



2305 Stabilock[®]

TETRA Test Set

User's Guide

Firmware version 2.10

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About This Guide

- “Purpose and scope” on page xii
- “Assumptions” on page xii
- “Related information” on page xii
- “Technical assistance” on page xii
- “Conventions” on page xiii

Purpose and scope

The purpose of this guide is to help you successfully use the 2305 Stabilock features and capabilities. This guide includes task-based instructions that describe how to configure, use, and troubleshoot the 2305 Stabilock. Additionally, this guide provides a description of Aeroflex's warranty, services, and repair information, including terms and conditions of the licensing agreement.

Assumptions

This guide is intended for novice, intermediate, and experienced users who want to use the 2305 Stabilock effectively and efficiently. We are assuming that you have basic computer and mouse/track ball experience and are familiar with basic telecommunication concepts and terminology.

Related information

Use this guide in conjunction with the following information:

2305 Stabilock getting started manual, ordering number AG 295 102

Technical assistance

If you need assistance or have questions related to the use of this product, call Aeroflex's support. You can also contact Aeroflex by e-mail at support-muc@aeroflex.com.

Conventions

This guide uses naming conventions and symbols, as described in the following tables.

Table 1 **Typographical conventions**

Description	Example
User interface actions appear in this typeface .	On the Status bar, select Start .
Buttons or switches that you press on a unit appear in this TYPEFACE .	Press the ON switch.
Code and output messages appear in this <code>typeface</code> .	All results okay
Text you must type exactly as shown appears in this type-face .	Type: a:\set.exe in the dialog box.
Variables appear in this <code><typeface></code> .	Type the new <code><hostname></code> .
Book references appear in this typeface.	Refer to Newton's Telecom Dictionary
A vertical bar means "or": only one option can appear in a single command.	platform [a b e]
Square brackets [] indicate an optional argument.	login [platform name]
Slanted brackets <> group required arguments.	<password>

Table 2 **Keyboard and menu conventions**

Description	Example
A plus sign + indicates simultaneous keystrokes.	Press Ctrl+s
A comma indicates consecutive keystrokes.	Press Alt+f,s
A slanted bracket indicates choosing a submenu from menu.	On the menu bar, click Start > Program Files .

Table 3 Symbol conventions






	This symbol represents a general hazard.
	This symbol represents a risk of electrical shock.
	NOTE This symbol represents a note indicating related information or tip.

Table 4 Safety definitions

	WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Safety Notes

This chapter provides the safety notes for the 2305 Stabilock. Topics discussed in this chapter include the following:

- [“Safety class” on page xvi](#)
- [“Safety warnings” on page xvi](#)

Safety class

For the safety class of your 2305 Stabilock, please refer to the Getting Started Manual that was delivered with your Stabilock both as a hard-copy and as a PDF file on a CD.

Safety warnings

This product is designed for indoor use. As exposure to water may damage the instrument it has to be protected against moisture when used outdoors.



WARNING

Only use a 50 Ω N-type connector to connect to the **RF1 In/Out** and **RF2 Out** ports of the 2305 Stabilock. Use of any other connector may result in damage of the instrument.



WARNING

Do not cover the ventilation slits (on the left and right-hand side of the instrument and on the back). Covering them may result in serious damage and fire.



WARNING

Keep the heat sink at the back free!
The instrument may overheat otherwise.



WARNING

The maximum input power level at the **RF1 In/Out** connector is 70 W continuous level. Higher input levels may result in serious damage of the instrument.



WARNING

Do not feed signals or DC voltage into the **RF2 Out** port as it may result in serious damage of the instrument.



WARNING

Operate the instrument within the temperature range from 5°C (40°F) to 45°C (110°F) only. Operation outside this range will lead to invalid results.



Safety advice for the battery module

Do not crush. Do not heat or incinerate. Do not short-circuit. Do not dismantle. Do not immerse in any liquid, it may vent or rupture! Do not charge below 0°C (32°F) nor above 45°C (110°F).

Battery module usage

The battery module is for use with the Stabilock and the 9100 Hand-held Spectrum Analyzer Series only. Aeroflex does not accept any liability for damage of the battery or other equipment if the battery module is used with other electric or electronic equipment.

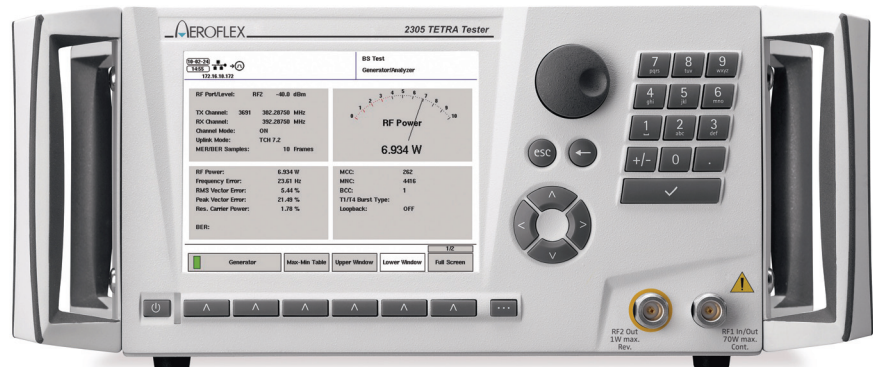
Overview

1

This chapter provides a general description of the 2305 Stabilock. Topics discussed in this chapter include the following:

- [“About the 2305 Stabilock” on page 2](#)
- [“What’s new in version 2.10” on page 3](#)
- [“Features and capabilities” on page 4](#)
- [“Options and accessories” on page 5](#)

About the 2305 Stabilock



The Aeroflex 2305 Stabilock is a mainframe with software available for testing either TETRA radio terminals, or base stations, or both. Service personnel use the Stabilock to ensure the quality of the transmitter and receiver.

- Base stations can be tested at output power levels up to 100 W. Base stations with separate connectors for transmitter and receiver can easily be connected.
- Radio terminals can be tested in terms of transmit and receive parameters; the digital circuits are also tested with call setup routines in trunked mode (TMO) or direct mode (DMO).

Highlights:

- All the service measurements for TETRA base stations and radio terminals
- Wide output level range for sensitivity and blocking measurements
- Wide input level range even for high power base stations
- Low investment cost
 - Serves network operators and user groups
 - public safety and security
 - transportation services
 - utilities
 - industrial companies

What's new in version 2.10

Introduces 2334 Base Station Control Option

Introduces Autotest feature for base stations (option)

Extends the frequency range in the lower band to 475 MHz

Adds a new trace mode (Accumulated) in the constellation diagram

Introduces multiple file selection in the file manager

Introduces user-definable wait time after MS Attach in Autotest

Automatically changes reverse mode operation in Generator/Analyzer when needed (at band edges)

Features and capabilities

General features

- Supports TETRA mobile and base station tests relevant for service
- Intuitive and failsafe user interface
- Made for the PMR service environment
- Bright screen and robust case
- Portable, lightweight and compact
- Optional battery operation
- Proven Stabilock® quality and precision with a 50-year tradition
- Field proven due to
 - low weight (< 4 kg)
 - battery option
 - large and high contrast screen
 - Remote control for automated testing in service and manufacturing
- RF signals over joint or separate RF ports
- TETRA test signals

Transmitter measurements

- RF power
- Carrier frequency offset
- Burst power profile over time (for mobile stations)
- Timing error (for mobile stations)
- Residual carrier power
- Unwanted output power
- Error vector magnitude (RMS, peak)
- Modulation spectrum
- Constellation diagram

Receiver measurements

- Single ended and loopback Bit Error Rate (BER) and Message Erasure Rate (MER)
- Test signals: T1 with TCH7.2, TCH2.4, SCH/F, with and without Frame 18
- Paging sensitivity (for mobile stations)

Options and accessories

2332 TETRA Base Station Test Option

Supports receiver and transmitter measurements at TETRA base stations according to EN 300 394: Air interface or external synchronization, different up and downlink test signalling channels and bit error rate. The 2305 Stabilock supports measurements at RF power levels up to 100 W at a joint or at separate RF connectors.

2333 TETRA Mobile Station Test Option

Approved by leading manufacturers of TETRA terminals, this option offers all the test functions needed for radio repair, tuning and preventive maintenance, including the standardized TETRA test modes and application tests for group calls. Frequent preventive testing is important to ensure the mobile stations are fully operational when they are needed most!

2330 DMO Option: Expand testing capabilities to TETRA Direct Mode Operation

With the 2330 DMO Option installed, the 2305 Stabilock also understands and analyses the TETRA DMO protocol for direct communication between two TETRA radios. This enables the user to test the single-frequency operation. Requires 2333 TETRA Mobile Station Test Option.

2331 Autotest Option: Efficient and time-saving checks through automated tests

Aeroflex offers a set of automatic test capabilities for the 2305 Stabilock. The 2331 Autotest Option allows to run typical test sequences automatically on the instrument. So you can run tests with the mere push of a button!

2334 TETRA Base Station Control Option: Automating the setup

Both the base station and the instrument must be set up for the testing, the results must be evaluated, and finally the base station must be reverted to normal operation. In manual operation, this requires the operator to switch between two different user interfaces. This error-prone operation can be simplified to interacting with the instrument only, by automating the base station operation. Base station control scripts for base stations from popular BS vendors are available on request.

2360 OCXO Option: Increasing frequency accuracy

TETRA mobile stations are usually running a reliable AFC (Automatic Frequency Correction) to match frequency offset to the base station. For tests on mobile stations which do not have this feature, Aeroflex offers the 2360 OCXO Option to make the reference frequency of the 2305 Stabilock ten times more accurate.

2361 Battery Option: Becoming independent from mains power

No need to spend time dismounting radios installed into vehicles: Take the tester on the road with the 2361 Battery Option! Using the high-capacity Li-Ion type battery, the 2305 Stabilock becomes independent from other power sources for about two hours. And with accessories like the desk charger and extra batteries, engineers are always prepared for a quick emergency mission.

1500 Battery Charger

The desktop charger allows you to recharge a battery while operating the 2305 Stabilock with another battery. This way, your 2305 will always be ready for use in the field!

4914 Antenna Coupler

The Aeroflex 4914 Antenna Coupler makes testing of TETRA terminals easier. Where technicians previously had to move around many RF adapters (radio frequency adapters) for different types of TETRA mobile stations, they now can simply place the unit under test on the 4914 Antenna Coupler, adjust the shuttle to a predefined position and start the test. Using a coupling device with an antenna has the additional advantage of including the antenna in the test whereas individual adapters are often connected in place of the antenna or with a connector that bypasses the antenna. The 4914 is designed for the frequency range from 350 to 495 MHz. For higher frequencies, the 4916 Antenna Coupler is the right choice.

Instrument Setup

2

This chapter describes how the instrument and measurement parameters are set up. Topics discussed in this chapter are as follows:

- “Starting the instrument” on page 8
- “Basic concepts of operation” on page 9
- “Adjusting the averaging” on page 13
- “Working with channel setups” on page 15
- “Changing the unit for power measurements” on page 14
- “Resetting parameters to factory settings” on page 14
- “Using the 2305 Stabilock with peripherals” on page 18
- “Setting up general parameters of the 2305 Stabilock” on page 26
- “Managing files on the 2305 Stabilock” on page 31
- “Obtaining the instrument status” on page 35
- “Installing software options” on page 36

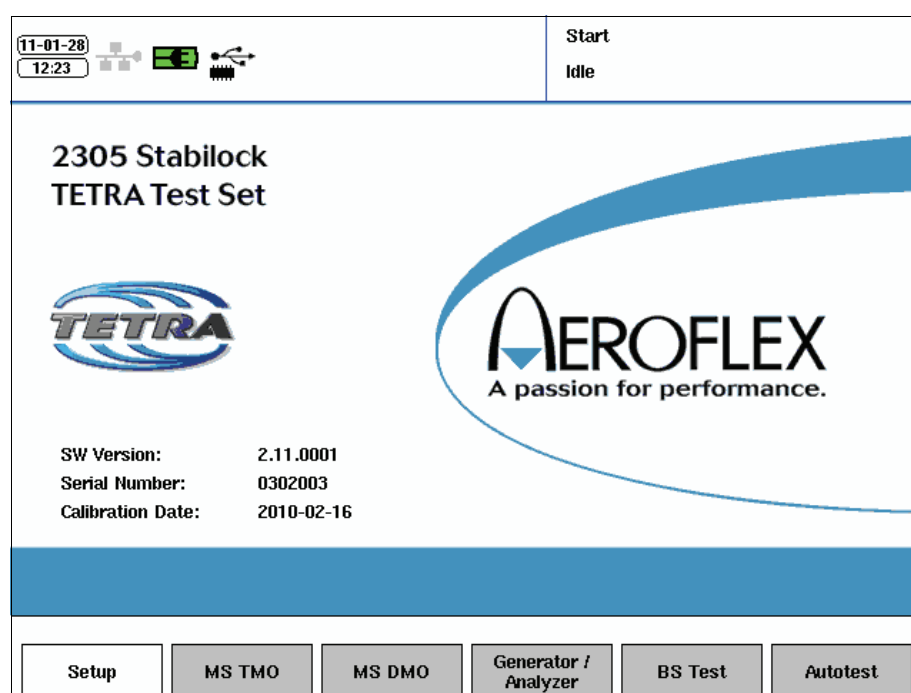
Starting the instrument

Please read the Getting Started manual for the 2305 Stabilock to learn how to power up the Stabilock. Once the firmware is booted, the Welcome menu appears (see below). Explanations in this user's guide typically start from this Welcome menu.

For a general description of the front panel elements and how to navigate the menus, see section ["Basic concepts of operation"](#) below.

For the principal operation when testing mobile stations, please refer to [Chapter 3 "General Operation for MS Testing"](#).

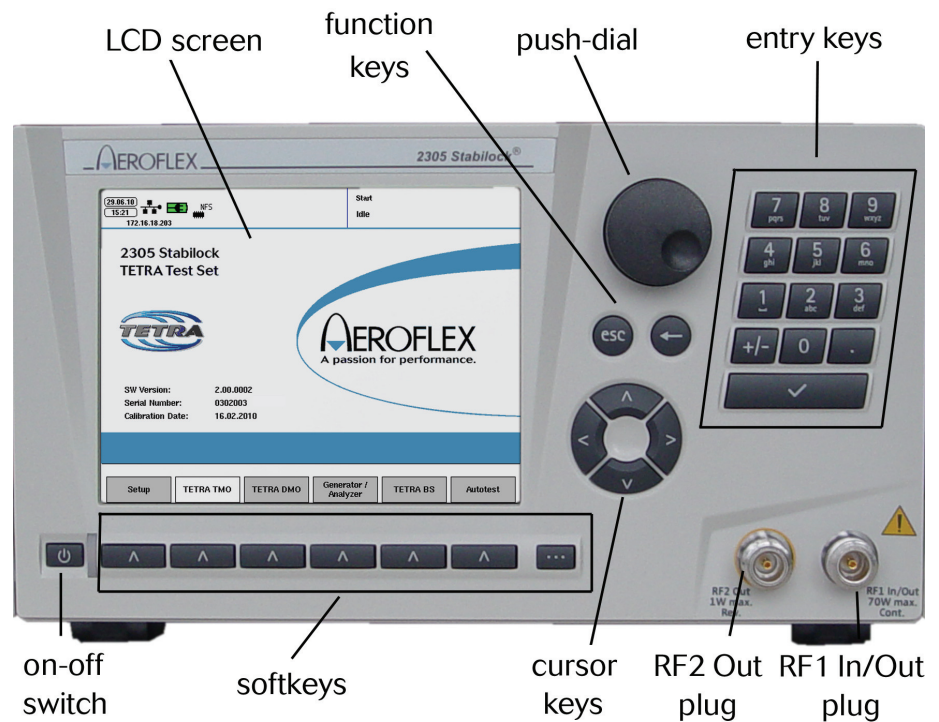
Setup and operation for base station testing are explained in [Chapter 8 "Instrument Setup and General Operation for BS Testing"](#).



Basic concepts of operation

The 2305 Stabilock can be operated either through the front panel or via remote control. The latter allows automation of test sequences; please contact Aeroflex to receive a list of SCPI commands if needed.

In manual mode, the 2305 Stabilock is operated through the front panel elements. The basic elements and functions are explained in the Getting Started Manual.



Menus and softkeys

The most important elements are the menus displayed on the LCD screen, and the six softkeys below the screen. The screen always displays a menu with either input fields or results or both, and a description of the current functions of each of the six softkeys.

Depending on the current description of the softkeys, each softkey starts or stops a function, provides access to parameters or changes to a new menu.

While you can go to a new menu level by pressing a softkey, you can return to the next lower menu level with the **ESC** function key.

Some menus contain more than six softkey functions. In such a case, the right-most one displays "1/2" or "2/2" on top of the softkey description. Press the ... key to move to get access to the remaining softkey functions.

Entry fields Most menus contain one or more entry fields where you can change test or control parameters. At any stage, the 2305 Stabilock is in one of two modes: the menu mode (where you can select an entry field or move to a different menu) and the entry mode (where the 2305 Stabilock is ready to accept your input for a parameter field).

In menu mode, you can move between the entry fields with the cursor keys (**RIGHT** key to jump to the next entry field on the right, **DOWN** to jump to the next entry field below, **LEFT** key to jump to the entry field on the left, or **UP** to jump to the next entry field above). The entry field currently selected is highlighted.

NOTE

The softkeys are also treated as entry fields, i.e. a softkey may be highlighted and selected instead of a normal entry field.

Entry mode is selected by either pressing the **ENTER** key [✓] or the push-dial, or by pressing one of the entry keys directly.

In entry mode, you can either enter numerical values or alphanumerical values, or select an entry from a defined list (list field). What you can actually enter here, depends on the type of input field.

- Numerical input fields allow you to enter a new numerical value using the entry keys, or change the value currently displayed with the **UP/DOWN** cursor keys or the push-dial. You can move the cursor within the field using the **LEFT/RIGHT** cursor keys.
- Alphanumerical input fields allow you to enter new text using the entry keys. Press an entry key repeatedly to select the desired letter.

Alternatively, you can use the push-dial to enter text. While in entry mode, turning the push-dial results in a vertical list of characters appearing on the right-hand side. Scroll up or down with the push-dial to select a character, then wait three seconds to accept the selection. The ... key allows you to toggle between lowercase, uppercase and additional symbols.

You can move the cursor about the entry field using the cursor keys –**LEFT/RIGHT** for horizontal cursor movement and **UP/DOWN** for vertical cursor movement in multiline input fields.

- List fields allow you to scroll through the list with either the cursor keys or the push-dial.

A numerical or alphanumerical input can be undone by pressing the **BACKSPACE** key [←]. The character before the current cursor position is deleted.

To close an input field and accept the selected input, press the **ENTER** key or the push-dial.

To close an input field and return to the previous input, press the **Esc** key.

Symbols used on the display

In the top-left corner, there are one or more symbols displaying the current instrument status. The symbols and their meaning are as follows:

Table 1 Symbols used in the Stabilock menus

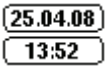
















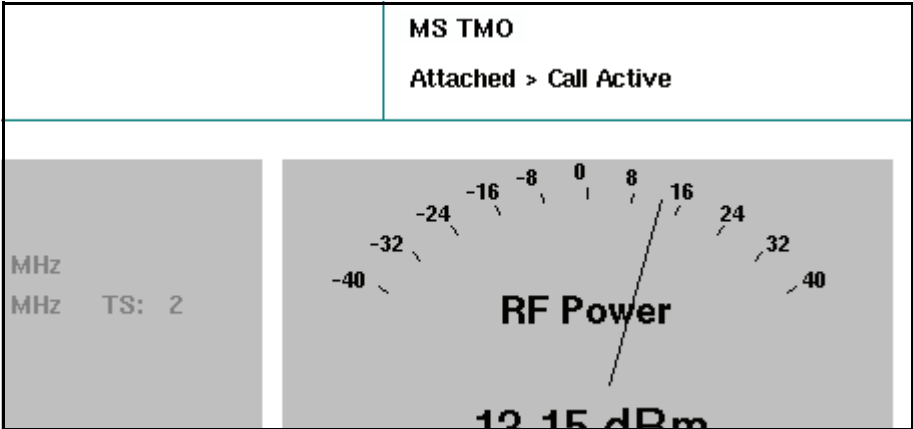
	Time and date. For date format and the displayed date and time, see sections “Setting the date format” on page 27 and “Setting the date and time” on page 27 .
	Not connected to LAN. See section “Connecting the instrument to the LAN” on page 19 for more details.
	Connected to LAN. See section “Connecting the instrument to the LAN” on page 19 for more details.
	Operating from the battery, with indication of charging level.
	Connected to external power supply, battery fully loaded.
	Connected to external power supply, loading battery.
	Connected to external power supply, no battery installed.
	A TX coupling factor of more than 3 dB has been set. This may be because the mobile station under test is coupled with the test instrument via an antenna, or because the base station is coupled via an attenuator.
	USB flash drive connected. If there is more than one USB flash drive connected, the symbol will also indicate the number. See section “Connecting and using a flash drive” on page 18 for more details.
	NFS drive connected over LAN. See section “Connecting the instrument to the LAN” on page 19 for more details.
	A duplex call has been set up and is currently active.
	A simplex call has been originated by the TETRA radio and is currently active.
	A simplex call has been originated by the tester and is currently active.

Table 1 Symbols used in the Stabilock menus (Continued)

	Warning: External synchronization is switched on, but PLL is not locked. This means that the transmit and receive frequencies of the Stabilock are not accurate.
	Warning: There is a shortcircuit at the USB port at the back panel – remove the device from the USB port on the rear! The USB port will be operational again after a short while.
	Warning: The Stabilock is not synchronized in time with the base station under test. Check if the test setup fulfills the prerequisites for the type of synchronization selected.
	The Stabilock is synchronized in time with the base station under test.

In the top-right corner, the 2305 Stabilock displays the name of the menu and the current signaling status. Example:



Adjusting the averaging

Graphical measurements in the 2305 Stabilock are displayed as an average of the last results if the **AVG** softkey is activated. The number of results affecting the displayed value can be changed in the range from 1 (no averaging) to 40 (i.e. 40 results are averaged to give one displayed value).

To change the number of bursts affecting the displayed measurement value:

- 1 Press **Setup > Definitions**.
The Definitions menu appears.
- 2 Go to the “Number of Samples” field and enter the required value.

Definitions	
Idle	
Pre-Attenuation	External Synchronization
RF-Analyzer (MS-TX): 0.00 dB	Auto. Detect: ON
RF-Generator (MS-RX): 0.00 dB	
Paging Sensitivity	High-Power Attenuator
Paging Sens. Start Level: -70.0 dBm	RF Level Limits: -40 dBm ... -122 dBm
Paging Sens. Step Width: 2.0 dB	
Paging Sens. Stop Level: -122.0 dBm	
Measurements	
Number of Samples: 10	
Unit of Powervalue: dBm	
<div>System Default</div>	

Note

The Definitions menu can also be called up directly from measurement menus by selecting ... > **Definitions**. By returning from the Definitions menu to the measurement menu, the measurements will be reset and started with the new averaging and pre-attenuation values.

Changing the unit for power measurements

By default, the 2305 Stabilock displays power measurement results in dBm (decibel relative to one milliwatt); the TETRA specifications define power steps and limits in this unit.

If you prefer the results to be displayed in watt, you can change the displayed unit as follows:

- 1 Open the **Setup > Definitions** menu.
- 2 In the Measurements section, toggle the Unit of Power Value entry between **dBm** and **Watt**.
All subsequent measurements are shown with the power result in the selected unit.

Definitions	
Idle	
Pre-Attenuation RF-Analyzer (MS-TX): 0.00 dB RF-Generator (MS-RX): 0.00 dB	External Synchronization Auto. Detect: ON
Paging Sensitivity Paging Sens. Start Level: -70.0 dBm Paging Sens. Step Width: 2.0 dB Paging Sens. Stop Level: -122.0 dBm	High-Power Attenuator RF Level Limits: -40 dBm ... -122 dBm
Measurements Number of Samples: 10 Unit of Power value: dBm	
<div>System Default</div>	

Resetting parameters to factory settings

In the **Setup > Definitions** menu, there are general parameters that you can change at your discretion. If you want to return to the factory settings, push the **System Default** button to set all the parameters from this menu back to their defaults. (Returning all the parameters to their factory defaults may take a few seconds.)

Similarly, a push on the **System Default** button in any of the Limits menus returns the user-definable limit values to their respective default values. Pressing the **System Default** button in the MS Test Limits menu only affects the limits for MS testing; the equivalent applies to pressing the button in the BS Test Limits menu.

Working with channel setups

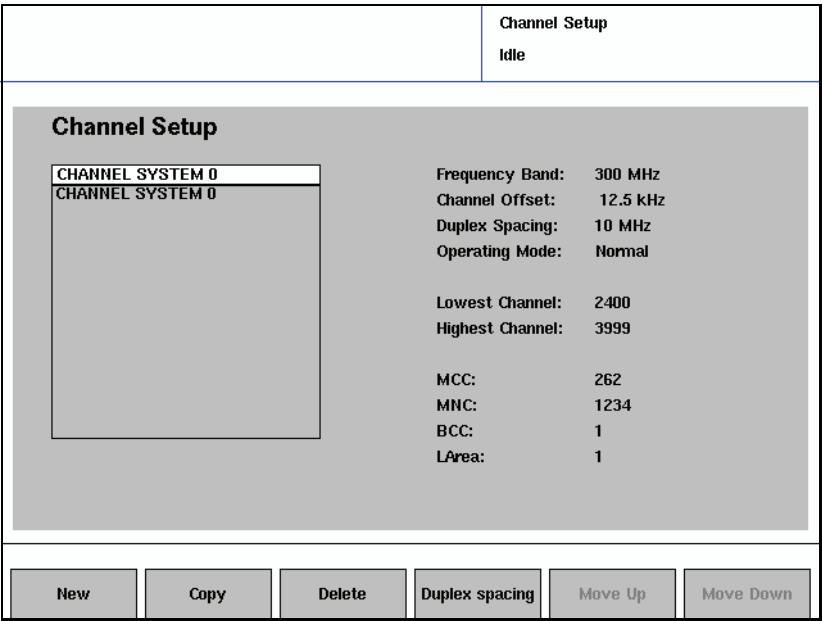
Creating, loading and modifying a channel setup

You can store and recall complete channel setups including channel numbers and base station details in channel setup files. Once a channel setup has been defined, it can be used in the setup for a manual test or an Autotest.

Note

Channel setups are applicable to both MS and BS tests. Not all of the parameters, however, are always used for BS testing: MCC, MNC, BCC, LArea.

- 1 From the Welcome menu, select **Setup > Channel Setup**.
The Channel Setup menu appears.



- 2 From the scroll box on the left-hand side, select an existing channel setup that you want to change, or push **New** to create a new parameter set. (New parameter sets are automatically named, e.g. "Channel System 2".)
- 3 On the right-hand side of the menu, select the base station and network parameters as explained in ["Setting up the network parameters" on page 40](#) (or on [page 124](#) for base station testing) and in ["Calculating channel numbers and frequencies" on page 178](#).
The new parameter values are automatically stored in the selected channel setup.

Copying channel setups

Channel setups are part of a setup file. Only those channel setups which are in the currently loaded setup are visible and can be used; when one setup file is loaded you cannot see and load a channel setup

that has been stored in a different setup file. The Stabilock can, however, exchange the full list of channel setups of one file with the channel setup list of the Default file or a file on an external storage device (USB flash disk or network drive).

The channel setup list of the receiving file will be amended by the copied files, i.e. the channel setups already existing will not be overwritten.

If a channel setup with the same name already exists and if the channel setup to be copied is different then the channel setup will appear twice in the list, the copied setup being shown further down in the list.

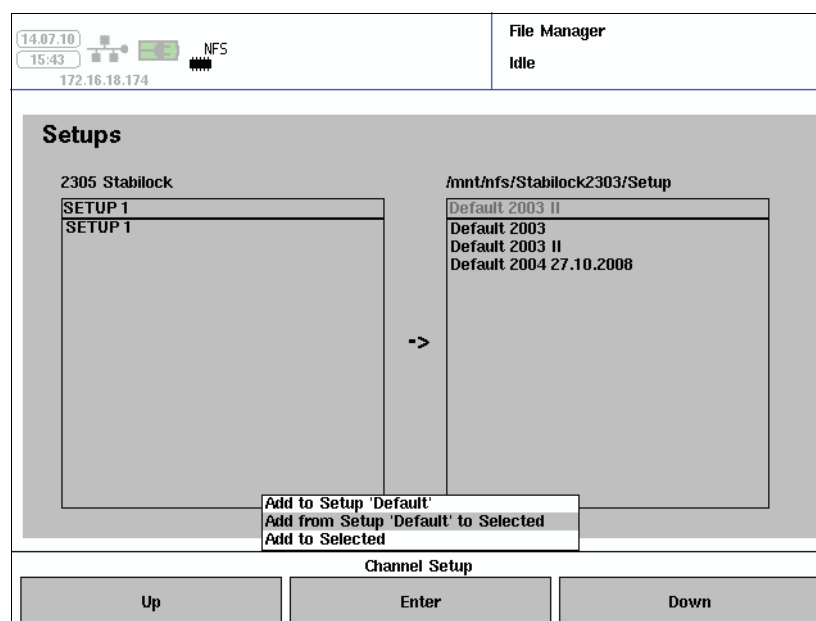
In order to copy the channel setups from one setup file to another, please proceed as follows:

- 1 From the Welcome menu, select **Setup > File Manager**.
A pull-up menu appears, showing different file types.
- 2 Select **Setups**.
The File Manager appears with a list of setups on the Stabilock.

Note

If a USB flash disk or a network drive is installed, the setup files on that device are listed on the right.

- 3 Select the device and setup file from or to which to copy the channel setups.
- 4 Push **... > Channel Setup**.
A pull-up menu appears, indicating the available options.



- 5 Push **Add to Setup 'Default'** if you want to copy the channel setups from the selected setup file to the Default setup file on the Stabilock.

Or: Push **Add from Setup 'Default' to Selected** if you want to copy the channel setups from the Default setup file on the Stabilock to the selected setup file.

Or: Push **Add to Selected** if you want to copy the channel setups from the selected setup file on one device to the selected setup file on the other (note the direction of the arrow in the center of the menu). This option is only available if an external device is available.

Setting up new duplex spacing entries

The Stabilock comes with a few, most used values in the Duplex Spacing fields. Additional values can be defined which then show up in the respective selection fields.


Take the following steps to add your own duplex spacing values:

- 1 Select Setup > **Channel Setup** > **Duplex**.
The Channel Setup Duplex Spacing menu appears.

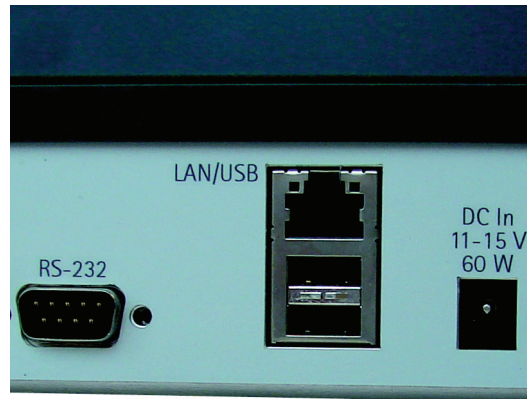
Channel Setup	
Idle	
Duplex spacing	
Frequency Band: 300 MHz	
IE	
000:	ON 10.00000 MHz
001:	ON 45.00000 MHz
010:	ON 0.00000 MHz
011:	OFF
100:	OFF
101:	OFF
110:	OFF
111:	OFF
System Default	

- 2 In the Frequency Band field, select the band for which the new duplex spacing value shall apply.
- 3 The first column shows the binary representation of the value in the duplex spacing field (IE) used in the protocol between the base station and the mobile radio. Choose the binary value for the new duplex spacing value; in the field in the middle column of that row, change the value to ON.
- 4 On the right-hand side in the same row, enter the duplex spacing (in MHz).

Using the 2305 Stabilock with peripherals

Connecting and using an external keyboard	The 2305 Stabilock can be operated conveniently through its front panel elements, in particular with the click-dial. However, if you need to enter a lot of data an external keyboard may be useful. The 2305 Stabilock supports standard keyboards with USB interface; the keyboard layout for France, Germany, the UK and the USA are automatically recognized.
Setting up the keyboard	In the Setup menu, select the keyboard layout in the Keyboard external selection field. Available layouts are those for the USA, the UK, Germany, France, Italy, Portugal and Spain.
Special keys	<p>The softkeys are assigned to function keys F1 through F6, with the ... key being assigned to F7.</p> <p>To enter negative numbers, just press the – key in the numeric block (the Num Lock function must be active).</p>
Connecting and using a flash drive	<p>The 2305 Stabilock can store various data on a flash drive and retrieve them at a later time. The following data file types are supported:</p> <ul style="list-style-type: none">– Pictures of the screen contents (screenshots)– Instrument settings– Measurement results– Configuration for TETRA mobile or base stations– Scripts for base station remote control <p>The 2305 Stabilock supports standard (commercially available) USB flash drive with any capacity from 128 kB to 4 GB. Connect the USB flash drive to any of the USB ports on the rear panel.</p> <p> If a USB flash drive is successfully connected, the USB flash drive symbol appears in the upper left corner of the Stabilock menus.</p>

Connecting the instrument to the LAN



In addition to operating the 2305 Stabilock through its front panel elements, it can also be controlled remotely from a PC through the serial (RS-232) interface or the LAN (local area network).

The LAN interface of the Stabilock supports 10 or 100 Mbps connections (10BASE-T or 100BASE-TX) over a Cat5 cable (with RJ-45 connectors at both ends).

Simply plug one end of the cable into the LAN socket on the rear panel of the Stabilock and the other into the socket of your LAN.

If you do not have a LAN but a PC with a LAN socket, you can connect the instrument to the PC directly using a cross-connect LAN cable. This cable type is available in computer shops or from Aeroflex.

The Stabilock must be physically connected to a LAN or a PC with an active LAN interface before the instrument is switched on.

In order to set up the IP address parameters of the 2305 Stabilock, you can either enter them directly or activate DHCP (Dynamic Host Configuration Protocol). DHCP is a protocol that automates the configuration of TCP/IP devices on a local area network; the IP address and subnet mask are assigned by a DHCP server that must be available on the LAN.

To enable DHCP, proceed as follows:

- 1 From the Welcome menu, select **Setup > Connection Setup**. The Connection Setup menu appears.

Connection Setup	
Idle	
Ethernet	RS-232
DHCP: <input type="button" value="OFF"/>	Mode: SCPI
IP Address: 192.168.151.1	Bit Rate: 115200
Subnet Mask: 255.255.255.0	Bits: 8
Gateway: 0.0.0.0	Parity: NONE
Remote Control	Stopbits: 2
Port: 49200	Remote Control
Terminator: CRLF	Terminator: CRLF
NFS	
Server: 0.0.0.0	
Path: Willtek	

- 2 In the DHCP list field, select **On**. DHCP is activated; if a DHCP server is available on the LAN, the Stabilock will obtain its IP address and the subnet mask from that server. If successful, both will be displayed in the Connection Setup menu and the Connected to LAN icon will be shown in the top-left corner of the menu.
- 3 Switch the Stabilock off and on again for the changes to take effect.

To disable DHCP and enter the IP parameters manually, proceed as follows:

- 1 From the Welcome menu, select **Setup > Connection Setup**. The Connection Setup menu appears.
- 2 In the DHCP list field, select **Off**. DHCP is de-activated.
- 3 In the IP Address field, enter an IP address that is not already being used on the LAN.
- 4 In the Subnetmask field, enter the mask for the subnet that the Stabilock belongs to.
- 5 If you communicate with the 2305 Stabilock over a gateway, enter the Gateway address for the Stabilock.
- 6 Select a port number for remote control. The port number addresses the remote control entity of the 2305 Stabilock. The default (used by the 7310 Lector & Scriptor family of test automation programs) is 49200.

- 7 Select the line terminator that the remote control software uses. This can be Carriage Return (CR), Line Feed (LF) or a combination of both (CRLF).
- 8 Switch the Stabilock off and on again for the changes to take effect.



As long as the 2305 Stabilock is not successfully connected in hardware and software, the LAN Not Connected symbol is displayed in the upper left corner of the menus.



172.16.18.198

As long as the 2305 Stabilock is connected, the Connected to LAN symbol is displayed in the upper left corner of the menus, along with the IP address.

Connecting and using a disk drive on the network

The 2305 Stabilock can store various data on a hard disk on the network and retrieve them at a later time. The following data file types are supported:

- Pictures of the current screen contents (screenshots)
- Instrument settings
- Measurement results
- Configuration for TETRA mobile and base stations
- Script files for base station remote control

For accessing a disk drive on the network, a protocol is required. The 2305 Stabilock supports the NFS (Network File System) and has an NFS client already built into its software. This protocol is available with most operating systems: most UNIX and Linux versions come with NFS server software, and there is free or low-cost third-party NFS server software available for MS Windows (such as TrueGrid NFS Server or nfsAxe). The NFS server typically provides access to a particular folder on a disk drive.

Once an NFS server is set up on the computer network, all you need to know is the computer's IP address and a path where to store the data. In order to set up the NFS connection on the 2305 Stabilock, proceed as follows:

- 1 Ensure that the 2305 Stabilock is properly connected to a computer network (see [“Connecting the instrument to the LAN” on page 19](#)). The network symbol with the Stabilock's IP address appears in the top-left corner.



2 Select the Setup menu.

15.05.09 11:16 172.16.18.216		Connection Setup Idle	
Ethernet DHCP: ON IP Address: 172.16.18.196 Subnet Mask: 255.255.252.0 Gateway: 172.16.16.167 Remote Control Port: 49200 Terminator: CRLF NFS Server: 172.16.18.137 Path: 2303/0002056		RS-232 Mode: SCPI Bit Rate: 115200 Bits: 8 Parity: NONE Stopbits: 2 Remote Control Terminator: CRLF	

3 In the Server input field of the NFS section, enter the (numerical) IP address of the remote computer.

4 In the Path input field, enter the path (i.e. the subfolder of or path relative to the folder which is allocated in the remote computer's NFS server software).

If the data have been entered correctly and the 2305 Stabilock can set up a connection successfully, the NFS drive appears at the top-left of the Stabilock menus.



Using the RS-232 interface

In addition to operating the 2305 Stabilock through its front panel elements, it can also be controlled remotely from a PC through the serial (RS-232) interface or the LAN (local area network). Alternatively, the Stabilock can control a base station for test purposes.

- 1 Use an RS-232 cable with 9-pin female connectors at both ends to connect the RS-232 socket on the rear panel of the Stabilock to the RS-232 socket of the PC.
- 2 From the Welcome menu, select **Setup > Connection Setup**. The Connection Setup menu appears.

Connection Setup	
Idle	
Ethernet DHCP: <input type="checkbox"/> OFF IP Address: 192.168.151.1 Subnet Mask: 255.255.255.0 Gateway: 0.0.0.0 Remote Control Port: 49200 Terminator: CRLF NFS Server: 0.0.0.0 Path: Willtek	RS-232 Mode: SCPI Bit Rate: 115200 Bits: 8 Parity: NONE Stopbits: 2 Remote Control Terminator: CRLF

- 3 In the Mode field of the RS-232 section, you should select if you want to control the Stabilock remotely or if you want the Stabilock to control a base station. Set Mode to SCPI for remote control of the Stabilock, or set it to BS Control for remote control of a base station.
- 4 Use the Bit Rate field to select a bit rate; valid entries are 9600, 19,200, 38,400, 57,600 and 115,200 bps. The default bit rate is 115,200 bps.
- 5 In the Bits field, select the number of bits per character (5 to 8).
- 6 In the Parity field, select any additional parity bit that is being transferred (even, odd or none).
- 7 Select the number of stop bits being transferred after each character (1 or 2).
- 8 Select the line terminator that the remote control software uses. This can be Carriage Return (CR), Line Feed (LF) or a combination of both (CRLF).
- 9 On the PC, select the same interface parameters and in addition, activate the RTS, CTS handshake parameters.

Using the **TRIGGER IN/OUT** connector

Depending on whether you are testing a base station or a mobile radio, the 2305 Stabilock uses the **TRIGGER IN/OUT** BNC socket on the rear either as an input or an output.

With the 2333 TETRA Mobile Station Test Option, the Stabilock can output a TTL pulse (high, 3.3 V) of 550 ns length at the start of each active (assigned) uplink time slot.

With the 2332 TETRA Base Station Test Option, the Stabilock can accept a trigger signal for synchronization with the base station. Please refer to [“Preparing for hardware synchronization” on page 123](#) and [“Using the TRIGGER IN/OUT connector” on page 24](#) to learn how to apply it.



Using an external time base

In order to improve the absolute frequency accuracy of the 2305 Stabilock, you can connect a reference oscillator to **EXT. REF. IN** on the rear panel. The clock rate must be either 5, 10 or 13 MHz and the power level of the signal must exceed 0 dBm (1 mW into 50 Ω).

Copying the screen contents to a file

The screen contents can be copied to a file upon the press of a key. The file will be saved either on the local hard disk or on the USB flash drive (if inserted) or on a disk on the computer network (if connected). See [“Managing files on the 2305 Stabilock” on page 31](#) to learn how to copy or move screenshots stored on the internal disk onto a USB flash drive or a network drive. Section [“Connecting and using a flash drive” on page 18](#) explains how to use a USB flash drive, and section [“Connecting and using a disk drive on the network” on page 21](#) shows how to connect the 2305 Stabilock to a disk drive on the network.

- 1 You can define the location where the file will be stored as described in [“Selecting the file location for screenshots and Auto-test results” on page 28](#).
- 2 Push the **BACKSPACE** key.
A file with the screen contents at the time of the keypress is written to the specified disk. The file format is Windows Bitmap (BMP).

Viewing the screen contents on a PC monitor

As an alternative to using a USB flash drive or a network drive for producing screenshots (see previous section), the Stabilock can be set up to deliver the actual screen contents to a web browser running on the same network. Once the connection has been set up, another new screenshot can be requested and will be delivered over the local area network (LAN) at any time. The screenshot can then be stored on the PC.

In order to have the Stabilock deliver a screenshot to your local PC, proceed as follows:

- 1 Connect the Stabilock to your LAN (see [“Connecting the instrument to the LAN”](#) on page 19).
The IP number is displayed at the top of each Stabilock menu.
- 2 In the Welcome menu, enter **9-3-2-7-3-7-8-3-7** (webserver) using the keypad.
- 3 On the PC, start your favourite web browser.
- 4 In the address field, enter “http://” immediately followed by the IP address. Example: **http://172.16.18.174**
The web browser will display the screen contents in a window similar as below.



- 5 You can now save the screenshot as a graphics file on your computer (most web browsers support this from a menu appearing after right-clicking on the graphics).
- 6 Load a new screenshot into the web browser at any time by selecting **Refresh** or **Reload** in your web browser.

Setting up general parameters of the 2305 Stabilock

Setting up the user interface language

The default language of the user interface is English, i.e. all text is displayed in this language. You can change the language as follows:

- 1 From the Welcome menu, select the **Setup** menu.
The Setup menu appears.
- 2 In the Language list field, select the desired language. Languages currently supported are English, French and German.

Entering special national characters

Some menus allow you to enter text (see paragraph on alphanumerical input fields in section “[Entry fields](#)”). Text can be entered with either the entry keys or the push-dial. The character set available with the push-dial can be extended by national characters such as “ü”. To do so, go to the **Setup** menu and select a different character set in the **Keyboard internal** selection field. “English” and “German” are currently available.

Setting up the menu colors

The color style of the Stabilock menus can be changed as follows:

- 1 From the Welcome menu, select the **Setup** menu.
The Setup menu appears.

Setup		Idle
2305 Stabilock		
Setup: Default		
Language:	English	Preferred Location
Keyboard intern:	English	Screenshot: USB / Internal
Keyboard extern:	USA	Autotest Result: Internal
Color Style:	Standard	
Date Format:	yyyy-mm-dd	Setup / MS-Type / BS-Type
Date:	2011-01-28	Directory: Stabilock2300
Time:	11:21:58	Screenshot / Autotest Result
		Directory: Stabilock2300
Brightness:	97 %	Name: <input type="text"/>
		Company: <input type="text"/>
		1/2
Update Manager	File Manager	Connection Setup
Definitions	Limits	Channel Setup

- 2 In the Color Style field, select a style from the list. Currently supported styles are Standard (grey background, the active input field is shown with white background), Std Color Select (the list in active list input fields is shown on yellow background) and One Background (white background with the active input field shown

with grey background); the default is Standard.
The new color style becomes active immediately after closing the input field.

