will'tek

OPERATING INSTRUCTIONS

STABILOCK® 4032
Communication Test Set

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Cross if applicable

- ❒ DUPLEX-FM/ΦM Stage
- ❒ Modulation Generator GEN B
- ❒ Control Interface A, B, C, D
- ❒ OPTION CARD
- ❒ DATA Module
- ❒ ASCII Keyboard
- ❒ VSWR Test Probe
- ❒ VSWR Test Set
- ❒ RS-232/Centronics Interface
- ❒ SSB Stage
- ❒ External Battery
- ❒ RF Generator
- ❒ Spectrum Analyzer
- ❒ ACPM
- ❒ 2nd RF generator + Fast Tracking
- ❒ FEX
- ❒ .....
- ❒ .....

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Cross if applicable

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- ❒ NMT 450i
- ❒ NMT 900 (Scandinavia)
- ❒ Natel-C (Switzerland)
- ❒ NMT France
- ❒ NMT 450/900 BS Test
- ❒ NMT Turkey
- ❒ NMT Benelux
- ❒ NMT 450 universal
- ❒ NMT 900 universal
- ❒ Network C Austria (NMT 450i)
- ❒ Network C Germany
- ❒ Network C Portugal
- ❒ Network C SAPO
- ❒ EAMPS
- ❒ NAMPS
- ❒ DSAT/DST (NAMPS)
- ❒ ETACS-UK
- ❒ TACS Japan (J-TACS)
- ❒ NTACS
- ❒ RC 2000 HD
- ❒ DIGI-S (includes VDEW Digital)
- ❒ FMS
- ❒ VDEW digital
- ❒ VDEW direct dialing
- ❒ VDEW digital (Bosch)
- ❒ ZVEI binary
- ❒ ZVEI binary (600 Baud)
- ❒ ZVEI extended
- ❒ AT&T Microcell
- ❒ Cityruf
- ❒ POCSAG (NRZ)
- ❒ POCSAG (FFSK)
- ❒ Trunking (MPT 1327/PAA 2424)
- ❒ Combiner Test
- ❒ US Signalling Formats
- ❒ LTR + US Signalling
- ❒ NADC 45 BS Test
- ❒ NADC 45 MS Test
- ❒ NADC (DAMPS) MS Test
- ❒ NADC (DAMPS) BS Test
- ❒ NADC MS Test AUTORUN
- ❒ GSM/DCS 1800/1900 MS Test
- ❒ GSM BS Test
- ❒ GSM MS Test AUTORUN
- ❒ PDC MS Test
- ❒ ATIS
- ❒ DECT
- ❒ CDMA BS Test
- ❒ Tetra MS Test
- ❒ Tetra BS Test
- ❒ IS-136 MS and IS-136 DB Tracking
- ❒ 2,1 GHz Analyzer Tracking
- ❒ Fast IEEE Measurements
- ❒ .....
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Declaration of EEC Conformity

Manufacturer	Willtek Communications GmbH Gutenbergstrasse 2 – 4 85737 Ismaning Germany
Product Name	STABILOCK 4032

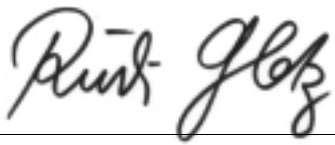
This product conforms with the regulations of the following European Directives:

The low-voltage directive has been superseded by the directive 93/68/EEC	73/23/EEC
EMC Directive	89/336/EEC

The conformity of this product to the above-mentioned directives is proved by application of the following Standards:

EMC	EN 55022, class B (1995) EN 60801, part 2, test level 1 (1994) ENV 50140, test level 2 (1995) IEC 1000-4-4, test level 3 (1995)
Safety	EN 61010, part 1 (1993)

Ismaning, December 6th 1996



Rudi Glotz, Quality Manager

This declaration may not be interpreted as an assurance of characteristics. The safety instructions in the product documentation should be observed.

Document name: C_40323.DOC

☞ **Note please:** Since mid of 2002 the manufacturer of the STABILOCK 4032 has the new legal name Willtek Communications GmbH. This renaming is reflected by the current available basic operating manual of the Communication Test Set. However, the descriptions of the numerous hardware and software options could still show older company names like Acterna or Wavetek.

Startup

Notes on Safety

STABILOCK 4032 has been built and tested in line with DIN 57411 Part I/VDE 0411 Part 1 (protective measures for electronic measuring apparatus). The instrument left the works quite correctly engineered for safety. To maintain this state and ensure safe operation, observe carefully what is said below:

Power fuse

Only use fuses of the type stated (see section "Replacing fuse"). Do NOT patch your fuses or short the fuse holder.

Grounding

The line plug of STABILOCK 4032 may only be connected to a socket with a grounding contact. The protection (grounding) that this produces may not be cancelled by using an extension cable that has no safety ground conductor. Nor is it permissible to intentionally interrupt the safety ground conductor either inside or outside the instrument (eg by undoing the connection for the safety ground conductor).

If there is no grounding through the safety conductor and a defect occurs, the housing of STABILOCK 4032 could become live, which is highly dangerous!

Shutdown upon defect

If you suspect that the 4032 is not safe to operate, shut it down immediately and secure it in such a way that it cannot be switched on again, especially by persons who are unaware of the danger. Then contact a Willtek service agency.

Maintenance

Before any adjustment, maintenance, repair or replacement of parts the instrument must be separated from all voltage sources if it will be necessary to open it. Maintenance or repairs on the instrument while voltage is applied should only be performed by someone who is well aware of the dangers involved by this.

What You Should Know

The firmware of STABILOCK 4032 (internal operating system stored in EPROMs) is what produces the performance features of the communication tester. And because this firmware is constantly being maintained and further developed, you can expect to have to make a number of firmware updates to your STABILOCK 4032. Of course, the operating instructions sent you with the new EPROMs are of little use if you do not know what has been changed or what has been added.

So, when firmware is updated, you should first refer to the sections **"Version status"** and **"STABILOCK 4032 Lifeline"** (Chapter 12) of the new operating instructions. There you will find the information you need in short form.

Superscript digits in the text mark important passages that have been altered or newly included. The version status tells you about the meaning of the digits. In this way you can find out at any time, for example, whether an IEEE command marked by a superscript digit is also available on your communication tester.

☞ Maybe you received these operating instructions together with a new 4032 and not with an update. In that case you will not be interested in "water under the bridge", and you can safely ignore the superscript digits.

Equipment Supplied

Your STABILOCK 4032 is delivered to you with the following standard accessories:

2 x Miniature line fuses 3.15 A
1 x Power cable
1 x TNC/BNC adapter
1 x TNC protective cap
1 x Front-panel cover
1 x Headphones plug
1 x Memory card (32 kbytes, blank)
1 x Operating manual

The ordered options are usually already incorporated in the Communication Test Set. You can see what options are in your 4032 at any time by calling up the socalled status mask on the screen. The callup of the status mask is described in Chapter 4.

Preparations for First Startup

Different power supplies

Before switching STABILOCK 4032 on with the POWER button, refer to the illustrations below to find out what version of the POWER SUPPLY your Communication Test Set is fitted with.

The power supply without a DC input is standard. If you want to be able to operate STABILOCK 4032 away from a power outlet, you need the optional AC/DC power supply (ordering code 204 033, **Fig. 1.2**).

☞ Do you have an older STABILOCK 4031/4032 (serial number < 1388123)? If so, do **not** use its power supply (204 031) in a later STABILOCK Communication Test Set![6].

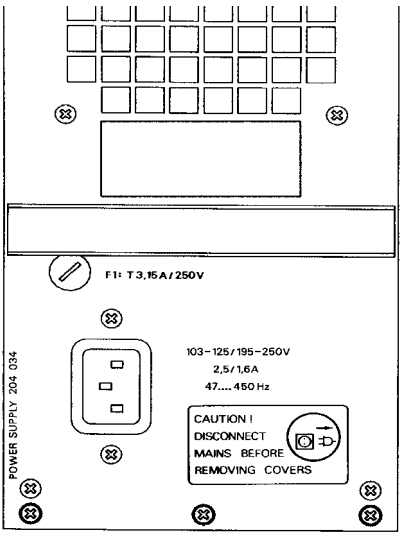


Fig. 1.1: Power supply[6] without DC input.

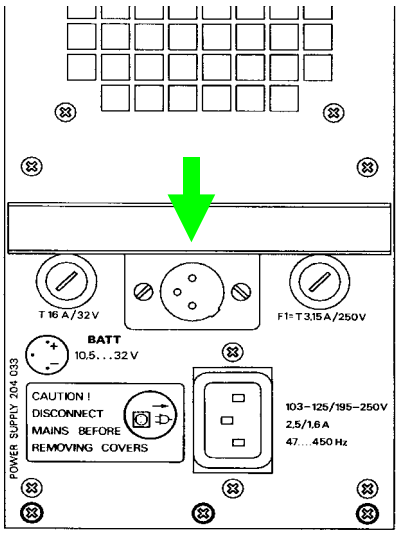


Fig. 1.2: Power supply[6] with DC input.

Admissible line voltage

Both power supplies adjust automatically to the applied line voltage (ie 110 or 230 Vac). The line-voltage tolerances within which the power supply will work correctly can be found on its back panel.

Replacing fuse

You will need the following fuse, regardless of the line voltage:

T3.15/250D (slow-blow; 3.15 A; 5.2 x 20 mm)

☞ Note that, with older versions of the power supply, the rating of the fuse depends on the applied line voltage. But you cannot go wrong as long as you look at what is printed on the power supply module.

Line/battery in parallel

When STABILOCK 4032 is being line-powered, this does not mean that an external battery has to be disconnected[6)]. This parallel mode of operation will not endanger either the battery or the 4032. The line takes priority, so the battery is neither discharged nor charged.

Preparations for Battery Powering

Feed-in point

In mobile use STABILOCK 4032 can also be powered from a battery (external). The connecting cable for this should have a cross-section of at least 1.5 mm^2. The feed-in point (3-way flange connector) is located on the back panel on the POWER SUPPLY module[6)].

Battery voltage and power requirement

A battery voltage of between 10.5 and 32 Vdc is permissible (at turn-on a minimum voltage of 10.8 Vdc is necessary). For 12 Vdc the current drain is approx. 7.5 A and for 24 Vdc approx. 3.75 A.

Fuse

There is a miniature fuse T16/32 V (slow; 16 A; format 6.3 mm x 32 mm) in the lefthand fuse holder[6)]. The rating of this fuse is independent of the battery voltage.

Preparing battery cable

When you connect a lead to the battery connector, it is best to refer to the marking next to the flange connector for the poling. The third terminal of the battery connector is left vacant[6)]. The battery connector and the flange connector are non-reversible. If the poling is nevertheless reversed, eg when connecting the battery, an internal protective diode will prevent any damage occurring to STABILOCK 4032. Note that the battery cable must be capable of conducting up to 10 A rated current, and check the ready cable for shorting across the poles before using it.

Battery/line in parallel

If an external battery is connected to STABILOCK 4032, the unit can still be fed from the line[6)]. The line takes priority, so the battery will not be discharged in parallel mode, but it will not be charged either.

Permissible RF input power

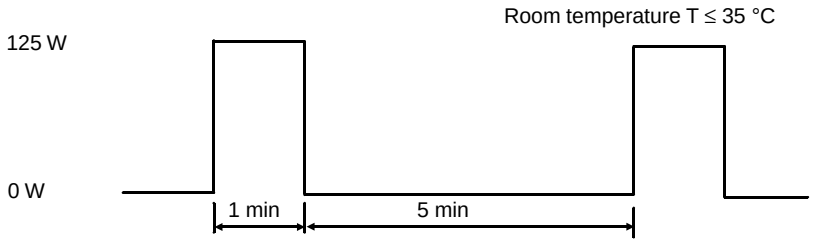
The permissible input power of STABILOCK 4032 means the average value of the applied power ($P_{average}$ or P_{av} for short).

RF DIRECT socket

Make sure under all circumstances that no signal of more than 500 mW is fed into the RF DIRECT input/output socket. If this critical limit is exceeded, the highly sensitive RF input stage of the Communication Test Set will immediately be destroyed. The time during which the maximum permissible average power may be applied to the RF DIRECT socket is not limited.

RF socket

Power of up to P_{av} = 50 W may be applied to the RF socket for any length of time. The Communication Test Set can for a short time sustain higher input power up to P_{av} = 125 W. The following diagram illustrates for P_{av} = 125 W the relationship between permissible duration of application and the waiting time between two measurements:



1 min = permissible duration of application
5 min = waiting time between two measurements

For power of 50 W < P_{av} < 125 W the permissible duration of application is correspondingly lower. When you reach the permissible duration of application, the message REDUCE RF POWER appears on the monitor.

When the message REDUCE RF POWER appears on the monitor, you must immediately reduce the applied power to $P_{av} \leq 50$ W. Otherwise the internal power attenuator will be destroyed. Furthermore: For as long as power of $P_{av} \geq 50$ W is applied, STABILOCK 4032 may **not** be switched off (switch-off → attenuator = 0 dB → **danger for preamplifier). The** REDUCE RF POWER message may also remain during the cooling-off phase of the power attenuator, meaning that STABILOCK 4032 is not ready to measure during this time.

Switch-on

Once you have completed the preparations for first-time startup, you can connect your STABILOCK 4032 to the line without any worry and start it by striking the [POWER] key. Switch-on is confirmed by a short signal tone; after a few seconds one of the socalled screen masks will appear on the monitor. You can adjust the intensity of the display with the INTENS rotary knob.

If you have not made any entries on STABILOCK 4032 for 20 to 25 min, the momentarily displayed mask will be replaced by a screen protection. As soon as a key is pressed, the monitor will again show the mask originally displayed. The GENERAL PARAMETERS foldout tells you how to disable this screen protection (see Chapter 4).

Now you should familiarize yourself with the "Notation Rules" in Chapter 3. After that there are two ways of getting acquainted with STABILOCK 4032. If you have already gained experience with computer-controlled communication test sets, you are likely to find detailed guidance an encumbrance, so we recommend the trial-and-error method because, as the saying goes, an ounce of practice is worth a pound of theory. What is more, the user-friendly concept of the 4032 guarantees a high rate of success. And you need not worry about damaging the set, as long as you ensure that no signals of an impermissibly high level are applied to the inputs. The maximum values are marked on the front panel.

You will find any help you need for the trial-and-error approach through the Index of Terms and in Chapters 2, 3 and 4. These provide information in condensed form. Refer to Chapters 2 and 3 respectively if you get into difficulties with the following:

- meanings of keys, sockets, knobs and switches
- elementary rules of operation

Chapter 4 shows the various masks of the 4032. The accompanying text answers questions about the following points:

- callup of mask
- functions of softkeys
- meanings of mask fields

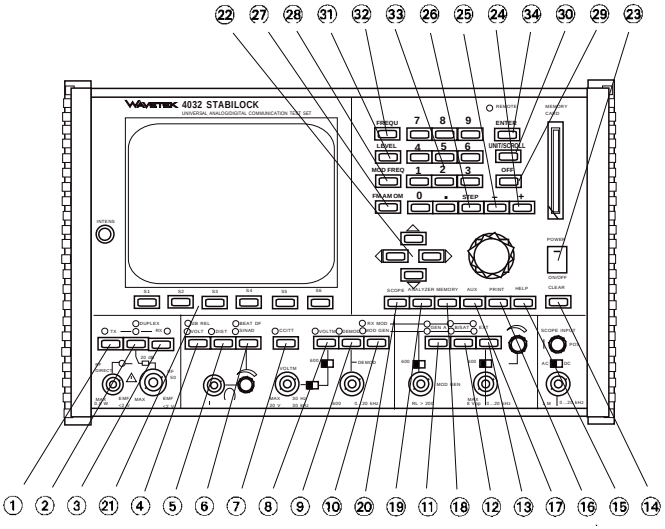
If you lack experience in computer-controlled communication test sets or attach importance to thorough instruction, then you should turn to Chapter 11. There is a course made up of different lessons that teach the essentials of operating STABILOCK 4032.

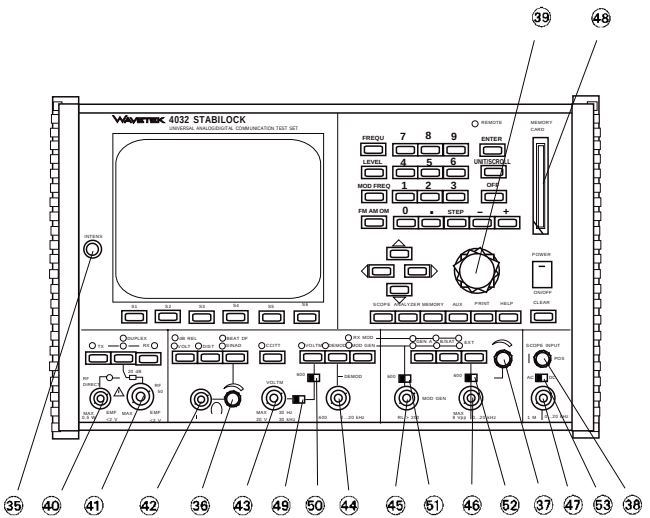
The course lasts about three or four hours. You should take the time because then you will acquire a really good grounding in proper use of the Communication Test Set. You will derive the greatest benefit from the course if you do not simply read through it but instead actually practice the many entry instructions on the 4032.

Front and Rear Panel

Front Panel

The function of the particular control is explained in this section under the same number.





Meaning of Keys

1 [TX] Calls up the basic TX mask (transmitter measurement). [TX] also takes you to the basic TX mask if a submask has been called up. In this case [TX] substitutes for multiple operation of the softkey (RETURN).

2 Unnamed This is repeatedly tapped to select the modes SIMPLEX, AUTO-SIMPLEX and optionally DUPLEX (basic DUPLEX mask). SIMPLEX = manual switchover between TX and RX; AUTO-SIMPLEX = automatic switchover from RX to TX if the RF power fed in is ≥ approx. 30 mW.

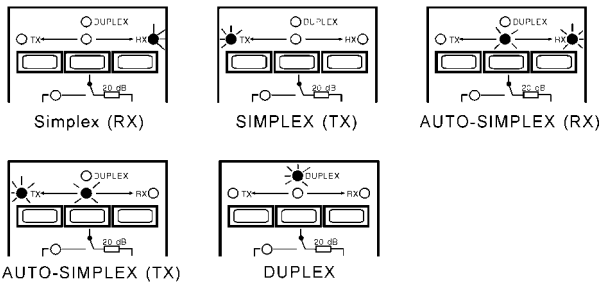


Fig. 2.1: Illuminating LEDs signal the mode selected.

3 [RX] Calls up the basic RX mask (receiver measurement). [RX] also takes you to the basic RX mask if a submask has been called up. In this case [RX] substitutes for multiple operation of the softkey (RETURN).

4 [VOLT/dB REL]

- Calls up the RMS pointer instrument on the screen (AF voltmeter with RMS display + AF counter), as long as one of the three basic masks (RX, TX, DUPLEX) is current. If display of the AF POWER meter has been declared in the GENERAL PARAMETERS mask, this will appear instead of the RMS meter as long as the VOLTM input is coupled with [VOLTM].
- If the RMS instrument (or AF POWER) has already been called up, it will be replaced by the dBr meter (relative level measurement). The reference value (0 dB) is the level measured immediately before by the RMS meter. The reference value is maintained if you switch to another AF signal source with [VOLTM], [DEMOD] or [RX MOD/MOD GEN] (important for SAT loop measurement for example).

5 [DIST]

Calls up the DIST (distortion factor) pointer instrument on the screen if one of the three basic masks is current.

6 [BEAT/SINAD]

- Calls up the SINAD meter on the screen if the RX or DUPLEX mask is present.
- Enables an RF frequency offset (beat) to be listened to on the internal loudspeaker if the TX mask is present (beat = frequency offset between input signal and tuned frequency of test receiver).
- If the BEAT function is not called up in TX mode, the loudspeaker reproduces the AF signal momentarily applied to the AF instruments of the 4032 (signal selection with [VOLTM], [RX MOD/MOD GEN] or [DEMOD]).

7 [CCITT]

Inserts the CCITT P53 A filter (psophometric weighting) into the signal path to the AF instruments of the 4032. Tapping the key again takes the filter out of the signal path. By selecting a scroll variable the CCITT filter can also be cut into the signal path to the DEMOD instrument (see "OPTION CARD" in Chapter 4).

8 [VOLTM]

Conducts the signal from the input socket of the same name VOLTM to the momentarily called AF instruments. The [VOLTM] key is interlocked with the [DEMOD] and [RX MOD/MOD GEN] keys.

9 [DEMOD]

Conducts the demodulated signal from the 4032 test receiver internally to the momentarily called AF instruments. This function is disabled if the RX mask is called. The [DEMOD] key is interlocked with the [VOLTM] and [RX MOD/MOD GEN] keys.

10 [RX MOD/MOD GEN] Conducts the modulation signal of the current modulation signal source(s) GEN A, EXT and GEN B (option) to the momentarily called AF instruments. The [RX MOD/MOD GEN] key is interlocked with the [VOLTM] and [DEMOD] keys.

11 [GEN A] Activates the modulation generator GEN A with the settings (frequency, level) selected on the screen. Striking the key again will cut out generator GEN A. If the RX or DUPLEX mask is called up, GEN A can be switched to the RX **or** TX signal path by repeatedly striking the [GEN A] key (level input field = Mod. or Lev.). But in the TX mode only the TX signal path is possible (level input field = Lev.).

- ❍ If the TX signal path is switched (red LED illuminated), the modulation signal is output AC-coupled on socket MOD GEN and DC-coupled on socket Bu 29 (back panel).
- ❍ If the RX signal path is switched (green LED illuminated), the modulation signal feeds the modulator of the 4032 signal generator. This modulation signal can be brought out DC-coupled but only on socket Bu 27 (back panel).
- ❍ If further modulation-signal sources are activated (EXT and optionally GEN B), the result will be a sum modulation signal (modulation overlaying).

12 [B/SAT] Activates the modulation generator GEN B (option) with the settings (frequency, level) selected on the screen. Tapping the key again will cut the generator out.

If the RX or DUPLEX mask is called up, GEN B can be switched to the RX **or** TX signal path (see [GEN A]) by repeatedly tapping the [B/SAT] key. In the TX mode only the TX signal path is possible (see Chapter 8, Modulation Generator GEN B).

The green LED assigned to the [B/SAT] key has a special function when the optional data module is used for testing radiotelephones. In such cases the LED will only illuminate when there is background signaling (SAT; cf Chapter 10).

13 [EXT]

Couples the signal fed in on socket EXT MOD into the RX/TX signal path of the modulation generators. Tapping the key again will disconnect the signal.

In DUPLEX mode the external modulation signal can be coupled into the RX **or** TX signal path of the modulation generators (see [GEN A]) by repeatedly tapping the [EXT] key.

14 [CLEAR]

Triggers a reset pulse for the microprocessors of the 4032 but without deleting the set test parameters. [CLEAR] will generally eliminate any blockage of the internal digital signal processing. A total reset eliminates stubborn blockages, but replaces test parameters set by the user with works settings (defaults) and calls up the status mask.

To execute a total reset, press the [OFF] key, keep it depressed and additionally press the [CLEAR] key for a short time.

15 [HELP]

- Shows up all entry fields of a mask by briefly brightening them up (inverted display), ie provided that no entry field has been opened.
- Following [HELP] the individual entry fields show a number between 0 and 99. The numbers serve for identifying the fields if they are assigned contents by AUTORUN or controller programs.
- Reports permissible entry values for that field which is momentarily open.

> [TX] + [MOD FREQ] + [HELP] → Message "Range: 30 Hz - 30 kHz" at the foot of the mask

16 [PRINT]

Causes printout of the momentary screen content. First the 4032 has to be adapted to the printer: the `Printer` field of the GENERAL PARAMETERS mask (call: [AUX] + [DEF.PAR] + [ETC]) permits selection from the available printer-driver software. On the ink-jet printer option the DIP switches have to be set to LISTEN ALWAYS.

17 [AUX]

Leads to the submask OPTION CARD, enabling the optional modules (eg AF filter) to be cut in and out. The softkey functions of the mask permit further branching into lower mask levels, which are mostly tied to options.

18 [MEMORY]

Calls up the MEMORY mask. This mask offers several functions in conjunction with the memory cards:

- ❍ Storage of several complete device settings.
- ❍ Storage of screen contents (eg measured results or scope curves).
- ❍ Storage and starting of AUTORUN test routines.
- ❍ Loading and starting of system programs (software options) for testing radio-data sets and cellular radiotelephones.

19 [ANALYZER]

- ❍ Calls up the spectrum analyzer (entry fields and panoramic display) on the screen if the TX mask is selected.
- ❍ Calls up the sweep generator (see Chapter 6) if the RX mask is selected.

20 [SCOPE]

Inserts the oscilloscope (entry fields and oscilloscope display) in the lower half of the TX, RX and DUPLEX mask.

21 S1 to S6

Softkeys of the 4032. The functions of the individual softkeys are always stated in the bottommost line of the screen. A displayed function is not executed until **after** the associated softkey has been struck. So you do not see the called function but the one that can be called at the moment.

> [RF DIR] → couples socket RF DIRECT as th current RF input/output; at the same time the softkey showes RF as the new function that can be called

22 Cursor block

- ❍ As long as no entry field has been opened, the individual entry fields of a mask can be located with the four cursor keys (sustained pressing of a cursorkkey produces a repeat function).
- ❍ If an entry field for numeric values has been opened, eg with [ENTER], the keys pointing to the left and right will move the cursor **within** the entry field.

23 [POWER]

The power button of the 4032. When it is switched on again, the Communication Test Set has the same operating status as before it was switched off, meaning that interrupted chores can rapidly be resumed.

A total reset replaces all settings on the 4032 with works settings (defaults) and causes the status mask to be called up. To execute a total reset, press the [OFF] key, keep it depressed and additionally switch on the 4032 with the [POWER] key.

24 [+]

- Leads together with the sign into the `Offset` entry field of the RX mask or DUPLEX mask (option), provided that the `RF Frequency` field was opened immediately beforehand.

  [FREQU] + [+] → offset field is opened with plus sign

- Increases the frequency value in the `RF Frequency` field or the level value in the `Level` field by the defined stepping width every time it is tapped, ie provided that the corresponding entry field (STEP) for stepping width has been opened (see also explanations to [STEP] key).

  [RX] + [FREQU] + <150 (MHz)> + [ENTER] + [FREQU] + [STEP] + <20> + [ENTER] + [+] → **every time** [+] is tapped, the frequency of the 4032 signal generator is incremented by 20 kHz: 150.02 MHz; 150.04 MHz etc.

- Issues the plus sign if the RF level is to be set with dBm or dB units, ie provided that the `Level` field is open.
- If it is tapped several times, it displays scroll variables when the currently active field is a scroll field. When the top end of the list of scroll variables is reached, [+] produces no more reaction, ie scroll back with [–].

25 [–]

This function is analogous to [+].

26 [STEP]

❍ Displays the STEP entry field for defining a stepping width (see also 24 [+]). The entry must be terminated with [ENTER]. The prerequirement for calling the STEP field is that the RF Frequency field with the units MHz or the Level field has been opened (frequency or level variation).

> [RX] + [LEVEL] + [STEP] + [6] + [ENTER] → **the level of the signal generator can now be altered in 6-dB increments with** [+] and [–] if the STEP field has been opened

❍ If the STEP field is already on-screen but not inverted, [STEP] will relocate and open this field, ie provided that no entry field has been opened.

❍ Changes over the lower and upper sideband in duplex mode.
Example: Before [STEP] the Communication Test Set transmits in the lower sideband and receives in the upper sideband. After [STEP] the Communication Test Set transmits in the upper sideband and receives in the lower sideband.
Requirement: the RF Frequency field is opened and the units in the field are NoL or NoU.

27 [FM AM ΦM] In the RX and DUPLEX mask (option) this immediately opens the Mod entry field and in the TX mask the Lev. entry field. [FM AM ΦM] also automatically triggers switch-on of the modulation generator GEN A.

- If the [UNIT/SCROLL] key is operated several times immediately after [FM AM ΦM], this will select the class of modulation in the mask header (at the same time the matching unit is set in the Mod field).

  [TX] + [FM AM ΦM] + [UNIT/SCROLL] → TX-FM, TX-ΦM, TX-AM

- If a numeric value is entered in the Mod field (RX mask) following [FM AM ΦM], this value will specify the modulation (eg frequency deviation). The matching unit (kHz, rad, %) can subsequently be assigned with [UNIT/SCROLL], provided the Mod field is open. A selected modulation value (eg 2.4 kHz) is stored if you set another class of modulation (eg 60 %).

  [RX] + [FM AM ΦM] + <2.4> + [UNIT/SCROLL] **→ 2.4 rad, 2.4 %, 2.4 kHz**

- If a numeric value is entered in the Lev. field (TX mask) following [FM AM ΦM], this value will specify the output level of mod. generator GEN A. [UNIT/SCROLL] then selects the unit (mV, V or dBm).

  [TX] + [FM AM ΦM] + [4] + [UNIT/SCROLL] **→ 4 mV, 4 V, 4 dBm**

28 [MOD FREQ] Leads to immediate opening of the AF GEN A entry field (modulation frequency of GEN A). [MOD FREQ] also automatically triggers switch-on of the modulation generator GEN A.

[TX] + [MOD FREQ] + [2] + [ENTER] + [FM AM ΦM] + <1.2 (V)> + [ENTER]
→ a signal with f = 2 kHz and V = 1.2 V appears on socket MOD GEN

29 [OFF]

- Cuts out the 4032 signal generator, ie provided that the `Level` entry field has been opened. Switch on again (with original level value) using [LEVEL].
- Removes a STEP entry field from the screen that has been fetched with [STEP], ie provided that the STEP field has been opened.

30 [UNIT/SCROLL]

a) Operating this key several times permits assignment of the required unit to the entered numeric value in the current (brightened up) mixed numeric field, ie provided that the [UNIT/SCROLL] key is pressed immediately after entering the numeric value (and before [ENTER]).

[RX] + [LEVEL] + [4] + [UNIT/SCROLL] → 4 mV, 4 µV, 4 dBm, 4 dBµ

b) Operating the key several times shows the available entry variants of the current scroll field.

c) Operating the key several times produces conversion of the numeric value in the `Level` field to the required unit (dB, V/mV or dBm), ie provided that the entry in the `Level` field was terminated immediately beforehand with [ENTER].

[RX] + [LEVEL] + <12 (mV)> + [ENTER] + [NIT/SCROLL] → the display in the level field changes between -25.4 dBm, 81.6 dBµ, 12 mV

d) Operating the key several times immediately after [FM AM ΦM] produces selection of the class of modulation (indicated in the mask header).

