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R8100 Series TETRA TMO
Operating Guide

Introduction

This document will provide guidance to ensure all the major functions, features and related measurements are described.

Start Up (Power On Button)

The R8100 will power up in the default analog mode or the last used Pre-set. Analog default configuration shown below with no Pre-set Loaded. Please wait for the configuration file to finish loading as indicated in the message bar.
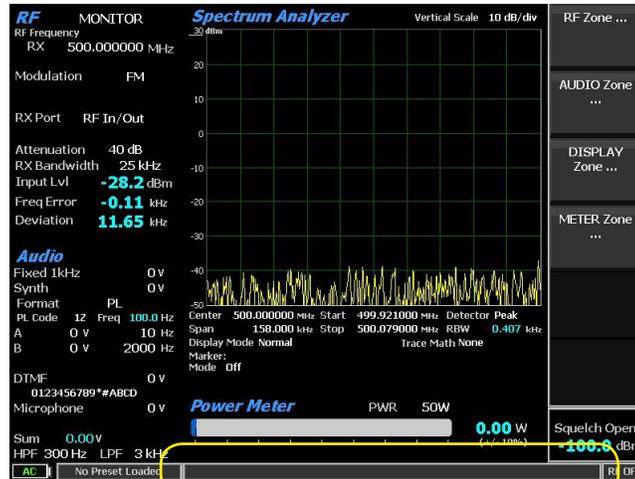
Message bar

If a TMO configuration Pre-Set is loaded its name will appear in the pre-set message bar and the unit will power up in the TMO Test Mode

Select the TETRA TMO key to start making measurements.

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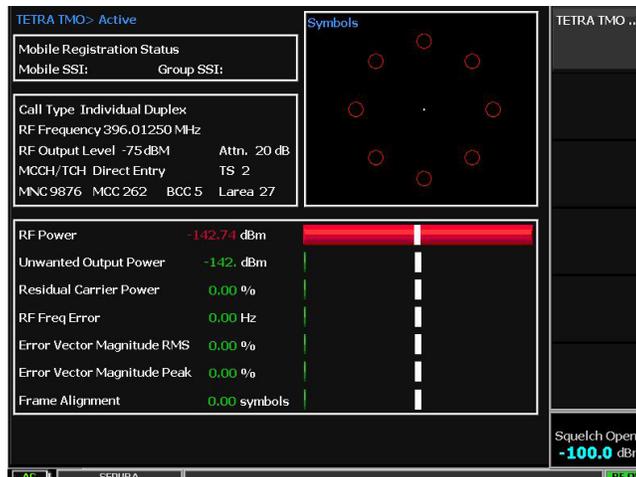
Selecting the TMO Application from Power Up default or a non TMO pre-set

Select the "TEST" hard key to bring up the menu below
Select "Test Mode" key
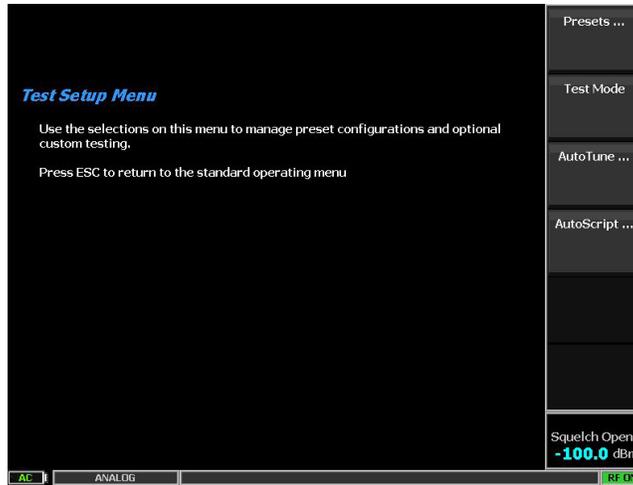
All available installed Radio Test applications will appear in the bottom selection menu.