Setting the date format

The 2305 Stabilock supports the following date formats:

- yyyy-mm-dd (international notation, e.g. 2008-04-25)
- dd.mm.yyyy (continental European style, e.g. 25.04.2008)
- mm/dd/yyyy (American format, e.g. 04/25/2008)

The date format affects the way the date is presented in the upper left corner of each menu and in the test protocols. Change the date format as follows:

- 1 From the Welcome menu, select the **Setup** menu.
The Setup menu appears.

2305 Stabilock		Setup	Idle
Setup:	Default		
Language:	English	Preferred Location	
Keyboard intern:	English	Screenshot:	USB / Internal
Keyboard extern:	USA	Autotest Result:	Internal
Color Style:	Standard	Setup / MS-Type / BS-Type	
Date Format:	yyyy-mm-dd	Directory:	Stabilock2300
Date:	2011-01-28	Screenshot / Autotest Result	
Time:	11:21:58	Directory:	Stabilock2300
Brightness:	97 %	Name:	<input type="text"/>
		Company:	<input type="text"/>
		1/2	
Update Manager	File Manager	Connection Setup	Definitions
		Limits	Channel Setup

- 2 In the Date Format field, select a format from the list.
The new date format becomes active immediately after closing the input field.

Setting the date and time

The date and time can be entered in the **Setup** menu.

Entering the date

The date should be entered in the selected date format, except that the slash '/' should be replaced by the minus sign '-'.

Entering the time

The time should be entered in the 24-hour format. The colon ':' should be replaced by the dot '.'.

Setting the brightness of the display	You can set the display brightness in the Brightness field of the Setup menu as a value from 0 (dark) to 100 (very bright).
Entering service centre details	Test protocols generated by the Autotest feature may include the name of the company (service centre) and the repair technician. Just enter these details in the Name and Company text fields within the Setup menu.
Selecting the file location for screenshots and Autotest results	<p>Screenshots and Autotest results of the 2305 Stabilock can be saved either on the internal hard disk, on a USB flash drive (if attached to the Stabilock) or on a disk on the computer network (if connected). The screenshots are saved in folder \Stabilock2300\Screenshot; Autotest results are saved in Stabilock2300\Autotest. The file name includes the date (in the format yyyyymmdd) and the time (in the format hhmmss).</p> <p>In order to select the device on which the 2305 Stabilock shall store the files, proceed as follows:</p> <ol style="list-style-type: none">1 Select the Setup menu.2 In the Screenshot or Autotest Result selection field, select<ul style="list-style-type: none">– Internal for the storage device within the 2305 Stabilock.– USB/Internal to have the 2305 Stabilock save the respective file type on the USB flash drive (if connected).– USB/NFS/Internal to have the 2305 Stabilock save the respective file type on the USB drive if available. If the USB drive is not connected then the 2305 Stabilock will attempt to save the file on an external computer using the NFS protocol. If this is not available either, the files will be saved on the Stabilock's internal storage device.– NFS/USB/Internal to have the 2305 Stabilock save files of the respective type on an external computer using the NFS protocol if available. If the NFS drive is not connected then the 2305 Stabilock will attempt to save the files on the USB drive. If this is not available either, the files will be saved on the Stabilock's internal storage device. <p>See "Copying the screen contents to a file" on page 24 to learn how to create a screenshot. See "Managing files on the 2305 Stabilock" on page 31 to learn how to copy or move screenshots stored on the internal disk onto a USB flash drive.</p> <p>See Chapter 7 "Performing Autotests at Mobile Stations" to learn more about Autotests.</p>

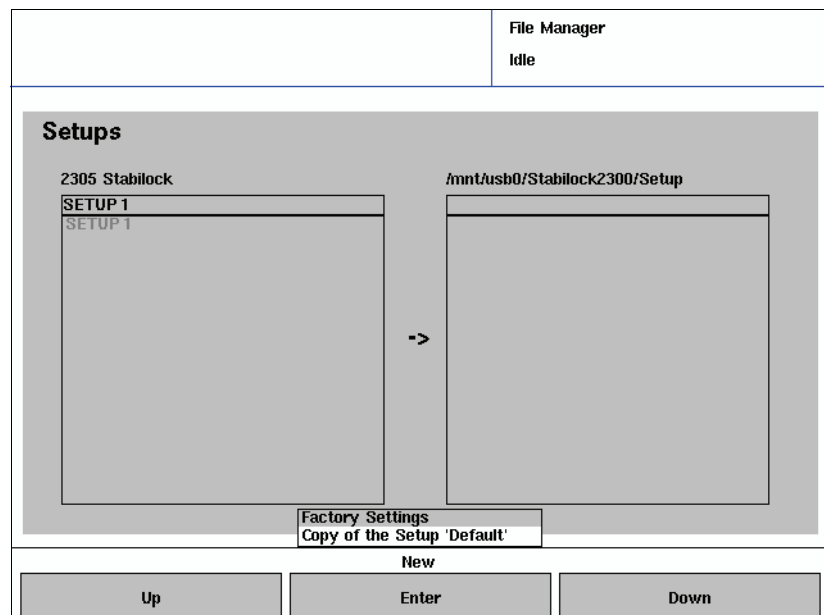
Working with instrument setups

All instrument settings, including the channel setups and SDS status messages, can be stored in files using the File Manager (see menu **Setup > File Manager**). As long as no other setup is selected, the settings are stored in a setup file named Default. At the beginning you will set up the instrument with channel setups and many more. At some point you may want to differentiate between different sets of instrument parameters or user-definable settings. You may then save the current (Default) settings under a new name and start modifying them. All the changes made under a setup name are automatically stored for that name.

Channel setups and status SDS settings can be copied either to and from the Default file, or to and from a setup file on external storage media (USB flash disk or FTP server). If you have a setup file called, say, "Michael" with a channel setup that you want in another setup file called "Jim" then you can copy it from "Michael" to "Default", change to the Jim setup and then copy it from "Default" to "Jim".

Creating a new setup file

- 1 Select **Setup > File Manager**.
A pull-up menu appears.
- 2 Select **Setups** from the pull-up menu.
The file manager for setups appears, showing the setups available on the Stabilock and on a different media (if connected).
- 3 Place the cursor in one of the fields below "2305 Stabilock" using the cursor keys, and press the **New** softkey.
A pull-up menu appears.



- 4 From the pull-up menu, select **Copy** of the setup 'Default' if you want to take over the current settings from the Default file, or select **Factory Settings** if you want to base your new setup file on the factory settings.
A new setup file is created (e.g. " 1").

- 5 Select the setup file name with the cursor and change the name to something more meaningful using either the front panel keys or an external keyboard (attached via USB). The file name may include the blank character.

Note

Please refer to section [“Managing files on the 2305 Stabilock” on page 31](#) for file handling options.

Selecting an instrument setup

All instrument settings can be stored in setup files using the File Manager (see menu **Setup > File Manager**). The file name assigned can be used to retrieve an instrument setup as follows.

- 1 From the Welcome menu, select the Setup menu.
The Setup menu appears.

Setup		Idle
2305 Stabilock Setup: Default		
Language:	English	Preferred Location
Keyboard intern:	English	Screenshot: USB / Internal
Keyboard extern:	USA	Autotest Result: Internal
Color Style:	Standard	
Date Format:	yyyy-mm-dd	Setup / MS-Type / BS-Type
Date:	2011-01-28	Directory: Stabilock2300
Time:	11:21:58	Screenshot / Autotest Result
		Directory: Stabilock2300
Brightness:	97 %	Name: <input type="text"/>
		Company:
		1/2
Update Manager	File Manager	Connection Setup
Definitions	Limits	Channel Setup

- 2 In the Setup selection field, select a setup file name from the list.
- 3 Push **ENTER** to confirm your selection.
The instrument settings that were active when the file was saved are retrieved and re-activated.

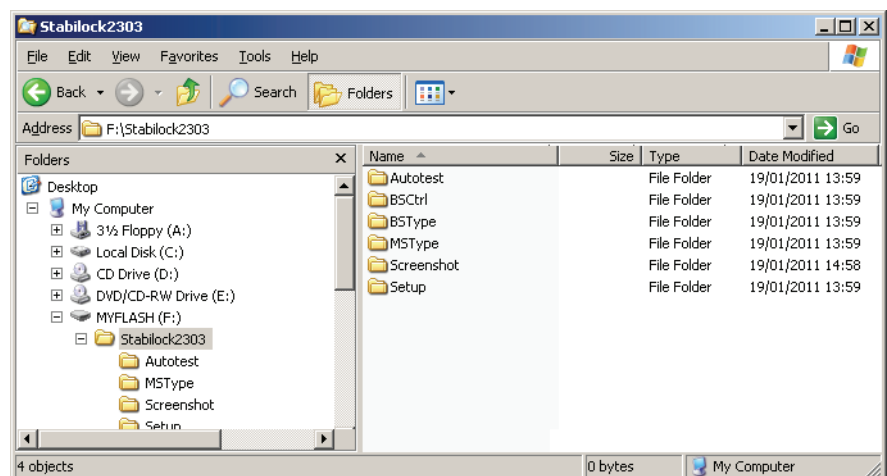
Managing files on the 2305 Stabilock

You can save various types of data on the Stabilock's internal hard disk, on a USB flash drive or on a hard disk on an external computer (using the NFS protocol). Internally stored files can be deleted, or copied or moved to a USB flash drive using the Stabilock's File Manager.

Types of files The following types of files can be processed:

- Setups (these may be useful to store and quickly reload a set of individual instrument settings, and for error reporting)
- Screenshots (see [“Copying the screen contents to a file” on page 24](#))
- Lists of mobile radio types
- Lists of base station types
- Script files for base station remote control
- Autotest results (see [Chapter 7](#) and [Chapter 11](#))

Directory structure By default, files are saved on the USB flash drive in the following folder structure:



You can change the name of the folder in which all the files are saved in subfolders.

Moreover, you can define two different folders, one holding the files and subdirectories with data that can be exchanged with other Stabilocks, and one with files that represent results.

These changes can be done as follows:

- 1 In the Welcome menu, push **Setup**.
The Setup menu appears.

		Setup Idle																														
2305 Stabilock Setup: Default <table> <tr> <td>Language:</td> <td>English</td> <td>Preferred Location</td> </tr> <tr> <td>Keyboard intern:</td> <td>English</td> <td>Screenshot: USB / Internal</td> </tr> <tr> <td>Keyboard extern:</td> <td>USA</td> <td>Autotest Result: Internal</td> </tr> <tr> <td>Color Style:</td> <td>Standard</td> <td></td> </tr> <tr> <td>Date Format:</td> <td>yyyy-mm-dd</td> <td>Setup / MS-Type / BS-Type</td> </tr> <tr> <td>Date:</td> <td>2011-01-28</td> <td>Directory: Stabilock2300</td> </tr> <tr> <td>Time:</td> <td>11:21:58</td> <td>Screenshot / Autotest Result</td> </tr> <tr> <td></td> <td></td> <td>Directory: Stabilock2300</td> </tr> <tr> <td>Brightness:</td> <td>97 %</td> <td>Name: <input type="text"/></td> </tr> <tr> <td></td> <td></td> <td>Company: <input type="text"/></td> </tr> </table>			Language:	English	Preferred Location	Keyboard intern:	English	Screenshot: USB / Internal	Keyboard extern:	USA	Autotest Result: Internal	Color Style:	Standard		Date Format:	yyyy-mm-dd	Setup / MS-Type / BS-Type	Date:	2011-01-28	Directory: Stabilock2300	Time:	11:21:58	Screenshot / Autotest Result			Directory: Stabilock2300	Brightness:	97 %	Name: <input type="text"/>			Company: <input type="text"/>
Language:	English	Preferred Location																														
Keyboard intern:	English	Screenshot: USB / Internal																														
Keyboard extern:	USA	Autotest Result: Internal																														
Color Style:	Standard																															
Date Format:	yyyy-mm-dd	Setup / MS-Type / BS-Type																														
Date:	2011-01-28	Directory: Stabilock2300																														
Time:	11:21:58	Screenshot / Autotest Result																														
		Directory: Stabilock2300																														
Brightness:	97 %	Name: <input type="text"/>																														
		Company: <input type="text"/>																														
		1/2																														
Update Manager	File Manager	Connection Setup																														
Definitions	Limits	Channel Setup																														

- 2 Use the **Screenshot** selection field to change the device on which screenshots shall be stored. Example: If you select USB/Internal, the Stabilock will store screenshots on the USB flash drive if attached to the Stabilock, otherwise it will be stored on the internal hard disk.
- 3 Similarly, select the device on which to store Autotest result files in the **Autotest Result** field.
- 4 In the **Setup / MS-Type / BS-Type Directory** input field, enter the folder name in which files of these types shall be stored.
- 5 In the **Screenshot / Autotest Result Directory** input field, enter the folder name under which to store files of these types.

File operations You can process the internal files as follows:

Note

A USB flash drive must be attached when entering the File Manager in order to save files on the USB drive. Similarly, an NFS connection to a remote computer must be set up when entering the File Manager in order to save files on the remote computer's disk drive.

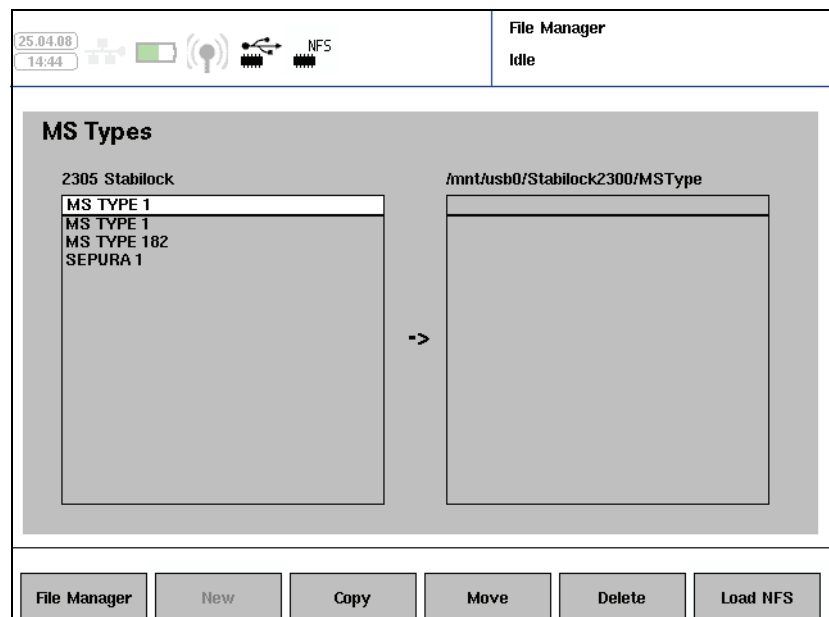
Note

The amount of disk space available on the internal hard disk, the USB flash drive and the NFS drive on the remote computer can be viewed in the **Setup > Status** menu.

- 1 To enter the File Manager, press **Setup > File Manager**.
A pop-up menu with the types of files appears.



- 2 Select the desired file type and press **ENTER**.
The corresponding File Manager menu appears, on the left-hand side displaying the available files that are stored on the Stabilock and with the files in the corresponding folder of the USB or NFS drive on the right-hand side.



- 3 If a folder on the USB drive is displayed and you want to exchange files with the network drive, push the **Load NFS** button. Similarly, if a folder on the NSF drive is displayed and you want to exchange files with the USB drive, push the **Load USB** button.
- 4 Select a file on the Stabilock. You can also select multiple files by selecting a file with the cursor, then marking it by pushing the **+/-** key and repeating these actions with more files. Deselect a file from the list by marking it and pushing the **+/-** key again.

- 5 Push the following key for the corresponding action:
- a (For setup files only) In the Setups menu, push **New** to save the current settings in a new file.
A pop-up menu appears; select if you want to save the factory settings or the current settings (setup 'Default') and push **ENTER** to save the file. The file name will automatically be generated by the Stabilock.
 - b In order to copy files from the Stabilock onto the respective drive, select a file on the Stabilock and push **Copy**. A pop-up menu appears, allowing you to choose between the selected file and all files to be copied. Select an entry and push **ENTER**; the file(s) will then be copied onto the external drive. Note that files with the same file name already existing on the external drive will be overwritten!
 - c In order to copy files from the Stabilock onto the external drive and delete the file on the Stabilock, select a file on the Stabilock and push **Move**. A pop-up menu appears, allowing you to choose between the selected file and all files to be moved. Select an entry and push **ENTER**; the file(s) will then be copied onto the external drive and deleted on the Stabilock. Note that files with the same file name already existing on the drive will be overwritten!
 - d In order to delete files on the Stabilock, select a file on the Stabilock and push **Delete**. A pop-up menu appears, allowing you to choose between the selected file and all files to be deleted. Select an entry and push **ENTER**; the file(s) will then be removed from the Stabilock's hard disk.

Note

You can also copy or move files from the external drive to the 2305 Stabilock: Select the file on the respective drive to be copied or moved twice. The copy or move direction is changed, indicated by the arrow changing its direction. You can now push the **Copy** or **Move** softkey for the appropriate action.

The direction is changed back by selecting a file on the Stabilock twice.

Obtaining the instrument status

For service and support purposes, it may be useful to see the instrument status in terms of firmware and hardware. The status can also be saved on a USB flash drive

For a quick and easy-to-read overview of serial number, firmware version, calibration status and IP connection, press **Setup > ... > Status**.

Status	
Idle	
2305 Stabilock	
Serial Number:	0302003
SW Version:	2.00.0002
Calibration Date:	16.02.2010
Next Calibration Due:	16.02.2011
Last Service:	
Calibration Number:	C000A0343
Calibration Lab:	Willtek
Alignment Date:	16.02.2010
IP Address:	172.16.18.203
Subnet Mask:	255.255.252.0
Gateway:	172.16.16.167
MAC Address:	00:50:C2:B5:11:62
Memory	Size Used
Internal:	2.0 MB 15.0 %
USB:	
NFS:	82.4 GB 9.5 %
Screenshot:	Destination Directory
Autotest Result:	Internal
Save System Information on USB-Stick	

For a more detailed status, press **Setup > ... > System**.

System	
Idle	
Software	Hardware
2305 Stabilock Version: 2.10.0001 DSP SIG DSP BL: BL 2.0.0 SIG DSP MS: 1.8.5-20090529 SIG DSP BS: 1.5.5-20100209 MEAS DSP BL: BL 1.0.0 MEAS DSP: 0.1.28 FPGA DUPO FPGA: 25.11.2009 FIFO FPGA: 16.10.2009 MCU	MCU - DSP 0302003 4 253009 A RF 0302003 3 230086 0 Motherboard 0302003 3 227095 0 Frontpanel 0302003 3 227094 A Accuboard 0302003 1 205015 0 Battery ..V.... 205012
Save System Information on USB-Stick	

Insert a USB flash drive into a free USB slot and push **Save System Information to USB Stick**.

Hardware and firmware information is stored in file infodat.txt in the root directory of the USB flash drive. A previous file will be overwritten without a warning.

Installing software options

You can check which options are installed by pressing **Setup > ... > Options** from the Welcome menu.
The Options menu appears.

Options	
Idle	
2305 Stabilock Options	
Option Key:	000000000000
Serial Number: 0302003	
2330 DMO:	Yes
2331 Autotest:	Yes
2332 BS-Test:	Yes
2333 MS-Test:	Yes
2334 BS-Ctrl:	Yes
2360 OCXO:	Yes
2361 Battery:	Yes

If you purchase a new software option as an upgrade, you will receive an option key. This key is a sequence of alphanumeric characters that allow you to install the option quickly on your workbench, without the need to ship it to an Aeroflex service center.

- 1 Ensure that the Stabilock is running the latest firmware. The version number of the firmware installed can be checked under **Setup > ... > Status**. The latest firmware is available from Aeroflex's website.
- 2 To install a new software option, enter the code in the Option Key input field and hit **Return**.
The Stabilock checks if the option key is valid for this instrument (depending on its serial number).
- 3 Switch off and on your Stabilock to enable the new functionality.

General Operation for MS Testing

3

This chapter describes how the instrument and measurement parameters are set up for tests and measurements at TETRA mobile stations (mobile radios). The 2333 TETRA Mobile Station Test Option is required for these measurements.

Topics discussed in this chapter are as follows:

- [“Connecting the device under test” on page 38](#)
- [“Setting up the network parameters” on page 40](#)
- [“Setting up the call parameters” on page 44](#)
- [“Setting up test limits” on page 47](#)
- [“Working with SDS status messages” on page 51](#)

Connecting the device under test

General observations There are two ways of connecting the 2305 Stabilock with the TETRA radio device (mobile station): either with a proper RF cable or with an antenna coupler. Both methods have their advantages, but a cable connection is not always possible because some TETRA mobile stations are lacking an RF connector or because there is no RF cable with an appropriate connector available.

If you connect the TETRA device under test with the 2305 Stabilock using a double-shielded RF cable you can test the transmitter and receiver with the most accurate results. This is because the connection is least affected by loss of signal strength or distortion through other radiated signals. The drawback of this method is that one component of the TETRA mobile station (MS) is not included in the tests, and that is the antenna and in some cases even the antenna connector.

If you use an antenna coupler to connect the TETRA MS with the instrument, you will be able to test the complete TETRA device including the antenna. Also you do not need different RF cables for various types of TETRA mobiles in store, so testing over an antenna coupler eases test handling.

On the other hand, only a small fraction of the signal transmitted from both sides reaches the other end, and this small fraction may be distorted by other signals on the air as long you do not take any precautions. If you use an RF shielding device such as Aeroflex's 4921 RF Shield, the problem of signal distortion can be avoided. With the knowledge of the exact attenuation of the signal in a given shielding solution and at a specified position relative to the antenna coupler, the signal attenuation at the antenna coupler can be compensated.

Note

Tests and measurements at mobile stations are performed through the **RF1 IN/OUT** connector only. The **RF2 OUT** connector is not used.

Using a cable connection

- 1 Use a double-shielded RF cable with an N-type connector at one end and the appropriate connector for the TETRA MS under test at the other end.
- 2 Plug the N-type connector into the N-type jack **RF1 IN/OUT** at the 2305 Stabilock.
- 3 Plug the other end of the cable into the RF jack of the MS.
- 4 In the **Setup > Definitions** menu, ensure that the RF pre-attenuation is properly set. If you do not know the exact attenuation of the cable, set both the RX Pre-Attenuation and the TX Pre-Attenuation to 0 dB.

Note

The Definitions menu can also be called up directly from measurement menus by selecting ... > **Definitions**. By returning from the Definitions menu to the measurement menu, the measurements will be reset and started with the new averaging and pre-attenuation values.

Using an antenna coupler



- 1 Connect the 2305 Stabilock with the coupler using a double-shielded RF cable with appropriate connectors:
 - a Plug the N-type connector into the N-type jack **RF1 IN/OUT** at the 2305 Stabilock.
 - b The next step depends on whether or not you want to use an RF shielding device:
 - If you are not using an RF shielding device, plug the other end of the cable into the RF plug of the antenna coupler.
 - If you are using an RF shielding device, plug the other end of the cable into the external RF plug of the shielding device. Use another cable to connect the RF plug inside the shielding device with the antenna coupler inside the shielding device.
- 2 Mount the TETRA MS on the antenna coupler.
- 3 If you are using an RF shielding device: Once a connection has been set up, close the shielding device to avoid the RF signals to be distorted by other signals in the environment.
- 4 In the **Setup > Definitions** menu, ensure that the RF pre-attenuation is properly set so that the 2305 Stabilock can compensate the signal loss.

Note

See [“Determining the RF Coupling Factors” on page 189](#) to learn how to obtain the pre-attenuation for a particular type of TETRA MS.

Setting up the network parameters

The following parameters should be carefully selected so that the TETRA mobile station can successfully synchronize with the Stabilock simulating a base station. The parameters are all accessible on a single menu:
From the Welcome menu, press the **MS TMO** softkey to enter the MS TMO Setup menu.

MS TMO Setup	
Idle	
RF Level: -115.0 dBm	Channel System: User Defined
MCCH: 3600 390.01250 MHz	Frequency Band: 300 MHz
TCH: 3600 390.01250 MHz TS: 2	Channel Offset: 12.5 kHz
	Duplex Spacing: 10 MHz
	Operating Mode: Normal
	Lowest Channel: 3600
	Highest Channel: 3999
	MCC: 262
	MNC: 1234
	BCC: 1
	LArea: 1
<div>Start Select Channel System Start Tetra Test Mode</div>	

RF Level This is the RF power level that the 2305 Stabilock transmits to TETRA MS. Valid entries are in the range from –120 to –40 dBm if no pre-attenuation is set (see [“Connecting the device under test” on page 38](#)).

NOTE
TETRA mobiles typically receive signals well above –104 dBm.

MCCH This is the channel number and frequency (in megahertz) of the Main Control Channel (MCCH) that the network simulated by the 2305 Stabilock is using. See [Appendix A section “Calculating channel numbers and frequencies” on page 178](#) for the proper selection of channels and frequencies. The range for valid entries may be restricted by the Lowest Channel and Highest Channels on the right-hand side of the menu.
Once that the Stabilock has started the base station simulation, the MCCH cannot be changed anymore.
If you change the channel number (on the left-hand side), the change will automatically be translated into the associated new frequency (on the right-hand side), and vice versa. The 2305 Stabilock uses the

channel parameters on the bottom right (channel offset, duplex spacing, frequency band) to calculate channel numbers and frequencies.

TCH This is the channel number and frequency (in megahertz) of the Traffic Channel (TCH) that the network simulated by the 2305 Stabilock is using. See [Appendix A section “Calculating channel numbers and frequencies” on page 178](#) for the proper selection of channels and frequencies. The range for valid entries may be restricted by the Lowest Channel and Highest Channels on the right-hand side of the menu.

TS In this input field, you can select the time slot (TS) used for the traffic channel. Possible entries are from 2 to 4. Time slot 1 is reserved for the MCCH.

Channel System The base station and network parameters on the right-hand side can be either user-defined or predefined. See [“Working with channel setups” on page 15](#) to learn how to create a predefined base station parameter set.

Push the **Select Channel System** softkey to select a different (predefined) parameter set or to edit the parameters in the user-defined mode.

Note

If a predefined set of parameters is selected, the individual parameters cannot be changed. You can, however, change to user-defined settings; the current settings (from the predefined parameter set) remain on the screen and can be edited.

Frequency Band The frequency band is a multiple of 100 MHz specifying the frequency range in which the mobile phone can operate. One of the following values can be selected from a list: 300 MHz, 400 MHz, 800 MHz, 900 MHz.

Channel Offset The channel offset is the offset of the carrier frequency relative to a multiple of 25 kHz. One of the following values can be chosen from a list: 0 kHz, 12.5 kHz, +6.25 kHz, –6.25 kHz.
Ensure that the correct channel offset is selected. If the Stabilock is not set to the same channel offset as the network for which the TETRA MS is programmed, the MS might not communicate with the Stabilock.

Duplex Spacing The duplex spacing is the difference between the downlink (base station transmit) frequency and the uplink (mobile station transmit) frequency. By default, you can select from the following list: 0 MHz, 10 MHz, 45 MHz. Most networks transmitting in the 300 and 400 MHz range are applying a duplex spacing of 10 MHz while networks operating in the 800 and 900 MHz bands typically apply 45 MHz duplex spacing.
You can extend the list of available duplex spacing values; please see section [“Setting up new duplex spacing entries” on page 17](#).

Operating Mode Select **Normal** if the base station transmits at the higher frequency. Otherwise, if the base station transmits in the lower band, select **Reverse**.

Lowest Channel In this input field you can enter the lowest channel number that the MS supports. This helps to ensure that only valid MCCH and TCH channel numbers are entered.

Note

When a new channel setup is loaded (as shown in [“Working with channel setups” on page 15](#)), the lowest and the highest channel are reset for the maximum possible range.

Highest Channel In this input field you can enter the highest channel number that the TETRA MS supports. This helps to ensure that only valid MCCH and TCH channel numbers are entered.

MCC The Mobile Country Code (MCC) is a three-digit number identifying the country. See [“Mobile Country Code MCC” on page 184](#) for more information. The combination of MCC and MNC as entered in the Stabilock must match that in the TETRA MS for a connection to be established successfully.

MNC The Mobile Network Code (MNC) is a number in the range from 0 to 16,383 identifying the network within a given country. The combination of MCC and MNC as entered in the Stabilock must match that in the MS for a connection to be successfully established.

BCC The Base station Color Code (BCC) is a number in the range from 0 to 63 identifying a scrambling code that is used on all channels of the base station. The scrambling code can be chosen randomly.

LArea The Location Area (LArea) code is a number in the range from 0 to 16,383 identifying the cell. For TETRA mobile stations not restricted to a certain area, the location area can be chosen freely.

Setting up the call parameters

These parameters determine the type of call and the addresses that should be used. You can access the parameters in the MS TMO menu by selecting **MS TMO > Start**.

MS TMO	
Waiting for Attach	
<div>RF Level: -60.0 dBm</div> <div>MCCH: 3600 390.01250 MHz</div> <div>TCH: 3600 390.01250 MHz TS: 2</div> <div>Call Setup Type: Group</div> <div>Short Subscriber ID: 1001010</div> <div>Dynamic Group: 2303</div> <div>DGNA Name Type: Default</div>	<div>TETRA Air IF Standard:</div> <div>Short Subscriber ID:</div> <div>Selected Group:</div> <div>Paging Sensitivity:</div> <div>Disconnect Cause:</div>
<div>1/2</div> <div>CallEmergency CallDynamic GroupSDSPaging SensitivityRequest Command Registration</div>	

Call Setup Type This field specifies the type of call that the 2305 Stabilock shall use when it sets up a call with the TETRA MS. One of the following call types can be selected from a list: Individual Simplex, Individual Duplex, Group, Phone, Ambient Listening.

NOTE

Depending on the capabilities of the MS, one or the other call setup type may not be available. The setup types actually available are shown once the MS is attached, i.e. when it has registered with the network simulated by the 2305 Stabilock.

The Individual Simplex setting means that a call is set up where only one party can talk at any one time. In order for the MS under test to transmit, the PTT (push-to-talk) button must be pressed. Individual Duplex means that a call from one MS to another is set up, and both parties can talk and listen at the same time. Group means that the TETRA MS is called under one of its group numbers. At any time during the call, you can either talk or listen, but not both at the same time. Note that you may need to assign a group number before you can actually perform a group call (see [“Testing the incoming group call” on page 61](#)). With the Phone setting, a call from or into the public telephone network can be simulated. When the Stabilock receives a call setup request into the public telephone network, it displays an appropriate symbol. Phone calls are duplex calls by nature.

With the Ambient Listening setting, the TETRA MS is automatically set into call mode without the need to answer the call (i.e. without pushing a button). The MS will transmit, but not receive any voice data.

Which call setup type do I need?

For standard MS transmitter and receiver tests, select Individual Duplex or, if not available, Individual Simplex.

If you want to ensure that the TETRA mobile station is programmed correctly, select

- “Group” to check the pre-programmed group number (TETRA MS must ring when called).
- “Individual Duplex” or “Individual Simplex” to check the programmed emergency call number. The number called by the MS will appear with a symbol indicating an emergency call.
- “Phone” to test the capability to initiate or receive calls into or from the public telephone network.
- “Ambient Listening” to verify this feature.

Short Subscriber ID

The short subscriber identity is a number in the range from 1 to 16,777,215 used to identify a TETRA MS in an individual call (Individual Duplex, Phone or Ambient Listening).

Enter a valid number for the simulated MS that is virtually calling the MS under test. In an individual call to the MS under test, this number will likely be displayed on the TETRA MS as the calling party.

Dynamic Group

A group number or name is used to address the TETRA MS in a group call (Dynamic Group Number Assignment, DGNA). The number must be assigned to the MS under test before a group call can be performed; see [“Testing the incoming group call” on page 61](#).

The group number should be in the range from 1 to 16,777,215.
Example: group number “2300”.

DGNA Name Type

The TETRA radio can typically display a text with or instead of the group number. This can be controlled by the network, or the Stabilock in this case. The 2305 Stabilock can define it in three different ways.

During registration you will be asked if the 2305 Stabilock shall assign the dynamic group number permanently or temporarily. If you do not want the MS to keep the number used for test purposes, select “Temporary”.



Effect on TETRA radio usability

When you assign a dynamic group with the 2305 Stabilock, dynamic groups with the same group identity previously stored in the radio are deleted. This means that they are not available anymore when you use the TETRA radio on a real network. Therefore, please check after your tests if

- the dynamic groups assigned during the test are deleted again in the TETRA radio.
- the main group is activated again when the radio leaves service.

Selecting a group number
along with standard text

- 1 In the Dynamic Group input field, enter a number in the range from 1 to 16,777,215.
- 2 In the DGNA Name Type field, select "Default".
The group number will be displayed along with the text "DGNA".

Example: If the group number is set to Stabilock, the TETRA radio will display "DGNA 2300".

Selecting a freely selectable
text

- 1 In the Dynamic Group input field, enter a number in the range from 1 to 16,777,215.
- 2 In the DGNA Name Type field, select "Free".
An additional input field DGNA Name is displayed.
- 3 In the DGNA Name field, enter the group name to be used. Up to 15 characters (including numbers) can be entered.
The resulting group name to be assigned will be the name entered.

Example: If the DGNA group name is set to "Elephant 1", the TETRA radio will display "Elephant 1".

Short Subscriber ID:	1001010
Dynamic Group:	2303
DGNA Name Type:	Free
DGNA Name:	<input type="text"/>

Selecting a combination of
name and group number

- 1 In the Dynamic Group input field, enter a number in the range from 1 to 16,777,215.
- 2 In the DGNA Name Type field, select "Postnumber".
An additional input field DGNA Name is displayed.
- 3 In the DGNA Name field, enter the group name to be used. Up to six characters can be entered.
The resulting group name to be assigned is the name entered + " " + the number.

Example: If the group number is set to Stabilock and the DGNA group name is set to "Sierra", the TETRA radio will display "Sierra 2300".

Setting up test limits

The 2305 Stabilock indicates when a test result exceeds the limit. By default, the limits programmed into the Stabilock are those defined in the TETRA specifications. You may, however, want to change the limits e.g. to take the measurement uncertainty or sharper, manufacturer-defined limits into account.

The test limits menu can be accessed from the Welcome menu by pressing **MS TMO > Start > ... > Limits**. The same menu is also available from various measurement menus directly, and from **MS DMO > Start > ... > Limits**. Please note that there are separate limits available for frequency error, frame alignment and RF level in direct mode (DMO).

MS TMO Limits					
Limits			Power Class: 4 (1W)		
	Lower	Upper	RF Level	Exp. RF Power	
Frequency Error:	-100.00 Hz	100.00 Hz	for DMO:	30.00 dBm	± 2.00 dB
for DMO:	-1000.00 Hz	1000.00 Hz	≤ -83.5 dBm	30.00 dBm	± 2.00 dB
RMS Vector Error:	0.00 %	10.00 %	≤ -78.5 dBm	25.00 dBm	± 2.50 dB
Peak Vector Error:	0.00 %	30.00 %	≤ -73.5 dBm	20.00 dBm	± 2.50 dB
Res. Carrier Power:	0.00 %	5.00 %	-68.5 dBm	15.00 dBm	± 2.50 dB
Frame Alignment:	-0.250 sym.	0.250 sym.			
for DMO:	-10.000 sym.	10.000 sym.			
Paging Sens.:	≤ -112.0 dBm		TT MER:	≤ -112.0 dBm	0.00 %
T1 MER:	≤ -112.0 dBm	0.00 %	TT BER Class 0:	≤ -112.0 dBm	0.00 %
T1 BER:	≤ -112.0 dBm	0.00 %	TT BER Class 1:	≤ -112.0 dBm	0.00 %
			TT BER Class 2:	≤ -112.0 dBm	0.00 %
					System Default

Frequency Error

The frequency error is measured relative to the frequency of the base station (or the test instrument in this case). An upper and a lower limit can be defined here. The ETSI standard defines a tolerance range of ± 100 Hz (see also [page 69](#)) in trunked mode and ± 1000 Hz for direct mode.

Note

There are different limits for the frequency error in direct mode, therefore there is a second limit input field for the frequency error in DMO.

RMS Vector Error

The vector error is a measure of the modulation quality; only an upper limit can be defined here because the RMS vector error is an absolute value (the lowest value possible is 0%). The ETSI limit is 10%; see [page 71](#) for more details.

Peak Vector Error The peak vector error is the maximum vector error within a burst. The ETSI limit for the peak value is 30%; see [page 71](#) for more details.

Res. Carrier Power The residual carrier power (residual carrier magnitude) is another measure of the modulation quality. The minimum value is 0; the maximum allowable value can be entered here. ETSI defines a limit of 5%; see [page 73](#) for more details.

Frame Alignment The Frame Alignment test determines the timing error of the burst in multiples of symbol periods. An upper and a lower limit can be entered here.

NOTE

According to the TETRA specifications (EN 300 394-1), the burst timing error (frame alignment) should not exceed ± 0.25 symbol periods in trunked mode.

Note

Due to the absense of a base station defining the system timing, the frame alignment measurement is not defined for direct mode. The measurement is anyway displayed in the Stabilock to support fault finding when there are no measurement results; the Stabilock takes measurements in a defined time window only.

Power Class Set up the power class of the mobile station before entering the applicable power limits. This is necessary e.g. because there are typically narrower limits at the highest power level. See section "[Power levels for TETRA mobile stations](#)" on [page 181](#) for more details.

Select **User defined** to be able to enter your own table of power steps.

Power Class:	2 (10W)	
	2L (5.6W)	
	3 (3W)	
RF Level	3L (1.8W)	0W
for DMO:	4 (1W)	+
	4L (0.56W)	+
<= -83.5 dBm	User defined	+

RF Level, Exp. RF Power

The MS TMO Limits menu displays a table of the nominal output power values (in the middle column), associated power limits (right-hand column) and associated receive power levels (left column).

Power Class:		4 (1W)
RF Level	Exp. RF Power	
for DMO:	30.00 dBm	+/- 2.00 dB
<= -83.5 dBm	30.00 dBm	+/- 2.00 dB
<= -78.5 dBm	25.00 dBm	+/- 2.50 dB
<= -73.5 dBm	20.00 dBm	+/- 2.50 dB

In the column on the right-hand side, you can adjust the symmetric power tolerance for each of the nominal power level steps.
Example: If you set the tolerance range for the nominal power of 20 dBm to ± 2.5 dB, a measurement value of 17.5 dB will be within the limits, but 17.4 dB will be out of tolerance.

The column in the middle shows the power level steps as defined by the TETRA standard. This column can be changed only if “User defined” is selected in the Power Class field.
TETRA mobile stations only support open loop power control, i.e. the transmit power level is adjusted by the MS in 5-dB steps, depending on the received power level. You can impact the TETRA radio’s transmit power level by increasing or decreasing its receive level, which is equivalent to the Stabilock’s output power. The Stabilock assumes that when its output power level is equal or below the value in the left-hand column, the TETRA MS will try and transmit at the power level in the middle column. The associated tolerance range (in the right-hand column) will then be applied.

In the left-hand column you can select the threshold input level at which the mobile radio is expected to switch to a higher or lower output power level.

Paging Sens.

The Paging Sensitivity test is a means of determining the receiver quality at low levels. The test is described in section [“Paging Sensitivity test” on page 79](#).

The value entered here is the limit for the test, i.e. the TETRA radio must be able to receive and respond to paging messages at this receive level (and higher). If the TETRA radio does not respond to paging at this level, the test fails. This is an Aeroflex-defined test, there are no specified limits. Aeroflex recommends a limit of -112 dBm.

T1 MER

The two input fields allow you to enter the maximum power level and the corresponding message erasure rate (MER) in the T1 loopback test (in asynchronous mode). The MER must not be exceeded at power levels above the given value.

T1 BER	The two input fields allow you to enter the maximum power level and the corresponding bit error rate (BER) in the T1 loopback test (in asynchronous mode). The BER must not be exceeded at power levels above the given value.
TT MER	The two input fields allow you to enter the maximum power level and the corresponding message erasure rate (MER) in the TETRA Test mode loopback test (in call mode). The MER must not be exceeded at power levels above the given value.
TT BER Class 0	The two input fields allow you to enter the maximum power level and the corresponding bit error rate (BER) of Class 0 bits in the TETRA Test mode loopback test (in call mode). The BER must not be exceeded at power levels above the given value.
TT BER Class 1	The two input fields allow you to enter the maximum power level and the corresponding bit error rate (BER) of Class 1 bits in the TETRA Test mode loopback test (in call mode). The BER must not be exceeded at power levels above the given value.
TT BER Class 2	The two input fields allow you to enter the maximum power level and the corresponding bit error rate (BER) of Class 2 bits in the TETRA Test mode loopback test (in call mode). The BER must not be exceeded at power levels above the given value.

Working with SDS status messages

The TETRA standard allows to predefine status messages; an individual number is assigned to each of these messages. Instead of entering the complete text, the user selects the predefined message, and a number is transmitted in a Short Data Service message. The radio unit of the receiving party decodes the number and displays the associated message text.

Defining SDS status messages

The 2305 Stabilock can send, receive and decode status messages (see [“Testing the short data service capabilities” on page 66](#)). The allocation of message numbers can be done in the SDS Setup menu as follows.

- 1 Select Setup > Stat. SDS Def.
The SDS Setup menu appears.

SDS Setup	
Idle	
<div> <div> Status SDS Setup </div> <div> <div> DEST. NOT REACHABLE EMERGENCY GENERAL STATUS ACK. GEN. STAT. NEG. ACK. NOT AUTHORIZED UNRECOGNISED ADDRESS DEST. NOT EXISTING DEST. NOT REACHABLE DEST. NOT AUTHORIZED DESTINATION BUSY STAT. OUT OF RANGE URGENT CALLB. REQU. CALLBACK REQUEST </div> <div> SDS Content: 65029 </div> </div> </div>	
New	Copy
Delete	System Default
Move Up	Move Down

- 2 In order to change the message number of a predefined message, select the message text on the left-hand side and enter the new number in the SDS Content entry field on the right-hand side.
- 3 If you want to assign a different message text to an existing message number, enter the number in the SDS Content field, then select the appropriate message text on the left-hand side.
- 4 Define a new message as follows:
 - a Select **New**.
A new message is created with a default text (e.g. “STATUS SDS DEF. 12”).

- b Overwrite the default text with a meaningful message text by entering it in the text field (on the left-hand side) using the alpha-numerical keys (e.g. press "2" twice to enter the letter "A") or the push-dial (for letter selection) in conjunction with the ... key (for switching between lowercase, uppercase and symbols).
- c In the SDS Content field, enter the message number.

Copying Status SDS messages

Status SDS messages are part of a setup file. Only those Status SDS messages which are in the currently loaded setup are visible and can be used; when one setup file is loaded you cannot see and load a Status SDS message that has been stored in a different setup file. The Stabilock can, however, exchange the full list of Status SDS messages of one file with the Status SDS messages of the Default file or a file on an external storage device (USB flash disk or network drive).

The Status SDS messages of the receiving file will be amended by the copied files, i.e. the Status SDS messages already existing will not be overwritten.

If a Status SDS message with the same name already exists and if the Status SDS message to be copied is different then the Status SDS message will appear twice in the list, the copied message being shown further down in the list.