31 [LEVEL]

Leads in the RX and DUPLEX mask (option) to immediate opening of the `Level` entry field.

32 [FREQU]

Leads to immediate opening of the RF `Frequency` entry field.

33 Numeric cluster

Used to enter numerics in the current (brightened up) field. The start of the entry opens the field and clears the previously contained value. If only one digit is to be altered, it is better to open the field with [ENTER] and mark the digit concerned with the cursor.

34 [ENTER]

- Terminates entries in numeric fields as long as the entered value is legal. Any attempt to create an illegal value is advised by a warning tone; the numeric field will then show that value again which it had before the illegal entry.
- Opens numeric fields without altering their content.

Meaning of Rotary Knobs

35 INTENS — Adjusts the intensity of the screen display. Automatic cut-out prevents burns on the monitor. This is activated if no entry is made for about 20 to 25 min. If this automatic cutout is disabled, you must reduce screen intensity to prevent burns (see also chapter 4, "GENERAL PARAMETERS").

36 Unnamed — Volume control; effective when monitoring a current AF signal or a frequency offset (cf 6 [BEAT/SINAD]). Current AF signal = signal applied to AF instruments; selection of signal with [VOLTM], [DEMOD] or [RX MOD/MOD GEN].

37 Unnamed — Attenuator for the level of the modulation signal fed in on socket EXT MOD. With this control it is possible, for example, to vary the frequency deviation produced by the external modulation signal in a receiver measurement. The attenuator control is only active if the adjacent slide switch is set to VAR >35 kΩ.

38 POS — Positions the zero line of an oscillogram on the vertical axis, ie provided that the SCOPE function has been called up.

39 Unnamed — Multifunction handwheel for continuously altering numeric values and calling up entry variables for the scroll field. The handwheel always governs the current (brightened up) field.

- Alteration of numeric values: open the entry field with [ENTER] for example, move the cursor to the required position → **turning the handwheel alters the value of the position, carries also being allowed for. The alteration immediately affects the display of the measured results concerned.**

  [TX] + [VOLT] + [GEN A] + [RX MOD/MOD GEN] + [FM AM ΦM] + <value>
  → **the alterations of the level value in the** Lev entry field (with the handweel) is immediately shown on the RMS meter

- Callup of entry variables for the scroll field: the entry variables are shown by slowly turning the handwheel clockwise or counterclockwise.

Meaning of Sockets

40 RF DIRECT — RF input/output (input for transmitter measurement; output for receiver measurement). Coupling to the internal RF input/output stage with the softkey function (RF DIR). The power of a signal that is fed in may under no circumstances exceed 500 mW, otherwise the input stage/attenuator will be destroyed! RF DIRECT is to be used primarily for very small RF input signals. In DUPLEX mode RF DIRECT may be selected as a separate signal-generator output (see also explanations to RF socket).

41 RF — RF input/output (input for transmitter measurement; output for receiver measurement) with a 20-dB attenuator in the signal path. Coupling to the internal RF input/output stage with the softkey function (RF). The permissible input power of a signal that is applied constantly is 50 W, and shortterm (1 min) 125 W is permissible (see also Chapter 1, "Preparations for Startup"). If the TX-ΦM or TX-FM mask is called up, a squelch suppresses weak RF input signals onwards from the IF stage (switching threshold approx. -40 dBm).

In DUPLEX mode the RF socket is to be used as a common input/output, as long as there is a difference of at least 60 dB between output level and input level. If the difference is smaller (transponder measurements), select the RF DIRECT socket with (RF DIR). The latter is then the output and socket RF the input (the RF socket remains active because the DUPLEX output coupling is not affected by the switchover).

42 Unnamed — Jack socket for connecting headphones of any impedance (the internal loudspeaker is then disconnected).

43 VOLTM — Input for the AF signal. The signal can only be applied to the AF meters of the 4032 if the VOLTM key is tapped (cf points 49 and 50).

44 DEMOD — AF output for the demodulated TX signal. The DEMOD key has no effect on the DEMOD socket.

45 MOD GEN — AF output for the modulation signal, ie provided that the TX signal path is switched for the modulation-signal source(s). If several modulation-signal sources are activated - GEN A, EXT and optionally GEN B - the sum signal appears on the MOD GEN socket. The output is shortcircuit-proof; a transformer balances the output signal (cf point 51).

46 EXT MOD — AF input for an external modulation signal (cf point 52).

47 SCOPE INPUT — AF input for the 4032 oscilloscope (cf point 53).

48 MEMORY CARD — Slot for memory cards (a memory card is a battery-buffered RAM data medium for software options, AUTORUN programs, complete device settings and screen contents).

Meaning of Slide Switches

49 SYM — Determines whether the earthy pole of the VOLTM socket is connected to ground (unbalanced input) or not (balanced input).

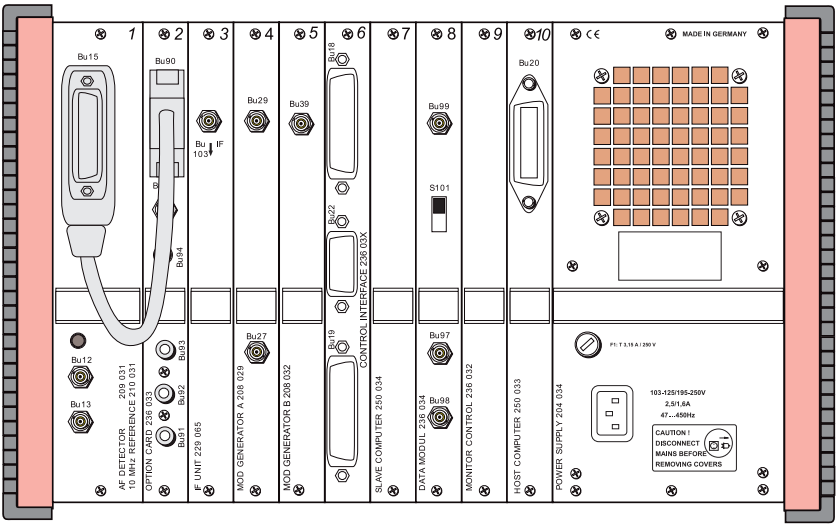
50 600 Ω/100 kΩ — Puts the input impedance of the VOLTM socket on 600 Ω or on 100 kΩ.

51 600 Ω/10 Ω — Puts the output impedance of the MOD GEN socket on 600 Ω or on 10 Ω.

52 600 Ω/ VAR > 35 kΩ — Puts the input impedance of the EXT MOD socket on 600 Ω or on 35 kΩ. In the VAR >35 kΩ setting it is possible to reduce the level of the applied modulation signal with the adjacent attenuator (37).

53 AC/DC — Determines whether the input socket of the oscilloscope (47) is DC-coupled or AC-coupled.

Back Panel

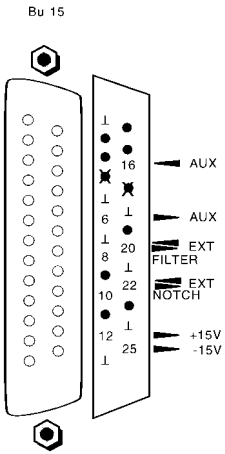


Standard Configurations:

Stage 1	AF DETECTOR + 10 MHz REFERENCE
Stage 3	IF UNIT
Stage 4	MOD GENERATOR A
Stage 7	SLAVE COMPUTER
Stage 9	MONITOR CONTROL
Stage 10	HOST COMPUTER
–	POWER SUPPLY

AF DETECTOR + 10 MHz REFERENCE (module 1)

Socket 15 (Bu 15): Interface for connecting module 2 (OPTION CARD) with adapter cable 384 752 (see also Chapter 9, section "OPTION CARD") or for connecting external filters.



Point = pin not used
Cross = pin conducts control signal used internally

Pin 6 = TTL control output
Pin 8 = output (to external AF filter)
Pin 10 = output (to external notch filter)
Pin 12 = +15 V to GND (I_{max} = 50 mA)
Pin 16 = TTL control input
Pin 20 = input (from external AF filter)
Pin 22 = input (from external notch filter)
Pin 25 = –15 V to GND (I_{max} = 50 mA)

Fig. 2.2: Socket Bu 15: pinning

Socket 12 (Bu 12): Input for synchronizing the internal 10-MHz reference oscillator (see data sheet for specifications) with an external signal. Synchronization range approx. 1 x 10^{-6} Hz
0.2 V V_{syn} 1 V
R_i = 200 Ω

Socket 13 (Bu 13): Output for synchronizing external oscillators with the 10-MHz reference oscillator.
f = 10 MHz
P_{out} = 4 mW
R_i = 50 Ω

IF UNIT (module 3)

The IF unit performs the AM, FM or ΦM demodulation of the IF signal. The frequency-offset measurement, the selective power measurement and the analyzer signal are also evaluated in the IF unit.

Socket 103 (Bu 103): Delivers IF signal for GSM or DAMPS option.
Do not feed any signal into this socket!

MOD GENERATOR A (module 4)

Socket 29 (Bu 29): DC-coupled output for the modulation signal in TX mode (transmitter testing). If several modulation-signal sources are connected into the TX signal path (GEN A, EXT MOD and optionally GEN B), an output amplifier adds the individual signals and produces the sum signal on Bu 29 (modulation overlay).

V_{max} = 5 V_{rms} (EMF)
R_i = 600 Ω

The signal on the MOD GEN socket (front panel) is identical to that on Bu 29 but AC-coupled (output transformer).

Socket 27 (Bu 27): DC-coupled output for the modulation signal in RX mode (receiver testing). The signal corresponds to that which is fed to the modulators of the 4032 internally. If several modulation-signal sources are connected into the RX signal path (GEN A, EXT MOD and optionally GEN B), an output amplifier adds the individual signals and produces the sum signal on Bu 27 (modulation overlay). There is no signal (0 V) on Bu 27 in TX mode.

The maximum output level of 2 V (peak) into 600 Ω represents, depending on the class of modulation, 100 % AM or 40 kHz FM (35.3 mV = 1 rad ΦM).

SLAVE COMPUTER (module 7)

The slave computer is responsible for all internal measurements and the control signals required for them.

MONITOR CONTROL (module 9)

The monitor control is responsible for displaying the screen masks and for the scope and analyzer display.

HOST COMPUTER (module 10)

The host computer is responsible for the operation, the Memory Card and IEEE-bus interface and the AUTORUN function.

Socket 20 (Bu 20): IEEE-488 interface of STABILOCK 4032. An IEEE-bus printer can be connected to Bu 20 for logging measured results (set DIP switches on printer to LISTEN ALWAYS).

POWER SUPPLY

User notes: see Chapter 1

Operating

Notation Rules

The rules about notation in this section will simplify your work with the operating manual. The whole purpose of the rules is to state requests for the entry of test parameters in a compressed but unambiguous form. So make a mental note of the forms of notation, because they apply throughout for all chapters.

Prompt to Operate Key

[CLEAR]	Notation for keys.
(ZOOM)	Notations for softkeys (these are the six function keys along the bottom edge of th screen).,
[VOLTM] + [GEN A]	Notation for entry prompts. In plain text this example means: first press the [VOLTM] key and then the [GEN A] key.

If there is just lower-case text between pointed brackets, there is **no** key with this name. In such cases entries are meant, examples of which will be given below.

If a number appears between pointed brackets, this refers to the entry of this number on the keypad.

[FREQU]	Operate the [FREQU] key

[FREQU] + <value> + [ENTER]	This string means that first you press the [FREQU] key and then, using the keys of the numeric cluster, enter the required (frequency) value. Finally you transfer the value to the 4032 with [ENTER]. <value> can also mean that you only have to alter a previously entered value with the hand

1. [FREQU] 2. <value> 3. [ENTER]	This is the numeric stringing of the preceding example.

Assigning units

If a unit has to be assigned to a numeric value (this is possible with some entries using the [UNIT/SCROLL] key), the required unit is shown in parentheses.

<4 (mV)>	After entering the numeric value 4, keep tapping the [UNIT/SCROLL] key until the unit mV appears next to the numeric value.

[FREQU] + <158 (MHz)> + [ENTER]	You are prompted to enter the (frequency) value 158 MHz and transfer it to the 4032 with [ENTER].

Keys with dual assignments

Many of the socalled softkeys as well as the [dB REL/VOLT] key on the AF field (front panel) have dual occupancy. Repeated tapping of such keys produces alternation between the two functions, ie if a change of function is permissible. The prompt to operate a key always names the function that is to be called up.

[dB REL]	Tap the [dB REL/VOLT] key to call up the dB REL function (the associated LED illuminates). If the dB REL function is already present, the key may not be operated because this would call up the VOLT function.

Repeated striking of key

Tapping some keys ([GEN A], [B/SAT], [EXT], [CCITT]) a number of times will cancel the function previously called up with this same key. The prompt to operate a key of this kind always refers, unless expressly stated otherwise, to calling up the function. The LEDs assigned to the keys will show whether a function has already been called up.

[GEN A]	Activate the modulation generator with the [GEN A] key. If the generator is already operative (associated LED illuminated), do not operate the key.

Cursor Movements

Prompts to move the cursor are indicated as follows:

<cursor u>	Cursor up
<cursor d>	Cursor down
<cursor l>	Cursor left
<cursor r>	Cursor right

...<value> + [ENTER] + <cursor d> + <value>...	After entering a numeric value, tap the cursor key that points downwards (location of a new entry field) and again enter a value.

Screen Messages in Running Text

`Offset` Notation for texts when they are to be read off the screen.

Following the text `IEEE-488 ADR.:` there is a number ... on the screen shown in inverted form.	`IEEE-488 ADR.:` is a screen message that you will look at later when calling up the socalled status mask.

Operating Rules

The operating rules for correct working with the 4032 concern in the first place proper filling in of the entry fields displayed on the screen. When reading this section for the first time, open the "Basic RX Mask" for an illustration of the examples.

Types of Fields

Each screen mask consists of entry fields, text fields and display fields.

Entry fields

Entry fields have to be selected by the user and are then ready to accept an entry. The entry may be a frequency or level value, for example, or one of several entry suggestions that are presented. Entry fields are therefore divided up into "scroll fields" and "numeric fields":

Scroll fields

Scroll fields offer at least two "scroll variables", one of which is to be selected. The scroll field EXT, for example, has the scroll variables AC coupled and DC coupled.

Numeric fields

Numeric fields are to be filled in with values entered on the numeric cluster.

Numeric fields are subdivided again into "pure numeric fields", "mixed numeric fields" and "hidden numeric fields".

Pure numeric fields

Pure numeric fields only require the entry of a numeric value, the unit is fixed. The pure numeric field AF GEN A, for example, contains the value 1.0000, the unit kHz being unalterable.

Mixed numeric fields

Mixed numeric fields require the entry of a numeric value and then allow assignment of the required unit by repeated operation of the UNIT/SCROLL key. In the mixed numeric field Mod, for instance, the units kHz, % and rad can be selected.

Hidden numeric fields

Hidden numeric fields are pure numeric fields that are not necessarily displayed on the screen. They can be made to appear and disappear as required. In the foldout of the basic RX mask, for example, the two hidden numeric fields STEP and CONT are on-screen. The foldout explains how they are made visible and blanked.

Text fields

Text fields primarily have the task of giving a name to the entry fields that are assigned to them. The content of entry fields can alter, but not that of text fields. A text field is usually followed by a single entry field. Such fields are simply given the name of the associated text field in the operating instructions. If the `Offset` entry field is being spoken of, for instance, the numeric field is meant that appears next to the `Offset` text field. In the foldout of the basic RX mask the content of this field is `0.0 kHz`.

If a text field is followed by several entry fields - this being an exception - the entry fields are designated after their content. That content is named which the fields have after a total reset (default setting).

Display fields

Display fields are not accessible for the user. In these fields the Communication Test Set reports measured results, for instance, or shows status messages (see also "Status Mask" foldout). The user has no access to display fields. Text fields are also allocated to display fields to show the meaning of the field(s). Display fields are always named in the operating instructions after the text field that accompanies them.

Moving to Entry Fields

The current entry field is always brightened up on the screen. Only this field can be accessed (in the foldout of the basic RX mask the current field CONT is dark because of the inverted display). Any entry field can be moved to with the four cursor keys, as long as no numeric field has been opened. The field that has been moved to is at the same time the current entry field.

Entering New Numeric Values

If the current entry field is a numeric field, access begins by opening the field: entry of the numeric value on the keypad automatically opens the field and deletes the original content. [ENTER] opens numeric fields without deleting their content. An opened numeric field can always be recognized by the flashing of the cursor.

Individual digits can be overwritten if they are marked with the cursor. Use the cursor key pointing right or left for this purpose.

Entries in numeric fields by way of the keypad must always be terminated with [ENTER], otherwise they will not be valid. [ENTER] closes an opened numeric field, recognizable by the fact that the flashing cursor disappears. Then is it possible to move to every other entry field with the four cursor keys.

Fast Access to Numeric Fields

The numeric fields that are most often required - RF Frequency, Level, AF GEN A, and Mod. or Lev. - can be located and opened with a single keystroke. Tap one of the following keys: [FREQU], [LEVEL], [MOD FREQ] or [FM AM ΦM].

With the fast access to one of the fields named above, you exit from the numeric field that was active before, even if an entry has not been terminated with [ENTER]. In this case the entry is lost and is replaced by the old content of the numeric field. Therefore you should always terminate numeric fields immediately after making an entry.

Altering Numeric Values

Method 1: Move to the numeric field concerned with the cursor keys and open it with [ENTER], or use one of the keys for fast access to numeric fields. Mark the particular digit with the cursor and overwrite it with the new value. After [ENTER] the altered numeric value is valid.

Method 2: Move to the numeric field concerned with the cursor keys and slightly turn the handwheel. This opens the field. One of the keys for fast access to numeric fields also goes this far. Move the cursor to the required position and turn the handwheel until the required value appears at the cursor position. Note that when you go over 9 or under 0 there will be a carry at the adjacent position. Every variation of a numeric value with the handwheel is immediately valid. Confirmation with [ENTER] is only necessary when you leave the field again. Use the handwheel to observe the effect of continuously altering the input value on a measurement result.

Selecting Units in Mixed Numeric Fields

Move to the numeric field concerned with the cursor keys and open it with [ENTER], or use one of the keys for fast access to numeric fields. Enter the required numeric value and immediately afterwards press the [UNIT/SCROLL] key several times. This assigns the numeric value the available units. Terminate the entry as usual with [ENTER].

Converting Units of RF Level

The Level entry field for the RF level of the 4032 signal generator is a mixed numeric field with the speciality that the entered level value can be converted into one with the unit you commonly use. The available units are: µV/mV, dBm and dBµ.

First enter the value with the required unit and terminate the Level field with [ENTER]. Afterwards press the [UNIT/SCROLL] key several times and the value will be converted to the other units and displayed in the field.

Selecting Scroll Variables

Move to the scroll field concerned with the cursor keys and press the [UNIT/SCROLL] key several times. The handwheel may also be turned slowly (left/right). Both result in the scroll field displaying all its scroll variables one after the other. The variable that is displayed is valid. Confirmation with [ENTER] is unnecessary, you can leave the field again immediately.

Working with Softkeys

The softkeys (row of keys below the screen) are given their function by the mask that is called up. The function that a softkey has at any particular time is shown by the brightened up fields at the bottom edge of the screen.

Very often the softkeys have dual assignments, ie as soon as the one function is called up (by striking the softkey), the key is assigned the other function to show what you can subsequently change to. (RF DIR) connects the RF DIRECT socket for instance. The softkey function immediately changes to (RF) so that this same softkey - when it is struck again - will enable the RF socket to be connected.

For softkeys with dual assignments you always see the function that is being **offered** to you, ie not the one you have. If softkey S1 shows the (RF) function for instance, this means that the RF DIRECT socket is connected and the 4032 is offering you the RF socket as an alternative. Therefore, the displayed softkey function is **not** confirmation of the momentary operating status, it is a pointer to the alternative function using the same softkey.

Working with Channel Numbers

The STABILOCK 4032 allows you to work with channel numbers (instead of frequencies) in all modes (SIMPLEX, AUTO-SIMPLEX, DUPLEX).

SIMPLEX/AUTO-SIMPLEX Mode

First call up the GENERAL PARAMETERS mask by entering [AUX] + [DEF.PAR] and make the following declarations:

1. `Channel space` enter the value of the active channel spacing.
2. `Duplex space` enter the value zero so that later, when working with channel numbers, you do not have to observe any upper/lower band.
3. `Channel` enter the channel number of any valid channel number/frequency pair.
4. `Corresp. freq.` enter the frequency value from the channel number/frequency pair chosen above in 3.
5. `Channel no.` select the scroll variable so that frequencies increase or decrease with ascending channel number.

The STABILOCK 4032 is now prepared to work with channel numbers in the SIMPLEX modes. The link between values of frequency and channel numbers is produced by the declarations above. Call up the basic RX or TX mask:

1. Declare with [FREQU] the `RF Frequency` field to be the current (opened) field and switch to channel-number entry (`NoL` or `NoU`) with [UNIT/SCROLL]. The field will then indicate the channel number of the frequency that was previously shown in the same field (tuning frequency of signal generator or test receiver).

2. Enter the channel number momentarily required with the numeric keys. It is irrelevant whether you make your entry for the lower-band (NoL) or upper-band (NoU) channel. After confirmation with [ENTER] the signal generator or test receiver is immediately set to the appropriate frequency.

3. Open the field again, eg with [ENTER], and mark the channel number with the aid of the cursor keys. Now any channel numbers can be set quite simply with the handwheel (confirmation with [ENTER] is unnecessary).

4. To return to frequency display you use [ENTER] and [UNIT/SCROLL]. The frequency is displayed of the last channel number that was set.

DUPLEX Mode

First call up the GENERAL PARAMETERS mask by entering [AUX] + [DEF.PAR] and make the following declarations:

1. `Channel space` enter the value of the active channel spacing.
2. `Duplex space` enter the value of the duplex spacing.
3. `Channel` enter the channel number of any valid channel number/frequency pair.
4. `Corresp. freq.` enter the frequency value from the channel number/frequency pair chosen above in 3.
5. `Channel no.` select the scroll variable so that frequencies increase or decrease with ascending channel number.
6. `RX ↔ TX (MHz)` select the scroll variable to determine whether f_{RX} is to be automatically offset upwards or downwards from f_{TX} by the duplex spacing. The `NOT` variable prevents this (f_{RX} and f_{TX} set separately). This declaration is not absolutely necessary when working with channel numbers; it is only of importance for the direct entry of frequencies.

The STABILOCK 4032 is now prepared to work with channel numbers in the DUPLEX mode. The link between values of frequency and channel numbers is produced by the declarations above. Call up the basic DUPLEX mask:

1. Declare with [FREQU] **the** RF Frequency field in the RX portion of the mask to be the current (opened) field and switch to channel-number entry (NoU or NoL) with [UNIT/SCROLL].

2. Enter with the numeric keys the number of the channel on which the 4032 signal generator is to transmit in the upper band (NoU) or lower band (NoL). After confirmation with [ENTER] the signal generator is immediately set to the appropriate frequency. At the same time the test receiver - without further ado - is tuned and offset by the duplex spacing.

3. Open the field again, eg with [ENTER], and mark the channel number with the aid of the cursor keys. Now any channel numbers can be set quite simply with the handwheel (confirmation with [ENTER] is unnecessary). The corresponding channel number is set automatically in the TX portion of the mask.

4. To return to frequency display you use [ENTER] and [UNIT/SCROLL]. The frequencies (f_{RX}, f_{TX}) are displayed of the channel numbers that were last set.

5. Points 2 through 4 apply in corresponding fashion if, to start with, the RF Frequency field in the TX portion of the mask is switched to channel-number entry.

6. If you want to enter the frequencies f_{RX}, f_{TX} directly, it is likewise sufficient to enter just one value. As a result of declaration 6 the other value is produced automatically. If the test receiver and signal generator of the 4032 are to be tuned to random frequencies (no forced duplex spacing), the NOT variable must have been selected.

Entry Examples

Setting signal generator to 50.00055 MHz

1. [RX] + [FREQU] + <50.0005 (MHz)> + [ENTER]
2. [+] + <0.05> + [ENTER]

Calling up the RX mask switches the signal generator on. Then enter the frequency, roughly to start with, as far as the 100-Hz place in the `RF Frequency` field (50.0005 MHz). For fine tuning open the offset field with [+] and enter the value 0.05 kHz (maximum resolution 50 Hz). 50 Hz resolution is possible up to f = 500 MHz and above that 100 Hz.

Setting output level of signal generator to EMF

1. [RX] + [EMF] ([EMF] is alternative function to [50 Ω])

Striking the [EMF] softkey changes the name of the entry field for output level from `Level/50Ω` to `Level/EMF` and doubles the set output level. It is not possible to switch to EMF level if the units in the `Level/50Ω` field are `dBm`.

Setting signal generator to –40 dBm output level

1. [RX] + [LEVEL] + <-40> + [UNIT/SCROLL] + [ENTER]

After entering the value -40 in the `Level` field, you can assign it dBm as units with [UNIT/SCROLL] before terminating the entry with [ENTER].

How many mV correspond to –22.0 dBm output level?

1. [RX] + [LEVEL] + <-22 (dBm)> + [ENTER] + [UNIT/SCROLL]

First enter the level value –22 in the `Level` field, assign it dBm as units and terminate the entry with [ENTER]. [UNIT/SCROLL] then converts the set level value to the other units that are available. Confirm the display that is to be kept (eg 17.7 mV) with [ENTER].

Tuning frequency of test receiver in 20-kHz increments

Starting frequency = 153.0100 MHz

1. [TX] + [FREQU] + <153.0100 (MHz)> + [ENTER]
2. [FREQU] + [STEP] + <20> + [ENTER] + [+]

Calling up the TX mask switches on the test receiver. First enter the starting frequency in the RF Frequency field and terminate this entry with [ENTER]. Then open the RF Frequency field again with [FREQU] **and display the hidden numeric field** STEP with [STEP]. After you have entered and confirmed the value 20 kHz, the tuned frequency will be increased by 20 kHz every time you strike the plus key.

Setting test receiver for AM demodulation

1. [TX] + [FM AM ΦM] + [UNIT/SCROLL] + [ENTER]

Declare the Lev field of the TX mask as the current field and then choose the demodulation, visible in the mask header, with [UNIT/SCROLL]. Confirmation of this with [ENTER] is not absolutely necessary.

Listening to FM modulation of received 100-MHz signal

1. [TX] + [FM AM ΦM] + [UNIT/SCROLL] + [ENTER]
2. [FREQU] + <100 (MHz)> + [ENTER]
3. [DEMOD]

In step 1 set the FM demodulation (display TX-FM) in the mask header and confirm it. Step 2 tunes the test receiver to 100 MHz. [DEMOD] then applies the demodulated signal to the input of the internal AF-signal processing so that the signal can be listened to over the internal loudspeaker (set the volume with the rotary knob beneath the [BEAT/SINAD] key). If the BEAT function is called up (red LED illuminated), the demodulated signal is not heard but instead a frequency offset between the tuned frequency of the test receiver and the actual frequency of the input signal.

Examining unknown AF signal

1. [VOLT] + [VOLTM]

Apply the AF signal to the VOLTM socket (front panel). [VOLTM] couples this socket to the internal AF-signal processing. [VOLT] produces the RMS pointer meter on the screen, no matter what basic mask (RX, TX, optionally DUPLEX) happens to be called up. The meter indicates the level (RMS) and frequency of the AF signal. The signal can also be looked at as a curve using the SCOPE function (see Chapter 6).

Generating 345-MHz signal with 2.8 kHz FM (f = 2 kHz)

1. [RX] + [FREQU] + <345 (MHz)> + [ENTER]
2. [FM AM ΦM] + <2.8> + [UNIT/SCROLL] + [ENTER]
3. [MOD FREQ] + <2> + [ENTER]
4. [RF]

Set the signal generator to 345 MHz, enter the value 2.8 in the `Lev` field and select the `kHz` units (means frequency modulation). [FM AM ΦM] automatically cuts in modulation generator GEN A. In the third step you define the modulation frequency as 2 kHz. Finally connect the RF socket on which you wish to tap the signal (signal level = value in `Level` field).

Masks

Status Mask

The status mask tells you about the current status of the 4032 (fitted options, IEEE-bus address, software versions of microprocessors).

Callup of masks

Cold start 1: Press the [OFF] key, keep it depressed and additionally press the [CLEAR] key for a short time.

Cold start 2: Press the [OFF] key, keep it depressed and switch on the communication test set with the [POWER] key.

Warm start: [AUX] + [DEF.PAR] + [STATUS]

Caution: Cold start 1 and cold start 2 replace all settings made by the user with default settings! This does not happen if you call up a mask with warm start.

Functions of softkeys

(HW REVISIONS) Takes you to a mask of the same name that provides information about the development status of individual 4032 stages (useful when telephoning for service). This mask also allows to call up the self-diagnostic program SELF CHECK (Go/No-Go function check of important stages and modules).

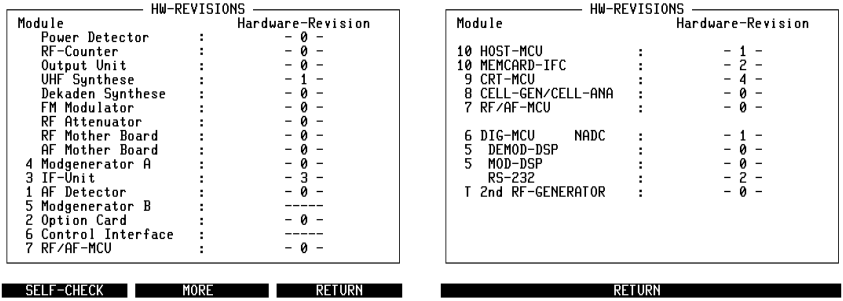


Fig. 4.1: The two pages of the HW-REVISIONS mask. (MORE) takes you from the first page to the second.[5)] The numbers tell you the design status of the individual modules and installed hardware options. The numbers displayed in the figure do not reflect the actual state.

(START)

- ❍ Calls up the RX mask if the status mask has been called up with cold start 1 or cold start 2.
- ❍ Takes you back to the GENERAL PARAMETERS mask if the status mask has been called up with warm start.

(OPTIONS) Takes you to the OPTION mask, offering a list with details of the fitted options (especially the OPTION CARD).

