STABILOCK 4031 4032

# 2.1 GHz Analyzer Tracking

**Software Option 897 928**

**Operating Instructions**

63_anatr Doc. Version: 9806-100-C

Acterna Muenchen GmbH, Gutenbergstr. 2 – 4, D-85737 Ismaning

☎ +49 (89) 9 96 41-0 Fax: +49 (89) 9 96 41-160

Supplement for the Operating Manual; file under chapter 10

10

# Contents



10

☞ **Differences to former software versions: see the Lifeline at the end of this supplement.**

# Technical Data

| Performance | |
|---|---|
| Dynamic range of level display | 100 dB |
| Level resolution | 0.1 dB |
| Sweep time (for 150 MHz Sweep width, 100 points resolution) | 4 s |
| Sweep range | 125 to 2100 MHz |
| Minimum sweep width | 20 kHz |
| Maximum sweep width | 1974.9999 MHz |
| Maximum frequency resolution | 100 Hz |
| Level zoom | Yes |
| Store/load curve | Yes |
| Superimpose two curves | Yes |
| Overlay graticule | Yes |
| Differential measurements | Yes |

# Requirements for Analyzer Tracking

**Hardware**

- Hardware option "FEX" must be installed (hardware option 248 295).
- Hardware option "Spectrum analyzer" must be installed (hardware option 248 290/248 291).

**Firmware**

- Call up the status mask of the test set with AUX + DEF.PAR + STATUS and check whether the HOST-MCU, CRT-MCU and RF/AF-MCU fields show the following firmware version:

| | STABILOCK 4031 | STABILOCK 4032 |
|---|---|---|
| HOST-MCU | ≥ 4.20 | ≥ 6.20 |
| CRT-MCU | ≥ 3.20 | ≥ 3.20 |
| RF/AF-MCU | ≥ 4.20 | ≥ 6.20 |

If your firmware is an earlier version, you will need to update it.

The software option must be installed just once before the first callup from the delivered memory card (see section "Installation").

# Accessories supplied

- Memory card (Ordering code: 897 928) for enabling the software option
- Operating instructions
- Cable TNC to N (Ordering code: 382 261)

# Recommended accessories

| | |
|---|---|
| Cable N to N | Ordering code: 382 128 |
| SWR bridge | Anritsu Company, Type 60 NF 50<br>Anritsu Company,<br>490 Jarvis Drive,<br>Morgan Hill, CA 95037-2809,<br>USA<br><br>or<br><br>Eagle Company, Type RLB150N4A<br>Eagle Company,<br>PO Box 4010<br>Sedona, AZ 86340<br>USA |

# Call-up of Analyzer Tracking

1) Call up the spectrum analyzer with TX + ANALYZER.
2) Call up Analyzer Tracking with ETC + TRACKING. The TRACKING softkey will not appear if the Communication Test Set does not satisfy the above-mentioned requirements.
3) Return to the spectrum analyzer with ANALYS..