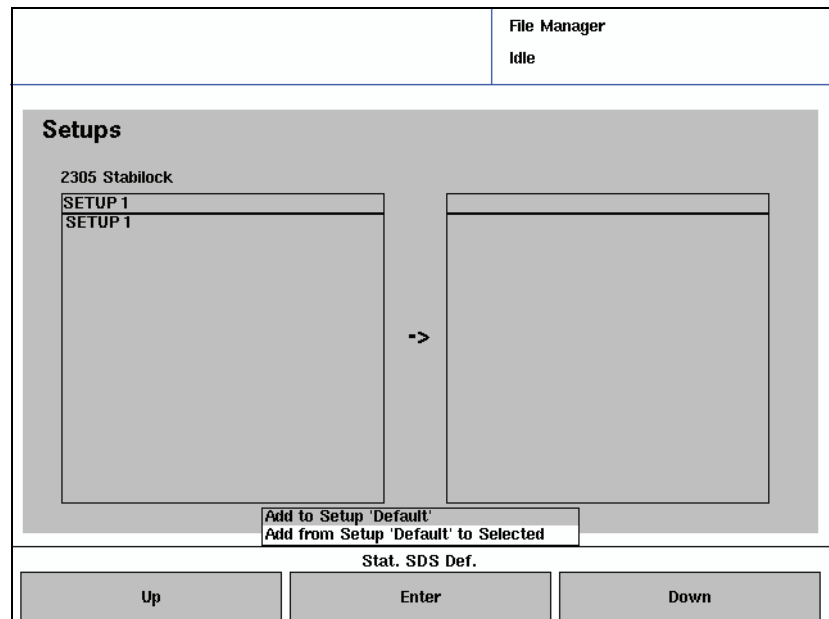
In order to copy the Status SDS messages from one setup file to another, please proceed as follows:

- 1 From the Welcome menu, select **Setup > File Manager**.
A pull-up menu appears, showing different file types.
- 2 Select **Setups**.
The File Manager appears with a list of setups on the Stabilock.

Note

If a USB flash disk or a network drive is installed, the setup files on that device are listed on the right.

- 3 Select the device and setup file from or to which to copy the Status SDS messages.
- 4 Select the **Stat. SDS Def.** softkey.
A pull-up menu appears, indicating the available options.



- a Push **Add to Setup 'Default'** if you want to copy the Status SDS messages from the selected setup file to the Default setup file on the Stabilock.
Or: Push **Add from Setup 'Default' to Selected** if you want to copy the Status SDS messages from the Default setup file on the Stabilock to the selected setup file.
Or: Push **Add to Selected** if you want to copy the Status SDS messages from the selected setup file on one device to the selected setup file on the other (note the direction of the arrow in the center of the menu). This option is only available if an external device is available.

Performing MS Tests and Measurements in Trunked Mode

4

This chapter provides task-based instructions for testing mobile radios using the 2333 TETRA Mobile Station Test Option. Topics discussed in this chapter are as follows:

- “Performing functional tests” on page 56
 - “Reading capabilities of the TETRA MS” on page 56
 - “Testing the incoming call (mobile terminated)” on page 57
 - “Testing the outgoing call (mobile originated)” on page 59
 - “Testing the incoming group call” on page 61
 - “Testing the incoming emergency call” on page 63
 - “Testing the short data service capabilities” on page 66
 - “Testing the Direct Mode capability” on page 67
- “Performing transmitter tests” on page 68
 - “Measuring the transmit power” on page 68
 - “Measuring the frequency error” on page 69
 - “Measuring the modulation error (vector error)” on page 71
 - “Measuring the residual carrier power” on page 73
 - “Viewing the modulation error in the constellation diagram” on page 74
 - “Viewing the burst profile” on page 76
 - “Viewing the modulation spectrum” on page 77
- “Performing receiver tests” on page 79
 - “Paging Sensitivity test” on page 79
 - “TETRA Test Mode” on page 80

Performing functional tests

Reading capabilities of the TETRA MS

Once a TETRA mobile station (MS) has registered with the network (in other words, when it is attached to a network), some parameters and capabilities of the TETRA MS can be read over the air interface. The 2305 Stabilock can display some of these parameters, e.g. the simplex and duplex capabilities.

In order to read the parameters, proceed as follows:

- 1 Connect the MS as described in [“Connecting the device under test” on page 38](#).
- 2 On the Welcome menu, press the **MS TMO** softkey. The MS TMO Setup menu appears.

		MS TMO Setup	
		Idle	
RF Level: -115.0 dBm		Channel System: User Defined	
MCCH: 3600 390.01250 MHz		Frequency Band: 300 MHz	
TCH: 3600 390.01250 MHz TS: 2		Channel Offset: 12.5 kHz	
		Duplex Spacing: 10 MHz	
		Operating Mode: Normal	
		Lowest Channel: 3600	
		Highest Channel: 3999	
		MCC: 262	
		MNC: 1234	
		BCC: 1	
		LArea: 1	
Start		Select Channel System	Start Tetra Test Mode

- 3 Set up the parameters for the network and base station as described in [“Setting up the network parameters” on page 40](#).
- 4 Press the **Start** softkey. The MS TMO menu appears.

MS TMO Waiting for Attach	
<p>RF Level: -60.0 dBm</p> <p>MCCH: 3600 390.01250 MHz TCH: 3600 390.01250 MHz TS: 2</p> <p>Call Setup Type: Group</p> <p>Short Subscriber ID: 1001010 Dynamic Group: 2303 DGNA Name Type: Default</p>	<p>TETRA Air IF Standard:</p> <p>Short Subscriber ID: Selected Group:</p> <p>Paging Sensitivity:</p> <p>Disconnect Cause:</p>
<div> <div>Call</div> <div>Emergency Call</div> <div>Dynamic Group</div> <div>SDS</div> <div>Paging Sensitivity</div> <div>Request Command Registration</div> </div> <div>1/2</div>	

- 5 Switch on the MS and wait until the Stabilock displays Attached in the upper right corner.
The air interface standard version supported, the short subscriber ID of the MS and its group number are displayed on the right-hand side of the menu.
- 6 Press ... > **Class of MS**.
The Class of MS menu appears. You can now read the TETRA mobile's capabilities.

NOTE

Although it would be useful to know the power class of the TETRA MS, this parameter is not communicated over the air interface in normal operation, so the 2305 Stabilock cannot query and display this information from the MS.

The power class can, however, be queried in TETRA Test Mode. See section [“TETRA Test Mode” on page 80](#) for more details.

- 7 To return to the Idle menu, press the **ESC** key.

Testing the incoming call (mobile terminated)

The purpose of the incoming test call is to verify that the MS can receive and accept calls. This includes that the display of the calling party and the alert tone speaker are tested. The call can also be used to perform transmitter and receiver measurements.

In order to test the incoming call capabilities, proceed as follows:

- 1 Connect the TETRA MS as described in [“Connecting the device under test” on page 38](#).
- 2 On the Welcome menu, press the **MS TMO** softkey.
The MS TMO Setup menu appears.

MS TMO Setup	
Idle	
RF Level: -115.0 dBm	Channel System: User Defined
MCCH: 3600 390.01250 MHz	Frequency Band: 300 MHz
TCH: 3600 390.01250 MHz TS: 2	Channel Offset: 12.5 kHz
	Duplex Spacing: 10 MHz
	Operating Mode: Normal
	Lowest Channel: 3600
	Highest Channel: 3999
	MCC: 262
	MNC: 1234
	BCC: 1
	LArea: 1
Start	Select Channel System
Start Tetra Test Mode	

- Set up the parameters for the network and base station as described in [“Setting up the network parameters” on page 40](#).
- Press the **Start** softkey.
The MS TMO menu appears.
- Switch on the MS and wait until the Stabilock displays Attached in the upper right corner.
The air interface standard version supported and the Short Subscriber ID of the MS are displayed on the right-hand side of the menu.

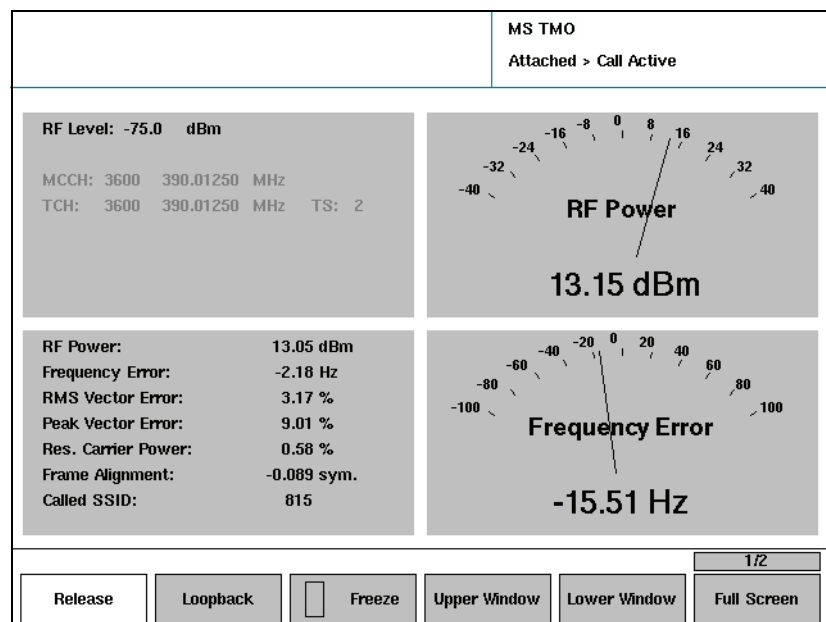
MS TMO	
Attached	
RF Level: -60.0 dBm	TETRA Air IF Standard: EN 300 392-2, -7
MCCH: 3600 390.01250 MHz	Short Subscriber ID: 10030
TCH: 3600 390.01250 MHz TS: 2	Selected Group: 100
Call Setup Type: Group	Paging Sensitivity:
Short Subscriber ID: 815	Disconnect Cause:
Dynamic Group: 2303	
DGNA Name Type: Default	
1/2	
Call	Emergency Call
Dynamic Group	SDS
Paging Sensitivity	Request Command Registration

- Set up the call parameters as explained in [“Setting up the call parameters” on page 44](#). In particular, enter the call setup type and Short Subscriber ID; the dynamic group number is not required in an individual call.

- 7 Push the **Call** softkey.
An individual call is set up and the MS starts ringing. The short subscriber ID entered on the left-hand side of the Stabilock menu is displayed on the MS as the calling party.
- 8 Accept the call: If an individual simplex call is selected, press the PTT button. If this is an individual duplex call, press the Call key. The Call Active menu appears. You can now perform radio measurements (see [“Performing transmitter tests” on page 68](#)).

NOTE

If the call fails or when the call is released, the Attach menu re-appears.



- 9 To stop the call, push the release button on either the TETRA MS or the 2305 Stabilock.
The Attach menu appears again. The MS is still attached to the network and you can now perform another call.

Testing the outgoing call (mobile originated)

The purpose of the outgoing test call is to verify that the TETRA MS can originate calls. This includes a test of the numeric keys and the call button.

The call can also be used to initiate transmitter and receiver measurements.

In order to test the outgoing call capabilities, proceed as follows:

- 1 Connect the MS as described in [“Connecting the device under test” on page 38](#).
- 2 On the Welcome menu, press the **MS TMO** softkey.
The MS TMO Setup menu appears.

MS TMO Setup	
Idle	
RF Level: -115.0 dBm	Channel System: User Defined
MCCH: 3600 390.01250 MHz	Frequency Band: 300 MHz
TCH: 3600 390.01250 MHz TS: 2	Channel Offset: 12.5 kHz
	Duplex Spacing: 10 MHz
	Operating Mode: Normal
	Lowest Channel: 3600
	Highest Channel: 3999
	MCC: 262
	MNC: 1234
	BCC: 1
	LArea: 1
Start	Select Channel System
Start Tetra Test Mode	

- 3 Set up the parameters for the network and base station as described in [“Setting up the network parameters”](#) on page 40.
- 4 Press the **Start** softkey.
The MS TMO menu appears.
- 5 Switch on the MS and wait until the Stabilock displays Attached in the upper right corner.
The air interface standard version supported and the Short Subscriber ID of the MS are displayed on the right-hand side of the menu.

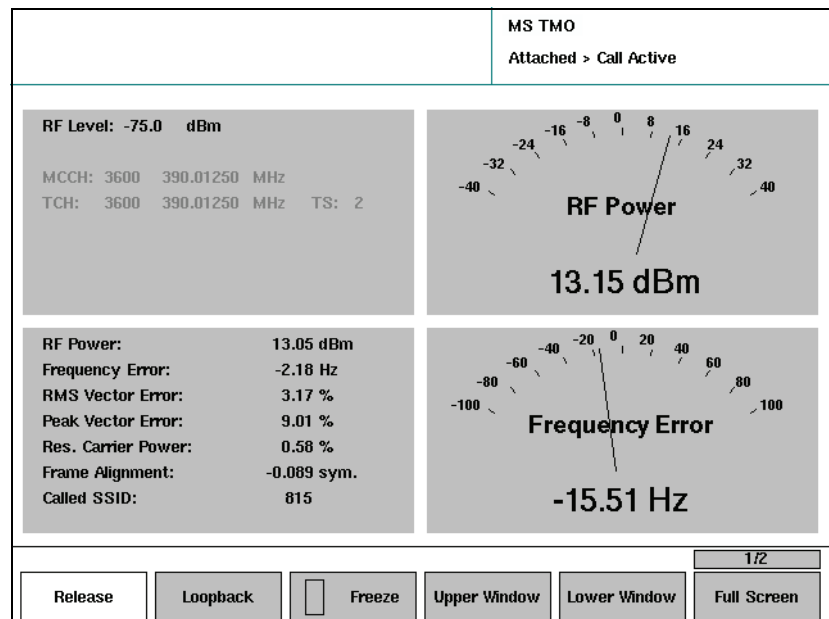
MS TMO	
Attached	
RF Level: -60.0 dBm	TETRA Air IF Standard: EN 300 392-2, -7
MCCH: 3600 390.01250 MHz	Short Subscriber ID: 10030
TCH: 3600 390.01250 MHz TS: 2	Selected Group: 100
Call Setup Type: Group	Paging Sensitivity:
Short Subscriber ID: 815	Disconnect Cause:
Dynamic Group: 2303	
DGNA Name Type: Default	
1/2	
Call	Emergency Call
Dynamic Group	SDS
Paging Sensitivity	Request Command Registration

- 6 Set up the call parameters as explained in [“Setting up the call parameters”](#) on page 44. In particular, enter the call setup type (Individual Duplex or Individual Simplex); the Short Subscriber ID and the dynamic group number are not required in an individual, outgoing call.

- 7 On the MS, dial a number in the range from 1 to 16,777,215 using as many different numeric keys as possible (e.g. 12345678) and verify the dialed number on the display of the MS.
- 8 Push the Call key on the MS.
An individual call is set up and the Call Active menu appears. You can now perform radio measurements.

NOTE

If the call fails or when the call is released, the Attached menu re-appears.



- 9 To stop the call, push the release button on either the MS or the 2305 Stabilock.
The Attached menu appears again. The MS is still attached to the network and you can now perform another call.

Testing the incoming group call

The purpose of the incoming group call test is to verify that the MS can be reached under the programmed group number. The call can also be used to initiate transmitter and receiver measurements.

In order to test the incoming call capabilities, proceed as follows:

- 1 Connect the TETRA MS as described in [“Connecting the device under test” on page 38](#).
- 2 On the Welcome menu, press the **MS TMO** softkey.
The MS TMO Setup menu appears.

MS TMO Setup	
Idle	
RF Level: -115.0 dBm	Channel System: User Defined
MCCH: 3600 390.01250 MHz	Frequency Band: 300 MHz
TCH: 3600 390.01250 MHz TS: 2	Channel Offset: 12.5 kHz
	Duplex Spacing: 10 MHz
	Operating Mode: Normal
	Lowest Channel: 3600
	Highest Channel: 3999
	MCC: 262
	MNC: 1234
	BCC: 1
	LArea: 1
Start	Select Channel System
Start Tetra Test Mode	

- Set up the parameters for the network and base station as described in [“Setting up the network parameters” on page 40](#).
- Press the **Start** softkey.
The MS TMO menu appears.
- Switch on the MS and wait until the Stabilock displays Attached in the upper right corner.
The air interface standard version supported and the Short Subscriber ID of the MS are displayed on the right-hand side of the menu.

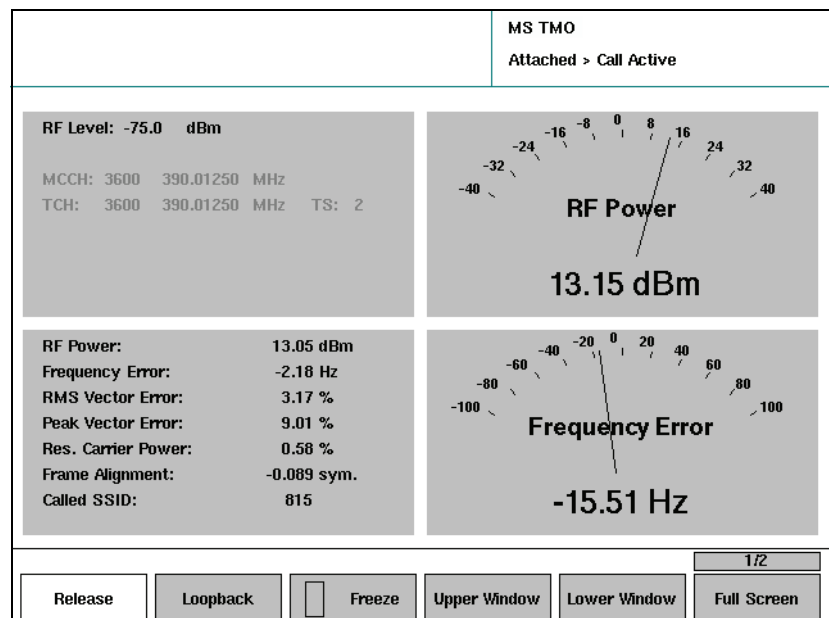
MS TMO	
Attached	
RF Level: -60.0 dBm	TETRA Air IF Standard: EN 300 392-2, -7
MCCH: 3600 390.01250 MHz	Short Subscriber ID: 10030
TCH: 3600 390.01250 MHz TS: 2	Selected Group: 100
Call Setup Type: Group	Paging Sensitivity:
Short Subscriber ID: 815	Disconnect Cause:
Dynamic Group: 2303	
DGNA Name Type: Default	
1/2	
Call	Emergency Call
Dynamic Group	SDS
Paging Sensitivity	Request Command Registration

- Set up the call parameters as explained in [“Setting up the call parameters” on page 44](#). In particular, enter the call setup type and the dynamic group number; the Short Subscriber ID is not required in an incoming group call.

- 7 If the TETRA MS does not hold any pre-programmed group numbers: Push the **Dynamic Group** softkey. (Observe warning on [page 46](#).)
The group number entered in [step 6](#) is assigned to the MS.
You will be asked if the 2305 Stabilock shall assign the dynamic group number permanently or temporarily. If you do not want the MS to keep the number used for test purposes, select "Temporary".
- 8 Push the **Call** softkey at the Stabilock.
The TETRA MS alerts.
- 9 Accept the call by pressing the PTT button.
The Call Active menu appears. You can now perform radio measurements (see "[Performing transmitter tests](#)" on [page 68](#)).

NOTE

If the call fails or when the call is released, the Attach menu re-appears.



- 10 To stop the call, push the release button on either the MS or the 2305 Stabilock.
The Attach menu appears again. The MS is still attached to the network and you can now perform another call.

Testing the incoming emergency call

The purpose of the incoming emergency call test is to verify that the TETRA MS alerts the user accordingly when an emergency call is received.
The call can also be used to initiate transmitter and receiver measurements.

In order to test the incoming call capabilities, proceed as follows:

- 1 Connect the MS as described in "[Connecting the device under test](#)" on [page 38](#).

- 2 On the Welcome menu, press the **MS TMO** softkey.
The MS TMO Setup menu appears.

MS TMO Setup	
Idle	
RF Level: -115.0 dBm	Channel System: User Defined
MCCH: 3600 390.01250 MHz	Frequency Band: 300 MHz
TCH: 3600 390.01250 MHz TS: 2	Channel Offset: 12.5 kHz
	Duplex Spacing: 10 MHz
	Operating Mode: Normal
	Lowest Channel: 3600
	Highest Channel: 3999
	MCC: 262
	MNC: 1234
	BCC: 1
	LArea: 1
Start	Select Channel System
Start Tetra Test Mode	

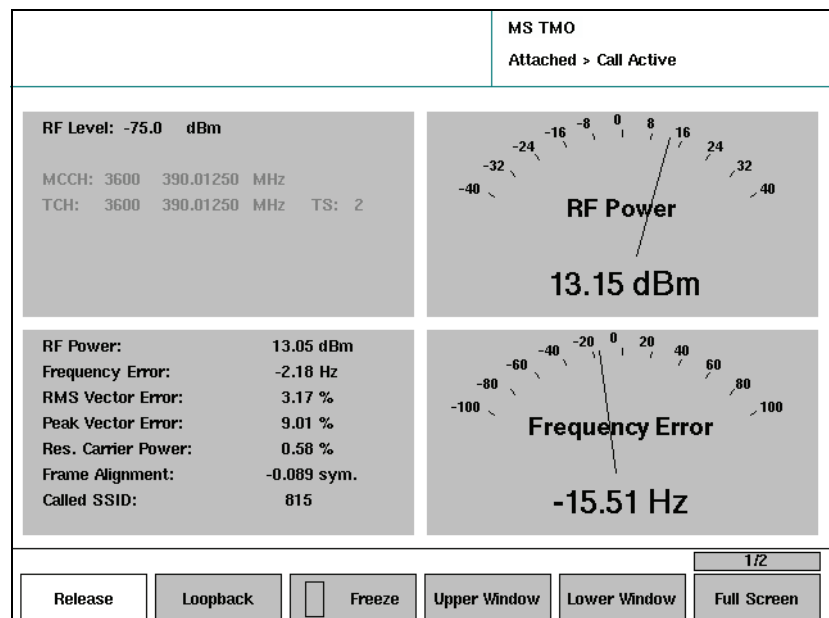
- 3 Set up the parameters for the network and base station as described in [“Setting up the network parameters” on page 40](#).
- 4 Press the **Start** softkey.
The MS TMO menu appears.
- 5 Switch on the MS and wait until the Stabilock displays Attached in the upper right corner.
The air interface standard version supported and the Short Subscriber ID of the MS are displayed on the right-hand side of the menu.

MS TMO	
Attached	
RF Level: -60.0 dBm	TETRA Air IF Standard: EN 300 392-2, -7
MCCH: 3600 390.01250 MHz	Short Subscriber ID: 10030
TCH: 3600 390.01250 MHz TS: 2	Selected Group: 100
Call Setup Type: Group	Paging Sensitivity:
Short Subscriber ID: 815	Disconnect Cause:
Dynamic Group: 2303	
DGNA Name Type: Default	
1/2	
Call	Emergency Call
Dynamic Group	SDS
Paging Sensitivity	Request Command Registration

- 6 Set up the call parameters as explained in [“Setting up the call parameters” on page 44](#). In particular, enter the call setup type; the Short Subscriber ID and the group number are not required in an incoming emergency call.
- 7 Push the **Emergency Call** softkey at the Stabilock.
The TETRA MS alerts.
- 8 Check if the acoustic and visual alert is according to the settings for an emergency call.
- 9 Accept the call by pressing the PTT button.
The Call Active menu appears. You can now perform radio measurements (see [“Performing transmitter tests” on page 68](#)).

NOTE

If the call fails or when the call is released, the Attach menu re-appears.



- 10 To stop the call, push the release button on either the MS or the 2305 Stabilock.
The Attach menu appears again. The MS is still attached to the network and you can now perform another call.

Testing the short data service capabilities

The 2305 Stabilock can send, receive and display the various types of SDS (Short Data Service) messages defined in the TETRA standard. The supported types are:

Status
Type 1-3 2Byte
Type 1-3 4Byte
Type 1-3 8Byte
Type 4 Text
Type 4 GPS
Type 4 Flash
Type 4 LIP
Type TL Text
Type TL GPS
Type TL Flash

For transmission of an SDS message, data can be entered for the respective message type. For Status messages, for example, a predefined message can be selected in the Status Message line (see [“Working with SDS status messages” on page 51](#)). For byte-type messages, a decimal number can be entered, and for text messages, text can be entered using the alphanumeric keypad.

The MS TMO SDS menu displays two sections – the upper part contains the message that the 2305 Stabilock is to send, and the lower part displays the message received from the TETRA MS.

Sending an SDS message to the TETRA radio

In order to send an SDS message to the TETRA radio, proceed as follows:

- 1 On the Welcome menu, press **MS TMO > Start > SDS**. The MS TMO SDS menu appears.

		MS TMO SDS	
		Attached	
<div>RF Level: -75.0 dBm</div> <div>SDS Type: Status</div> <div>Status Message: 65024 GENERAL STATUS ACK.</div>			
<div>Short Subscriber ID: 10002</div> <div>SDS Type: Status</div> <div>Status Message: 65029 DEST. NOT REACHABLE</div>			
	Send	SDS	SDS Type

- 2 Select the RF level (the level from the MS TMO menu is selected by default).

- 3 Select an SDS message type from the list that appears either by selecting the SDS Type menu item in the upper section, or by pushing the **SDS Type** softkey.
- 4 Select or enter the contents of the message in the Message field.
- 5 Push **Send SDS** to send the message.
The message is sent to the TETRA radio; the radio may display the message and/or return an SDS message to the 2305 Stabilock.

Note

Whether or not the TETRA radio displays the message sent, depends on the capabilities programmed into the radio.

Receiving an SDS message

While on the MS TMO SDS menu, the 2305 Stabilock always displays the last message received from the TETRA radio in the lower section of the menu.

Testing the Direct Mode
capability

The Direct Mode test and associated measurements are described in [Chapter 5 "Testing the TETRA Radio in Direct Mode"](#).

Performing transmitter tests

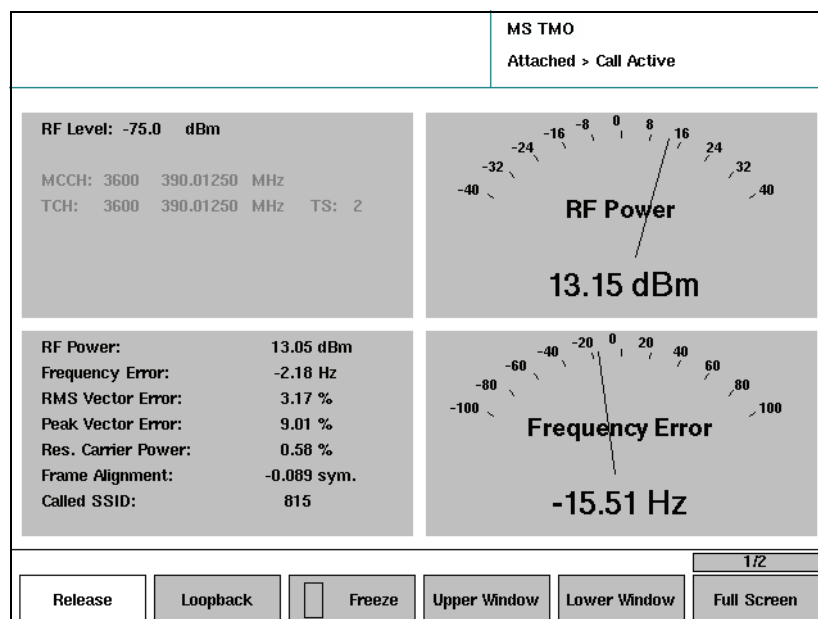
Measuring the transmit power

This measurement relates to the average transmit power in the active part of the time slot. Separate measurements relate to the residual carrier power and the burst profile.

The transmit power is averaged over the active time slot. The power level of the TETRA MS depends on the signal strength received from the base station, i.e. the 2305 Stabilock. See [“Power levels for TETRA mobile stations” on page 181](#) for more information about power control, power levels and tolerances.

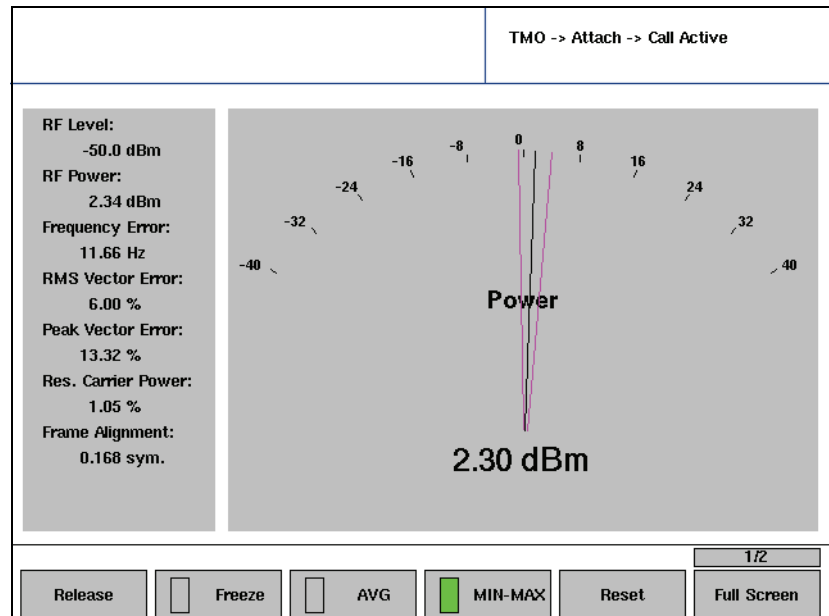
To take a power measurement, proceed as follows:

- 1 Connect the TETRA MS, initialize the 2305 Stabilock and set up a call as described in [“Testing the incoming call \(mobile terminated\)” on page 57](#) or [“Testing the outgoing call \(mobile originated\)” on page 59](#).
An individual call is set up and the Call Active menu appears.



- 2 If you have set up an individual simplex call, keep the PTT button of the MS pressed.
The MS transmits, and the 2305 Stabilock continually updates the measurement results.
- 3 Read the Power value on the left-hand side of the menu.
You can compare the power measurement value to limits if you know a) the power class and b) the current power step.
- 4 You can also configure one of the pointer instruments on the right-hand side to display the power level by pushing the **Upper Window** or **Lower Window** softkey and selecting **Power**.

- 5 Alternatively, you can even have the power level graphically displayed in large size by pushing the **Full Screen** softkey and selecting **Power**. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) displayed by pushing the **MIN-MAX** softkey to the on state, i.e. until the green rectangle appears, indicating that the minimum and maximum pointers are switched on.



- 6 While the call is active, you can also perform other transmitter measurements.
- 7 When you are finished with measurements you can stop the call by pushing the Release button on either the MS or the 2305 Stabilock. The Attach menu appears again. The MS is still attached to the network.

Measuring the frequency error

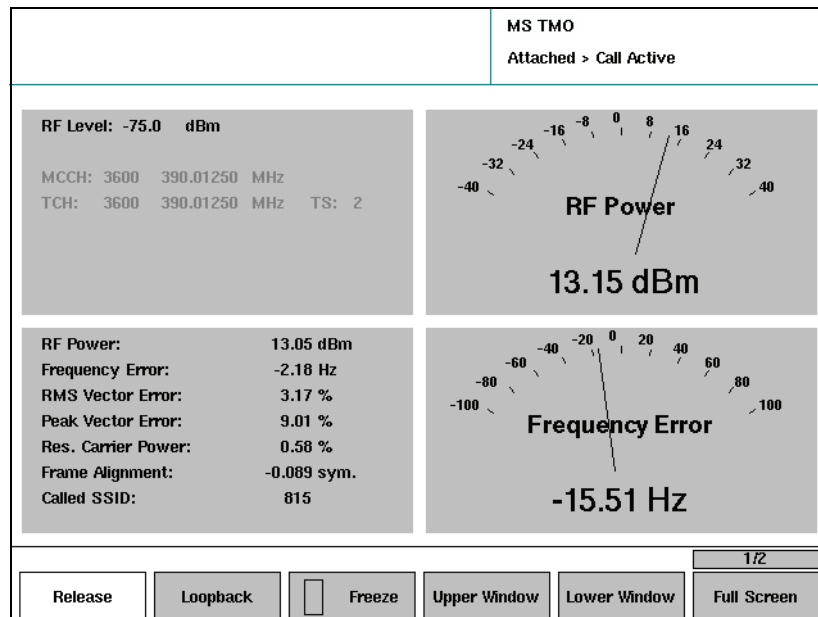
The frequency error is a measure of the TETRA mobile station's capability to keep its base frequency locked to the base station's center frequency.

NOTE

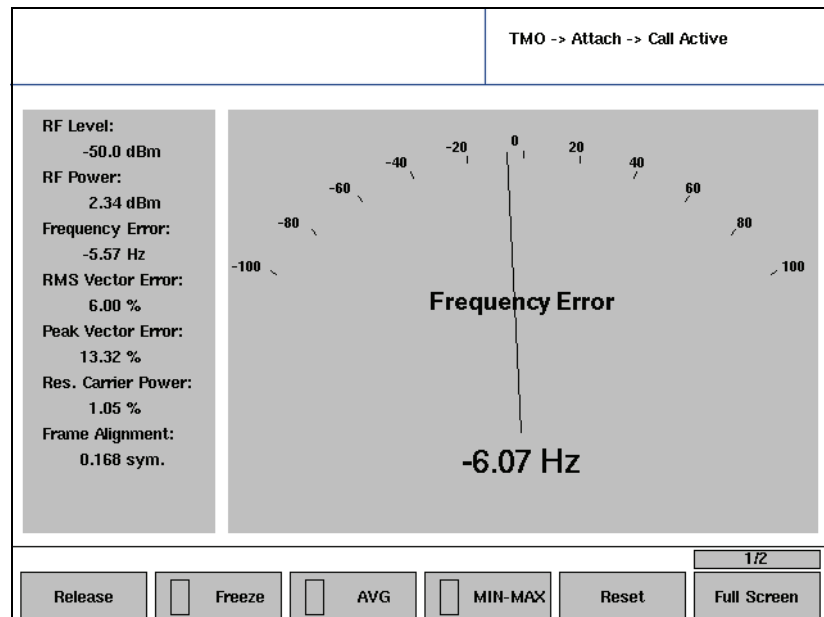
According to the TETRA specifications (EN 300 394-1), the frequency error should not exceed 100 Hz.

To take a frequency error measurement, proceed as follows:

- 1 Connect the TETRA MS, initialize the 2305 Stabilock and set up a call as described in ["Testing the incoming call \(mobile terminated\)" on page 57](#) or ["Testing the outgoing call \(mobile originated\)" on page 59](#).
An individual call is set up and the Call Active menu appears.



- 2 If you have set up an individual simplex call, keep the PTT button of the MS pressed.
 The MS transmits, and the 2305 Stabilock continually updates the measurement results.
- 3 Read the Frequency Error value on the left-hand side of the menu.
- 4 You can also configure one of the pointer instruments on the right-hand side to display the frequency error by pushing the **Upper Window** or **Lower Window** softkey and selecting **Frequency Offset**.
- 5 Alternatively, you can even have the frequency error graphically displayed in large size by pushing the **Full Screen** softkey and selecting **Frequency Offset**. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) displayed by pushing the **MIN-MAX** softkey until the function is de-activated (indicated by the green rectangular in the softkey description field disappearing).



- 6 While the call is active, you can also perform other transmitter measurements.
- 7 When you are finished with measurements you can stop the call by pushing the release button on either the MS or the 2305 Stabilock. The Call Active menu appears again. The MS is still attached to the network.

Measuring the modulation error (vector error)

The vector error is a measure of the TETRA mobile station's modulation quality. The lower the vector error, the better the radio connection will be at low receive levels or under interference conditions.

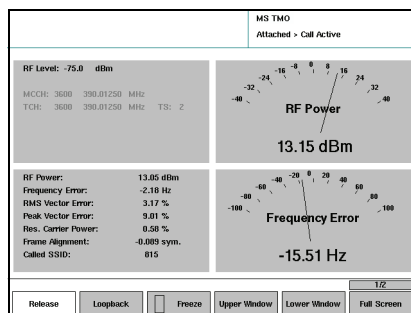
The vector error is calculated for each symbol; the maximum (peak) value over all the symbols of a burst is examined as well as the RMS average.

NOTE

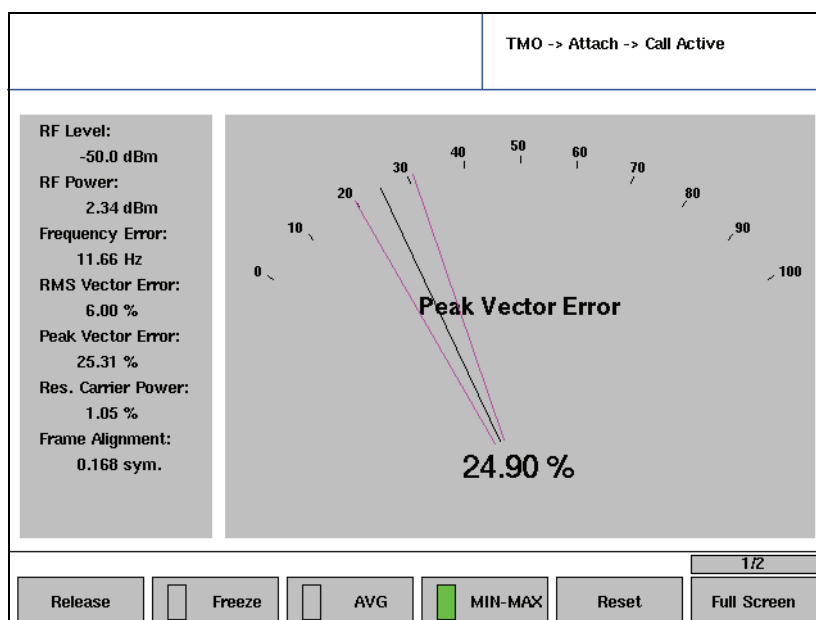
According to the TETRA specifications (EN 300 394-1), the RMS vector error should not exceed 10%; the peak vector error should be less than 30%.

To take vector error measurements, proceed as follows:

- 1 Connect the TETRA MS, initialize the 2305 Stabilock and set up a call as described in ["Testing the incoming call \(mobile terminated\)" on page 57](#) or ["Testing the outgoing call \(mobile originated\)" on page 59](#).
An individual call is set up and the Call Active menu appears.



- If you have set up an individual simplex call, keep the PTT button of the MS pressed.
The MS transmits, and the 2305 Stabilock continually updates the measurement results.
- Read the RMS Vector Error and the Peak Vector Error values on the left-hand side of the menu.
- You can also configure one of the pointer instruments on the right-hand side to display the vector error by pushing the **Upper Window** or **Lower Window** softkey and selecting the corresponding vector error measurement (**RMS Error** or **Peak Error**).
- Alternatively, you can even have the vector error graphically displayed in large size by pushing the **Full Screen** softkey and selecting the corresponding vector error measurement. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) displayed by pushing the **MIN-MAX OFF** softkey.



- While the call is active, you can also perform other transmitter measurements.

- 7 When you are finished with measurements you can stop the call by pushing the release button on either the MS or the 2305 Stabilock. The Attach menu appears again. The MS is still attached to the network.

Measuring the residual carrier power

The residual carrier power is a measure of the TETRA mobile station's modulation quality and may be caused by DC offsets in the I and Q signal paths. The lower the carrier power, the better the radio connection will be at low receive levels or under interference conditions.

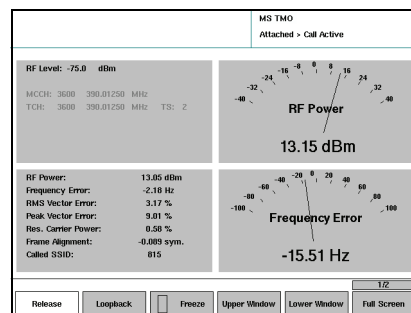
The residual carrier power is calculated over all symbols of a burst.

NOTE

According to the TETRA specifications (EN 300 394-1), the residual carrier magnitude should not exceed 5%.

To take residual carrier power measurements, proceed as follows:

- 1 Connect the TETRA MS, initialize the 2305 Stabilock and set up a call as described in ["Testing the incoming call \(mobile terminated\)" on page 57](#) or ["Testing the outgoing call \(mobile originated\)" on page 59](#).
An individual call is set up and the Call Active menu appears.



- 2 If you have set up an individual simplex call, keep the PTT button of the MS pressed.
The MS transmits, and the 2305 Stabilock continually updates the measurement results.
- 3 Read the Res. Carrier Power values on the left-hand side of the menu.
- 4 While the call is active, you can also perform other transmitter measurements.
- 5 When you are finished with measurements you can stop the call by pushing the release button on either the MS or the 2305 Stabilock. The Attach menu appears again. The MS is still attached to the network.

Viewing the modulation error in the constellation diagram

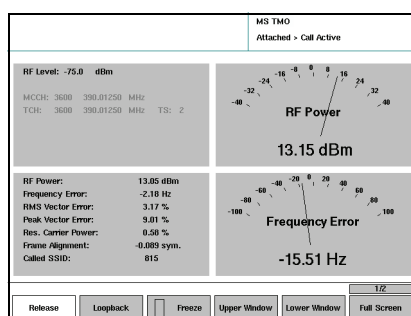
The constellation diagram allows you to test the modulation characteristics of the mobile. The Stabilock offers fast visual judgement of the modulation quality with the graphical representation of the modulation quality in several configurable ways. The horizontal axis shows the in-phase component (I) of the signal while the vertical axis displays the quadrature component (Q), normalized to the average burst power.

NOTE

Aeroflex offers the constellation display for your convenience, e.g. for modulator alignment; it is not a measurement specified in TETRA specification EN 300 394-1.

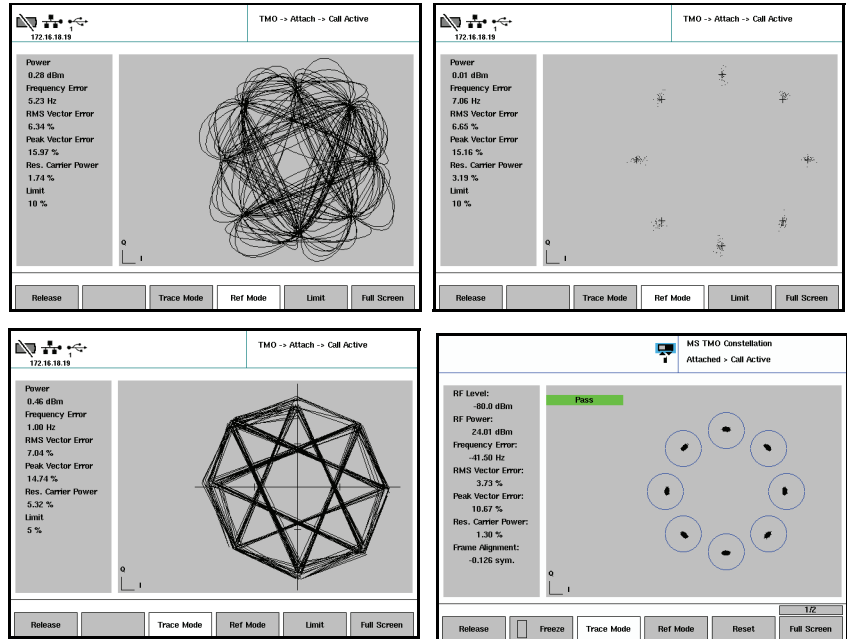
To view the constellation diagram, proceed as follows:

- 1 Connect the TETRA MS, initialize the 2305 Stabilock and set up a call as described in [“Testing the incoming call \(mobile terminated\)” on page 57](#) or [“Testing the outgoing call \(mobile originated\)” on page 59](#).
An individual call is set up and the Call Active menu appears.

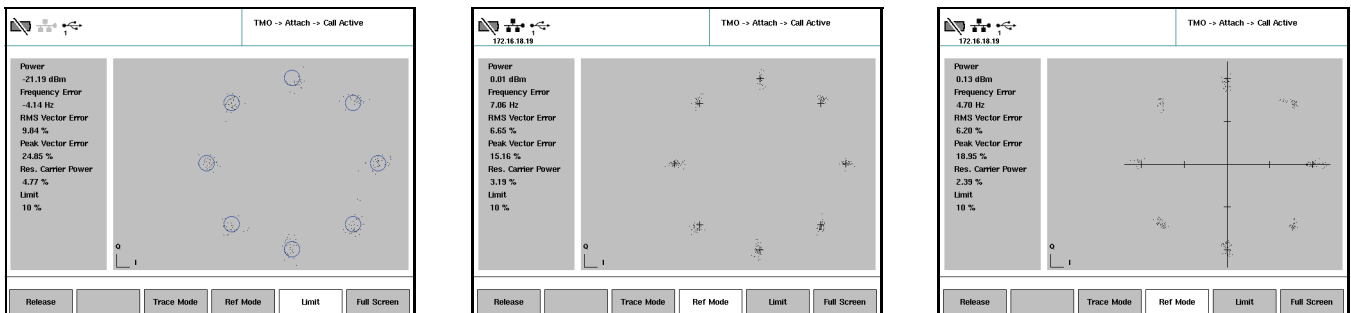


- 2 If you have set up an individual simplex call, keep the PTT button of the MS pressed.
The MS transmits, and the 2305 Stabilock continually updates the measurement results.
- 3 You can now configure one of the graphs on the right-hand side to show the constellation display by pushing the **Upper Window** or **Lower Window** softkey and selecting **Constellation**.