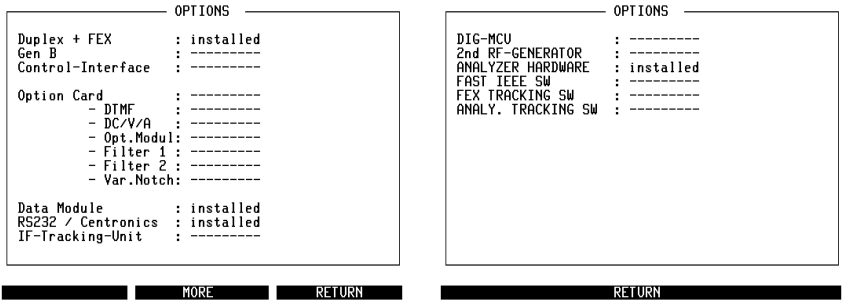


Fig. 4.2: The two pages of the OPTIONS mask. (MORE) takes you from the first page to the second.[5)] Ready built-in options are indicated by `installed` and separated by hardware or software option; dashes mean that an option is missing.

Meaning of fields

`SERIAL NO` (display field); shows the serial number of your particular STABILOCK 4032.

`IEEE-488 ADR` (pure numeric field); content = IEEE-bus address of the 4032.

`TALK & LISTEN` (scroll field); the scroll variables specify the IEEE-bus operating mode:

`TALK ONLY`	unidirectional data flow (4032 is talker);
`TALK & LISTEN`	bidirectional data flow (4032 is talker or listener).

`CR&LF` (scroll field); the scroll variables specify the IEEE-bus control command:

`CR`	Carriage Return.
`CR&LF`	Carriage Return & Line Feed.

`EOI` (scroll field); the scroll variables specify the IEEE-bus control command:

`EOI`	"End or Identify" is declared
	"End or Identify" is not declared

`DCL` (scroll field); the scroll variables define whether the Communication Test Set executes a reset or a total reset after a DCL (Device Clear):

`DCL = CLR + OFF`	Total reset,
`DCL = CLR`	Reset, like striking [CLEAR].

`SOFTWARE VERSIONS` (display fields); message from the 4032 saying with what software versions the internal processors HOST, CRT, RF/AF as well as CELL-GEN/ANA (DATA module option) and IFC (RS-232/Centronics interface option) are working. The number of the particular software version (x.xx) is indicated together with the software checksum `CRC` (xxxx). By referring to the checksums it is possible to find a fault in the system software when you ask for service over the telephone for example.

SELF-CHECK

The SELF-CHECK mask allows you to call up a diagnostics program that checks the function of all important stages and modules of the 4032 in less than 20 s.

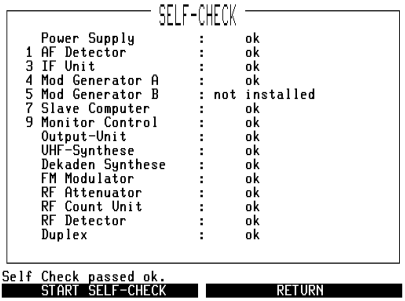


Fig. 4.3: SELF-CHECK mask; all stages tested here are ok.

Calling up the mask

(AUX) + (DEF.PAR.) + (STATUS) + (HW-REVISIONS) + (SELF-CHECK)

This calling up should only be done if you see one of the basic masks on screen (RX, TX or DUPLEX).

Starting the program

(START SELF-CHECK) Before starting the diagnostics program, two conditions have to be fulfilled:

- ❍ 4032 reference oscillator warmed up (wait approx. 10 min).
- ❍ No cable connected to RF/AF sockets of the 4032.

(START LED-TEST) Tests all LEDs of STABILOCK 4032. The first time you strike the softkey, all LEDs light up. Strike it a secondtime to end the test.

(RETURN) Takes you back to the HW-REVISIONS mask.

Program messages

`ok`	Stage test passed
`failed`	Stage test not passed
`not installed`	Hardware option to be tested is missing
`related test failed`	Stage test cannot be performed due to failure of other stage

The diagnostics program is finished when one of the following messages is displayed in the status line at the bottom edge of the mask:

`Self Check passed ok`	all stages functioning well
`Self Check failed`	one stage at least failed

Basic RX Mask

The basic RX mask activates the signal generator of the 4032 for receiver testing.

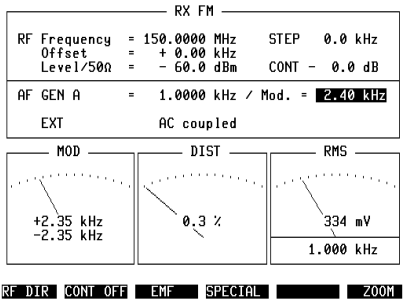


Fig. 4.4: Mask RX FM; content of entry fields = default values (setting ex works)

Callup of mask

(RX)

Functions of softkeys

(RF DIR) (alternative function: (RF)); determines which of the two RF input/output sockets (RF DIRECT or RF) is coupled to the RF output stage of the signal generator.

(CONT OFF) (alternative function: (EMF CONT)); blanks the numeric field CONT from the mask (displayed with (EMF CONT), but not for amplitude modulation).

(EMF) (alternative function: (50 Ω)); determines whether the level of the signal generator set with the Level field is the EMF or the output level measured into 50 **Ω**. The EMF function cannot be called up if dBm units are selected in the Level entry field.

(SPECIAL) takes you to the selection menu of the RX Specials (see "RX Specials").

(ZOOM) takes you to the selection menu for displaying full-format instruments.

Meaning of fields

`RF Frequency` (mixed numeric field [MHz, NoL, NoU]); the content of the numeric field determines the carrier frequency of the generator signal. When you are working with channel numbers (NoL: channel number in lower band; NoU: channel number in upper band), the assignment between frequency and channel number applies that is made in the GENERAL PARAMETERS mask.

`STEP` (hidden numeric field); can be allocated with [STEP] either to the `RF Frequency` or `Level` (opened) field. As long as the `STEP` field is inverted, the plus/minus keys will permit step by step alteration of the carrier frequency or of the RF output level (step width = content of STEP field). [OFF] blanks the (opened) `STEP` field.

`Offset` (pure numeric field); the entered value (including sign +/-) detunes the carrier frequency upwards or downwards (fine tuning of the carrier frequency). Fast access with [FREQU] + [+] or [FREQU] + [–]. The actual carrier frequency is then the sum of the values in `RF Frequency` and `Offset`.

`Level` (mixed numeric field [dBm, dBµ, µV/mV]); the content determines the level of the signal generator (`Level/50Ω` → level into 50 Ω; `Level/EMF` → level is EMF). As long as an entry has not yet been terminated with [ENTER], the required units can be assigned to the entered value with [UNIT/SCROLL]. If an entry has been terminated with [ENTER], [UNIT/SCROLL] then causes conversion of the entered value to the other units. [OFF] switches off the signal generator; for this the `Level` field must be open; switch on again with [LEVEL].

`CONT` (hidden numeric field); an entered value, after confirmation with [ENTER], reduces the RF level of the signal generator without switching interruptions by the attenuator by max. 20 dB (necessary for squelch measurements).

Example: Level = –60 dBm; [EMF CONT] + <10> + [ENTER] → the output level of the signal generator is reduced continuously to –70 dBm (value in `Level` field remains at -60 dBm however). Continuous level reduction is possible with the handwheel. The `CONT` field can be cut in/out with the softkey [EMF CONT]/[CONT OFF] (not for AM). After [CONT OFF] the actual output level and the value in the `Level` field again correspond.

`AF GEN A` (pure numeric field); the entered value defines the modulation frequency of modulation generator GEN A (the same applies to the `GEN B` field when the GEN B option is installed). GEN A + GEN B active = superimposed modulation.

`Mod` (mixed numeric field [rad, %, kHz]); the content of this field determines the modulation of the carrier signal (phase deviation, modulation depth or frequency deviation). As long as an entry has not yet been terminated with [ENTER], the required units can be assigned to the entered value with [UNIT/SCROLL]; thus simultaneous selection of the class of modulation.

Repeated tapping of the [GEN A] key (until the associated red LED lights) replaces the `Mod.` field by the mixed numeric field `Lev.` (see also foldout Basic TX Mask). This field determines the level of modulation generator GEN A. The GEN A signal then no longer goes to the modulator of the 4032 however, but instead is output AC-coupled on socket MOD GEN and DC-coupled on socket Bu 29 (rear panel).

`EXT` (scroll field); the scroll variables (`AC` and `DC coupled`) determine the coupling of the external modulation-signal source. The field is only produced on the screen if the EXT MOD input socket has been connected to the modulation-signal path with [EXT].

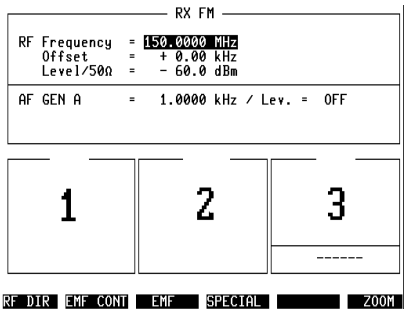
Available instruments

RMS	(RMS AF voltmeter and AF frequency counter); call up with [VOLT]
dBr	(relative level measurement); call up with [dB REL]
DIST	(distortion meter); call up with [DIST]
MOD	(modulation meter); call up with [EXT]
SINAD	(SINAD meter); call up with [SINAD]
PWR	(RF power meter); call up with [ZOOM] + [POWER]
AF POWER	(AF power meter); call up alternatively to RMS by GENERAL PARAMETERS mask

Meter locations in basic RX mask

Fig. 4.5:

1 = MOD can only be called up with [EXT])
2 = SINAD or DIST
3 = RMS or dBr or AF POWER



Basic TX Mask

The basic TX mask activates the test receiver of the 4032 for transmitter testing.

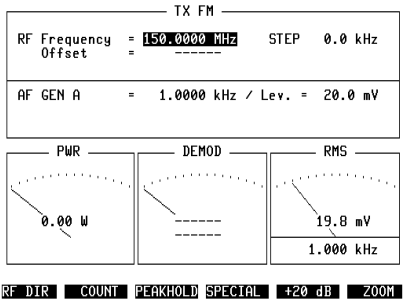


Fig. 4.6: Mask TX FM; contents of entry fields = default values (settings ex works).

Callup of mask

(TX)

Functions of softkeys

(RF DIR) (alternative function: (RF)); determines which of the two RF input/output sockets (RF DIRECT or RF) is coupled to the RF input stage of the test receiver.

If the maximum permissible input power on socket RF DIRECT (500 mW) is exceeded, the input stage will immediately be destroyed!

(COUNT) (alternative function: (OFFSET)); (COUNT) switches on the RF frequency counter. (OFFSET) switches on the offset counter. The measured values are displayed in the `RF Frequency` field (frequency counter) and `Offset` field (offset counter).

(PEAKHOLD) (alternative function: (NORM)); (PEAKHOLD) makes the DEMOD modulation meter store the highest value measured and constantly display it. In AM measurements modulation peaks are only detected at the instant of sampling. With (NORM) the DEMOD instrument always displays the momentary modulation.

(SPECIAL) takes you to the selection menu of the TX Specials (see "TX Specials").

(+20 dB) (alternative function: (−20 dB)); increases the level of modulation generator GEN A by 20 dB for checking the effectiveness of modulation limiting for instance. (−20 dB) reduces the level by 20 dB.

(ZOOM) takes you to the selection menu for displaying full-format instruments.

Meaning of fields

RF Frequency (mixed numeric field [MHz, NoL, NoU]); the entered value tunes the test receiver. When you are working with channel numbers (NoL: channel number in lower band; NoU: channel number in upper band), the assignment between frequency and channel number applies that is made in the GENERAL PARAMETERS mask. If the COUNT function is called up, the field becomes a display field (displayed value is at the same time the tuning of the test receiver).

STEP (hidden numeric field); can be allocated with [STEP] to the (opened) RF Frequency field. As long as the STEP field is inverted, the plus/minus keys permit step by step alteration of the carrier frequency (step width = content of STEP field). [OFF] blanks the (opened) STEP field.

Offset (display field); indicates the frequency offset of the RF input signal from the tuning frequency of the test receiver (display >>>>>>: measuring range exceeded). The field is not displayed if the COUNT function is called up.

AF GEN A (pure numeric field); the entered value defines the modulation frequency of modulation generator GEN A (the same applies to the GEN B field when the GEN B option is installed).

Lev (mixed numeric field [mV, V, dBm]); the content determines the level of modulation generator GEN A. As long as an entry has not yet been terminated with [ENTER], [UNIT/SCROLL] will permit selection of the units (the same applies to the GEN B option). The following applies to the dBm unit: the output impedance must be set to 600 Ω so that the level on the MOD GEN socket corresponds to the display in the Lev. field. If the field is inverted but no entry has been commenced, [UNIT/SCROLL] leads to selection of the class of demodulation, recognizable in the mask header.

EXT (display field); points out that the EXT MOD input socket has been connected to the modulation-signal path with [EXT] (automatically AC-coupled in the TX mode).

Available instruments

RMS	(RMS AF voltmeter and AF frequency counter); call up with [VOLT].
dBr	(relative level measurement); call up with [dB REL].
DIST	(distortion meter); call up with [DIST].
DEMOD	(modulation meter); called up automatically.
OFFSET	(analog display of frequency offset); call up with [ZOOM] + [OFFSET].
PWR	(RF power meter); called up automatically as long as the RF socket is selected.
AF POWER	(AF power meter); call up alternatively to RMS by GENERAL PARAMETERS mask.
SEL.PWR	(selective RF power meter); call up with [SPECIAL] + [SEL.PWR].
VSWR	(display of voltage standing-wave ratio with option VSWR measuring head); alternative function of [SEL.PWR].

Meter locations in basic TX mask

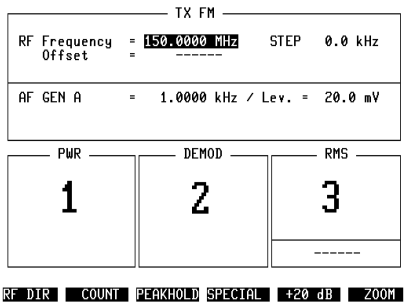


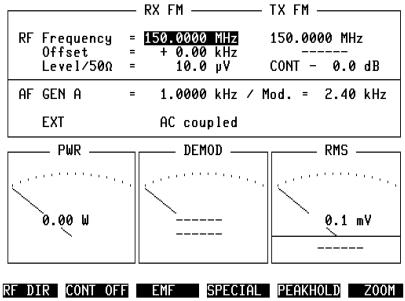
Fig. 4.7:

1 = PWR
2 = DEMOD
3 = RMS oru dBr or AF POWER or DIST

Basic DUPLEX Mask

The basic DUPLEX mask simultaneously activates the signal generator and the test receiver (DUPLEX unit) of the 4032.

Fig. 4.8: Mask DUPLEX ; contents of entry fields = default values (settings of ex works).



Callup of mask

Strike the key arranged between the [TX] and [RX] keys until the "DUPLEX" LED illuminates (callup is only possible if the DUPLEX FM/ΦM Demodulator is installed).

Functions of softkeys

(RF DIR) (alternative function: (RF)); determines which of the two RF input/output sockets (RF DIRECT or RF) is coupled to the test receiver and signal generator. Exception: the broadband RF power meter (PWR instrument) and the DUPLEX stage are connected directly to the RF socket and thus not affected by any switchover of the coupling.

If the maximum permissible input power on socket RF DIRECT (500 mW) is exceeded, the input stage will be destroyed!

(CONT OFF) (alternative function: (EMF CONT)); blanks the numeric field CONT from the mask (displayed again with (EMF CONT)).

(EMF) (alternative function: (50 Ω)); determines whether the level of the signal generator set with the Level field is the EMF or the output level measured into 50 Ω. The EMF function cannot be called up if dBm units are selected in the Level entry field.

(SPECIAL) takes you to the selection menu of the DUPLEX Specials (see "DUPLEX Specials").

(PEAKHOLD) (alternative function: (NORM)); (PEAKHOLD) makes the DEMOD modulation meter store the highest value measured and constantly display it. In AM measurements modulation peaks are only detected at the instant of sampling. With (NORM) the DEMOD instrument always displays the momentary modulation.

(ZOOM) takes you to the selection menu for displaying full-format instruments (see "Zoom").

Meaning of fields

`RF Frequency` (mixed numeric field [MHz, NoL, NoU]); determines in the RX part of the mask the carrier frequency of the signal generator, in the TX part of the mask the tuning frequency of the test receiver. For the automatic offset of the frequency values by the duplex spacing and linking of the frequency values to the channel numbers (NoL and NoU) the same applies as in the GENERAL PARAMETERS mask.

`Offset` (pure numeric field/display field); enables fine tuning of the carrier frequency in the RX part of the mask. In the TX part of the mask the `Offset` field indicates a frequency offset between the applied RF signal and the tuning frequency of the test receiver.

`Level` (mixed numeric field [dBm, dBµ, µV/mV]); the content determines the level of the signal generator (Level/50Ω → level into 50 Ω; Level/EMF → level is EMF). As long as an entry has not yet been terminated with [ENTER], the required units can be assigned to the entered value with [UNIT/SCROLL]. If an entry has been terminated with [ENTER], [UNIT/SCROLL] then causes conversion of the entered value to the other units. [OFF] switches the signal generator off; for this purpose the Level field must be open. Switch on again with [LEVEL].

`CONT` (hidden numeric field); the content defines a continuous RF-level setting range (with no switching interruptions by the attenuator), as required for squelch measurements. The CONT field can be cut in/out with the softkey (EMF CONT)/(CONT OFF). Instead of the `CONT` field the `STEP` field can be called up.

STEP (hidden numeric field); can be assigned to the (opened) Level field with [STEP]. As long as the STEP field is inverted, the plus/minus keys permit step by step alteration of the RF output level (step width = content of STEP field). [OFF] blanks the (opened) STEP field. Instead of the STEP field the CONT field can also be displayed.

AF GEN A (pure numeric field); the entered value defines the modulation frequency of modulation generator GEN A (the same applies to the GEN B field when the optional modulation generator GEN B is installed).

Mod (mixed numeric field [rad, %, kHz]); the content of this field determines the modulation of the carrier signal (phase deviation, modulation depth or frequency deviation). As long as an entry has not yet been terminated with [ENTER], the required units can be assigned to the entered value with [UNIT/SCROLL]. Thus the class of modulation/demodulation is set at the same time (AM not possible).

EXT (scroll field); the scroll variables (AC and DC coupled) determine the coupling of the external modulation-signal source. The field is only produced on the screen if the EXT MOD input socket has been connected to the modulation-signal path with [EXT].

Instruments of basic DUPLEX mask

RMS (RMS AF voltmeter and AF frequency counter); call up with [VOLT].

dBr (relative level measurement); call up with [dB REL].

DIST (distortion meter); call up with [DIST].

SINAD (SINAD meter); call up with [SINAD].

MOD (modulation meter RX); call up with [RX MOD/MOD GEN].

DEMOD (modulation meter TX); call up with [DEMOD].

OFFSET (analog display of frequency offset); call up with [ZOOM] + [OFFSET].

PWR (RF power meter); called up automatically.

AF POWER (AF power meter); call up alternatively to RMS by GENERAL PARAMETERS mask.

Meter locations in basic DUPLEX mask

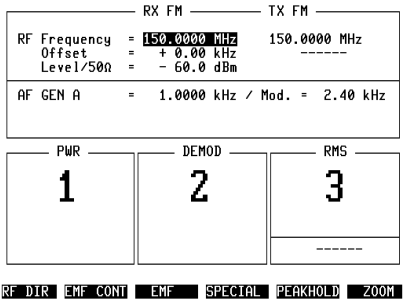


Fig. 4.9:

1 = PWR
2 = DEMOD or MOD
3 = RMS or dBr or AF POWER or DIST or SINAD

GENERAL PARAMETERS

In this mask declarations can be made about generally valid operating parameters. A total reset replace the declarations with the default settings that are made ex works.

☞ Calling up system programs (SYSTEM CARDs) can alter the declarations in the mask fields.

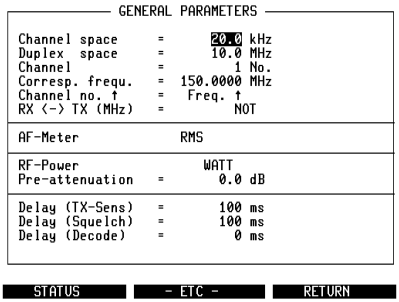


Fig. 4.10: Mask GENERAL PARAMETERS; contents of entry fields = default values (settings ex works).

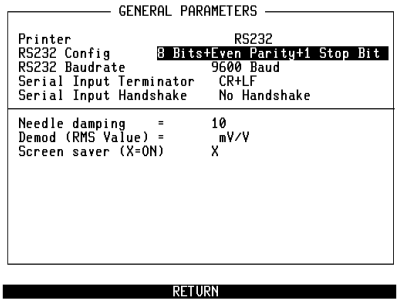


Fig. 4.11: Mask GENERAL PARAMETERS after (- ETC -).

Callup of mask

(AUX) + (DEF.PAR)

Functions of softkeys

(STATUS)	leads to callup of the status mask.
(- ETC -)	turns to the second page of the GENERAL PARAMETERS mask ((RETURN) takes you back to the first page).
(RETURN)	takes you back to the OPTION CARD mask.

Meaning of fields

`Channel space` (pure numeric field); the content determines the channel spacing when you work with channel numbers.

`Duplex space` (pure numeric field); in the DUPLEX mask the entered value produces automatic offset of the transmit and receive frequencies by the duplex spacing (see also `RX ↔ TX` field).

`Channel` (pure numeric field); the entered channel number is assigned to the frequency stated in the `Corresp. frequ.` field.

`Corresp. frequ` (pure numeric field); the entered frequency is assigned to the channel number declared in the `Channel` field.

`Channel no.` (scroll field); the two scroll variables (arrow pointing up or down) determine whether the frequency increases or decreases with ascending channel number when you are working with channel numbers.

`RX ↔ TX (MHz)` (scroll field); the three scroll variables enable the following declarations when you work with frequency values in the DUPLEX mask:

- `RX > TX` the carrier frequency of the signal generator, offset by the duplex spacing, is automatically above the tuning frequency of the test receiver.
- `RX < TX` the carrier frequency of the signal generator, offset by the duplex spacing, is automatically below the tuning frequency of the test receiver.
- `NOT` the signal generator and the test receiver can be tuned as wished, there is no automatic coupling.

`AF meter` (scroll field); the three scroll variables affect the RMS instrument:

- `RMS` the RMS voltmeter is displayed in the masks.
- `dBm` instead of the RMS instrument the AF power meter AF POWER (meter display: dBm into 600 **Ω**) is displayed in the masks if the VOLTM input socket is coupled.
- `WATT` as described under "dBm", but meter display in watts (select the reference impedance in the adjacent pure numeric field).

`RF power` (scroll field with four scroll variables); two scroll variables determine whether the RF power meters PWR and SEL.PWR indicate the measured value in watts or dBm (into 50 Ω).

In modulation mode AM the RF power meter PWR displays peak power if one of the scroll variables is set to `WATT PEAK 5 W` or `WATT PEAK 150 W` (power range 5 W respectively 150 W). In that case `PEAK` is displayd on the power meter.

`Pre-attenuation` (pure numeric field); in TX testing the content automatically corrects the measured value with externally connected pre-attenuation (eg display of the actual transmitted power **before** the attenuator). In RX testing the actual RF output level is greater by the value in the `Pre-attenuation` field than the value indicated in the `Level` field. Level shows the level that the radio set receives (level **after** the external attenuator). Example: see following page.

If any other value than 0 is entered in the `Pre-attenuation` field, the pointer `ATT` appears at appropriate points in the basic masks to draw your attention to the correction of the measured value or level (eg next to the Level field and in the header of the PWR instrument).

`Delay (TX-Sens)` (pure numeric field); the content of the field defines a time duration. This time is waited when the TX Special SENS (measurement of modulation sensitivity) is running after each alteration of the set variable so that transient responses of the radio transmitter can decay

`Delay (Squelch)` (pure numeric field); the content of the field defines a time duration. This time is waited when the RX Special SQUELCH (measurement of squelch characteristics) is running after each alteration of the set variable so that transient responses of the radio receiver can decay.

`Delay (Decode)` (pure numeric field); the content of the field defines a time duration (0 to 999 ms). The decoder of the 4032 is activated delayed by this time after keying of the radio transmitter. Requirements: TX or DUPLEX mask called up; RF socket coupled; demodulated signal is decoded; no continuous input signal but transmitter keying. Application: avoiding transients of the transmitter of the test item when decoding (selective call or VDEW extension dialing).

Printer	(scroll field); the scroll variables HP-2225, EPSON FX80 and PT 88 produce matching of the IEEE-488 interface (data format) to the printers of the same name with an IEEE-488 interface. If the optional RS-232/Centronics interface is incorporated, the scroll variables RS232 and Centronics can also be set. In this case the "Epson Graphics" data format automatically applies for output on these interfaces. The Mem.Card scroll variable diverts print output to MEMORY CARD.
RS232 Config	(scroll field); with scroll variables it is possible to set eight different communication protocols for the RS-232 interface (number of data bits, even/odd parity, number of stop bits). The control commands for this interface are described in Chapter 8.
RS232 Baudrate	(scroll field); with eight scroll variables the baud rate for data transfer on the RS-232 interface can be set between 110 Baud and 9600 Baud.
Serial Input Terminator	(scroll field); six scroll variables like CR+LF or EOT define the end marking necessary for the RS-232 control command SER_In (see Chapter 8). If scroll variable Number is set, a 3-digit number can also be entered in a numeric field to define after how many incoming characters the serial reading operation is terminated (see also Chapter 8, special commands WRITE or SLAVE).
Serial Input Handshake	(scroll field); the scroll variables RTS ↔ CTS and No Handshake define whether the level on pin 4 of the RS-232 interface signals that STABILOCK 4032 is ready to receive. If scroll variable RTS ↔ CTS is entered and the Communication Test Set is ready to receive, pin 4 will be High. If the set is not ready to receive, pin 4 is Low. With No Handshake pin 4 is always Low and the set does not show its readiness to receive. Readiness to send of the opposite station (CTS signal) is checked independently of the selected scroll variable. For this, apply the CTS signal to pin 5 In addition to this hardware handshake, a software handshake is also possible (see Chapter 8, special commands WRITE or SLAVE).
Needle damping	(pure numeric field); the entered value determines the needle damping of the simulated pointer meters as soon as the automatic range switching has been replaced by a fixed measurement range (large value = strong damping).

`Demod (RMS Value)` (scroll field); the scroll variables `kHz` and `mv/V` define whether, in TX mode, the RMS meter displays the level of the demodulated signal with the unit `mV/V` after [DEMOD] (normal case) or the level is converted to the corresponding frequency deviation (average value) and the result is displayed. Use this average indication if the DEMOD meter (peak indication) fails to produce a clear reading (eg when interference is superimposed).

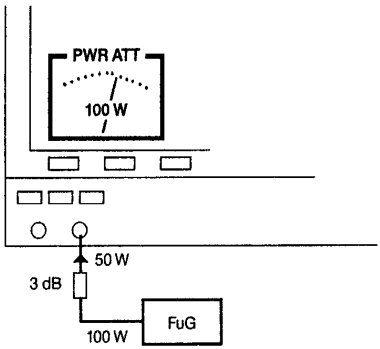
`Screen Saver` (scroll field); if the `X` scroll variable is entered, the screen protection is activated after about 20 to 25 min. A blank in the scroll field shuts down the screen protection. In this case the brightness has to be reduced to prevent burns (see also Chapter 2, Meaning of Rotary Knobs, INTENS). When the Communication Test Set is switched on again or after [CLEAR], the screen protection is automatically activated.

Example: Pre-attenuation

If you work with external pre-attenuation, and this is correctly entered in the `Pre-attenuation` field, you do not have to make any further allowance for the pre-attenuation.

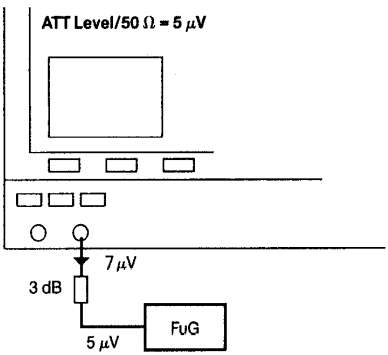
TX measurements:

Fig. 4.12: You want to measure the RF power of a 100-W transmitter over a longish period. The maximum permissible continuous input power on the RF socket is 50 W however. Thus external pre-attenuation of, for example, 3 dB is necessary. Without an entry in the `Pre-attenuation` field the 4032 would then indicate 50 W. If you enter the value 3 in the `Pre-attenuation` field, the 4032 indicates the actual transmitted power, ie 100 W. The entry saves you subsequent correction of the measured value with the possibility of making an error. But make sure that the entry in the `Pre-attenuation` field is also altered if you change the pre-attenuation!



RX measurements:

Fig. 4.13: You have provided external pre-attenuation of, for example, 3 dB for TX measurements and now want to carry out RX measurements without removing the pre-attenuation. The value 3 is still entered in the `Pre-attenuation` field. The Level field indicates 5 µV for example. This is the level directly on the RF input of the radio set. The actual output level of the 4032 signal generator is 7 µV to compensate for the effect of the attenuator. Again make sure that the entry in the `Pre-attenuation` field is altered if you change the pre-attenuation!



ZOOM

This chapter shows the zoom display of the analog instruments that can be called up proceeding from the basic RX, TX and DUPLEX (option) masks.

Function of instruments

PWR

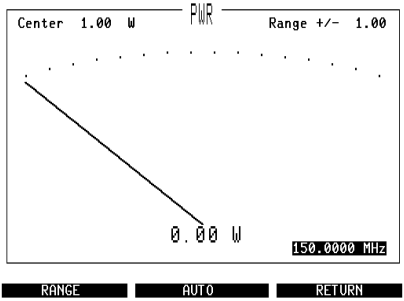


Fig. 4.14: Instrument PWR. Broadband RF power meter; measures signals fed in on the RF socket. Selection of the units in the GENERAL PARAMETERS mask (RF Power field).

MOD

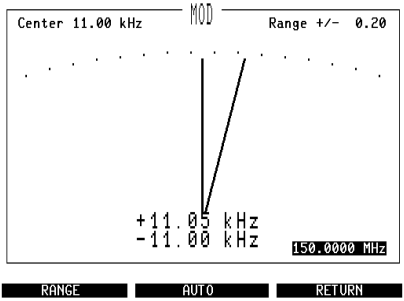


Fig. 4.15: Instrument MOD. Modulation meter RX; indicates the modulation of the 4032 signal generator.

