



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.



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.

TETRA TMO> Active	Symbols	17 miles	TETRA TMO
Mobile Registration Status	0		
Mobile SSI: Group SSI:	, i i i i i i i i i i i i i i i i i i i		
Call Type Individual Duplex	0		5
RF Frequency 396.01250 MHz			
RF Output Level -75 dBM Attn. 20 dB	0		
MCCH/TCH Direct Entry TS 2			
MNC 9876 MCC 262 BCC 5 Larea 27			
RF Power -142.74 dBm			
Unwanted Output Power -142, dBm			
Residual Carrier Power 0.00 %			
RF Freq Error 0.00 Hz			
Error Vector Magnitude RMS 0.00 %			
Error Vector Magnitude Peak 0,00 %			
Frame Alignment 0.00 symbols			
			Squelch Opens
			-100.0 dBm
AC I SEPURA			RFON



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 the TETRA TMO key to start and configure operational settings

TETRA TMO> Active	Symbols	TETRA TMO
Mobile Registration Status Mobile SSI: Group SSI:		
Call Type Individual Duplex RF Frequency 396.01250 MHz	0 · 0	
RF Output Level -75dBM Attn. 20 dB MCCH/TCH Direct Entry TS 2 MNC 9876 MCC 262 BCC 5 Larea 27	0 0	
RF Power -142.74 dBm		
Unwanted Output Power -142. dBm		
Residual Carrier Power 0.00 %		
RF Freq Error 0.00 Hz		
Error Vector Magnitude RMS 0,00 %		
Error Vector Magnitude Peak 0.00 %		
Frame Alignment 0.00 symbols		
		Squelch Opens
AC I SEPURA		REON

The "TETRA TMO" field will display " sync in progress xx seconds" After a few seconds the field will display "Active"

TETRA TMO> Sync in progress 1.5 seconds	Symbols	0		Graphical Displays
Mobile Registration Status Mobile SST: Group SST:	(0	
	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			Call Type
Call Type Individual Duplex	0		0	
RF Frequency 396.01250 MHz				
RF Output Level -40 dBM Attn. 20 dB	Ċ		0	Select Group
MCCH/TCH Direct Entry TS 2	12			
MNC 9876 MCC 262 BCC 5 Larea 27				
	-			Voice
RF Power -142.28 dBm			18	Loopback
Unwanted Output Power -142, dBm				
Residual Carrier Power 0.00 %				RF Output
RF Freg Error 0.00 Hz				Level
Franz Vester Mognitude DMC 000 0/				
				More
Error Vector Magnitude Peak 0.00 %				1 of 2
Frame Alignment 0.00 symbols				
AC ANALOG			•	RFON
Call Mobile Channel Plan TX Test	RX Test	PLC Test	T1 Test	Main Screen



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... OHz. +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



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.

Channel System				Channel Syst	em					
MCCH TCH TS	3600 3600 2	Frequency 390.00000 MHz Frequency 380.00000 MHz	Band	MCCH TCH TS Frequency	30 30 2 / Band 30	600 F 600 F 00 MHz	Frequency 390. Frequency 380.	00000 MHz 00000 MHz		Operating Mode
Channel Offset Duplex Offset Operating Mode	0 Hz 10 MHz Normal		MCCH	Channel O Duplex Of Operating	ffset 0 fset 10 Mode No	Hz 0 MHz Iormal				MCC
Network			TS	Network						MNC
MCC MNC RCC	262 9876 5			MCC MNC	20 98	62 876				
Larea	27		Channel Offset	Larea	2	7				BCC
			More 1 of 3							More 2 of 3
AC E ANALOG			REON		4141.00				[ar ou
Call Mobile Channel P	lan TX Test	RX Test PLC Test T	1 Test Main Screen		ANALOG Dian	1 TV T-++	1 py rest 1	DI C Test	T1 Test	RF UN
				Call Mobile	Channel Plan	TX Test	RX Test	PLC lest	TITest	Main Screen



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)

sults				
	Current	Min	Мах	Average
RF Power dBm		14.632	14.81	
Unwanted Power dBm		-40.149	-39.486	-39.772
Frequency Error Hz		11.315	15.315	
RMS Vector Error %		5.29	6.684	
Peak Vector Error %		14.603	24.166	
Residual Carrier Power %		0.196	2.883	
Frame Alignment Symbols		0.109	0.195	0.165



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.