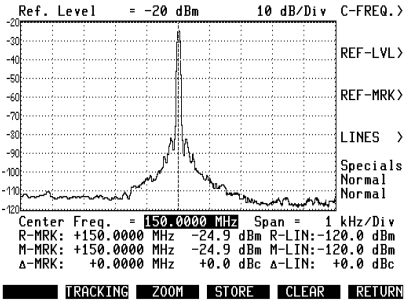



**Fig. 10.1:**
The main mask of the spectrum analyzer shows the TRACKING softkey.

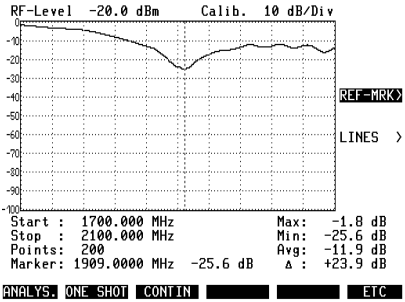



**Fig. 10.2:**
Analyzer Tracking mask. The user interface is oriented on that of the spectrum analyzer.

# Test Setup

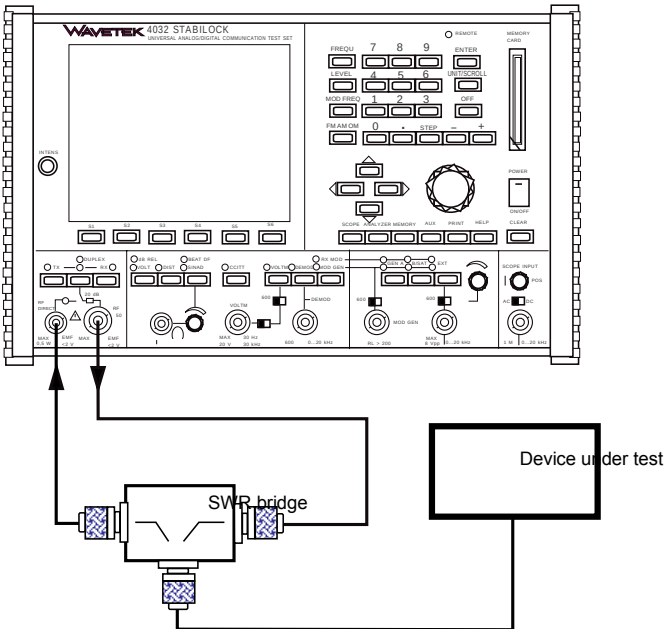



**Fig. 10.3:**
The SWR bridge is connected to the RF DIRECT socket (input) and to the RF socket (output).

# Basic Settings

Normally you make the basic settings just once at the beginning of a measurement and then hardly have to change them.

The RF DIRECT socket is automatically selected as signal input socket, the signal output socket is the RF socket. The LED RF DIR is dark!

**Overload risk:** Make sure the test signal does not exceed the permissible input power level of the Communication Test Set when making measurements on active twoports (see Chapter 1, "Permissible RF input power").

## Activating/deactivating graticule

The main mask can be overlaid with a graticule for easier orientation.

**Graticule conceals level lines:** It is best to blank the graticule when working with the horizontal level line.

| | | |
|---|---|---|
| 1. | ANALYZER | Call up the SETTINGS mask. |
| 2. | Preparation | If necessary, position the cursor on the `GRID` scroll field. |
| 3. | Select scroll variable | Choose the required function, eg with UNIT/SCROLL.<br>`ON`: activates graticule<br>`OFF`: deactivates graticule |
| 4. | RETURN | Return to the main mask. |

## Setting RF output level

| | | |
|---|---|---|
| 1. | Preperation | Move the cursor in the main mask with the cursor buttons to the `RF-Level` entry field. |
| 2. | Enter required level on numeric block | The entry determines the output level of the RF generator (level of sweep signal).<br><br>Permissible input range:<br>–20.0 dBm to –70.0 dBm<br>(dBm are fixed unit). |
| 3. | ENTER | Confirm your entry. |

10

## Entering start/stop frequency

The figures for start and stop frequency determine the frequency band that appears in the tracking window.

| | |
|---|---|
| 1. Locate entry field | Move the cursor to the `Start` or `Stop` entry field. |
| 2. <value> | Enter the required figures for the start and stop frequency (of the sweep signal).<br><br>Permissible figures:<br>125 MHz to 2100.0000 MHz<br><br>**Note:** The stop frequency must be at least 20 kHz higher than the start frequency. |
| 3. ENTER | Confirm your entry.<br><br>**Note:** When correct entrys are confirmed, there may be slight corrections of the start or stop frequency. The reason for this is, that the frequency of the sweep signal can only be altered in increments of 100 Hz or a multiple of this. If the frequency figures and selected resolution do not allow this, the figure for the stop frequency is (normally) corrected automatically. |