OFFSET

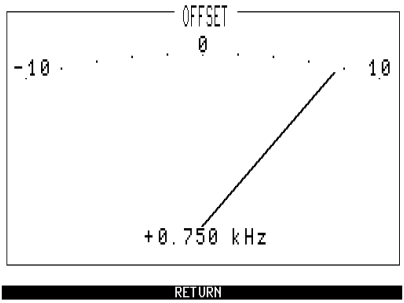


Fig. 4.16: Instrument OFFSET. Frequency-offset meter; indicates the frequency offset of a carrier signal applied to the RF or RF DIRECT socket from the tuning frequency of the 4032 test receiver contained in the entry field RF Frequency.

DEMOD

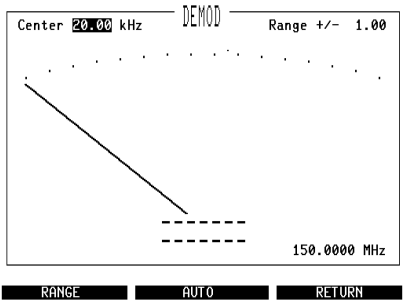


Fig. 4.17: Instrument DEMOD. Modulation meter TX; indicates the modulation of the RF signal applied to the RF or RF DIRECT socket.

RMS

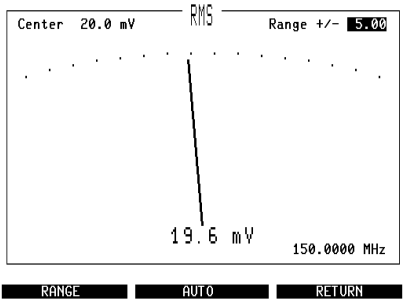


Fig. 4.18: Instrument RMS. RMS AF voltmeter and AF frequency counter; after [RX MOD/MOD GEN] the display applies for the modulation signal, after [DEMOD] for the demodulated signal and after [VOLTM] for the signal applied to the VOLTM socket.

dBr

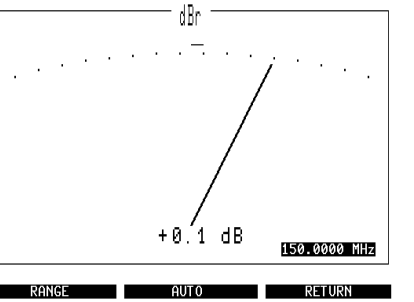


Fig. 4.19: Instrument dBr. Level meter (relative); the reference level (0 dB) is the level indicated by the RMS meter immediately before the dBr instrument is called up.

DIST

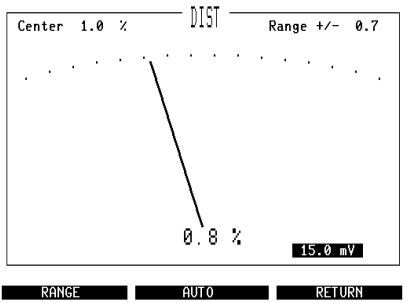


Fig. 4.20: Instrument DIST. Distortion-factor meter; the display applies to the same signal sources described for the RMS instrument.

SINAD

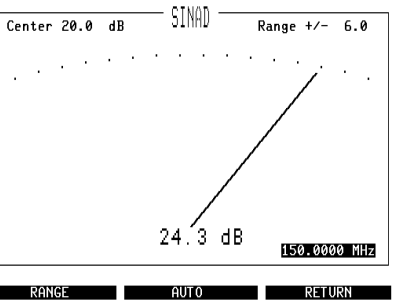


Fig. 4.21: Instrument SINAD. SINAD meter; after [RX MOD/MOD GEN] the display applies for the modulation signal, after [VOLTM] for the signal applied to the VOLTM socket.

AF PWR

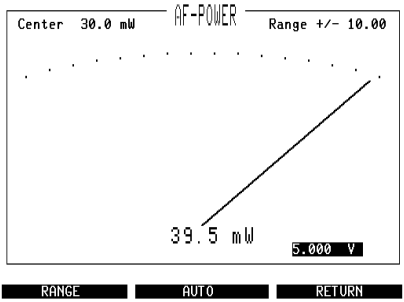


Fig. 4.22: Instrument AF-POWER. AF power meter; measures the power of the signal applied to the VOLTM socket. Selection of the units in the GENERAL PARAMETERS mask (AF `Meter` field).

Callup of instruments

Each of the three basic masks offers the [ZOOM] softkey. [ZOOM] produces reassignment of the softkeys with the designations of the instruments that can momentarily be zoomed. The selection menu that is offered is determined in part by the operating status of the 4032. The following variants are possible:

RX-Maske	
POWER - MOD - RMS	after striking [VOLT] key, if RMS is declared in GENERAL PARAMETERS mask (AF Meter field).
POWER - MOD - dBr	after [dB REL]
POWER - MOD - DIST	after [DIST]
POWER - MOD - SINAD	after [SINAD]
POWER - MOD - AF PWR	after [VOLTM] + [VOLT], if dBm or WATT is declared in GENERAL PARAMETERS mask (AF Meter field).
TX-Maske	
POWER - OFFSET - DEMOD - RMS	after striking [VOLT] key, if RMS is declared in GENERAL PARAMETERS mask (AF Meter field).
POWER - OFFSET - DEMOD - dBr	after [dB REL]
POWER - OFFSET - DEMOD - DIST	after [DIST]
POWER - OFFSET - DEMOD - AF PWR	after [VOLTM] + [VOLT], if dBm or WATT is declared in GENERAL PARAMETERS mask (AF Meter field).
DUPLEX-Maske	
POWER - OFFSET - DEMOD - RMS	after striking [VOLT] key, if RMS is declared in GENERAL PARAMETERS mask (AF Meter field).
POWER - OFFSET - DEMOD - dBr	after [dB REL]
POWER - OFFSET - DEMOD - DIST	after [DIST]
POWER- OFFSET - DEMOD - SINAD	after [SINAD]
POWER - OFFSET - DEMOD - AF PWR	after [VOLTM] + [VOLT], if dBm or WATT is declared in GENERAL PARAMETERS mask (AF Meter field).

Striking the appropriate softkey produces large-format display of the required instrument. Thereby the actual input field of the basic mask is transferred to the enlarged format display. If wished, (CCITT) inserts the CCITT P53-A filter in the signal path to the AF instruments RMS/dBr/AF PWR, DIST and SINAD.

Functions of softkeys

Without any special declaration the analog instruments will work with automatic switching of the measurement range. If this is not wished, the measurement range can be adapted to requirements very effectively.

(RANGE) inserts in the header of the instruments the numeric fields `Center` and `Range +/-`. The two numeric fields permit individual definition of a measurement range. If a measurement range has already been specified in this way, it will become valid again after (RANGE).

(AUTO) produces automatic switching of the measurement range. If a measurement range has already been specified with the RANGE function, it will be replaced by the automatic range switching. (AUTO) does not delete the specified measurement range however; it immediately becomes valid again after (RANGE).

(RETURN) takes you back to the particular basic mask without adopting a specified measurement range in the normal display of the instrument concerned. After (RETURN) the basic masks again show the instruments that were displayed before calling up the zoom function, with automatic switching of the measurement range.

Meaning of fields

`Center`	(pure or mixed numeric field, depending on the instrument); the content of the field is assigned to the scale centre of the instrument.
`Range +/-`	(pure numeric field); the content of the field defines the upper and lower end of the scale, referred to the centre value. Example: `Center` = 160 mV; `Range +/-` = 20.00 → pointer at lower end of scale corresponds to 140 mV, at upper end of scale to 180 mV.
`xxxxxxx`	(numeric or scroll field); the activated input field (brightened up) of the basic mask will be transferred into the enlarged format display and displayed at the bottom right corner of the screen. As long as this field is activated on the zoomed display, the field content can be varied the usual way (for example, value variation using the spin wheel). The reaction can be simultanuously red on the meter.

RX SPECIALS

RX Specials are complete programs that execute typical receiver tests within seconds (sensitivity, IF bandwidth and centre-frequency offset, AF frequency response, squelch characteristic). Relevant test parameters can be set beforehand as wished. The RX Specials are a standard part of the 4032.

Callup and start of an RX Special

The selection menu of the RX Specials is called up from the basic RX mask with (SPECIAL). This produces reassignment of the softkeys with the available Special functions (selection menu). At the same time the mask of the last Special used (Special mask field) is displayed in the bottom half of the basic RX mask.

If you now strike the softkey of the required Special function, the appropriate mask is called up. (HELP) will mark all fields that can accept entries: In the RX mask field only set the correct channel frequency (RF Frequency field) plus the test modulation (Mod. field). The remaining entry fields of the RX mask are filled in automatically by the Specials.

After the entry of relevant test parameters and selection of scroll variables in the Special mask field (see below), (RUN) will start the Special. The program can be aborted with the alternative function (STOP). (RETURN) takes you back to the basic RX mask.

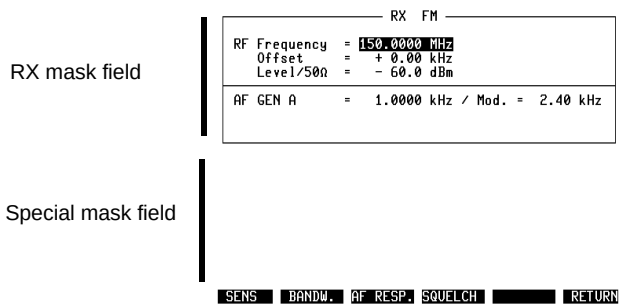


Fig. 4.23: Monitor display after striking (for the first time) the (SPECIAL) softkey. The softkeys then enable individual Specials to be called up.

Description of Specials

(SENS) measures receiver sensitivity; the Special mask field contains three entry fields (content of the fields in this case default values):

`20 dB` (pure numeric field); enter the required SINAD or S/N reference value. The value is stored assigned to the test method so that the reference value is automatically adapted if the test method is altered.

`SINAD` (scroll field); the selected scroll variable `SINAD` or `S/N` determines the test method.

`dBm` (scroll field); select under the scroll variables the unit of measurement that the result is to have.

After the start of the routine the RF level of the signal generator is successively approximated, beginning at –77 dBm, and with each step a SINAD or S/N measurement is performed. This continues until the measured value corresponds to the given reference value (permissible tolerance: 0.5 dB S/N; 0.8 dB SINAD). The result, the corresponding RF level, is displayed in the Special mask field with the required unit of measurement.

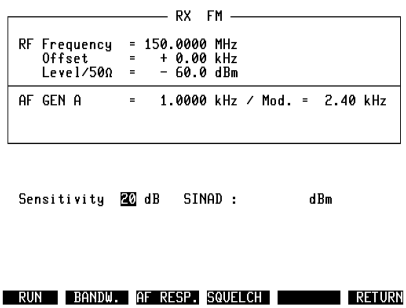


Fig. 4.24: Special SENS.

(BANDW) measures IF bandwidth and centre-frequency offset; the Special mask field contains one entry field (content in this case a default value):

6 dB (pure numeric field); enter the value of the attenuation to which the bandwidth is to be referred.

The routine first measures the background noise with noise suppression of 10 dB. The associated RF level is then increased by the value of the attenuation (normally 6 dB). The routine then detunes the carrier frequency towards greater values until 10 dB noise suppression is reached again. The frequency offset necessary for this is buffered and the frequency detuning is repeated, this time towards smaller values. From the two offset values the routine computes the bandwidth and the centre-frequency offset and indicates their values in the Special mask field.

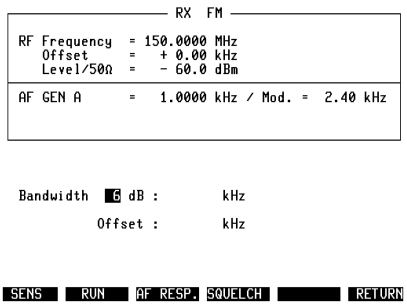


Fig. 4.25: Special BANDW.

(AF RESP) measures AF frequency response; the Special mask field contains eight entry fields (content in this case default values):

`1 kHz` (pure numeric field); enter the frequency that is to represent the reference point 0 dB.

`0.15 bis 6 kHz` (pure numeric fields); enter up to seven frequencies at which the routine is to measure the AF level.

The routine first determines the AF level at the reference frequency and sets this value as a reference for relative level measurement at all seven frequencies. The AF frequency response is thus a display of the relative level deviation together with the corresponding frequencies.

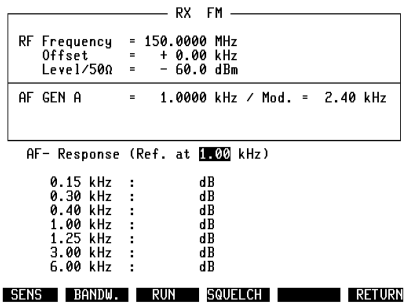


Fig. 4.26: Special AF RESP.

(SQUELCH) measures the characteristics of the squelch; the Special mask field contains two entry fields (content in this case default values):

`RX MUTE` (scroll field); select the scroll variable `RX MUTE` if the squelch cutout (AF off) is to be determined. If you set the scroll variable `RX UNMUTE`, the squelch cutin (AF on) is determined.

`dBm` (scroll field); select under the scroll variables the unit of measurement that the result is to have.

After the start the Special first continually reduces the RF level of the signal generator, beginning at –80 dBm, in 5-dB steps until the squelch switches (AF path blocked). This roughly determined level is increased by 15 dB and then reduced again in 1-dB steps until the squelch switches once more. This level is then increased by 2 dB and reduced in 0.2-dB steps until the squelch again switches. The level obtained in this way is the squelch cutout value RX MUTE.

If the cutin value of the squelch is called for, the routine then increases the level again, proceeding from the RX MUTE value, in 0.2-dB steps until the squelch enables the AF path (RX UNMUTE). The squelch hysteresis is the difference between the two levels.

With the exception of the first approximation to the cutout value RX MUTE, all changes in level are made with the aid of the CONT function (continuous alteration of level without interruption).

If transient responses in the receiver disturb the measurement, a delay should be entered in the GENERAL PARAMETERS mask in the `Delay` field (squelch). The routine then waits a suitable length of time after each change in RF level before checking the AF level.

In the Special mask field the hysteresis plus the MUTE or UNMUTE value are indicated. [UNIT/SCROLL] shows the other value depending on which scroll field brightens up.

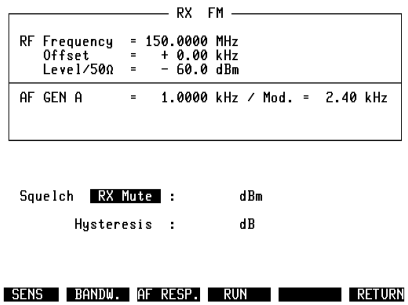


Fig. 4.27: Special SQUELCH.

TX SPECIALS

TX Specials are complete programs that perform the two typical transmitter tests of modulation sensitivity and AF frequency response within seconds. Relevant test parameters can be set beforehand as wished. The TX Specials are a standard part of the 4032.

Callup and start of a TX Special

The selection menu of the TX Specials is called up from the basic TX mask with (SPECIAL). This produces reassignment of the softkeys with the Special functions (SENS) and (AF RESP) (the other functions SEL.PWR and DC-CAL. are not Specials; there is more about this at the end of the chapter). At the same time the mask of the last Special used (Special mask field) is displayed in the bottom half of the basic TX mask.

If you now strike the softkey of the required Special function, the appropriate mask is called up. (HELP) marks all fields that can accept entries:
In the TX mask field only set the correct channel frequency (RF Frequency field) plus the modulation frequency (AF GEN A field). The other entry fields of the TX mask are filled in automatically by the Specials.

After the entry of relevant test parameters and selection of scroll variables in the Special mask field (see below), (RUN) will start the Special. The program can be aborted with the alternative function (STOP). (RETURN) takes you back to the basic TX mask.

Description of Specials

(SENS) measures modulation sensitivity; the Special mask field contains two entry fields (content of the fields in this case default values):

- Deviation (pure numeric field); in this field enter the modulation value to which the sensitivity is to be referred (eg test modulation).
- expected Value (pure numeric field); in this field enter the value of modulation sensitivity that you expect.

To prevent the transient responses of modulators with AGC from affecting the measurement, a delay (pause between the individual measurements of the routine) can be entered in the `Delay (TX Sens)` field of the GENERAL PARAMETERS mask.

The SENS routine first checks whether the required modulation is exceeded at twice the expected value. If this is not so, the routine is terminated and you can start the Special again with an expected value that has been corrected upwards. If the first check shows a relevant value however, this will start the actual measuring routine.

The program first determines what modulation results from half the expected value of the AF level, computes from this information the slope of the modulation characteristic and then sets the AF level that will most likely produce the required modulation. If this level results in modulation with ±2 % tolerance referred to the rating, the routine will report this level as the result in the Special mask field. If the modulation is outside of the tolerance window however, the routine calculates the slope again from the last current measured value and then tries again to approximate to the correct AF level.

If the characteristic is very nonlinear and the approximation is unsuccessful, the routine again sets half the expected value, increases the level step by step by 5 % of half the expected value and thus approaches the rating for the modulation. In this case the result will show an error of maximally ±5 %.

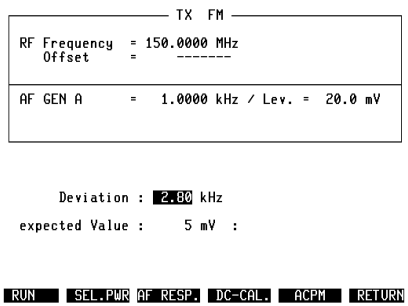


Fig. 4.28: Special SENS.

(AF RESP) measures AF frequency response; the Special mask field contains eight entry fields:

`1 kHz` (pure numeric field); enter the frequency that is to represent the reference point 0 dB.

`0.15 kHz` ... `6 kHz` (pure numeric fields); enter up to seven frequencies at which the routine is to measure the AF level.

The routine evaluates the demodulation signal coming from the 4032 test receiver (automatic switchover to DEMOD). First the AF level is determined at the reference frequency, and then this value is used as a reference for relative level measurement at all seven test frequencies. The result for the AF frequency response is indication of the relative level deviation together with the corresponding frequencies.

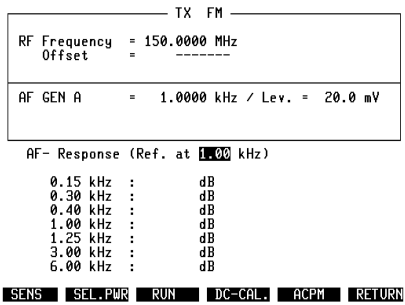


Fig. 4.29: Special AF RESP.

Meaning of other softkeys

(SEL.PWR) (alternative function: (VSWR)); (SEL.PWR) inserts the simulated pointer instrument of the selective RF power meter (bandwidth = 30 kHz) in the Special mask field. In contrast to the broadband RF power meter PWR, the small signal at P < 0 dBm may be applied to the RF DIRECT socket. Declarations in the GENERAL PARAMETERS mask permit selection of the unit of measurement and automatic correction of the measured value with external pre-attenuation (see also Chapter 9).

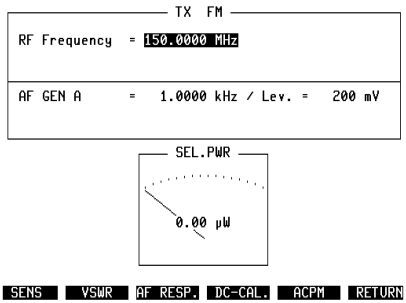


Fig. 4.30: Selective RF power meter.

(VSWR) inserts the display field of the VSWR meter in the Special mask field (VSWR measurement needs option VSWR measuring head; see Chapter 9).

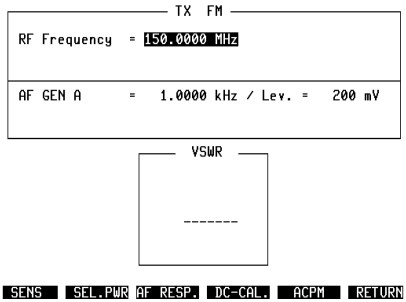


Fig. 4.31: VSWR display.

(DC-CAL.) (DC-CAL.) produces DC calibration of the FM demodulator in the 4032. This adjustment is necessary if the zero of the demodulated signal is of importance. Data telegrams that are transmitted by the NRZ (non return to zero) method, for instance, require correct zero adjustment of the demodulator so that data bits 1 and 0 are reliably detected. (DC-CAL.) does not call up any mask.

DUPLEX SPECIALS

In the DUPLEX mode (option, calls for DUPLEX FM/ΦM stage) the 4032 offers routines for measuring signal transfer (DESENS), AF frequency response and DC zero adjustment of the FM demodulator.

Callup and start of a DUPLEX Special

The menu of the DUPLEX Special is called up from the basic DUPLEX mask with (SPECIAL). This leads to reassignment of the softkeys with the Special functions (DESENS) and (AF RESP) (the (DC-CAL.) function is not a Special). At the same time the mask of the Special that was last used is displayed in the bottom half of the basic DUPLEX mask (Special mask field).

Tap the softkey of the required Special function to call up the appropriate mask. [HELP] will then mark all fields that can accept entries:
Set the correct channel frequencies in the DUPLEX mask field (`RF Frequency` fields) and the required test modulation (`Mod.` field). The selection of the AF signal path (eg DEMOD or VOLTM) and of the instruments (eg SINAD meter or dBr meter) is made by the Specials automatically.

After the entry of relevant test parameters and selection of scroll variables in the Special mask field (see below), (RUN) will start the Special. The program can be aborted with the alternative function (STOP). (RETURN) takes you back to the basic DUPLEX mask.

Description of Specials

(DESENS) measures signal transfer in duplex operation, ie desensitizing or how much the sensitivity of the radio receiver is reduced when the radio transmitter is operating. The Special mask field contains two entry fields (content of the fields in this case default values):

`20 dB` (pure numeric field); enter the required SINAD or S/N reference value. The value is stored assigned to the test method so that the reference value is automatically adapted if the test method is altered.

`SINAD` (scroll field); the selected scroll variable `SINAD` or `S/N` determines the test method.

The DESENS routine first performs the RX Special SENS and determines the receiver sensitivity with the radio transmitter switched off (measured value S1). Then an instruction appears at the bottom edge of the monitor telling you to key the transmitter or switch to TX. If this is not done within about eight seconds, the routine will be terminated. Otherwise the receiver sensitivity is measured again (value S2). The result of the measurement, the difference between the two measured values (desensitizing), appears in the Special mask field in dB.

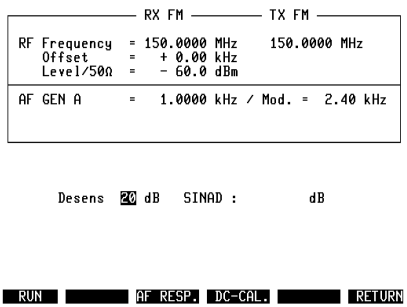


Fig. 4.32: Special DESENS.

(AF RESP) measures AF frequency response; the Special mask field has eight entry fields:

`1 kHz` (pure numeric field); enter the frequency that is to be the 0 dB reference point.

`0.15 bis 6 kHz` (pure numeric fields); enter up to seven frequencies at which the routine is to measure the AF level.

The input signal for the DUPLEX transceiver is that of the 4032 signal generator. The signal returned from the transceiver, offset by the duplex spacing, is evaluated. First the routine modulates the signal generator with the reference frequency and determines for this frequency the AF level on the output of the DUPLEX FM/ΦM demodulator. This measured value is the reference value for relative level measurement at all seven test frequencies. The result for the AF frequency response is indication of the relative level deviation for the corresponding frequencies.

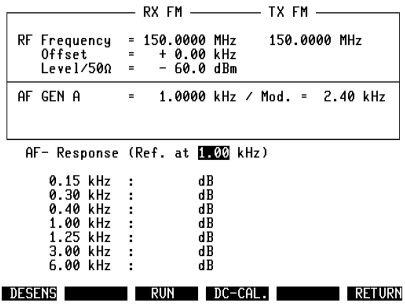


Fig. 4.33: Special AF RESP.

Meaning of other softkeys

(DC-CAL.) (DC-CAL.) produces DC calibration of the FM demodulator in the 4032. This adjustment is necessary if the zero of the demodulated signal is of importance. Data telegrams that are transmitted by the NRZ (non return to zero) method, for instance, require correct zero adjustment of the demodulator so that data bits 1 and 0 are reliably detected. (DC-CAL.) does not call up any mask.

OPTION CARD

The OPTION CARD mask enables you to:

a) operate the modules installed on the OPTION CARD (see also Chapter 9);

b) branch to masks of software options loaded from memory card (see also Chapter 7);

c) call up the mask for operating control interface A, B or C (see also Chapter 9);

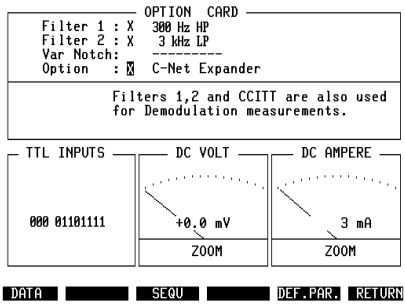
d) branch to DTMF mask (see also Chapter 5);

e) branch to mask levels of selective-call systems (see also Chapter 5);

f) call up the GENERAL PARAMETERS mask.

☞ a) through d) only with corresponding options installed.

Fig. 4.34: OPTION CARD mask: OPTION CARD shown equipped with the 300-Hz highpass filter, 3-kHz lowpass filter and C-Net Expander.



Calling up the mask

AUX That mask can be started from any other mask.

Softkey functions

(DATA) Activates the DATA MODULE option, automatically loads the system program (software option) from the inserted SYSTEM CARD and calls up the corresponding mask. (DATA) produces entry into the test procedure for radio-data sets and cellular radiotelephones.

(CONTROL) (Optional) Calls up the CONTROL INTERFACE mask (control of the optional control interface).

(SEQU) Calls up the basic sequential mask (testing of selective-call sets).

(DTMF) (Optional) Calls up the DTMF mask (control of the optional DTMF module).

(DEF.PAR) Calls up the GENERAL PARAMETERS mask.

(RETURN) Returns to the mask from where the OPTION CARD was called up.

Meaning of the input fields

`Filter 1 :` (text field/scroll field); if the slot Bu 1 on the OPTION CARD is still vacant, the text field is followed by dashes. If a filter module is inserted in the slot however, the text field is followed by a scroll field and a display field (brief designation of the installed, optional module). The scroll field uses the variables "X" and "□" (space).

- X — Filter will be connected into the AF signal path when leaving the OPTION CARD mask (see block diagram next page).
- □ — Filter will be cut out of the AF signal path when leaving the mask.

`Filter 2 :` (text field/scroll field); function corresponds to that of filter 1, related to slot Bu 2. To connect both filters in series: both variables = X.

`Var Notch:` (text field/scroll field); if the variable notch filter is installed on the OPTION CARD, it substitutes, by selecting scroll variable X, the standard notch filter. (DIST) connects the variable notch filter (f = 200 to 600 Hz, self-tuning) into the AF signal path for distortion measurement.

☞ When measuring distortion all other filters have to be switched off.

`Option:` (text field/scroll field); if a module is installed in slot Bu 6 on the OPTION CARD (eg C-Net Expander), the module can be connected into the AF signal path by selecting scroll variable X (see **Fig. 4.35**).

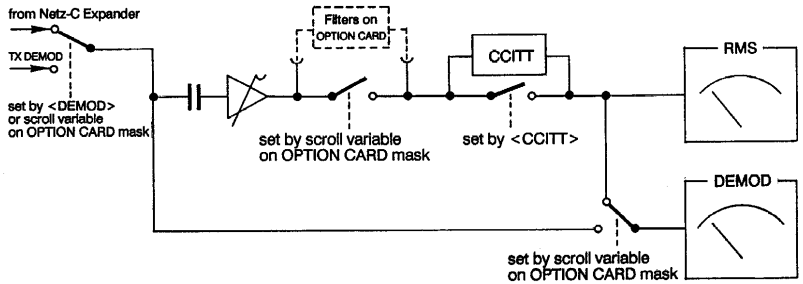


Fig. 4.35: Block diagram: Switchable paths of signal sources TX DEMOD and C-Net Expander to meters RMS/dBr (RMS level meter/relative level meter) and DEMOD (modulation meter).

`Filters 1,2 and CCITT are also used for demodulation measurements` (scroll field); With this scroll field you can decide whether the signal of the momentary AF signal source goes to the DEMOD meter directly or filtered (see also **Fig. 4.35**). This is selected with the scroll variables "X" and "□" (space):

X — Filters activated on the OPTION CARD (filter 1 and/or filter 2) and/or the standard CCITT filter are inserted in the AF signal path to the DEMOD meter when you leave the OPTION CARD mask. The note FLT in the header of the DEMOD meter shows that the signal is now filtered.

□ — The signal of the momentary AF signal source goes to the DEMOD meter unfiltered.

If the 4-kHz bandpass filter (option) is cut into the AF signal path for example, it is possible in NMT systems to filter out the pilot tone (SAT) and measure its shift.

Independently of the choice of scroll variables the RMS meter is fed with the filtered signal as soon as the CCITT filter and/or a filter on the OPTION CARD is activated.

Meters of the mask OPTION CARD

DC VOLT	DC voltmeter; calls for module 248 172 on OPTION CARD.
DC AMPERE	DC ammeter; calls for module 248 172 on OPTION CARD.

The ZOOM field can be located with the cursor keys. If the field is brightened up, UNIT/SCROLL calls up the full-format display of the instrument on the screen

The signal inputs for both meters are on the back panel, OPTION CARD:

Bu 91 and Bu 92	ammeter
Bu 93 and Bu 94	voltmeter

For further information see Chapter 9, DC Voltmeter/Ammeter.

TTL INPUTS

If the 4032 is equipped with one of the control interfaces (option), the TTL INPUTS field shows the logic levels applied to the TTL inputs of the control interface. The first three digits relate to the trigger inputs, the remaining eight digits relate to the TTL inputs of socket Bu 22 of the control interface (see also Chapter 9).

Applications

Introduction

In this chapter we shall be looking at solutions to typical measuring tasks: put the Communication Test Set into its basic TX or RX setting and then turn to the section shown in the contents for the measuring task you wish to carry out. Each section is a complete application: concrete entry instructions for the 4032, a list of the boundary conditions that are to be maintained plus information about the purpose of the measurement and indications of permissible limit values.

Measurements that are normally time-consuming are speedily carried out with the "Specials" of the 4032. If the 4032 offers a Special for a particular measuring task, the entry instructions are headed "Special Measurement". The entry instructions for common, purely manual measurements are also listed (in addition) if there is a Special. The entry instructions are always contained in a frame: the entries on the left, and a brief explanation on the right.

☞ For the entry instructions it is assumed that the measurement concerned is a one-shot measurement. This means that all the necessary entries are listed. For series of measurements however it is sufficient to enter parameters like test modulation or reference frequencies just once because the 4032 retains these values. In the course of series of measurements therefore, only the remaining relevant entry instructions have to be followed.