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

TETRA TMO> Active	Power Profile	Bar Charts
Mobile Registration Status Mobile SSI: 8 Group SSI: 3004		
Call Type Individual Duplex RF Frequency 390.00000 MHz		Spectrum
RF Output Level -40 dBM Attn. 20 dB MCCH/TCH 3600 TS 2 MNC 1234 MCC 262 BCC 5 Larea 27	4 4	Power Profile
RF Power 14.71 dBm	E	Constellation
Unwanted Output Power -39.6 dBm		
Residual Carrier Power 1.12 % RF Freq Error -18.7 Hz	=	Upper Mini Graph
Error Vector Magnitude RMS 6,04 %		Lower Mini Graph
Frame Alignment 0.18 symbols		

Ind Duplex Type is a Duplex bidirectional connection and can be used to make continuous measurements. Alternatively, Phone Type.



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.

Pass

6. Enabling a fast assessment of the radios overall health.



Fail

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.



-Select "Main Screen" to Return

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

X Setup					Burst Samples
No. of Bursts for Average Calcu	lation: 100				Start Test
	Current	Min	Max	Average	Test Desults
RF Power dBm	0	0	0	0	Test Results
Unwanted Power dBm	0	0	0	0	
Frequency Error Hz	0	0	0	0	
RMS Vector Error %	0	0	0	0	
Peak Vector Error %	0	0	0	0	
Residual Carrier Power %	0	0	0	0	
Frame Alignment Symbols	0	0	0	0	
'X Status					
Burst Samples Counter:					
					REC
Call Mobile Channel Plan	TX Test	RX Test	PLC Tes	st T1 Test	Main Screen

Set Up Display

lesults					St
	Current	Min	Max	Average	
RF Power dBm	14.695	14.632	14.81	14.732	Tes
Unwanted Power dBm	-39.651	-40.149	-39,486	-39.772	
Frequency Error Hz	11.399	11.315	15.315	12.376	
RMS Vector Error %	5.726	5.29	6.684	5.82	
Peak Vector Error %	20.048	14.603	24.166	19.764	_
Residual Carrier Power %	1.118	0.196	2,883	1.098	
Frame Alignment Symbols	0.164	0.109	0.195	0.165	

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.



Result is automatically added to the "Test Results" file

TETRA TMO> RX Test	Start Level	TETRA TMO> RX Test	Start Level
RX Sensitivity		RX Sensitivity	
Start Level: -100 Step Level: 2 RX Sensitivity:	Step Level	Start Level: -100 Step Level: 2 RX Sensitivity: -122 dBm	Step Level
	Start RX Test		Start RX Test
	Test Results		Test Results
	PE ON		PEON
Call Mobile Channel Plan TX Test RX Test PLC Test T1 Test	Main Screen	Call Mobile Channel Plan TX Test RX Test PLC Test T1 Test	Main Screen

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

TETRA TMO>Power Loop Control Test	Start PLC Test	TETRA TMO>Power Loop Control Test>Testing Power Level 2	Start PLC Test
Power Class 3L (1.8W)		Power Class 3L (1.8W)	_
Power Level $1 = 15 \text{ dBm} \pm 2 \text{ dBm}$ 0 dBm	Test Results	Power Level 1 = 15 dBm ± 2 dBm 14.66 dBm	Test Results
Power Level 2 = 20 dBm ±2 dBm 0 dBm	reserves and	Power Level 2 = 20 dBm ±2 dBm 15.056 dBm	
Power Level 3 = 25 dBm ±2 dBm 0 dBm		Power Level 3 = 25 dBm ±2 dBm 0 dBm	
Power Level 4 = 30 dBm ±2 dBm 0 dBm		Power Level 4 = 30 dBm ±2 dBm 0 dBm	
Power Level 5 = 32.5 dBm ±2 dBm 0 dBm		Power Level 5 = 32.5 dBm ± 2 dBm 0 dBm	
			-
AC I ANALOG	REON		RFO
Call Mobile Channel Plan TX Test RX Test PLC Test T1 Test	Main Screen	Call Mobile Channel Plan TX Test RX Test PLC Test T1 Tes	t Main Screen



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.

