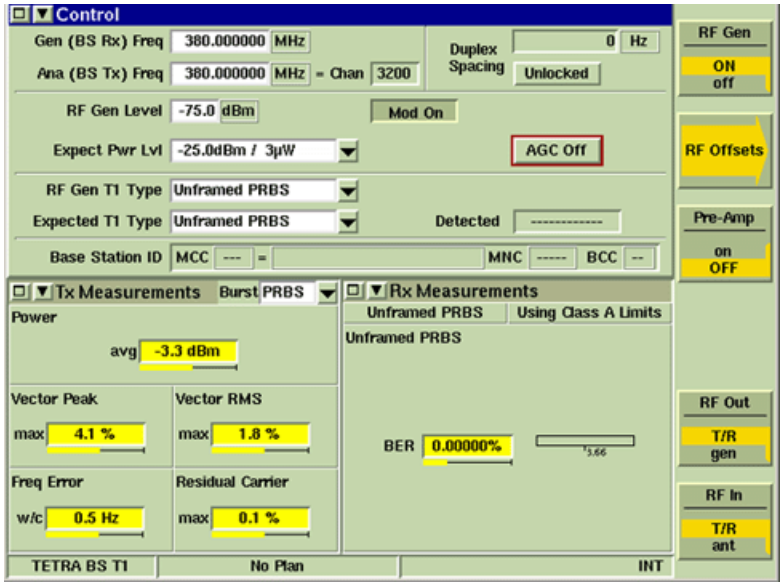


Fig. 8-6 ETRA BS T1 Control Tile - No Channel Plan Selected

8.5.1.B Gen (BS Rx) Freq

Sets the frequency of Test Set's RF Generator. The Channel Number closest to that frequency is displayed in the adjacent = Chan. field. The parameter is applicable when No Plan is selected as the Channel Plan.

8.5.1.C Ana (BS Tx) Freq

Sets the Test Set's RF Analyzer center frequency. The Channel Number closest to the set frequency is displayed in the adjacent = Chan. field. The parameter is applicable when No Plan is selected as the Channel Plan.

8.5.1.D Duplex Spacing

The effect of this parameter depends on the status of the Locked/Unlocked button. The parameter is applicable when No Plan is selected as the Channel Plan.

8.5.1.D.1 Locked

The Duplex Spacing parameter is a setting that controls the frequency differential between the Test Set RF Generator frequency (Gen (BS Rx) Freq) and the Test Set RF Analyzer frequency (Ana (BS Tx) Freq). For example, if Duplex Spacing is set to 10 MHz, the Test Set RF Generator frequency is automatically set 10 MHz lower than the Test Set RF Analyzer frequency. Negative values represent a 'reverse duplex' configuration, in which the Test Set RF Generator frequency is higher than the Test Set RF Analyzer frequency.

8.5.1.D.2 Unlocked

The Duplex Spacing parameter is a reading of the frequency difference between the Test Set RF Generator frequency (Gen (BS Rx) Freq) and the Test Set RF Analyzer frequency (Ana (BS Tx) Freq), provided for information. The Test Set RF Generator frequency (Gen (BS Rx) Freq) and the Test Set RF Analyzer frequency (Ana (BS Tx) Freq) are set independently.

8.5.1.E RF Gen Level

The RF Generator Level parameter is set to any value within the range of the Digital Signal Generator. Default setting is -75 dBm.

NOTE	When RF Offsets are applied, the indicated levels include the Offset values.

8.5.1.F Modulator

The Mod On toggle button enables and disables the Test Set's internal modulation generators.

8.5.1.G RF Gen

Indicates the state of the Test Set RF Generator. The soft key provides an overall enable/disable for the RF generator, so that when the soft key indicates OFF, the RF generator is always off. The RF Generator is only turned ON when the Test Set is synchronized to the signal received from the base station (RF signal or pulse as appropriate) and when the soft key indicates ON.

The RF OFF indicator disappears when the RF Generator is turned ON and the Test Set is receiving the sync signal from the base station. When the RF Generator is ON, and the Test Set is not receiving the base station sync signal, the RF OFF indicator is displayed.

8.5.1.H Expected Power Level

Specifies an expected power input level for the Test Set. The RF Analyzer attenuators must be set to the values required for this input level. The range of values available for selection at any time depends on which RF input connection is selected and the value of any RF input offset that is set. When AGC function is ON the set Power Level is overridden.

8.5.1.I AGC (Automatic Gain Control)

The Expected Power Level setting is overridden by the AGC function if the AGC Button is set to the ON state. With the AGC set to ON the Test Set optimizes the gain of the RF analyzer to give the best resolution to the measurements made to the signal.

8.5.1.J RF Gen T1 Type

The RF Gen T1 Type drop-down menu selects the T1 Signal Type sent to the base station under test. When Detected is selected, the Test Set identifies the type of T1 Signal requested in the system information contained in the RF signal received from the Base Station and produces a T1 Signal of that type (this applies to T1 Types 7, 8, 9 and 10).

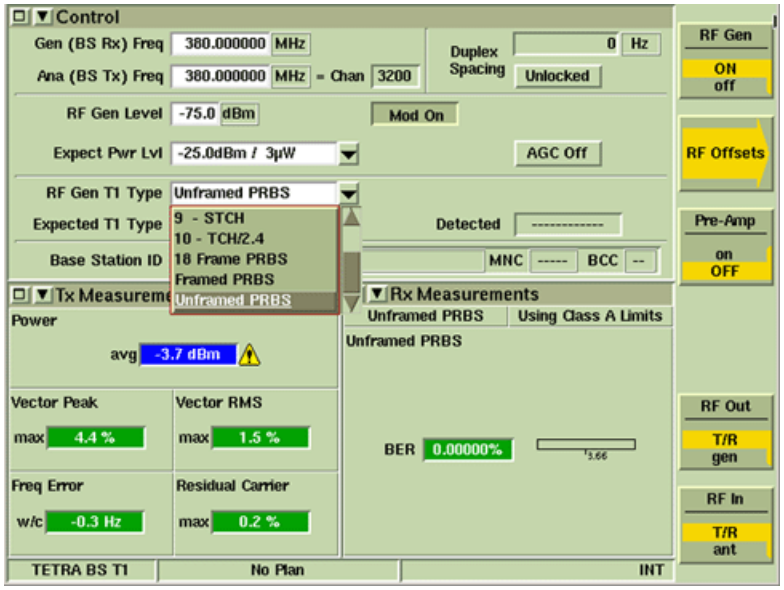


Fig. 8-7 TETRA BS T1 RF Gen T1 Type Drop-down Menu

8.5.1.J.1 T1 Types 7, 8, 9 and 10

T1 Types 7, 8, 9 and 10 are the uplink T1 Signals specified in ETSI EN 300 394-1 for base station receiver testing.

Type 7 (TCH/7.2) and Type 10 (TCH/2.4) are used for BER testing with no protection and high protection respectively.

Type 8 (SCH/F) and Type 9 (STCH) are used for MER testing with full slot and half slot signaling respectively.

When the RF Gen T1 Type is set to 7, 8, 9 or 10, the Test Set generates a fixed signal of that type. When the RF Gen T1 Type is set to Detected, the Test Set generates T1 Type 7, 8, 9 or 10 automatically according to the type requested by the base station.

8.5.1.J.2 Other Signal Types

The other types of signals (18 Frame PRBS, Framed PRBS, Unframed PRBS) are only generated when a fixed signal of that type is selected.

18 Frame PRBS follows the TETRA TDMA frame structure and is similar to T1 Type 7 (TCH/7.2), except that the TCH/7.2 signal (and the PRBS pattern) extends to frame 18, not just frames 1 to 17; the structure of timeslot 1 is therefore the same as the structure of the other three timeslots, each of which carries an independent TCH/7.2 PRBS signal. There is, in effect, no multi-frame structure of 18 frames, since the signal in each timeslot continues uninterrupted each TDMA frame of four timeslots. These TCH/7.2 PRBS signals are subject to scrambling, as with the T1 Signals.

Framed PRBS does not follow the TETRA TDMA frame structure and generates a continuous sequence of Normal Uplink Bursts with Training Sequence 1. Each burst contains 432 bits of O.153 511-bit PRBS-9 data, and the PRBS sequence continues from one burst to the next. This signal is subject to scrambling, as with the T1 Signals.

Unframed PRBS does not follow any burst or frame structure and generates a continuous stream of modulating bits obtained directly from O.153 511-bit PRBS-9 data. This signal is not subject to any scrambling.

8.5.1.K Scrambling

With the exception of the Unframed PRBS signal, all of the signal types generated by the Test Set are subject to scrambling, and are expected to be subject to de-scrambling when received by the base station. The base station normally indicates the scrambling code that it expects the Test Set to use by setting the values of the MCC, MNC and BCC parameters accordingly.

When the Test Set Base Station Identity Parameters are set to Update - Automatic, the Test Set automatically uses the correct scrambling sequence as indicated by the base station. Select Update - Manual and set these values manually if the base station does not use these parameters to indicate its expected scrambling sequence, or if testing a base station receiver independently from its transmitter or if the transmitter is switched OFF.

8.5.1.L Expected T1 Type

Sets the type of T1 Signal expected by the Test Set. When Loopback or a Type 7, 8, 9 or 10 Loopback T1 Signal is selected, the Test Set expects the base station to re-transmit the received signal for BER measurement by the Test Set.

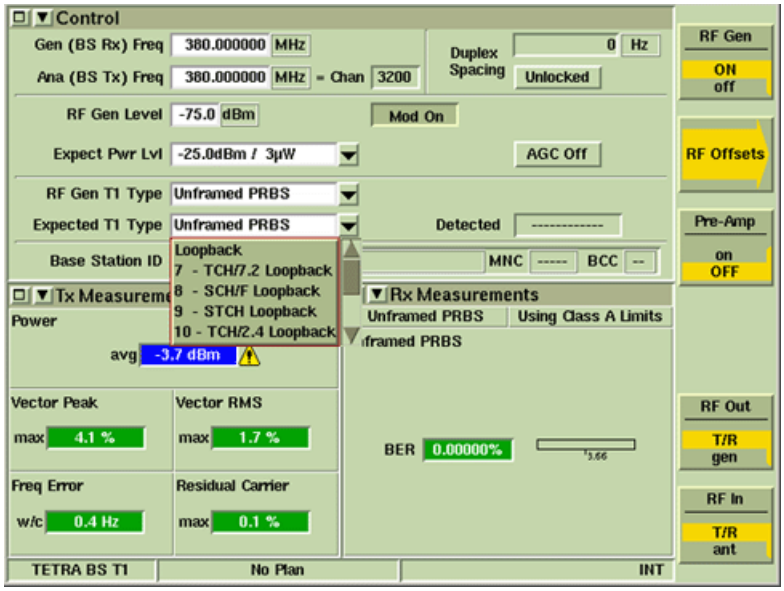


Fig. 8-8 TETRA BS T1 Expected T1 Type Drop-down Menu

The expected T1 Type directly controls the type of BER and/or MER Rx measurements performed by the Test Set in the Rx Measurements Tile. When the expected T1 Type is set to Type 7 Loopback, Type 8 Loopback, Type 9 Loopback or Type 10 Loopback, the Test Set expects the base station to be in a mode in which it re-transmits to the Test Set PRBS data received on the corresponding uplink T1 Channel Type. The loopback data is always contained in a TCH/7.2 signal, regardless of the type of uplink T1 Channel, and the format for the loopback data is as defined in ETSI EN 300 394-1, Annex D, Clauses D.8.4.5 to D.8.4.8. Rx Measurements are performed by the Test Set according to the expected T1 Type.

NOTE	If the base station is not performing loopback, or is transmitting a different type of signal, these measurements will not be representative of the base station receiver performance.

When the Expected T1 Type is set to TCH/7.2 PRBS, 18 Frame PRBS, Framed PRBS or Unframed PRBS, the Test Set may perform a BER measurement on the signal transmitted by the base station. However, such signals are likely to be autonomously transmitted by the base station, so any BER measurements made on these signals reflect the accuracy of the content of the transmitted signal (Tx BER) rather than being a measure of the base station receiver performance.

When the expected T1 Type is set to Loopback, the Test Set expects the base station to be in a mode in which the PRBS data is received on the same uplink T1 Channel Type as which the Test Set is currently transmitting (7, 8, 9 or 10) is re-transmitted to the Test Set. The Test Set does not have control over the types of signals that the base station is generating or expecting to receive. However, the base station can control the Test Set, if the Test Set RF Gen T1 Type is set to Detected and the Test Set Expected T1 Type is set to Loopback. In this case, the base station should be set up to indicate (in its transmitted downlink T1 Signal) the type of T1 Signal it is expecting to receive (in the uplink T1 Signal generated by the Test Set) and to loopback the received data in the downlink T1 Signal that it transmits to the Test Set. The Test Set then generates the requested T1 Signal Type and measures the BER/MER for that type automatically.