All settings, limit values and boundary conditions stated in this chapter are based to a large extent on the Recommendations of the CEPT (Conference of European Postal and Telecommunications Administrations) for mobile radio services. Within these operating instructions the figures are simply intended as realistic **examples** however. Only the various national specifications are binding, so consult the testing regulations or licensing conditions of the responsible PTT administration.

For the terms "maximum frequency deviation" and "(FM) test modulation" used below, the conditions are the usual ones:

- Maximum permissible frequency deviation = ±20 % of the channel spacing, ie ±4 kHz for a channel spacing of 20 kHz for example.
- Test modulation = 60 % of the maximum permissible frequency deviation (f_{mod} = 1 kHz).
- Channel frequency = rated carrier or receiver frequency of the radio set, not to be confused with the actual frequency of the radio set.

Test Setup

With the test setup that is shown, it will usually be possible to perform all standard transmitter and receiver measurements. In the case of receiver measurements the required RF output level will determine whether the radio set has to be connected to the RF or RF DIRECT socket. Normally connection will be made to the RF socket.

In transmitter measurements the radio set will also normally be connected to the RF socket. Depending on the particular measurement however, the input level of a small signal may be less than the permissible minimum of 10 mW. In such cases you should use the RF DIRECT socket so that the specifications of the 4032 continue to apply. For precise details of the minimum and maximum values on the two RF input/output sockets, refer to the data sheet of the communication test set.

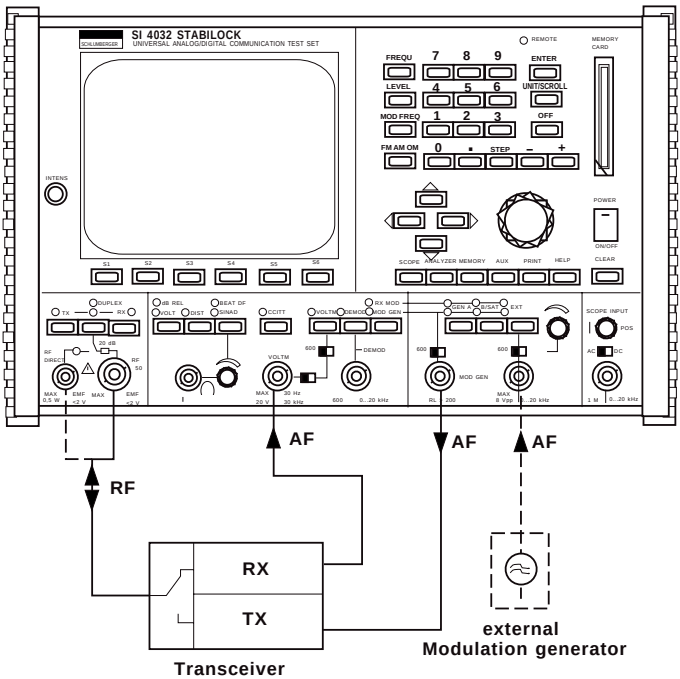


Fig. 5.1: Typical setup for standard RX/TX measurements: The external modulation generator is necessary if modulation overlaying is required and the Communication Test Set is not fitted with the GEN B option (second internal modulation generator).

Basic TX Settings

The basic TX settings are the foundation for all standard transmitter measurements. It is sufficient to perform these basic settings once before starting the actual transmitter measurements. In the course of transmitter measurements the basic settings will normally be maintained unaltered, meaning that only a few extra entries are necessary.

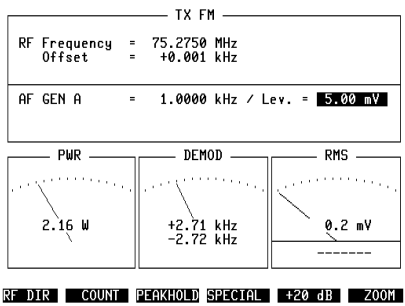
1. [TX]	Call up TX mask.
2. [RF] or [RF DIR]	Connect to appropriate input socket.
3. [FREQU] + <value> + [ENTER]	Tune test receiver to channel frequency of radio set and confirm entry.
4. [MOD FREQ] + <1> + [ENTER]	f_{mod} = 1 kHz (GEN A).
5. [DEMOD]	Demodulated signal is switched through to AF instruments.
6. [FM AM ΦM] + [UNIT/SCROLL]	Switch-on of GEN A and selection of modulation (display TX-AM, TX-FM, TX-ΦM in mask header).
7. Switch on transmitter of radio set	

Following the last step of the basic settings the `Lev` entry field (modulation level for radio set) in the TX mask is ready to accept a value; the following LEDs must illuminate red on the front panel of the 4032: TX, DEMOD and GEN A. Now you can commence any standard transmitter measurement.

If you use TX Specials, you can skip step 5. of the basic TX settings because the Specials automatically switch the demodulated signal through to the AF instruments.

Fig. 5.2: Basic TX setting: The following operating parameters are declared in the mask for example:

channel frequency = `75.2750 MHz`
f_{mod} = `1.0000 kHz`
modulation = `FM`
RF socket is active input
`Lev` field is active and expects, depending on test to be performed, entry or variation of modulation level.



Frequency Offset and Carrier Frequency

Boundary conditions:

- Carrier unmodulated
- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Observe specified measurement range (see data sheet) in precision offset measurements because actual measurement range is greater
- For carrier-frequency measurement only apply signal to RF socket

Measurement frequency offset

1. Check basic TX settings.
2. Read measured frequency offset in `Offset` field.

The frequency offset is measured with the accuracy stated in the data sheet up to the specified value. This accuracy is no longer guaranteed for greater values. An overflow of the measurement range is signaled by the offset field with the display ">>>>>>" or "------" (very large offset).

If, after the offset measurement, the test receiver is automatically tuned to the frequency of the input signal with {COUNT}, the offset field may show a residual offset of up to ±40 Hz. This residual offset results from the different resolution of the frequency counter compared to the frequency entry format in the RF Frequency field.

Acoustic adjustment of transmit frequency: If the BEAT function is called up with the [BEAT/SINAD] key, the frequency offset of the input signal from the tuning frequency of the test receiver can be heard on the internal loudspeaker (volume setting with rotary knob).

Measurement carrier frequency

1. Check basic TX settings.
2. (COUNT) Switch on frequency counter.
3. Read carrier frequency in RF `Frequency` field.

If the frequency of the signal reduces during measurement, it is possible in exceptional cases that the display in the RF Frequency field will not react. In this case the frequency counter measures an harmonic. If you suspect that the measurement is erroneous, switch the counter off and back on again immediately with (OFFSET) + (COUNT) to obtain the correct measured result.

As long as the (COUNT) function is active, the test receiver of the 4032 is automatically tuned to the measured frequency.

Purpose of measurement

To check whether the carrier frequency of a transmit signal is within tolerances. If the frequency offset from the rated value exceeds the permissible limit, a receiver will no longer be able to demodulate the signal properly for example, ie there will be distortion. Large frequency offsets lead to adjacent-channel interference.

Typical limit values

The permissible frequency offset depends on the frequency range. The CEPT permits much greater offsets in UHF than in VHF:

Frequency range	Permissible offset
30 bis 50 MHz	±0,60 kHz
50 bis 100 MHz	±1,35 kHz
100 bis 300 MHz	±2,00 kHz
300 bis 1000 MHz	±2,50 kHz

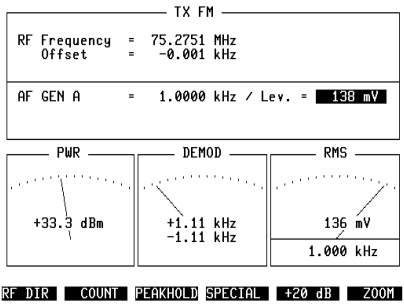


Fig. 5.3: The `Offset` display field indicates that the carrier frequency of the device under test deviates from the rated channel frequency.

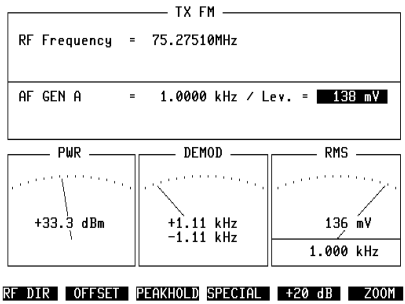


Fig. 5.4: Carrier frequency: As soon as the `COUNT` function is called up, the `RF Frequency` field indicates the carrier frequency of the device under test.

RF Power (broadband)

Boundary conditions

- P_{max} = 50 W (continuous application) or P_{max} = 125 W for maximally 1 min (see also Chapter 1 "Permissible RF input power")
- Carrier signal applied unmodulated to RF socket
- Check setting of pre-attenuation
- If necessary, first perform zero adjustment for PWR meter with (SPECIAL) + (DC-CAL.) with input open-circuit (for zero adjustment FM modulation must be selected)

Measurement

1. Check basic TX settings
2. Read average carrier power on PWR meter

The power measurement is broadband with the specification given in the data sheet. If the measuring unit `Watt` or `dBm` is selected in the GENERAL PARAMETERS mask (`RF Power` field) the PWR instrument displays the average value of the applied power. In modulation mode AM the peak power is displayed if one of the scroll variables `WATT PEAK 5 W` or `WATT PEAK 150 W` is selected. If pre-attenuation is applied externally, the resulting falsification of the measured value can be compensated for automatically by entering the pre-attenuation value in the `Pre-attenuation` field of the GENERAL PARAMETERS mask. The ATT pointer in the header of the PWR meter indicates that the display of the measured value is corrected by the factor of the pre-attenuation (see "General Parameters").

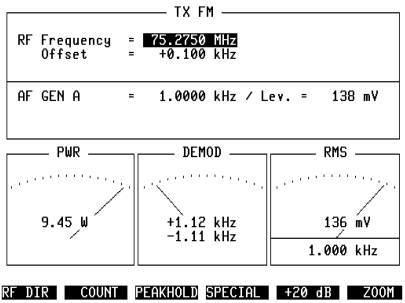


Fig. 5.5: Transmitting power: The PWR meter, which is always displayed in the TX mask, shows the average carrier power of the device under test. The measurement is broadband, so the channel frequency (`RF Frequency` field) is insignificant.

If the REDUCE RF POWER message appears on the monitor for P > 50 W, immediately reduce the applied power to P ≤ 50 W (see also Chapter 1, "Permissible RF input power").

Purpose of measurement

To check whether the average carrier power of a radio set meets the specifications. Values that are too low mean a loss of range and values that are too high produce propagation overshoot.

Typical limit values

The standard value of the carrier power may be exceeded by maximally 2 dB under extreme test conditions and underrun by maximally 3 dB.

RF Power (test bandwidth 3 MHz)

Boundary conditions

- Carrier unmodulated
- Level > 0 dBm → apply signal to RF socket
- Level < 0 dBm → apply signal to RF DIRECT socket
- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Check setting of pre-attenuation

Measurement

1.	Check basic TX settings.	
2.	(COUNT)	Tune 4032 test receiver to frequency of RF input signal.
3.	(SPECIAL)	Call up menu of TX Specials.
4.	(SEL.PWR)	Switch-on of selective power RF meter.
5.	Read measured value on SEL.PWR meter.	

The average value of the applied power is measured with 3 MHz bandwidth to max. +37 dBm (see data sheet). Selection of the measuring unit (`Watt` or `dBm`) in the GENERAL PARAMETERS mask, `RF Power` field. If pre-attenuation is applied externally, the resulting falsification of the measured value can be compensated for automatically by entering the pre-attenuation value in the `Pre-attenuation` field of the GENERAL PARAMETERS mask. The `ATT` pointer in the header of the SEL.PWR meter indicates that the display of the measured value is corrected by the factor of the pre-attenuation (see chapter 4, "General Parameters").

It is not possible to measure the power of harmonics because the mixer of the input stage is in this case overdriven by the fundamental. The display `>>>>>` signals overflow of the measurement range. If the message `REDUCE RF POWER` appears on the monitor for very high overloading (P > 50 W), reduce the applied power immediately (see also Chapter 1, "Permissible RF input power").

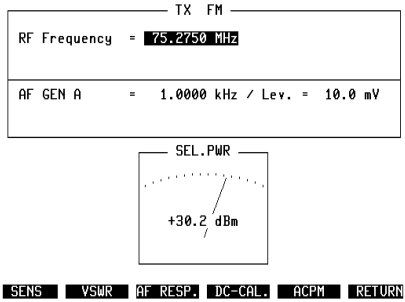


Fig. 5.6: Selective power measurement: Here the SEL.PWR meter shows the measured value with dBm units because these units were declared in the RF Power field of the GENERAL PARAMETERS mask.

Modulation Frequency Response

Boundary conditions

- When applying signal to RF DIRECT socket, observe deviation restriction (see data sheet)
- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Disconnect CCITT filter
- Disconnect filter on OPTION CARD (if present)

Special Measurement

1.	Check basic TX settings.	
2.	<value>	Alter modulation level (Lev field) with handwheel until DEMOD meter shows required modulation (eg 20 % of maximum frequency deviation).
3.	(SPECIAL)	Call up menu of TX Specials.
4.	(AF. RESP.)	Special for modulation frequency response.
5.	<value> + (ENTER)	Enter 0-dB reference frequency in inverted field and confirm (unless default is accepted).
6.	<cursor d> + <value> + (ENTER)	Alter f_{mod} (7 reference values) if necessary.
7.	(RUN)	Start measuring routine.
8.	Read modulation frequency response (7 reference values) from Special mask field.	

If the CCITT filter is cut in, a warning signal is heard after (RUN). Measurement with the filter is not permissible because the filter characteristic affects the measured result too much.

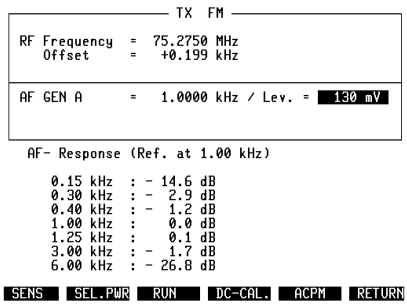


Fig. 5.7: Modulation frequency response: The Special mask field in the bottom half of the display shows seven reference values for the modulation frequency response of the device under test. 1 kHz has been declared as the 0-dB reference frequency.

Manual Measurement

1.	Check basic TX settings.	
2.	<value>	Alter modulation level (Lev field) with handwheel until DEMOD meter shows required modulation (eg 20 % of maximum frequency deviation).
3.	[dB REL]	Normalize level of demodulated signal (f_{mod} = 1 kHz).
4.	[MOD FREQ] + <value>	Vary f_{mod}
5.	During step 4. read on dBr meter whether dB tolerance range is maintained.	

If the carrier signal of the radio set is phase-modulated, ensure that the maximum frequency deviation is not exceeded at the highest modulation frequency. The use of deviation limiting would falsify the measured result. See Introduction for definition of maximum frequency deviation (page 5-3).

Purpose of measurement

To check whether the frequency or phase deviation or modulation depth of a carrier signal - depending on the frequency of the modulation signal - remains within the permissible tolerance range (modulation frequency response). If the curve of the modulation frequency response goes out of the tolerance range, transmission quality will be degraded.

Typical limit values for FM and ΦM

For defining a reference point (0 dB) the carrier signal should be modulated with 1 kHz so that the frequency deviation reaches 20 % of maximum deviation (eg 20 % of 4 kHz = 0.8 kHz). If the modulation frequency f_{mod} is then varied between 300 Hz and 6 kHz, the relative AF level of the demodulated signal must remain within the following tolerances:

f_{mod}	limit values
0,3 kHz...3 kHz:	+1 dB...-3 dB
>3 kHz...<6 kHz	The level may not exceed the value measured at 3 kHz
≥6 kHz	The level must be at least 6 dB below the value measured at 1 kHz

Modulation Sensitivity

Boundary conditions

- When applying signal to RF DIRECT socket, observe deviation restriction (see data sheet)
- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Disconnect CCITT filter
- Disconnect filter on OPTION CARD (if present)
- If necessary select a delay in the `Delay (TX-Sens)` field of the GENERAL PARAMETERS mask

Special Measurement

1.	Check basic TX settings.	
2.	(SPECIAL)	Call up menu of TX Specials.
3.	(SENS)	Special for modulation sensitivity.
4.	<value> + (ENTER)	Enter nominal frequency deviation (eg value of test modulation) in `Deviation` field (unless default is accepted).
5.	<cursor d> + <value> + (ENTER)	Enter expected level (sensitivity) in `Expected Value` field.
6.	(RUN)	Start measuring routine.
7.	Read value displayed to right of expected value.	

If the entry in the `Expected Value` field differs very much from the actual modulation sensitivity, the Special is terminated after a short duration and "-----" is indicated as the result.

Manual Measurement

1.	Check basic TX settings.	
2.	<value>	Alter modulation level (`Lev` field) with handwheel until DEMOD meter shows required modulation (eg test modulation).
3.	Read AF level in `Lev` field.	

Purpose of measurement

To check what AF level (f_{mod} = 1 kHz) is necessary on the microphone input of the radio set to produce a certain frequency or phase deviation or modulation depth (modulation sensitivity). The test parameter "Frequency deviation", "Phase deviation" or "Modulation depth" is usually the test modulation. The modulation sensitivity influences the volume information of radiocommunication at the transmitting end.

Typical limit values

The modulation sensitivity also depends very much on the sensitivity of the microphone that is used, so no typical limit values can be given.

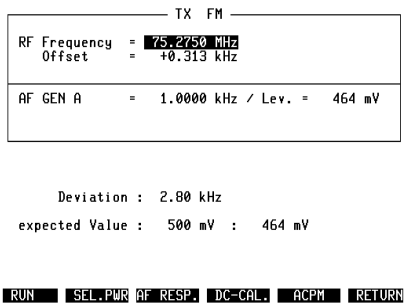


Fig. 5.8: Modulation sensitivity: The Special SENS was started with the test parameters `Deviation: 2.80 kHz and expected Value: 500 mV`. The result shows that the device under test has modulation sensitivity of `464 mV`.

Modulation Distortion (f_{mod} = 1 kHz)

Boundary conditions

- Disconnect CCITT filter
- Disconnect filter on OPTION CARD (if present)
- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Modulation frequency f_{mod} = 1 kHz.

Measurement

1.	Check basic TX settings.	
2.	<value>	Alter modulation level (Lev field) with handwheel until DEMOD meter shows test modulation.
3.	DIST	Call up DIST meter.
4.	Read modulation distortion on DIST meter.	

The OPTION CARD, fitted with the variable notch filter, is required (see Chapter 9) for measuring modulation distortion with modulation frequencies between 200 and 600 Hz (to CEPT).

Purpose of measurement

To check what distortion the AF signal already exhibits at the transmitting end. The distortion factor is the ratio of the sum RMS value of all harmonics of an AF signal to the RMS value of the overall AF signal (fundamental plus harmonics). A large distortion factor degrades transmission quality.

Typical limit values

The distortion factor may not exceed a value of 10 % at f_{mod} = 1 kHz.

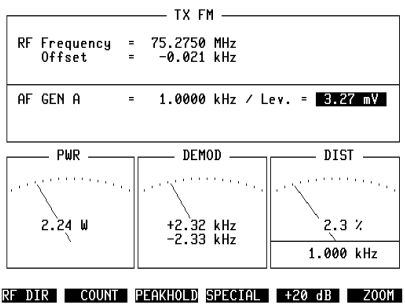


Fig. 5.9: Modulation distortion: The DIST meter confirms that the modulation distortion of the device under test does not exceed the permissible limit value.

Residual Modulation

Boundary conditions

- Disconnect filter on OPTION CARD (if present)
- Warning: P > 500 mW on RF DIRECT will destroy input stage!

Measurement

1.	Check basic TX settings.	
2.	<value>	Alter modulation level (Lev field) with handwheel until DEMOD meter shows test modulation.
3.	CCITT	Cut in weighting filter.
4.	dB REL	AF level (at test modulation) becomes reference level (0 dB) for dBr meter.
5.	GEN A	Cut out modulation generator GEN A.
6.	Read weighted signal/noise ratio on dBr meter.	

Purpose of measurement

To check what residual modulation appears referred to the test modulation (hum, noise) if the transmitter of the radio set is not modulated with a useful signal. Excessive residual modulation causes a disturbing background noise that impairs intelligibility.

Typical limit values

Weighted S/N ratio at least –40 dB.

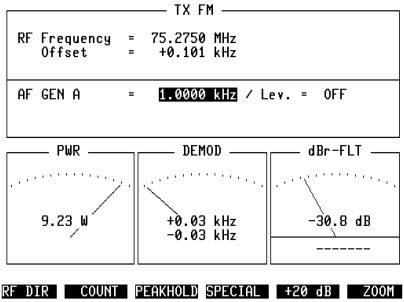


Fig. 5.10: Weighted S/N ratio: The display on the dBr meter shows that the device under test in this case exhibits a weighted S/N ratio of -30.8 dB (CCITT weighting).

Deviation Limiting

Boundary conditions

- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Disconnect filter on OPTION CARD (if present)

Measurement

1.	Check basic TX settings.	
2.	<value>	Alter modulation level (Lev field) with handwheel until DEMOD meter shows test modulation.
3.	(+20 dB)	Increase AF output level by 20 dB.
4.	Read maximum modulation on DEMOD meter.	

After the measurement (−20 dB) restores the original test modulation. If the DEMOD meter will not permit a clear reading on frequency-modulated signals because of superimposed interference, the RMS meter can be used for a "steady" display of the average value of the frequency deviation (see Chapter 4, "GENERAL PARAMETERS", DEMOD (RMS VALUE) field).

Purpose of measurement

To check if, when there is a strong modulation signal on the microphone input of the radio set, the maximum permissible modulation (deviation or AM depth) is exceeded. If the limit value is not maintained, adjacent-channel interference may result.

Typical limit values for FM

The frequency deviation must remain between 70 and 100 % of the maximum permissible frequency deviation.

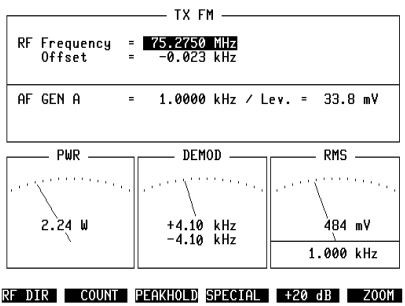


Fig. 5.11: Deviation limiting: After the output level of the modulation generator GEN A has been increased to 33.8 mV with (+20 dB) (Lev field), the DEMOD meter shows +4.10 kHz peak deviation in this case. Thus the device under test slightly exceeds the maximum permissible value (here 4 kHz).

Harmonics

Boundary conditions

- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Specifications of analyzer apply for measurement with unmodulated carrier

Measurement

1.	Check basic TX settings.	
2.	(COUNT)	Tune test receiver to carrier frequency of radio-set transmitter.
3.	[ANALYZER]	Switch on analyzer.
4.	(HARM)	Call up harmonics submask; set reference level in `Ref. Level` scroll field so that brightened up field at bottom edge of analyzer window is of minimum height and message `OVERLOAD!` does not yet appear.
5.	(FREEZE)	Freeze display.
6.	Read levels of harmonics (dBc values).	

The first seven harmonics are always detected up to a fundamental frequency of 142.79 MHz. At higher fundamental frequencies the analyzer only measures harmonics up to 999.9999 MHz. Details of harmonics measurement are given in Chapter 6.

Purpose of measurement

To check whether the harmonics of the carrier signal are below the permissible limits. If the limit is not maintained, this can lead to interference in the frequency range into which the harmonic intrudes.

Typical limit values

According to CEPT Recommendation TR17, no harmonic may exceed a power limit of 0.25 µW.

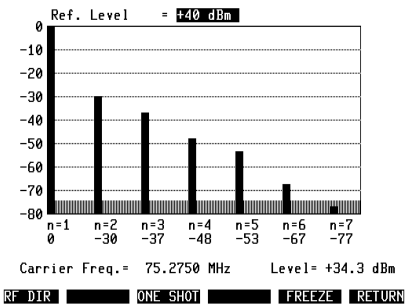


Fig. 5.12: Harmonics: The harmonics measurement shows an absolute level of +34.3 dBm for the fundamental (75.2750 MHz), a relative level of –30 dBc for the second harmonic, –37 dBc for the third harmonic, etc.

With 0,37 mW (+34,3 dBm – 30 dBc = – 4,3 dBm) the second harmonic exceeds the permissible limit.

Basic RX Settings

The basic RX settings are the foundation for all standard receiver measurements. It is sufficient to perform these basic settings once before starting the actual receiver measurements. In the course of receiver measurements the basic settings will normally be maintained unaltered, meaning that only a few extra entries are necessary.

1.	[RX]	Call up RX mask.
2.	[RF] or [RF DIR]	Connect to appropriate input socket.
3.	[FREQU] + <value> + [ENTER]	Tune signal generator to channel frequency of radio set.
4.	[LEVEL] + <20 (µV)> + [ENTER]	Set RF output level to 20 µV (EMF).
5.	[MOD FREQ] + <1> + [ENTER]	f_{mod} = 1 kHz (GEN A)
6.	[VOLTM]	Connect VOLTM socket (AF input).
7.	[FM AM ΦM] + <value> + [UNIT/SCROLL] + [ENTER]	Enter value for test modulation in `Mod` field and select class of modulation (kHz, %,red); GEN_A switched on automatically.
8.	Switch on receiver of radio set.	

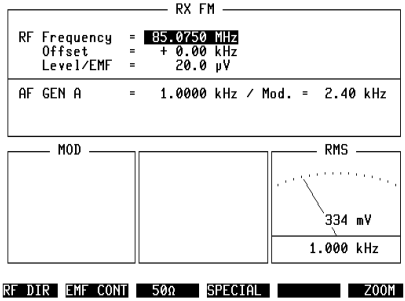
Following the last step of the basic settings the `Mod` entry field (brightened up) in the RX mask is active; the LEDs RX (green), GEN A (green) and VOLTM (yellow) must illuminate on the front panel. Now you can commence any standard receiver measurement.

If you use RX Specials, you can skip steps 6. and 7. of the basic RX settings. The RX Specials automatically couple the VOLTM socket and set a modulation frequency of 1 kHz if this is necessary.

☞ When you are altering the RF output level, there may be a jump in level of > 0.1 dBm at the boundary between +5.0 dBm and +5.1 dBm (RF DIRECT socket) or –15.0 dBm and –14.9 dBm (RF socket). At these level boundaries a second output stage is cut in or cut out respectively, meaning that the actual jump in level depends on the tolerances of both amplifiers (see data sheet). This jump in level will not appear when the level is altered continuously with (EMF CONT).

Fig. 5.13: Basic RX setting: In the RX mask the following operating parameters are declared here:

RF is the active RF socket
RF level = 20.0 µV/EMF
channel frequency = 85.0750 MHz
f_{mod} = 1.0000 kHz
modulation = FM
test modulation = 2.40 kHz



5

Sensitivity (S/N and SINAD)

Boundary conditions

- Cut out squelch of radio set
- Disconnect filter on OPTION CARD (if present)
- Only measure SINAD with f_{mod} = 1 kHz

Special Measurement

1.	Check basic RX settings.	
2.	CCITT	Cut in weighting filter.
3.	SPECIAL	Call up menu of RX Specials.
4.	SENS	Call up Special for receiver sensitivity; line `Sensitivity` appears with three entry fields: first select measuring method (`S/N` or `SINAD`) in centre field (scroll field)
5.	RUN	Start measuring routine.
6.	Read measured result from Special mask field.	

The Special stores the entered reference value for the two measuring methods S/N and SINAD. When the measuring method is selected therefore, the reference value last entered is set automatically. After the measurement UNIT/SCROLL converts the measured value to the other units if the units scroll field is brightened up.

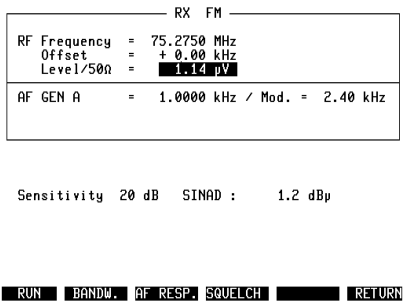


Fig. 5.14: Receiver sensitivity: Special `SENS` was started after selecting test method (`SINAD`), reference value (`20 dB`) and units that measured result is to have (here dBµ): the result of the measurement is `1.2 dBµ` (corresponding to value in `Level` field).

Measurement SINAD manual

1.	Check basic RX settings.	
2.	CCITT	Cut in weighting filter.
3.	SINAD	Call up SINAD meter.
4.	LEVEL + <value>	Alter RF output level of signal generator with handwheel until SINAD meter shows required reference value.
5.	Read level value (EMF) in `Level` field.	

Measurement S/N manual

1.	Check basic RX settings-	
2.	CCITT	Cut in weighting filter.
3.	dB REL	Call up dBr meter.
4.	GEN A	Switch off modulation generator GEN A.
5.	LEVEL + <value>	Alter RF output level of signal generator with handwheel until dBr meter shows required reference value.
6.	Read level value (EMF) in `Level` field-	

Check the measured result by switching modulation generator GEN A on again and resetting the AF level value with VOLT + dB REL. If GEN A is then switched off again, the dBr meter should immediately show the required reference value. If there are deviations, adjust the RF level in the `Level` field with the handwheel.

Purpose of measurement

To determine what RF level is required on the antenna input of the radio set so that the AF signal on the loudspeaker output of the radio set exhibits a specific signal quality, characterized by the S/N or SINAD.

$$\frac{S}{N}\,[\mathrm{dB}] = 20 \times \log \frac{\mathrm{Signallevel}}{\mathrm{Noiselevel}}$$

$$\mathrm{SINAD}\,[\mathrm{dB}] = 20 \times \log \frac{\mathrm{Signallevel} + \mathrm{Noiselevel} + \mathrm{Harmoniclevel}}{\mathrm{Noiselevel} + \mathrm{Harmoniclevel}}$$

Typical limit values

6 dBµV (2 µV) EMF for 12 dB SINAD or 20 dB S/N.

AF Frequency Response

Boundary conditions

- Disconnect CCITT filter
- Disconnect filter on OPTION CARD (if present)

Special Measurement

1.	Check basic RX settings.	
2.	(SPECIAL)	Call up menu of RX Specials.
3.	(AF RESP)	Special for AF frequency response.
4.	<value> + (ENTER)	Enter 0-dB reference frequency in inverted field and confirm (unless default is accepted).
5.	<cursor d> + <value> + (ENTER)	Alter f_{mod} (7 reference values) if necessary.
6.	(RUN)	Start measuring routine.
7.	Read AF frequency response (7 reference values).	

If the CCITT filter is cut in, a warning signal is heard after (RUN) and the warning `CCITT Filter is on` appears in the status line. Measurement with the CCITT filter is not permissible because the filter characteristic affects the measured result too much.