TETRA TMO> Test Results					Operator ID	TETRA TMO> Test Results					Operator ID
Radio Test Results						Radio Test Results					
Operator ID						TX Test:					
Mobile ID					Mobile ID	RF Power	14.6948	14.6322	14.8096	14.7317 (PASS)	Mobile ID
Test Date	27/6/2018					Unwanted Output Power	-39.6508	-40.1489	-39.4860	39.7717 (PASS)	
Test Time	10:12:46 AM		1			Residual Carrier Power	1.1184	0.1957	2.8829	1.0982 (PASS)	
Frequency	390.00000 MHz					RF Frequency Error	11.3994	11.3149	15.3150	12.3765 (PASS)	
Network	262/1234				Export to CSV	Error Vector Magnitude RMS	5.7262	5.2900	6.6844	5.8196 (PASS)	Export to CSV
					Linport to dov	Error Vector Magnitude Peak	20.0482	14.6034	24.1658	19.7638 (PASS)	
	Last	Min	Max	Average		Frame Alignment	0.1641	0.1094	0.1953	0.1646 (PASS)	
TX Test:						RX Test:			(
RF Power	14.6948	14.6322	14.8096	14.7317 (PASS)		RX Sensitivity	-122 dBm (PASS)				
Unwanted Output Power	-39.6508	-40.1489	-39.4860	39.7717 (PASS)	Clear Results	PLC Test:					Clear Results
Residual Carrier Power	1.1184	0.1957	2.8829	1.0982 (PASS)		Power Level 1	14.660 dBm (PASS)	1	0		
RF Frequency Error	11.3994	11.3149	15.3150	12.3765 (PASS)		Power Level 2	20.164 dBm (PASS)	1			
Error Vector Magnitude RMS	5.7262	5.2900	6.6844	5.8196 (PASS)		Power Level 3	25.035 dBm (PASS)	1	3.		
Error Vector Magnitude Peak	20.0482	14.6034	24.1658	19.7638 (PASS)		Power Level 4	29.913 dBm (PASS)	1	(
Frame Alignment	0.1641	0.1094	0.1953	0.1646 (PASS)		Power Level 5	32.253 dBm (PASS)	l l			
RX Test:			1			Power Level 6			6		
RX Sensitivity	-122 dBm (PASS)		-			T1 Test:					
PLC Test:						T1 BER					
Power Level 1	14.660 dBm (PASS)					T1 MER					
ACE I ANALOG					RFON	AC I ANALOG					RFON
Call Mobile Channel Plan	TX Test	RX Test	PLC Te	st T1 Test	Main Screen	Call Mobile Channel Plan	TX Test	RX Test	PLC Tes	t T1 Test	Main Screen



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

Display > Dal Charts		Average Readings
RF Power 14.71	dBm	Reddings
		Limits Default
Unwanted output power39,7	dBm	
Residual carrier power 0.79	%	Power Class
RF Freq Error -12.8	Hz	Unwanted Power
	0/	
Error vector magnitude RMS 5.07		Residual Carrier Power
Error vector magnitude Peak 21.28	⁰∕₀	
		More 1 of 2
Frame Alignment 0,12	symbols	2012
		DE ON
Release Call Chapped Dan TV Test DV Test DI C Test	T1 Tect	Main Ecroop

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



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





Test Limits

Test Limits	Lower	Upper		
RF Power Level	28 dB	32 dB		
Unwanted Power		-36 dB		Peak Vector
Residual Carrier Power	0 % 0	5 %		
Frequency Error	-100 Hz	100 Hz		Frame Align
RMS Vector Error	0 %	10 %		Symbols
Peak Vector Error	0%	30 %		
Frame Alignment Symbol	s -0.250 sym	0.250 sym		RX Sensitivity
RX Sensitivity	-114 dBm			
MS T1 BER		3.000 %		MS T1 BER
MS T1 MER		3.000 %		
				More 2 of 3
				2010
AC F ANALOG REON				
Release Call Channel Plan	TX Test	RX Test	PLC Test T1 Test	Main Screen

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.