- 4 You can have the constellation display shown in large size instead by pushing the **Full Screen** softkey and selecting **Constellation**. The display is configurable:
 - Push **Trace Mode** and select one of the options (**Phase Tracer**, **Dots**, **Lines**, **Accumulated**) from the pull-down menu.



- Push **Ref Mode** and select one of the options from the pull-down menu: **Ref Circles** for a limit circle around each point of maximum effect, **Ref Lines** for a cross-hair at each point of maximum effect, **Ref Scale** for coordinate axes.



- Push **Limit** and select either **5 %** or **10 %** as the limit for the peak vector error. The selected limit is then shown as a circle while **Ref Circles** is selected.

When you are finished with the full-screen constellation display, return to the Call Active menu by pushing the **ESC** button.

- 5 While the call is active, you can also perform other transmitter measurements.

- When you are finished with measurements you can stop the call by pushing the release button on either the MS or the 2305 Stabilock. The Attach menu appears again. The MS is still attached to the network.

Viewing the burst profile

The burst profile display allows you to assess the TETRA mobile station's ability to ramp up and down the power level within the required time, and to keep the power level during the active part of the burst at a constant power level for the points of maximum effect.

NOTE

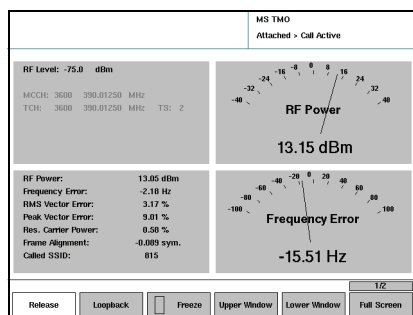
According to the TETRA specifications (EN 300 392-2), the following power limits apply:

During the last 16 symbol periods before the first information symbol is transmitted, the power level must not exceed 6 dB above the average burst power during the active part.

During the first 15 symbol periods after the last information symbol is transmitted, the power level must not exceed 3 dB above the average burst power during the active part.

To view the burst profile, proceed as follows:

- Connect the TETRA MS, initialize the 2305 Stabilock and set up a call as described in [“Testing the incoming call \(mobile terminated\)” on page 57](#) or [“Testing the outgoing call \(mobile originated\)” on page 59](#).
An individual call is set up and the Call Active menu appears.

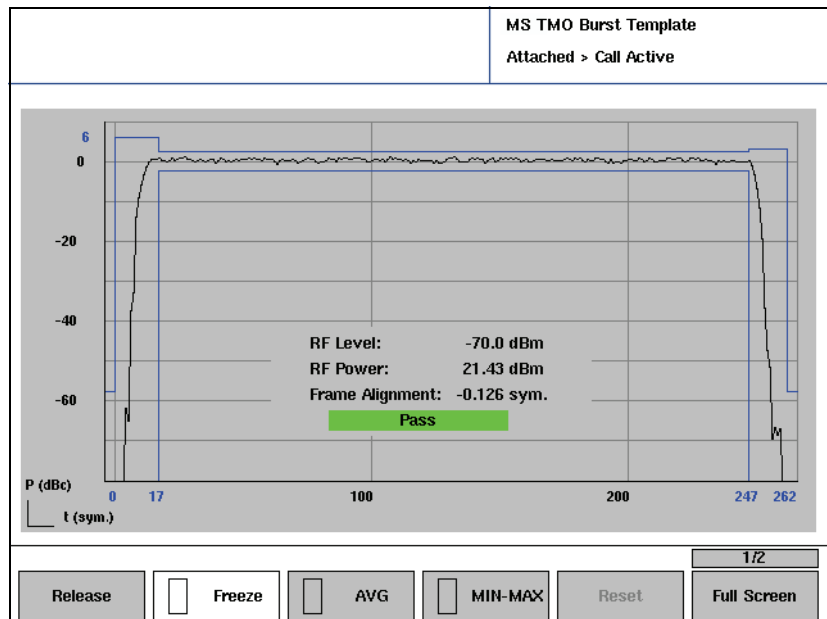


- If you have set up an individual simplex call, keep the PTT button of the MS pressed.
The MS transmits, and the 2305 Stabilock continually updates the measurement results.
- You can now configure one of the graphs on the right-hand side to show the burst profile by pushing the **Upper Window** or **Lower Window** softkey and selecting **Burst Template**.
- You can have the burst profile shown in large size instead by pushing the **Full Screen** softkey and selecting **Burst Template**.
The burst profile is shown (with 16 leading symbol periods, 231 symbol periods as the active part of the burst and 15 trailing symbol periods). The horizontal axis shows the time in bit periods,

the vertical axis indicates the power level in dBc. In addition, the timing error of the burst is shown in multiples of symbol periods (Frame alignment).

NOTE

According to the TETRA specifications (EN 300 394-1), the burst timing error (frame alignment) should not exceed ± 0.25 symbol periods.



- 5 When you are finished with the full-screen burst profile display, return to the Call Active menu by pushing the **ESC** button.
- 6 While the call is active, you can also perform other transmitter measurements.
- 7 When you are finished with measurements you can stop the call by pushing the release button on either the MS or the 2305 Stabilock. The Attach menu appears again. The MS is still attached to the network.

Viewing the modulation spectrum

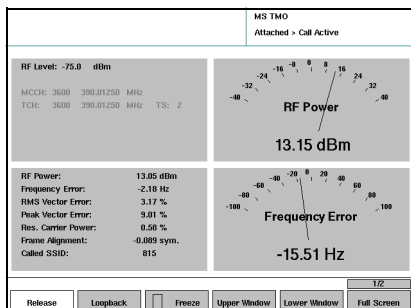
The modulation spectrum display allows you to assess the TETRA mobile station's modulation quality in the frequency domain.

The modulation spectrum is shown in the range ± 18 kHz from the carrier frequency, i.e. the span is 36 kHz.

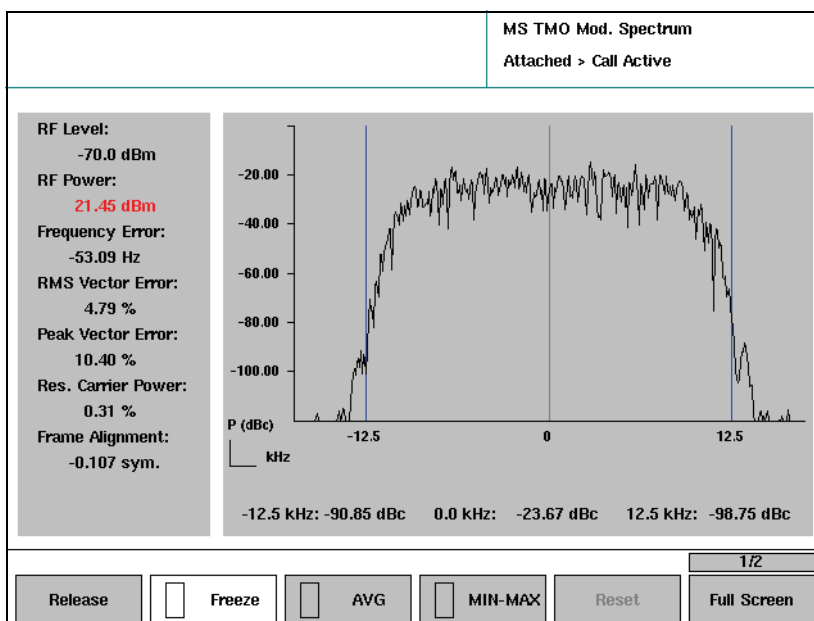
The horizontal axis shows the frequency in kHz, the vertical axis indicates the power spectrum density. The vertical blue lines indicate the boundaries of the 25 kHz TETRA channel.

To view the modulation spectrum, proceed as follows:

- 1 Connect the TETRA MS, initialize the 2305 Stabilock and set up a call as described in “Testing the incoming call (mobile terminated)” on page 57 or “Testing the outgoing call (mobile originated)” on page 59.
An individual call is set up and the Call Active menu appears.



- 2 If you have set up an individual simplex call, keep the PTT button of the MS pressed.
The MS transmits, and the 2305 Stabilock continually updates the measurement results.
- 3 You can now configure one of the graphs on the right-hand side to show the burst profile by pushing the **Upper Window** or **Lower Window** softkey and selecting **Mod Spectrum**.
- 4 You can have the burst profile shown in large size instead by pushing the **Full Screen** softkey and selecting **Mod Spectrum**.
The modulation spectrum is displayed along with the power at the band center and the edges.



- 5 When you are finished with the full-screen modulation spectrum display, return to the Call Active menu by pushing the **ESC** button.
- 6 While the call is active, you can also perform other transmitter measurements.

- 7 When you are finished with measurements you can stop the call by pushing the release button on either the MS or the 2305 Stabilock. The Attach menu appears again. The MS is still attached to the network.

Performing receiver tests

This section describes the receiver tests supported by the 2305 Stabilock in call mode under Trunked Mode Operation. Please also refer to [“Performing receiver measurements” on page 103 in Chapter 6 “Performing Tests at Mobile Stations without a Call Setup”](#).

Paging Sensitivity test

In the paging sensitivity test, the 2305 Stabilock pages the TETRA radio at a defined power level. If the radio responds, the test is passed for that level, the instrument decreases its power level and repeats the test. This continues until a predefined power level is reached. The paging sensitivity test is passed if the TETRA radio still responds at a predefined (low) power.

- 1 From the Welcome menu, select **Setup > Definitions**. The Definitions menu appears.

Definitions	
Idle	
Pre-Attenuation RF-Analyzer (MS-TX): 0.00 dB RF-Generator (MS-RX): 0.00 dB	External Synchronization Auto. Detect: ON
Paging Sensitivity Paging Sens. Start Level: -70.0 dBm Paging Sens. Step Width: 2.0 dB Paging Sens. Stop Level: -122.0 dBm	High-Power Attenuator RF Level Limits: -40 dBm ... -122 dBm
Measurements Number of Samples: 10 Unit of Powervalue: dBm	
<div style="text-align: right;">System Default</div>	

Note

The Definitions menu can also be called up directly from measurement menus by selecting ... > **Definitions**. By returning from the Definitions menu to the measurement menu, the measurements will be reset and started with the new averaging and pre-attenuation values.

- 2 Set up the Paging Sensitivity test parameters:

- a Paging Sens. Start Level is the receive power level in the TETRA radio at which the paging sensitivity test is started.
 - b Paging Sens. Step Width is the interval by which the receive power level is decreased in each test step.
 - c Paging Sens. Stop Level defines the lowest receive power level at which the paging sensitivity test is performed (unless the radio fails the test at a higher level).
 - d Paging Sens. Retries specifies how often the TETRA radio is paged on any power level step before the test is failed.
- 3 Return to the Welcome menu by selecting **ESC** twice.
 - 4 Select **MS TMO > Start** and wait until the radio is attached.
 - 5 Push the **Paging Sensitivity** softkey.
The test is started and the TETRA radio is paged while the power level is reduced until the paging sensitivity stop level has been reached.
 - 6 The result of the paging sensitivity test is displayed on the right-hand side of the menu.

		MS TMO Attached	
RF Level: -75.0 dBm MCCH: 3600 390.01250 MHz TCH: 3600 390.01250 MHz TS: 2 Call Setup Type: Individual Duplex Short Subscriber ID: 815 Dynamic Group: 2303 DGNA Name Type: Postnumber DGNA Name: Air		TETRA Air IF Standard: ETS 300 392-2, -7 Short Subscriber ID: 10002 Selected Group: Paging Sensitivity: -114.0 dBm <div style="background-color: green; color: white; text-align: center; padding: 2px;">Pass</div> Disconnect Cause:	
1/2			
Call	Emergency Call	Dynamic Group	SDS Paging Sensitivity Request Command Registration

TETRA Test Mode

With Edition 2 in 1999, the ETSI conformance testing specification for TETRA introduced a new, mandatory TETRA Test protocol for RF loop back tests, enabling in particular receiver measurements. This method allows a test set to set up a connection, transmit a pseudo-random bit sequence (PRBS) to the TETRA radio and receive the data looped back over the RF to calculate the bit error rate.

The 2305 Stabilock supports BER and MER measurements on a voice channel (TCH/S) with and without frame erasure.

The TETRA Test mode uses an extended TETRA protocol to measure the receiver performance. Additional receiver measurements utilizing non-call mode features are the T1 loopback BER and the single-ended receiver measurements; please refer to [“Performing receiver measurements” on page 103](#) for more information.

Preparing and starting a receiver measurement

- 1
- From the Welcome menu, select **MS TMO** to enter the MS TMO Setup menu, and select the parameters as outlined in [“Setting up the network parameters” on page 40](#).

Note

The entries for MCC and MNC are ignored for the purposes of the TETRA Test mode; they are both set to 1.

		MS TMO Setup	
		Idle	
RF Level: -115.0 dBm		Channel System: User Defined	
MCCH: 3600 390.01250 MHz		Frequency Band: 300 MHz	
TCH: 3600 390.01250 MHz TS: 2		Channel Offset: 12.5 kHz	
		Duplex Spacing: 10 MHz	
		Operating Mode: Normal	
		Lowest Channel: 3600	
		Highest Channel: 3999	
		MCC: 262	
		MNC: 1234	
		BCC: 1	
		LArea: 1	
Start		Select Channel System	Start Tetra Test Mode

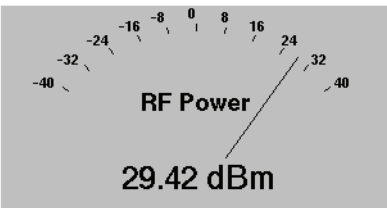
- 2
- Select “Start Tetra Test Mode”.
The TETRA Test menu appears.

		MS TMO Waiting for Attach	
RF Level: -70.0 dBm MCCH: 3600 390.01250 MHz TCH: 3600 390.01250 MHz TS: 2 Loopback-Type: With Frame Erasure MER/BER Samples: 10 Frames Short Subscriber ID: 815		TETRA Air IF Standard: Short Subscriber ID: TEI: Power Class: Receiver Class: Disconnect Cause:	
		1/2	
Call			Request Command Registration

- 3 Enter the RF level, the traffic channel, the time slot and the short subscriber ID as explained in [“Setting up the call parameters” on page 44](#).
- 4 Select a loopback type. Available types are “with frame erasure” and “without frame erasure”.
 Loopback with frame erasure supports BER measurements on class 0 bits (unprotected on the air interface) and class 2 bits (with strong protection against failure).
 Loopback without frame erasure supports BER measurements on class 0 bits, class 1 bits and the measurements of the Message Erasure Rate (MER).
- 5 Activate the TETRA Test mode in the mobile station.
 The TETRA radio registers with the 2305 Stabilock. The Stabilock requests important parameters from the TETRA radio and displays them on the right-hand side of the menu. These parameters are Short Subscriber ID, TEI, Power Class and Receiver Class. See section [“Understanding TETRA radio parameters in TETRA Test Mode” on page 85](#) for a discussion of these parameters.

MS TMO	
Attached	
<p>RF Level: -115.0 dBm</p> <p>MCCH: 3600 390.01250 MHz</p> <p>TCH: 3600 390.01250 MHz TS: 2</p> <p>Loopback-Type: With Frame Erasure</p> <p>MER/BER Samples: 10 Frames</p> <p>Short Subscriber ID: 815</p>	<p>TETRA Air IF Standard: ETS 300 392-2, -7</p> <p>Short Subscriber ID: 1234567</p> <p>TEI:</p> <p>Power Class:</p> <p>Receiver Class:</p> <p>Disconnect Cause:</p>
<div> <div>Call</div> <div></div> <div></div> <div></div> <div></div> <div>1/2</div> <div>Request Command Registration</div> </div>	

- Push **Call** to set up a voice channel and activate the loop. The Call Active menu appears. You can now switch between different views and observe the measurement results.

MS TMO							
Attached > Call Active							
<p>RF Level: -112.0 dBm</p> <p>MCCH: 3600 390.01250 MHz</p> <p>TCH: 3600 390.01250 MHz TS: 2</p> <p>Loopback-Type: Without Frame Erasure</p> <p>MER/BER Samples: 10 Frames</p>	 <p>RF Power</p> <p>29.42 dBm</p>						
<p>RF Power: 29.42 dBm</p> <p>Frequency Error: -0.32 Hz</p> <p>RMS Vector Error: 6.04 %</p> <p>Peak Vector Error: 12.38 %</p> <p>Res. Carrier Power: 0.67 %</p> <p>Frame Alignment: 0.065 sym.</p> <p>Called SSID: 1234567</p>	<p>Non Residual BER</p> <table> <tr> <td>Class 0:</td> <td>0.00 %</td> </tr> <tr> <td>Class 1:</td> <td>0.00 %</td> </tr> <tr> <td>Class 2:</td> <td>0.00 %</td> </tr> </table>	Class 0:	0.00 %	Class 1:	0.00 %	Class 2:	0.00 %
Class 0:	0.00 %						
Class 1:	0.00 %						
Class 2:	0.00 %						
<div> <div>Release</div> <div></div> <div>Freeze</div> <div>Upper Window</div> <div></div> <div>1/2</div> <div>Full Screen</div> </div>							

Note

In TETRA Test mode you can switch between different views as in TMO, except that the window on the lower right-hand side is not configurable. It will always display the receiver results instead.

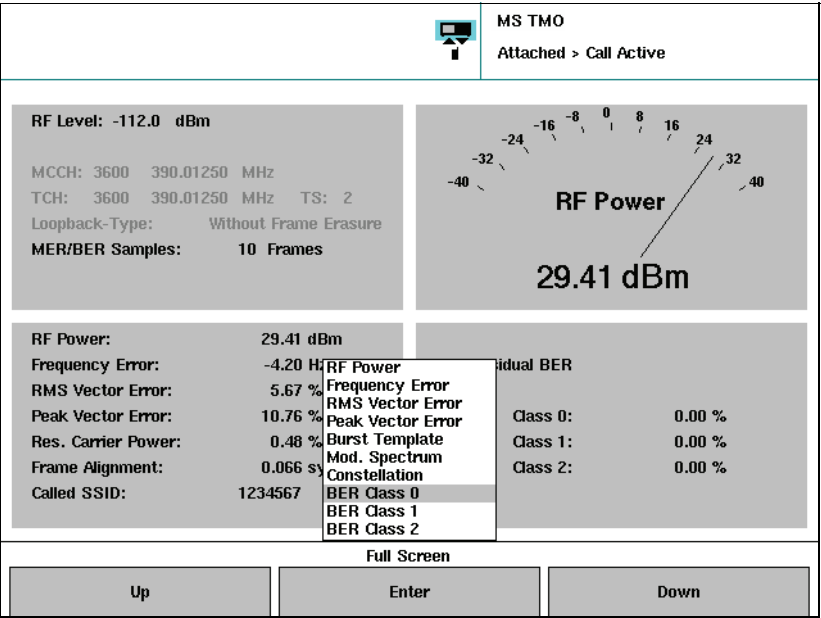
Performing measurements

Upper and lower results window

The measurement window on the lower right-hand side always displays the receiver measurement results. The window on the upper right-hand side is configurable using the **Upper Window** softkey.

Observing results in full-screen mode

In order to observe one (set of) results in large, push the **Full Screen** softkey.
A pull-up menu appears, offering different measurement views.



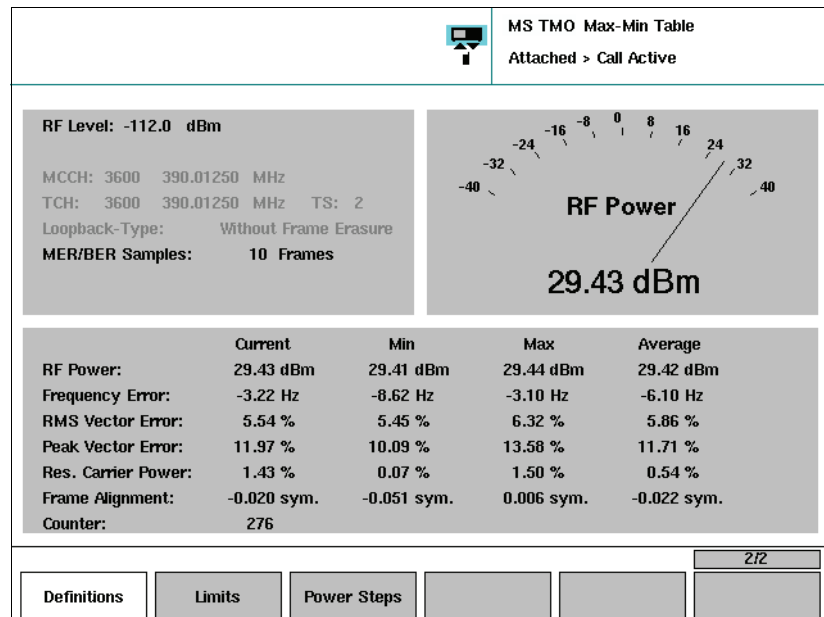
Measurement samples, results, counter

Each BER measurement sample on a TCH/S is comprised of 51 class 0 bits (unprotected), 56 class 1 bits (moderately protected) and 30 class 2 bits (strongly protected).

Each numerical measurement result presented is an average over a defined number of samples. The number of samples over which the 2305 Stabilock averages is defined in the Definitions menu.

Please note that the average values presented in the TETRA Test Max-Min Table menu are an average of all the measurement results since the start of the test.

The measurement counter in the TETRA Test Max-Min Table menu is incremented with each measurement result. If the number of measurement samples over which the Stabilock averages is very low, the results appear at a very high rate and the Stabilock may not be able to display all of them. This is why the counter may increment at step size higher than 1.



Understanding TETRA radio parameters in TETRA Test Mode

The TETRA Test Mode provides an opportunity to request information about the TETRA radio that is not normally available over the radio interface.

Short Subscriber ID

The short subscriber ID is a number used over the radio interface to identify individual TETRA mobile stations. See also [“Short Subscriber ID” on page 45](#).

TEI

The TETRA Equipment Identifier (TEI) is the electronic serial number of the TETRA radio. It consists of six-digit type approval code (TAC), a 2-digit final assembly code (FAC), a 6-digit electronic serial number (ESN) and a 1-digit spare number. Each digit is a hexadecimal number (from 0 to 9 or A to F).

Power Class

The power class determines the maximum power that the TETRA radio can transmit. See a list of power classes on [page 181](#).

Receiver Class

Valid receiver classes are A, B, D and E. See [“Glossary” on page 221](#) for a definition of receiver classes.

Testing the TETRA Radio in Direct Mode

5

This chapter provides task-based instructions for using the 2305 Stabilock to test the DMO function of the TETRA mobile station. Topics discussed in this chapter are as follows:

- [“Introduction” on page 88](#)
- [“Preparing the measurement” on page 88](#)
- [“Performing a DMO functional test” on page 89](#)
- [“Performing transmitter measurements” on page 90](#)

Introduction

This chapter shows how the direct mode operation of the TETRA radio can be tested using the 2305 Stabilock with the 2330 DMO Option. The functional test of the DMO capability can be complemented by transmitter measurements.

In DMO, the TETRA radios communicate directly with each other, without a base station. The 2305 Stabilock simulates a DMO radio that is already transmitting a presence signal. If the radio parameters of the Stabilock and the TETRA mobile match, the mobile should be able to find the channel with the presence signal. By pressing the PTT button, the transmitter is keyed on and measurements can be performed.

Preparing the measurement

In this step, the TETRA MS and the 2305 Stabilock are prepared for the measurements.

Prepare the TETRA tester and the TETRA radio as follows:

- 1 Connect the TETRA MS as described in [“Connecting the device under test” on page 38](#).
- 2 On the Welcome menu, press the **MS DMO** softkey. The MS DMO Setup menu appears. The parameters are explained briefly below; for more details, please refer to section [“Setting up the network parameters” on page 40](#).

TETRA DMO Setup	
Idle	
RF Level: -50.0 dBm	Channel System: User Defined
MCCH: 3999 399.97500 MHz	Frequency Band: 300 MHz
	Channel Offset: 0 kHz
	Lowest Channel: 3600
	Highest Channel: 3999
	MCC: 262
	MNC: 1234
Start	Select Channel System

- 3 Push the **Select Channel System** softkey to select a set of predefined channel parameters. Alternatively, if the RF and network parameters required are not stored in a file, proceed as follows:

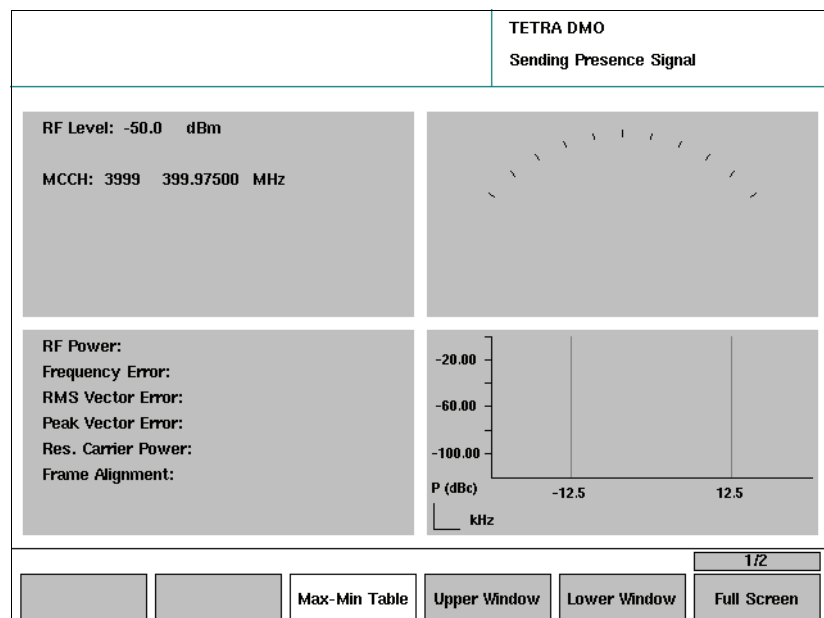
- a On the right-hand side of the menu, enter the lowest and highest channel number supported by the TETRA radio under test. (These parameters are for your convenience to avoid trying to test on channels that are not supported by the mobile station.)
- b Select the frequency band and channel offset.
- 4 On the left-hand side of the menu, set the RF Level value according to your requirements. This is the output level of Stabilock's RF generator.
- 5 Enter the channel number or center frequency under MCCH. This is the frequency on which either the Stabilock or the TETRA radio will transmit. (There is no duplex spacing in DMO.)

Note

If you enter a frequency that does not correspond to the channel frequency system on the lower right-hand side of the menu, those channel frequency parameters will be changed accordingly.

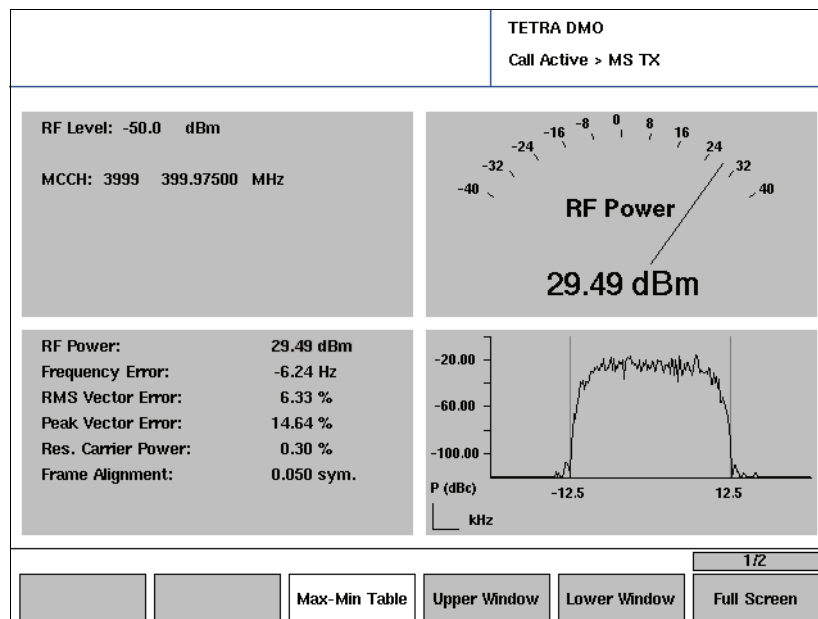
Performing a DMO functional test

- 1 From the Welcome menu, select **MS DMO > Start** to proceed to the tests.
The Stabilock displays the DMO menu and starts transmitting a presence signal.



- 2 Turn the TETRA MS on and switch it into DMO mode.
The Stabilock emits a presence signal, allowing the TETRA radio to synchronize with the Stabilock.
- 3 When the MS indicates that it has found a DMO channel, keep the PTT pressel pushed.
The TETRA MS transmits a DMO signal in synchronization with the

Stabilock's signal. The Stabilock displays "Call Active > MS TX" in the upper right-hand corner of the menu, and transmitter measurement results in the results section.



Performing transmitter measurements

In DMO, the TETRA radio keeps transmitting DMO bursts while the PTT is pressed.

When the measurements are running (see [“Preparing the measurement” on page 88](#)), the following measurement results are available on the left-hand side of the MS DMO menu:

- RF power
- Frequency error
- RMS and peak vector error
- Residual carrier magnitude
- Frame alignment

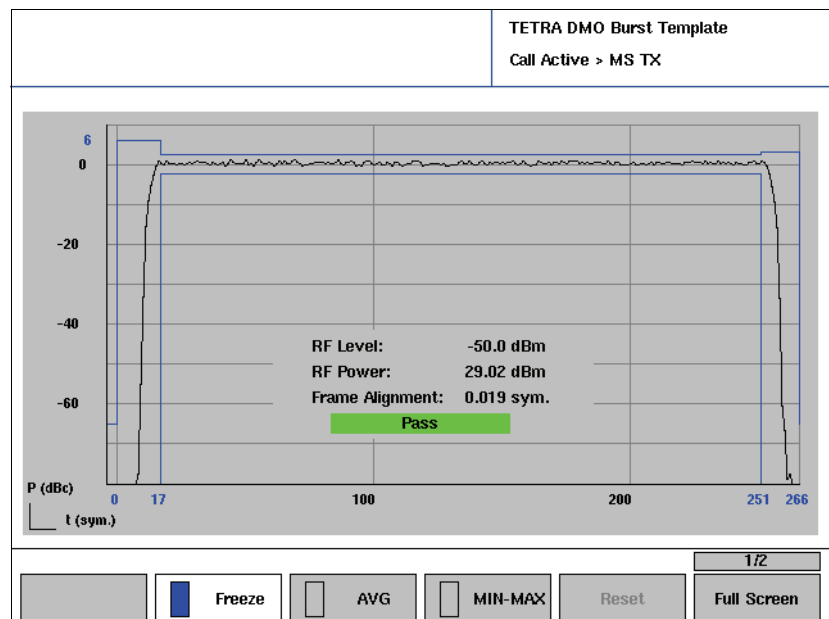
Some of these measurements are also available in a graphical representation. Additional graphical measurements include:

- Burst profile
- Modulation spectrum
- Constellation diagram

The transmitter measurements are basically the same as in trunked mode (TMO), please see [“Performing transmitter tests” on page 68](#). There are two exceptions:

- The frequency offset has different limits in DMO. The carrier frequency error in DMO must not exceed 1 kHz.

- The power-time template in DMO differs from that in trunked mode because the setup and length of the time slot is different. See a typical measurement below.



Performing Tests at Mobile Stations without a Call Setup

6

This chapter provides task-based instructions for using the 2305 Stabilock features in asynchronous mode. These measurements require the 2333 TETRA Mobile Station Test Option. Topics discussed in this chapter are as follows:

- [“Introduction” on page 94](#)
- [“Preparing the measurement” on page 94](#)
- [“Using the signal generator” on page 96](#)
- [“Performing transmitter measurements” on page 98](#)
- [“Performing receiver measurements” on page 103](#)

Introduction

The tests and measurements shown in [Chapter 4 “Performing MS Tests and Measurements in Trunked Mode”](#) assume a fully functional TETRA mobile station (MS) with call processing capabilities.

This chapter shows how transmitter measurements can be made without the need to set up a call beforehand. These measurements may even be possible without synchronization to a base station; that’s why they are called asynchronous measurements.

The prerequisite for these measurement tasks is that the TETRA MS is in a special mode where it transmits without any registration and call processing. This mode is sometimes referred to as a service mode in the MS.

The signal to be measured should consist of either normal uplink bursts, DMO normal bursts or a continuous signal made up of normal uplink bursts, with one of the defined training sequences.

The test steps are explained for the Generator/Analyzer mode. In addition, the 2305 Stabilock can also take measurements while generating a special test signal (T1). Details about the T1 signal generator can be found at the end of this chapter.

The 2305 Stabilock can perform transmitter measurements at continuous signals, synchronized burst signals (using the same frequency and time reference) and asynchronous burst signals. Although the 2305 Stabilock usually takes several measurements per second it may sometimes need a second between two measurements to resynchronize with the transmit signal.

Preparing the measurement

In this step, the TETRA MS and the 2305 Stabilock are prepared for the measurements.

The MS may require a certain signal from the 2305 Stabilock (the simulated base station), e.g. a typical base station signal including the SCH/F for frequency alignment.

To take a power measurement, proceed as follows:

- 1 Connect the TETRA MS as described in [“Connecting the device under test” on page 38](#).
- 2 On the Welcome menu, press the **Generator / Analyzer** softkey. The Generator/Analyzer Setup menu appears. The parameters are explained briefly below; for more details, please refer to section [“Setting up the network parameters” on page 40](#).

				Generator/Analyzer Setup	
				Idle	
RF Level:		-70.0 dBm		Channel System: User Defined	
TX Channel:		3600	390.01250 MHz	Frequency Band: 300 MHz	
RX Channel:			380.01250 MHz	Channel Offset: 12.5 kHz	
				Duplex Spacing: 10 MHz	
Channel Mode:		ON		Operating Mode: Normal	
				Lowest Channel: 3600	
				Highest Channel: 3999	
				MCC: 262	
				MNC: 1234	
				BCC: 1	
Generator / Analyzer		Select Channel System		T1 Loopback MS RX	
				T1 MS RX	

- 3 Push the **Select Channel System** softkey to select a set of predefined channel parameters. Alternatively, if the RF and network parameters required are not stored in a file, proceed as follows:
 - a On the right-hand side of the menu, select the frequency band, channel offset and duplex spacing. If your system requires the mobile station to transmit in the higher band (MS frequency above BS frequency), set the **Operating Mode** field to Reverse, otherwise to Normal.
 - b Enter the lowest and highest channel number supported by the TETRA radio under test. (These parameters are for your convenience to avoid trying to test on channels that are not supported by the mobile station.)
 - c Enter the MCC, MNC and BCC parameters of the base station simulated by the Stabilock. (Skip these parameters if you do not require a typical base station signal from the 2305 Stabilock.)
- 4 On the left-hand side of the menu, set the RF Level value according to your requirements. This is the output level of Stabilock's RF generator.
- 5 Enter the transmit channel number or center frequency under TX Channel. This is the (uplink) frequency at which the Stabilock will take measurements. The downlink frequency (Stabilock generator frequency) will be set according to the selected duplex spacing. Alternatively, enter the downlink (generator) frequency in the RX Channel input field; the Stabilock will automatically adapt the analyzer frequency.

Note

If you enter a frequency that does not correspond to the channel frequency system on the lower right-hand side of the menu, those channel frequency parameters will be changed accordingly.

Note

The channel spacing in TETRA is 25 kHz; however the 2305 Stabilock can be tuned in steps of 250 Hz. If you perform tests with the generator or analyzer frequency tuned in smaller steps than 25 kHz you can set the **Channel Mode** input field to Off. The Channel Number input field will disappear. Set Channel Mode to On again for the Channel Number field to re-appear.

Note

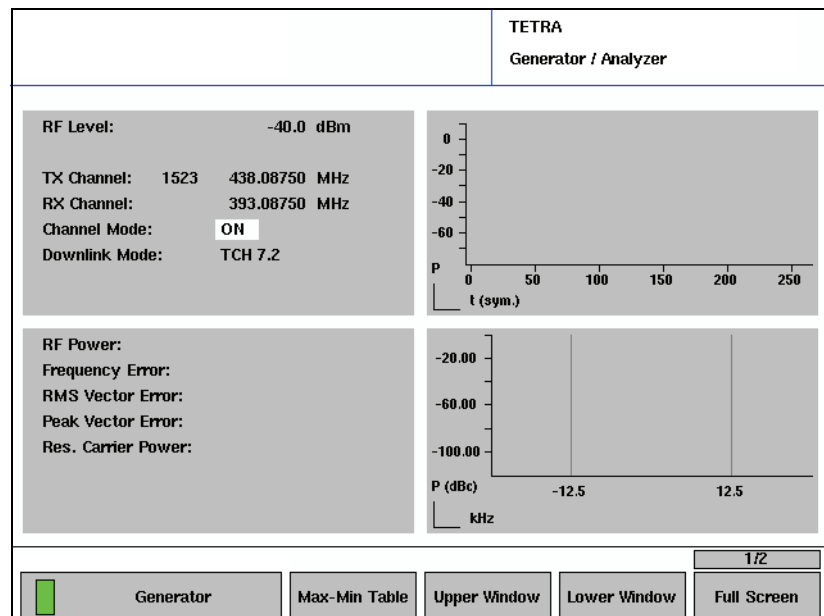
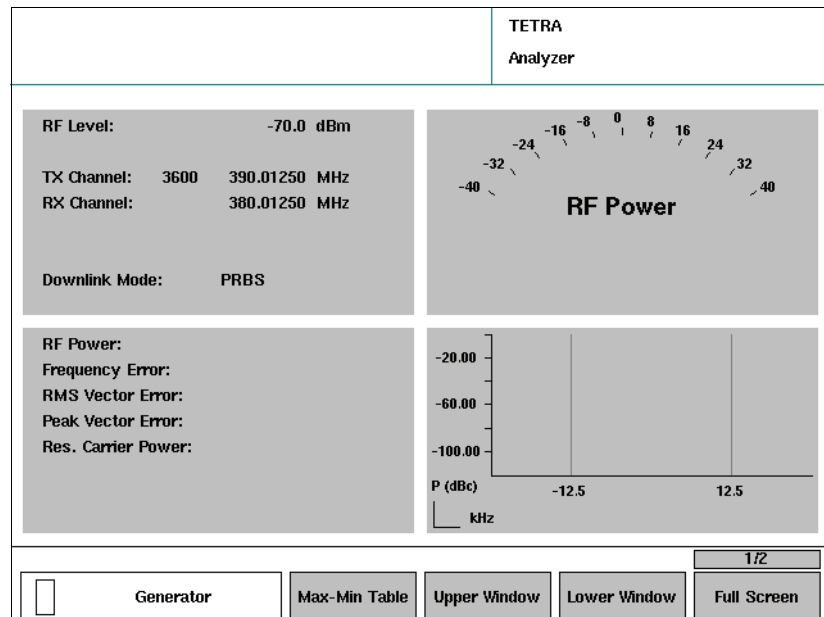
At the band edges, if you enter a frequency or channel number for TX or RX that, after applying the duplex spacing, would render the other value invalid because it is not supported by the Stabilock, the Operating Mode value is switched (from Normal to Reverse or vice versa) so that both fields show valid inputs.

- 6 Select **Generator/Analyzer** to perform transmitter measurements with or without the signal generator function. (Please refer to [“Performing receiver measurements” on page 103](#) for measurements involving a T1 signal).
The Analyzer or the Generator / Analyzer menu appears, see next section.

Using the signal generator

The signal generator in asynchronous mode can be set up to transmit a modulated signal with different bit patterns or with a typical TETRA channel signal. Alternatively, the signal generator can be switched while asynchronous transmitter measurements without a downlink (base station) signal are required.

- 1 From the Welcome menu, select **Generator / Analyzer > Generator / Analyzer**.
The Analyzer menu or the Generator / Analyzer menu appears.



- 2 If you want to turn on the signal generator, push the **Generator** softkey until the green symbol appears in the softkey description and the menu name displayed in the top-right corner is "Generator / Analyzer".
- 3 In the Downlink Mode field, select one of the following generator signals:
 - T1 (TCH 7.2)** (the Stabilock transmits four time slots per frame, one containing a typical TCH/7.2 signal, the other slot filled with dummy bursts)
 - T1 (TCH 2.4)** (the Stabilock transmits four time slots per frame, one containing a typical TCH/2.4 signal, the other slot filled with dummy bursts)
 - T1 (SCH/F)** (the Stabilock transmits four time slots per frame, one containing a typical control channel; this signal is useful for MER

measurements)

PRBS (T1 signal; the Stabilock transmits a pseudo-random bit sequence)

All Symbols 00 (the Stabilock transmits a sequence of zeros only)

All Symbols 01 (the Stabilock transmits a sequence of bit inversals only)

All Symbols 10 (the Stabilock transmits a sequence of bit inversals only)

All Symbols 11 (the Stabilock transmits a sequence of ones only)

Unscrambled TCH 7.2 (the Stabilock transmits four time slots, one with a TCH)

T2 (PRBS) (the Stabilock transmits the T2 signal as defined in EN 300 394-1 § 5.3.3)

T3 (All Symbols 00) (the Stabilock transmits the T3 signal as defined in EN 300 394-1 § 5.3.4)

The selected signal is transmitted by the Stabilock.

- 4 For taking transmitter measurements, turn on the transmitter of the MS.

The Stabilock starts the measurements.

Performing transmitter measurements

When the measurements are running (see [“Preparing the measurement” on page 94](#)), the following measurement results are available on the left-hand side of the Generator / Analyzer menu:

- Power
- Frequency error
- RMS and peak vector error
- Residual carrier magnitude

Some of these measurements are also available in a graphical representation. Additional graphical measurements include:

- Burst profile
- Modulation spectrum
- Constellation diagram

Note

For optimal accuracy of transmitter measurement results, switch off the generator of the 2305 Stabilock to avoid any interference with the internal signal.

Power measurements

The transmit power is averaged over the active time slot, taking the training sequence into account to determine the active part of the burst.

In addition to the numeric result shown on the left-hand side, you can also configure one of the pointer instruments on the right-hand side to display the power level by pushing the **Upper Window** or **Lower Window** softkey and selecting **Power**.

Alternatively, you can even have the power level graphically displayed in large size by pushing the **Full Screen** softkey and selecting **Power**. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) graphically displayed by pushing the **MIN-MAX** softkey to OFF state.

A statistical evaluation of the results is available upon a push of the **Max-Min Table** softkey. The associated menu displays a matrix of different transmitter parameters with the last measurement result, the minimum and maximum results and the average value since the start of the measurements. The evaluation can be restarted with the **Reset** softkey.

Frequency error measurements

The frequency error is a measure of the TETRA mobile station's capability to keep its base frequency locked to the base station's center frequency.

NOTE

According to the TETRA specifications (EN 300 394-1), the frequency error should not exceed 100 Hz.

You can also configure one of the pointer instruments on the right-hand side to display the frequency error by pushing the **Upper Window** or **Lower Window** softkey and selecting **Frequency Offset**.

Alternatively, you can even have the frequency error graphically displayed in large size by pushing the **Full Screen** softkey and selecting **Frequency Offset**. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) graphically displayed by pushing the **MIN-MAX OFF** softkey.

A statistical evaluation of the results is available upon a push of the **Max-Min Table** softkey. The associated menu displays a matrix of different transmitter parameters with the last measurement result, the minimum and maximum results and the average value since the start of the measurements. The evaluation can be restarted with the **Reset** softkey.