Manual Measurement

1.	Check basic RX settings.	
2.	(dB REL)	Call up dBr meter.
3.	(MOD FREQ) + <value>	Vary frequency of modulation signal between 300 Hz and 6 kHz with handwheel.
4.	During step 3. read on dBr meter whether permissible dB tolerance range is maintained.	

Purpose of measurement

To check whether the AF frequency response of the radio set - depending on the frequency of the modulation signal - remains within the permissible tolerance range (modulation frequency response). If the curve of the modulation frequency response goes out of the tolerance range, the standard of intelligibility will be degraded.

Typical limit values for FM and ΦM

If the modulation frequency f_{mod} is varied between 300 Hz and 6 kHz, the AF level of the demodulated signal must remain within the following tolerances:

f_{mod}	limit values
0,3 kHz...3 kHz	+1 dB...–3 dB
>3 kHz...<6 kHz	The level may not exceed the value measured at 3 kHz
≥6 kHz	The level must be at least 6 dB below the value measured at 1 kHz

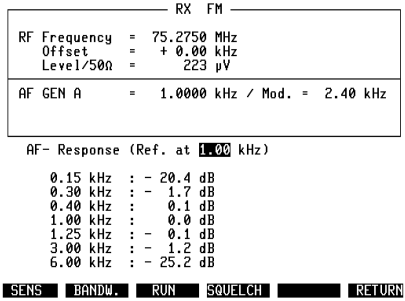


Fig. 5.15: AF frequency response: The Special mask field in the bottom half of the display shows the AF frequency response of the device under test in the form of seven reference values. The value `1.00 kHz` has been declared as the 0-dB reference frequency.

Demodulation Distortion

Boundary conditions

- Disconnect CCITT filter
- Disconnect filter on OPTION CARD (if present)
- Modulation frequency f_{mod} = 1 kHz

Measurement

1.	Check basic RX settings.	
2.	DIST	Call up DIST meter.
3.	Read demodulation distortion on DIST meter.	

The OPTION CARD, fitted with the variable notch filter, is required for measuring demodulation distortion with modulation frequencies between 200 and 600 Hz.

Purpose of measurement

To check to what extent the receiver of the radio set distorts the useful AF signal. The distortion factor is the ratio of the sum RMS value of all harmonics of an AF signal to the RMS value of the overall AF signal (fundamental plus harmonics). A large distortion factor degrades the standard of intelligibility.

Typical limit values

The distortion factor may not exceed 10 % for f_{mod} = 1 kHz.

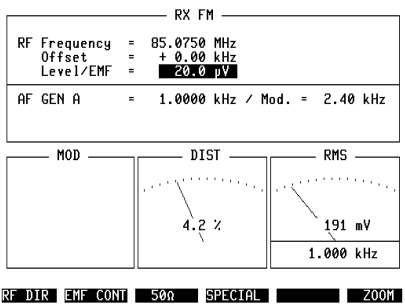


Fig. 5.16: Demodulation distortion: The DIST meter shows a distortion factor of 4.2 % for the device under test.

IF Bandwidth and Centre-frequency Offset

Boundary conditions

- Cut out squelch on radio set

Special Measurement

1.	Check basic RX settings.	
2.	SPECIAL	Call up menu of RX Specials.
3.	BANDW	Call up IF Special.
4.	<value> + ENTER	Enter reference value of attenuation.
5.	RUN	Start measuring routine.
6.	Read measured values for IF bandwidth and offset from nominal centre frequency.	

If the measured IF bandwidth is greater than 51 kHz, the displayed result is "------".

Manual Measurement

1.	Check basic RX settings	
2.	GEN A	Switch off modulation generator GEN A.
3.	LEVEL + <0.04 (µV)> + ENTER	RF output level = 0.04 µV/EMF
4.	LEVEL + OFF	Switch off signal generator.
5.	dB REL	Call up dBr meter.
6.	LEVEL + <value>	Switch on signal generator and increase level until dBr meter shows –10 dB (noise suppression).
7.	STEP + <value> + ENTER + +	Increase RF level by reference value of attenuation (eg 6 dB).
8.	FREQU + + + <5> + ENTER	First roughly detune signal generator (with Offset field) by +5 kHz.
9.	ENTER + <value>	Open Offset field and finely detune offset value with handwheel until dBr meter again shows –10 dB: note offset value.
10.	Repeat steps 8. and 9. with –5 kHz	
11.	The two noted offset values, added together, are the IF bandwidth; centre-frequency-offset = $(f_{+} - f_{-})/2$.	

Purpose of measurement

The measurement determines indirectly the bandwidth of the IF filter and its centre-frequency offset. Too small a bandwidth reduces the standard of intelligibility, too large a bandwidth reduces adjacent-channel selectivity and thus sensitivity. Highly unbalanced IF filters (large centre-frequency offset) produce distortion of the AF signal.

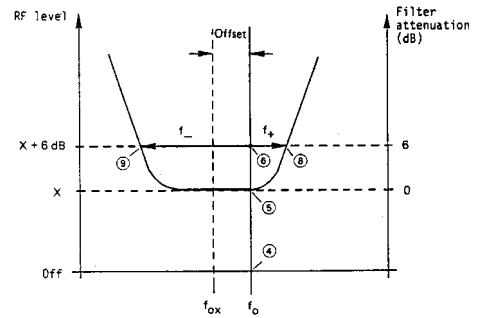


Fig. 5.17: IF filter curve: The numbers refer to the different steps in manual measurement.

Typical limit values

Depending on the channel spacing the nominal bandwidth is between 8 and 15 kHz. The permissible centre-frequency offset is 0.5 to 1 kHz.

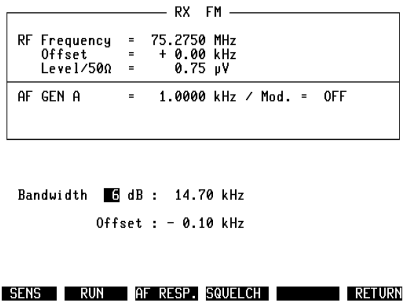


Fig. 5.18: IF bandwidth and centre-frequency offset: The Special `BANDW` was started here with the usual parameter `6 dB` as the reference value of the attenuation. In contrast to time-consuming manual measurement, the Special presents the values measured for IF bandwidth (`14.70 kHz`) and centre-frequency offset (`-0.10 kHz`) after just a few seconds.

Squelch Characteristic

Boundary conditions

- Cut in squelch on radio set
- For a slowly responding squelch declare a delay in the GENERAL PARAMETERS mask (`Delay Squelch` field)

Special Measurement

1.	Check basic RX settings.	
2.	(SPECIAL)	Call up menu of RX Specials.
3.	(SQUELCH)	Call up squelch Special; the line `Squelch` contains two scroll fields: in left field select `RX Mute` (measurement to determine muting threshold of squelch) or `RX Unmute` (unmuting threshold)
4.	(RUN)	Start measuring routine.
5.	Read measured values for switching threshold and hysteresis.	

After the measurement the second threshold value that is not displayed can be produced with (UNIT/SCROLL) if the `RX Mute` or `RX Unmute` field is active (inverted).

If a time duration has been declared in the `Delay Squelch` field of the GENERAL PARAMETERS mask, this time will be waited between the individual setting steps (RF level value) so that slow squelches have sufficient time to respond.

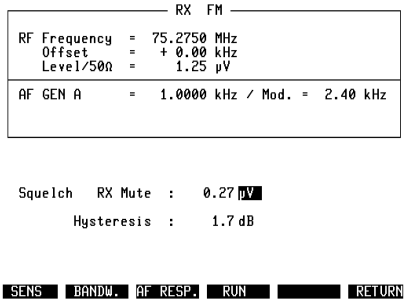


Fig. 5.19: Squelch characteristic: Here the Special `SQUELCH` showed `0.27 µV` as the muting threshold (`RX Mute`) of the squelch. The hysteresis is `1.7 dB`.

Manual Measurement

1.	Check basic RX settings	
2.	LEVEL + <value>	Reduce RF output level with handwheel until AF signal drops abruptly: note RF level (RX Mute).
3.	<value>	Increase RF level with handwheel until AF signal abruptly appears: note RF level (RX Unmute).
4.	Difference between levels is squelch hysteresis	

If the attenuator switches during the manual measurement (recognizable by the sound) close to the point of response of the squelch, it will not be possible to determine the exact level (RX Mute/RX Unmute) because of the hysteresis. In this case set the closest RF level (unit dBm) that does not produce muting of the AF and show the CONT field with the (EMF CONT) softkey. Then alter the initial value of the CONT field (eg 0 dB) with the handwheel. Thus you **continuously** reduce the output level of the signal generator by the particular dB value (max. –20 dB). The actual RF output level is the sum of the values in the fields Level/EMF and CONT.

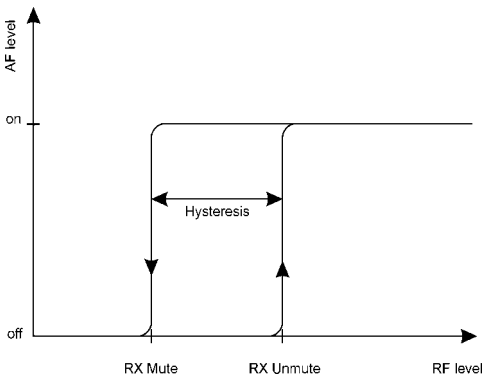


Fig. 5.20: Squelch characteristic: When the increasing RF level on the antenna input of the radio set reaches the enabling threshold (RX Unmute) of the squelch, the latter enables the AF signal. When the decreasing RF level reaches the blocking threshold (RX Mute), the AF signal is blocked or muted. The hysteresis prevents uncontrolled response of the squelch when the RF level alters minimally.

Purpose of measurement

To determine at what RF level on the antenna input of the radio set the receiver blocks the AF signal path (muting threshold) and enables it again (unmuting threshold). The difference between the two RF levels is the squelch hysteresis in dB. If the muting threshold is set too high, it will spoil the high sensitivity of a receiver.

Typical limit values

Both switching thresholds are generally below the value for receiver sensitivity. The hysteresis is commonly about 2 dB.

Limiter Characteristic

Boundary conditions

- Call up AF POWER meter; first locate GENERAL PARAMETERS mask
- Use RF DIRECT socket

Measurement

1.	Check basic RX settings.	
2.	[LEVEL] + <2 (µV)> + [ENTER]	Set RF output level of 2 µV EMF and volume on radio set to 25 % of rated AF power.
3.	[dB REL]	Call up dBr meter.
4.	[LEVEL] + <100 (mV)> + [ENTER]	Set RF output level to 100 mV EMF.
5.	Read relative change in level on dBr meter.	

Purpose of measurement

To check how much the loudspeaker level of the receiver alters when a weak and a strong RF signal are applied alternately to the antenna input. The limiter should prevent the occurrence of any largish fluctuations in volume.

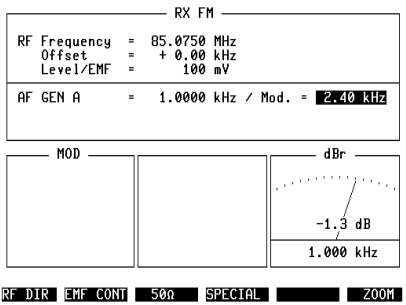


Fig. 5.21: Limiter characteristic: After the AF level has been normalized at 2 µV RF level by calling up the dBr meter, the meter now shows `-1.3 dB` at `100 mV` RF level.

Typical limit values

Maximally ±3 dB change in AF level referred to the AF level for 2 µV RF input level.

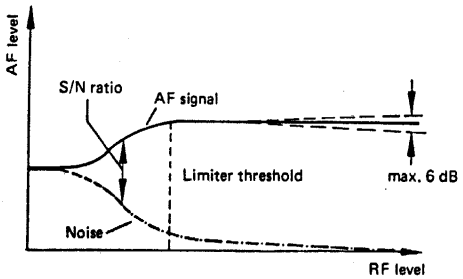


Fig. 5.22: Limiter characteristic: The AF output level of the radio set is virtually independent of the RF input level after the limiter has responded.

Basic DUPLEX Settings

The basic DUPLEX settings are a combination of the basic TX and RX settings:

1. Call up the basic DUPLEX mask (option).
2. Couple the current RF input/output socket.
3. Tune the signal generator to channel frequency f_{TX} of the radio set*).
4. Tune the test receiver to channel frequency f_{RX} of the radio set*).
5. Set the RF level to the required value (eg 20 µV).
6. Set the modulation frequency (eg 1 kHz).
7. Select the modulation (eg 2.4 kHz frequency deviation).

*) If the linking of the two frequency values with the duplex spacing has been declared in the GENERAL PARAMETERS mask, it is sufficient to enter just one value (see also chapter 4, "GENERAL PARAMETERS").

☞ [STEP] changes the lower and upper sideband (see also Chapter 2, "Meaning of Keys", 26).

Select input/output socket

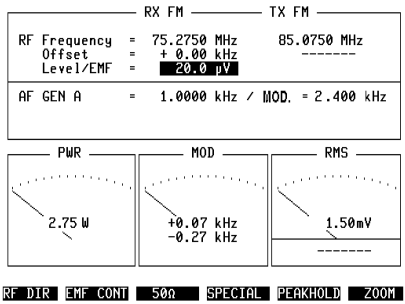
Select the RF socket as the current input/output if the device under test is a single-port radio set. The level of the signal generator must then be at least 60 dB smaller than the transmit level of the radio set so that the two signals are adequately isolated. Normally this condition is always satisfied.

In the case of a dual-port radio set connect its transmitter to the RF socket and its receiver to the RF DIRECT socket. Couple the RF DIRECT socket as the current RF output with (RF DIR). The RF socket remains effective as the RF input because the duplex demodulator is connected directly behind this socket, before the RF/RF DIRECT switchover.

If a duplex radio set is to be tested on several channels, the entry procedure can be very much shortened by making suitable declarations in the GENERAL PARAMETERS mask (refer to Chapter 3, Operating Rules - Working with channel numbers).

Fig. 5.23: Basic DUPLEX setting: Here the following parameters are specified in the DUPLEX mask:

RF is the active socket
f_{TX} = 85.0750 MHz
f_{RX} = 75.2750 MHz
RF level = 20.0 µV
f_{mod} = 1.0000 kHz
modulation = FM
test modulation = 2.400 kHz



Signal Transfer

Boundary conditions

- Switch off squelch of radio set
- Set RF output level on `Level/EMF`
- Switch off transmitter of radio set before starting, switch on receiver
- Disconnect filter on OPTION CARD (if present)

Special Measurement

1.	Check basic DUPLEX settings.	
2.	(SPECIAL)	Call up menu of DUPLEX Specials.
3.	(DESENS)	Call up Special for measuring duplex signal transfer (desensitizing). Line `Desens` appears with two entry fields. First select test method (`S/N` or `SINAD`) in righthand field (scroll field). Then enter S/N or SINAD reference value in lefthand field.
4.	(RUN)	Start test routine.
5.	Following request on screen, switch on transmitter within 8 s.	
6.	Read measured value for duplex signal transfer (in dB).	

Purpose of measurement

Single-port duplex radio sets use one and the same antenna for their transmitter and receiver, the transmitted and received signals being isolated from one another by a duplexer. Duplex signal transfer is a measure of this isolation. Good isolation should be aimed at so that as little transmitted power as possible reaches the receiver input and reduces receiver sensitivity, ie desensitizing. The duplex signal transfer results from two measurements of sensitivity on the radio receiver with the transmitter switched off and on. The ratio between the two values is the duplex signal transfer expressed in dB.

Typical limit values

The duplex signal transfer (desensitizing) should not exceed 3 dB.

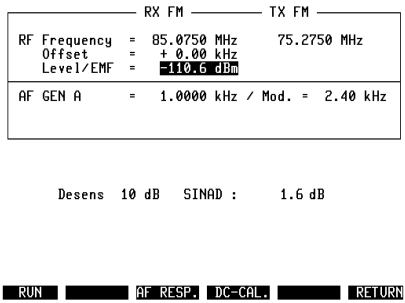


Fig. 5.24: Duplex signal transfer: The Special DESENS was used to test a device with the parameters SINAD (test method) and 10 dB (reference value). Result: 1.6 dB duplex signal transfer.

Selective-call encoder and decoder

The standard STABILOCK 4032 comes with a selective-call encoder and decoder. Common standard tone sequences can be used whose parameters (frequency, tone duration, pause) permit variation (user tone sequences). A user tone sequence can be stored. What are called "sequential masks" are used to operate the encoder and decoder and to display the measured results.

Technical data

Encoder

Setting ranges

With all standard and user-defined tone sequences it is possible to vary tones 1 to 15 in all parameters (tones 16 to 30: duration and pause can only be varied uniformly).

Frequenzy	200 to 3000 Hz
Resolution	0,1 Hz
Tone duration	1 to 9999 ms at least one cycle
Resolution	1 ms
Pause duration	0 to 9999 ms
Resolution	1 ms

Decoder

Frequenzy measurement

Measuring range	300 to 3000 Hz
Resolution	0,1 Hz
Measuring error*)	< 2 Digit

Tone duration measurement

Measuring range	40 to 9999 ms
Resolution	0,1 ms
Measuring error*)	< 3 ms + 2 cycles of lowest frequency in tone sequence

Pause duration measurement

Measurement range	2 to 9999 ms
Resolution	0,1 ms
Measuring error*)	< 3 ms + 2 cycles of lowest frequency in tone sequence

Receiving bandwidth

Setting range	±0,1 % to ±9,9 %
Response time measurement	2 to 9999 ms
Resolution	1 ms

*) Measuring errors referres to signal on VOLTM socket with level > 360 mV_{eff}.

Basic Sequential Mask

The basic sequential mask is called up with [AUX] + [SEQU]. This means that the monitor shows the basic mask that was last current (TX, RX or optionally DUPLEX) in the top half of the screen and the basic sequential mask in the bottom half. With [HELP] all entry fields can now be identified by briefly brightening them up. The entry fields are accessed as usual with the cursor keys. For the fields in the top half of the screen there is still the possibility of rapid access, eg with [FREQU].

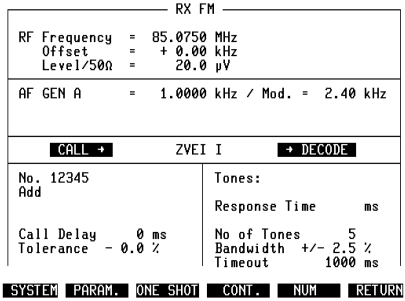


Fig. 5.25: Basic sequential mask: Before the call with [AUX] + [SEQU] the basic RX mask was current, and it is kept in the upper half of the screen. The scroll field in the centre shows that the mode `CALL → DECODE` is set. The pointer `ZVEI I` reminds you of the standard tone sequence that is presently set.

Setting Mode of Operation

One of four possible operating modes can be selected in the basic sequential mask for selective calling. These modes are:

CALL
DECODE
CALL → DECODE
CALL ← DECODE

CALL

The encoder generates the required call tone sequence (the decoder is not activated).

DECODE

The decoder expects the arrival of a tone sequence. When this appears, it is decoded. The encoder is not activated in this mode.

CALL → DECODE

This is the mode for an acknowledgement call. First the encoder generates the required call tone sequence. Then the decoder waits for the arrival of a tone sequence. When this appears, it is decoded. Switching from encoding to decoding takes about 80 ms (without the optional DUPLEX FM/ΦM stage). The option reduces the switching time to approx. 15 ms.

☞ If the generator of the 4032 is keyed (see "Carrier Keying"), this lengthens the switching time by approx. 20 ms.

The last pause of a call tone sequence (see "Modifying Tone-sequence Parameters") is not waited for in the CALL → DECODE mode; after the last tone of the call tone sequence the decoder is activated with a delay of only 5 ms or 100 ms.

CALL ← DECODE

This mode is only possible if the optional DUPLEX FM/ΦM unit is incorporated.

To begin with, the decoder expects the arrival of a tone sequence. As soon as this appears, it is decoded. With the arrival of the last tone, the delay begins that is entered in the Call Delay field (at least 100 ms), before the encoder outputs the call tone sequence. During the minimum delay of 100 ms the decoder is able to decode a tone sequence with maximally five tones. The decoding of more extensive tone sequences lasts longer (eg about 380 ms for a 30-tone sequence), so that in such cases the minimum delay of 100 ms cannot be maintained. The call tone sequence is then output immediately upon completion of decoding.

You can set the required mode of operation with [UNIT/SCROLL], by turning the handwheel or by striking the plus/minus keys. First the scroll field in the centre of the screen must be located with the cursor keys.

If one of the control interfaces is available, relay 3 of this option is set automatically when the decoder (4032) begins a decoding operation. The relay can be used, for example, to trigger the expected tone sequence on the radio set. At the end of the decoding operation the relay drops out again.

Selecting AF or RF Signal Path

An AF or RF signal path is possible for the output and feeding in of the tone sequences. The call tone sequence generated by the encoder can always be brought out as an AF signal on the MOD GEN socket (front panel) and on socket Bu 29 (back panel) if the AF generators (GEN A, GEN B) are switched on the TX signal path. In the RX or DUPLEX mode the tone sequence signal (AF) is available at socket Bu 27 (back panel) if the generators are switched on the RX signal path.

The AF can be fed in on the VOLTM socket (front panel), which must be connected to the internal AF signal processing with [VOLTM].

If the RF signal path is used, the current RF parameters (modulation, transmit/receive frequency, RF level) must be set before the basic sequential mask is called up in the basic RX and TX mask and the RF socket must be activated. If the DUPLEX FM/ΦM unit is integrated, the DUPLEX mask automatically adopts these values. The basic mask into which the basic sequential mask is transferred determines whether the RF signal path may be used simultaneously for the output and feeding in of the tone sequences:

Basic RX mask visible

Output of the call tone sequence on the RF socket. The feeding in of a tone sequence is only possible on the VOLTM socket because the test receiver is not activated.

Exception: In the CALL → DECODE mode there is an **internal** switch from RX to TX as soon as the call tone sequence is output. After decoding of the arriving tone sequence (or termination of decoding) there is a switch back to RX. This means that specially in this mode RF output and RF feed-in is permissible on the RF socket if the basic RX mask is visible.

Basic TX mask visible

RF feed-in of a tone sequence is permissible on the RF socket. For this purpose connect the decoder to the demodulator with [DEMOD]. Output of the call tone sequence is only possible on the socket MOD GEN/Bu 29 because the signal generator is not activated.

Basic DUPLEX mask visible

RF output of the call tone sequence and RF feed-in of a tone sequence are permissible on the RF socket. For this purpose connect the decoder to the demodulator with [DEMOD].

Carrier Keying

In the CALL and CALL → DECODE modes carrier keying is possible if the signal generator of the 4032 is first switched off in the RX or DUPLEX mask with [LEVEL] + [OFF]. The encoder then keys the signal generator automatically. Following any carrier delay that is set (content of Call Delay field) the call tone sequence is sent and the signal generator is switched off again.

Selecting Standard Tone Sequence

(SYSTEM) calls up the SEQUENTIALS submask, which allows you to select different standard tone sequences. A tone sequence is selected by moving the cursor in front of the appropriate entry with the cursor keys and then executing [UNIT/SCROLL]. The encoder and the decoder adapt to the parameters of the selected tone sequence.

The USER entry stands for a stored tone sequence with parameters defined by the user.

(RETURN) takes you back to the basic sequential mask. Here the display field in the centre of the screen always shows the name of the selected tone sequence.

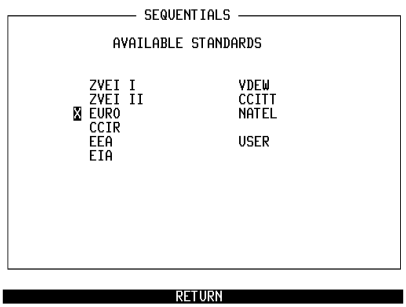


Fig. 5.26: SEQUENTIALS submask: This submask of the basic sequential mask permits you to select the tone sequence whose parameters are to be valid for the encoder and decoder. In this case the EURO tone sequence has been selected.

Modifying Tone-sequence Parameters

(PARAM.) takes you from the basic sequential mask to the PARAMETER submask. This shows the parameters of the selected tone sequence. In this mask too, [HELP] briefly brightens up all entry fields. In this case they are all pure numeric fields. All of them can be located with the cursor keys and the entered values can be modified. Terminate each entry with [ENTER]. In this way individual frequency values can be allocated to the call digits 0 through F. You can also modify the parameters TIME (tone duration) and PAUSE (duration of pause until next tone) individually for tones 1 through 15. For tones 16 through 30 only a common TIME and PAUSE value can be declared.

The R entry field defines the repeat tone. You can locate this entry field with the cursor keys and open it with [ENTER]. Enter hex characters A through F with the softkeys. As usual, terminate the entry with [ENTER].

If one and the same value is to be entered throughout in the TIME or PAUSE column, it is sufficient to enter the new value just once. After confirmation of the value with [ENTER], (ALL LIKE CURSOR) will change all values to the new value.

(STORE TO USER) causes the 4032 to store the momentarily set tone-sequence parameters as a USER tone sequence in RAM. The parameters of this tone sequence can then be called up by way of the SEQUENTIALS submask just like those of the standard tone sequences. (CAUTION: Master Reset also deletes the parameters of a USER tone sequence.)

(STD) cancels all modifications to parameters. If this softkey is struck, a modified standard tone sequence will return to its standard parameters. A modified USER tone sequence will again take on the parameters that were originally stored.

(RETURN) takes you back to the basic sequential mask. If values have been altered in the PARAMETER submask, the encoder and decoder will adopt the new values. In such a case the pointer n.Std (non-standard) beneath the name of the tone sequence in the basic sequential mask will indicate to you that the original (standard) parameters are not being used.

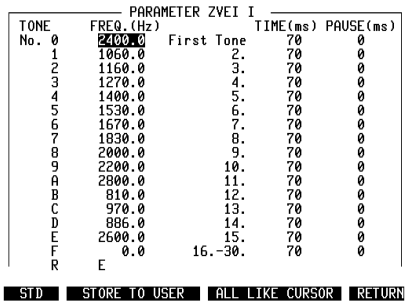


Fig. 5.27: PARAMETER submask: The mask not only shows the parameters of the currently active tone sequence, it also permits modification of the parameters. The repeat tone is entered in the R field.

Entering Call Number

The pure numeric field No. in the basic sequential mask holds call numbers up to the 15th digit if the field is located with the cursor keys. If the field already contains a call number, this can be deleted with [OFF] before entering the new one. For entering hexadecimals the softkeys are assigned the hex digits A through F as soon as the field is opened, eg with [ENTER]. Incorrect entries can be corrected by overwriting them when they are marked by the cursor. As usual, entries are to be terminated with [ENTER].

If a call number consists of more than 15 digits (maximally 30 digits), the remaining digits are to be entered in the Add field, which can also be located with the cursor keys. When the call tone sequence is output, the digits of the Add field are joined precisely to the digits of the No. field.

Double-tone Sequence

As long as only modulation generator GEN A is available, Add is a common text field with an associated numeric field. If the 4032 contains the GEN B option however, Add is a scroll field with the scroll variables Add and 2nd:

Add	Encoder generates single-tone sequence with maximally 30 tones.
2nd	Encoder generates double-tone sequence with maximally 15 tones.

The numeric field (accessed with cursor keys) that is assigned to the scroll field thus holds either the digits 16 to 30 of a single-tone sequence or the digits of a double-tone sequence. In the case of a double-tone sequence the associated digits in the fields No. and 2nd form the digit pair of a double tone.

If double tones are only to be generated at the end of a single-tone sequence (eg for driving a siren), proceed as follows: locate the 2nd field with the cursor, open the field with [ENTER] and move the cursor to the location after which double tones are wished.

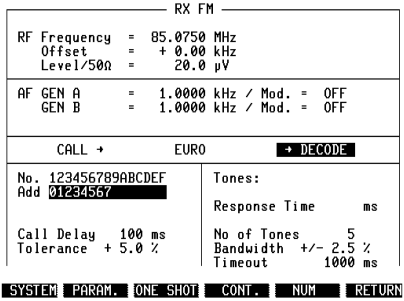


Fig. 5.28: Single-tone and double-tone sequence: If a single-tone sequence has more than 15 call digits, the remaining digits must be entered in the Add field.

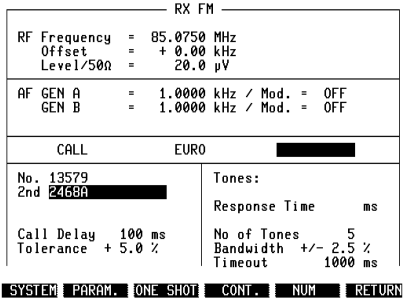


Fig. 5.29: The GEN B option also enables double-tone sequences to be generated, like here for example with the double tones 1-2, 3-4, 5-6, etc.

Declaring Test Parameters

Five other entry fields of the basic sequential mask enable test parameters to be entered: two for the encoder, three for the decoder.

Call Delay

A call delay of the call tone sequence, as required in the CALL ← DECODE mode (eg testing of a base station), can be declared in the Call Delay field (permissible value: 0 to 999 ms). If no call delay is permissible, the field content is forced set to 0.

Encoder Tolerance

An intentionally produced frequency offset of the call tones (call tone sequence) tests the decoding bandwidth of the device. The frequency offset is entered as a percentage deviation of the call tone frequency from rated values (PARAMETER submask) in the Tolerance field (permissible value: 0 to 9.9 %). This field has an associated scroll field for selecting the sign (+/-).

Number of Tones Decoded

The value in the No. of Tones field specifies how many call tones of an incoming tone sequence are to be decoded by the decoder (permissible value: 0 to 30).

Decoder Bandwidth

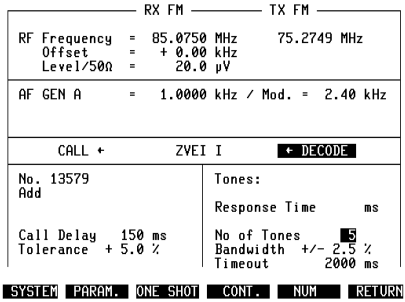
If call tones arrive with a frequency offset, it will depend on the value in the Bandwidth +/- field whether these tones are then decoded. In an analogous manner to the encoder tolerance, this decoder bandwidth also refers to the rated frequency of the call tones (PARAMETER submask). Values between 0 and ±9.9 % are permissible for the decoder tolerance (typically 2.5 %).

Timeout

The entry in the Timeout field (permissible value: 0 to 9999 ms) prevents the decoder from remaining blocked by incomplete tone sequences. The timeout counter is started at the end of a call tone, and reset at the start of the following call tone. If no call tone is received during timeout, the decoding is stopped.