Select TETRA TMO

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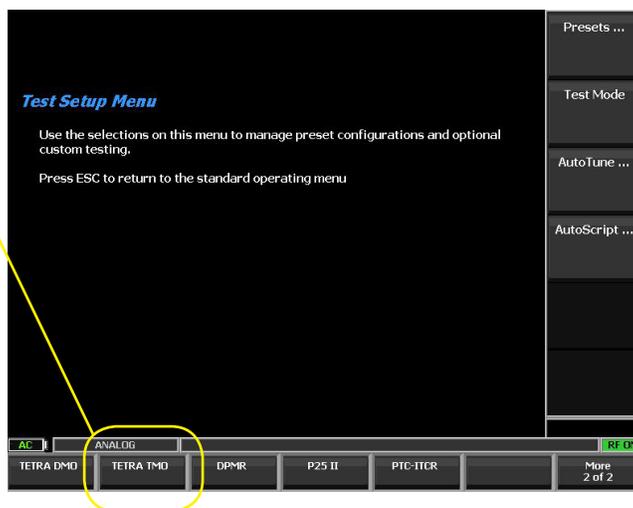
Select the TETRA TMO key to start and configure operational settings
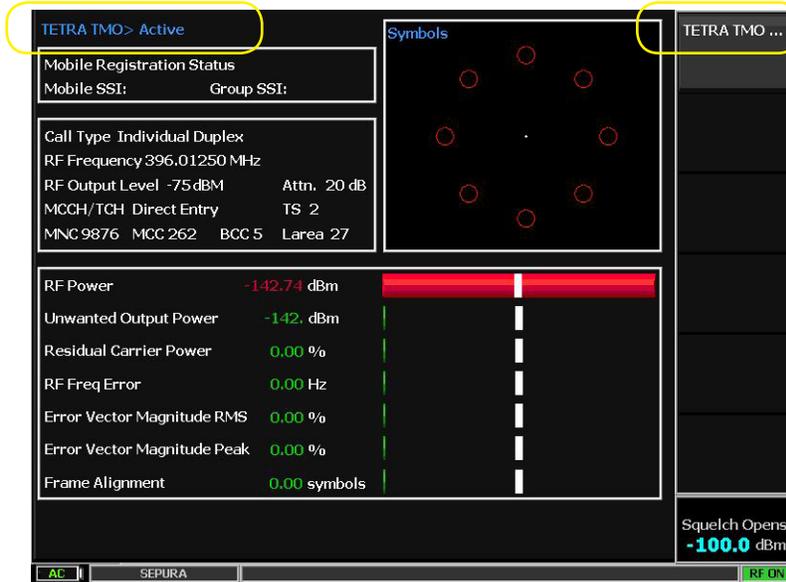
The "TETRA TMO" field will display " sync in progress xx seconds"
After a few seconds the field will display "Active"

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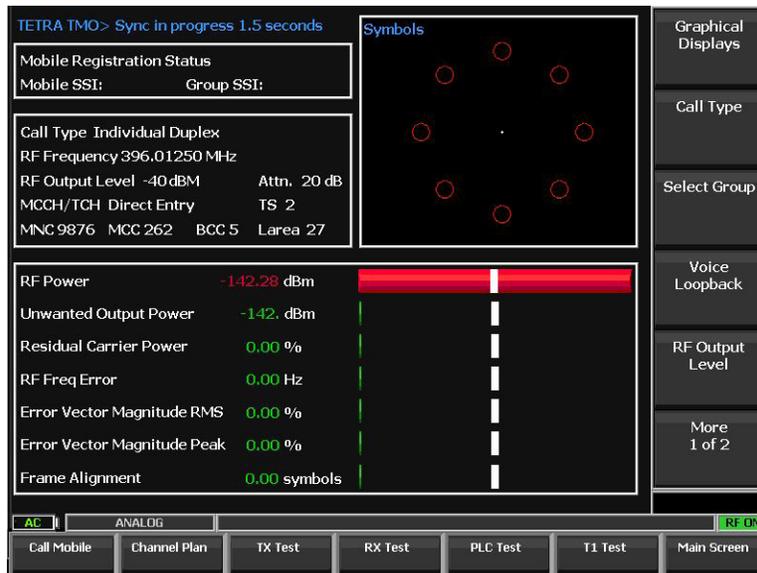
Setting up Channel and Network Parameters

Note: This part of the procedure may be skipped if the mobile radio under test already has had its parameters programmed in the R8100 Channel Plan previously or recalled from a saved Pre-set
As the R8100 will emulate e REAL Base Station and Network it is ESSENTIAL to ensure that the Frequencies and Network settings of the radio under test are known and replicated in the R8100 Channel Plan before connecting a radio.

The Channel Plan has been designed to cater for all bands, all channel spacings and duplex offsets deployed worldwide.

Channel Plan Settings
   Select "Channel Plan"
   Select "Band" and choose your band from the dropdown menu.
   Select Main Control Channel "MCCH" and enter your operational channel
   Example 3600 = a base of 390.000MHZ
   Select "TS" and enter the Time Slot to use in making measurements
   Select "Channel Offset" and enter your operational offset from the dropdown menu
   Channel Offsets… 0Hz. +6.25kHz, -6.25kHz, +12.5kHz, -12.5kHz.
   Select "Duplex Offset" and enter your operational offset from the dropdown menu
   Valid offsets are limited by the chosen Band.
   Select "Operating Mode", Normal or Reverse : + or – Duplex sets TCH above or below the MCCH frequency.

TCH Final uplink/downlink frequencies are calculated automatically from the settings above

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Network Settings

Select "MCC" Mobile Country Code and enter your operational code
Select "MNC" Mobile Network Code and enter your operational code
"BCC" Base Station Colour Code (Not needed to make a connection)
"Larea" Local Area Code (Not needed to make a connection}
Select "Main Screen" for return to the main menu display

Note The "Frequency" menu key allows the direct entry of a MCCH frequency only. The settings of all other channel and network parameters are set as above. The MCCH and TCH fields will display "Direct Entry" in place of the channel numbers.