8.5.1.M Detected

Displays the type of T1 Signal detected by the Test Set, i.e., the T1 Type indicated by the base station in its downlink T1 Signal specifying the type of uplink T1 Signal that it is expecting the Test Set to generate. This field may be blank if the signal transmitted by the base station is something other than the T1 Test Signal defined in ETSI EN 300 394-1.

8.5.1.N Base Station ID: MCC; =; MNC; BCC

Displays the Base Station Identity information contained in the T1 Signal from the Base Station. If the Test Set Base Station Identity Update parameter is set to Automatic, these displayed values also indicate the scrambling code used by the Test Set for de-scrambling downlink signals received from the base station and for scrambling uplink signals generated by the Test Set. If the Test Set Base Station Identity Update parameter is set to Manual, these displayed values indicate the values contained in the base station T1 Signal, which may be different from the values manually set in the Test Set. These fields may be blank if the signal transmitted by the base station is something other than the T1 Test Signal defined in ETSI EN 300 394-1.

8.5.1.O RF Gen Soft Key

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

8.5.1.P Pre-Amp Soft Key

The 3900 is equipped with an internal 15 dB broadband amplifier that affects the T/R and ANT Input Ports. When Pre-Amp is ON, the 3900 has a typical noise figure of -9 dB, resulting in a noise floor level around -140 dBm in the spectrum analyzer (RBW = 300 Hz) and around -126 dBm for the Inband power meter (IF = 6.25 kHz). Use of the Pre-Amp feature dramatically increases the sensitivity of the 3900.

NOTE	When Pre-Amp is used, special attention is required; it is a broadband amplifier and could lead to saturation or compression problems in the receiver chain if the signal of interest is very low, but a strong out of band signal is present.

8.5.1.Q RF Offsets Soft Key

Opens a soft key sub-menu that selects to Include or Exclude any set Analyzer or Generator Offset.

8.5.1.R Gen Offset Soft Key

The Gen Offset Soft Key controls the use of the RF Generator Level Offset value.

ON inserts the defined RF Generator Level Offset into the RF Path between the selected 3900 generator output connector and the device under test.

OFF removes the defined RF Generator Level Offset from the RF Path between the selected 3900 generator output connector and the device under test.

8.5.1.S Ana Offset Soft Key

The Ana Offset Soft Key controls the use of the RF Analyzers Level Offset value.

ON inserts the defined RF Analyzers Level Offset into the RF Path between the selected 3900 receiver input connector and the device under test.

OFF removes the defined RF Analyzers Level Offset from the RF Path between the selected 3900 receiver input connector and the device under test.

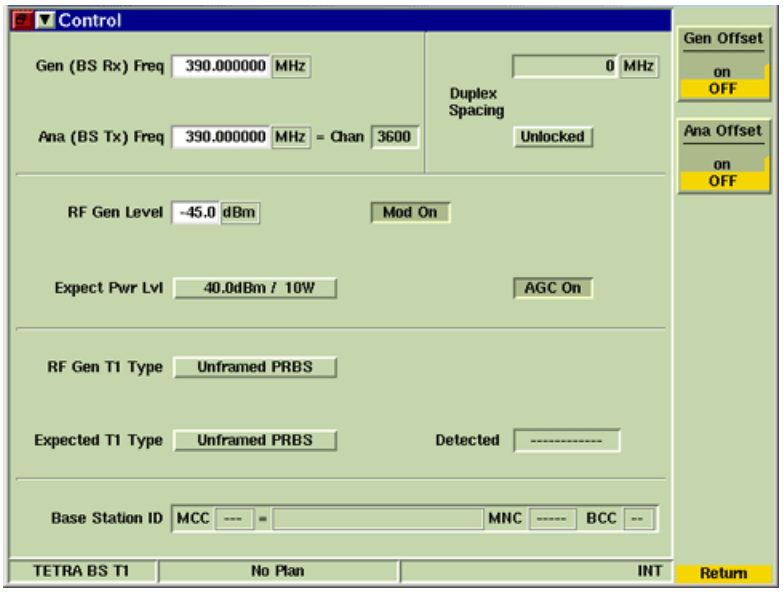


Fig. 8-9 TETRA BS T1 Generator and Analyzer Offset Soft Keys

8.5.1.T RF Out Soft Key

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

8.5.1.U RF In Soft Key

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

8.6 TX MEASUREMENTS TILE

Measurement Tiles display the results of measurements of the signals produced by the base station under test. Any two Measurement Tiles can be viewed when the display is minimized, they can also be maximized to full screen display. The Tiles are selected from the drop-down menu on each tile.

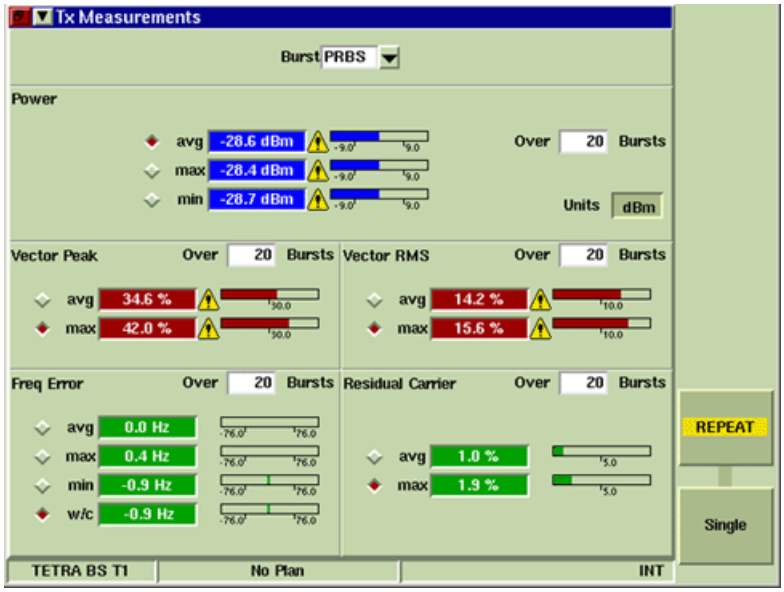


Fig. 8-10 TETRA BS T1 Tx Measurements Tile - Maximized View

The TETRA BS T1 Tx Measurements Tile operates the same as the Tx Measurements Tile in the TETRA BS System. Upper and Lower limits are defined on the Tx Measurements Limits Configuration Tile.

When the base station is transmitting a downlink T1 Signal conforming to ETSI EN 300 394-1, bursts with Normal Training Sequence 2 (TS2) only occur when the base station is performing linearization. Synchronization bursts may contain linearization activity, and bursts with Normal Training Sequence 1 (TS1) never contain linearization activity. Therefore, Burst Type TS1 should be selected to always exclude linearization activity from Tx measurements, or Burst Type TS2 to only make measurements during linearization activity. When the base station is transmitting something other than the ETSI T1 Signal, this relationship between burst type and linearization activity cannot be guaranteed.

8.6.1 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

8.6.2 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

Chapter 9 - TETRA DM System

9.1 INTRODUCTION

TETRA DM (Direct Mode) is an optional TETRA system that provides features for testing TETRA Mobile to Mobile functionality. The Test Set functions as the Master when a Call Mobile request is initiated from the Operations/Status Tile. When a call is initiated by the Mobile, the mobile operates as the Master. When the system is operating in Quiet State, no actions are performed (i.e., registration, group attachment or synchronization). The TETRA DM System provides the following test capabilities:

The TETRA DM System provides the following test capabilities:

- Mobile to mobile tests.
- Transmitter measurements (power, modulation accuracy, frequency error).
- Graphical displays of modulation, trajectory, constellation and power readings.
- History log of activity between mobile and Test Set.

9.2 TETRA DM DISPLAY LAYOUT

The Manual - Tiled Display Mode provides a display screen divided into six sections. Fig. 9-1 shows TETRA DM with Manual - Tiled Display Mode selected and with the Tiles minimized.

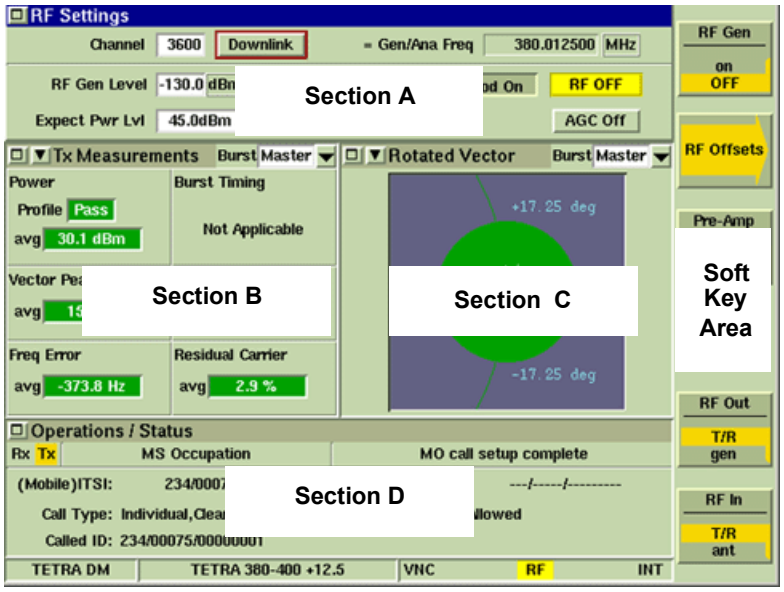


Fig. 9-1 TETRA DM System Display - Minimized Tiles

Each section of the screen is used to display certain types of Tiles:

- Section A always shows the RF Settings Tile.
- Sections B and C can be configured to display Measurements Tiles, the Protocol History Tile, the Oscilloscope and the Channel Analyzer. Tiles can be displayed simultaneously in Sections B and C.
- Section D always displays the Operations/Status Tile.

Fig. 9-1 shows the RF Settings Tile selected (Section A). The soft keys displayed are relevant to the RF Settings Tile. The Information bar displays the System title TETRA DM and indicates that TETRA 380-400 +12.5 Channel Plan has been selected.

Refer to section titled Channel Plans in Chapter 2 for instructions on configuring channel plans).

9.3 TETRA DM CONFIGURATION TILES

9.3.1 Call Timers Configuration Tile

Call Timers parameters are set from the Call Timers Configuration Tile. These parameters control Test Set behavior during a call.

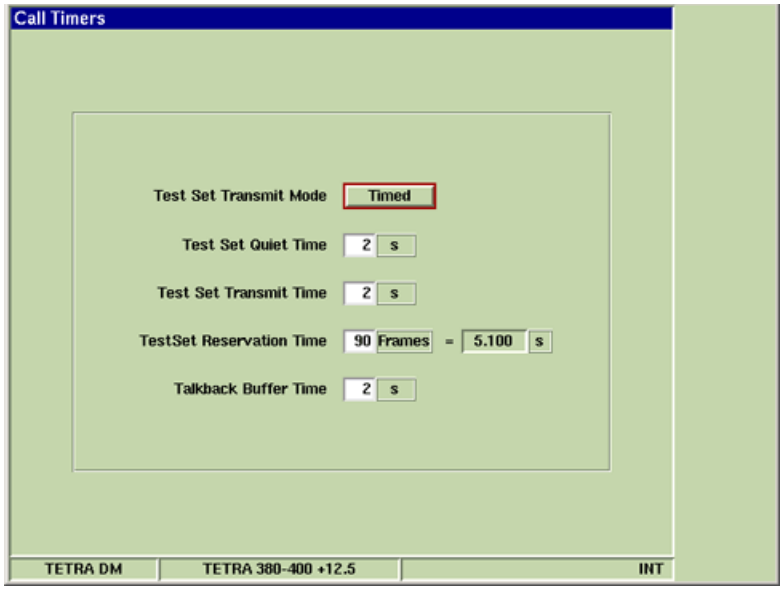


Fig. 9-2 TETRA DM Call Timers Configuration Tile

9.3.1.A Field Definitions

9.3.1.A.1 Test Set Transmit Mode

Test Set Transmit Mode allows users to select the Test Set behavior on a simplex call when the mobile is not transmitting.

None

The Test Set does not automatically simulate another user transmitting when the mobile under test is not transmitting. Press the PTT button on the mobile at any time to request transmission or the user can manually simulate another user transmitting. Group calls are subject to the Test Set Reservation Time setting.