Fig. 5.30: Test parameters: Here, for example, the declared test parameters are:

call delay = 150 ms
encoder tolerance = +5.0 %
number of decoded tones = 5
decoder tolerance = ±2.5 %
timeout = 2000 ms



Test Procedure

After you have selected the operating mode and entered the appropriate parameters, (ONE SHOT) or (CONT.) will trigger the test.

One-shot Test

(ONE SHOT) causes a test cycle to run one time. Depending on the chosen selective-call operating mode the 4032 starts to output the required tone sequence, for instance, or it awaits the arrival of a tone sequence. As long as the test cycle is in progress, softkey S3 has the (STOP) function to enable the test to be terminated. The one-shot test is possible in each of the four selective-call operating modes.

Continuous Test

(CONT.) causes a test cycle to run repeatedly. But the continuous test is only possible if the CALL or DECODE selective-call operating mode is selected beforehand:

CALL — The required call tone sequence is output continuously. Before each output of the tone sequence there is the start delay declared in the Call Delay field. The minimum start delay is 100 ms. If the value in the Call Delay field is smaller, it will be increased to 100 ms automatically. This test cannot be performed in carrier keying to protect the attenuator of the 4032 against rapid wear.

DECODE — The arriving tone sequences are decoded continuously and the call digits are entered in the Tones field.

As long as the test cycle is in progress, softkey S4 has the (STOP) function to enable the test to be terminated.

Level Setting

AF output of tone sequence: Call up TX basic mask, switch AF generators to TX path and enter desired AF level in input field Lev. of basic mask. Output signal of the tone sequence is available on socket MOD GEN (front panel) and on socket Bu 29 (back panel).

RF output of tone sequence: Select RX or DUPLEX basic mask, switch AF generators to RX signal path and enter desired modulation in input field Mod. of basic mask.

Single tones are output with the level entered in the input field Lev. of GEN A respectively with the modulation set in the input field Mod. For double tones following formula applies:

$Level_{A+B}$ = (Level A/2) + (Level B/2) resp. $Deviation_{A+B}$ = (Dev. A/2) + (Dev. B/2)

This combination is necessary for correct siren control and applies to sequential masks only.

Call Tone Sequence with Continuous Tone

If the GEN A and GEN B generators are switched off, they will be switched on automatically by (ONE SHOT) and (CONT.) for the duration of the call tone sequence(s). If a continuous tone is necessary before or after the call tone sequence (declare the frequency in the AF GEN A field), switch GEN A on before the test (in case of RF output select RX signal path). GEN B should be switched on (in case of RF output select RX signal path) if the call tone sequence is to have an underlying continuous tone.

Call tone sequences can be reproduced on the loudspeaker of the 4032 by coupling the modulation generator(s) with the internal AF signal processing by means of [RX MOD/MOD GEN].

Transients of Test Item

Strong transients of the transmitter (test item) can lead to incorrect decoding of received tone sequences by the 4032. This can be avoided by not activating the decoder until the transients have decayed. It is best if you use the one-shot function of the 4032 oscilloscope for precisely measuring the duration of the transients (demodulated transmitted signal). Then enter this time in the Delay (Decode) field of the GENERAL PARAMETERS mask (permissible value: 0 to 999 ms). This delay takes effect for the decoder when the following requirements are satisfied:

- RF socket is coupled.
- DUPLEX or TX mask is called up.
- Demodulated signal is decoded.
- No sustained input signal on RF socket but transmitter keying.

The delay begins with the transmitter keying. If the delay is too long, the tone sequence will not be decoded from the beginning.

Results of Decoding

The 4032 enters the call digits of a decoded tone sequence in the Tones display field of the basic sequential mask. Up to 30 single tones are decoded (no double tones).

The reaction time of an acknowledgement-call system can be read from the Response Time display field if the CALL → DECODE mode is selected. Measurement of very fast response times (< 100 ms) calls for the DUPLEX FM/ΦM option.

The 4032 shows the parameters of the decoded tone sequence after (NUM) in the DECODING submask. The decoded call digits (NR) appear with the measured frequency (FREQ.), the frequency deviation from rating (DEV) plus the measured tone duration (TIME) and pause duration (PAUSE). (16-30) turns to the second page of the DECODING submask.

The DECODING submask also offers the (ONE SHOT) and (CONT.) functions, meaning that you do not have to leave this mask for repeated or continuous decoding with parameter display. While decoding is in progress you do not have to worry about switching backwards and forwards between the pages of the DECODING submask - the decoding is not affected.

You can start decoding at any time in the DECODING submask because the DECODE selective-call operating mode is automatically activated, regardless of the operating mode that you selected in the basic sequential mask.

Fig. 5.31: DECODING submask: In this mask the 4032 enters the parameters of a decoded tone sequence (here, for example, a EURO tone sequence) including the deviation of the frequency from its rating. After the last tone there is no defined pause duration, consequently the display shows >>>>.>.

DECODING EURO

NR	FREQ. (Hz)	DEV. (%)	TIME (ms)	PAUSE (ms)
1	903.4	+ 0.0	106.2	2.0
2	833.1	+ 0.0	98.4	2.2
3	767.2	+ 0.0	97.7	2.5
4	707.2	+ 0.0	100.3	2.7
5	652.3	+ 0.0	91.9	>>>>.>

16 - 30 | ONE SHOT | CONT. | | RETURN

Results readout on controller

The decoded call digits of a tone sequence (content of Tones field) can be read to a controller with the IEEE command RESULt1 (digits 1 to 20) or RESULt2 (digits 21 to 30).

Spectrum Analyzer
Oscilloscope
Tracking

Spectrum Analyzer

With the spectrum analyzer of STABILOCK 4032 you can determine the occupancy of a frequency band for example, analyze the spectral distribution of an RF signal or evaluate the graphic display of the harmonics of a fundamental. The analyzer is fed the test signal, depending on the power level, on the RF or RF DIRECT socket.

☞ **Optional analyzer:** The standard analyzer described below is only available if your Communication Test Set is not fitted with the optional analyzer (ordering code: 248 291). If you are using the more powerful optional analyzer, refer to the separate operating instructions (Chapter 9).

Basic Analyzer Mask

The analyzer can only be called up in the TX operating mode:

1.	[TX]	Call up basic TX mask.
2.	[ANALYZER]	Call up basic analyzer mask.

The [ANALYZER] entry clears the basic TX mask and produces full-format display of the basic analyzer mask. [HELP] and [PRINT] retain their usual functions in this mask (and its submasks).

Calling up the basic mask simultaneously activates the analyzer. Two entry fields can then be accessed with the cursor keys for selecting the reference level and the centre frequency.

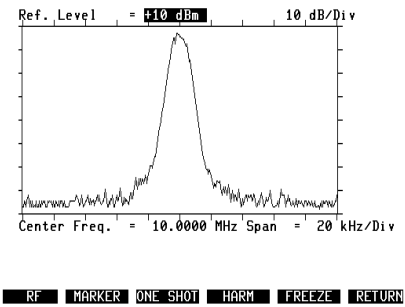


Fig. 6.1: Basic analyzer mask. A reference level of `+10 dBm` is set in the `Ref. Level` scroll field. The dynamic range of the analyzer display is thus matched optimally to the dynamic range of the applied 10-MHz signal.

Setting Reference Level

If the Ref. Level scroll field at the upper edge of the screen is the current (intensified) entry field, [UNIT/SCROLL], slow turning of the handwheel or striking the plus/minus keys will lead as usual to callup of the available scroll variables (reference-level values). The critical limits of the reference level depend on whether the RF or RF DIRECT socket is being used.

In the mask the set reference level corresponds to the top edge of the analyzer window. The bottom edge represents a level value of 80 dB below the reference level (dynamic range of display: 80 dB). The scale marks on the left and right edges of the window (10 dB/div) simplify reading of the values in between.

The reference level should be set so that the strongest component of the displayed spectrum does not quite reach the top edge of the analyzer window. This prevents any overdriving of the analyzer and at the same time optimal use is made of its dynamic range.

If there are strong signal components outside of the displayed spectrum, these can also overdrive the analyzer because its input stage is broadband. In this case the optimal setting of the reference level goes by the strongest component in the overall frequency range of the analyzer (2 to 999.9999 MHz).

Setting Centre Frequency

The analyzer initially adopts that value for the centre frequency of the displayed frequency spectrum that is shown in the RF Frequency field of the basic TX mask. In the basic analyzer mask this value can be altered if the mixed numeric field Center Freq. is current. Enter new values on the numeric keys (confirm with [ENTER]) or alter the set value continuously with the handwheel.

Setting Frequency Resolution

The frequency resolution of the spectrum that is to be displayed is determined by the scroll variables 20 kHz/Div., 200 kHz/Div. and 1 MHz/Div. of the Span scroll field. Depending on the set resolution the overall width of the window thus corresponds to the frequency range 200 kHz, 2 MHz or 10 MHz.

Functions of Softkeys (basic analyzer mask)

(RF-DIR) (alternative function (RF)) This permits, like in the basic masks, connection on the RF or RF DIRECT input.

(MARKER) This calls up the analyzer submask "Marker", in which precise determination of frequency and level is possible with a marker line.

(ONE SHOT) Triggers a single measurement. The display of the measured frequency spectrum is frozen on the screen.

(HARM) This calls up the analyzer submask "Harmonics", in which harmonics (n_{max} = 7) of the applied RF signal are shown in the form of a bar chart.

(CONTIN) Triggers continuous measurement. The display of the measured frequency spectrum is continuously updated. After (CONTIN) the softkey has the alternative function (FREEZE). (FREEZE) freezes the display that is visible when the softkey is operated. The softkey then adopts the CONTIN function again.

(RETURN) Takes you back to the basic TX mask. You can also exit from the basic analyzer mask with [AUX], [MEMORY], [TX], [RX] or by calling the basic duplex mask. The centre frequency last set is adopted in the particular mask.

Marker Submask

The marker submask adopts all settings made in the basic analyzer mask, although these can still be altered as described above. Only alteration of the centre frequency with the handwheel is no longer possible: in the marker submask the handwheel can only be used to shift the position of the marker that is displayed.

The submask shows four display fields, these being in direct relation to the current marker position:

Marker frequency the `Marker Freq.` display field shows the frequency of the marked spectral component.

Marker level the `Level` display field shows the level of the marked spectral component.

Offset frequency from the `Offset Freq.` display field you can read the offset of the marker frequency from the centre frequency.

Offset level the `Level` display field indicates the offset of the marker level from the level measured at centre frequency. The offset level is a relative level quantity.

Functions of Softkeys (marker submask)

(RF-DIR) (alternative function (RF)); this permits, like in the basic masks, connection on the RF or RF DIRECT input.

(TUNE) Adopts the marker frequency last set as the new centre frequency in the `Center Freq.` field. This shifts the analyzer window along the frequency axis in the "continuous measurement" mode. (TUNE) is also permissible in a frozen display. The adoption of the marker frequency as the new centre frequency does not take effect until after (CONTIN) however.

(ONE SHOT) Triggers a single measurement. The display of the measured frequency spectrum is frozen on the screen.

(OFF) Returns to the basic analyzer mask.

(CONTIN) Triggers continuous measurement. The display of the measured frequency spectrum is continuously updated. After (CONTIN) the softkey has the alternative function (FREEZE). (FREEZE) freezes the display that is visible when the softkey is operated. The softkey then adopts the (CONTIN) function again.

(RETURN) Returns to the basic TX mask.

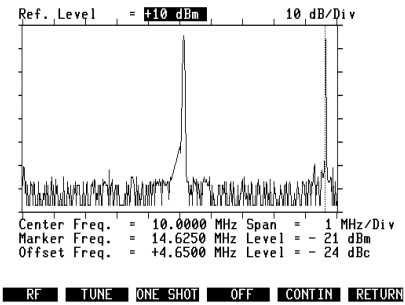


Fig. 6.2: Marker submask. The marker (vertical dotted line) has been set with the handwheel `14.6250 MHz`. The level of the corresponding spectral component reaches `-21 dBm`. The marker is offset from the centre frequency (`10 MHz`) by `+4.6500 MHz`; the level measured at the marker frequency is `-24 dBc` below the level at centre frequency.

Harmonics Submask

The harmonics submask shows harmonics of the applied RF signal in the form of vertical bars. Down to a fundamental frequency of 2 MHz and up to one of 142.79 MHz, seven harmonics (ie including the fundamental) are always displayed. At higher fundamental frequencies the harmonics submask only shows the actual harmonics whose frequency does not go beyond the upper analyzer limit of 999.9999 MHz.

From the basic analyzer mask the harmonics submask takes the values for reference level and centre frequency for the entry fields `Ref. Level` and `Center Freq.` Both values can be altered in the submask in the same way as in the basic mask.

If the centre frequency has been determined manually by marker tuning, there may be slight differences between the set centre frequency and the actual carrier frequency. This frequency offset will not affect harmonics measurement up to a value of about 400 kHz because an offset measurement is also performed. The analyzer balances the result of the offset measurement against the set centre frequency, thus producing correct frequency readings for the harmonics.

The level of the harmonics, referred to the level of the fundamental (carrier frequency), determines the height of the bars that are shown. Weak harmonics produce short bars and strong harmonics produce long ones. The bar at the lefthand edge of the display (n = 1) always represents the fundamental, its absolute level (dBm) being shown in the bottom right corner of the display. The relative levels (dBc, c = carrier) given the individual harmonic bars are referred to this value: there is a linear relationship between bar height and value in dBc.

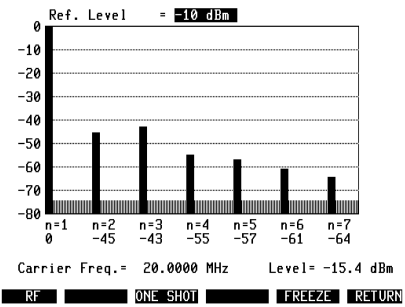


Fig. 6.3: Harmonics submask.

Functions of Softkeys (harmonics submask)

(RF-DIR) (alternative function (RF)) This permits, like in the basic masks, connection on the RF or RF DIRECT input.

(ONE SHOT) Triggers a single measurement. The display of the measured harmonics spectrum is frozen on the screen.

(CONTIN) Triggers continuous measurement. The display of the measured harmonics spectrum is continuously updated. After (CONTIN) the softkey has the alternative function (FREEZE). (FREEZE) freezes the display that is visible when the softkey is operated. The softkey then adopts the (CONTIN) function again.

(RETURN) Takes you back to the basic analyzer mask.

Setting Reference Level

The harmonics submask offers two means of optimally matching the sensitivity of the analyzer to the applied RF signal. If the analyzer is overloaded because the reference level is too low, for instance, the message OVERLOAD ! will appear. You should then increase the reference level (ie reduce the sensitivity) in increments by repeatedly tapping the plus key, for example, until the message disappears and a bar chart appears.

On the other hand the sensitivity of the analyzer should not be reduced unnecessarily, because otherwise the background noise of the set will obscure weak harmonics. The sensitivity is set optimally when the dynamic range of the signal makes full use of the dynamic range of the analyzer display (80 dB). In this case harmonics will show up optimally against the background noise of the analyzer. But if the sensitivity of the analyzer is reduced by way of the reference level to such an extent that the fundamental only calls for a dynamic range of 60 dB for instance, then 20 dB of dynamic display range is unnecessarily lost for weak harmonics.

The reserve dynamic range of the analyzer that is not used appears as a bright zone at the bottom edge of the harmonics submask. If the field is at least 10 dB, you can set a smaller reference level (as long as the lower limit is not yet reached) and thus match the dynamic range of the display better to the dynamic range of the signal. This will improve measuring accuracy, especially for weak harmonics.

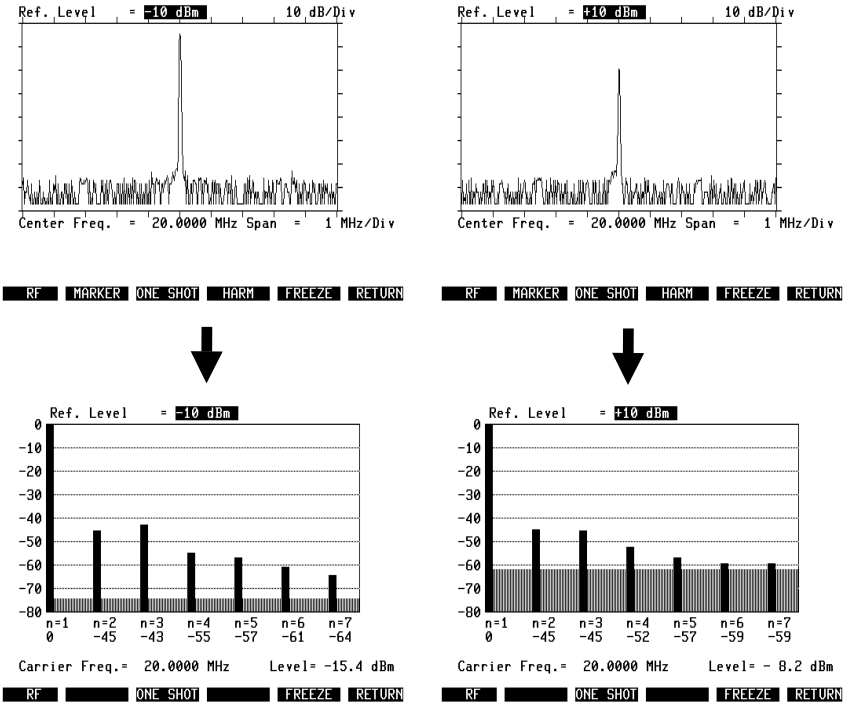


Fig. 6.4: Effect of reference level. When the reference level is set optimally (left), no dynamic display range is wasted. If the reference level is too high (right), weak harmonics hardly contrast against the background noise, the measurement is then rather dubious.

Oscilloscope

The oscilloscope (or simply scope) of STABILOCK 4032 shows the characteristics of AF signals applied internally or externally on the monitor. You can call up the scope from each of the three basic masks (TX, RX and optionally duplex) using [SCOPE]. If you wish to examine the modulation signal of an RF signal that is fed in, only the appropriate RF input socket has to be coupled with (RF) or (RF DIR) before calling up the scope.

AUTOTRIG Scope Mask

The [SCOPE] entry clears the bottom half of the current basic mask and shows instead one of the two scope masks: AUTOTRIG or VARIABLE TRIGGER. [HELP] and [PRINT] again retain their usual functions in these masks. In the remaining upper half of the original basic mask the settings (eg tuned frequency, level, type of modulation) can be altered at any time. The corresponding entry fields are accessed as usual with the cursor keys or by fast access.

The two scope masks have no mask header; they are named after the softkeys used to produce them on the display. The masks differ primarily through the fact that in one the triggering is automatic, while in the other the trigger level can be varied. Now strike (AUTOTRIG) and call up the AUTOTRIG mask if it is not already shown on the screen.

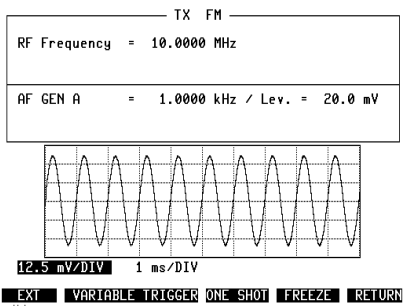


Fig. 6.5: AUTOTRIG mask. Display of the GEN A modulation signal. The vertical deflection coefficient is `12.5 mV/div`, the horizontal deflection coefficient is `1 ms/div`.

(RETURN) takes you from the AUTOTRIG mask back to the basic mask that was active before the scope was called up. You can also leave the scope mode immediately with [TX], [RX], [AUX], [MEMORY] or by calling up the basic duplex mask (option). All the major scope settings are stored when you exit from the scope mode.

Setting Zero Line

The position of the zero line in the scope window can be shifted with the POS control (front panel, scope field). For this it is best to choose the AUTOTRIG mask, because only then will the zero line be displayed in the absence of an input signal. If the zero line is outside the scope window, an arrow symbol (trace finder) appears at the left edge of the screen, pointing to where the zero line is located and thus assisting use of the POS control.

Selecting Test Signal

The (EXT) softkey function and its alternative function (INT) permit you to decide whether an internally processed AF signal is to be displayed or one applied directly to the scope input:

(EXT) couples the SCOPE INPUT socket (front panel) directly to the scope input.

(INT) on the other hand applies one of the internally processed AF signals to the scope.

The maximum level applied to the scope input should not exceed 24 Vpp. Upwards of this value 12-V clamping diodes in the input stage will limit the test signal.

One of the internally processed AF signals can be selected with the [VOLTM], [DEMOD] and [RX MOD/MOD GEN] keys. The signal can then - unlike the signal applied to the SCOPE INPUT - be fed via the 1-kHz notch filter or the optional modules on the OPTION CARD before it reaches the scope input (see also Chapter 12, "AF-signal Paths").

[VOLTM]	Selects the signal applied to the AF input socket of the same name.
[DEMOD]	Selects the demodulated signal in the TX and duplex (option) modes.
[RX MOD/MOD GEN]	Selects the modulation signal. If several modulation-signal sources are activated, the sum signal will be displayed.

Inserting a Filter

Deciding whether the internally processed AF signal is to be applied to the scope input directly or by way of a filter is made as follows:

VOLT — The AF signal goes to the scope directly if no optional module is activated on the OPTION CARD (see chapter 2, "OPTION CARD"). As soon as one of the optional modules `Filter 1/2` or `Option` is activated, it will be inserted in the signal path to the scope.

DIST — The AF signal goes by way of the 1-kHz notch filter. The scope input receives the signal without its 1-kHz component (residual distortion signal). If the optional module `Var Notch` is activated on the OPTION CARD, this filter will be inserted into the signal path instead of the 1-kHz filter.

Calling up the basic scope mask simultaneously activates the scope. Two scroll fields that can be accessed with the cursor keys then permit setting of the vertical and horizontal deflection coefficients.

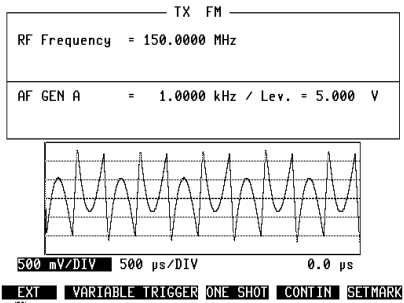


Fig. 6.6: Residual distortion signal. A high level has been set for GEN A in the `Lev` field of the basic TX mask. The resulting residual distortion signal becomes visible as soon as DIST inserts the 1-kHz notch filter in the AF signal path.

Vertical Deflection Coefficient

If the scroll field in the bottom left corner of the scope window is active (brightened up), [UNIT/SCROLL], slow turning of the handwheel or striking the plus/minus keys will call up the available deflection coefficients. The value in the scroll field is the one that is valid. The number, graduation and units of the deflection coefficients are dependent on the operating mode and the selected AF signal. For the units (%/div, Hz/div, V/div or rad/div) the allocations are as follows (MOD = RX MOD/MOD GEN):

	RX-AM	RX-FM	RX-ΦM	TX-AM	TX-FM	TX-ΦM	DUPLEX-FM	DUPLEX-ΦM
MOD	%	Hz	rad	V	V	V	Hz	rad
DEMOD	---	---	---	V	Hz	rad	Hz	rad
VOLTM	V	V	V	V	V	V	V	V

If the SCOPE INPUT is coupled with [EXT], the vertical deflection coefficient will always take the V/div unit.

Overloading of preamplifier

The vertical deflection coefficient is decisive for the amplification factor of the scope preamplifier. Too high an amplification factor leads to overloading and thus to an inaccurate signal display. This can very likely be the case when a weak residual distortion signal is to be displayed (overloading through fundamental).

If the preamplifier is overloaded, `Overload` will appear in the status line at the bottom edge of the screen. In this case a faithful display of the signal is only possible if a larger vertical deflection coefficient is set.

Horizontal Deflection Coefficient

The second scroll field at the bottom edge of the scope window, in the same way as described above, permits setting of the X deflection. The number, graduation and units (s/div) of the deflection coefficients are not dependent on the operating mode.

VARIABLE TRIGGER Scope Mask

The VARIABLE TRIGGER mask, permitting manual setting of the trigger level, is called up with (VARIABLE TRIGGER). You can change from one scope mask to another at any time.

A marker at the lefthand edge of the display shows the trigger level that was set the last time the mask was called up. With the handwheel it is then possible to shift the marker along the level axis and thus to set the trigger level.

In the VARIABLE TRIGGER mask the handwheel is reserved for setting the trigger level. Alteration of the deflection coefficients is permissible just as in the AUTOTRIG mask, but it can only be done with [UNIT/SCROLL] or the plus/minus keys.

If the trigger condition is not satisfied, (BEAMFND) produces a narrow brightened up bar at the left edge of the screen. The location and the vertical extension of the bar correspond to the location of the signal and the peak-to-peak value. The bar display is updated by (BEAMFND). Thus the bar will not show a shift in the zero (turning of POS control), for example, until the (BEAMFND) softkey is struck.

There are the following possibilities for satisfying the trigger condition:

- Correct the location of the trigger level with the handwheel
- Correct the zero position of the signal with the POS control
- Increase the vertical deflection coefficient

Softkey (NEG TRIG) (alternative function (POS TRIG)) permits selection of the triggering instant; (NEG TRIG) produces triggering on the negative (falling) edge of the signal, (POS TRIG) triggers on the positive signal edge.

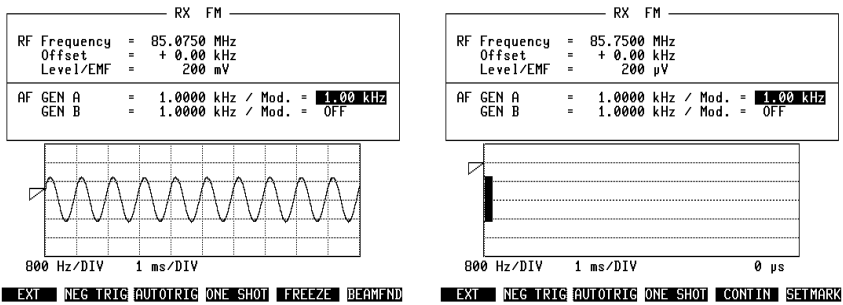


Fig. 6.7: VARIABLE TRIGGER mask. In contrast to the AUTOTRIG mask, the trigger level can be set manually. The marker at the lefthand edge of the screen shows the position of the trigger level. If the trigger condition is not satisfied, (BEAMFND) produces a bar that indicates the location and peak-to-peak value of the test signal.

One-shot Function

(ONE SHOT) triggers a one-shot measurement as soon as the trigger condition is satisfied. The one-shot measurement will use deflection coefficients altered beforehand. The measured result (curve trace) is frozen.

The one-shot function is available in both scope masks. It indicates the momentary trigger level at the lefthand edge of the screen with the trigger marker, but does not permit alteration of the level: the required level must be set in the VARIABLE TRIGGER mask before calling up the one-shot function.

(ONE SHOT) assigns new functions to softkeys S5 and S6. (CONTIN) takes you back to continuous measurement, ie you exit from the one-shot function; the stored curve trace is then deleted. With (SETMARK) the frozen curve trace can be precisely measured in time (see section "Measuring Curve Trace").

Freeze Function

The freeze function is virtually identical to the one-shot function. (FREEZE) uses automatic triggering however and freezes a curve trace irrespective of a trigger condition: the curve trace is stored that is visible at the instant when the softkey is operated. The freeze function is available in both scope masks. It assigns the (CONTIN) function to softkey S5 (exit from freeze function) and the (SETMARK) function to softkey S6 (see section "Measuring Curve Trace").

Measuring Curve Trace

As soon as the (ONE SHOT) or (FREEZE) function is called up, the handwheel takes on a new function: it alters the width of a "timing field", while the time duration, corresponding to the momentary width of the field, appears in the bottom right corner of the scope window. Thus any part of a curve acquired by the field can be precisely measured in time. (SETMARK) sets the start position (zero point) of the timing field. Use the handwheel to move the shiftable edge of the timing field to the required start position (beginning or end of the curve section) and then strike the softkey. The timing field can then be extended over the curve section with the handwheel. The resolution of the timing field is 1/40 of the horizontal deflection coefficient.

When the function (ONE SHOT) or (FREEZE) function is called up, the handwheel can only be used to set the expansion of the timing field. Scroll variables can only be called up with (UNIT/SCROLL) or the plus/minus keys.

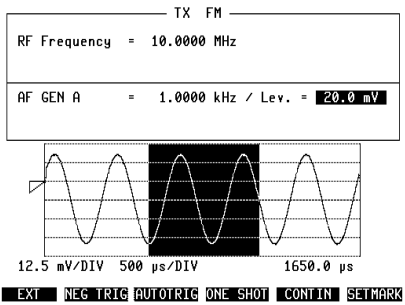


Fig. 6.8: Timing measurement. First the shiftable edge of the timing field was moved to the negative amplitude of the signal curve with the handwheel. (SETMARK) defined this point as the new start position of the timing field, which can then be expanded as required. The portion of the signal marked here has a duration of 1650 µs.

Tracking

With tracking, frequency-related network analyses can be performed, eg graphic display of a filter curve. Together with the VSWR test set (ordering code: 248 145) you can measure the reflexion coefficient of antennas, 50 Ω attenuators etc.

The Communication Test Set produces a sweep signal for the purpose, which has to be fed into the network that is being examined. At the same time the signal level following the network is measured and shown as a curve on the monitor of the STABILOCK as a function of frequency. The RF DIRECT socket is the signal source and the RF socket is the test input.

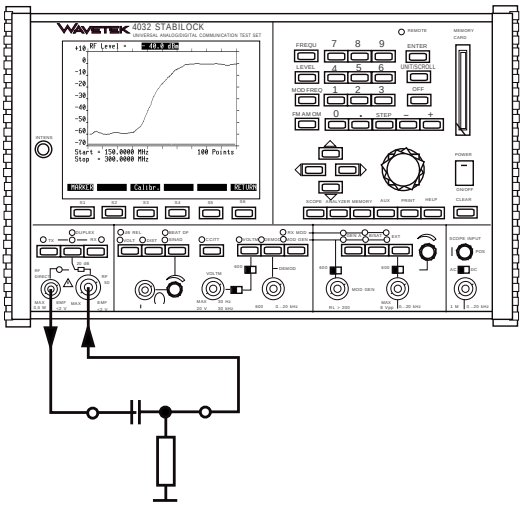


Fig. 6.9: Connection of a bipole to the STABILOCK.