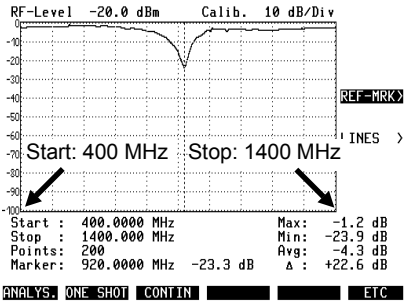



**Fig. 10.4:**
Measurement here is in the frequency range 400 to 1400 MHz.

## Selecting frequency resolution

The tracking window gives you resolution of 400 points on the frequency axis. But measurement is only made on every 2nd, 4th or even 8th point so that the update cycle for refreshing the display does not take too long.

| | | |
|---|---|---|
| 1. | Locate entry field | Move the cursor to the `Points` scroll field. |
| 2. | Select scroll variable | Choose the required resolution, eg with (UNIT/SCROLL) (50, 100 or 200 points). |

# Calibrating Test Setup

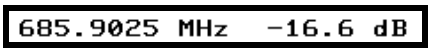
You should calibrate the test setup immediately before a measurement. This compensates errors caused by the test set in the entire frequency range. At the same time the current RF output level of the RF generator becomes the 0 dB reference for all subsequent level measurements.

| | | |
|---|---|---|
| 1. | Preparation | Make the basic settings (this mainly involves setting the RF output level).<br><br>Connect the RF DIRECT socket to the RF socket. Use the RF cables that will be used later to connect the test item (see Fig 10.3). The calibration is started without the device under test, the SWR bridge is open. |
| 2. | (ZEROCAL) | Start the calibration. As soon as this has been completed, `Uncal.` will be replaced by `Calib.` |

# Meaning of Test Lines

Analyzer Tracking offers you two different test lines for reading frequency and level figures.

**Frequency marker** The vertical test line always produces two figures: frequency and level at the current marker position. Display of the measured figure in the `Marker` field.




**Level line** The horizontal test line is intended for simpler reading of level figures, and it also delimits the visible segment for the zoom function (see section "Zoom").

☞ All measured level figures are relative, ie referred to 0 dB. So do not forget to calibrate the test setup before a measurement for the correct reference to 0 dB.

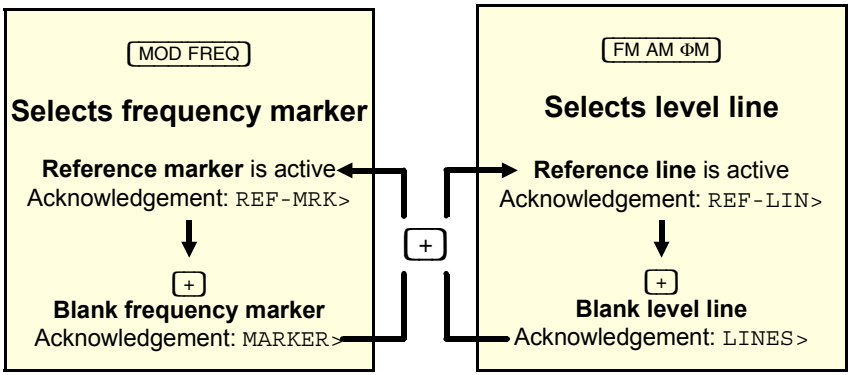
**Example:** When the test setup is calibrated, the external RF generator has an RF output level of –20 dBm for instance. After calibration this absolute figure is assigned the relative figure 0 dB (20 dBm ≙ 0 dB). So a measured figure of –16.6 dB (referred to 0 dB) corresponds to an absolute figure of –36.6 dBm.

## Activation test lines

You move the frequency marker and level line with the spinwheel. So before moving a test line, you must decide which one you want to move. The two scroll fields at the righthand edge of the display point (>) to the keys for assigning the spinwheel to a test line.

MOD FREQ — **Activates frequency marker:** the `MARKER>` scroll field becomes the active field and shows the `REF-MRK>` scroll variable. This indicates that the spinwheel is now acting on the frequency marker. [+] will blank the marker.