Timed Mode

When the PTT button of the mobile under test is released, the Test Set waits for the Test Set Quiet Time period. During the Test Set Quiet Time period, the mobile's PTT button may be pressed again to request permission to transmit, which the Test Set always grants. If the mobile's PTT button is not pressed, the Test Set simulates another user talking for the Test Set Transmit Time period, after which it reverts to Quiet Mode. During Quiet Mode the mobile's PTT button may be pressed again to request transmission. In a group call, the maximum duration of Quiet Mode is determined by the Test Set Reservation Time period. When the Test Set Reservation Time expires, the Test Set automatically clears down a group call. Timed is the default Transmit Mode.

Continuous Mode

When the PTT button of the mobile under test is released, the Test Set immediately simulates another user talking for an indefinite length of time until the Test Set Transmit Cease Soft Key is pressed. Depending on the mobile, it may be possible to interrupt the other user and request to transmit by pressing the mobile's PTT button again. Timer values do not apply when Continuous Mode is selected. To keep the mobile receiver open in a simplex call, select Continuous Mode as the Test Transmit Mode or select None and manually control Test Set transmission.

9.3.1.A.2 Test Set Quiet Time

Defines the period for which the Test Set waits after the mobile's PTT button is released before simulating another user talking in Timed Mode. Range is 0 to 30 s. Default setting is 2 s.

9.3.1.A.3 Test Set Transmit Time

Defines the period for which the Test Set simulates another user talking in Timed Mode. Range is 1 to 30 s. Default setting is 2 s.

9.3.1.A.4 Test Set Reservation Time

Defines the period following the end of Test Set transmission. At the end of Test Set transmission, if the mobile does not send a change over request the call is cleared down. The Reservation Time is entered as the number of frames, which are rounded to the nearest multiple of 6. Range is 0 to 378.

9.3.1.A.5 Talkback Buffer Time

When the mobile is transmitting, the incoming speech is recorded in the Talkback Buffer. The contents of the Talkback Buffer are replayed for subsequent transmission from the Test Set to the mobile. Range is 1 to 30 s.

When set to 2 s, the last 2 s of incoming speech are recorded and replayed repeatedly during the simplex Test Set transmission.

9.3.2 Call Types Configuration Tile

The Call Types Configuration Tile defines parameters for the selected Call Type. A Call Type is selected from the Call Type drop-down menu, which displays the associated Tile. Each Call Type opens a specific display Tile.

Parameters can be configured for each call type: some parameters for some call types are pre-configured. Parameters that can be edited are displayed in a numeric entry box or a drop-down selection box as appropriate.

NOTE	Not all combinations of call type options are valid. If an invalid combination is selected the call may fail.

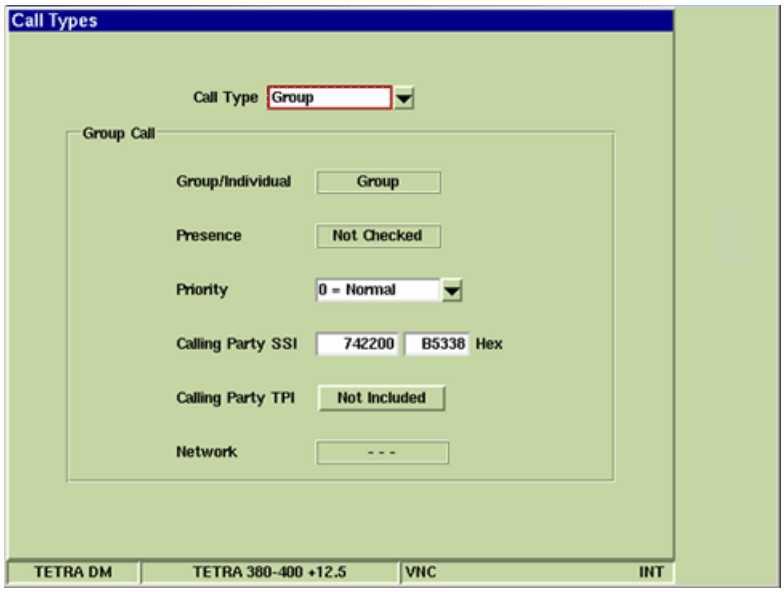


Fig. 9-3 TETRA DM Call Types Configuration Tile

The following tables show the parameters for each call type, with the default values and available ranges, or pre-configured values where appropriate.

9.3.2.A Call Type Parameters

9.3.2.A.1 Group Call

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Group Call	Pre-defined value
Presence	Not Checked	Pre-defined value
Priority	0 = Normal	0 = Normal, 1 = High, 2 = Pre-emptive, 3 = Emergency
Calling Party SSI	742200 (Test Set)	00000000 to 16777215
Calling Party TPNI	Not Included	Included, Not Included
Network	--	Pre-defined (none)

9.3.2.A.2 Private Call

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Individual Call	Pre-defined value
Presence	Not Checked	Not Checked
Priority	0 = Normal	0 = Normal, 1 = High, 2 = Pre-emptive, 3 = Emergency
Calling Party SSI	742200 (Test Set)	00000000 to 16777215
Calling Party TPNI	Not Included	Included, Not Included
Network	--	Pre-defined (none)

9.3.2.A.3 Emergency Call

Parameter	Defaults or Pre-configured Value	Range
Group/Individual	Group Call	Group/Individual Call
Presence	Not Checked	Group Call: Pre-defined to Not Checked Individual Call: Set to Checked, Not Checked
Priority	Emergency	Pre-defined value
Calling Party SSI	742200 (Test Set)	00000000 to 16777215
Calling Party TPNI	Not Included	Included, Not Included
Network	--	Pre-defined value

9.3.2.A.4 Open Group

Parameter	Defaults	Range
Group/Individual	Group Call	Pre-defined value
Presence	Not Checked	Pre-defined value
Priority	0 = Normal	0 = Normal, 3 = Emergency
Calling Party SSI	16777186 (PABX gateway)	00000000 to 16777215
Calling Party TPNI	Not Included	Not Included, Included
Network	Mobile MCC-MNC	Mobile MCC-MNC, Open Channel

9.3.3 Channel Plan Configuration Tile

TETRA DM uses non-allocated RF Carriers, referred to as DM Channels, to allow valid users to access an uplink or downlink DM Channel at any time. TETRA DM protocol uses group and individual addresses as a means of controlling the use of the DM channel. TETRA DM protocol does not specify Channel Plans in the same manner as TETRA MS specifications; TETRA DM mobiles are typically configured to operate using Channel Plans that are based on TETRA MS parameters. The Channel Plan Configuration Tile allows users to select the desired Channel Plan or to define a Channel Plan.

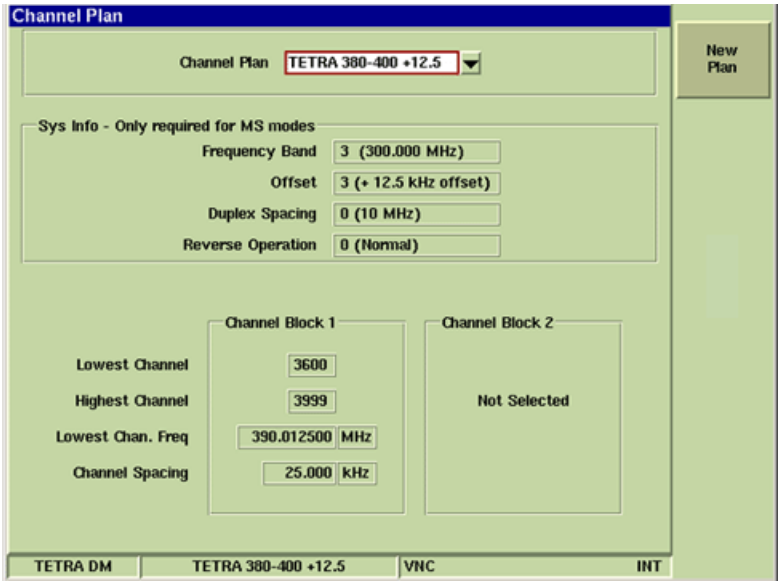


Fig. 9-4 TETRA DM Channel Plan Configuration Tile

9.3.4 Messages Configuration Tile

The Messages Configuration Tile is configured to meet the requirements of the message type to be used for testing. The Message Type drop-down menu selects the message type. TETRA DM supports Status Messages, SDS Type 1, 2 and 3 Messages and SDS Type 4 Messages.

Refer to Chapter 4, Common TETRA Configuration Tiles, for a more detailed description of the Messages Configuration Tile.

9.3.4.A Status Message Tile

A Mobile Originated Status Messages has the following characteristics:

- 16-bit number with pre-defined meaning.
- Message is addressed to an individual TETRA user or a group of TETRA users.

A Mobile Terminated Status Message has the following characteristics:

- 16-bit number with pre-defined meaning.
- Message is addressed to an individual TETRA user or a group of TETRA users

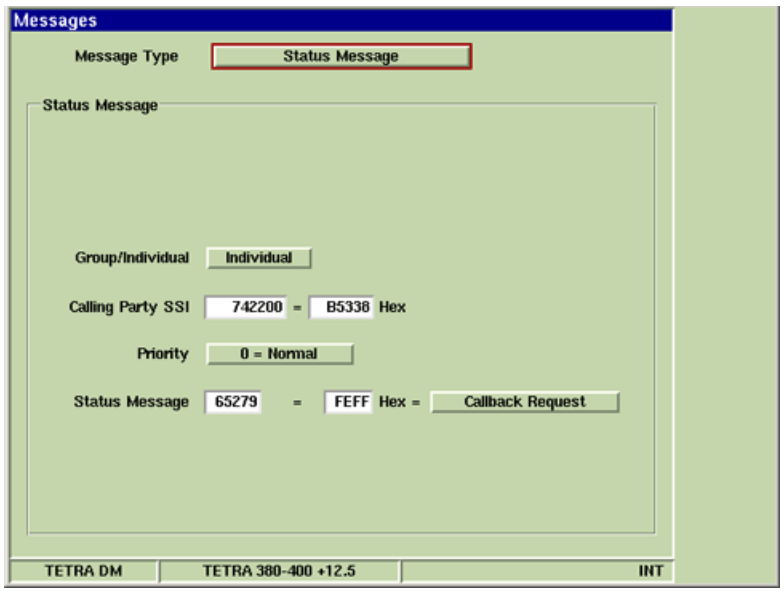


Fig. 9-5 TETRA DM Status Message Configuration Tile

9.3.4.B Mobile Originated Short Data (SDS) Message

A Mobile Originated Short Data Messages has the following characteristics:

- Type 1: 16-bit number
- Type 2: 32-bit number
- Type 3: 64-bit number
- Type 4: variable length Text Message or other SDS-TL application

TETRA DM supports SDS Type 1, 2 and 3 messages and four types of SDS Type 4 messages. The ability to receive SDS message types depends on the capabilities and configuration of the mobile under test.

9.3.4.C SDS Type 1, 2 & 3

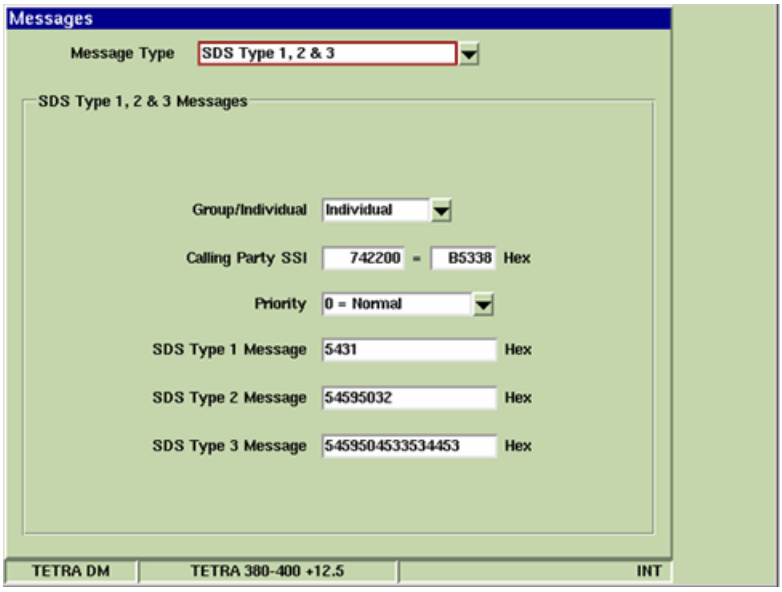


Fig. 9-6 TETRA DM - SDS Type 1, 2 &3 Message Tile

Mobile Terminate Short Data Message Types have the following characteristics:

- Type 1: 16-bit number
- Type 2: 32-bit number
- Type 3: 64-bit number

Message is addressed to an individual TETRA user or a group of TETRA users

9.3.4.D SDS Type 4 - SDS - TL Text Message

A Mobile Terminated Short Data Message has the following characteristics:

- Variable length user application data.
- SDS-TL Header identifier message control.
- SDS-TL Header delivery reports may be requested.
- Message is addressed to an individual TETRA user or a group of TETRA users.