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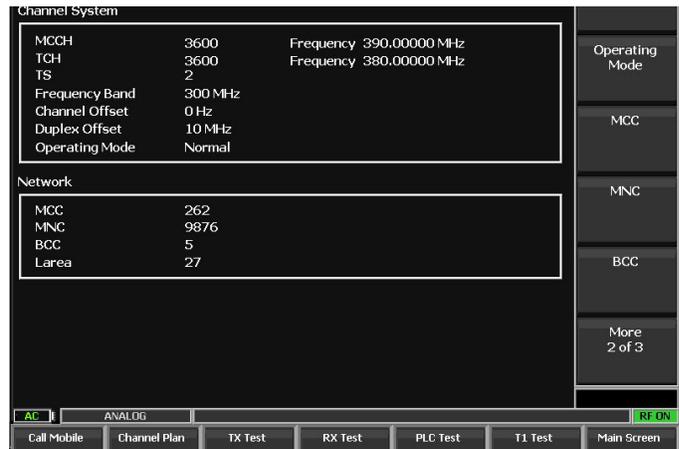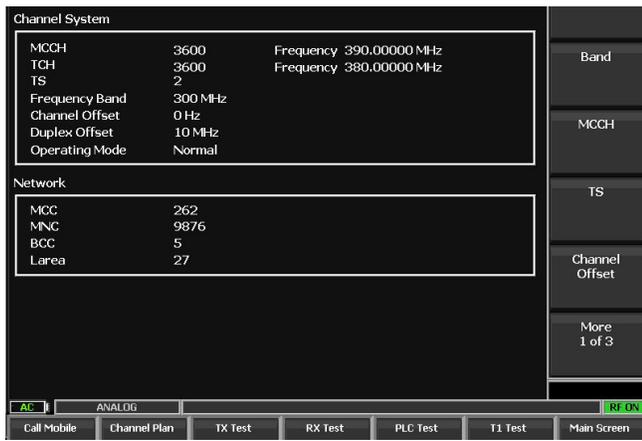
Main Screen Display Areas

The main screen has several display areas that show settings, status, digital measurements and graphical measurements.
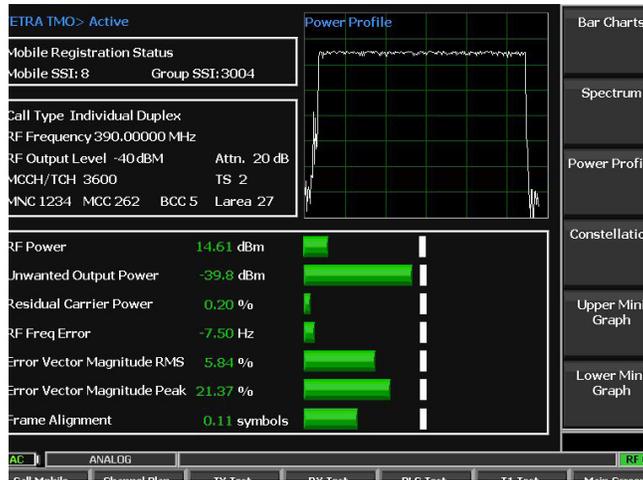
TETRA TMO

"Self Synch in progress" and a timing counter in seconds.
In the event of a radio not being registered or a radio drops the connection the Self Synch restarts after 30 seconds to re-establish a connection automatically.
"Active" Self Synch is complete, and we are ready to make a connection (Registration) with the Radio.
Mobile Registration Status
Mobile SSI: Group SSI:

These are data fields transmitted by the connected radio after a successful registration.

Settings and Configuration Status Display

Digital Measurements (TX)

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The displayed measurements are colour coded Pass/Fail to either the ETSI published specifications or user defined Test Limits. Green=Pass, Red=Fail