Vector error

The vector error is a measure of the TETRA mobile station's modulation quality. The lower the vector error, the better the radio connection will be at low receive levels or under interference conditions.

The vector error is calculated for each symbol; the maximum (peak) value over all the symbols of a burst is examined as well as the RMS average.

NOTE

According to the TETRA specifications (EN 300 394-1), the RMS vector error should not exceed 10%; the peak vector error should be less than 30%.

You can also configure one of the pointer instruments on the right-hand side to display the vector error by pushing the **Upper Window** or **Lower Window** softkey and selecting the corresponding vector error measurement (**RMS Error** or **Peak Error**).

Alternatively, you can even have the vector error graphically displayed in large size by pushing the **Full Screen** softkey and selecting the corresponding vector error measurement. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) graphically displayed by pushing the **MIN-MAX OFF** softkey.

A statistical evaluation of the results is available upon a push of the **Max-Min Table** softkey. The associated menu displays a matrix of different transmitter parameters with the last measurement result, the minimum and maximum results and the average value since the start of the measurements. The evaluation can be restarted with the **Reset** softkey.

Residual carrier power

The residual carrier power is a measure of the TETRA mobile station's modulation quality and may be caused by DC offsets in the I and Q signal paths. The lower the carrier power, the better the radio connection will be at low receive levels or under interference conditions.

The residual carrier power is calculated over all symbols of a burst.

NOTE

According to the TETRA specifications (EN 300 394-1), the residual carrier magnitude should not exceed 5%.

A statistical evaluation of the results is available upon a push of the **Max-Min Table** softkey. The associated menu displays a matrix of different transmitter parameters with the last measurement result, the minimum and maximum results and the average value since the start of the measurements. The evaluation can be restarted with the **Reset** softkey.

Constellation diagram

The constellation diagram allows you to test the modulation characteristics of the mobile. The Stabilock offers fast visual judgement of the modulation quality with the graphical representation of the modulation quality in several configurable ways. The horizontal axis shows the in-phase component (I) of the signal while the vertical axis displays the quadrature component (Q), normalized to the average burst power.

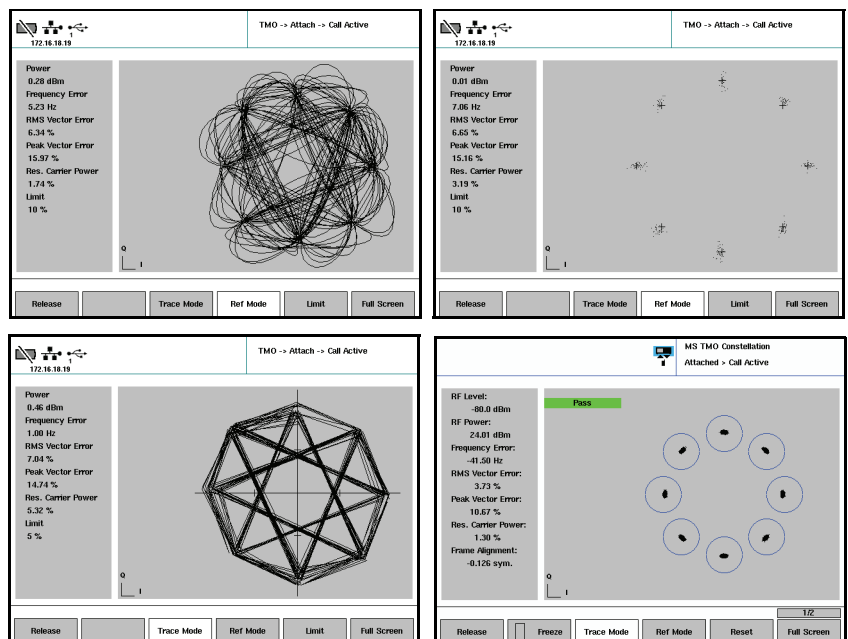
NOTE

Aeroflex offers the constellation display for your convenience, e.g. for modulator alignment; it is not a measurement specified in TETRA specification EN 300 394-1.

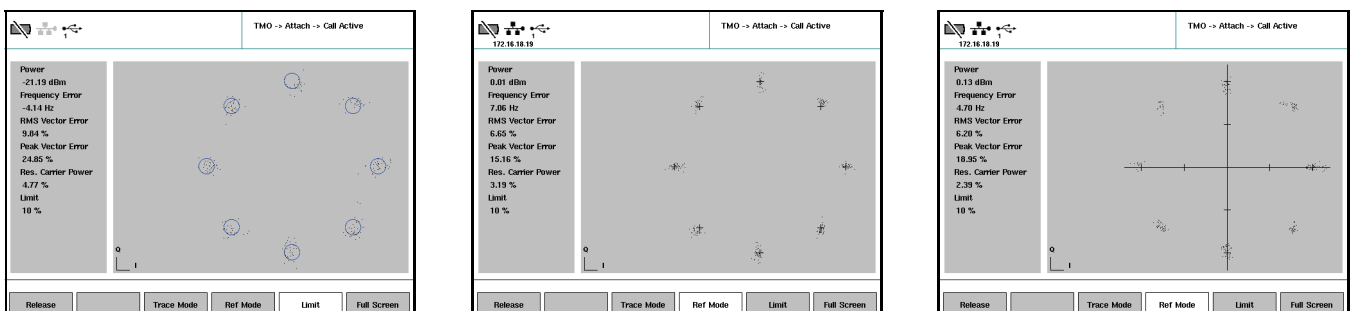
You can configure one of the graphs on the right-hand side to show the constellation display by pushing the **Upper Window** or **Lower Window** softkey and selecting **Constellation**.

Alternatively, you can have the constellation display shown in large size instead by pushing the **Full Screen** softkey and selecting **Constellation**. The display is configurable:

- Push **Trace Mode** and select one of the options (**Phase Tracer**, **Dots**, **Lines**, **Accumulated**) from the pull-down menu.



- Push **Ref Mode** and select one of the options from the pull-down menu: **Ref Circles** for a limit circle around each point of maximum effect, **Ref Lines** for a cross-hair at each point of maximum effect, **Ref Scale** for coordinate axes.



- Push **Limit** and select either **5 %** or **10 %** as the limit for the peak vector error. The selected limit is then shown as a circle while Ref Circles is selected.

When you are finished with the full-screen constellation display, return to the Generator / Analyzer menu by pushing the **ESC** button.

Burst profile

The burst profile display allows you to assess the TETRA mobile station's ability to ramp up and down the power level within the required time, and to keep the power level during the active part of the burst at a constant power level for the points of maximum effect.

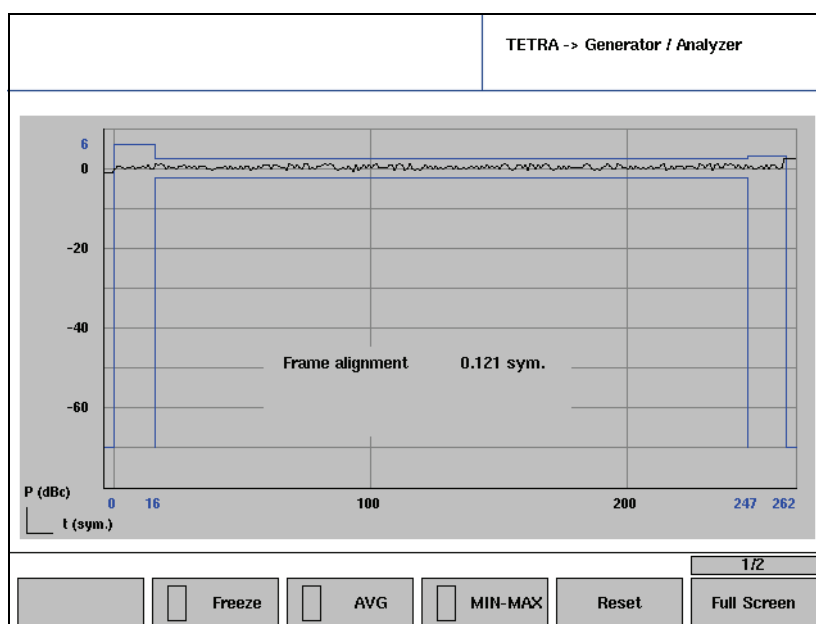
NOTE

According to the TETRA specifications (EN 300 392-2), the following power limits apply to normal uplink bursts:
 During the last 16 symbol periods before the first information symbol is transmitted, the power level must not exceed 6 dB above the average burst power during the active part.
 During the first 15 symbol periods after the last information symbol is transmitted, the power level must not exceed 3 dB above the average burst power during the active part.

You can configure one of the graphs on the right-hand side to show the burst profile by pushing the **Upper Window** or **Lower Window** softkey and selecting **Burst Template**.

You can have the burst profile shown in large size instead by pushing the **Full Screen** softkey and selecting **Burst Template**.

The burst profile is shown (with 16 leading symbol periods, 231 symbol periods as the active part of the burst and 15 trailing symbol periods). The horizontal axis shows the time in bit periods, the vertical axis indicates the power level in dBc.



When you are finished with the full-screen burst profile display, return to the Generator / Analyzer menu by pushing the **ESC** button.

Modulation spectrum

The modulation spectrum display allows you to assess the TETRA mobile station's modulation quality in the frequency domain.

The modulation spectrum is shown in the range ± 18 kHz from the carrier frequency, i.e. the span is 36 kHz.

The horizontal axis shows the frequency in kHz, the vertical axis indicates the power spectrum density. The vertical blue lines indicate the boundaries of the 25 kHz TETRA channel.

NOTE

Aeroflex offers the modulation spectrum for your convenience, e.g. for modulator alignment; it is not a measurement specified in TETRA specification EN 300 394-1.

You can configure one of the graphs on the right-hand side to show the burst profile by pushing the **Upper Window** or **Lower Window** softkey and selecting **Mod Spectrum**.

Alternatively, you can have the burst profile shown in large size instead by pushing the **Full Screen** softkey and selecting **Mod Spectrum**.

When you are finished with the full-screen modulation spectrum display, return to the Generator / Analyzer menu by pushing the **ESC** button.

Performing receiver measurements

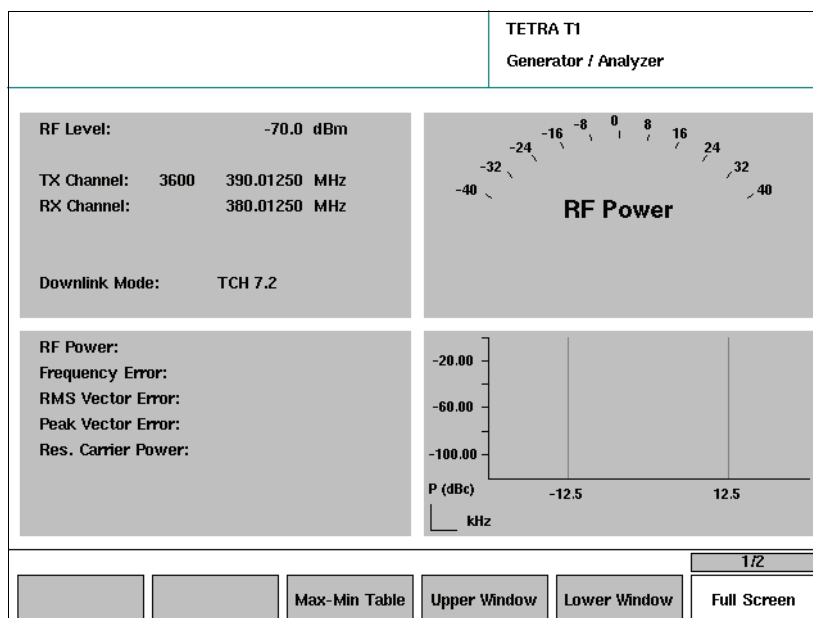
The 2305 Stabilock supports two types of receiver measurements in asynchronous mode, i.e. they do not require a call setup. You should, however, have knowledge how to set the TETRA radio into a test mode so that the radio supports the measurement.

Single-ended BER measurement (normal T1 test mode)

The measurement is performed within the TETRA mobile station. For this purpose, TETRA specification EN 300 394-1 defines a test signal T1 which is a scrambled downlink traffic channel containing a pseudo-random bit sequence (PRBS). The instrument transmits this signal at a defined power level and the MS tries to demodulate and decode the signal. Many types of TETRA mobile stations support the measurement by evaluating the received signal, correlating it with the known PRBS and calculating the bit error rate (BER). The BER is then displayed on the MS or a computer attached to the MS.

In order to set up the 2305 Stabilock for the T1-based BER test, proceed as follows:

- 1 Connect the TETRA MS as described in [“Connecting the device under test” on page 38](#).
- 2 Set up the generator as described in [“Preparing the measurement” on page 94](#).
- 3 In the Generator/Analyzer Setup menu, push **MS RX**. The TETRA T1 menu appears.



- 4 Select a signal type in the Downlink Mode field:
TCH 7.2 (the Stabilock transmits four time slots per frame, one containing a typical TCH/7.2 signal, the other slots filled with dummy bursts)
SCH/F (the Stabilock transmits four time slots per frame, one containing a typical control channel; this signal is useful for MER measurements)
BSCH + SCH/HD (the Stabilock transmits four time slots per frame, one containing a BSCH + SCH/HD signal with a PRBS, the other slots filled with dummy bursts)
TCH 2.4 (the Stabilock transmits four time slots per frame, one containing a typical TCH/2.4 signal, the other slots filled with dummy bursts)

Note

The channel combinations, the scrambling and the data payload are as defined in the ETSI specifications for testing (e.g. EN 300 394-1 Annex D.8.4). MCC and MNC are set to 1, overruling the settings in the Generator/Analyzer Setup menu.

- 5 Prepare the TETRA MS for the T1 receiver test and read the result on the display of the MS or the attached PC.

NOTE

According to the TETRA specifications (EN 300 394-1), the reference sensitivity performance is defined such that the bit error rate (BER) at a power level of -112 dBm must be below 0.122%.

- 6 When finished, switch the TETRA radio off and on again to clear the test mode and resume normal operation.

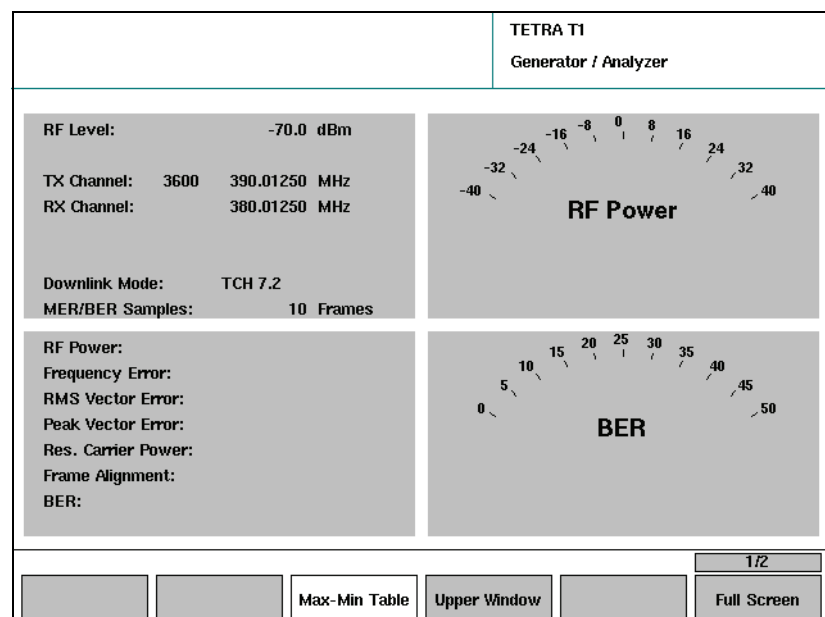
T1 loop back test mode

The TETRA radio must be in service mode. The test set (i.e. the 2305 Stabilock) transmits a T1 signal. The radio recognizes the T1 and loops it back in the uplink path. The test set receives the looped-back data and compares it with the transmitted data. As a result, the test set calculates and displays the bit error rate (BER).

TETRA specification EN 300 394-1 defines several types of test signal T1. T1 is always a scrambled downlink channel containing a pseudo-random bit sequence (PRBS). There are several different channels that may carry the T1 signal.

In order to set up the 2305 Stabilock for the T1-based BER test in loop-back mode, proceed as follows:

- 1 Connect the TETRA MS as described in [“Connecting the device under test” on page 38](#).
- 2 Set up the generator as described in [“Preparing the measurement” on page 94](#).
- 3 In the Generator/Analyzer Setup menu, push **T1 Loopback MS RX**. The TETRA T1 menu appears.



- 4 Select a signal type in the Downlink Mode field:
TCH 7.2 (the Stabilock transmits four time slots per frame, one containing a typical TCH/7.2 signal, the other slots filled with dummy bursts)
SCH/F (the Stabilock transmits four time slots per frame, one containing a typical control channel; this signal is useful for MER measurements)
BSCH + SCH/HD (the Stabilock transmits four time slots per frame, one containing a BSCH + SCH/HD signal with a PRBS, the other slots filled with dummy bursts)
TCH 2.4 (the Stabilock transmits four time slots per frame, one containing a typical TCH/2.4 signal, the other slots filled with dummy bursts)

Note

The channel combinations, the scrambling and the data payload are as defined in the ETSI specifications for testing (e.g. EN 300 394-1 Annex D.8.4). MCC and MNC are set to 1, overruling the settings in the Generator/Analyzer Setup menu.

- 5 In the MER/BER Samples field, enter the number of frames over which a measurement shall be performed.
- 6 Prepare the TETRA MS for the T1 loopback receiver test. (This procedure depends on the vendor and model of the TETRA radio.) Once the TETRA MS is in loopback mode, the 2305 Stabilock synchronizes onto the signal received from the TETRA MS and displays the receiver measurement results in terms of bit error rate.

NOTE

According to the TETRA specifications (EN 300 394-1), the reference sensitivity performance is defined such that the bit error rate (BER) at a power level of –112 dBm must be below 0.122%.

- 7 When finished, switch the TETRA radio off and on again to clear the test mode and resume normal operation.

Performing Autotests at Mobile Stations

7

This chapter provides task-based instructions for performing Autotests at mobile radios with the 2305 Stabilock. Autotests at mobile radios require the 2331 Autotest Option and the 2333 MS Test Option to be installed.

Topics discussed in this chapter are as follows:

- [“Introduction” on page 108](#)
- [“Setting up an automated mobile station test” on page 109](#)
- [“Performing an automated mobile station test” on page 117](#)
- [“Viewing the results” on page 118](#)

Introduction

The Autotest feature of the 2305 Stabilock allows you to perform an automated overall RF check of the mobile station. There is a test sequence stored in the Stabilock, with certain parameters that can be affected by the user:

- Stored mobile-specific parameters (type of coupling and shuttle position) are stored in the Stabilock and can easily be loaded.
- Network-specific parameters (such as the frequency range being used) are stored in the Stabilock and can be called up.
- A few test parameters can be affected, e.g. if and how the paging sensitivity test is performed.
- The test limits can be changed.

The concept behind the setup and test capabilities is that the same setup parameters are used when testing a particular type of TETRA radio, e.g. you will always use the same test setup (instrument, coupler and RF shielding device, or cable) and use the same frequency channels and network parameters to be tested.

Setting up an automated mobile station test

Managing types of TETRA radios

Before starting an Autotest, the radio frequency (RF) connection between the TETRA mobile station and the 2305 Stabilock should be defined. Also, if the 4914 Antenna Coupler is used then the RF coupling factors should be entered so that the correct factors can be taken into account in the measurement setup and results.

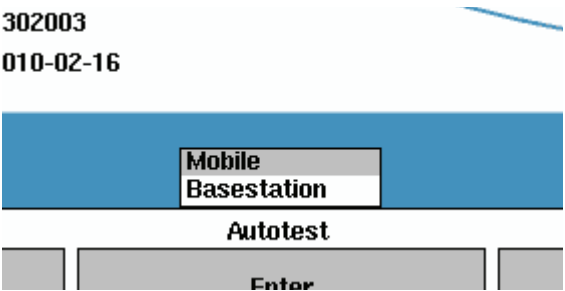
These parameters can be set up either by manually entering the information before each test is started, or they can be stored in an MS Type setup file and easily loaded at the beginning of a test.

Note

In the Autotest MS Type Setup menus described below, there is always an active MS type selected and loaded. Any changes you make to a configuration will be stored immediately with that MS type, i.e. the previous settings will be overwritten without warning.

Loading predefined radio settings

- 1 From the Welcome menu, select **Autotest**.
If both MS and BS testing capabilities are available, confirm **Mobile** in the selection field appearing onscreen.



- 2 Select **Setup**.
The Autotest MS Type Setup menu appears. The top-left input field displays the radio settings file currently loaded.

Autotest MS Type Setup				
Idle				
<div><div><div>MS Type</div><div><div>MS TYPE 182</div><div>MS TYPE 1</div><div>MS TYPE 182</div><div>SEPURA 1</div></div></div><div><div>Type: Coupler</div><div>Antenna Coupler Position X: A</div><div>Y: 1</div><div>Sequence ...</div><div>Channel Setup ...</div><div>Limits ...</div></div></div>				
<div><div>New</div><div>Copy</div><div>Delete</div><div>Sequence</div><div>Channel Setup</div><div>1/2</div><div>Limits</div></div>				

- 3 From the list on the left-hand side, select an entry that corresponds to the type of mobile station to be tested.
The connection type and (if the TETRA is connected through a coupler) the shuttle are displayed on the right-hand side.

Defining the radio settings

This section explains how to set up the radio type-specific parameters before starting an Autotest.

- 1 From the Welcome menu, select **Autotest > Setup**.
The Autotest MS Type Setup menu appears.

Autotest MS Type Setup				
Idle				
<div><div><div>MS Type</div><div><div>MS TYPE 182</div><div>MS TYPE 1</div><div>MS TYPE 182</div><div>SEPURA 1</div></div></div><div><div>Type: Coupler</div><div>Antenna Coupler Position X: A</div><div>Y: 1</div><div>Sequence ...</div><div>Channel Setup ...</div><div>Limits ...</div></div></div>				
<div><div>New</div><div>Copy</div><div>Delete</div><div>Sequence</div><div>Channel Setup</div><div>1/2</div><div>Limits</div></div>				

- 2 In the Type selection field, choose how you connect the TETRA radio to the Stabilock (Cable or Coupler).

- 3 If the TETRA radio is connected through the 4914 Antenna Coupler, you can enter the position of the shuttle on the coupler in the Antenna Coupler Position fields (X and Y).
- 4 In order to enter the coupling factors for transmission and reception, return to the Welcome menu by pressing **ESC** twice, then push **Setup > Definitions**. The coupling factor for the direction from the Stabilock to the TETRA mobile can be entered in the RX field and the factor for the direction from the TETRA mobile to the Stabilock can be entered in the TX field.

Definitions	
Idle	
Pre-Attenuation RF-Analyzer (MS-TX): 0.00 dB RF-Generator (MS-RX): 0.00 dB	External Synchronization Auto. Detect: ON
Paging Sensitivity Paging Sens. Start Level: -70.0 dBm Paging Sens. Step Width: 2.0 dB Paging Sens. Stop Level: -122.0 dBm	High-Power Attenuator RF Level Limits: -40 dBm ... -122 dBm
Measurements Number of Samples: 10 Unit of Powervalue: dBm	
<div style="text-align: right;">System Default</div>	

Note

The Definitions menu can also be called up directly from measurement menus by selecting ... > **Definitions**. By returning from the Definitions menu to the measurement menu, the measurements will be reset and started with the new averaging and pre-attenuation values.

Storing radio settings in a file

The TETRA radio settings can be entered as described above, and stored in a file so that the settings can easily be loaded and used again. The Stabilock stores the connection type, the position of the shuttle and the coupling factors.

- 1 Set the TETRA radio parameters as described in "[Defining the radio settings](#)" above.
- 2 From the Welcome menu, push **Autotest > Setup**.

Autotest MS Type Setup					
Idle					
<div> <div> MS Type <table border="1"> <tr><td>MS TYPE 182</td></tr> <tr><td>MS TYPE 1</td></tr> <tr><td>MS TYPE 182</td></tr> <tr><td>SEPURA 1</td></tr> </table> </div> <div> Type: Coupler Antenna Coupler Position X: A Y: 1 Sequence ... Channel Setup ... Limits ... </div> </div>		MS TYPE 182	MS TYPE 1	MS TYPE 182	SEPURA 1
MS TYPE 182					
MS TYPE 1					
MS TYPE 182					
SEPURA 1					
<div> <div>1/2</div> <div> New Copy Delete Sequence Channel Setup Limits </div> </div>					

- 3 Push the **New** softkey to store the settings.
The Stabilock stores the TETRA radio settings in a file on its internal hard disk. The file name is chosen automatically. The new settings file becomes the active file in the MS Type selection box.

Renaming an MS Type file

It is a good idea to use the type of TETRA radio (and test conditions if there are more than one) as a file name, so that you can easily find the correct setup file for your tests. An MS Type file can be renamed as follows:

- 1 Make the file to be renamed the active file (i.e. select the file name in the file selector box).
The file name appears in the field above.
- 2 Go to the field showing the file name, and enter a new name using the alphanumerical keypad. The file name may include the blank character.
- 3 Close the field by pushing the **ENTER** key.
The new file name is displayed both in the field for the active file and in the file selector box.

Copying an MS Type file

In order to copy a file with TETRA radio settings (rather than storing the currently active settings), select the file in the Autotest MS Type Setup menu, and push the **Copy** softkey.
A copy of the file is stored on the internal hard disk. The file name is chosen automatically. The new settings file becomes the active file in the MS Type selection box.

Deleting an MS Type file

- 1 In the Autotest MS Type Setup menu, select the file that you want to delete.

- 2 Push the **Delete** softkey.
The selected file is deleted. The next file in the list is highlighted, but not loaded.

Sorting MS Type files You want to maintain a certain sequence of MS Type files in the list, e.g. to be able to access the most used file with the least keypresses. In order to change the sequence of files:

- 1 Select the file that you want to move up or down in the list on the right-hand side of the Autotest MS Type Setup menu.
- 2 Push ..., then **Move Up** or **Move Down** to change the position of the file in the list.

Setting up the channels When you define an MS Type configuration, the channels and the network parameters must be defined. These definitions are stored with the MS Type configuration.

You can load an existing channel setup that was previously defined and saved in the Channel Setup menu.

You can define the channel setup for Autotests as follows:

- 1 From the Welcome menu, select **Autotest > Setup > Channel Setup**. The Autotest MS Type Channel Setup menu appears.

		Autotest MS Type Channel Setup	
		Idle	
MS Type Channel Setup (MS TYPE)			
MCCH: 3600		Frequency Band: 300 MHz	
TCH1: ON		Channel Offset: 12.5 kHz	
Channel:	3600 TS: 2	Duplex Spacing: 10 MHz	
RX Pre-Attenuation:	2.00 dB	Operating Mode: Normal	
TX Pre-Attenuation:	2.00 dB		
TCH2: ON		Lowest Channel: 2400	
Channel:	3600 TS: 3	Highest Channel: 3999	
RX Pre-Attenuation:	2.00 dB		
TX Pre-Attenuation:	2.00 dB	MCC: 262	
TCH3: ON		MNC: 1234	
Channel:	3600 TS: 4	BCC: 1	
RX Pre-Attenuation:	2.00 dB	LArea: 1	
TX Pre-Attenuation:	2.00 dB		
Load Channel Setup			

- 2 If you already have a base station and network configuration file from manual mode, select **Load Channel Setup** and select a channel setup file. Otherwise, enter the network and channel parameters on the right-hand side of the menu as described in [“Setting up the network parameters” on page 40](#).

- 3 On the left-hand side of the menu, select a channel number for the MCCH (Main Control Channel) if not given by the channel setup file loaded.
- 4 The menu offers up to three channels to test. You can define on which of the channels a test should be performed (e.g. three channels to test the frequency band at the lower end, in the middle and at the higher end). For each of the three channels:
 - a Specify if the TETRA radio should be tested on the channel by selecting either ON (radio tests will be performed) or OFF (no test will be performed).
 - b Enter the channel number and a time slot to test.
 - c Enter the attenuation for that frequency in the downlink (RX: base station transmit, TETRA radio receive frequency) and in the uplink (TX: base station receive, TETRA radio transmit frequency). The attenuation may be caused by cable loss or radiation over the air, and is frequency-dependent. See [“Connecting the device under test” on page 38](#) for more details.
- 5 Select **ESC** to return to the Autotest MS Type Setup menu.

Changing the test limits

In each test, a number of measurements are performed, averaged and the result is compared with predefined limits. If one result fails the limit, the whole Autotest is failed.

In order to define the limits, proceed as follows:

- 1 From the Welcome menu, select **Autotest > Setup > Limits**. The Autotest MS Type Limits menu appears.

				Autotest MS Type Limits	
				Idle	
MS Type Limits					
		RF Level		Exp. RF Power	
Power Step 2:	OFF	-100.0 dBm	40.00 dBm	+- 2.00 dB	
Power Step 3:	OFF	-90.0 dBm	35.00 dBm	+- 2.50 dB	
Power Step 4:	ON	-95.0 dBm	30.00 dBm	+- 2.00 dB	
Power Step 5:	ON	-75.0 dBm	25.00 dBm	+- 2.50 dB	
Power Step 6:	ON	-70.0 dBm	20.00 dBm	+- 2.50 dB	
Power Step 7:	ON	-40.0 dBm	15.00 dBm	+- 2.50 dB	
		Lower	Upper		
Frequency Error:	-100.00 Hz	100.00 Hz		Paging Sens. <=	-106.0 dBm
RMS Vector Error:	0.00 %	10.00 %			
Peak Vector Error:	0.00 %	30.00 %			
Res. Carrier Power:	0.00 %	5.00 %			
Frame Alignment:	-0.250 sym.	0.250 sym.			
Load RF Power Limits					

- 2 You may want to push the **Load RF Power Limits** softkey to select the power class of the TETRA radio to be tested.
The power step settings are overwritten with typical values, and the power steps not applicable to the selected power class are greyed out.
- 3 For each of the power step values, select the receive RF level, the nominal transmit power level and the limits as described in “[RF Level, Exp. RF Power](#)” on page 49. (Whether or not a power step is tested depends on the appropriate entry in the Autotest MS Type Sequence menu, see “[Affecting the test sequence](#)” on page 115).
- 4 Enter the limit values for the transmitter test parameters (frequency error etc.) and the paging sensitivity as described in “[Setting up test limits](#)” on page 47.
- 5 Select **ESC** to return to the Autotest MS Type Setup menu.

Affecting the test sequence

Some parameters of the standard Autotest sequence can be customised as follows:

- 1 From the Welcome menu, select **Autotest > Setup > Sequence**.
The Autotest MS Type Sequence menu appears.

Autotest MS Type Sequence	
Idle	
Parameters (MS TYPE)	
RF Level:	-70.0 dBm
No. Of Samples For Avg.:	5
Registration to Call Delay:	0 s
Paging Sensitivity:	ON
Paging Sens. Start Level:	-106.0 dBm
Paging Sens. Step Width:	1.0 dB
Paging Sens. Stop Level:	-122.0 dBm
MS Type Channel Setup	
TCH1:	ON
TCH2:	ON
TCH3:	ON
User Definitions	
MS Identity:	OFF
Power Steps	
Power Step Waiting Time:	8 s
Power Step 2:	OFF
Power Step 3:	OFF
Power Step 4:	ON
Power Step 5:	ON
Power Step 6:	ON
Power Step 7:	ON
<div style="text-align: right;">System Default</div>	

- 2 Change any of the parameters if required.
 - a **RF Level** affects the receive power level in the TETRA radio. This power level is applied during the signalling processes, i.e. while setting up or releasing a call, and should be sufficiently high to ensure that the signalling assumes an unknown state.
 - b **No. Of Samples For Avg.** is the number of measurements to be averaged before comparing the result with a test limit.

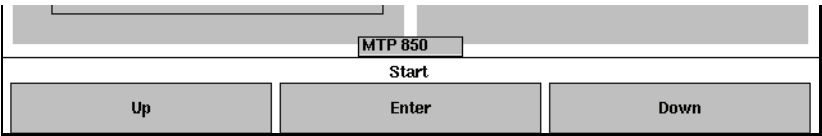
- c **Registration to Call Delay** is the time to delay a call to the TETRA radio after it has been registered. The default is 0 s, but some radios do not accept a call immediately after registration, so they need a few seconds before the Stabilock sets up a call.
 - d **Paging Sensitivity** defines whether this receiver test shall be performed or not. See [“Paging Sensitivity test” on page 79](#) for more details.
 - e **Paging Sens. Start Level** is the receive power level in the TETRA radio at which the paging sensitivity test is started.
 - f **Paging Sens. Step Width** is the interval by which the receive power level is decreased in each test step.
 - g **Paging Sens. Stop Level** defines the lowest receive power level at which the paging sensitivity test is performed (unless the radio fails the test at a higher level).
 - h **Paging Sens. Retries** specifies how often the TETRA radio is paged on any power level step before the test is failed.
 - i **TCH1** through **TCH3** define whether these channels are tested in the Autotest. The channel number for each TCH is defined in the Autotest MS Type Channel Setup menu, see [“Setting up the channels” on page 113](#) for more details.
 - j **MS Identity** specifies if the serial number or inventory number of the TETRA radio shall be recorded for the results log. If set to “ON”, the MS identity will be queried at the beginning of an Autotest. The number (up to 16 characters) can be entered manually using the front panel or an external keyboard, or automatically using a bar code scanner connected to the USB interface.
 - k **Power Step Waiting Time** is the time the 2305 Stabilock waits after changing its output power level until the next power level is performed. Due to the open loop power control procedure, the TETRA radio adapts its transmit power according its receive power level; it may take some time until the TETRA radio changes its transmit power.
 - l **Power Step 2** through **Power Step 7** define if a test at the respective transmit power level step is performed or not. The power level steps and their limits are defined in the Autotest MS Type Limits menu.
- 3 Select **ESC** to return to the Autotest MS Type Setup menu.

Performing an automated mobile station test

- 1 In the Welcome menu, push the **Autotest** softkey. If both the MS and the BS option are installed, a menu appears; select the Mobile option.
The Autotest MS menu appears.



- 2 Push **Start**.
A list of predefined TETRA radio types is shown.

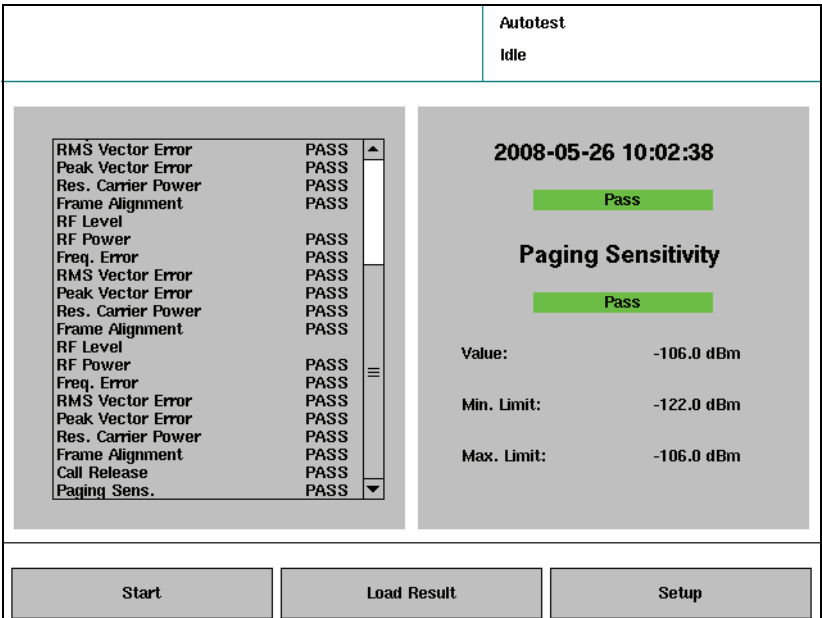


- 3 From the list of TETRA mobile stations, select the type that is equivalent to the TETRA radio that you want to test.
The test is started. The left-hand side of the menu displays the test progress while the right-hand side displays the result.
- 4 To abort a running test, press the **ESC** key. Otherwise, once the test is completed, the final results will be displayed on the right-hand side. The results will be stored (see [“Selecting the file location for screenshots and Autotest results” on page 28](#)) and can be viewed in detail as explained in [“Viewing the results” on page 118](#).
- 5 To start a new test, continue with [step 2](#).

Viewing the results

The results of a test can be checked in detail either immediately after the test or later on.

- 1 If the results are not already being displayed, push the **Load Result** softkey of the Autotest menu.
The 2305 Stabilock displays a list of Autotest results stored in the current Autotest save folder (see [“Selecting the file location for screenshots and Autotest results”](#) on page 28).
- 2 Select an Autotest results log file and push the **Enter** softkey.
The short-form results are displayed on the left-hand side of the display (progress section). The right-hand side (details section) shows the date and time of the test, the overall result, the name of the test or test step, the measurement result and the upper and lower limits (if applicable, otherwise the progress details are displayed).



- 3 In the progress section, highlight a short-form result or test step.
Details regarding the short-form result or test step are shown in the details section.

Autotest
Idle

RMS Vector Error	PASS
Peak Vector Error	PASS
Res. Carrier Power	PASS
Frame Alignment	PASS
RF Level	
RF Power	PASS
Freq. Error	PASS
RMS Vector Error	PASS
Peak Vector Error	PASS
Res. Carrier Power	PASS
Frame Alignment	PASS
RF Level	
RF Power	PASS
Freq. Error	PASS
RMS Vector Error	PASS
Peak Vector Error	PASS
Res. Carrier Power	PASS
Frame Alignment	PASS
Call Release	PASS
Paging Sens.	PASS

2008-05-26 10:02:38

Pass

Freq. Error

Pass

Value: -13.48 Hz

Min. Limit: -100.00 Hz

Max. Limit: 100.00 Hz

Start

Load Result

Setup

Autotest
Idle

RMS Vector Error	PASS
Peak Vector Error	PASS
Res. Carrier Power	PASS
Frame Alignment	PASS
RF Level	
RF Power	PASS
Freq. Error	PASS
RMS Vector Error	PASS
Peak Vector Error	PASS
Res. Carrier Power	PASS
Frame Alignment	PASS
RF Level	
RF Power	PASS
Freq. Error	PASS
RMS Vector Error	PASS
Peak Vector Error	PASS
Res. Carrier Power	PASS
Frame Alignment	PASS
Call Release	PASS
Paging Sens.	PASS

2008-05-26 10:02:38

Pass

Parameter

RF Level: -40.0 dBm

Start

Load Result

Setup

4 Press **ESC** to return to the Welcome menu.

Instrument Setup and General Operation for BS Testing

8

This chapter describes how the instrument and measurement parameters are set up for tests and measurements at TETRA base stations. Testing base stations with the 2305 requires the 2332 TETRA Base Station Test Option to be installed.

Topics discussed in this chapter are as follows:

- [“Connecting the device under test” on page 122](#)
- [“Setting up the network parameters” on page 124](#)
- [“Starting a measurement” on page 128](#)
- [“Setting up test limits” on page 129](#)

Connecting the device under test

General observations There are two ways of connecting the 2305 Stabilock with the TETRA base station: either with a joint cable for input and output signals or with separate cables. This depends on the base station having connectors for a joint or for separate receive/transmit antennas.

Connecting with the single-antenna base station

- 1 Use a double-shielded RF cable with an N-type connector at one end and the appropriate connector for the TETRA BS under test at the other end.
- 2 Plug the N-type connector into the N-type jack **RF1 IN/OUT** at the 2305 Stabilock.
- 3 Plug the other end of the cable into the RF jack of the BS.
- 4 In the **TETRA BS** setup menu, make sure that RF Port is set to RF1.
- 5 In the **Setup > Definitions** menu, ensure that the RF pre-attenuation is properly set. If you do not know the exact attenuation of the cable, set both the RX Pre-Attenuation and the TX Pre-Attenuation to 0 dB.

Note

The Definitions menu can also be called up directly from measurement menus by selecting ... > **Definitions**. By returning from the Definitions menu to the measurement menu, the measurements will be reset and started with the new averaging and pre-attenuation values.

Connecting with the multi-antenna base station

- 1 Ensure that you have double-shielded RF cables with an N-type connector at one end and the appropriate connector for the TETRA BS under test at the other end.
- 2 Screw the first cable to the transmitter output of the base station (TX) and connect the other end to the N-type jack **RF1 IN/OUT** at the 2305 Stabilock.
- 3 Screw the second cable to the (first) receiver input (RX) at the base station and connect the other end of the cable with the RF2 Out jack at the 2305 Stabilock.
- 4 In the **TETRA BS** setup menu, make sure that RF Port is set to RF2.
- 5 In the **Setup > Definitions** menu, ensure that the RF pre-attenuation is properly set. If you do not know the exact attenuation of the cable, set both the RX Pre-Attenuation and the TX Pre-Attenuation to 0 dB.

Preparing for hardware synchronization

The 2305 Stabilock can synchronize in time with the base station either over the RF or using a synchronization signal provided by the base station; this should be a TTL pulse then, indicating the start of either a frame or a multiframe.

For hardware synchronization, use a cable with a BNC connector at one end to connect that end with the Trigger In/Out plug at the 2305 Stabilock, with the appropriate plug at the other end to connect it to the respective base station jack.

Hardware synchronization with an external trigger signal must also be activated in the menus of the 2305 Stabilock. Please refer to [“Synchronization” on page 126](#) and [“Using the TRIGGER IN/OUT connector” on page 24](#).

Setting up the network parameters

The following parameters should be carefully selected so that the 2305 Stabilock can successfully synchronize with the base station under test. The parameters are all accessible on a single menu:
From the Welcome menu, press the **TETRA BS** softkey to enter the BS Test Setup menu.

BS Test Setup	
Idle	
RF Port/Level:	RF2 -110.0 dBm
Gen. Channel:	3600 400.00000 MHz
Ana. Channel:	390.00000 MHz
Channel Mode:	ON
Base Station:	User Defined
Bit Sequence Mode:	PRBS
Uplink Mode:	TCH 7.2
Test Signal:	T1 (EN 300394)
Synchronization:	RF Signal
Downlink Mode:	Detected
Channel System:	User Defined
Frequency Band:	300 MHz
Channel Offset:	0 kHz
Duplex Spacing:	10.00000 MHz
Operating Mode:	Reverse
Lowest Channel:	2000
Highest Channel:	4095

Start

Select Channel System

RF Port/Level The RF Port field determines whether the 2305 uses separate plugs for its input and output signals, or if it uses a common plug. If set to RF1 then a common port, **RF1 IN/OUT**, is used; if set to RF2 then separate ports are used and the output signal of the 2305 is provided at the **RF2 IN** port.

In the next input field, you can set the power level that the 2305 Stabilock transmits to the base station under test. Valid entries are in the range from –122 to –40 dBm for **RF1 IN/OUT** and –122 to 0 dBm for **RF2 OUT** if no pre-attenuation is set (see [“Connecting the device under test” on page 122](#)).

NOTE
TETRA base stations typically receive signals above –108 dBm well.

Gen. Channel This is the (channel number and) frequency (in megahertz) of the RF channel to be tested. The channel number appears only if Channel Mode is set to ON. See [Appendix A section “Calculating channel numbers and frequencies” on page 178](#) for the proper selection of channels and frequencies.
If you change the TX Channel number or frequency, this will automatically affect the RX Channel frequency because the two are related (see

Duplex Spacing).

The range for valid entries may be restricted by the Lowest Channel and Highest Channels on the right-hand side of the menu.

If you change the channel number (on the left-hand side), the change will automatically be translated into the associated new frequency (on the right-hand side), and vice versa. The 2305 Stabilock uses the channel parameters on the right (frequency band, channel offset, duplex spacing) to calculate channel numbers and frequencies.