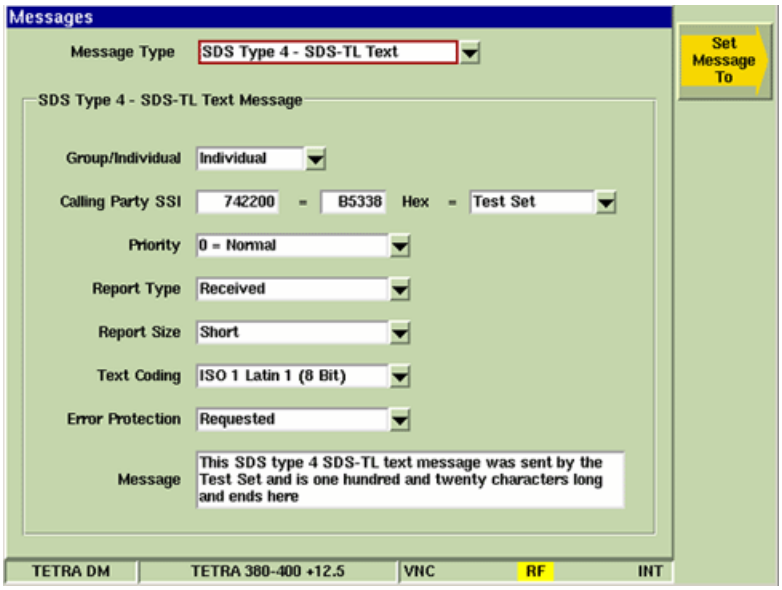


Fig. 9-7 TETRA DM - SDS Type 4 - TL Text

SDS Type 4 Messages are of variable length and use the SDS Transport Layer (SDS-TL) protocol to identify their content and request delivery reports. All SDS Type 4 Messages should contain at least a minimal 8-bit Protocol identifier as specified in ETSI EN 300 392-2 Clause 29.

The Test Set provides a minimal single line display of the form SDS Msg: Type 4 (xxx) xxxxxx when any SDS type 4 Message is received. Select the yellow envelope icon to display the full message content.

SDS Message types are described in detail in Chapter 5, TETRA MS System, in the section titled Status and Short Data (SDS) Messages.

9.3.4.E SDS Type 4 - Simple Text Message

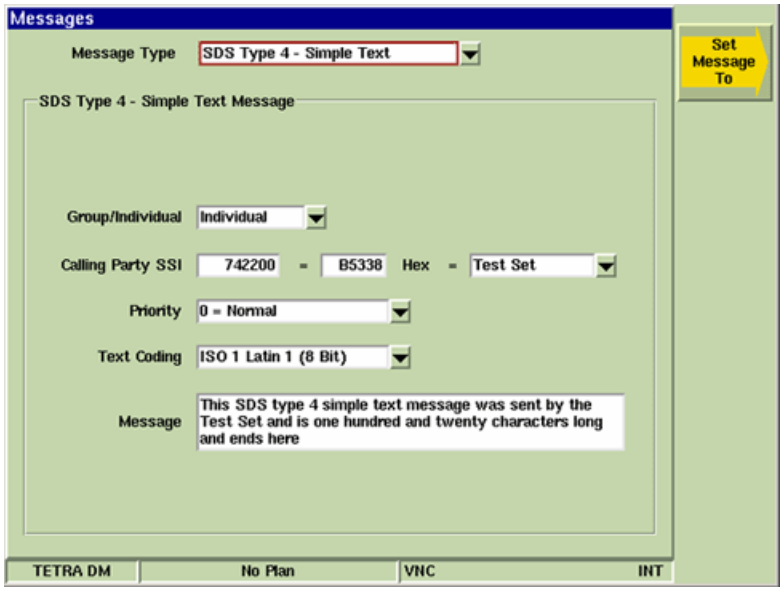


Fig. 9-8 TETRA DM - SDS Type 4 - Simple Text

A Mobile Terminated Short Data Message Type 4 - Simple Text Message type has the following characteristics:

- Variable length text message.
- SDS-TL header identifies message content.
- SDS-TL delivery reports may not be requested.

9.3.4.F SDS Type 4 - Hex Message

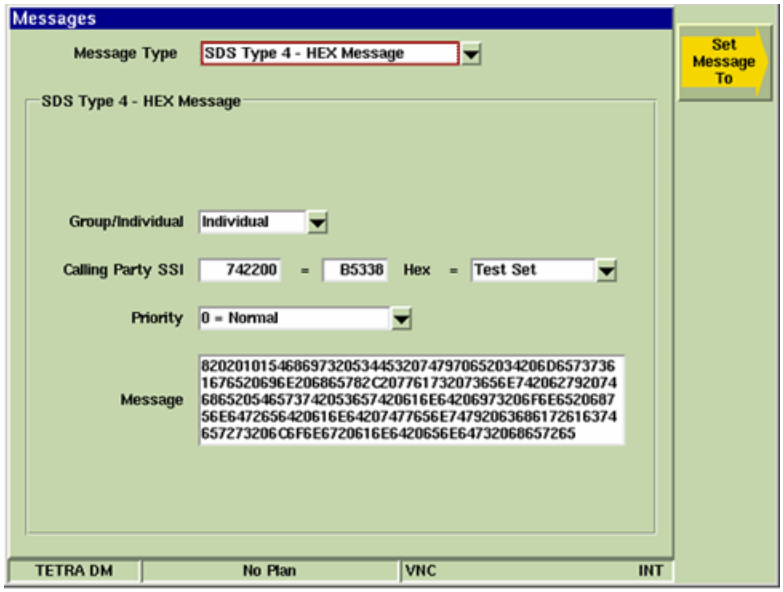


Fig. 9-9 TETRA DM - SDS Type 4 - Hex Message

A Mobile Terminated Short Data (SDS) Message Type 4 - Hex Message has the following characteristics:

- Variable length user application data.
- SDS-TL header not sent - include in message data if required or use SDS-TL other.
- SDS-TL delivery reports not requested - include request in message data if required or use SDS-TL other.

9.3.4.G SDS Type 4 - Other SDS-TL

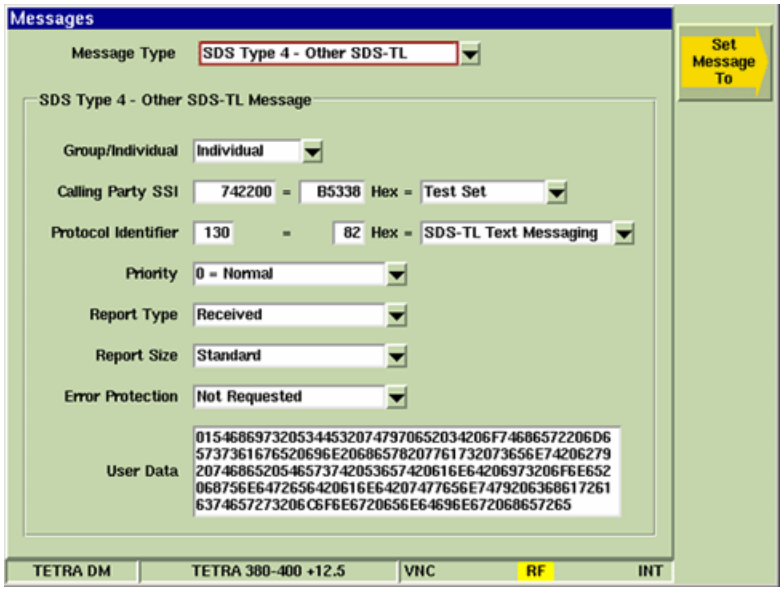


Fig. 9-10 TETRA DM - SDS Type 4 - Other SDS-TL

A Mobile Terminated Short Data Message Type 4 has the following characteristics:

- Variable length user application data.
- SDS-TL Header identifier message control.
- SDS-TL Header delivery reports may be requested.
- Message is addressed to an individual TETRA user or a group of TETRA users.

9.3.5 Mobile Parameters Configuration Tile

The Mobile Parameters Tile allows changes to be made to the mobile radio's MNI, SSI, GSSI and Power Class. User can select Use Reported, which defines the values according to the information provided by the mobile under test, or user can select Use Fixed to enter specific values.

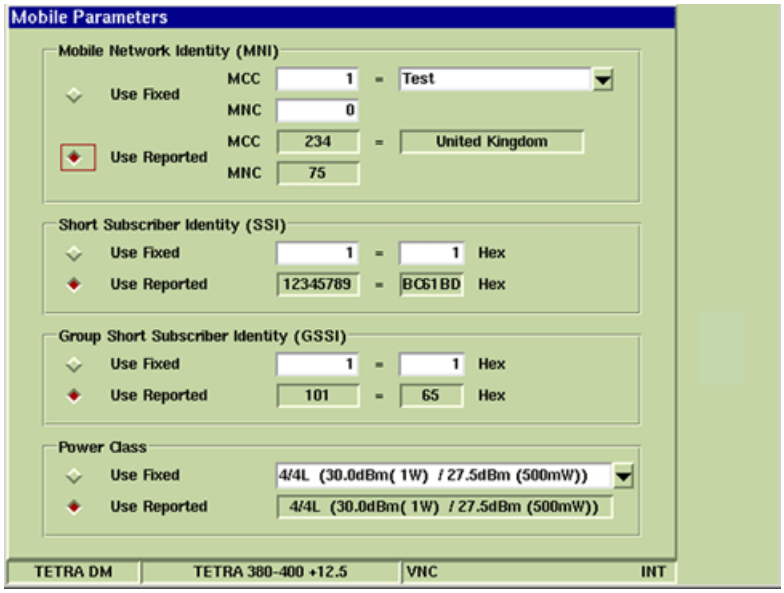


Fig. 9-11 TETRA DM Mobile Parameters Configuration Tile

9.3.5.A Field Definitions

9.3.5.A.1 Use Fixed

To use a manually entered value, select Use Fixed and enter the desired values in the data fields.

9.3.5.A.2 Use Reported

When Use Reported is selected the Test Set must receive a mobile originated call in order to acquire the values used when the Test Set places a call. If Use Reported is selected and the Test Set has not received a mobile originated call, the Test Set uses the last Use Fixed values.

9.3.5.A.3 Mobile Network Identity (MNI)

Mobile Country Code (MCC)

Sets the MCC sent to the mobile. The MCC Text drop-down menu selects an MCC by name if the MCC is known. Range is 0 to 999 (decimal).

Mobile Network Code (MNC)

Sets the MNC sent to the mobile in the Broadcast Synchronization Information. Range is 0 to 16383 (decimal).

9.3.5.A.4 Short Subscriber Identity (SSI)

The Short Subscriber Identity is used by the Test Set to make calls or send messages to the mobile. When Use Reported is selected, the value is automatically updated when the Test Set receives a call from the mobile.

9.3.5.A.5 Group Short Subscriber Identity (GSSI)

The Group Short Subscriber Identity is used by the Test Set to make a group call or send a group addressed message to the mobile. If the mobile has initiated a call to a group, the group is indicated as the reported value when Use Reported is selected; otherwise the last Use Fixed values are used.

9.3.5.A.6 Power Class

The Power Class of the mobile is used by the Test Set to determine the maximum power level expected from the mobile. The Power Class of the mobile is used to indicate the accuracy of the Test Set's estimation of the mobile power level displayed. When Tx Measurement Limits are enabled, the Power Class decides the Pass/Fail limits for the Tx Power measurement and bar graph.

9.3.6 Test Set Parameters Configuration Tile

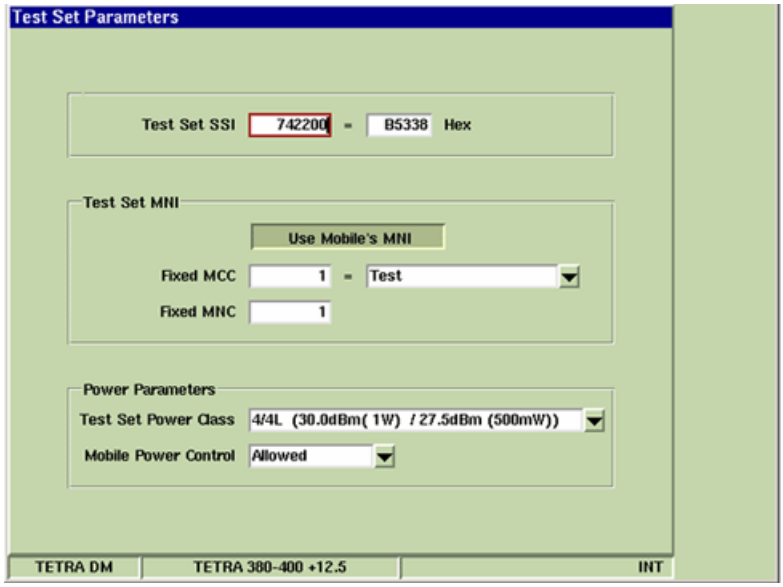


Fig. 9-12 TETRA DM Test Set Parameters Configuration Tile

9.3.6.A Field Definitions

9.3.6.A.1 Test Set Short Subscriber Identity (SSI)

The Short Subscriber Identity is used by the mobile to make calls or send messages to the Test Set. Registration does not occur between the Test Set and mobile during DM operation so the SSI must be entered manually.