FM AM ΦM — **Activates level line:** the `LINES>` scroll field becomes the active field and shows the `REF-LIN>` scroll variable. This indicates that the spinwheel is now acting on the frequency marker. [+] will blank the level line.



## Special notes on operation

- The frequency marker and level line are blanked: if you turn the spinwheel, the frequency marker always appears.
- When they are activated again, the frequency marker and level line always appear at the position last set.
- When the frequency marker or the level line is blanked, the numeric display of the measured figure stays. The measured figures are for the position last set. They are not updated until you reposition the marker or line.

# Starting Measurement

The Communication Test Set offers the usual functions for starting and evaluating a measurement in Analyzer Tracking.

(ONE SHOT) Triggers a one-shot measurement (the curve is measured once). The onscreen display is frozen (static) so that you can analyze it more easily.

(CONTINUE) Triggers a continuous measurement. The curve is measured continuously for analysis of the dynamic display.

(FREEZE) The momentary display is frozen. (CONTINUE) or (ONE SHOT) triggers a new measurement.

# Test Results

For manual measurement of the displayed curve you have the frequency marker and the level line (result display in the `Marker` field). Parameters of the curve are measured and displayed automatically.

`Marker` **Frequency marker active:** display of the marker frequency and the level measured at this frequency.

The following level figures are independent of the test lines. These results are derived from the course of the curve. Those level components are also considered that project out of the window, upwards or downwards, and are consequently not visible. But signal components outside of the displayed frequency band are not taken into consideration.

`Max` Maximum level of curve.

`Min` Minimum level of curve.

`Avg` Floating average of the level, computed from the preceding measured figures.
Computation of average (recursive):

$$a = 1 - \frac{1}{n}$$

$$Y_0 = \frac{X_0}{(1 - a)}$$

$$Y_k = a \cdot Y_{k-1} + X_k$$

$$Y = Y_k\,(1 - a)$$

n = number of preceding, weighted measured figures
$X_0$ = first measured figure
$Y_{0,\,k}$ = weighted, preceding average
Y = floating average

$\Delta$ Level difference (`Max` – `Min`).

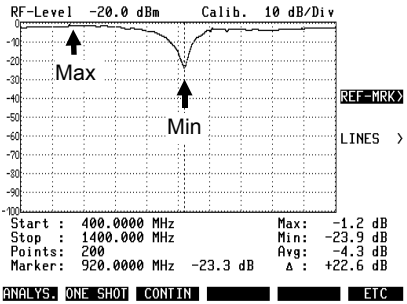



**Fig. 10.5:** The level difference is computed from the maximum and the minimum level.

# Test Aids

## Zoom

| | | |
|---|---|---|
| 1. | (ZOOM) | Shows the segment below the current level line magnified on the monitor. (ZOOM OFF) takes you back to the normal mode. |

## Saving curve

### Temporary save

| | | |
|---|---|---|
| 1. | (STORE) | This saves the curve momentarily displayed in the main memory of the Communication Test Set. Only the contents of the window are saved, ie without any markers and lines.<br><br>The curve is kept in the main memory until a total reset of the Communication Test Set. |

### Permanent save on memory card

| | | |
|---|---|---|
| 1. | (STORE) | This saves the curve in the main memory of the Communication Test Set. |
| 2. | [ANALYZER] | Call up the SETTINGS mask. |
| 3. | (SAVE) | Call up the SAVE mask. |
| 4. | Select memory location | Mark the memory location with the cursor in which the curve is to be saved. If the selected memory location is already occupied, the stored curve will be overwritten. A maximum of four curves can be saved on one memory card, regardless of its capacity. |
| 5. | (ENTER) | Opens the entry field for the name of the curve. |
| 6. | Enter name | Enter the name of the curve with the softkeys. |
| 7. | (ENTER) | Ends entry of the name and saves the curve on memory card. |

# Loading saved curve

## From main memory

| | | |
|---|---|---|
| 1. | (RECALL) | The curve saved in the main memory is displayed on the monitor. |