Graphical Displays

The two Graphical Display zones are programable to two of five possible selections.
Both Upper and Lower displays may be freely selected to display: Spectrum. Power Profile, Symbols, Trajectories or Bar Charts.
In addition, each display can be expanded in a full screen mode.
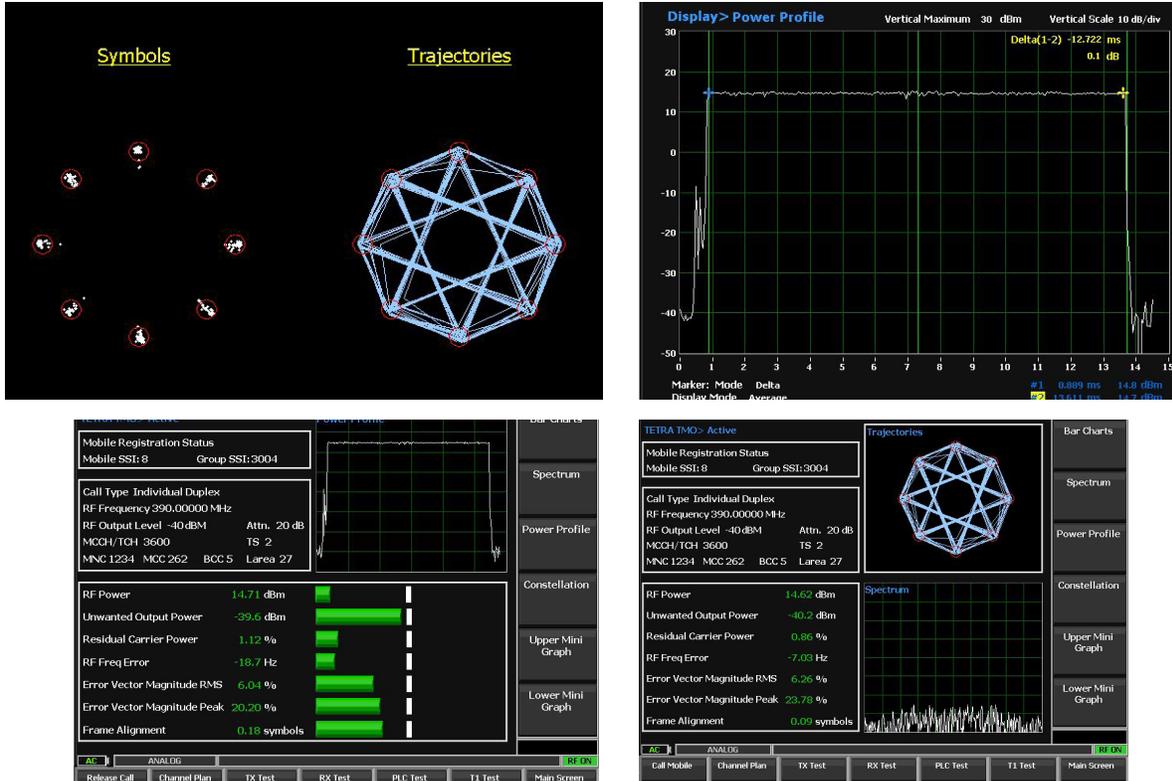
Mobile Connection and Radio Registration

1 Connect the Mobile Radio using suitable adaptors to the RF I/O port of the R8100.
Note if the external cable loss is known it may be entered as an offset in the standard R8100 "Settings" menu

Select "Settings" hard key, "Systems Settings", Page 3 of 5, RF Level Offset ON, RF IN/OUT Offset, Enter value. Esc, Esc, key to return to Main Screen.

2. Power up the radio and select the relevant Network and Group you wish to connect to and test. The radio may be already powered up if desired. Connection procedure will be the same.
3. The radio will scan its frequency and network lists for a valid and authorised network. If it fails, you have one or more incorrect settings.

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4. On finding a valid network the radio will beep, indicate on its display the MNC/MCC it will connect to and a service bar indicator. Finally, it will send its Registration SSI (Subscriber ID) and Group SSI ID' to the R8100

5. The R8100 will display the Radio's registration data
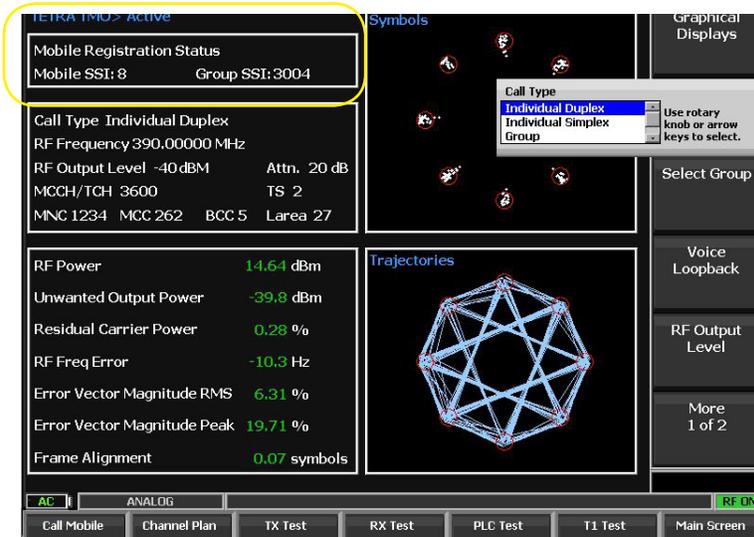
Measurements Functions and Features

Call Type Selection
Select "Call Type"
Select the desired type from the dropdown menu
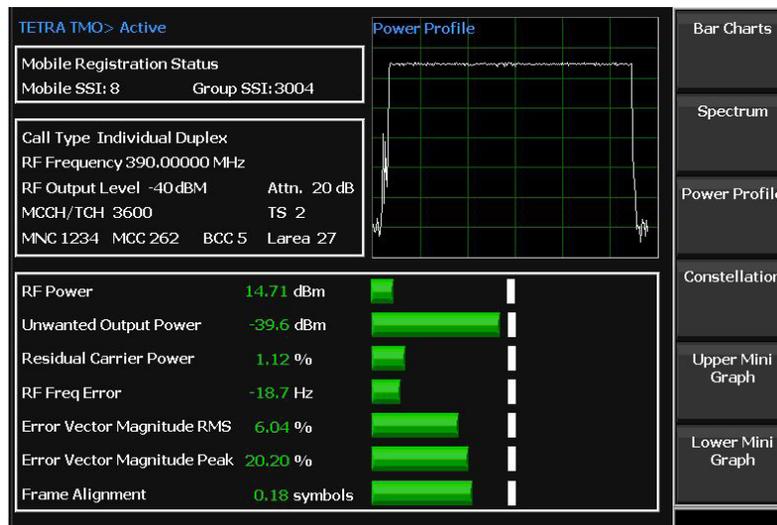
Ind Duplex Type is a Duplex bidirectional connection and can be used to make continuous measurements. Alternatively, Phone Type.