9.3.6.A.2 Test Set MNI

Mobile Country Code (MCC)

Sets the MCC sent to the mobile in the Broadcast Synchronization Information. The MCC Text drop-down menu selects an MCC by name if the MCC is known. Range is 0 to 999 (decimal).

Mobile Network Code (MNC)

Sets the MNC sent to the mobile in the Broadcast Synchronization Information. Range is 0 to 16383 (decimal).

9.3.6.A.3 Power Parameters

Test Set Power Class

Sets the Test Set's Power Class so that the mobile can determine the maximum power level expected from the Test Set. Sets the Power Class to the maximum power level expected to be received.

Mobile Power Control

When the Test Set is acting as the Master, the Power Control flag determines whether or not the Test Set allows the mobile, which is acting as the Slave, to control power.

The power control flag is present in the following message types:

- DM - RESERVED
- DM - SETUP
- DM - SETUP PRES
- DM - CONNECT ACK
- DM - OCCUPIED

9.3.7 Tx Measurements Limits Configuration Tile

The Tx Measurements Tile defines Pass/Fail limits that are applied to measurements on the Tx Measurements Tile, Modulation Accuracy Tiles and Power Profile Tiles. The limits shown on the Tx Measurement bar graphs are also obtained from the Tx Measurements Limits settings.

The Tile for each burst type is opened by selecting the desired burst type from the Burst drop-down menu. The example below shows the Configuration Tile with Master burst type selected. The limits applicable to each burst type are set independently. The Toggle Buttons Enable and Disable individual parameters or groups of parameters. The Burst Timing, or frame alignment measurement, shows the measured symbol timing of the mobile's Slave bursts. Burst Timing is only applicable to Slave bursts. 'Not Applicable' is displayed in this Tile area for all other burst types.

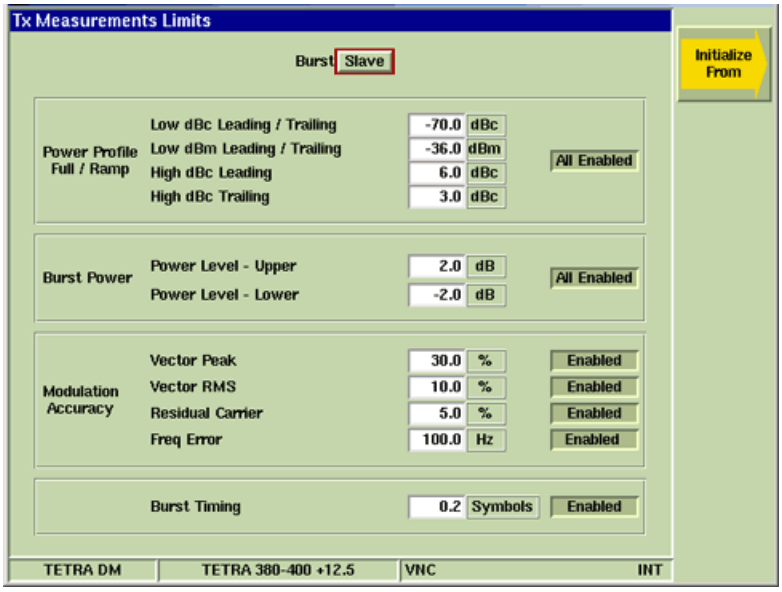


Fig. 9-13 TETRA DM Tx Measurements Limits Configuration Tile

9.3.8 Offsets Configuration Tile

The TETRA DM Offsets Configuration Tile functions in the same manner as the Offsets Configuration Tile in TETRA MS and BS Systems. Refer to Chapter 4, Common TETRA Configuration Tiles for information on this Tile.

9.4 TETRA DM TEST TILES

9.4.1 Burst Tile

The Burst Tile provides a graphic representation of the TETRA signal in the active timeslot. The data displayed on the TETRA DM Burst Tile is dependent on which timeslots contain data. By default, the TETRA DM Burst Tile displays timeslot one, so long as it contains information. If timeslot one is empty, the TETRA DM Burst Tile displays timeslot three if it contains any data. If timeslot one and three contain data, timeslot one is displayed.

NOTE	The Burst Tile is intended to provide an indication of the activity present in the TETRA signal. Use Using Data Display Mode for a detailed view of signal content.

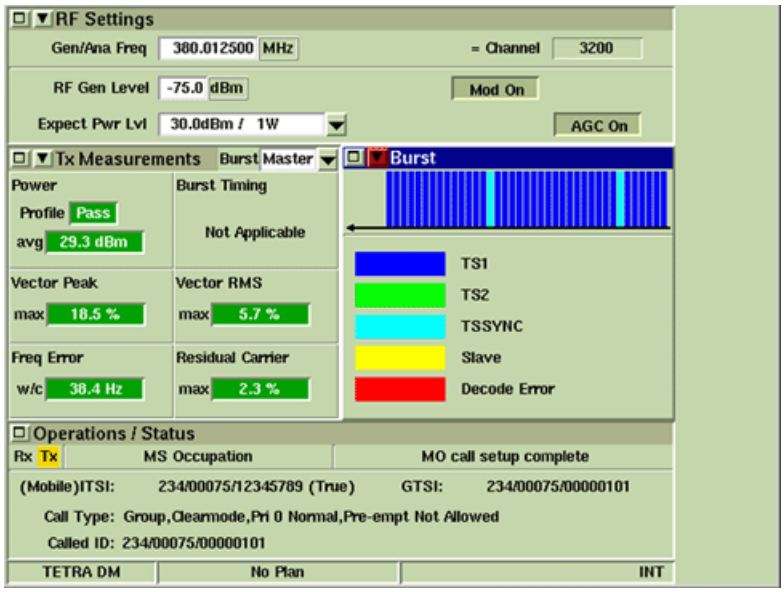


Fig. 9-14 TETRA DM - Measurement Tile location

The Burst Tile uses color-coding to represent various burst types present in TETRA systems. The color-coding allows for quick identification of the information received across the signal.

TETRA DM uses the following color-coding to identify burst type:

	Represents a TS1 burst.
	Represents a TS2 burst.
	Represents a TSSYNC burst.
	Indicates a Slave burst. Occupies the bottom third of bar when present; top two thirds of bar represents the burst's training sequence.
	Represents protocol decode failure. Occupies the bottom third of bar when present.

Fig. 9-14 and Fig. 9-15 provide examples of a TETRA signal that contains the following:

- TS1 bursts shown in dark blue
- TSSYNC bursts shown in light blue

The can be selected from the drop-down menu on the Measurements Tiles as shown in Fig. 9-14, or from the drop-down menu on the RF Settings Tile as shown in as shown in Fig. 9-15.

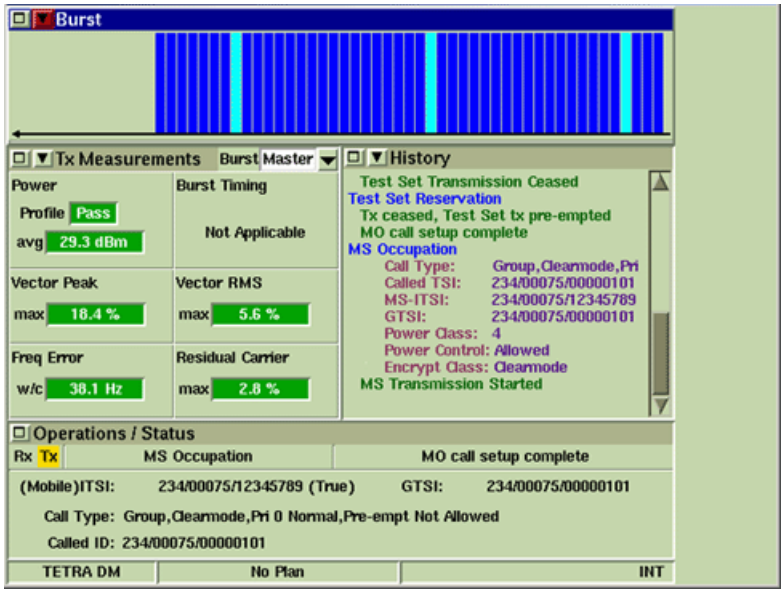


Fig. 9-15 TETRA DM - RF Settings Tile location

9.4.2 Modulation Accuracy - Constellation Tile

The Constellation Tile shows the spread of symbol points for a burst and gives a visual representation of whether the deviations are phase or magnitude related. Limit circles may be displayed as shown in this example. The constellation point circle is pushed into an oval when an I/Q imbalance is present.

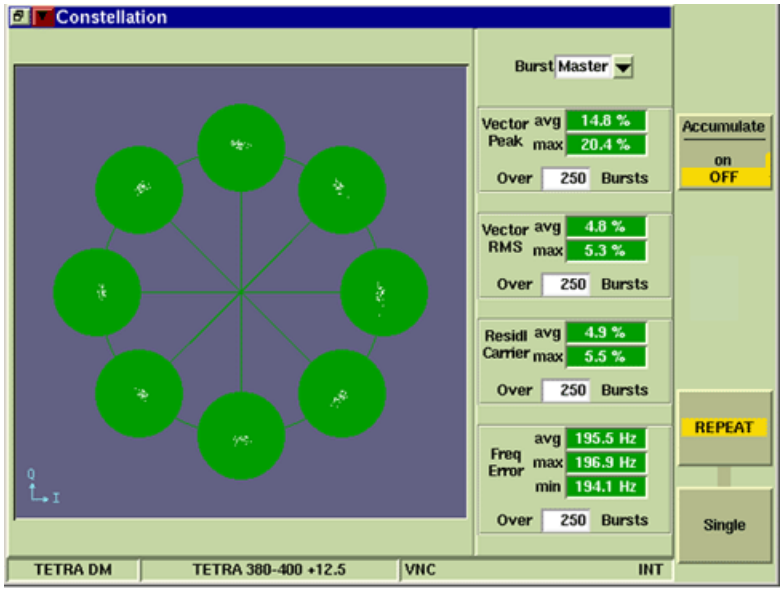


Fig. 9-16 TETRA DM Constellation Tile - Maximized View

9.4.3 Modulation Accuracy - Magnitude Error Tile

Magnitude Error is the amount by which the signal differs from the magnitude of the ideal signal. The value is expressed as a positive or negative percentage of the magnitude of the ideal signal. The Magnitude Error Tile displays the magnitude error for each symbol for a whole burst, excluding any phase error that may be present. Increases in magnitude error over time may indicate power supply problems. Errors at the start or end of a burst may indicate ramp-up or ramp-down problems.

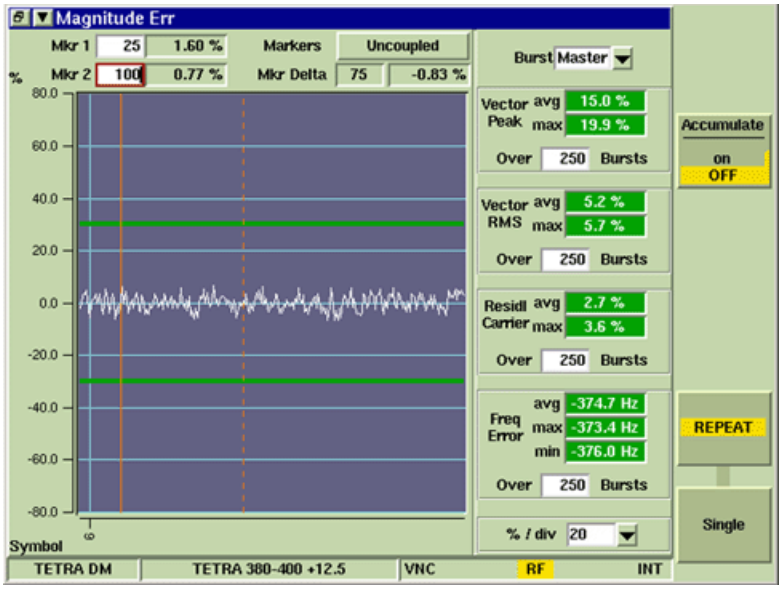


Fig. 9-17 TETRA DM Magnitude Error Tile - Maximized View

9.4.4 Modulation Accuracy - Phase Error Tile

Phase Error is the amount by which the signal leads or lags from the ideal signal. The reading is expressed as a positive (anti-clockwise movement) or negative (clockwise movement) angle. The Phase Error Tile displays the phase error for each symbol for an entire burst, excluding any magnitude error that may be present. Large variations at the start of the burst may indicate oscillator settling problems. Variations during the burst may be due to oscillator control issues.