## From memory card

| | | |
|---|---|---|
| 1. | Insert memory card | Put the memory card with the saved curve in the slot. |
| 2. | (ANALYZER) | Call up the SETTINGS mask. |
| 3. | (LOAD) | Calls up the LOAD mask. |
| 4. | Select curve | Select the memory location holding the required curve with the cursor keys. |
| 5. | (LOAD) | Confirm your choice. The curve is loaded into the main memory of the Communication Test Set. Any curve already saved here will be overwritten. |
| 6. | (RECALL) | Shows the curve loaded to the main memory on the monitor. |

# Superimposing two curves

| | | |
|---|---|---|
| 1. | Load curve to main memory | First a curve must be loaded to the main memory of the Communication Test Set, ie you either temporarily save a current curve or load a curve saved on memory card. |
| 2. | (RECALL) | Shows the curve loaded to the main memory on the monitor. |
| 3. | Start measurement | Start the measurement with (CONTINUE) or (ONE SHOT). The curve from the main memory stays onscreen. The new curve is displayed at the same time. |

# Deleting curve

| | | |
|---|---|---|
| 1. | (CLEAR) | The curve loaded to the main memory is blanked, only the momentarily measured curve is displayed. |

# Application example

## Measuring Q of RF cables and antennas

**Purpose**

**Cable:** RF cables are usually specified over a wide range of frequency. But you want to know the precise return loss for a certain operating frequency.
**Antenna:** You want to check that the good VSWR promised by the manufacturer of an antenna is really obtained at the operating frequency of the antenna.

**Preparation**

- Enter the start/stop frequency in the tracking mask and determine the reference level (see "Preparing to Test"). Do not change levels and frequencies while testing.
- Calibrate test setup (see "Calibrating Test Setup").
- **Cable** (or a specimen): Fit the cable with connectors for joining it to the bridge and a 50-Ω termination. Connect the bridge to the Communication Test Set (see "Test Setup")
  **Antenna:** Connect the antenna to the DEVICE UNDER TEST socket of the VSWR bridge. Connect the bridge to the Communication Test Set (see "Test Setup").

The aids (eg cable to connect the antenna) should have as high a return loss as possible so that the measured result is not corrupted.

After you change the RF level, the test setup should be calibrated.

**Procedure**

The curve shows the return loss of the RF cable or of the antenna as a function of frequency.

**Example (see Fig. 10.7):**

- ❍ Procede measurement.
- ❍ Activate marker and set to the operating frequency of the cable or antenna.

  Measured figure = –25.6 dB (return loss)

  This return loss corresponds to a VSWR of 1.1108 and a reflection coefficient of 5.2481 % (see table in the Appendix).

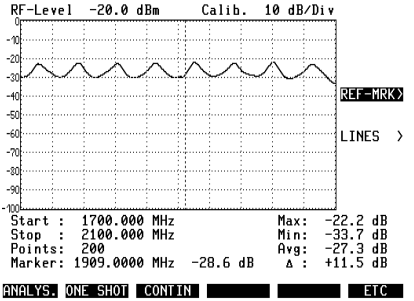



**Fig. 10.6:**
Cable measured in the CDMA / PCS 1900 band. This cable is not useable in this frequency band.

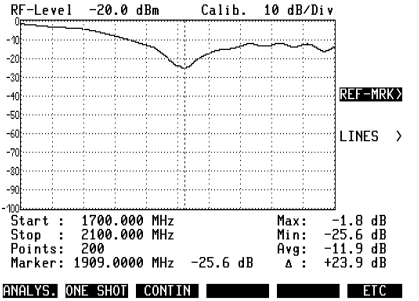



**Fig. 10.7:**
Antenna in the CDMA / PCS 1900 band.

# IEEE and AUTORUN Commands

## Settings

| IEEE command | Meaning |
|---|---|
| Analyzer mask | |
| ANALZ | Call up settings mask of spectrum analyzer (only if the TX mode is activated with SETTX) |
| SOFT_ETC | Call up second softkey level |
| SOFT_TRACKING | Call up analyzer tracking mask |
| Analyzer Tracking mask | |
| ANALZ | Call up settings mask of Analyzer Tracking mask |
| WRTVA01,ndBm | n = output level |
| WRTVA02,nMHz | n = start frequency |
| WRTVA03,nMHz | n = stop frequency |
| WRTVA04,n | n = resolution (points) |
| Settings mask of Analyzer Tracking | |
| WRTVA01,G | Activate or deactivate the graticule<br>G = ON (graticule on) or OFF (graticule off) |