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Manual Measurements

1. Select "Call Type", scroll to "Ind Duplex" and "Enter"
2. Select "Call Mobile"
3. Answer the call from the radio
4. Observe R8100 Digital and Graphical Measurement displays
5. Measurements are colour coded pass fail to ETSI standards on the main display and in Bar Charts.
6. Enabling a fast assessment of the radios overall health.
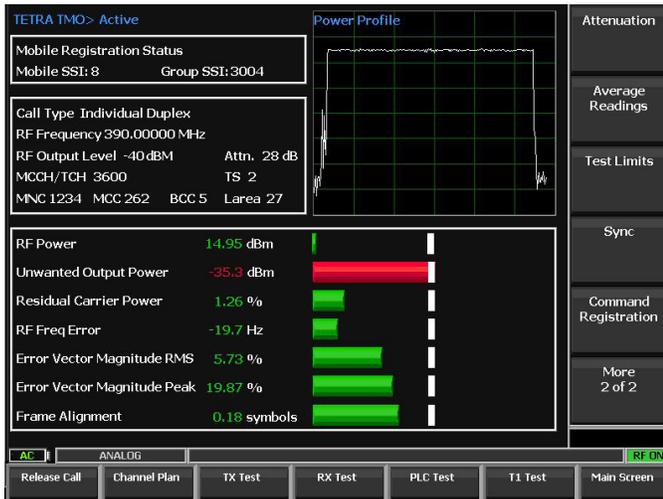
Fail   Pass
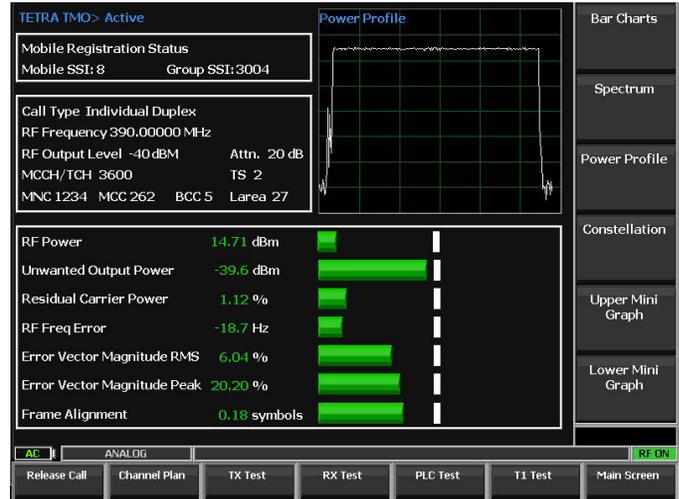
AutoTest Functions

Three AutoTest functions are provided to measure, record and save test results for achieving a radios history and/or provide a print out for RMA Maintenance activities:

     TX Test
     In the Main Screen select "TX Test"
     -Select "Burst Samples" and enter the number of bursts (Default is 100)
     -Select "Start Test"

The display will show rolling live measurements for Current, Minimum, Maximum and Average for all TX parameters. Colour coded pass/fail.

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-Select "Main Screen" to Return

The measurements are automatically saved to the "Test Results" file.

Set Up Display   Measurements Display

RX Sensitivity Test

-In the Main Screen select "RX Test"
-Start level is default -100dBm
-Step Level is default 2dB

These may be changed by the operator by selecting and entering new levels.

-Select "Start RX Test"

The R8100 will step down the RF output level, then send CMD Reg to the radio at each step and report the level at which the radio fails to respond.