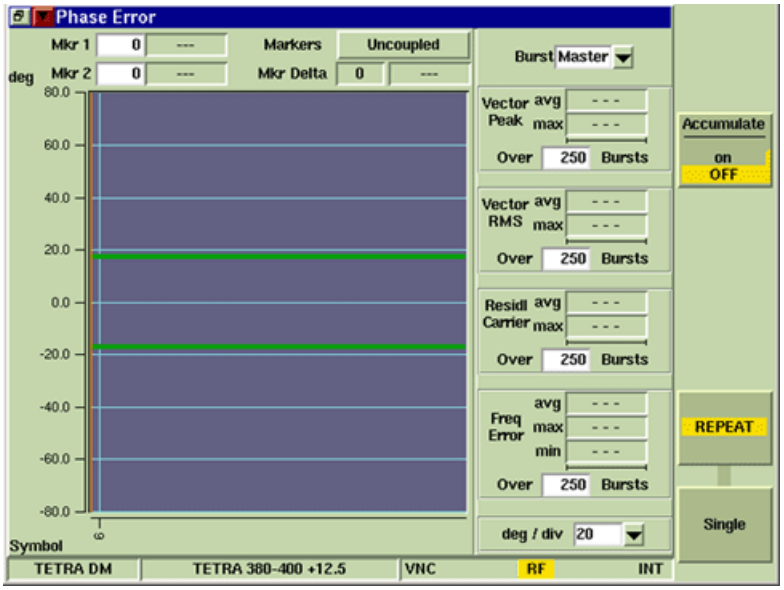


Fig. 9-18 TETRA DM Phase Error Tile - Maximized View

9.4.5 Modulation Accuracy - Rotated Vector Tile

The Rotated Vector Tile is based on the Constellation Tile. The eight segments present on the Constellation Tile are rotated so that the ideal vectors overlay each other, displaying a larger representation. Once again a limit circle may be displayed. The spread of values along the unit circle line indicates Phase problems. The spread of values horizontally indicates Magnitude problems.

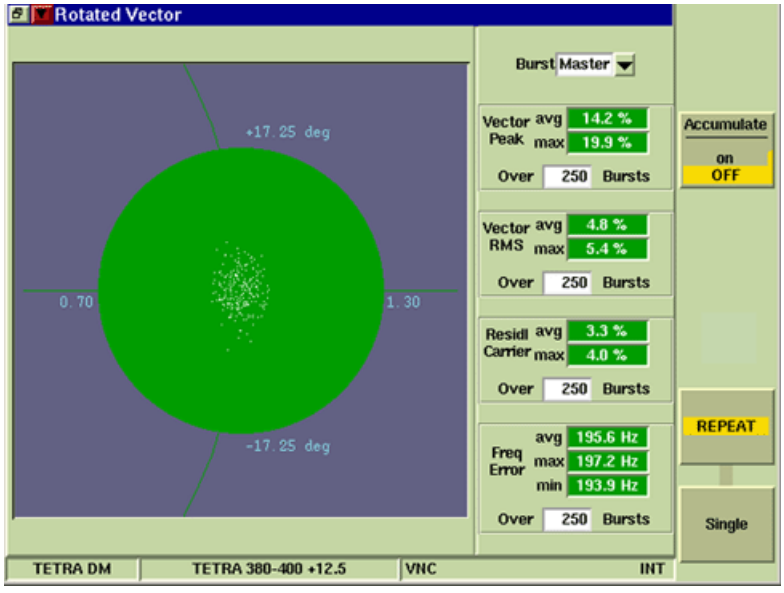


Fig. 9-19 TETRA DM Rotate Vector Tile - Accumulate ON

9.4.6 Modulation Accuracy - Trajectory Tile

The Trajectory Tile displays the actual carrier transitions (phase and amplitude) during the burst and the power deviations and the targeting onto the symbol points. Compression of the carrier is indicated by compressed outer loops. Incorrect filtering is indicated by a signal spread at the constellation points.

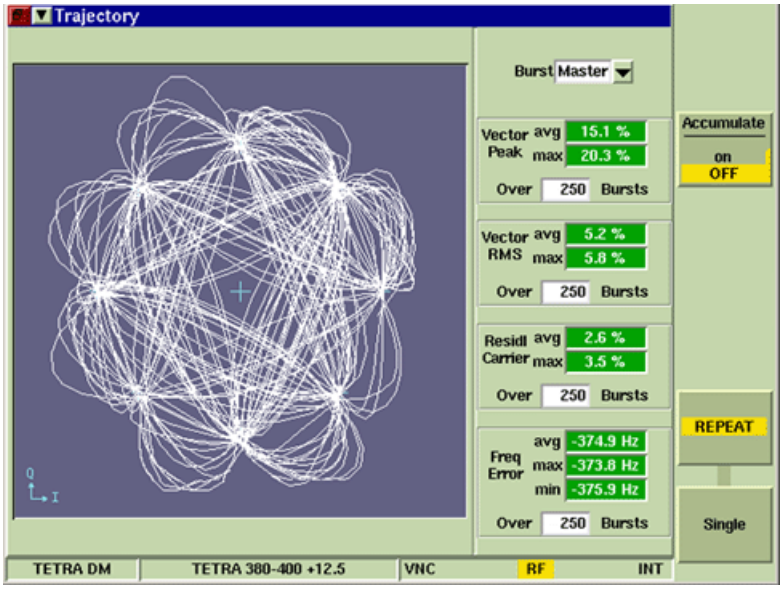


Fig. 9-20 TETRA DM Trajectory Tile - Maximized View

9.4.7 Modulation Accuracy - Vector Error Tile

The Test Set displays the vector error for each symbol point for an entire burst. All of the vector errors across a burst are analyzed to produce the RMS and Peak Vector Error readings for the burst.

Fig. 9-21 TETRA DM Vector Error Tile - Maximized View

9.4.8 Operations/Status Tile

The Operation/Status Tile provides operation for call placing and message sending functions. The Tile is Protocol State dependent, with the soft keys provided to make calls, select call types and other functions.

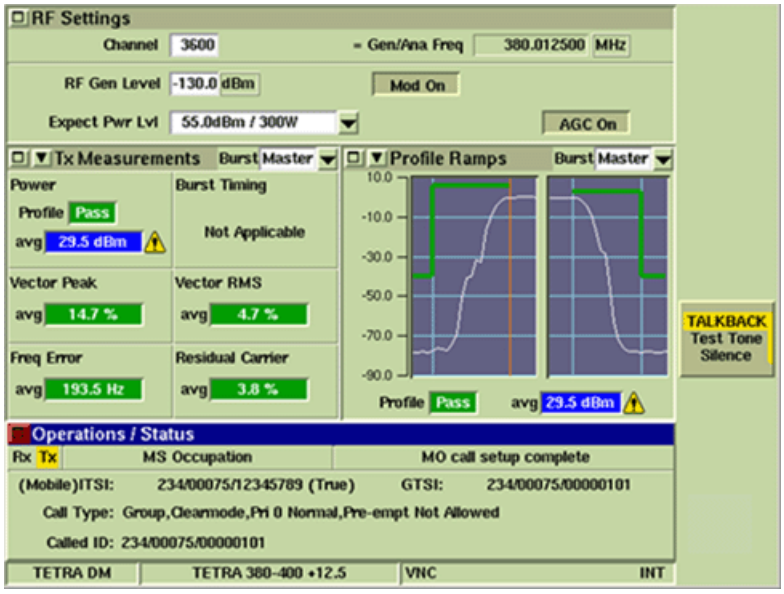


Fig. 9-22 TETRA DM Operations/Status Tile - Minimized View

This Tile shows the state of the Test Set in relation to a mobile under test. The information shown is:

- Current state of the channel (e.g. Quiet Channel, MS Occupation, MS Reservation, TS Occupation).
- Most recent event (e.g. Test Set cease transmission, MO call setup complete, Call Timed out).
- The Operations/Status Tile displays details and status of the current or latest call.
- Status Messages are displayed on the Operations/Status Tile in the Current Events box and in the Miscellaneous message area.

9.4.8.A Field/Soft Key Definitions

9.4.8.A.1 Mode, Events and Messages

The Operations/Status Tile shows the current TETRA Test Mode of the Test Set, the current action and SDS Messages and information.

9.4.8.A.2 Call Mobile Soft Key

Opens a soft key sub-menu that allows user to initiate a call to the mobile. Call types are Group, Private, Emergency and Open Group Call.

9.4.8.A.3 Reset To Quiet Soft Key

Clears Test Set from any current actions and resets Test Set to idle mode in which it is ready to receive a new signal.

9.4.8.A.4 Send Message Soft Key

Opens a soft key sub-menu that allows user to send a Status Message or an SDS message to the mobile. This feature is currently under development.

9.4.9 Power Profile Frame Tile

The Profile Frame Tile shows a graphic form of the power profile of the inactive and active slots of a TETRA frame. Whereas the Profile Ramps Tile shows a profile of the Rise and Fall Ramps of a single burst, the Power Frame Tile shows a profile mask of the signal levels over an entire TETRA frame.

Power measurements are calculated by measuring the power of each burst through a TETRA filter at the symbol point over the usable part of the burst. The average reading shows the power measurement taken over a defined number of bursts.

> **NOTE** Due to the high dynamic range requirements of this particular test, set the Expected Power Level field on the RF Settings Tile to the mobile's transmit power level and turn AGC (Automatic Gain Control) ON.

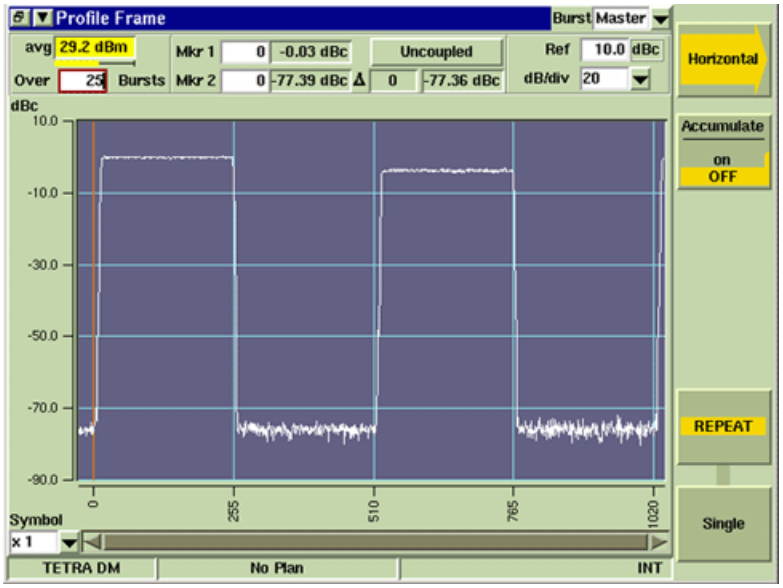


Fig. 9-23 TETRA DM Power Profile Frame Tile - Maximized View

9.4.9.A Field/Soft Key Definitions

9.4.9.A.1 Horizontal Axis Zoom Control

The Horizontal Axis Zoom Control drop-down menu located at the bottom left of the Tile selects the length of horizontal axis that is displayed. Selecting x1 displays the entire horizontal axis; selecting x2 displays half of the horizontal axis.

This menu is linked to the Expand and Contract Horizontal soft keys. When the Expand/ Contract soft keys are used to adjust the horizontal axis, the value in the Horizontal Axis Zoom Control field is updated accordingly.

9.4.9.A.2 Horizontal Scroll Bar

The Horizontal Scroll bar allows user to scan left and right along the length of the horizontal axis.

9.4.9.A.3 Horizontal Soft Key

The Horizontal Soft Key accesses additional soft keys to configure horizontal display parameters.

9.4.9.A.4 Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Selecting ON with the Accumulate Soft Key starts the accumulation of traces.

Selecting OFF with the Accumulate Soft Key clears any accumulated traces and causes each trace to overwrite the previous trace.

9.4.9.A.5 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

9.4.9.A.6 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

9.4.10 Power Profile Full Tile

The Profile Full Tile shows a graphic format of the profile of the signal bursts that make up the signal from a TETRA Mobile. The ramp-up, middle and ramp-down of the burst are shown, with a profile mask defining the acceptable signal levels over the burst period. The power profile of Initial bursts is only displayed on the Profile Initial Tile.