## Commands for controlling test lines

| IEEE command | Meaning |
|---|---|
| MARKPx | Positioning of frequency marker,<br>x = pixels from left margin (0 = marker left,<br>400 = marker right). |
| MARKFx | Positioning of marker,<br>x = frequency at which the marker is to be positioned. |
| LINEPx | Positioning oflevel line,<br>x = pixels from the lower segment (0 = marker down,<br>160 = marker up). |

## Polling results

| Poll | Command |
|---|---|
| Frequency at marker position | RESULt5 |
| Level at marker position | RESULt6 |
| Maximum level | RESULt7 |
| Minimum level | RESULt8 |
| Difference maximum and minimum level | RESULt9 |
| Average of level | RESULtA |

# Appendix

## Conversion of measured figures

| **Return loss** | VSWR | Reflection coefficient |
|---|---|---|
| 0 dB | ---------- | 100.0000 % |
| 1 dB | 17.3910 | 89.1251 % |
| 2 dB | 8.7242 | 79.4238 % |
| 3 dB | 5.8480 | 70.7946 % |
| 4 dB | 4.4194 | 63.0951 % |
| 5 dB | 3.5698 | 50.2341 % |
| 6 dB | 3.0095 | 50.1187 % |
| 7 dB | 2.6149 | 44.6684 % |
| 8 dB | 2.3229 | 39.8107 % |
| 9 dB | 2.0889 | 35.4813 % |
| 10 dB | 1.9250 | 31.8228 % |
| 11 dB | 1.7849 | 28.1838 % |
| 12 dB | 1.6709 | 25.1189 % |
| 13 dB | 1.5769 | 22.3872 % |
| 14 dB | 1.4985 | 19.9526 % |
| 15 dB | 1.4326 | 17.7828 % |
| 16 dB | 1.3767 | 15.8489 % |
| 17 dB | 1.3290 | 14.1254 % |
| 18 dB | 1.2880 | 12.5883 % |
| 19 dB | 1.2528 | 11.2202 % |
| 20 dB | 1.2222 | 10.0000 % |
| 21 dB | 1.1957 | 8.9125 % |
| 22 dB | 1.1726 | 7.9433 % |
| 23 dB | 1.1524 | 7.0795 % |
| 24 dB | 1.1347 | 6.3096 % |
| 25 dB | 1.1192 | 5.6234 % |
| 26 dB | 1.1055 | 5.0119 % |
| 27 dB | 1.0935 | 4.4668 % |
| 28 dB | 1.0829 | 3.9811 % |
| 29 dB | 1.0736 | 3.5481 % |
| 30 dB | 1.0653 | 3.1623 % |
| 31 dB | 1.0580 | 2.8184 % |
| 32 dB | 1.0515 | 2.5119 % |
| 33 dB | 1.0458 | 2.2387 % |
| 34 dB | 1.0407 | 1.9953 % |
| 35 dB | 1.0362 | 1.7783 % |
| 36 dB | 1.0322 | 1.5849 % |
| 37 dB | 1.0287 | 1.4125 % |
| 38 dB | 1.0255 | 1.2589 % |
| 39 dB | 1.0227 | 1.1220 % |
| 40 dB | 1.0202 | 1.0000 % |

## Conversion formulas

**Return Loss (dB) to VSWR**

$$VSWR = \frac{[\overline{\log}\,(\frac{|RL|}{20})] + 1}{[\overline{\log}\,(\frac{|RL|}{20})] - 1}$$

Example:
The result of the measurement is a return loss of 14 dB.
The table and the formula shows a VSWR of 1.4985.