Ana. Channel	<p>This is the frequency (in megahertz) of the channel that the 2305 Stabilock is transmitting. See Appendix A section “Calculating channel numbers and frequencies” on page 178 for the proper selection of channels and frequencies. The range for valid entries may be restricted by the Lowest Channel and Highest Channels on the right-hand side of the menu.</p> <p>If you change the RX Channel frequency, this will automatically affect the TX Channel number and frequency because the two are related (see Duplex Spacing).</p>
Channel Mode	<p>If set to ON, the channel number field is displayed and channel numbers can be entered directly; the corresponding TX and RX frequencies are calculated from the frequency band, channel offset and duplex spacing entries.</p> <p>With Channel Mode set to ON, frequency entries will automatically be checked and corrected to fit into the selected channel scheme.</p>
Base Station Type	This field cannot be modified in this firmware version.
Bit Sequence Mode	This field cannot be modified in this firmware version.
Uplink Mode	<p>This field determines the channel simulated by the 2305 Stabilock. Valid entries are:</p> <ul style="list-style-type: none"> TCH 7.2 SCH/F STCH + STCH TCH 2.4 SCH/HU + SCH/HU <p>For an explanation of these channels, please refer to the “Glossary” on page 221.</p>

Test Signal This field defines which test signal should be expected from the base station. This can be either a T1 signal according to EN 300 394 (with synchronization information in Frame 18) or a modified T1 signal with no specific Frame 18.

Synchronization This selection field determines the method for synchronization of the 2305 Stabilock with the base station.
 If RF Signal is selected then the Stabilock will synchronize with the signal on the RF link. The scrambling parameters (MCC, MNC, BCC) to be used in the uplink are derived from the downlink signal.
 If Ext. Trigger is selected then the Stabilock will use an input signal on the **TRIGGER IN/OUT** plug on the rear to synchronize with the base station signal. Additional parameters (trigger signal, slope, delay) should be entered. – The scrambling parameters (MCC, MNC, BCC) to be used in the uplink must be entered on the right-hand side of the menu. – See also [“Preparing for hardware synchronization” on page 123](#) for more details.

Downlink Mode This field is visible only if RF Signal synchronization has been selected.

Downlink Mode:	TCH 7.2
Test Signal:	T1 (EN 300394)
Synchronization:	RF Signal
Downlink Mode:	Detected

Start	Select Channel System	
-------	-----------------------	--

In this field you can select the type of downlink channel that the 2305 Stabilock should use to synchronize with the base station. Select from the following list:

- TCH 7.2 (for RF channels carrying no Main Control Channel)
- SCH/F (for RF channels carrying the Main Control Channel)
- STCH + STCH
- TCH 2.4
- SCH/HD + SCH/HD
- T1 Protocol (for base stations in T1 Test Mode)
- Detected (select this if you are unsure; may, however, produce unreliable results in a few cases)

For an explanation of the channels, please refer to the [“Glossary” on page 221](#).

Signal This field is visible only if Ext. Trigger is selected as the synchronization method.

Test Signal:		T1 (18 frames)	MCC:	100
			MNC:	200
Synchronization:		Ext. Trigger	BCC:	1
Signal:		Multiframe		
Slope:		Positive		
Delay:		0 sym.		

Start
Select Channel System

In this field, you should indicate if the trigger signal occurs at the beginning of every new downlink frame (ie. every 56.67 ms) or every multi-frame (1.02 s).

Slope This field is visible only if Ext. Trigger is selected as the synchronization method. – In this field, you can select the slope of the trigger signal, ie. if the level changes up (positive) or down (negative) at the beginning of the frame or multiframe.

Delay This field is visible only if Ext. Trigger is selected as the synchronization method. – In this field, you can enter the delay of the trigger signal relative to the start of the downlink frame or multiframe, in symbols. Valid entries are in the range from –1020 to +1020 symbol periods, thus covering ± 1 frame.

Channel System Push the **Select Channel System** softkey to select a different (predefined) parameter set or to edit the parameters in the user-defined mode.

Note

If a predefined set of parameters is selected, the individual parameters cannot be changed. You can, however, change to user-defined settings; the current settings (from the predefined parameter set) remain on the screen and can be edited.

Frequency Band The frequency band is a multiple of 100 MHz specifying the frequency range in which the base station operates. One of the following values can be selected from a list: 300 MHz, 400 MHz, 800 MHz, 900 MHz.

Channel Offset The channel offset is the offset of the carrier frequency relative to a multiple of 25 kHz. One of the following values can be chosen from a list: 0 kHz, 12.5 kHz, +6.25 kHz, –6.25 kHz.

Ensure that the correct channel offset is selected. If the Stabilock is not set to the same channel offset as the base station, the 2305 Stabilock might not be able to synchronize with the BS.

Duplex Spacing The duplex spacing is the difference between the downlink (base station transmit) frequency and the uplink (mobile station transmit) frequency. By default, you can select from the following list: 0 MHz, 10 MHz, 45 MHz. Most networks transmitting in the 300 and 400 MHz range are applying a duplex spacing of 10 MHz while networks operating in the 800 and 900 MHz bands typically apply 45 MHz duplex spacing.
You can extend the list of available duplex spacing values; please see section [“Setting up new duplex spacing entries” on page 17](#).

Operating Mode Select **Normal** if the base station transmits at the higher frequency. Otherwise, if the base station transmits in the lower band, select **Reverse**.

Lowest Channel In this input field you can enter the lowest channel number that the BS supports. This helps to ensure that only valid TX channel numbers are entered.

Note

When a new channel setup is loaded (as shown in [“Working with channel setups” on page 15](#)), the lowest and the highest channel are reset for the maximum possible range.

Highest Channel In this input field you can enter the highest channel number that the TETRA BS supports. This helps to ensure that only valid TX channel numbers are entered.

Starting a measurement

Measurements are started by selecting **TETRA BS > Start**. Please see more about the measurements in [Chapter 9](#).

Setting up test limits

The 2305 Stabilock indicates when a test result exceeds the limit. By default, the limits programmed into the Stabilock are those defined in the TETRA specifications. You may, however, want to change the limits e.g. to take the measurement uncertainty or sharper, manufacturer-defined limits into account.

The BS Test Limits menu can be accessed from the Welcome menu by pressing **TETRA BS > Start > ... > Limits** or by selecting **Setup > Limits > BS Limits**.

BS Test Limits				
Generator/Analyzer				
BS - Limits				
	Lower	Upper	Power Class	Exp. RF Power
Frequency Error:	-100.00 Hz	100.00 Hz	2 (25W)	44.00 dBm +- 2.00 dB
RMS Vector Error:	0.00 %	10.00 %		
Peak Vector Error:	0.00 %	30.00 %		
Res. Carrier Power:	0.00 %	5.00 %		
BER:	<= -110.0 dBm	1.00 %		
MER:	<= -112.0 dBm	0.00 %		
				System Default

Frequency Error The frequency error is measured relative to the internal frequency base of the Stabilock. The accuracy can be improved by using an external time and frequency reference; please refer to [“Using an external time base” on page 24](#) for connecting it.

An upper and a lower limit can be defined here. The ETSI standard defines a tolerance range of ± 0.2 ppm up to 520 MHz, and ± 0.1 ppm above 520 MHz; this equates to a range of better than ± 100 Hz.

RMS Vector Error The vector error is a measure of the modulation quality; only an upper limit can be defined here because the RMS vector error is an absolute value (the lowest value possible is 0%). The ETSI limit is 10%; see [page 140](#) for more details.

Peak Vector Error The peak vector error is the maximum vector error within a burst. The ETSI limit for the peak value is 30%; see [page 140](#) for more details.

Res. Carrier Power The residual carrier power (residual carrier magnitude) is another measure of the modulation quality. The minimum value is 0; the maximum allowable value can be entered here. ETSI defines a limit of 5%; see [page 141](#) for more details.

BER The two input fields allow you to enter the maximum power level and the corresponding bit error rate (BER) in the T1 loopback test. The BER must not be exceeded at power levels above the given value.

MER The two input fields allow you to enter the maximum power level and the corresponding message erasure rate (MER) in the T1 loopback test. The MER must not be exceeded at power levels above the given value.

Power Class Set up the power class of the base station before entering the applicable power limits. This is necessary e.g. because there are typically narrower limits at the highest power level. ETSI defines a tolerance of ± 2 dB. See section [“Power levels for TETRA base stations” on page 183](#) for more details.

Select **User defined** to be able to enter a new power class with its own nominal output power.

Upper	Power Class	Exp. l
0.00 Hz	User Defined	44.00 dB
0.00 %	1 (40W)	
0.00 %	2 (25W)	
0.00 %	3 (15W)	
5.00 %	4 (10W)	
	5 (6.3W)	
	6 (4W)	
1.00 %	7 (2.5W)	
0.00 %	8 (1.6W)	
	9 (1W)	
	10 (0.6W)	

Power Class, Exp. RF Power The BS Test Limits menu displays a table of the nominal output power values (in the middle column) with associated power limits (right-hand column).

Power Class	Exp. RF Power
2 (25W)	44.00 dBm +- 2.00 dB

In the column on the right-hand side, you can adjust the symmetric power tolerance for each of the nominal power level steps.

Example: If you set the tolerance range for the nominal power of 38 dBm to ± 2.5 dB, a measurement value of 35.5 dB will be within the limits, but 35.4 dB will be out of tolerance.

Performing Base Station Tests and Measurements

9

This chapter provides task-based instructions for using the 2305 Stabilock features for the 2332 TETRA Base Station Test Option. Topics discussed in this chapter are as follows:

- [“Introduction” on page 134](#)
- [“Deriving base station information from the downlink signal” on page 134](#)
- [“Performing transmitter tests” on page 135](#)
 - [“Starting and stopping the measurements” on page 135](#)
 - [“Measuring the transmit power” on page 138](#)
 - [“Measuring the frequency error” on page 139](#)
 - [“Measuring the modulation error \(vector error\)” on page 140](#)
 - [“Measuring the residual carrier power” on page 141](#)
 - [“Viewing the modulation error in the constellation diagram” on page 141](#)
 - [“Viewing the modulation spectrum” on page 143](#)
- [“Performing receiver tests” on page 144](#)
 - [“Receiver measurements in TETRA” on page 144](#)
 - [“Loopback bit error rate measurements” on page 144](#)
 - [“Single-ended bit error rate measurements” on page 145](#)
 - [“Preparing and starting a receiver measurement” on page 145](#)
 - [“Reading results” on page 147](#)

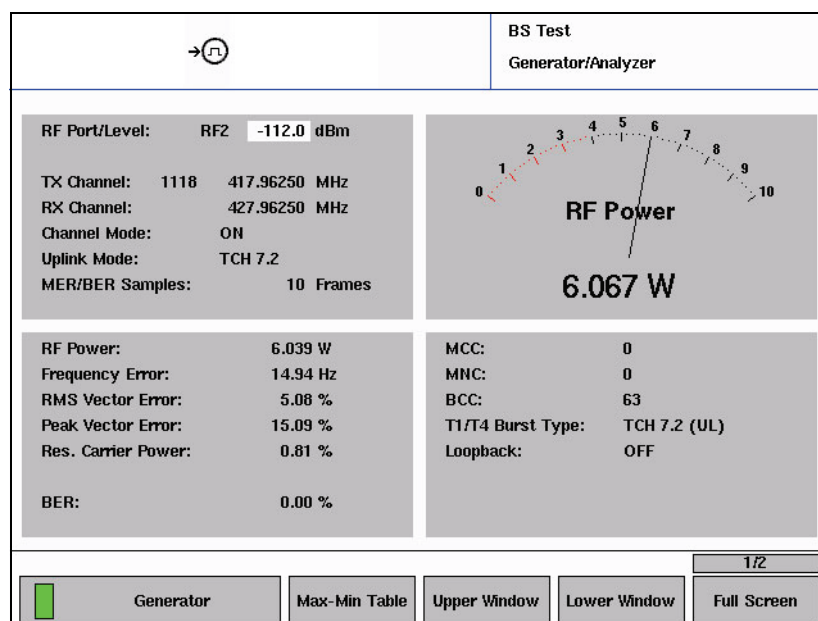
Introduction

This chapter shows how to perform measurements and read the results. The base station should be connected and the 2305 Stabilock should be set up as explained in [Chapter 8](#).

Deriving base station information from the downlink signal

Sometimes it is necessary to know base station parameters like MCC, MNC and BCC, e.g. to set up the scrambling parameters of the Stabilock. These can be found as follows:

- 1 Connect and start up the TETRA BS (see [page 122](#)).
- 2 Initialize the 2305 Stabilock and select **BS Test > Start**.
The BS Test menu appears.
The Stabilock searches for a TETRA RF signal and, once it has found it, displays measurement results.
- 3 Select **Lower Windows > BS T1 Information**.
The lower right part of the menu displays the MCC, MNC, BCC, burst type and the loopback flag of the downlink channel that the 2305 Stabilock is synchronized to.



You can return to the BS Test Setup menu with the **Esc** key.

Performing transmitter tests

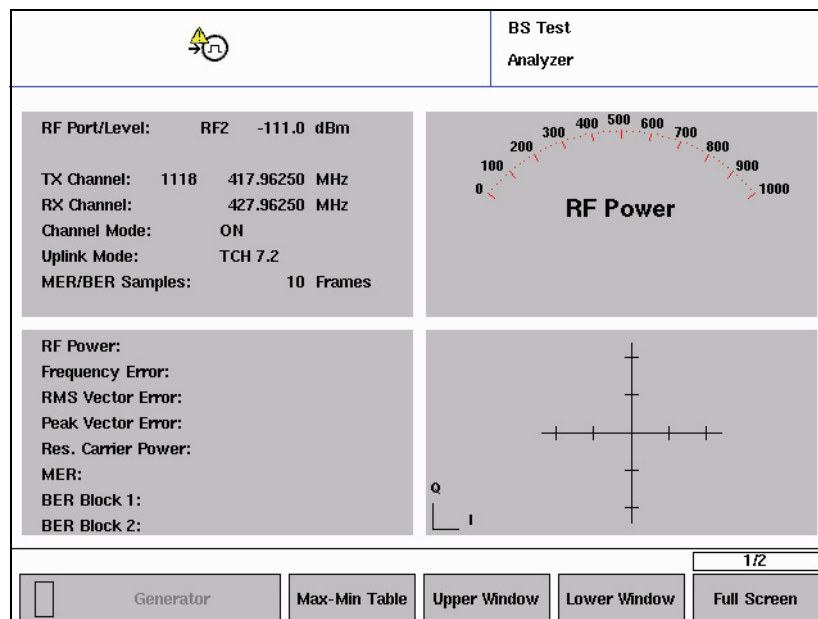
Starting and stopping the measurements

To start the measurements, proceed as follows:

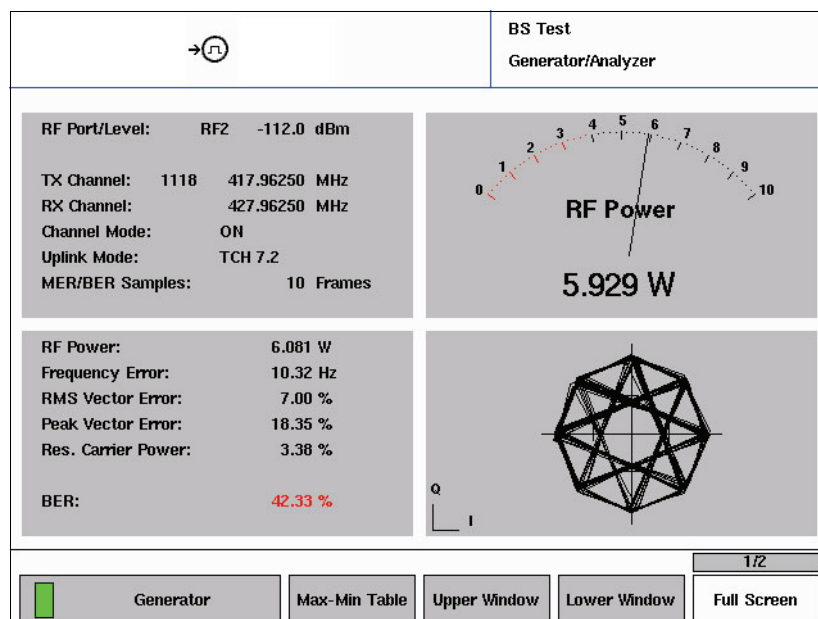
- 1 Connect and start up the TETRA BS (see [page 122](#)).
- 2 From the Welcome menu, push the **TETRA BS** softkey. The BS Test Setup menu appears.

BS Test Setup	
Idle	
RF Port/Level:	RF2 -110.0 dBm
Channel System:	User Defined
Gen. Channel: 3600	400.00000 MHz
Frequency Band:	300 MHz
Ana. Channel:	390.00000 MHz
Channel Offset:	0 kHz
Channel Mode:	ON
Duplex Spacing:	10.00000 MHz
Operating Mode:	Reverse
Base Station:	User Defined
Lowest Channel:	2000
Bit Sequence Mode:	PRBS
Highest Channel:	4095
Uplink Mode:	TCH 7.2
Test Signal:	T1 (EN 300394)
Synchronization:	RF Signal
Downlink Mode:	Detected
<div> <div>Start</div> <div>Select Channel System</div> </div>	

- 3 Select the channel parameters for the base station under test. These are the TX and RX channels on the left-hand side, and the frequency band, channel offset, duplex spacing and operating mode on the right-hand side of the menu. If you are testing base stations for different networks, you can easily preset the parameters on the right-hand side for the respective network by selecting a channel system. Please refer to [“Setting up the network parameters” on page 124](#) for an explanation of these parameters.
- 4 Select the logical channel to test (Uplink Mode) and the frame structure in test mode that is supported by the base station (Test Signal). Please refer to [page 125](#) for these parameters.
- 5 Choose the synchronization method and associated parameters (Synchronization and Downlink Mode field, see [page 126](#)).
- 6 Push the **Start** softkey.
The BS Test menu appears. The synchronization symbol in the top-left corner of the menu shows that the Stabilock is not synchronized with the base station. The 2305 Stabilock now starts to synchronize with the base station.



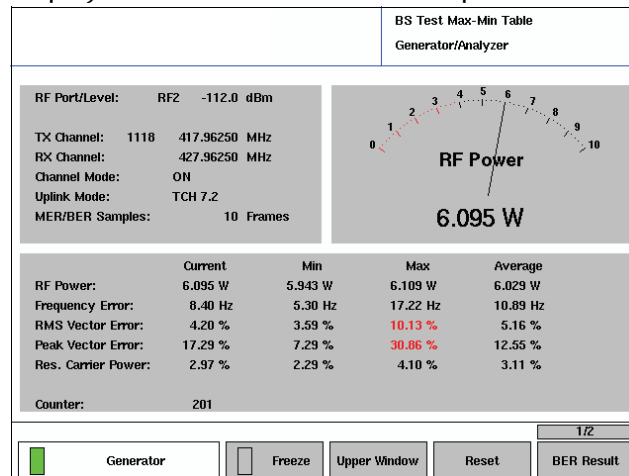
Once the 2305 Stabilock is synchronized with the base station, the synchronization symbol in the top-left corner changes, and the transmitter measurements are started.



The following sections provide more details about the measurements and how to set up the display for different views of the results.

When you are finished with measurements you can stop them by returning to the BS Test Setup menu with the **Esc** key.

Using the softkeys, results can be configured to be displayed in the upper or lower right of the display, on the full screen or in a statistic display in the lower half (see example below).



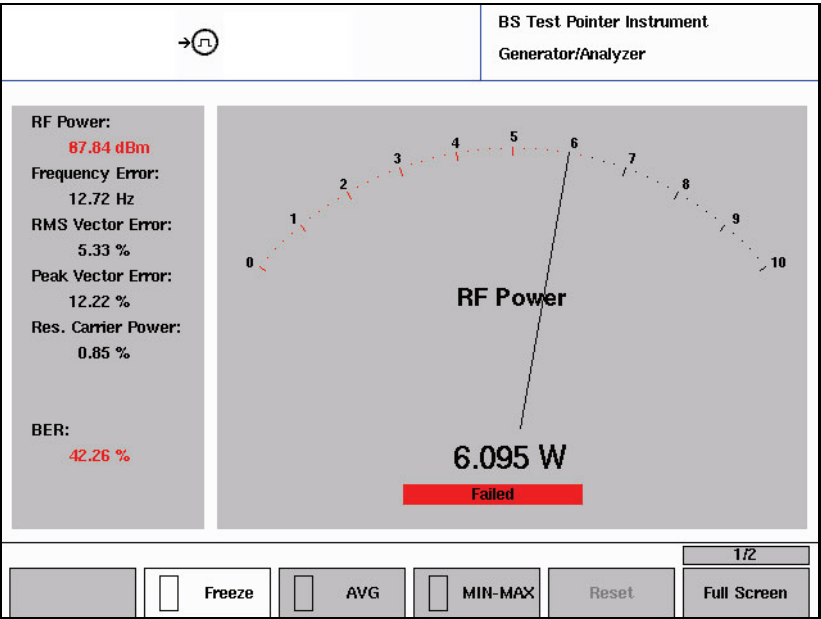
Measuring the transmit power

This measurement relates to the average transmit power in the active part of the time slot. Separate measurements relate to the residual carrier power and the burst profile.
The transmit power is averaged over a time slot. See “Power levels for TETRA mobile stations” on page 181 for more information about power control, power levels and tolerances.

In the BS Test menu, the Power value can be found on the left-hand side of the menu. If the result exceeds the limits then the result value appears in red.

You can also configure one of the pointer instruments on the right-hand side to display the power level by pushing the **Upper Window** or **Lower Window** softkey and selecting **Power**.

Alternatively, you can even have the power level graphically displayed in large size by pushing the **Full Screen** softkey and selecting **Power**. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) displayed by pushing the **MIN-MAX** softkey to the on state, i.e. until the green rectangle appears, indicating that the minimum and maximum pointers are switched on.



Measuring the frequency error

The frequency accuracy depends on the oscillator and related circuits.

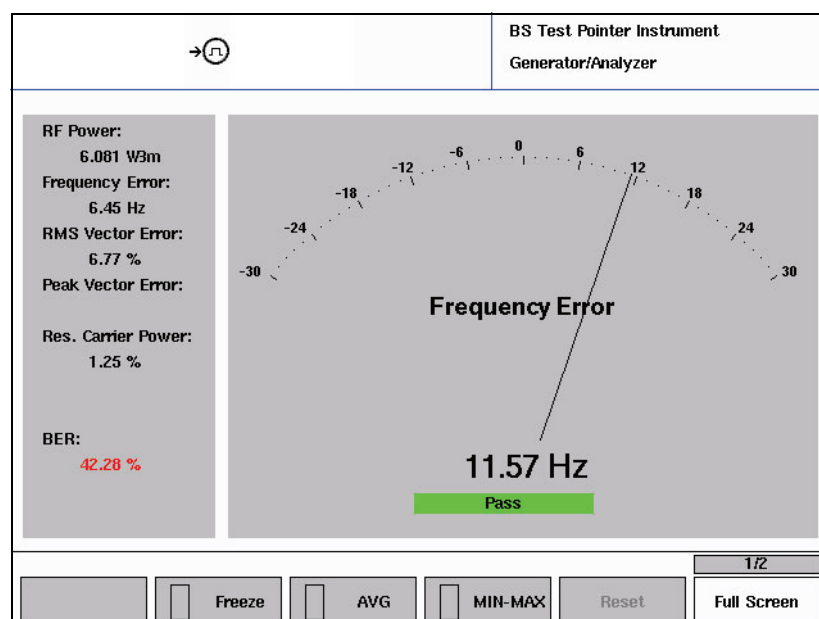
NOTE

According to the TETRA specifications (EN 300 394-1), the frequency error should not exceed 100 Hz.

Read the Frequency Error value on the left-hand side of the menu. If the result exceeds the limits then the value appears in red.

You can also configure one of the pointer instruments on the right-hand side to display the frequency error by pushing the **Upper Window** or **Lower Window** softkey and selecting **Frequency Offset**.

Alternatively, you can even have the frequency error graphically displayed in large size by pushing the **Full Screen** softkey and selecting **Frequency Offset**. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) displayed by pushing the **MIN-MAX** softkey until the function is de-activated (indicated by the green rectangular in the softkey description field disappearing).



Measuring the modulation error (vector error)

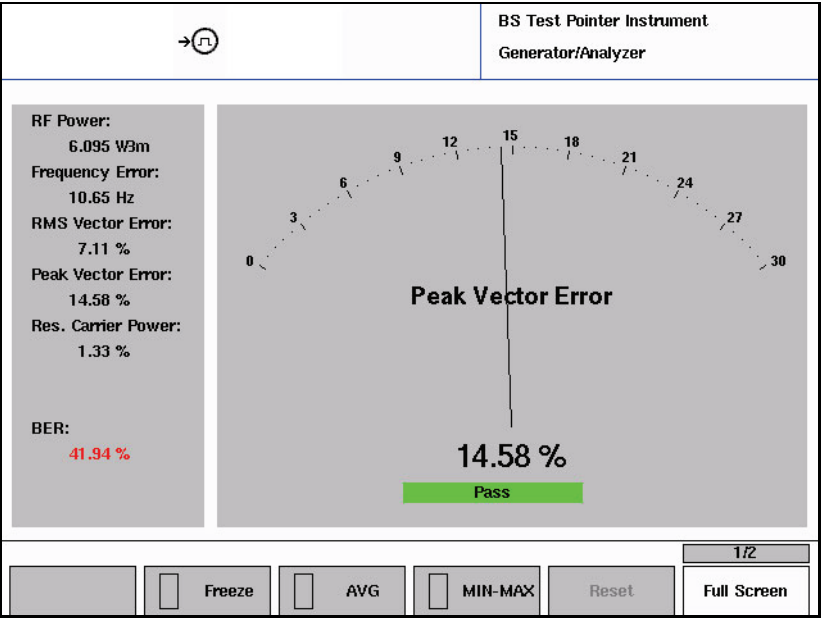
The vector error is a measure of the TETRA base station's modulation quality. The lower the vector error, the better the radio connection will be at low receive levels or under interference conditions. The vector error is calculated for each symbol; the maximum (peak) value over all the symbols of a burst (time slot) is examined as well as the RMS average.

NOTE
According to the TETRA specifications (EN 300 394-1), the RMS vector error should not exceed 10%; the peak vector error should be less than 30%.

Read the RMS Vector Error and the Peak Vector Error values on the left-hand side of the menu. If the result exceeds the limits then the value appears in red.

You can also configure one of the pointer instruments on the right-hand side to display the vector error by pushing the **Upper Window** or **Lower Window** softkey and selecting the corresponding vector error measurement (**RMS Error** or **Peak Error**).

Alternatively, you can even have the vector error graphically displayed in large size by pushing the **Full Screen** softkey and selecting the corresponding vector error measurement. In this mode you can also have the minimum and maximum measurement values (since the start of the measurements) displayed by pushing the **MIN-MAX OFF** softkey.



Measuring the residual carrier power

The residual carrier power is a measure of the TETRA base station's modulation quality and may be caused by DC offsets in the I and Q signal paths. The lower the carrier power, the better the radio connection will be at low receive levels or under interference conditions. The residual carrier power is calculated over all symbols of a burst.

NOTE

According to the TETRA specifications (EN 300 394-1), the residual carrier magnitude should not exceed 5%.

Read the Res. Carrier Power values on the left-hand side of the menu. If the result exceeds the limits then the value appears in red.

Viewing the modulation error in the constellation diagram

The constellation diagram allows you to test the modulation characteristics of the base station. The Stabilock offers fast visual judgement of the modulation quality with the graphical representation of the modulation quality in several configurable ways. The horizontal axis shows the in-phase component (I) of the signal while the vertical axis displays the quadrature component (Q), normalized to the average burst power.

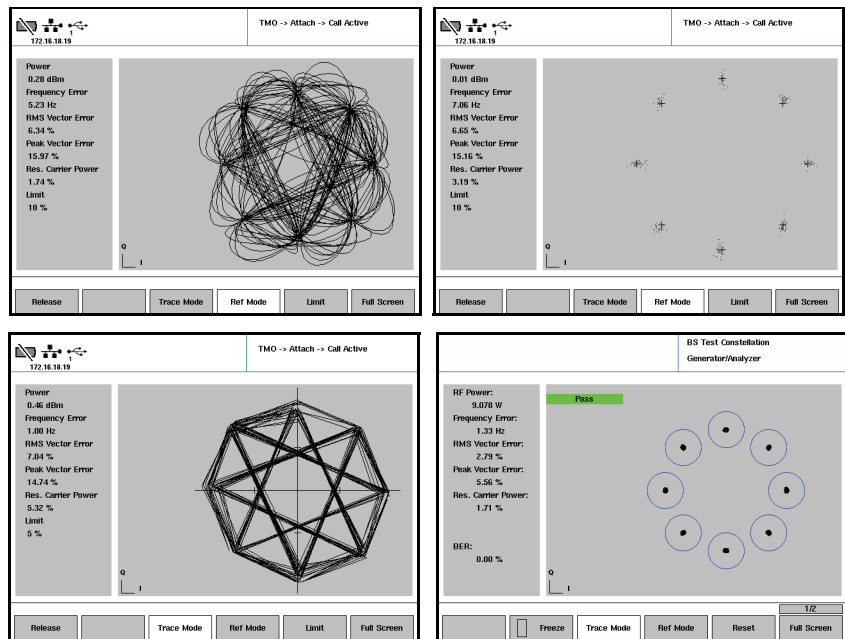
NOTE

Aeroflex offers the constellation display for your convenience, e.g. for modulator alignment; it is not a measurement specified in TETRA specification EN 300 394-1.

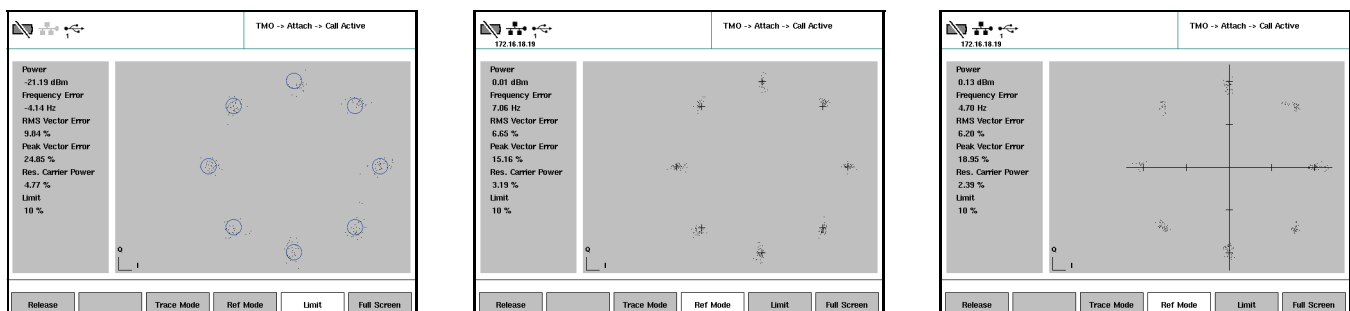
You can configure one of the graphs on the right-hand side to show the constellation display by pushing the **Upper Window** or **Lower Window** softkey and selecting **Constellation**.

You can have the constellation display shown in large size instead by pushing the **Full Screen** softkey and selecting **Constellation**. The display is configurable:

- Push **Trace Mode** and select one of the options (**Phase Tracer**, **Dots**, **Lines**, **Accumulated**) from the pull-down menu.



- Push **Ref Mode** and select one of the options from the pull-down menu: **Ref Circles** for a limit circle around each point of maximum effect, **Ref Lines** for a cross-hair at each point of maximum effect, **Ref Scale** for coordinate axes.



- Push **Limit** and select either **5 %** or **10 %** as the limit for the peak vector error. The selected limit is then shown as a circle while **Ref Circles** is selected.

When you are finished with the full-screen constellation display, return to the BS Test menu by pushing the **ESC** button.

Viewing the modulation spectrum

The modulation spectrum display allows you to assess the TETRA base station's modulation quality in the frequency domain.

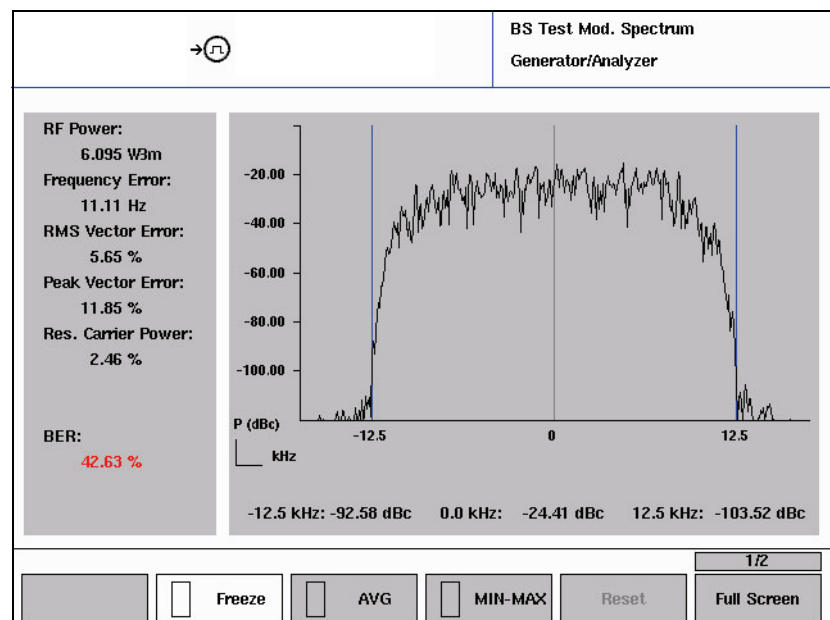
The modulation spectrum is shown in the range ± 18 kHz from the carrier frequency, i.e. the span is 36 kHz.

The horizontal axis shows the frequency in kHz, the vertical axis indicates the power spectrum density. The vertical blue lines indicate the boundaries of the 25 kHz TETRA channel.

You can configure one of the graphs on the right-hand side to show the burst profile by pushing the **Upper Window** or **Lower Window** softkey and selecting **Mod Spectrum**.

You can have the burst profile shown in large size instead by pushing the **Full Screen** softkey and selecting **Mod Spectrum**.

The modulation spectrum is displayed along with the power at the band center and the edges.



When you are finished with the full-screen modulation spectrum display, return to the BS Test menu by pushing the **ESC** button.

Performing receiver tests

This section describes the base station receiver tests and test support functions of the 2305 Stabilock.

Receiver measurements in TETRA

In communication systems with digital modulation of voice and data, the receiver is evaluated by means of bit error rate (BER) or message erasure rate (MER) measurements. The receiver of the unit under test is stimulated with a sequence of pseudo-random bits; ideally the unit under test loops the demodulated and decoded bit stream back and the test instrument counts the wrong bits (relative to the total number of bits sent and received). If the unit under test cannot decode a complete data frame then this is signalled back to the instrument as an erased message, resulting in a message erasure rate to be updated.

The strength of the signal offered to the base station under test can be of medium level, but typically the receiver is tested at very low (or very high) levels.

The receiver measurement can only be performed with the base station (the unit under test) being set to a test mode in which it loops data back (either over a cable or over the RF) even without a call being set up. The instrument simply selects a time slot to send the pseudo-random bit sequence on. The type of logical channel (e.g. traffic channel or signalling channel) must be defined though. Some base stations use the last frame in the multiframe (Frame 18) to exchange other information as on a real channel, others use up all the 18 frames per multiframe to receive and test channel data.

Loopback bit error rate measurements

If the base station loops the data stream received, demodulated and decoded back over the radio interface then the 2305 Stabilock can evaluate the data stream and perform bit error rate and/or message erasure rate measurements, depending on the channel (see list below). The results are indicated on the Stabilock screen.

The TETRA standard defines receiver measurements for different logical channels as shown in [Table 2](#).

Table 2 BS receiver measurements on logical channels

Channel	Measurement type	Notes
TCH (7.2 or 2.4)	BER	
SCH/F	MER	
STCH + STCH	MER	Measurement on two blocks
SCH/HU + SCH/HU	BER, MER	BER measurement on two blocks

Single-ended bit error rate measurements

Some base stations do not return the received signal to the test instrument but instead evaluate the receiver performance directly. They can do this because the test data sent by the instrument is not random but a defined bit sequence. You do need, however, confidence in the base station manufacturer correctly evaluating and displaying the receiver performance for their own base stations.

In case of these single-ended receiver measurements, the 2305 Stabilock cannot display the results. They are typically shown on the computer that is used to set the base station into test mode.

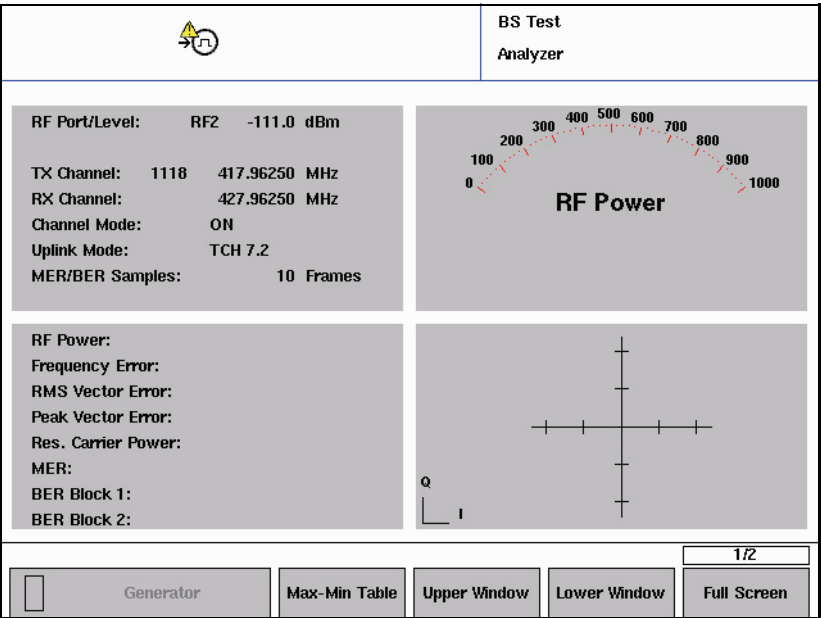
Preparing and starting a receiver measurement

- 1 From the Welcome menu, push the **TETRA BS** softkey. The BS Test Setup menu appears.

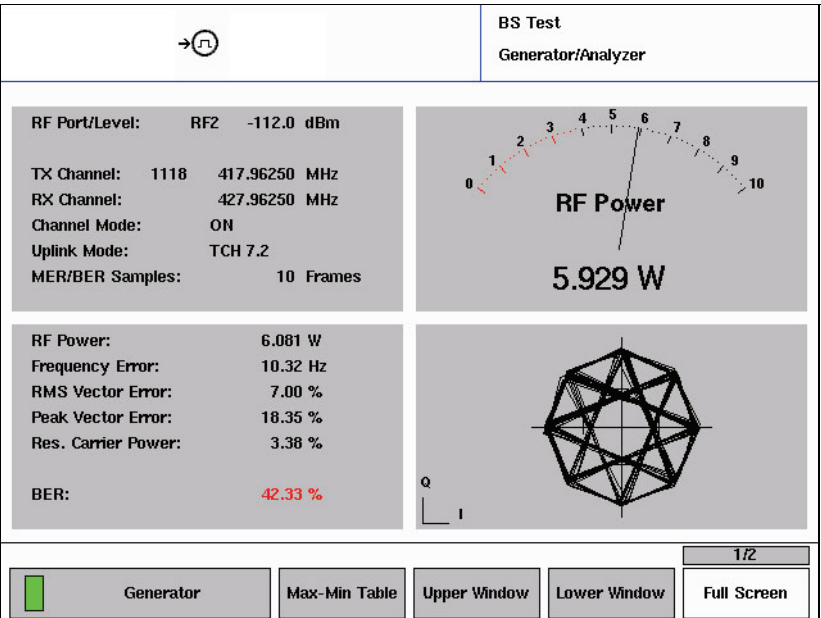
BS Test Setup			
Idle			
RF Port/Level:	RF2	-110.0 dBm	Channel System: User Defined
Gen. Channel:	3600	400.00000 MHz	Frequency Band: 300 MHz
Ana. Channel:		390.00000 MHz	Channel Offset: 0 kHz
Channel Mode:	ON		Duplex Spacing: 10.00000 MHz
			Operating Mode: Reverse
Base Station:	User Defined		
Bit Sequence Mode:	PRBS		
Uplink Mode:	TCH 7.2		
Test Signal:	T1 (EN 300394)		
Synchronization:	RF Signal		
Downlink Mode:	Detected		
		Lowest Channel:	2000
		Highest Channel:	4095
<div> <div>Start</div> <div>Select Channel System</div> </div>			

- 2 Select the channel parameters for the base station under test. These are the TX and RX channels on the left-hand side, and the frequency band, channel offset, duplex spacing and operating mode on the right-hand side of the menu. If you are testing base stations for different networks, you can easily preset the parameters on the right-hand side for the respective network by selecting a channel system. Please refer to [“Setting up the network parameters” on page 124](#) for an explanation of these parameters.
- 3 Select the logical channel to test (Uplink Mode) and the frame structure in test mode that is supported by the base station (Test Signal). Please refer to [page 125](#) for these parameters.
- 4 Choose the synchronization method and associated parameters (Synchronization and related fields, see [page 126](#)). These are
Downlink Mode if RF Signal synchronization is selected.
Signal, Slope, Delay, MCC, MNC, BCC if Ext. Trigger is selected.

- 5 Push the **Start** softkey.
The BS Test menu appears. The synchronization symbol in the top-left corner of the menu shows that the Stabilock is not synchronized with the base station. The 2305 Stabilock now starts to synchronize with the base station.



Once the 2305 Stabilock is synchronized with the base station, the synchronization symbol in the top-left corner changes, and the transmitter measurements are started.



- 6 Select the RF level of the Stabilock and turn the generator on by pushing the **Generator** softkey so that the green field appears on the softkey.
The Stabilock starts transmitting the bit sequence on the selected channel.
If the base station loops back the received data, the corresponding

BER and/or MER is displayed. If the base station does not loop back the data or if it cannot receive a signal from the Stabilock, the BER will be in range of 40 to 60% and the MER will be close to 100%.

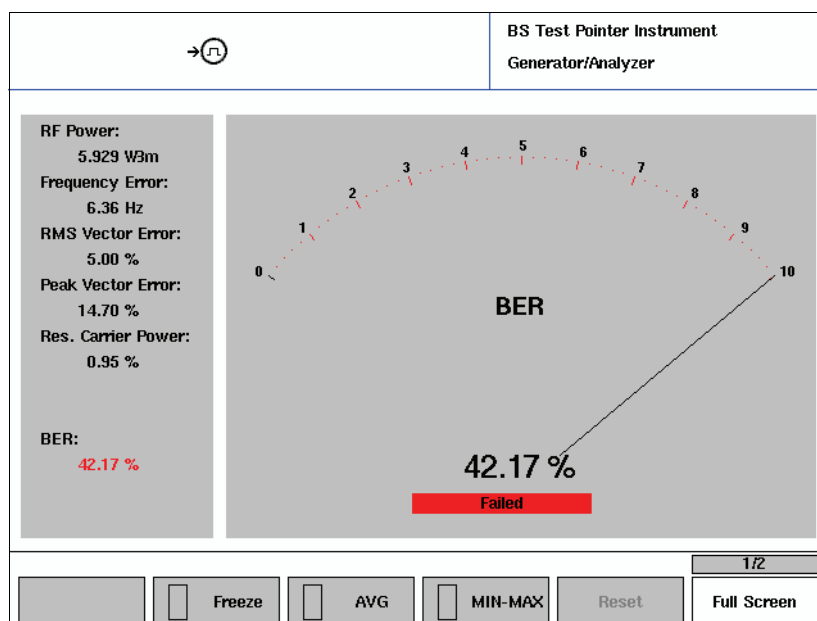
Note

Ensure that the Stabilock's generator is turned on when reading results. The generator is automatically turned off when the synchronization with the base station is lost, but is restarted when the Stabilock is synchronized again.

Reading results

The receiver measurement results are shown on the lower right part of the menu. With a push on the **Lower Window** or **Upper Window** softkey, a pull-up menu appears in which you can configure the menu to display the results graphically on the upper or lower-right of the menu.

Alternatively, the results can be shown graphically in full-screen mode. Select the respective receiver measurement with a push on the **Full Screen** softkey.



Controlling the Base Station

10

This chapter provides task-based instructions for remote control of the base station from the 2305 Stabilock. This feature requires the 2332 TETRA Base Station Option and the 2334 BS Control Option to be installed.