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Result is automatically added to the "Test Results" file
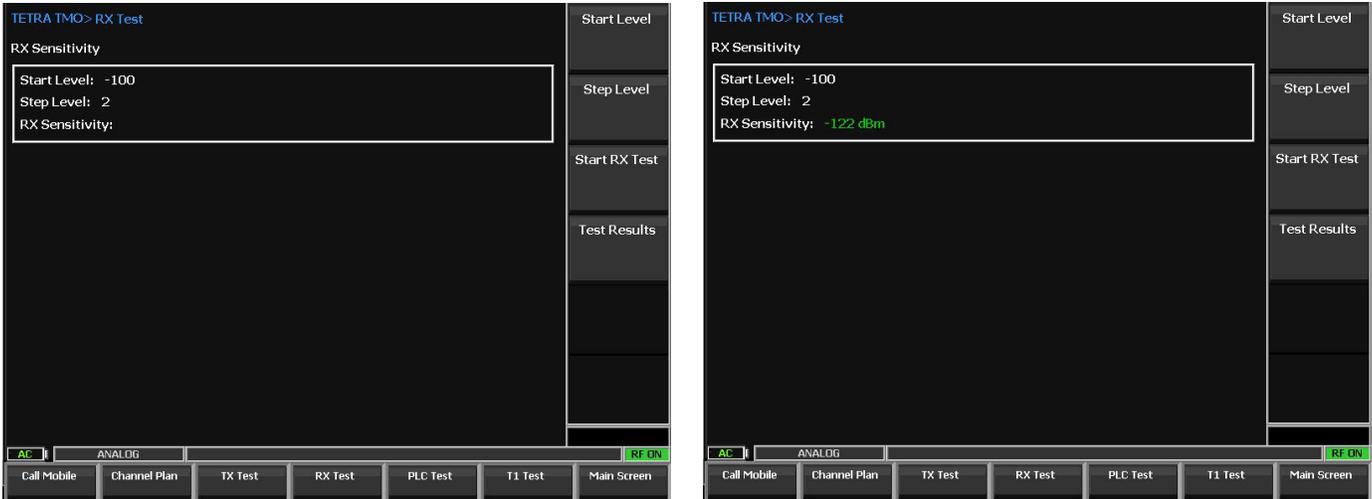
Power Loop Control (PLC)

TETRA radios have the capability to adjust their transmitted power based on Received Signal Strength (RSSI) level.

Note: Not all radios are set up to perform this functionality but programmed to use their full specified power 100% of the time.

    Select "PLC Test"
    Select "Start Test"

The R8100 sets its output RF signal level to the ETSI specified RSSI levels at which the radio must adjust its TX power output. This can take several seconds of response time to a new RSSI. Accuracy is ETSI specified +/-2dB from nominal.

Test Results are automatically saved in the "Test Results"" file

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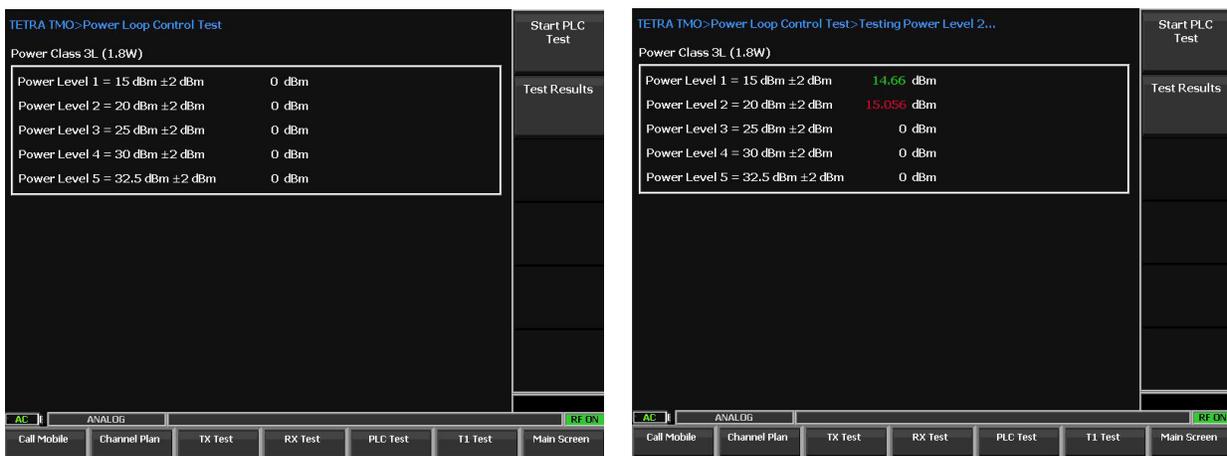
Test Results File

Test Results can be viewed from any of the AutoTest screens by selecting the "Test Results" key in each menu.

Results are automatically overwritten on subsequently running the tests again.
From this menu the file can be written to a USB Drive in .csv format.

"Operator ID" Select to Enter an Operator ID
"Mobile ID" Select to enter a Mobile ID or Serial Number
"Clear Results" Clears all fields
"Export to CSV" Sends the file to an installed R8100 USB drive.
    Note: USB drive must be present for this option to appear in the menu.

Left Screen

TETRA TMO> Test Results
Radio Test Results

	Last	Min	Max	Average
Operator ID				
Mobile ID				
Test Date	27/6/2018			
Test Time	10:12:46 AM			
Frequency	390.00000 MHz			
Network	262/1234			
TX Test:				
RF Power	14.6948	14.6322	14.8096	14.7317 (PASS)
Unwanted Output Power	-39.6508	-40.1489	-39.4860	39.7717 (PASS)
Residual Carrier Power	1.1184	0.1957	2.8829	1.0982 (PASS)
RF Frequency Error	11.3994	11.3149	15.3150	12.3765 (PASS)
Error Vector Magnitude RMS	5.7262	5.2900	6.6844	5.8196 (PASS)
Error Vector Magnitude Peak	20.0482	14.6034	24.1658	19.7638 (PASS)
Frame Alignment	0.1641	0.1094	0.1953	0.1646 (PASS)
RX Test:				
RX Sensitivity	-122 dBm (PASS)			
PLC Test:				
Power Level 1	14.660 dBm (PASS)			