**Return Loss (dB) to reflection coefficient** (RC in %)

$$RC = [\overline{\log}\,(-\frac{|RL|}{20}) \times 100]$$

Example:
The result of the measurement is a return loss of 14 dB.
The table and the formula shows a reflection coefficient of 19.9526 %.

## Software installation

The software option is a licensed application, so a separate procedure is necessary for installation on each STABILOCK Communication Test Set.

After installation on a Communication Test Set the memory card is no longer necessary for executing tracking.

The installation is registered on the memory card. Dual installations are *not* possible. Accidental dual installation on one and the same Communication Test Set is recognized in good time by the installation program and prevented.

☞ In any subsequent firmware update the software option installed on the Communication Test Set is maintained.

### Installation instructions

1) Be careful when choosing the test set (STABILOCK 4031/4032) on which you want to install the software. Once it has been installed, the software can only be removed from the Communication Test Set at the Wavetek plant (Germany).
2) Check the position of the write protect switch on the memory card: write protection must *not* be activated (see STABILOCK manual, Chapter 7).
3) Power on the Communication Test Set and insert the memory card in the front panel slot.
4) Call up the MEMORY mask with [MEMORY].
5) Move the cursor bar to the `TRACKING.SYS` entry with the cursor keys and start installation with (RECALL). The installation program then checks that the current configuration of the Communication Test Set meets requirements. If not, the screen will show which modules are affected (Fig. 10.8). Note any such messages and contact your nearest Wavetek office.
6) If the hardware check is ok, the installation program then checks the licence information on the memory card. If the card can be installed, this is indicated by `Card valid`.
7) If the licence check is ok, you will be asked if you are sure that the software really is to be installed on this particular Communication Test Set. (NO) enables you to abort installation (Fig. 10.9).

8) If you answer (YES), the software is permanently installed on the Communication Test Set. Once this has been completed, you will read `TRACKING successfully installed` (Fig. 10.10). After this remove the memory card and quit the installation program with (EXIT). The Communication Test Set then reboots to enable the software option.

9) Keep the memory card in a safe place (card is proof of purchase) and note the expiry date of its backup battery (see STABILOCK manual, Chapter 7).


**Fig. 10.8:**
Example of a message that appears if hardware requirements are not satisfied.

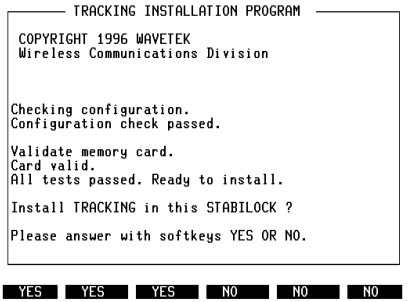



**Fig. 10.9:**
Display of a memory card ready for installation and a last question before you proceed.

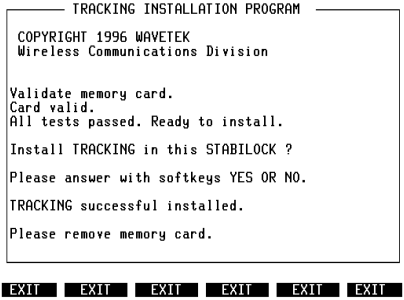



**Fig. 10.10:**
Following installation the installation program prompts you to remove the memory card.

# Lifeline

The chronological lifeline tells you what modifications have been made to the software (SW) and the operating instructions. After a software update the lifeline helps you to find out quickly about all major changes (see code) in the updated operating instructions that are supplied.

Code: C = Correction, IN = Important Note, NF = New Feature

| Doc. Version | Δ pages | Code | Changes |
|---|---|---|---|
| 9803-100-A | no | – | First edition. |
| 9804-100-B | 10-6 | NF | New SWR bridge supplier added. |
| 9806-100-C | 10-6 | NF | Equipment supplied added. |
| | some | C | Minor documentation faults corrected. |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

10