Power measurements are calculated by measuring the power of each burst through a TETRA filter at the symbol point over the usable part of the burst. The average reading shows the power measurement taken over a defined number of bursts.

> **NOTE** Due to the high dynamic range requirements of this particular test, set the Expected Power Level field on the RF Settings Tile to the mobile's transmit power level and turn AGC (Automatic Gain Control) ON.

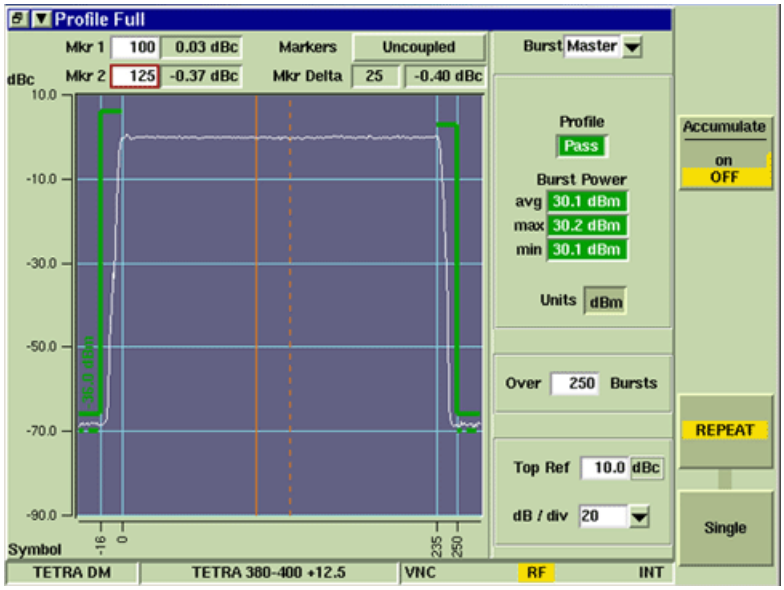


Fig. 9-24 TETRA DM Power Profile Full Tile - Maximized View

9.4.10.A Field Definitions

9.4.10.A.1 Graph Axes

The X axis is calibrated in Symbol Points over the Ramp Up and Ramp down periods and the Y axis is calibrated in dBc.

9.4.10.A.2 Power Measurement

The displayed mask limits, which are the Pass/Fail criteria for the Power Profile Measurement, are configured on the Tx Measurements Limits Configuration Tile. If these limits are set to Disabled, the mask is not displayed and the profile Pass/Fail assessment is not performed.

9.4.10.A.3 Burst Power Results

These results of the Tx Measurements shown on the Profile Full Tile are identical to the readings on the Tx Measurements Tile.

9.4.10.A.4 Units

Toggle button allows user to select dBm or W as unit of measurement for display fields.

9.4.10.A.5 Top Ref

Sets the top of scale of the Y axis.

9.4.10.A.6 dB/div

Sets the span of the sections along the Y axis.

9.4.10.A.7 Over n Bursts

The Over n Bursts setting affects the displayed Power Profile, Pass/Fail assessment and Burst Power measurement. The Power Profile is averaged over the Number of Bursts specified, which smooths out the noise, reducing the peak level of the power profile during the periods when the mobile's transmitter is inactive.

If a stringent level for the Low dBc limit is specified, e.g. -70 dBc, it may be necessary to average the profile over a large number of bursts, e.g. 200, to produce a fair assessment of the performance of the mobile transmitter under test.

9.4.11 Power Profile Initial Tile

The Power Initial Tile displays Initial burst measurement data. The graph's horizontal scale varies according to the length of the transmission from the mobile. When upper and/or lower limits have been set and enabled for Power measurements, a Pass/Fail indicator appears when measurements are outside of the set limits.

Power measurements are calculated by measuring the power of each burst through a TETRA filter at the symbol point over the usable part of the burst. The average reading shows the power measurement taken over a defined number of bursts.

> **NOTE** Due to the high dynamic range requirements of this particular test, set the Expected Power Level field on the RF Settings Tile to the mobile's transmit power level and turn AGC (Automatic Gain Control) ON.

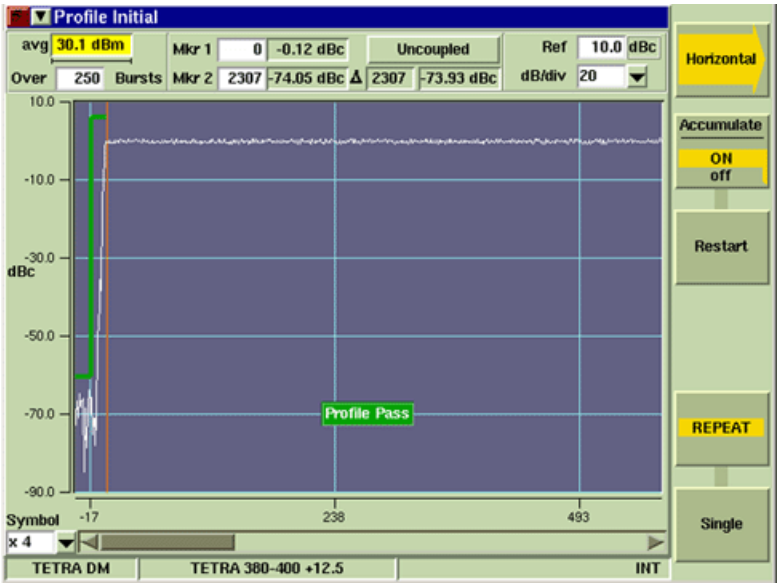


Fig. 9-25 TETRA DM Power Profile Initial Tile - Maximized View

9.4.11.A Field Definitions

9.4.11.A.1 Power Measurement

The average power measurements over the useful part of the burst is shown in the avg box.

9.4.11.A.2 Horizontal Axis Zoom Control

The Horizontal Axis Zoom Control drop-down menu located at the bottom left of the Tile selects the length of horizontal axis that is displayed. Selecting x1 displays the entire horizontal axis; selecting x2 displays half of the horizontal axis.

This menu is linked to the Expand and Contract Horizontal soft keys. When the Expand/ Contract soft keys are used to adjust the horizontal axis, the value in the Horizontal Axis Zoom Control field is updated accordingly.

9.4.11.A.3 Horizontal Scroll Bar

The Horizontal Scroll bar allows user to scan left and right along the length of the horizontal axis.

9.4.11.A.4 Horizontal Soft Key

The Horizontal Soft Key accesses additional soft keys to configure horizontal display parameters.

9.4.11.A.5 Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Selecting ON with the Accumulate Soft Key starts the accumulation of traces.

Selecting OFF with the Accumulate Soft Key clears any accumulated traces and causes each trace to overwrite the previous trace.

9.4.11.A.6 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

9.4.11.A.7 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

9.4.12 Power Profile Ramps Tile

The Profile Ramps Tile shows a graphic form of the profile of the Rise and Fall Ramps of the signal bursts from a TETRA Mobile. The profile mask defines the acceptable signal levels over the rise and fall periods. The power profile of Initial bursts is only displayed on the Profile Initial Tile.

Power measurements are calculated by measuring the power of each burst through a TETRA filter at the symbol point over the usable part of the burst. The average reading shows the power measurement taken over a defined number of bursts.

> **NOTE** Due to the high dynamic range requirements of this particular test, set the Expected Power Level field on the RF Settings Tile to the mobile's transmit power level and turn AGC (Automatic Gain Control) ON.

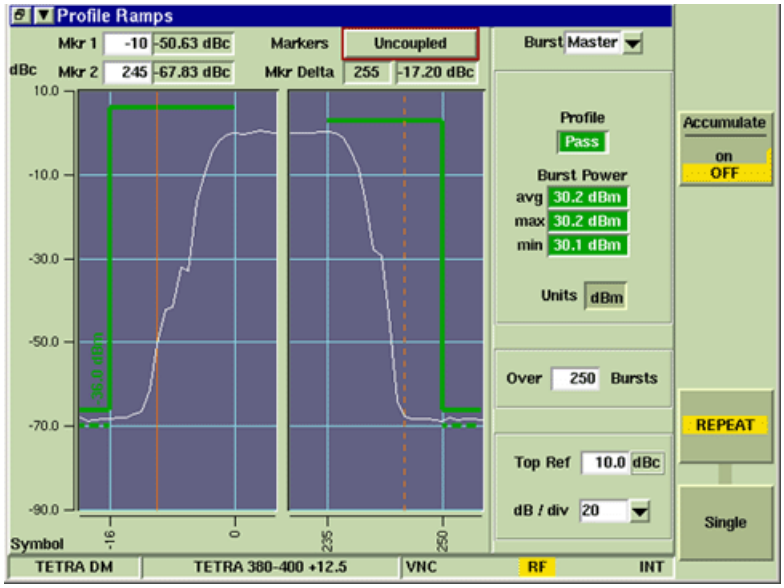


Fig. 9-26 TETRA DM Power Profile Ramps Tile - Maximized View

9.4.12.A Field Definitions

9.4.12.A.1 Burst Power Results

Maximize the Profile Ramps Tile to view the results of the Tx Burst Power measurements.

9.4.12.A.2 Accumulate Soft Key

The Accumulate Soft Key allows user to layer accumulated traces of successive measurements on the display to show a trend, or overwritten with each new trace.

Selecting ON with the Accumulate Soft Key starts the accumulation of traces.

Selecting OFF with the Accumulate Soft Key clears any accumulated traces and causes each trace to overwrite the previous trace.

9.4.12.A.3 Repeat Soft Key

Pressing the Repeat Soft Key at any time starts a group of measurements for all of the tests. When the number of measurements defined in the Number of Bursts box have been made, the first measurement is dropped from the average or worst case result, and the newest measurement included as a rolling result. The tests restart when the Repeat Soft Key is pressed.

9.4.12.A.4 Single Soft Key

Pressing the Single Soft Key at any time starts a group of measurements for all of the tests. After the measurement is made to the last sample of each test, no further measurements are made to that test until either the Single Soft Key or Repeat Soft Key is pressed.

9.4.13 Protocol History Tile

Protocol Tiles provide information relating to registration, call processing and messaging operations performed by the mobile and the Test Set. This information is available whether or not the Protocol Tiles were displayed during the protocol operations.

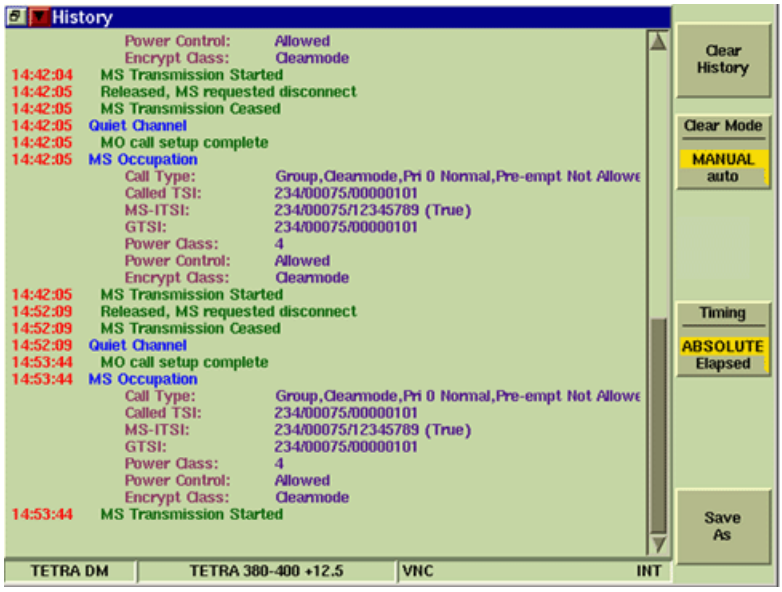


Fig. 9-27 TETRA DM Protocol History Tile - Maximized View

9.4.13.A Soft Key Definitions

9.4.13.A.1 Clear History Soft Key

Clears the information already recorded in the protocol history. If Auto is selected on the Clear Mode Soft Key, the information already recorded by the Test Set is cleared automatically when the Reset to Quiet Soft Key is pressed on the Operation/Status Tile.

9.4.13.A.2 Save As Soft Key

Saves a text file to the Test Set's hard drive that can be exported via the Utilities File Management feature.

9.4.13.A.3 Timing Soft Key

Timestamp information is shown in the maximized view of the Protocol History Tile. The timestamp can display real time (Timing = ABSOLUTE) or the time relative to the first entry in the history (Timing = ELAPSED). If the real time shown is incorrect, press the UTILS key to access the Test Set's hardware settings and make the necessary adjustments.