Operator ID / Mobile ID / Export to CSV / Clear Results

Call Mobile | Channel Plan | TX Test | RX Test | PLC Test | T1 Test | Main Screen

Right Screen

TETRA TMO> Test Results
Radio Test Results

	Last	Min	Max	Average
TX Test:				
RF Power	14.6948	14.6322	14.8096	14.7317 (PASS)
Unwanted Output Power	-39.6508	-40.1489	-39.4860	39.7717 (PASS)
Residual Carrier Power	1.1184	0.1957	2.8829	1.0982 (PASS)
RF Frequency Error	11.3994	11.3149	15.3150	12.3765 (PASS)
Error Vector Magnitude RMS	5.7262	5.2900	6.6844	5.8196 (PASS)
Error Vector Magnitude Peak	20.0482	14.6034	24.1658	19.7638 (PASS)
Frame Alignment	0.1641	0.1094	0.1953	0.1646 (PASS)
RX Test:				
RX Sensitivity	-122 dBm (PASS)			
PLC Test:				
Power Level 1	14.660 dBm (PASS)			
Power Level 2	20.164 dBm (PASS)			
Power Level 3	25.035 dBm (PASS)			
Power Level 4	29.913 dBm (PASS)			
Power Level 5	32.253 dBm (PASS)			
Power Level 6				
T1 Test:				
T1 BER				
T1 MER				

Operator ID / Mobile ID / Export to CSV / Clear Results

Call Mobile | Channel Plan | TX Test | RX Test | PLC Test | T1 Test | Main Screen

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RX Tones and Voice Loopback

This feature works in any Duplex call type.
Example:

    Set up a Group Call:
    Select "Call Type and "Group" from the dropdown menu
    Select "Select Group"" the radio will have sent Group Allocations during Registration.
    Select the Group to make the call to
    Select "Call Mobile"

The Mobile will indicate Group Call ID 777 on its display.
    Press PTT to observe TX measurements

    Release PTT
    "Select Voice Loopback"
    Scroll to each tone in the menu to hear them on the mobiles speaker
    Select "Voice"
    Press PTT and speak into the microphone to record a message
    Release PTT. Recorded message will play back repeatedly until "OFF" is selected

Note. A manual test of the RX sensitivity can be made by:
Selecting "RF Level" then adjust negatively until the speech be comes broken up. <-116 to -120 is a typical level for breakup of voice.

Full Screen Graphical Displays

Bar Charts
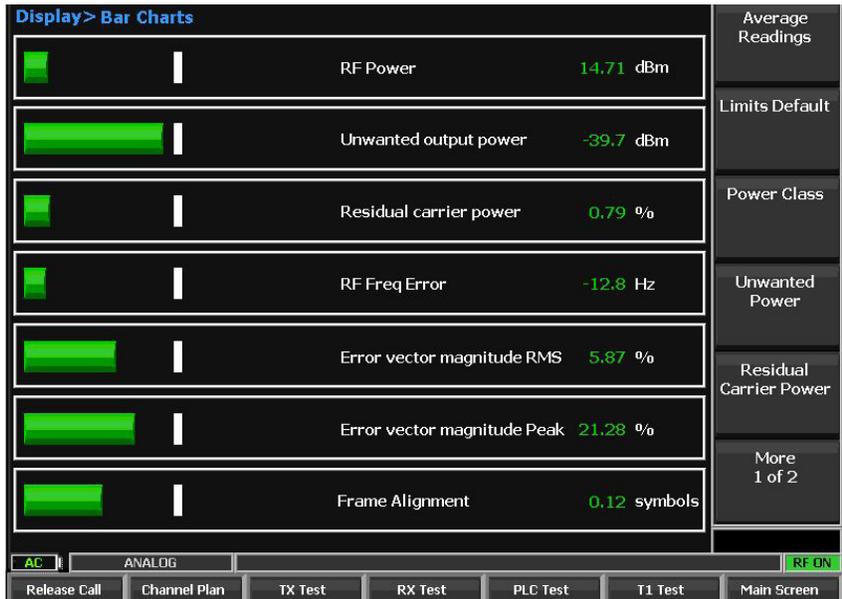
Bar charts provide a graphical representation of measured parameters.

   Colour coded pass/fail as in the main screen.
   The White markers indicate the limit of each parameter.
   Individual Limits may be adjusted by the operator
   Power Class selection loads the limits for that class of radio.