Topics discussed in this chapter are as follows:

- [“Introduction” on page 150](#)
- [“Applying a base station control script” on page 151](#)
- [“Creating and modifying a base station control script” on page 157](#)

Introduction

This chapter explains how base stations can be put under remote control from the 2305 Stabilock for the purposes of testing. This feature is useful for base stations typically requiring a number of commands to be entered manually from a PC over a serial interface (RS-232). The 2334 BS Control Option takes over this task, so you need to operate only one user interface. The option can typically place the base station into a test mode necessary for the measurements; it sets up the respective channels and returns the base station into normal state after testing.

The tests themselves can also be automated; this requires the 2331 Autotest Option additionally. See [Chapter 11 “Performing Autotests at Base Stations”](#) for more information.

Applying a base station control script

Starting a script We are assuming here that the 2305 Stabilock already has one or more base station control scripts installed. If there are not any, please refer to section [“Managing BS control script files” on page 156](#).

- 1 Connect the RF and control cables as explained in [“Connecting the device under test” on page 122](#).
- 2 Connect the RS-232 plugs of the 2305 Stabilock and the base station using an appropriate RS-232 cable.



- 3 In the **Setup > Connections** menu, ensure that **BS Control** is selected in the RS-232 Mode field.

Connection Setup	
Idle	
Ethernet	RS-232
DHCP: ON	Mode: <input type="text" value="SCPI"/> <input type="text" value="BS Control"/>
IP Address: 255.255.255.255	Bit Rate: 115200
Subnet Mask: 255.255.255.255	Bits: 8
Gateway: 255.255.255.255	Parity: NONE
	Stopbits: 1
Remote Control	Remote Control
Port: 49200	Terminator: CR
Terminator: CRLF	
NFS	
Server: 172.16.18.137	
Path: 2303/0002004	

- 4 Press **BS Test**.
The BS Test Setup menu appears.

BS Test Setup	
Idle	
RF Port/Level:	RF2 -110.0 dBm
Channel System:	User Defined
Gen. Channel:	3600 400.00000 MHz
Frequency Band:	300 MHz
Ana. Channel:	390.00000 MHz
Channel Offset:	0 KHz
Channel Mode:	ON
Duplex Spacing:	10.00000 MHz
Operating Mode:	Reverse
Base Station:	User Defined
Bit Sequence Mode:	EADS TB3
Lowest Channel:	2000
Highest Channel:	4095
Uplink Mode:	Motorola EBTBS
Test Signal:	Motorola MTS R52
MCC:	100
MNC:	200
BCC:	1
Synchronization:	Ext. Trigger
Signal:	Frame
Slope:	Positive
Delay:	2 sym.

Start

Select Channel System

- In the Base Station selection field, choose the control script for the respective base station and confirm with **ENTER**.
The setup parameters for that base station type are loaded. These parameters are greyed out and cannot be changed anymore.

BS Test Setup	
Idle	
RF Port/Level:	RF2 -70.0 dBm
Channel System:	User Defined
Gen. Channel:	3691 382.28750 MHz
Frequency Band:	300 MHz
Ana. Channel:	392.28750 MHz
Channel Offset:	12.5 KHz
Channel Mode:	ON
Duplex Spacing:	10.00000 MHz
Operating Mode:	Normal
Base Station Type:	Motorola MTS
Lowest Channel:	2400
Highest Channel:	4095
Bit Sequence Mode:	PRBS
Uplink Mode:	TCH 7.2
Test Signal:	T1 (18 frames)
MCC:	0
MNC:	0
BCC:	1
Synchronization:	Ext. Trigger
Signal:	Frame
Slope:	Positive
Delay:	2 sym.

Start

Select Channel System

- You can now define the remaining parameters, such as the channel system.

- 7 Press **Start**.
The BS Control menu appears.

		BS Control Generator/Analyzer	
BER/MER:		RSSI:	
<div></div>			
RF Port/Level:	RF2	-65.0 dBm	BS Receiver: RX2
MER/BER Samples:	10 Frames	BS Transmitter:	5W
Command:			
Start	BER/MER	Stop	

- 8 Press **Start**.
The test script is started. This typically results in the base station to be restarted in test mode with all the necessary parameters being set up. Messages from the base station control interface are displayed in the onscreen window. When the setup procedure is completed, the Start softkey changes to BS Test.

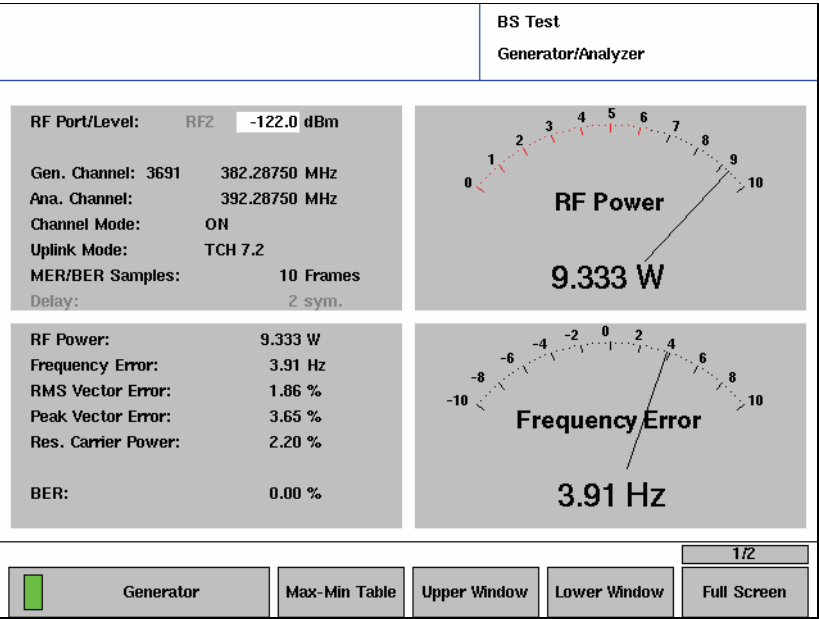
Note
The exact procedure depends on the test script.

Example:

		BS Test BS Control Generator/Analyzer	
BER/MER		0.02 %	
<div>Checking partitions... No partition table found on ramdisk:0 Verifying partition:1 name:ram device:ramdisk unit:0 lo:4 hi:2031 format:hafsfat Creating partition:1 name:ram lo:4 hi:2031 format:hafsfat Mounting volumes... Mounting volume: volume/1 Mounting volume /ramlog format:cifs device:cifs params:type=ram,blocksize=0x4000,size=0x4000 Mounting volume: volume/2 Mounting volume /log format:cifs device:cifs params:type=flash,blocksize=0x20000,size=0x20000 Mounting volume: volume/3 Mounting volume /ram format:hafsfat device:ramdisk params:unit=0,partition=1,quick Formatting volume /ram Checking flash objects... SUCCESS username: Downloading configuration file (brc01.cf.2)... SUCCESS</div>			
RF Port/Level:	RF2	-122.0 dBm	BS Receiver: RX2
MER/BER Samples:	10 Frames	BS Transmitter:	10W
Command:			
Start	BER/MER	Stop	

Starting transmitter
measurements

- 1 Select the required transmitter parameter in the **BS Transmitter** selection field. The available settings (such as transmit power level or transmitter number) are base station dependent.
- 2 Typical transmitter measurements are performed with a push of the **BS Test** softkey.
The BS Test Generator/Analyzer menu is displayed, the measurements are started and the results are displayed on the screen. Some test parameters may be changed onscreen. You can change the display of results using the softkeys available. See [Chapter 9 “Performing Base Station Tests and Measurements”](#) for more details.

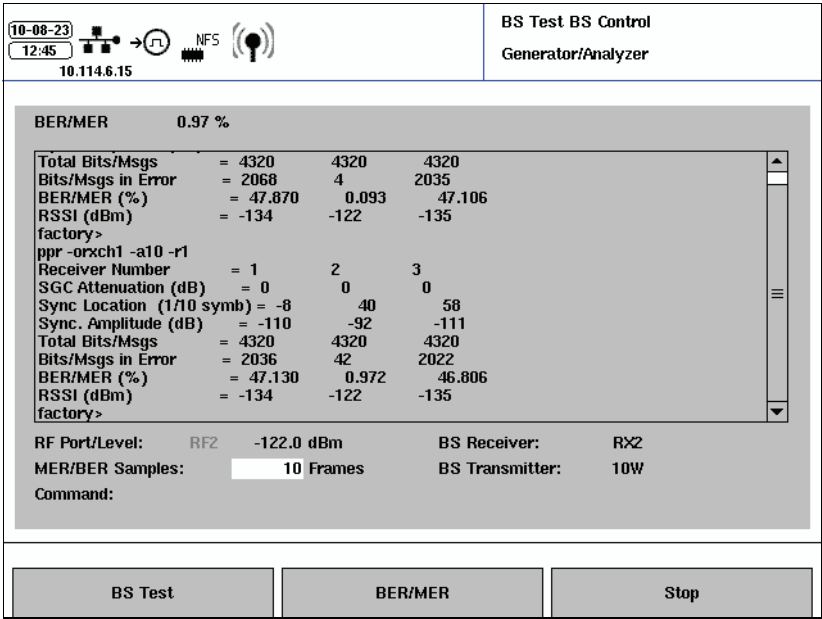


Press **ESC** to return to the BS Control menu.

Starting receiver
measurements

- 1 In the BS Test BS Control menu, select the required receiver parameters in the **BS Receiver** selection field. Depending on the base station type, this can be the number of the receiver or any other parameter.
- 2 Set up the receive power level (Stabilock transmit level) in the **RF Port/Level** field.
- 3 Typical receiver measurements are performed with a push of the **MER/BER** softkey.
Measurements are started and the results are displayed on the screen. Some test parameters may be changed onscreen.

Note
The exact parameters that are displayed and those that can be changed, depend on the test script and the capabilities of the base station.



Press **ESC** to return to the BS Control menu.

Note

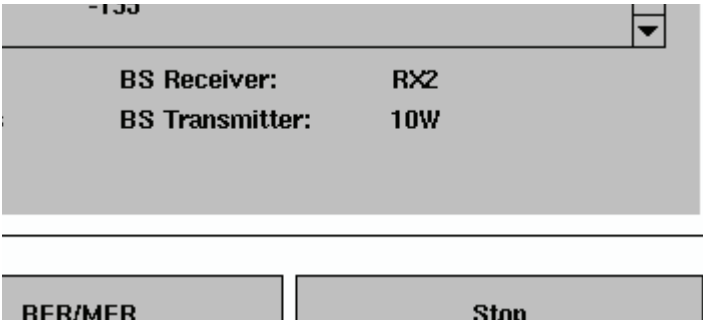
The receiver measurements are not taken by the 2305 Stabilock but by the base station (see also [“Performing receiver tests” on page 144](#)). The Stabilock fetches the results from the base station and displays them on the Stabilock’s screen.

The same applies to the RSSI measurements.

Selecting the base station parameters

You can easily take measurements of the base station transmitter at different power levels; the remote control software in the 2305 Stabilock can change the power level or any other user-selectable parameter.

In the BS Control menu, select the transmit power in the **BS Transmitter** selection field.
The measurements are halted, the base station transmitter is switched to the new power level and the measurements are resumed.



Selecting a base station receiver

If the base station is equipped with more than one receiver, the remote control software in the 2305 Stabilock can change the active receiver of the base station.

- 1 In the BS Control menu, select another transmitter in the **BS Receiver** selection field.
The measurements and the instrument's transmitter are halted, the previous base station receiver is switched off and a pop-up box instructs you to change the cable to the newly selected receiver.
- 2 Connect the newly selected receiver to the appropriate RF connector of the 2305 Stabilock.
- 3 Confirm the message.
The BS receiver is switched on, the instrument resumes transmission and the measurements are restarted.

Switching the base station transmitter off

For setup and other purposes, you can return from the BS Control menu by pressing **ESC**.
The 2305 Stabilock returns to the BS Test Setup menu. The base station is kept in test mode, but the transmitter is switched off.
From the BS Test Setup menu you can return to the BS Control menu by pushing the **Start** softkey; the transmitter will be turned on again.

Returning to normal base station operation

In the BS Control menu, push **Stop** to disable the test mode in the base station.
The base station is typically rebooted and set to normal conditions. The 2305 Stabilock displays the BS Test Setup menu.

Managing BS control script files

Base station control scripts can easily be copied or moved between different storage media. See section [“Managing files on the 2305 Stabilock” on page 31](#) for more information.

The files can be changed on an external computer using a standard text editor. An XML programming editor with syntax checking capability is recommended.

Creating and modifying a base station control script

Introduction You can adapt an existing script file to your requirements or a new base station type. The base station control script is stored in a standard text file on the 2305 Stabilock, and can be copied onto an external PC (see [“Managing files on the 2305 Stabilock” on page 31](#)). Aeroflex recommends making changes on a copy of the original file, applying a new file name so that you can easily revert to the old file if necessary.

File name convention On the 2305 Stabilock, the base station control scripts reside in the Stabilock2300/BSCtrl directory. The file name should always start with “Stabilock2300_”, followed by a name characterizing the base station type. The file name extension should be bsctrl.
Example: Stabilock2300_Motorola_MTS.bsctrl

In the Base Station selection field of the BS Test Setup menu and in the File Manager, only the text between “Stabilock2300_” and “.bsctrl” is displayed. This is “Motorola_MTS” in the example above.

File structure The file can be changed on an external computer using a standard text editor. An XML programming editor with syntax checking capability is recommended.

The script uses an XML-type command description with a structure as shown below.

```
- <Script>
  <!-- Service Terminal -->
  - <Interface>
    <!-- Final Runlevel -->
    - <Runlevel>
      <!-- Final Runlevel command - Initialize BS Testmode -->
      + <Start>
        <!-- Final Runlevel command - Set BS Receiver -->
        + <SetRX>
          <!-- Final Runlevel command - Set BS Transmitter -->
          + <SetTX>
            <!-- Final Runlevel command - BER/MER and RSSI measurement -->
            + <Measurement>
              <!-- Final Runlevel command - Switch off BS Transmitter -->
              + <Halt>
                <!-- Final Runlevel command - Terminate BS Testmode -->
                + <Stop>
              </Runlevel>
            </Interface>
          </Script>
```

The same script can be used in two different modes: In manual mode (also called BS Test mode), the communication between the 2305 Stabilock and the base station is shown on the instrument's screen; in BS Autotest mode, the communication is running in background.

Each mode requires its individual user guidance. Therefore the script may contain definitions of pop-up boxes with hints, along with attributes determining whether or not a box is shown in a particular mode.

User interface and script

For each menu item in the BS Control menu, there is a section (Final Runlevel command) defining the appropriate action to be taken. Table 3 shows how the softkeys and the corresponding Final Runlevel command sections in the script should be used.

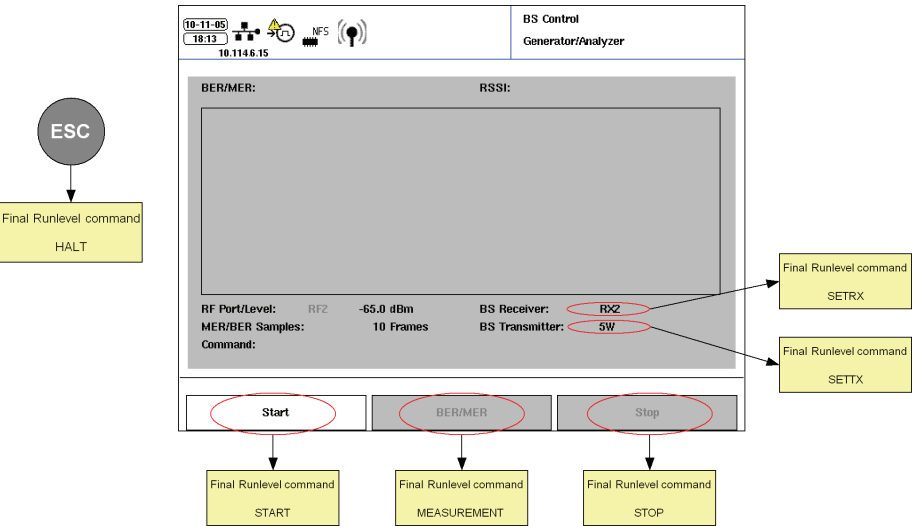


Table 3 Proposed use of the Final Runlevel commands

User interface input (keypress)	Final Runlevel command section	Proposed action
Start softkey	Start	Puts the base station into test mode and initializes it.
BS Test softkey	(no separate action initiated from the script)	The BS Test Generator/Analyzer menu is displayed, providing full access to the transmitter measurements. The MER/BER results are taken from the base station over the RS-232 interface.
MER/BER softkey	Measurement	Starts a single BER or MER and RSSI measurement in the base station and updates the screen with the results.
Input in BS Receiver selection field	SetRX	Changes receiver parameter settings. The receiver settings to be displayed and modified are defined in the script.

Table 3 Proposed use of the Final Runlevel commands

User interface input (keypress)	Final Runlevel command section	Proposed action
Input in BS Transmitter selection field	SetTX	Changes transmitter parameter settings. The transmitter settings to be displayed and modified are defined in the script.
Stop softkey	STOP	The test mode in the base station is terminated (ideally the BS is rebooted and set to normal mode).
esc key	HALT	Switches the base station transmitter off.

Syntax description A detailed description of the script elements can be found in [Appendix C](#).

Performing Autotests at Base Stations

11

This chapter provides task-based instructions for performing BS Autotests with the 2305 Stabilock. Autotests at base stations require the 2331 Autotest Option, the 2332 BS Test Option and the 2334 BS Control Option to be installed.

Topics discussed in this chapter are as follows:

- [“Introduction” on page 162](#)
- [“General concept” on page 162](#)
- [“Setting up an automated base station test” on page 163](#)
- [“Performing a base station test” on page 169](#)
- [“Viewing the results” on page 171](#)

Introduction

The Autotest feature of the 2305 Stabilock allows you to perform an automated overall RF check of the base station. In conjunction with the 2334 TETRA BS Control Option, the Autotest option can perform a number of tasks automatically, thus saving time for the user and making the operation of both the base station and the instrument more fail-safe:

- The base station is placed in test mode, with channel and power parameters automatically being set up and modified.
- Stored test setups are automatically loaded and test sequences executed.
- Measurement results from the Stabilock (transmitter measurements) and from the base station (receiver measurements) are evaluated against defined limits, and an overall Pass or Fail result is presented.

The concept behind the setup and test capabilities is that the same setup parameters and limits are used when testing a particular type of TETRA base station, e.g. you will always use the same test setup (instrument, cables) and use the same frequency channels and network parameters to test with.

General concept

The automated tests at base stations are controlled by an Autotest script which can be adapted to individual needs. This test script not only sets up the test parameters, calls up the measurement routines and evaluates the results. It also uses a base station control script to remotely put the base station into test mode and to set up and change parameters such as the frequencies and the transmit power. The base station control script also defines which parameters are fixed and which ones are user-definable.

There are two basic files that determine how a base station is tested: the BS Type file and the BS control script.

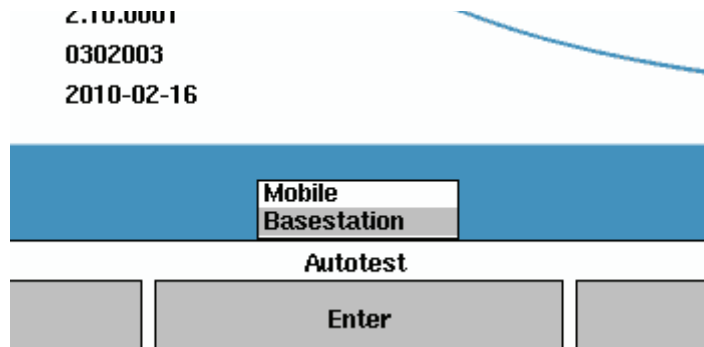
The BS Type file includes the name of the BS control script and all the test parameters that are user-definable.

The BS control script is specific for the type of base station to be tested. In addition, there are a few parameters that can be changed from the 2305 Stabilock's user interface; these include the number of transmitters and receivers, the power levels at which to test, the frequency channel settings and the test limits. These user-definable test parameters can be changed in the Sequence, Channel and Limit menus of the BS Autotest mode.

Setting up an automated base station test

Loading an Autotest parameter file

- 1 From the Welcome menu, select **Autotest**.
 If both the TETRA MS Test Option and the TETRA BS Test Option are installed, a selection field opens; select **Base Station**.



The Autotest BS menu appears.



- 2 Select **Setup**.
 The Autotest BS Type Setup menu appears.

Autotest BS Type Setup	
Idle	
<div><div>BS Type</div><div><div><div>mts (1)</div><div>mts (1)</div><div>ebts</div></div></div><div><div>Base Station: Motorola MTS</div><div>BS Identity: OFF</div><div>Sequence ...</div><div>Channel Setup ...</div><div>Limits ...</div></div></div>	
<div><div>New</div><div>Copy</div><div>Delete</div><div>Sequence</div><div>Channel Setup</div><div>1/2</div><div>Limits</div></div>	

- 3
- In the BS Type field, select a parameter file for the base station type at hand.
The base station control script and the associated parameters are loaded.

Defining the radio and test settings

This section explains how to set up the base station-specific parameters before starting an Autotest.

- 1
- From the Welcome menu, select **Autotest > Setup**.
The Autotest BS Type Setup menu appears.
- 2
- Push the **Sequence** softkey.
The Autotest BS Type Sequence menu appears.

Autotest BS Type Sequence	
Idle	
<div><div>BS Receiver (mts (1))</div><div><div><div>RF Port:</div><div>1. RF Level: -40.0 dBm</div><div>2. RF Level: -80.0 dBm</div><div>3. RF Level: -115.0 dBm</div><div>RSSI: ON</div><div>MER/BER Samples: 10 Frames</div><div>RX1: ON</div><div>RX2: ON</div><div>RX3: ON</div></div><div><div>RF2</div><div>BS Transmitter</div><div>5W ON</div><div>10W ON</div><div>40W ON</div><div>No. Of Samples For Avg.: 5</div><div>Receiver Measurement: 0W</div></div></div></div>	
<div><div></div><div>System Default</div></div>	

3 Check and change the radio and test parameters in the Autotest BS Type Sequence menu:

Note

The menu shows only those parameters that are relevant, as defined in the BS control script.

- a In order to change the base station's receive level during the tests, change the **RF Level** values in the BS Receiver section on the left-hand side.
Receiver tests are often performed at different power levels, e.g. at a high, a medium and a low receive level.
 - b In order to evaluate the RSSI measurement of the base station, set the **RSSI** selection field to ON; otherwise set it to OFF.
 - c The **MER/BER Samples** input field allows you to define the number of frames over which the MER and BER measurements shall be taken. The higher the value, the better the estimate and the higher the measurement time.
 - d In the **RX1**, **RX2**, ... selection fields, set up which of the receivers you want to test.
 - e In the BS Transmitter section, select the transmit power levels at which you want to test (e.g. 5W, 10W, 40W).
 - f Measurements are typically averaged and the averaged result is presented. In the **No. Of Samples For Avg.** field, enter the number of measurements over which to average.
 - g In the **Receiver Measurement** field, enter the power level at which the base station shall transmit during receiver measurements. A low value ensures low interference of the transmit signal with the receiver measurement. If the 2305 Stabilock is synchronized with the base station through an external trigger signal, you can enter 0 Watt. If the Stabilock is synchronized via the RF signal, use a low value that is still good enough to ensure proper synchronization.
- 4 When done with checking and changing the parameters in the Sequence menu, push the **ESC** key to return to the Autotest BS Type menu.
- 5 Push the **Channel Setup** softkey.
The Autotest BS Type Channel Setup menu appears.

Autotest BS Type Channel Setup	
Idle	
BS Type Channel Setup (mts (1))	
Gen. Channel: 3691	382.28750 MHz
Ana. Channel:	392.28750 MHz
Channel Mode:	ON
BS-TX Pre-Atten.:	1.50 dB
BS-RX Pre-Atten.:	24.50 dB
Frequency Band:	300 MHz
Channel Offset:	12.5 kHz
Duplex Spacing:	10.00000 MHz
Operating Mode:	Normal
Bit Sequence Mode:	PRBS
Uplink Mode:	TCH 7.2
Test Signal:	T1 (18 frames)
Synchronization:	Ext. Trigger
Signal:	Frame
Slope:	Positive
Delay:	2 sym.
Lowest Channel:	3691
Highest Channel:	3691
MCC:	0
MNC:	0
BCC:	1
<div> <div>Load Channel Setup</div> <div>Duplex spacing</div> </div>	

- 6 Change the parameters as described in [“Setting up the network parameters” on page 124](#). Parameters which are greyed out, cannot be changed because they are already defined in the base station control script.
- 7 When finished, press the **ESC** key to return to the previous menu.
- 8 Push the **Limits** softkey.
The Autotest BS Type Limits menu appears.

Autotest BS Type Limits	
Idle	
BS Type Limits (mts (1))	
Exp. RF Power	
5W	37.00 dBm +- 2.00 dB
10W	40.00 dBm +- 2.00 dB
40W	46.00 dBm +- 2.00 dB
1. RF Level BER/MER:	0.00 %
2. RF Level BER/MER:	0.00 %
3. RF Level BER/MER:	4.00 %
Frequency Error:	Lower: -100.00 Hz Upper: 100.00 Hz
RMS Vector Error:	0.00 % 10.00 %
Peak Vector Error:	0.00 % 30.00 %
Res. Carrier Power:	0.00 % 5.00 %
RSSI:	+- 2.00 dB
<div> <div></div> <div>System Default</div> </div>	

- 9 Change the test limits if necessary. (The menu shows only those measurement parameters that are defined as test parameters in the BS control script.)
- 10 When finished, press the **ESC** key to return to the previous menu.

Storing radio settings in a file

Creating a BS Type file

The TETRA radio settings can be entered as described above, and stored in a file so that the settings can easily be loaded and used again. The Stabilock stores the base station control script and the parameters that can be defined in the Sequence, Channel Setup and Limits menus.

- 1 Set the TETRA radio parameters as described in “[Defining the radio and test settings](#)” above.

- 2 In the **Autotest > Setup** menu, push the **New** softkey to store the settings.
The Stabilock stores the TETRA radio settings in a file on its internal hard disk. The file name is chosen automatically. The new settings file becomes the active file in the BS Type selection box.

Note

In the Autotest BS Type Setup menus described above, there is always an active BS type selected and loaded. Any changes you make to a configuration will be stored immediately with that BS type, i.e. the previous settings will be overwritten without warning.

Renaming a BS Type file

It is a good idea to use the type of TETRA base station (and test conditions if there are more than one) as a file name, so that you can easily find the correct setup file for your tests. A BS Type file can be renamed as follows:

- 1 Make the file to be renamed the active file (i.e. select the file name in the file selector box).
The file name appears in the field above.

- 2 Go to the field showing the file name, and enter a new name using the alphanumerical keypad. The file name may include the blank character.
- 3 Close the field by pushing the **ENTER** key.
The new file name is displayed both in the field for the active file and in the file selector box.

Copying a BS Type file

In order to copy a file with TETRA radio settings (rather than storing the currently active settings), select the file in the Autotest BS Type Setup menu, and push the **Copy** softkey.

A copy of the file is stored on the internal hard disk. The file name is chosen automatically. The new settings file becomes the active file in the BS Type selection box.

Deleting a BS Type file

- 1 In the Autotest BS Type Setup menu, select the file that you want to delete.
- 2 Push the **Delete** softkey.
The selected file is deleted. The next file in the list is highlighted, but not loaded.

Sorting BS Type files

You want to maintain a certain sequence of BS Type files in the list, e.g. to be able to access the most used file with the least keypresses. In order to change the sequence of files:

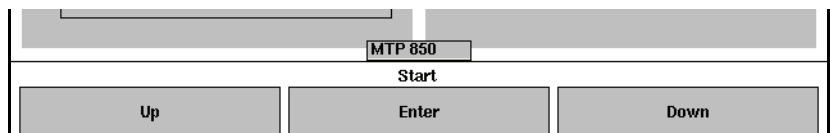
- 1 Select the file that you want to move up or down in the list on the right-hand side of the Autotest BS Type Setup menu.
- 2 Push ..., then **Move Up** or **Move Down** to change the position of the file in the list.

Performing a base station test

- 1 In the Welcome menu, push the **Autotest** softkey. If both the MS and the BS option are installed, a menu appears; select the **Base Station** option.
The Autotest BS menu appears.



- 2 Push **Start**.
A list of predefined TETRA base station types is shown.



- 3 From the list of TETRA base stations, select the type that you want to test.
The test is started. The left-hand side of the menu displays the test progress while the right-hand side displays the result.
- 4 To abort a running test, press the **ESC** key. Otherwise, once the test is completed, the final results will be displayed. The results will be stored (see ["Selecting the file location for screenshots and Auto-test results" on page 28](#)) and can be viewed in detail as explained in ["Viewing the results" on page 171](#).

		Autotest BS	
		Idle	
<div><div>RF Level BS BER RSSI RF Level BS BER RSSI RF Level BS BER RSSI BS Receiver RF Level BS BER RSSI RF Level BS BER RSSI RF Level BS BER RSSI End of Test</div><div>PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS PASS</div></div>		<div>Overall Result</div> <div>Pass</div>	
Start		Load Result	Setup

5 To start a new test, continue with [step 2](#).

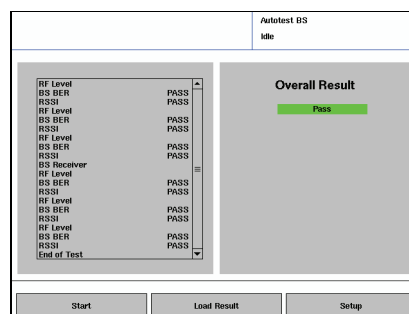
Viewing the results

The results of a test can be checked in detail either immediately after the test or later on.

- 1 If the results are not already being displayed, push the **Load Result** softkey of the Autotest menu.

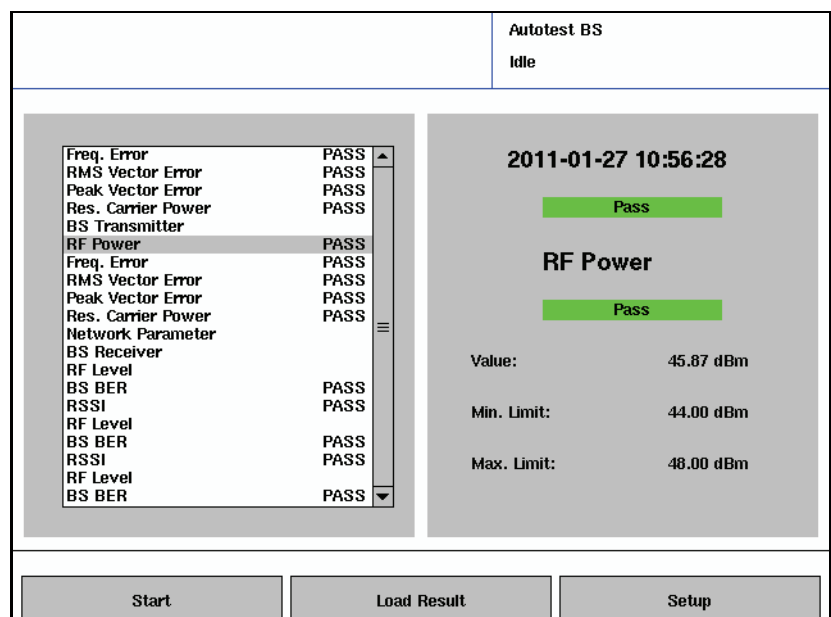
The 2305 Stabilock displays a list of Autotest results stored in the current Autotest save folder (see [“Selecting the file location for screenshots and Autotest results” on page 28](#)).

- 2 Select an Autotest results log file and push the **Enter** softkey. The short-form results are displayed on the left-hand side of the display (progress section). The right-hand side (details section) shows the overall result.



- 3 In the progress section, highlight a short-form result or test step to see more details.

The right-hand side (details section) shows the date and time of the test, the overall result, the name of the test or test step, the measurement result and the upper and lower limits (if applicable, otherwise the progress details are displayed).



- 4 Press **ESC** to return to the Welcome menu.

Maintenance and Troubleshooting

12

This chapter describes how to identify and correct problems related to the 2305 Stabilock. Topics discussed in this chapter are as follows:

- [“Maintaining your unit” on page 174](#)
- [“Troubleshooting” on page 175](#)

Maintaining your unit

Firmware updates Aeroflex seeks to permanently improve its products. Firmware updates are available on the Internet.

In order to replace Firmware version 2.10 or higher by a newer one, proceed as follows:

- 1 Download the firmware from Aeroflex's website.
- 2 Copy the firmware into the root directory of a USB flash drive.
- 3 Connect the USB flash drive to a USB port of the 2305 Stabilock.
- 4 From the Welcome menu, select **Setup > Update Manager**.
The Update Manager menu appears.
- 5 Select **Verify**.
Stabilock compares all the firmware parts on the USB flash drive with the firmware currently installed, and displays the results on the screen. If any part of the firmware can be updated to a newer version, the softkey description changes to "Install".
- 6 Select **Install**.
Newer firmware components are copied to the 2305 Stabilock. At the end of the update, the softkey description will change to "Reboot".
- 7 Select **Reboot**.
The instrument is rebooted and the new firmware is ready to be used.

Note

Ensure that the 2305 Stabilock is powered from a mains supply or has enough battery capacity for the entire update process!
If the 2305 Stabilock with firmware 1.40 or higher is operated from its battery and the capacity is low, the firmware update will not start.

Calibration and adjustment The 2305 Stabilock is a measurement device. As with all such instruments, the Stabilock should be calibrated on a regular basis to ensure accuracy. Aeroflex recommends calibration of the Stabilock at yearly intervals.

Troubleshooting

If you are unable to resolve problems related to the 2305 Stabilock, please refer to [“Technical assistance” on page xii](#).

Call ends unexpectedly

If the phone is registered (attached) to the simulated network and you are trying in vain to set up a call, observe the Disconnect Cause field on the right-hand side; it might provide useful information for finding the source of the problem.

The same applies if you experience calls dropping unexpectedly.

					MS TMO Attached	
<div>RF Level: -60.0 dBm</div> <div>MCCH: 3600 390.01250 MHz</div> <div>TCH: 3600 390.01250 MHz TS: 2</div> <div>Call Setup Type: Group</div> <div>Short Subscriber ID: 815</div> <div>Dynamic Group: 2303</div> <div>DGNA Name Type: Default</div>				<div>TETRA Air IF Standard: EN 300 392-2, -7</div> <div>Short Subscriber ID: 10030</div> <div>Selected Group: 100</div> <div>Paging Sensitivity:</div> <div>Disconnect Cause:</div>		
					1/2	
Call	Emergency Call	Dynamic Group	SDS	Paging Sensitivity	Request Command Registration	

Channel Parameters

A

This appendix is designed to help you properly select the channel and network parameters for testing. Topics discussed in this appendix are as follows:

- [“Calculating channel numbers and frequencies” on page 178](#)
- [“Power levels for TETRA mobile stations” on page 181](#)
- [“Power levels for TETRA base stations” on page 183](#)
- [“Network parameters” on page 184](#)

Calculating channel numbers and frequencies

In TETRA systems, there are typically two different channel numbering systems: One applied by the users or the network operator staff, and one used in the protocol.

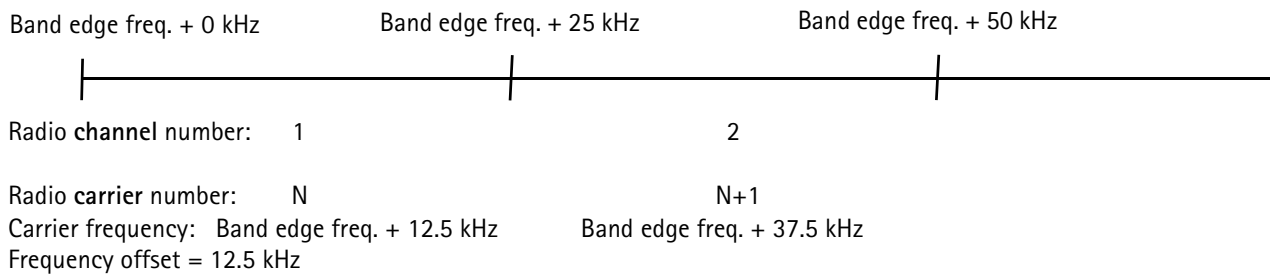
User speak: the radio channel numbers

The network operator and user groups typically start their channel numbers with 1 for the first channel of the allocated spectrum (e.g. the spectrum allocated for public safety and security services in Europe, starting at 380 MHz). This channel numbering system is also referred to as the radio channel numbers (see TS 300 392-15). The allocated spectrum typically starts at a full MHz number (380.000 MHz), irrespective of the channel offset (e.g. 12.5 kHz).

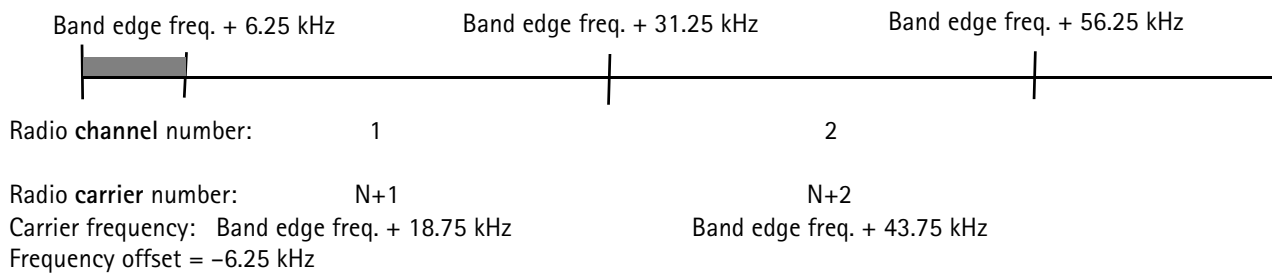
Users often agree on a distinct radio channel number in TETRA direct mode (DMO).

The following figure depicts different variants of channel radio numbering. Note the difference between the terms applied by users (radio channel numbers) and the terms applied by the signaling protocol (radio carrier number, carrier frequency, frequency offset).

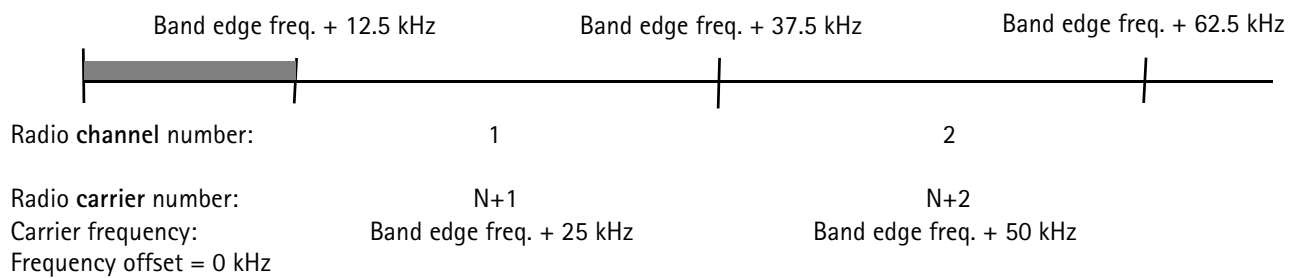
Variant A



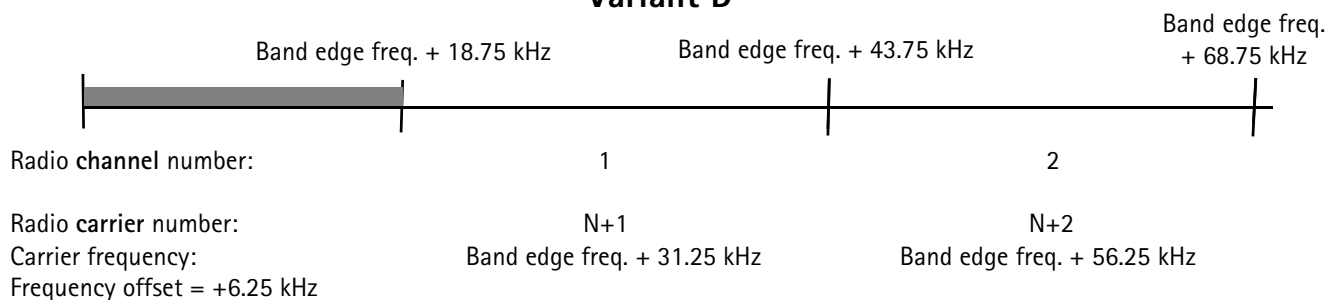
Variant B



Variant C



Variant D



Signaling and instrument speak: the radio carrier numbers

In conjunction with the TETRA frequency band, the frequency offset and the duplex spacing, the radio carrier number in the TETRA protocol is used to assign a well-defined radio frequency that is univocal in all TETRA systems and hence independent of the network implementation.

The equation that makes up the downlink (TETRA base station to TETRA mobile station) carrier frequency from these components is:

$$\text{DL Carrier Frequency} = \text{Frequency Band} + (\text{Radio Carrier Number}) * 25 \text{ kHz} + \text{Frequency Offset}$$

The uplink (TETRA MS to BS) carrier frequency is:

$$\text{UL Carrier Frequency} = \text{DL Carrier Frequency} - \text{Duplex Spacing}$$

The TETRA frequency band is a multiple of 100 MHz, so valid frequency bands are 100 MHz, 200 MHz, 300 MHz and so forth up until 900 MHz. (Note that the 2305 Stabilock only supports the frequency bands that are currently in use).

The frequency offset takes on one of the following values: 0, 12.5 kHz, +6.25 kHz, -6.25 kHz. The most common value is 12.5 kHz.

The duplex spacing determines the offset between the transmission frequencies of base station and mobile station. 10 MHz duplex spacing is most common in the 300 and 400 MHz bands, while 45 MHz is common in the 800 and 900 MHz bands.

The radio carrier number is simply a number that starts with 0 for a carrier frequency at or around the frequency denoted by the frequency band, e.g. 300 MHz.

Example: With a frequency offset of 12.5 kHz in the 300 MHz band, radio carrier number 3600 equates to DL carrier frequency 390.0125 MHz. In the European band reserved for public safety and security services, this would give the radio downlink channel number 1 as defined for the users. The corresponding uplink frequency is 380.0125 MHz.

Power levels for TETRA mobile stations

Power classes Each TETRA MS belongs to a power class defining the maximum RF output power capability. The power classes correspond to mobiles for different purposes, from small handheld devices (power class 4L, 0.56 W) to vehicle-mount mobile stations powered by the vehicle's battery (power class 1, 30 W). The power classes are listed in the table below.

The power class cannot be queried from the TETRA radio in normal mode. It is, however, available in TETRA Test Mode. See section "TETRA Test Mode" on page 64 for more details.

Table 4 Nominal power of TETRA mobile stations

Power class	Approximate power level	Nominal power level
1	30. W	45.0 dBm
1L	17.5 W	42.5 dBm
2	10. W	40.0 dBm
2L	5.6 W	37.5 dBm
3	3. W	35.0 dBm
3L	1.8 W	32.5 dBm
4	1. W	30.0 dBm
4L	0.56 W	27.5 dBm

Power control In addition, the MS is capable of adapting its power level to the external requirements in 5-dB steps. Two mechanisms are available: Open loop and closed loop power control.

In open loop power control, the TETRA MS adjusts its transmit power based on the signal quality it receives from the base station on the downlink. The weaker the signal from the base station, the more radio frequency (RF) power is transmitted by the MS. If the BS signal gets stronger, the MS reduces its RF power again. So don't be surprised to find the MS change its output power when you change the Stabilock's one!

On a traffic channel, reducing the Stabilock's power level might be the right way to change the power transmitted by the MS.

In closed loop power control, the base station measures the strength of the signal it receives from the MS. It may decide to instruct the MS to change its power level by a multiple of 5 dB. Of course, the MS

cannot obey if it is instructed to send at an RF power level that it does not support, i.e. either higher than the equivalent of its power class, or lower than its minimum output power.

The Stabilock does not support closed loop power control.

Power steps The TETRA MS must be able to change its output power in steps or multiples of 5 dB.