9.4.14 RF Settings Tile

The parameters that are available on the RF Settings Tile depend on whether or not a Channel Plan is selected on the Channel Plan Configuration Tile.

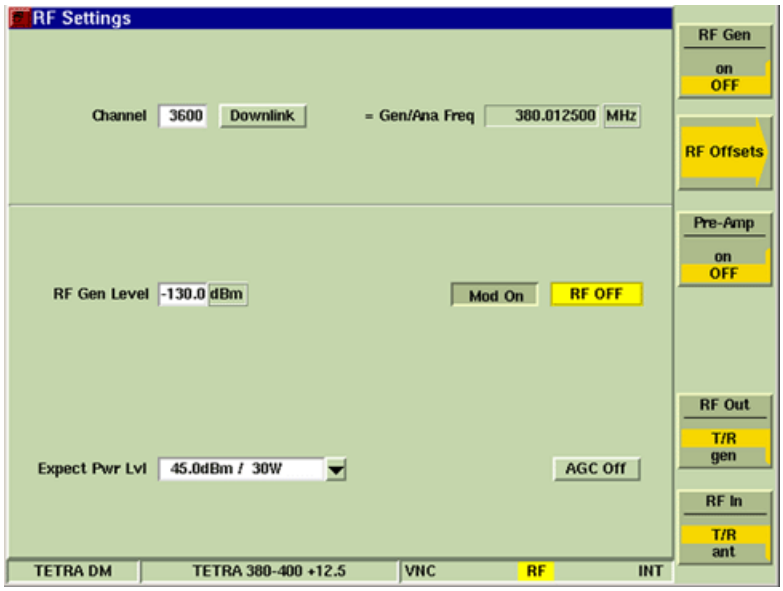


Fig. 9-28 TETRA DM RF Settings Tile - Channel Plan Selected

9.4.14.A Field/Soft Key Definitions

9.4.14.A.1 Channel Number

Sets the frequency of the RF Analyzer and the RF Generator (Gen/Ana Freq) within the Test Set to match the Channel frequency by specifying a Channel Number when a Channel Plan is selected. To set the Channel Frequency, enter the required Channel Number in the Channel settings box and press the ENTER Key. The transmit and receive frequency of the Test Set is shown in the Gen/Ana Freq field.

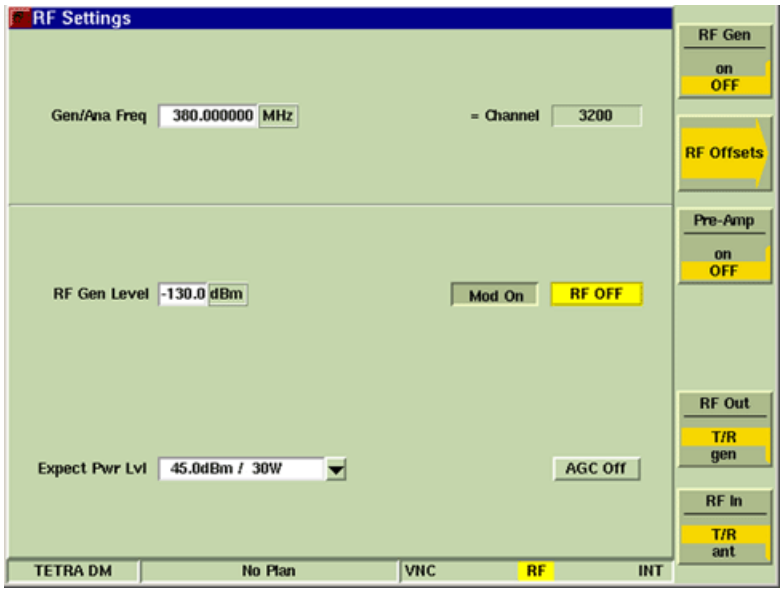


Fig. 9-29 TETRA DM RF Settings Tile - No Channel Plan Selected

9.4.14.A.2 Gen/Ana Freq

Sets the Test Set transmit and receive frequency. The Channel Number closest to the set frequency is displayed in the adjacent = Chan. field. This parameter is applicable when No Plan is selected on the Channel Plan Configuration Tile.

9.4.14.A.3 Uplink/Downlink

Selects an Uplink or Downlink frequency band. This toggle button is only visible when a Channel Plan is selected on the Channel Plan Configuration Tile.

9.4.14.A.4 RF Gen Level

Sets the RF Generator Level to any value within the range of the Digital Signal Generator.

NOTE	When RF Offset values have been used to compensate for gains or losses in external equipment, the RF Gen Levels indicate the power level after the external amplifier or attenuator.

9.4.14.A.5 Expected Power Level

Specifies an expected power input level for the Test Set. The RF Analyzer attenuators are set to the values required for this input level. The range of values available for selection at any time depends on which RF input connection is selected and the value of any RF input offset that is set. When AGC (Automatic Gain Control) function is ON the set Power Level is overridden.

9.4.14.A.6 AGC (Automatic Gain Control)

Overrides the Expected Power Level setting when AGC is set to the ON state. With the AGC set to ON the Test Set optimizes the gain of the RF analyzer to give the best resolution to the measurements made to the signal.

9.4.14.A.7 RF Gen Soft Key

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

9.4.14.A.8 RF Offsets Soft Key

Opens a soft key sub-menu that selects to Include or Exclude any set Analyzer or Generator Offset.

9.4.14.A.9 Gen Offset Soft Key

Enables/Disables defined RF Generator Offsets. Generator Offset values are defined on the Offsets Configuration Tile.

9.4.14.A.10 Ana Offset Soft Key

Enables/Disables defined AF Generator Offsets. AF Generator Offset values are defined on the Offsets Configuration Tile.

9.4.14.A.11 Pre-Amp Soft Key

The 3900 is equipped with an internal 15 dB broadband amplifier that affects the T/R Connector and ANT (Antenna) Connector. When Pre-Amp is turned ON, the 3900 has a typical noise figure of -9 dB leading to a noise floor level of approximately -140 dBm in the Spectrum Analyzer (RBW = 300 Hz) and approximately -126 dBm for the Inband Power Meter (IF = 6.25 kHz). Using the Pre-Amp feature increases the sensitivity of the 3900.

NOTE	When Pre-Amp is used, special attention is required; it is a broadband amplifier and could lead to saturation or compression problems in the receiver chain if the signal of interest is very low, but a strong out of band signal is present.

9.4.14.A.12 RF Out Soft Key

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

9.4.14.A.13 RF In Soft Key

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

9.4.15 Tx Measurements Tile

The Tx Measurements Tile shows the results of measurements made to the signal received from the mobile under test. Upper and Lower limits are defined on the Tx Measurements Limits Configuration Tile.

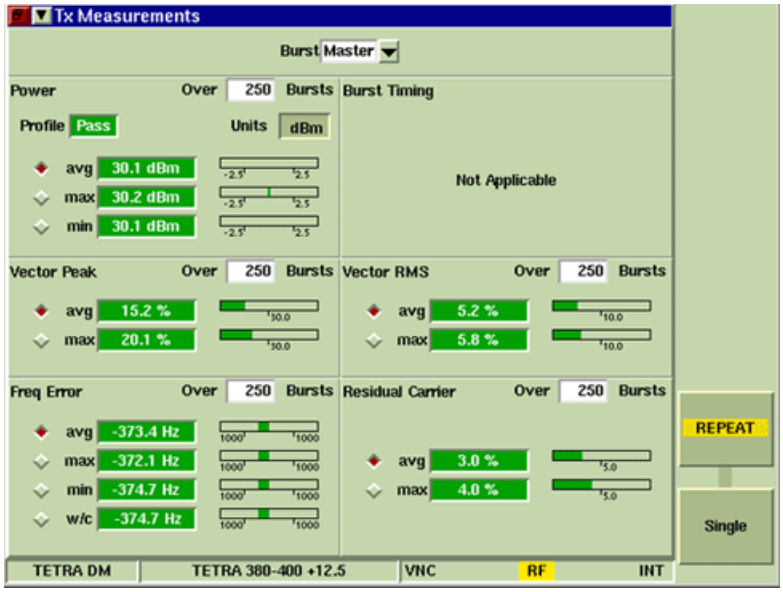


Fig. 9-30 TETRA DM Tx Measurements Tile - Maximized View

9.4.15.A Field/Soft Key Definitions

9.4.15.A.1 Results Display

The results of the measurements are shown numerically and as bar graphs when Tile is maximized.

The results of measurements are presented as different criteria for different tests, to give the most appropriate measurements. The results are obtained by making measurements on all of the symbols over the range of the number of samples (bursts) specified for the test. These criteria are listed below.

avg	Average value of all of the samples measured.
max	Maximum value of the burst that produced the highest result from the number of samples measured.
min	Minimum value of the burst that produced the lowest result from the number of samples measured.
w/c	Worst Case value of the burst that produced the lowest or highest result from the number of samples measured.

9.4.15.A.2 Burst

The Burst menu selects the Burst types transmitted by the mobile. Master, Normal, Sync and Initial burst types are transmitted by the mobile when it is operating as the Master. Slave burst type is transmitted by the mobile when it is operating as the Slave.

9.4.15.A.3 Power

The Power Measurement shows the average power during the measured burst. This measurement is taken over the usable part of the burst measured at the symbol points through a TETRA filter. Available units of measurement are dBm or W.

9.4.15.A.4 Burst Timing

The Burst Timing, or frame alignment measurement, shows the measured symbol timing of the mobile's Slave bursts. Burst Timing is only applicable to Slave bursts. 'Not Applicable' is displayed in this Tile area for all other burst types.

9.4.15.A.5 Vector Errors

The Vector Error Measurements show the vector error of the received symbols with respect to the ideal symbol points for the burst. These measurements are taken over the usable part of the burst, measured at the symbol points through a TETRA filter. The measurements are expressed as a percentage of the mean amplitude.

Vector Peak

The Vector Peak Measurement is the vector error of the symbol with the highest error.

Vector RMS

The Vector RMS Measurement is the root mean squared of the vector error of all the symbols.

Residual Carrier

The Residual Carrier Measurement is the mean residual carrier magnitude.

9.4.15.A.6 Freq Error

The Freq Error measurement shows the difference between the frequency of the received signal and the analyzer frequency of the Test Set. This measurement is taken over the usable part of the burst measured at the symbol points through a TETRA filter.

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Appendix A - Abbreviations

AF	Audio Frequency
AGC	Automatic Gain Control
Ana	Analyzer
ANT	Antenna
avg	Average
BCC	Base (Station) Color Code
BER	Bit Error Rate
BS	Base Station
BSCH	Broadcast Synchronization Channel
CH/Chan	Channel
CONFIG	Configuration
dB	decibel
dBm	decibel relative to 1 mW
DL	Downlink
DM	Direct Mode
DTMF	Dual Tone Multi Frequency
Dx	Duplex
ESN	External Subscriber Number
FAC	Final Assembly Code
FACCH	Fast Associated Control Channel
Freq	Frequency
GEN	Generator
GHz	Giga Hertz
GPIB	General Purpose Interface Bus
GSSI	Group Short Subscriber Identity
HEX	Hexadecimal
Hz	Hertz
ID	Identity
IF	Intermediate Frequency
Inc	Increments
ISDN	Integrated Service Digital Network
ISSI	Individual Short Subscriber Identity
kHz	Kilo Hertz
LA	Location Area

Max	Maximum
MCC	Mobile Country Code
MCCH	Main Control Channel
MER	Message Error Rate
MHz	Mega Hertz
MIC	Microphone
µs	Micro Seconds
µV	Micro Volt
Min	Minimum
Mkr	Marker
MNC	Mobile Network Code
Mod	Modulation
MS	Mobile Station
Msg	Message
PABX	Private Automated Branch Exchange
PDU	Protocol Data Unit
PRBS	Pseudo Random Binary Sequence
PSTN	Public Subscriber Telephone Network
PTT	Push to Talk
PUEM	Probability of Undetected Erroneous Measurement
QTT	Quasi Transmission Trunking
RBER	Residual Bit Error Rate
RF	Radio Frequency
RMS	Root Mean Square
RSSI	Radio Signal Strength Indication
Rx	Receive
S	Seconds
SDS	Short Data Service
SDU	Service Data Unit
SNR	Signal to Noise Ratio
SPR	Spare Digit
SSI	Short Subscriber Identity
T/R	Transmit/Receive
TAC	Type Approval Code
TCH	Traffic Channel
TDMA	Time Division Multiple Access
TEI	TETRA Equipment Identity
TL	Transport Layer
TPNI	Transmitting Party Number Indentification
TT	TETRA Test Mode
UTILS	Utilities
V	Volts

VBW	Video Bandwidth
W	Watt
w/c	Worst Case
UL	Uplink

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