Spectrum Analyser
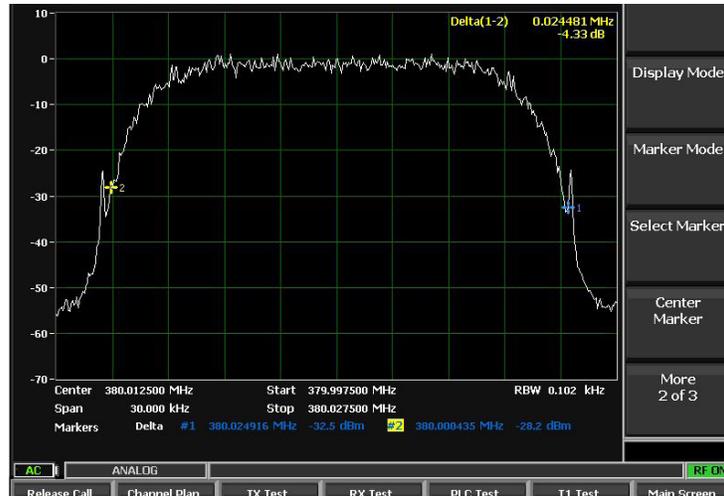
The Spectrum Analyser will be familiar as it is a copy on of the main Spectrum Analyser from the standard R8100. Only the functions applicable to TMO have been copied across,
Page through all the menu pages to see the features included.

    Start/Stop Frequency
    Display Mode
        -Max Hold is useful for capturing the TDMA Bursts.
    Markers
    Marker Modes
        -Delta Mode is useful to measure channel bandwidth
    Adjustable Span

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Power Profile
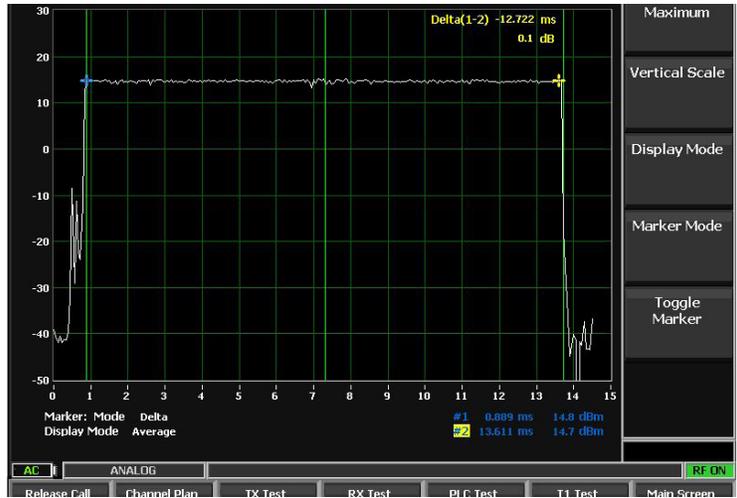
TDMA slot view
2 Markers for timing analysis
Markers toggle for Mkr1 or Mkr2 adjustment.

Constellation Display

Industry standard QPSK Constellations
Graphical representation of:
      Phase errors
      Amplitude Errors

      I/Q Imbalance

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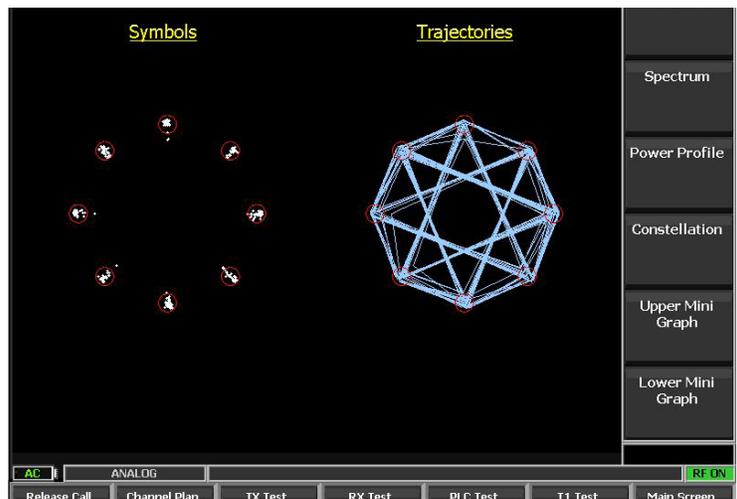
Test Limits

Test Limits	Lower	Upper
RF Power Level	28 dB	32 dB
Unwanted Power		-36 dB
Residual Carrier Power	0 %	5 %
Frequency Error	-100 Hz	100 Hz
RMS Vector Error	0 %	10 %
Peak Vector Error	0 %	30 %
Frame Alignment Symbols	-0.250 sym	0.250 sym
RX Sensitivity	-114 dBm
MS T1 BER		3.000 %
MS T1 MER		3.000 %

This menu allows the operator to set his own limits for each TMO parameter being measured
These limits are mirrored in the Bar Charts display.
The setting of each parameter is used to calculate pass/fail results automatically.

The default key returns all limits the ETSI standard

Call Types

Each type of call can be made individually to and from the mobile.

Ind Duplex Simultaneous TX and RX

Ind Simplex PTT to TX.

Group PTT to TX

Phone Simultaneous TX and RX

SDS & DGNA Send and Receive short message, Assign and Unassign Dynamic Groups OTA..
Emergency

Ambient Listening. Covert operation… Radio speaker is inhibited, Microphone is live.

All of these can be activated or turned off by the Radio's Programming software.
Call initiation and connections can be made by the MS Radio or the BS R8100.

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