The power accuracy must be ± 2 dB at the nominal power level equivalent to the power class, and ± 2.5 dB at all other nominal power levels. The difference between two adjacent power steps must be 5 dB ± 2.5 dB except for TETRA mobile stations with power class modifier L, where the step width from the highest supported nominal power level to the next lower one must be 2.5 dB ± 2.5 dB.

The nominal output power and its tolerances are shown in the tables below.

Table 5 Power steps and tolerances for TETRA mobile stations

Power step	Power class 1 (30 W)	Power class 2 (10 W)	Power class 3 (3 W)	Power class 4 (1 W)
1 (45 dBm)	45 dBm ± 2 dB	40 dBm ± 2 dB	35 dBm ± 2 dB	30 dBm ± 2 dB
2 (40 dBm)	40 dBm ± 2.5 dB	40 dBm ± 2 dB	35 dBm ± 2 dB	30 dBm ± 2 dB
3 (35 dBm)	35 dBm ± 2.5 dB	35 dBm ± 2.5 dB	35 dBm ± 2 dB	30 dBm ± 2 dB
4 (30 dBm)	30 dBm ± 2.5 dB	30 dBm ± 2.5 dB	30 dBm ± 2.5 dB	30 dBm ± 2 dB
5 (25 dBm)	25 dBm ± 2.5 dB	25 dBm ± 2.5 dB	25 dBm ± 2.5 dB	25 dBm ± 2.5 dB
6 (20 dBm)	20 dBm ± 2.5 dB	20 dBm ± 2.5 dB	20 dBm ± 2.5 dB	20 dBm ± 2.5 dB
7 (15 dBm)	15 dBm ± 2.5 dB	15 dBm ± 2.5 dB	15 dBm ± 2.5 dB	15 dBm ± 2.5 dB

Table 6 Power steps and tolerances for TETRA mobiles with power class modifier L

Power step	Power class 1L (17.5 W)	Power class 2L (5.6 W)	Power class 3L (1.8 W)	Power class 4L (0.56 W)
1 (45 dBm)	42.5 dBm ± 2 dB	37.5 dBm ± 2 dB	32.5 dBm ± 2 dB	27.5 dBm ± 2 dB
2 (40 dBm)	40 dBm ± 2.5 dB	37.5 dBm ± 2 dB	32.5 dBm ± 2 dB	27.5 dBm ± 2 dB
3 (35 dBm)	35 dBm ± 2.5 dB	35 dBm ± 2.5 dB	32.5 dBm ± 2 dB	27.5 dBm ± 2 dB
4 (30 dBm)	30 dBm ± 2.5 dB	30 dBm ± 2.5 dB	30 dBm ± 2.5 dB	27.5 dBm ± 2 dB
5 (25 dBm)	25 dBm ± 2.5 dB	25 dBm ± 2.5 dB	25 dBm ± 2.5 dB	25 dBm ± 2.5 dB
6 (20 dBm)	20 dBm ± 2.5 dB	20 dBm ± 2.5 dB	20 dBm ± 2.5 dB	20 dBm ± 2.5 dB
7 (15 dBm)	15 dBm ± 2.5 dB	15 dBm ± 2.5 dB	15 dBm ± 2.5 dB	15 dBm ± 2.5 dB

Power levels for TETRA base stations

Power classes Each TETRA BS belongs to a power class defining the RF output power capability. The power classes are listed in the table below. The tolerance is ± 2 dB.

Table 7 Nominal power of TETRA base stations

Power class	Approximate power level	Nominal power level
1	40.0 W	46.0 dBm
2	25.0 W	44.0 dBm
3	15.0 W	42.0 dBm
4	10.0 W	40.0 dBm
5	6.3 W	38.0 dBm
6	4.0 W	36.0 dBm
7	2.5 W	34.0 dBm
8	1.6 W	32.0 dBm
9	1.0 W	30.0 dBm
10	0.6 W	28.0 dBm

Network parameters

Mobile Country Code MCC

The MCC is a three-digit code identifying the country in which the network is set up. Valid Mobile Country Codes are defined in ITU standard E.212 ("Land Mobile Numbering Plan"). The table below lists the country codes currently assigned. In addition, the MCC 001 is often used for test purposes. This is, however, rarely implemented in TETRA mobile stations.

412 Afghanistan	346 Cayman Islands (UK)
276 Albania	623 Central African Republic
603 Algeria	622 Chad
544 American Samoa (US)	730 Chile
213 Andorra	460 China
631 Angola	732 Colombia
365 Anguilla	654 Comoros
344 Antigua and Barbuda	629 Republic of the Congo
722 Argentine Republic	548 Cook Islands (NZ)
283 Armenia	712 Costa Rica
363 Aruba (Netherlands)	612 Côte d'Ivoire
505 Australia	219 Croatia
232 Austria	368 Cuba
400 Azerbaijani Republic	280 Cyprus
364 Bahamas	230 Czech Republic
426 Bahrain	630 Democratic Republic of the Congo
470 Bangladesh	238 Denmark
342 Barbados	638 Djibouti
257 Belarus	366 Dominica
206 Belgium	370 Dominican Republic
702 Belize	514 East Timor
616 Benin	740 Ecuador
350 Bermuda (UK)	602 Egypt
402 Bhutan	706 El Salvador
736 Bolivia	627 Equatorial Guinea
218 Bosnia and Herzegovina	657 Eritrea
652 Botswana	248 Estonia
724 Brazil	636 Ethiopia
348 British Virgin Islands (UK)	288 Faroe Islands (Denmark)
528 Brunei Darussalam	542 Fiji
284 Bulgaria	244 Finland
613 Burkina Faso	208 France
642 Burundi	742 French Guiana (France)
456 Cambodia	547 French Polynesia (France)
624 Cameroon	628 Gabonese Republic
302 Canada	607 Gambia
625 Cape Verde	

282 Georgia	294 Republic of Macedonia
262 Germany	646 Madagascar
620 Ghana	650 Malawi
266 Gibraltar (UK)	502 Malaysia
202 Greece	472 Maldives
290 Greenland (Denmark)	610 Mali
352 Grenada	278 Malta
340 Guadeloupe (France)	551 Marshall Islands
535 Guam (US)	340 Martinique (France)
704 Guatemala	609 Mauritania
611 Guinea	617 Mauritius
632 Guinea-Bissau	334 Mexico
738 Guyana	550 Federated States of Micronesia
372 Haiti	259 Moldova
708 Honduras	212 Monaco
454 Hong Kong (PRC)	428 Mongolia
216 Hungary	354 Montserrat (UK)
274 Iceland	604 Morocco
404 India	643 Mozambique
405 India	414 Myanmar
510 Indonesia	649 Namibia
432 Iran	536 Nauru
418 Iraq	429 Nepal
272 Ireland	204 Netherlands
425 Israel	362 Netherlands Antilles (NL)
222 Italy	546 New Caledonia (France)
338 Jamaica	530 New Zealand
441 Japan	710 Nicaragua
440 Japan	614 Niger
416 Jordan	621 Nigeria
401 Kazakhstan	534 Northern Mariana Islands (US)
639 Kenya	242 Norway
545 Kiribati	422 Oman
467 Korea, North	410 Pakistan
450 Korea, South	552 Palau
419 Kuwait	714 Panama
437 Kyrgyz Republic	537 Papua New Guinea
457 Laos	744 Paraguay
247 Latvia	716 Peru
415 Lebanon	515 Philippines
651 Lesotho	260 Poland
618 Liberia	351 Portugal
606 Libya	330 Puerto Rico (US)
295 Liechtenstein	427 Qatar
246 Lithuania	647 Réunion (France)
270 Luxembourg	226 Romania
455 Macao (PRC)	250 Russian Federation

635 Rwandese Republic
356 Saint Kitts and Nevis
358 Saint Lucia
308 Saint Pierre and Miquelon (FR)
360 Saint Vincent & the Grenadines
549 Samoa
292 San Marino
626 São Tomé and Príncipe
420 Saudi Arabia
608 Senegal
220 Serbia and Montenegro
633 Seychelles
619 Sierra Leone
525 Singapore
231 Slovakia
293 Slovenia
540 Solomon Islands
637 Somalia
655 South Africa
214 Spain
413 Sri Lanka
634 Sudan
746 Suriname
653 Swaziland
240 Sweden
228 Switzerland
417 Syria
466 Taiwan
436 Tajikistan
640 Tanzania
520 Thailand
615 Togolese Republic
539 Tonga
374 Trinidad and Tobago
605 Tunisia
286 Turkey
438 Turkmenistan
376 Turks and Caicos Islands (UK)
641 Uganda
255 Ukraine
424 United Arab Emirates
430 United Arab Emirates (Abu Dhabi)
431 United Arab Emirates (Dubai)
235 United Kingdom
234 United Kingdom
310 United States of America
311 United States of America

312 United States of America
313 United States of America
314 United States of America
315 United States of America
316 United States of America
332 United States Virgin Islands
748 Uruguay
434 Uzbekistan
541 Vanuatu
225 Vatican City State
734 Venezuela
452 Viet Nam
543 Wallis and Futuna (France)
421 Yemen
645 Zambia
648 Zimbabwe

Mobile Network Code MNC	The MNC is a number in the range from 0 to 16,383. The Mobile Network Codes are assigned individually for each country. Please refer to the network operator for the correct network code.
----------------------------	--

Determining the RF Coupling Factors

B

This appendix shows how the radio frequency power loss can be measured when testing a TETRA mobile station over the air, i.e. over an antenna. The main topics are as follows:

- [“Introduction” on page 190](#)
- [“Selecting a reference mobile station” on page 190](#)
- [“Determining the TX pre-attenuation” on page 190](#)
- [“Determining the RX pre-attenuation” on page 191](#)
- [“Summary” on page 192](#)

Introduction

Measuring the transmitter and receiver quality of a TETRA mobile radio through an antenna coupler has several advantages. For precise power and receiver sensitivity measurements, this method requires knowledge of the exact coupling factors between the TETRA radio and the antenna coupler. The coupling factors should be entered in the Definitions menu as RX and TX pre-attenuation values (see [“Using an antenna coupler” on page 39](#) or [“Paging Sensitivity test” on page 79](#)).

It should be noted that the coupling factors with the antenna coupler and a shielding device are different from those with an antenna coupler only. Therefore the provider of the coupling factors should state the conditions under which they are valid.

This appendix explains how the pre-attenuation values (coupling factors) can be determined.

Selecting a reference mobile station

The coupling factors are determined with the help of a known good reference radio (also referred to as a “golden mobile” because it should be a mobile station with good performance). Measuring the coupling factor with a TETRA radio with unknown quality bears the risk of obtaining coupling factors that are not typical for a properly working TETRA mobile station.

Determining the TX pre-attenuation

The following instructions apply to a test setup with a TETRA radio, the Aeroflex 2305 Stabilock and the Aeroflex 4914 Antenna Coupler. The Aeroflex 4921 RF Shield can optionally be added.

- 1 Connecting the antenna coupler:
 - a Without the shielding box: Connect the antenna coupler to the 2305 Stabilock using a defined cable.
 - b With the shielding box: Place the antenna coupler in a defined position in the shielding box. Connect the RF plug of the antenna coupler with the internal RF plug of the shielding box. Connect the shielding box with the test set using a defined RF cable (N connector on both ends).
- 2 Switch on the 2305 Stabilock.
- 3 Under **Setup > Definitions**, set the RX and TX pre-attenuation values to zero.
- 4 Select **TMO**, and enter a low RF Level value (e.g. –95 dBm).

Note

A low power level from the Stabilock is important because the TETRA radio should transmit at its highest power level; this is achieved through open loop power control by stimulating the radio with a low input level.

- 5 Enter valid network and channel parameters. Either use a channel in the middle of the frequency band supported by the TETRA radio, or determine coupling factors at different frequencies, e.g. at the lowest, highest and a middle frequency.
- 6 Place the TETRA MS on the XY Shuttle of the antenna coupler, with the shuttle in position A-1. If you are using the shielding box, close it.
- 7 Start the tests.
- 8 Set up a call and ensure that the TETRA radio keeps transmitting (either with a duplex call or by keeping the PTT pressed).
- 9 Note down ten readings of the RF Power measurement.
- 10 Finish the call and calculate the mean value and the variation of the power results.
- 11 Repeat [step 6](#) through [step 10](#) for all other shuttle positions, i.e. for A-2, A-3, A-4, B-1 etc. through to D-4.
- 12 Note down the mean RF power value for the shuttle position with the least variation, together with the shuttle position.
- 13 Determine the true transmit power value:
Either repeat the measurement without the antenna coupler but with a cable connection between the TETRA radio and the 2305 Stabilock.
Or take the nominal maximum power level (according to the power class of the TETRA radio) as its true transmit power value.
- 14 The difference between the mean RF power measured at the best position (determined in [step 12](#)) and the true transmit power (determined in [step 13](#)) is the coupling factor for the transmission direction.

Determining the RX pre-attenuation

The following instructions apply to a test setup with a TETRA radio, the Aeroflex 2305 Stabilock and the Aeroflex 4914 Antenna Coupler. The Aeroflex 4921 RF Shield can optionally be added.

- 1 Set the TETRA MS into a mode where it displays the received signal strength on its screen or on a PC linked to the MS.
- 2 Connecting the antenna coupler:
 - a Without the shielding box: Connect the antenna coupler to the 2305 Stabilock using a defined cable.

- b With the shielding box: Place the antenna coupler in a defined position in the shielding box. Connect the RF plug of the antenna coupler with the internal RF plug of the shielding box. Connect the shielding box with the test set using a defined cable.
- 3 Switch on the 2305 Stabilock.
- 4 Under **Setup > Definitions**, set the RX and TX pre-attenuation values to zero.
- 5 Select **TMO**, and enter a medium RF Level value (e.g. –65 dBm).
- 6 Enter valid network and channel parameters. Either use a channel in the middle of the frequency band supported by the TETRA radio, or determine coupling factors at different frequencies, e.g. at the lowest, highest and a middle frequency.
- 7 Place the TETRA MS on the XY Shuttle of the antenna coupler, with the shuttle in the position determined in section [“Determining the TX pre-attenuation”](#).
- 8 Start the tests.
- 9 Set up a call and ensure that the TETRA radio is able to receive data (either with a duplex call or by keeping the PTT released).
- 10 Note down ten RSSI readings from the (PC or MS) screen.
- 11 Finish the call and calculate the mean value of the power results.
- 12 Compare the RSSI reading with the RF Level value set. The difference is the RX pre-attenuation (coupling factor) at this frequency.

Summary

The coupling factors can be entered as pre-attenuation values in the Definitions menu of the 2305 Stabilock. It is important to note the following conditions under which the factors have been determined, and apply them during testing of a TETRA radio of the same type:

- Type of TETRA MS
- Type of antenna coupler
- Shielding box used? Which one?
- Type of RF cable between antenna coupler and test set
- Channel number (if more than one set of values has been determined)

Syntax Definition for Base Station Control

C

This appendix details the syntax for BS remote control scripts. The main topics are as follows:

- [“Introduction” on page 194](#)
- [“Terms and definitions” on page 194](#)
- [“Escape sequences” on page 195](#)
- [“Comments” on page 196](#)
- [“Script elements” on page 197](#)

Introduction

This appendix lists and explains the valid elements of the script elements to control the base station. A general description of base station remote control and the file structure can be found in [Chapter 10 "Controlling the Base Station"](#).

The script language uses a subset of XML, see [Extensible Markup Language \(XML\) 1.0 W3C recommendation of November 2008](#).

Terms and definitions

XML — Extensible Markup Language

Tag — A markup construct that begins with "<" and ends with ">". Tags come in three flavors: start tags, for example <Script>, end-tags, for example </Script>, and empty-element tags, for example <BerMerResult/>.

Element — A logical component of a document which either begins with a start tag and ends with a matching end tag, or consists only of an empty-element tag. The characters between the start and end tags, if any, are the element's content, and may contain markup, including other elements, which are called child elements. An example of an element is

```
<Command> power -otxchl -a0\x0d</Command>.
```

Another is <BerMerResult/>.

Attribute — A markup construct consisting of a name/value pair that exists within a start tag or empty-element tag. For example the element Interface has three attributes, Baudrate, Format and Terminator:

```
<Interface Baudrate="19200" Format="8N1" Terminator="CR">
```

UNIX format — Unix and its derivatives (Linux, BSD, and others) all use the single LF character to represent a new line. DOS-based systems, including Windows, as well as a number of other, older non-Unix OSes use a carriage return (CR) character followed by a line feed (LF) character.

Runlevel — The term Runlevel refers to a mode of operation of a base station control interface. The final Runlevel is reached, if the test mode interface of the base station is activated.

Escape sequences

Instead of using character entity references (such as `&` and `<`), the script language of the 2305 Stabilock provides escape sequences for formatting.

Table 8 Escape sequences for output formatting

Escape sequence	Meaning
<code>\b</code>	Backspace
<code>\f</code>	Form feed
<code>\r</code>	Carriage return
<code>\t</code>	Horizontal tab
<code>\v</code>	Vertical tab
<code>\'</code>	Single quotation mark
<code>\"</code>	Double quotation mark
<code>\\</code>	Backslash
<code>\xhh</code>	ASCII characters in hexadecimal notation

Example:

```
<Runlevel Prompt="BRC" \r\x1b\x5b\x35\x43"
Input="reset\x0d" Wait="2" Timeout="45"
On-Error="\x0d">
```

Comments

Comments may appear anywhere in the definition file, except within a start, end or empty tag. Comments must be enclosed between the <!-- and --> characters. The content will be ignored.

Examples:

```
<!-- First Runlevel - Command interface in normal mode -->

<!-- Not used!
    <RFPort      Set="1"/>
    <TestSignal  Set="1"/>
    <Synchron    Set="1"/>
-->
```


Script elements

Interface The interface tag sets the RS-232 parameters.

Attributes

Attributes	Value	Description
Baudrate	9600 19200 38400 57600 115200	Allowed baud rate settings
Format	5N1, 6N1, 7N1, 8N1, 5O1, 6O1, 7O1, 8O1, 5E1, 6E1, 7E1, 8E1, 5N2, 6N2, 7N2, 8N2, 5O2, 6O2, 7O2, 8O2, 5E2, 6E2, 7E2 or 8E2	First character: 5, 6, 7 or 8 data bits Second character: Parity none (N), odd (O) or even (E) Third character: 1 or 2 stop bits
Terminator	CRLF LF CR	Carriage return and line feed Line feed Carriage return (Terminator used in final Run- level mode. This parameter is only used by the GUI com- mand input field.)

Child element Runlevel. Usually the first Runlevel, usually the command interface of the base station in normal mode.

Example

```
<Interface Baudrate="9600" Format="8N1" Terminator="CR">
...
</Interface>
```

Runlevel The Runlevel tag defines the final Runlevel or an intermediate step to reach it. The final Runlevel is defined as the base station command interface, which allows controlling of the receiver, transmitter and BER/MER measurement of the base station.

Attributes

Attributes	Value	Description
Prompt	Freely definable	Command line interface string indicating that the base station is ready to accept typed input.
Input	Freely definable	Command string, in order to achieve the next level. The absence of this attribute marks the final level.
Wait	0...65535	Period of time in seconds to wait after matching with the prompt text. Only if no further characters are received during this time , the prompt text is accepted.
Timeout	0...65535	During this period of time (in seconds) the prompt text should be found.
OnError	Freely definable	This command string is sent after the first timeout error. It should trigger the BS to send the prompt text again.

Child elements On Runlevels 1...n: Runlevel. Next Runlevel.

On final Runlevel:

- Initialization input parameters. Sets input parameters to the desired value and prevents changes by the user.
- Final Runlevel commands. To control the base station in final Runlevel mode, the Stabilock uses six basic commands.

Example

```
<Runlevel Prompt="username: " Input="mmm\x0d" Wait="2"
Timeout="5" OnError="\x0d">
...
    <Runlevel Prompt="factory> " Wait="0" Timeout="5"
OnError="\x0d">
...
    </Runlevel>
</Runlevel>
```

Initialization input parameters

These set input parameters to the desired value and prevent changes by the user.

Elements

Elements	Description
RFPort	See RF Port in the BS Test Setup menu
BitSeqMode	See "Bit Sequence Mode" in the BS Test Setup menu
UplinkMode	See "Uplink Mode" in the BS Test Setup menu
TestSignal	See "Test Signal" in the BS Test Setup menu
Synchron	See "Synchronization" in the BS Test Setup menu
DownlinkMode	See "Downlink Mode" in the BS Test Setup menu (Synchronization set to RF Signal)
Signal	See "Signal" in the BS Test Setup menu (Synchronization set to Ext. Trigger)
Slope	See "Slope" in the BS Test Setup menu (Synchronization set to Ext. Trigger)
Delay	See "Delay" in the BS Test Setup menu (Synchronization set to Ext. Trigger)
MCC	See MCC in the BS Test Setup menu
MNC	See MNC in the BS Test Setup menu
BCC	See BCC in the BS Test Setup menu
BerMerSamples	See MER/BER Samples in the BS Control – Generator/Analyzer menu
BSTransmitter	See BS Transmitter in the BS Control – Generator/Analyzer menu
BSReceiver	See BS Receiver in the BS Control – Generator/Analyzer menu

Attributes

Attributes	Value	Description
Set	Numerical value. The value range depends on the type of the input parameter. The first entry of a select field is selected with "0", the following with "1" etc.	Sets the input parameter to the desired value and disables the input field.

Attributes	Value	Description
Preset	Numerical value. The value range depends on the type of the input parameter. The first entry of a select field is selected with "0", the following with "1" etc.	BS Transmitter and BS receiver only Sets the input parameter to the desired value.
Text	Freely definable	BS Transmitter only Defines the text of the BS Transmitter select field. Should be used only in connection with the setting of a limit value.
Limit	0 ... 50.00	BS Transmitter only Sets the power class to "User defined" and the expected RF power to the given value in dBm, see BS Test Limits menu.

Child element Select. Defines the text of the BS Receiver selection field (BSReceiver only).

Example `<RFPort Set="1"/>`
 `<BSTransmitter Text="5Watt" Limit="36.99" />`

Final Runlevel commands In order to control the base station in final Runlevel mode, the Stabilock uses six basic commands.

Elements

Elements	Description
Start	Ensures that the final Runlevel is reached and initializes the test mode.
SetRX	Sets the base station receiver
SetTX	Sets the base station transmitter
Measurement	Starts a BER/MER measurement and reads the result
Halt	Stops measurement mode, leaving the BS in final Runlevel mode
Stop	Resets the base station and returns it to normal mode

Attributes

Attributes	Value	Description
Mode		For Measurement element only. Optional, default is Automatic.
	Manual	Starts BER/MER measurement only on BER/MER softkey press in BS Control menu
	Automatic	Periodically starts BER/MER measurement in BS Test menu

Child elements Sequence. Includes another final Runlevel command.

Command. Defines a base station command.

Hint. Opens an onscreen message window.

Example

```
<Stop>
  <Sequence>Halt</Sequence>
  <Command Wait="5" Timeout="5">reset -oplatform\x0d</
Command>
</Stop>
```

Hint (message boxes) The Hint element defines a message window.

Attributes

Attributes	Value	Description
Type		Defines the type of the message window.
	OK	Press ESC or ENTER to continue
	Query	Confirm with ENTER, Abort with ESC
Autotest		Defines the condition for the Autotest mode, which controls the behavior of the hint box. If it is not opened, the expected input is set to ESC.
	Never	The box is not opened
	Sequence	The box is only opened, if it is running as a sub-sequence.
	Command	The box is not opened, if it is running as a sub-sequence.
	Always	The box is always opened (default setting)
Manual		Defines the condition for the manual mode which controls the behavior of the hint box. If it is not opened, the expected input is set to ESC.
	Never	The box is not opened
	Sequence	The box is opened only if it is running as a sub-sequence.
	Command	The box is not opened if it is running as a sub-sequence.
	Always	The box is always opened (default setting)

Child elements

Sequence. The Sequence is executed if the message window was closed and not aborted by user input.

Command. The Command is executed if the message window was closed and not aborted by user input.

Hint. Opens another message window if the message window was closed and not aborted by user input.

English. Defines the message in English.

German. Defines the message in German.

French. Defines the message in French.

Example

```
<Hint Type="OK">
  <English>Connect the BS TX port\nto the RF1 port\ndand the
BS RX port to RF2 port.</English>
  <Sequence>SetRX</Sequence>
  <Hint Type="Query">
    <English>Activate BS Transmitter?</English>
    <Sequence>SetTX</Sequence>
  </Hint>
</Hint>
```

Message window language definition
These elements are only used as child elements of Hint. The user interface of the Stabilock supports three languages; for each of them an individual text can be defined.

Elements	
Elements	Description
English	Defines the English text.
German	Defines the German text.
French	Defines the French text.

Child elements

BSReceiver. Inserts text characterizing the base station receiver currently selected.

BSTransmitter. Inserts text characterizing the base station transmitter currently selected.

RFPort. Inserts text characterizing the RF port currently selected.

Example

```

<Hint Type="Query">
  <English>"Connect the BS"<BSReceiver>" port to the
"<RFPort>" port."
  </RFPort>
  </BSReceiver>
</English>
<Sequence>SetRX</Sequence>
</Hint>

```


Sequence	This element includes a final Runlevel command into another definition.
Content	Start, SetRX, SetTX, Measurement, Halt, Stop
Child elements	None.
Example	<pre> <Stop> <Sequence>Halt</Sequence> <Command Wait="5" Timeout="5">reset -oplatform\x0d</ Command> </Stop> </pre>

Command This element defines a base station command.

Attributes

Attributes	Value	Description
Prompt	Freely definable	Optional, replaces the final Run-level definition. Command line interface string, which indicates that the base station is ready to accept typed input.
Wait	0...65535	Optional, replaces the final Run-level definition. Period of time (in seconds) to wait after matching the prompt text. Only if in this time no further characters will be received, the prompt text is accepted.
Timeout	0...65535	Optional, replaces the final Run-level definition. During this period of time (in seconds) the prompt text should be found.

Child elements Variable parameters. User interface parameters to be inserted in the command text.

Sequence. Includes a final Runlevel command.

Command. Defines another base station command.

Hint. Opens a message window.

Result. Extracts a result from the data received from the base station.

Example

```

<Command>"ppr -orxchl -a"
  <BerMerSamples>
    <Command>" -r1\x0d"</Command>
  </BerMerSamples>
  <Result Qualifier="BER/MER (%)" Separator=" =\t"
Timeout="10">
    <BerMerResult BSReceiver="RX1">
      <BerMerResult BSReceiver="RX2">
        <BerMerResult BSReceiver="RX3" />
      </BerMerResult>
    </BerMerResult>
  </Result>
</Command>

```

Variable command parameters

These elements are input parameters from the user interface to be inserted into the base station command text. Numeric input values are inserted directly; selection field inputs must be translated by the Select element definition.

Elements

Elements	Description
BSTXFrequencyHz	Transmit frequency in Hertz, integer value. See frequency input field for TX Channel in the BS Test Setup menu.
BSTXFrequencyMHz	Transmit frequency in Megahertz, floating point value. See frequency input field for TX Channel in the BS Test Setup menu.
BSRXFrequencyHz	Receive frequency in Hertz, integer value.
BSRXFrequencyMHz	Receive frequency in Megahertz, floating point value.
RFPort	See RF Port in the BS Test Setup menu
BitSeqMode	See "Bit Sequence Mode" in the BS Test Setup menu
UplinkMode	See "Uplink Mode" in the BS Test Setup menu
TestSignal	See "Test Signal" in the BS Test Setup menu
Synchron	See "Synchronization" in the BS Test Setup menu
DownlinkMode	See "Downlink Mode" in the BS Test Setup menu (Synchronization set to RF Signal)
Signal	See "Signal" in the BS Test Setup menu (Synchronization set to Ext. Trigger)
Slope	See "Slope" in the BS Test Setup menu (Synchronization set to Ext. Trigger)
Delay	See "Delay" in the BS Test Setup menu (Synchronization set to Ext. Trigger)
MCC	See MCC in the BS Test Setup menu
MNC	See MNC in the BS Test Setup menu
BCC	See BCC in the BS Test Setup menu
BerMerSamples	See MER/BER Samples in the BS Control – Generator/Analyzer menu
BSTransmitter	See BS Transmitter in the BS Control – Generator/Analyzer menu
BSReceiver	See BS Receiver in the BS Control – Generator/Analyzer menu

Child elements **Select.** Defines the corresponding command text for a select field value.

Command. Defines additional command text.

Example `<Command>"freq -orx_all -f"
 <FrequencyMHz>
 <Command>\x0d</Command>
 </FrequencyMHz>
 </Command>`

If FrequencyMHz is 382.28750MHz, then it results in the following command text:

`freq -orx_all -f382.28750\x0d`

Select The Select element defines the command text for a selection field entry.

Attributes

Attributes	Value	Description
Command	Freely definable	Base Station command text
Text	Freely definable	BS Transmitter and BS Receiver only Defines the text of the BS Transmitter select field.
Limit	0 ... 50.00	BS Transmitter and AutotestRFLevel only Sets the power class to "User defined" and the expected RF power to the desired value, in dBm.
LRange	0...5.00	BS Transmitter only Sets the allowed deviation of the expected RF power, in dBm.
Autotest	ON or OFF	BS Transmitter only If ON is selected then the corresponding transmitter settings are measured in the autotest.

Child elements None.

Examples

```
<UplinkMode>
  <Select Command="TCH_72" />
  <Select Command ="SCH_F" />
  <Select Command ="STCH"/>
  <Select Command ="TCH_24"/>
  <Select Command ="SCH_HU"/>
</UplinkMode>

<BSTransmitter>
  <Select Text="0W" Command ="0" Limit="0"></Select>
  <Select Text="10W" Command ="10" Limit="40"></Select>
  <Select Text="40W" Command ="40" Limit="46.02"></
Select>
  <Select Text="60W" Command ="60" Limit="47.78"></
Select>
  <Select Text="85W" Command ="85" Limit="49.29"></
Select>
</BSTransmitter>
```

Result This element extracts a result from the data received from the base station.

Attributes

Attributes	Value	Description
Qualifier	Freely definable	The received data are scanned for this text.
Separator	Freely definable	The received data after the qualifier are separated into text segments. This character list defines one or more text delimiters.
Timeout	0 ... 65535	During this period of time (in seconds) the qualifier should be found.
Wait	0 ... 65535	Waiting period before the qualifier search begins. During this time the data are read, but not evaluated.
Terminal	VT100	VT100 terminal emulation is activated.

Child elements BerMerResult. Sets the BER/MER result to the value given by the text segment. This should be the BER or MER in %.
Alternatively, if the BerMerTotal and BerMerError are present, BerMerResult is automatically calculated from these values as follows: $\text{BerMerResult} = \text{BerMerError} * 100 / \text{BerMerTotal}$.

SkipResult. Ignores the text segment.

BerMerTotal. Sets the total number of bits received by the BS to the value given by the text segment. If the BerMerError is also valid, the BER/MER result is calculated (see BerMerResult).

BerMerError. Sets the number of erroneous bits received by the BS to the value given by the text segment. If the BerMerTotal is also valid, the BER/MER result is calculated (see BerMerResult).

BSRSSI. Sets the RSSI result to the value given by the text segment.

Result. Used to define a new qualifier text.

Command. Defines a command string which is sent if the qualifier is found. In this context no attributes and also only the other child elements of the Result element are allowed.

Example <Result Qualifier=" 0 " Separator=" =\t" Timeout="10">
 <SkipResult>
 <SkipResult>
 <SkipResult>
 <SkipResult>
 <SkipResult>
 <BerMerResult/>
 </SkipResult>
 </SkipResult>
 </SkipResult>
 </SkipResult>
 </SkipResult>
 </Result>

See also ["Result values" on page 212.](#)

Result values These elements are used to transfer the BER/MER measurements from the base station to the Stabilock.

Elements

Elements	Description
SkipResult	Skips the potential result.
BerMerResult	Sets the BER/MER result, or skips the result if the BS receiver is not selected.
BerMerTotal	Sets the BER/MER Total result, or skips the result if the BS receiver is not selected.
BerMerError	Sets the BER/MER Error result, or skips the result if the BS receiver is not selected.
BSRSSI	Sets the RSSI result, or skips the result if the BS receiver is not selected.

Attributes

Attributes	Value	Description
BSReceiver	Freely definable	BerMerResult and BerMerTotal only Defines the text of the BS Receiver select field. The entries not selected are handled like a Skip-Result element.
Calculate	Arithmetic operations (value)	BSRSSI only The result value can be changed by arithmetic operations +, -, * and /

Child elements BerMerResult. Several of these elements are differentiated by the BSReceiver attributes.

BerMerTotal: Several of these elements are differentiated by the BSReceiver attributes.

BerMerError: It is always handled as a pair with the BerMerTotal element.

BSRSSI: Several of these elements are differentiated by the BSReceiver attributes.

SkipResult: A potential result is ignored.


```
Example <Result Qualifier="BER/MER (%)" Separator="=\t"
Timeout="10">
  <BerMerResult BSReceiver="RX1">
    <BerMerResult BSReceiver="RX2">
      <BerMerResult BSReceiver="RX3" />
    </BerMerResult>
  </BerMerResult>
</Result>
```

If BS Receiver is 1 (RX2), then the following result will be extracted:

Qualifier	1	2	3
Receiver Number	1	2	3
SGC Attenuation (dB)	0	0	0
Sync Location (1/10 symb)	36	36	38
Sync. Amplitude (dB)	-86	-46	-87
Total Bits/Msgs	432	432	432
Bits/Msgs in Error	4	0	3
BER/MER (%)	0.926	0.000	0.694
RSSI (dBm)	-116	-75	-116

10-08-23
12:45
10.114.6.15

BS Test BS Control
Generator/Analyzer

BER/MER 0.97 %

Total Bits/Msgs	= 4320	4320	4320
Bits/Msgs in Error	= 2068	4	2035
BER/MER (%)	= 47.870	0.093	47.106
RSSI (dBm)	= -134	-122	-135
factory>			
ppr -orxch1 -a10 -r1			
Receiver Number	= 1	2	3
SGC Attenuation (dB)	= 0	0	0
Sync Location (1/10 symb)	= -8	40	58
Sync. Amplitude (dB)	= -110	-92	-111
Total Bits/Msgs	= 4320	4320	4320
Bits/Msgs in Error	= 2036	42	2022
BER/MER (%)	= 47.130	0.972	46.806
RSSI (dBm)	= -134	-122	-135
factory>			

RF Port/Level: RF2 -122.0 dBm
MER/BER Samples: 10 Frames
Command:

BS Receiver: RX2
BS Transmitter: 10W

BS Test BER/MER Stop

AutotestRFLevel The AutotestRFLevel element defines the RF level and the corresponding BER/MER limits used in the autotest BS Receiver measurements.

Child elements Select. Defines the corresponding RF level (Command attribute) and BER/MER limits (Limit attribute).

Example

```
<AutotestRFLevel>
  <Select Command="-20.0"   Limit="0"/>
  <Select Command="-80.0"   Limit="0"/>
  <Select Command="-115.0"  Limit="4"/>
</ AutotestRFLevel >
```

Warranty and Repair

D

This chapter describes the customer services available through Aeroflex. Topics discussed in this chapter include the following:

- [“Warranty information” on page 216](#)
- [“Equipment return instructions” on page 217](#)

Warranty information

Aeroflex warrants that all of its products conform to Aeroflex's published specifications and are free from defects in materials and workmanship for a period of one year from the date of delivery to the original buyer, when used under normal operating conditions and within the service conditions for which they were designed. This warranty is not transferable and does not apply to used or demonstration products.

In case of a warranty claim, Aeroflex's obligation shall be limited to repairing, or at its option, replacing without charge, any assembly or component (except batteries) which in Aeroflex's sole opinion proves to be defective within the scope of the warranty. In the event Aeroflex is not able to modify, repair or replace nonconforming defective parts or components to a condition as warranted within a reasonable time after receipt thereof, the buyer shall receive credit in the amount of the original invoiced price of the product.

It is the buyer's responsibility to notify Aeroflex in writing of the defect or nonconformity within the warranty period and to return the affected product to Aeroflex's factory, designated service provider, or authorized service center within thirty (30) days after discovery of such defect or nonconformity. The buyer shall prepay shipping charges and insurance for products returned to Aeroflex or its designated service provider for warranty service. Aeroflex or its designated service provider shall pay costs for return of products to the buyer.

Aeroflex's obligation and the customer's sole remedy under this hardware warranty is limited to the repair or replacement, at Aeroflex's option, of the defective product. Aeroflex shall have no obligation to remedy any such defect if it can be shown: (a) that the product was altered, repaired, or reworked by any party other than Aeroflex without Aeroflex's written consent; (b) that such defects were the result of customer's improper storage, mishandling, abuse, or misuse of the product; (c) that such defects were the result of customer's use of the product in conjunction with equipment electronically or mechanically incompatible or of an inferior quality; or (d) that the defect was the result of damage by fire, explosion, power failure, or any act of nature.

The warranty described above is the buyer's sole and exclusive remedy and no other warranty, whether written or oral, expressed or implied by statute or course of dealing shall apply. Aeroflex specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. No statement, representation, agreement, or understanding, oral or written, made by an agent, distributor, or employee of Aeroflex, which is not contained in the foregoing warranty will be binding upon Aeroflex, unless made in writing and executed by an authorized representative of Aeroflex. Under no circumstances shall Aeroflex be liable for any direct, indirect, special, incidental, or consequential damages, expenses, or losses, including loss of profits, based on contract, tort, or any other legal theory.

Equipment return instructions

Please contact your local service center for Aeroflex products via telephone or web site for return or reference authorization to accompany your equipment. For each piece of equipment returned for repair, attach a tag that includes the following information:

- Owner's name, address, and telephone number.
- Serial number, product type, and model.
- Warranty status. (If you are unsure of the warranty status of your instrument, include a copy of the invoice or delivery note.)
- Detailed description of the problem or service requested.
- Name and telephone number of the person to contact regarding questions about the repair.
- Return authorization (RA) number or reference number.

If possible, return the equipment using the original shipping container and material. Additional Aeroflex shipping containers are available from Aeroflex on request. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. Aeroflex is not liable for any damage that may occur during shipping. The customer should clearly mark the Aeroflex-issued RA or reference number on the outside of the package and ship it prepaid and insured to Aeroflex.

End-User License Agreement

E

This appendix describes the conditions for using the instrument software (firmware).

All copyrights in and to the software product are owned by Aeroflex GmbH or its licensors. The software is protected by copyright laws and international copyright treaties, as well as other intellectual property laws and treaties.

This end-user license agreement grants you the right to use the software contained in this product subject to the following restrictions. You may not:

- (i) use the software and/or any copy of the software in different computers concurrently, unless the software is an update that has been downloaded from the Internet at www.aeroflex.com;
- (ii) copy the software, except for archive purposes consistent with your standard archive procedures;
- (iii) transfer the software to a third party apart from the entire product;
- (iv) modify, decompile, disassemble, reverse engineer or otherwise attempt to derive the source code of the software;
- (v) export the software in contravention of applicable export laws and regulations of the country of purchase;
- (vi) use the software other than in connection with operation of the product.

The licensor's suppliers do not make or pass on to end users or any other third party, any express, implied or statutory warranty or representation on behalf of such suppliers, including but not limited to the implied warranties of noninfringement, title, merchantability or fitness for a particular purpose.

Aeroflex shall not be held liable for any damages suffered or incurred by you or any other third party (including, but not limited to, general, special, consequential or incidental damages including damages for loss of business profits, business interruption, loss of business information and the like), arising out of or in connection with the delivery, use or performance of the software.

Glossary

B

BER — Bit error rate.

D

DGNA — Dynamic Group Number Assignment.

DMO — Direct Mode Operation, an alternative mode (to TMO) in which TETRA radios communicate with each other directly, without a base station. All TETRA radios use a single frequency (simplex mode).

E

ETSI — European Telecommunications Standards Institute.

M

MCC — Mobile country code, a number that uniquely identifies the country in which the network is located or the TETRA mobile station is registered. See section [“Network parameters” on page 184](#) for a list of valid codes and their meaning.

MCCH — Main control channel.

MER — Message error rate.

MNC — Mobile network code. Each TETRA network is uniquely identified by the combination of MCC and MNC. See “[Mobile Network Code MNC](#)” on [page 187](#) for more details.

MS — Mobile station. This term is used to denote the mobile radio in TETRA.

P

Power Class — The power class determines the maximum power that the TETRA radio can transmit. See a list of power classes on [page 181](#).

PTT — Push to talk. The PTT is a button at the TETRA mobile station that switches the mobile from receive (listen) to transmit (talk) mode in simplex calls. It must be kept pressed as long as the users wants to transmit (talk).

R

Receiver classes — Different performance requirements are specified for TETRA radios and base stations, depending on their intended purpose and application. TETRA specification EN 300 392-2 identifies four different receiver classes:

- Class B equipment is optimized for use in built-up and urban areas.
- Class A equipment is optimized for use in urban areas and in areas with hilly or mountainous terrain.
- Class D equipment has the same performance requirements as class A for $\pi/4$ -DQPSK modulation, and is further optimized to enhance the performance of $\pi/8$ -D8PSK modulation in hilly or mountainous terrain using equalisation or other techniques.
- Class E equipment comprises an equalizer and is specified for $\pi/4$ -DQPSK modulation in static, TU50, HT200 (PACQ only) and EQ200 conditions. It is not applicable to BS equipment. Class E performance is specified only for $\pi/4$ -DQPSK modulation.

S

SCH/F — Synchronisation channel associated with a full rate channel.

SCH/HD — Signalling Channel for mapping onto Half-bursts on the Downlink.

SCH/HU — Signalling Channel for mapping onto Half-bursts on the Uplink.

SDS — Short Data Service. With SDS, TETRA radios can send and receive short messages. This service is similar to, but more powerful than the Short Message Service (SMS) known from public cellular systems.

SSID — The short subscriber ID (SSID) is a number used over the radio interface to identify individual TETRA mobile stations.

STCH — Stealing Channel, a signalling channel that momentarily replaces the traffic channel when needed.

T

T1 signal — Specification EN 300 394-1 defines a test signal T1 which is a scrambled downlink traffic channel containing a pseudo-random bit sequence (PRBS). The test system transmits this signal at a defined power level and the MS tries to demodulate and decode the signal. It is commonly used to test the receiver of the MS.

T2 signal — ETSI specification EN 300 394-1 defines a test signal T2 to be a continuous, PRBS-modulated signal without training sequence. It is used as an interfering (unwanted) signal in large test systems and typically not required for service testing.

T3 signal — ETSI specification EN 300 394-1 defines a test signal T3 to be a continuous, unmodulated, sinusoidal signal. It is used as an interfering (unwanted) signal in large test systems and typically not required for service testing.

TCH — Traffic channel. The TETRA standard defines traffic channels with different types of payload: full-rate and half rate voice channels (TCH/F, TCH/H) and data channels with different data rates (TCH 2.4, TCH 7.2)

TDMA — Time division multiple access, a technology that transfers several communication channels over one frequency carrier by multiplexing the channels into several time slots per frame. TETRA uses four time slots per frame, that means up to four calls can be made on one TETRA carrier. The base station transmits all four time slots in the downlink (to the TETRA mobile stations) while up to four mobiles transmit in turn. This requires precise synchronization in time. – Other access technologies include FDMA (frequency division multiple access), CDMA (code division multiple access) and OFDMA (orthogonal frequency division multiple access).

TEI — The TETRA Equipment Identifier (TEI) is the electronic serial number of the TETRA radio. It consists of six-digit type approval code (TAC), a 2-digit final assembly code (FAC), a 6-digit electronic serial number (ESN) and a 1-digit spare number. Each digit is a hexadecimal number (from 0 to 9 or A to F).

TETRA — Terrestrial Trunked Radio, the name of the ETSI standard.

TMO — Trunked mode operation, the normal operating mode in which the TETRA radios communicate through a network including one or more base stations. The radio communication is performed on a pair of channels: the base station transmits signals, e.g. from another TETRA radio, on one channel while the TETRA radio transmits on another channel. – The alternative to TMO is DMO.

TS — Time slot.

Publication History

Revision	Comment
1007-200-A	First version.
1101-210-A	Autotest for base stations and other features added for firmware version 2.10.

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