Callup of tracking mask

First set STABILOCK to duplex mode. Then tap the [ANALYZER] key. This leads to display of the tracking mask. After a short pause, during which the message `Calculating` appears, display of the curve begins on the screen (if the test input is open, this will be a straight line at the bottom edge of the screen window). In the tracking mask [HELP] also briefly illuminates all entry fields. You can move to any entry field with the cursor keys. The entry field for the RF output level can also be positioned on with [LEVEL].

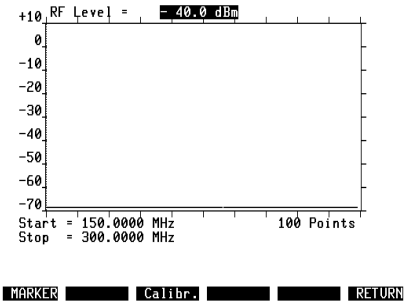


Fig. 6.10: Tracking mask.

Operation

Setting RF output level

The numeric field RF `Level` at the top edge of the mask is for setting the RF output level on the RF DIRECT socket. Select the unit (dBm, dBµ, µV/mV) as in the basic RX mask. There is no limit to the RF output level, ie as long as the RF input level on the RF socket remains below –10 dBm. Higher input levels are limited by the duplex input stage and thus lead to unwanted compression of the displayed curve. It is especially important to remain within the maximum permissible RF input level when testing active (amplifying) networks.

Meaning of level scale

For relative level measurements the tracking mask shows a scale with 10-dB divisions along the left margin. Relative level measurement means that only level differences (in dB) can be measured, and not absolute levels (eg in dBm). A typical relative level measurement is that of tracing the –3-dB point in a filter curve. For exact measurement of level differences an adjustable marker line can be produced on the screen with the (MARKER) softkey (see section "Meaning of softkeys").

The 0-dB mark on the scale corresponds approximately to a input level of –10 dBm. Therefore a displayed curve may not exceed this mark if it is to be shown undistorted. This restriction will be eliminated later so that active networks can produce curves in the positive range of the dB scale. The dB scale has already been prepared for this: the second largest value in the scale is a scroll field with the scroll variables `0`, `+10`, `+20` and `+30` that alters the scaling appropriately.

For analyzing passive networks it is best to set the scroll variable `0`. Optimal use is then made of the tracking display window with dynamic range of 0 to –70 dB (see illustration).

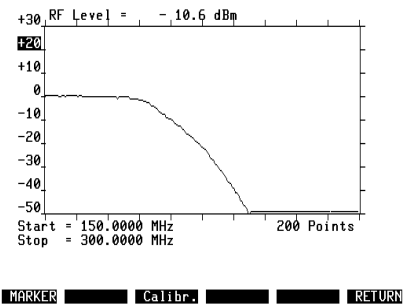


Fig. 6.11: Lowpass-filter curves plotted with the tracking function.

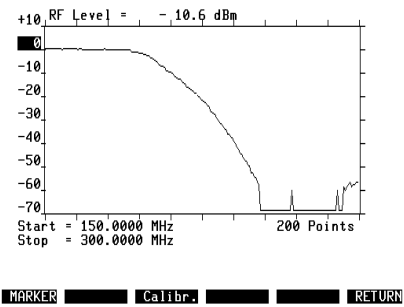


Fig. 6.12: When analyzing passive networks it is always best to do without the unnecessary display dynamic range between 0 and +40 dB and instead to spread the useful dynamic range to between 0 and –70 dB. Then the curve becomes visible in the lower level range.

Setting start/stop frequencies

The start/stop frequency of the sweep signal is determined by the content of the appropriate numeric fields (bottom edge of mask). On the horizontal frequency axis of the tracking mask the start frequency is at the left edge of the mask and the stop frequency at the right edge.

Permissible values of start frequency: 27 to 998.9999 MHz
Permissible values of stop frequency: 28 to 999.9999 MHz

After every alteration in the start/stop frequency the `Calculating` message appears for a few seconds in the status line before display of the curve commences. If inadmissible values are entered or if the sweep width (difference between start and stop frequency) is not at least 1 MHz, an error message will appear in the status line on the monitor.

Setting frequency resolution

The frequency resolution determines how precise a curve is displayed. The higher the frequency resolution, the more closely the displayed curve will correspond to the real characteristic. The frequency resolution is produced by the scroll field `Points` with the scroll variables `50`, `100` and `200`. The set scroll variable determines at how many frequency points on the displayed curve a measurement of level is made. This means that greater frequency resolution will always result in a slower update cycle for the curve, ie that alterations do not become visible until after a longish interval.

Meaning of softkeys

(MARKER) Inserts a marking line with which the displayed curve can be precisely measured (level/frequency association). As long as the marker is visible, only the position of the marker can be varied with the spinwheel (scroll variables can no longer be selected). The current position of the marker is shown by the `Marker Freq.` display field, the associated relative level (referred to the 0-dB mark on the scale) appearing in the `Level` field.

(Calibr.) No function at present.

(RETURN) Takes you back to the mask that was previously active.

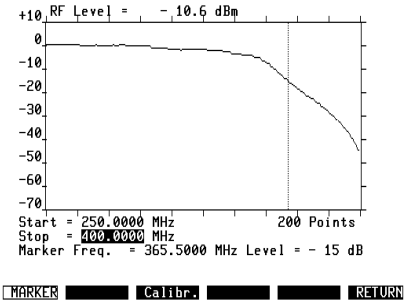


Fig. 6.13: Marker function. The marking line, which is adjustable with the spinwheel, permits exact measurement of relative level. The `Marker Freq.` field indicates the frequency at the current position of the marker, the `Level` field shows the corresponding relative level.

Technical data

Maximum permissible RF input level on RF socket	–10 dBm
Displayed level dynamic range	70 dB
Resolution in relative level measurement	1 dB
Maximum frequency range of sweep signal	27 MHz...999,9999 MHz
Minimum sweep width	1 MHz
Maximum sweep width	972,9999 MHz
Maximum frequency resolution	5 kHz

MEMORY

Introduction

"MEMORY" is a special mode of the 4032 that works with the memory card storage medium. Starting from the MEMORY mask, five different functions can be used:

- Storage and recall of complete device settings (setups). In this way the 4032 can be set up very quickly - even by someone with little experience - for different test applications that are always occurring.
- Storage and printout of screen contents. With this function you can store a measured result or oscilloscope curve, for example, when you are out testing, and then print it out when you arrive back at your base. You can also use this function when the screen contents are to be printed out a number of times and unaltered.
- Writing, storing, loading and starting AUTORUN programs. A program of this kind can perform a complete and automatic acceptance test on a radio set for example.
- Storage and printout of AUTORUN test reports. This function logs an AUTO-RUN test on memory card. This means that you can dispense with a printer for AUTORUN tests in the field. The test reports can be printed out when you return to base. The printout of a stored AUTORUN test report is identical to one that is printed out immediately.
- Loading of system programs (software options) for the testing of radio-data sets. Here the system programs handle the control of the DATA MODULE hardware option. A loaded system program is started automatically by calling up the DATA mask.

The first four functions above can be tried with the memory card that is included in the standard accessories. For the fifth function you require a software option (a memory card that is supplied written with a system program ex works) and the DATA MODULE.

On the following pages you are told how to work with memory cards and the individual MEMORY functions. Details of testing radio-data systems with the aid of system programs are given in Chapter 10.

Memory card

Memory cards are the storage medium for MEMORY mode. They contain RAM chips to hold data. Retention of data is ensured by a built-in lithium button cell.

☞ When you receive a memory card, enter the date on it for how long the battery is expected to last, ie unless the date has already been entered ex works. The lifetime of a battery starts on the day a memory card is despatched.
Note on care: Do not clean memory cards with liquids or detergents because this can lead to contact problems.

Slot for memory cards [7)]

When you push a memory card into the memory card slot (front panel), make sure it is the right way round (**Fig. 7.1**). Do not use force, slight pressure is enough to make the electric contacts engage with the pins of the connector. If the card is the wrong way round, a mechanical block will prevent electrical contact. Observe the handling instructions on the memory card and only use original cards.

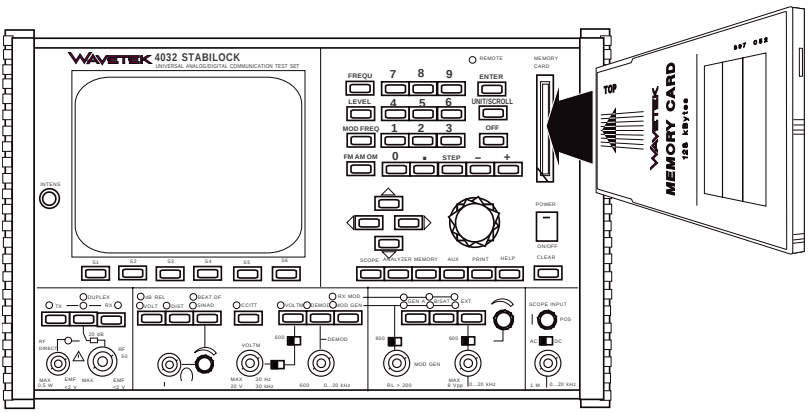


Fig. 7.1: The picture shows how a memory card should be inserted in the slot on the 4032. Mechanical coding prevents it from being inserted in the wrong way.

Two kinds of memory card[3)]

A modified memory card has been shipped since the end of 1994. The new card uses a different type of battery. The two kinds of memory card are easy to distinguish:

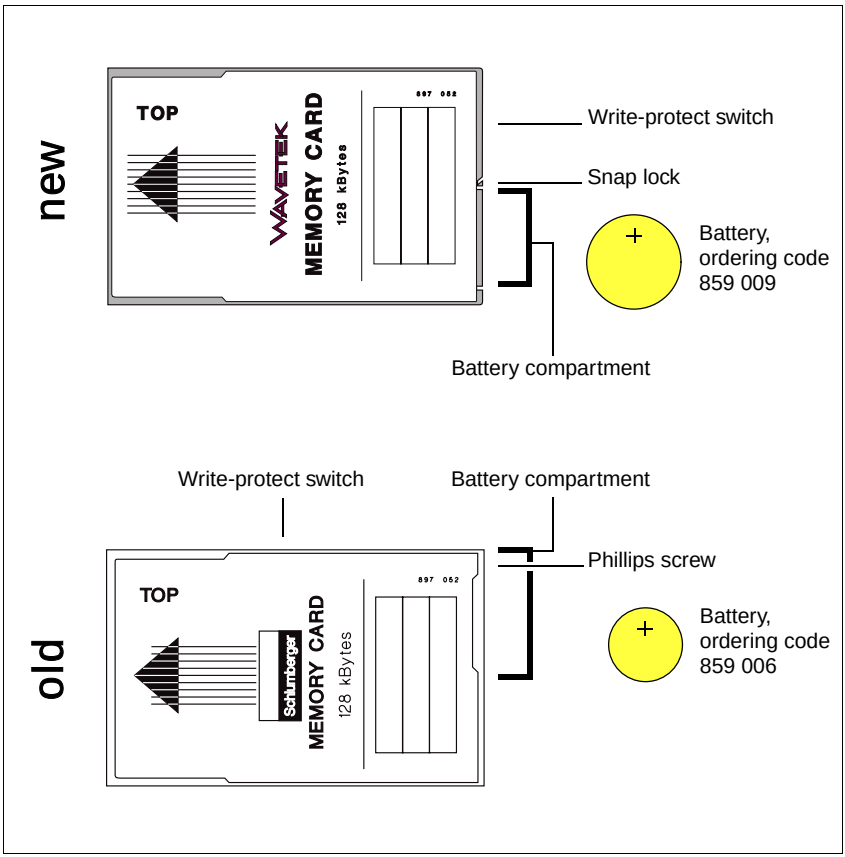


Fig. 7.2: The major differences between the new (top) and the old memory card.

Battery lifetime

New memory card

The built-in lithium button cell (ordering code 859 009) has a lifetime of 5 years, regardless of the capacity of the memory card.

Old memory card

The lifetime of the built-in lithium button cell (ordering code 859 006) depends on the capacity of the memory card:

Storage capacity	Battery lifetime
32 Kbytes	4 years
64 Kbytes	2 years
128 Kbytes	1 year

Changing battery – old memory card

To prevent any loss of data, you should replaca lithium button cells before the final date shown on the memory card (ordering code for new batteries: 859 006).

Procedure for replacing button cell

1. Power up the Communication Test Set and push the memory card into the slot. If you want to avoid any risk, make a copy of the memory card until you know that the battery has been replaced properly (note: memory cards containing a system program cannot be copied).
2. Undo the Phillips screw at the location shown in **Fig. 7.3**. This screw holds the battery compartment shut, which you can now open.
3. Take out the button cell (note the polarity and the indication on the memory card), insert a new cell with the right polarity and close the battery compartment.
4. Enter the expiry date of the new button cell on the memory card in one of the fields provided for this purpose (see table on page 7-6).

   Check

5. Take the memory card out of the slot for at least 10 min and then push it back in again.
6. Call up the MEMORY mask. The directory of the memory card must now show the same entries as before you replaced the button cell. If not, the contents of the memory card have been deleted! In such an event, check that the battery is correctly poled. If you have lost a system program, contact your nearest Willtek office or an authorized representative.

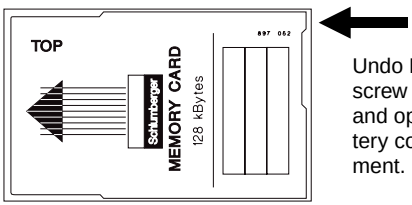


Fig. 7.3: The battery of a memory card has a limited lifetime. So do not forget to replace it in good time.

Proper disposal of used button cells

Do not put lithium batteries in the waste-paper basket. Take them to a point of collection for problem refuse. Willtek Communications GmbH and its sales offices will also take back button cells for correct, ie environment-friendly, disposal.

Changing battery – new memory card

To prevent any loss of data, you should replaca lithium button cells before the final date shown on the memory card (ordering code for new batteries: 859 009).

Procedure for replacing button cell

1. Power up the Communication Test Set and push the memory card into the slot. If you want to avoid any risk, make a copy of the memory card until you know that the battery has been replaced properly (note: memory cards containing a system program cannot be copied).
2. Release the lid of the battery compartment. To do this, press the tag in the direction of the arrow with a fingernail, as shown in **Fig. 7.4**. Remove the lid of the battery compartment.
3. Take out the used button cell. Watch out for the correct polarity when inserting the fresh button cell, see **Fig. 7.5**.
   The underside of the memory card bears an illustration showing you how to insert the button cell the right way round.

Risk of data loss! If the battery is wrongly poled, it will not contact the memory card and the stored data will be lost.

Risk of polarity reversal! The illustration of battery replacement does not apply to some of the new memory cards (battery wrongly poled).

No matter what model of memory card you have: you cannot go wrong as long as the battery is facing upwards with its plus pole, ie the same way as the top of the memory card with the name MEMORY CARD.

4. Replace the lid of the battery compartment the right way round (the tag must point in the direction of the write-protect switch) and let it click into place.
5. Enter the expiry date of the new button cell on the memory card.

   Check

6. Take the memory card out of the slot for at least 10 min and then push it back in again.
7. Call up the MEMORY mask. The directory of the memory card must now show the same entries as before you replaced the button cell. If not, the contents of the memory card have been deleted! In such an event, check that the battery is correctly poled. If you have lost a system program, contact your nearest Willtek office or an authorized representative.

Fig. 7.4: To open the battery compartment, press the tag on the lid in the direction of the arrow.

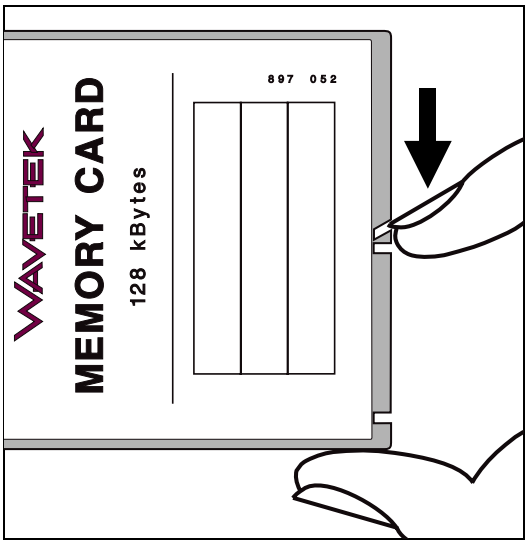
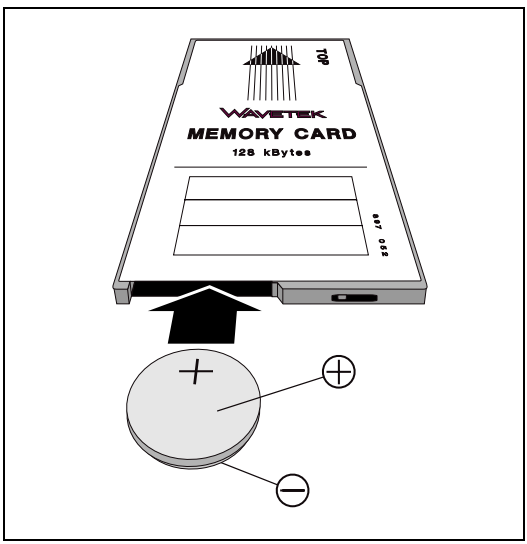


Fig. 7.5: Watch out for correct polarity when inserting the battery. A wrongly poled battery will cause the stored data to be lost.



7

Proper disposal of used button cells

Do not put lithium batteries in the waste-paper basket. Take them to a point of collection for problem refuse. Willtek Communications GmbH and its sales offices will also take back button cells for correct, ie environment-friendly, disposal.

SYSTEM CARDs

memory cards that are supplied ready with a system program are called SYSTEM CARDs to distinguish them from the normal memory cards. SYSTEM CARDs are identical technically to memory cards but cannot be copied. For this reason these memory cards - if they do not permit the battery to be replaced - have to be replaced by new cards before the battery expires (replacement by the factory or a sales agency).

☞ There should be no memory card in the slot on the 4032 when it is switched on or off (risk of losing data, noticable by sudden appearance of error message, eg `CHECKSUM WRONG`).

MEMORY Mask

It does not matter what the momentary operating status of the Communication Test Set is, the MEMORY mask can be called up at any time with MEMORY; this is the starting point for all MEMORY functions. RETURN takes you back to the mask that was on screen immediately before the MEMORY mask was called up.

Calling up Directory

After the MEMORY mask has been called up with MEMORY, it always shows a directory of ready loaded programs plus the contents of the currently adapted memory card and its memory capacity. The names of loaded programs are listed in the two screen lines beneath the text field EXECUTABLE PROGRAMS. The directory shows maximally two entries because the RAM of the 4032 can only hold one AUTORUN program and one system program.

The capacity of the adapted memory card can be read next to the text field FILES ON MEMORY CARD.

The directory of the memory card appears beneath the text field FILES ON MEMORY CARD: this shows a list of automatically reserved setup entries (see section "Formatting memory cards") and, depending on the memory content of the card, the names of AUTORUN programs or stored masks (screen contents). For SYSTEM CARDs only the name of the stored system program is displayed.

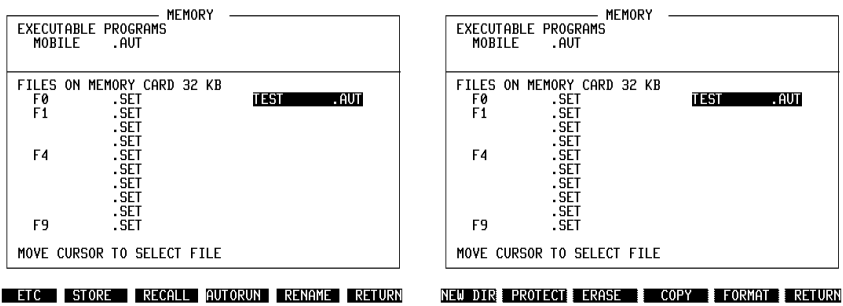


Fig. 7.6: The two pages of the MEMORY mask: The first page (left) is only different from the second page in its softkey functions. Here, for example, the socalled cursor bar marks the entry TEST.AUT in the directory FILES ON MEMORY CARD.

If there is no memory card in the slot on the front panel when the MEMORY mask is called up, the mask will simply show the directory EXECUTABLE PROGRAMS. If you then, having called up the MEMORY mask, insert a memory card, (ETC) + (NEW DIR) will take you to the complete directory. (ETC) turns to the second page of the MEMORY mask. The softkeys that are presented here automatically return to the first page of the MEMORY mask after the function concerned has been executed.

For clear distinction the different files (data records) have a label consisting of three letters that is automatically added to the name of the file.

SET = Setup
AUT = AUTORUN program*)
EXE = AUTORUN program*)
SYS = System program
PIC = Screen content
RES = AUTORUN test report

*) Unlike files with the label AUT, files with the label EXE cannot be edited.

Depending on its capacity a memory card can hold the following files:

Memory card	SET-Files	AUT-, EXE-, PIC, 16-KByte-RES-Files	4-KByte-RES-Files
32 Kbytes	10	1 *)	1 **)
64 Kbytes	10	3 *)	1 **)
128 Kbytes	10	7 *)	1 **)
256 Kbytes ***)	10	10 *)	1 **)

*) The number is the sum of the AUT, EXE, PIC and 16-Kbyte RES files that can be stored. So it is possible to store either one AUT or one EXE or one PIC or one 16-Kbyte RES file on a 32-Kbyte card; a 64-Kbyte card on the other hand can hold one AUT, one EXE and one PIC file for example (any combinations permissible).

**) On each memory card a 4-Kbyte RES file can be stored in addition (see Chapter 8, "AUTORUN Test Reports"). This corresponds roughly to a full page of A4 format.

***) This memory card can only be used with the new memory card interface. You know this is installed if MEMORY 2 appears in the title line of the MEMORY mask and hardware revision 2 is entered under MEMCARD-IFC in the HW-REVISIONS mask.[7)]

SYSTEM CARDs only contain the ordered system program; users cannot store files on these cards.

Only entries with the label AUT, EXE or SYS are possible in the directory EXECUTABLE PROGRAMS because only callable programs can be loaded into the RAM of the 4032. Setups are executed immediately after they have been loaded, and screen contents are immediately printed out.

Fig. 7.7: Directory of memory card: According to the directory FILES ON memory card the inserted memory card contains the AUTORUN program MOBILE.AUT and two setups. The AUTORUN program is already loaded in the RAM of the 4032; therefore MOBILE.AUT also appears in the directory EXECUTABLE PROGRAMS.

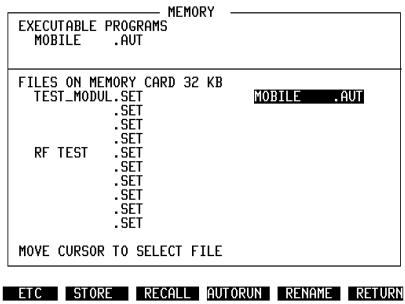
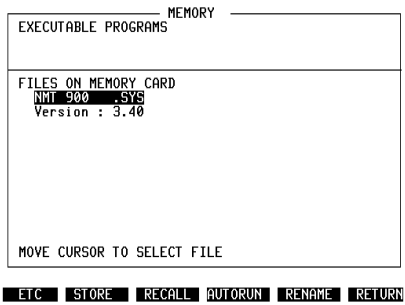


Fig. 7.8: Directory of SYSTEM CARD: The RAM of the 4032 contains no AUTORUN program. The inserted SYSTEM CARD contains the system program NMT-900.SYS, which can be loaded into main memory.



Formatting memory cards

Before a new memory card can store files, it has to be formatted. This later speeds up access to the stored files. SYSTEM CARDs are provided with write protection to prevent them from being formatted by accident. The formatting procedure is as follows:

1. Call up the MEMORY mask.
2. Insert the memory card.
3. Turn to the second page of the MEMORY mask with (ETC).
4. Start the formatting with (FORMAT). If a used memory card is formatted again, all its files will be deleted. To prevent deletion by mistake, in such cases (FORMAT) is followed on the screen by the question `OVERWRITE ????`, which can be answered with (YES) or (NO).
5. Formatting only takes a few seconds and it is finished when the first page of the MEMORY mask appears and the current directory is displayed.

After formatting there are ten files reserved for setups on a memory card, depending on its capacity. Up to eight more files are reserved for AUTORUN programs, AUTORUN test reports or screen contents. The reserved setup files can immediately be recognized in the `FILES ON memory card` directory by the label `.SET` (without any name preceding). Reserved AUT, EXE, RES or PIC files on the other hand are concealed as "blank entries" in the righthand column of the `FILES ON memory card` directory. The entry is not given a name until an AUTORUN program or screen contents are stored.

Any entry in the directory can be marked with the brightened up cursor bar, which can be manipulated with the four cursor keys. All further entries then refer to the marked entry.

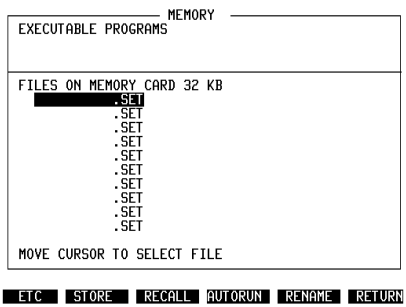


Fig. 7.9: Directory of memory card immediately after formatting.

Deleting Individual Files

Whereas (FORMAT) will delete all data on a memory card, (ERASE) can be used to delete specific files. SYS files cannot be deleted on SYSTEM CARDs.

1. Mark the entry that is to be deleted with the cursor bar in the directory `FILES ON memory card`.
2. Call up the second page of the MEMORY mask with (ETC).
3. Call up the deletion routine with (ERASE).
4. Check that the entry for deletion really is marked and then start the deletion routine with (YES) or abort it with (NO).

If the deleted file is an AUT, EXE, RES or PIC file, its name will be removed entirely from the directory. The label SET is left over in the directory from a deleted SET file.

Copying memory cards

In contrast to the content of SYSTEM CARDs, that of normal memory cards can be copied. The destination card is formatted automatically. The copying routine uses the AUTORUN RAM of the 4032 as a buffer, so any AUTORUN program stored in the RAM will be deleted. A loaded system program will survive the copying routine unharmed. The copying procedure is quite simple:

1. Adapt the source card.
2. Call up the second page of the MEMORY mask with (ETC).
3. Start the copying routine with (COPY).
4. If there is an AUTORUN program in the RAM of the 4032, you are asked `AUTORUN MEMORY USED. OVERWRITE ?`. Answering (YES) produces a prompt to adapt the destination card, (NO) aborts the copying routine.
5. Insert the destination card and strike any softkey.The destination card must have the same capycity as the source card.
6. Wait for the prompt `INSERT SOURCE CARD`, insert the source card and again strike any softkey.
7. Repeat the exchange of cards according to the instructions on the screen. The copying procedure is ended when the `COPY finished` message appears on the screen.

Naming Files

When you store a SET, AUT, EXE or PIC file, you can give an individual name to the marked file entry. For this purpose the softkeys - after the storing routine has been called up (see following sections) - show the characters of the alphabet, to begin with in groups of maximally six letters. At the same time the screen tells you to enter the file name (`INPUT FILE NAME...`).

As soon as you strike a softkey, the letters of the group you have selected are shown individually, one on each of the six softkeys. Striking a softkey then puts the letter concerned into the marked file entry, at the point where the flashing cursor is located. At the same time the softkeys will again show the letter groups so that you can select the next character. To correct an entry error, mark it with the cursor and then overwrite it.

A name may have no more than ten characters, and spaces also count as characters. After entering the last character you must strike [ENTER] to leave the text entry mode.

It is not absolutely essential to enter a name. If you choose not to and strike [ENTER] when the request `INPUT FILE NAME...` appears, the 4032 will give the file a name automatically:

HARDCOPY	for PIC files;
AUTORUN	for AUT files;
Fx	for SET files (x = 0-9, depending on where the SET file comes in the directory).

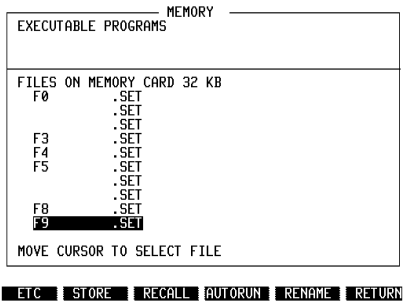


Fig. 7.10: When the files shown here were stored, they were not given individual names, their naming was left to the 4032.

If the marked file already has a name, you are first asked, after calling the storage routine, whether the file content is to be overwritten: (NO) terminates the routine, (YES) produces the request `INPUT FILE NAME...` and the text entry mode. If the existing file name is to be deleted, first strike [OFF] before entering a new name on the softkeys. But it is also possible to modify or add to an existing file name.

Renaming Files

A file that already has a name can be renamed with (RENAME). Here only the name of the file is altered, its content remains unchanged. SYS entries cannot be renamed however.

Marking file: In the directory `FILES ON MEMORY CARD` use the cursor bar to mark the file whose name is to be altered.

Altering file name: (RENAME) calls up the text entry mode (see section "Naming Files"). The old name can now be altered or added to. Strike softkey S6 twice to delete the character that the cursor is marking.

Storing new file name: If the new file name is shorter than the old one, [OFF] will delete the surplus characters (to the right of the cursor); the new file name is stored at the same time. If [OFF] is not used, you must terminate the entry with [ENTER].

Setting and Deleting Write Protection

(PROTECT) is used to protect the particular file on memory card against accidental erasure or overwriting that is marked by the cursor bar (software write protection).

Protected files can be recognized in the directory `FILES ON MEMORY CARD` by the letter "P" after the file identification. If (PROTECT) is made for a file that is already protected, this cancels the write protection. But before this happens, the 4032 will ask you for confirmation, ie (YES) or (NO).

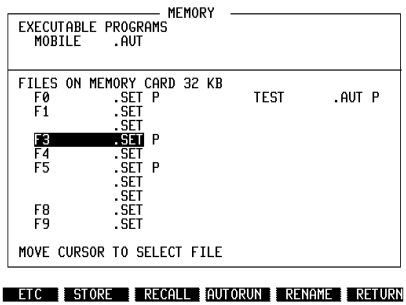


Fig. 7.11: The files marked "P" are protected against accidental erasure or overwriting.

Newer MEMORY CARDs and SYSTEM CARDs contain a small slide switch that interrupts the WRITE line and offers extra write protection for all files (hardware write protection). In contrast to the software write protection this is also effective if, because of interference, uncontrolled write pulses reach the memory card.

The switch setting on memory cards is detected by the 4032 and, as the case may be, the status line will show a prompt to reset the write protection. With memory cards it is advisable to set the hardware write protection as soon as the files on the memory card no longer have to be altered.

On SYSTEM CARDs the switch setting is not detected by the 4032, meaning that the user has to check it. The hardware write protection should not be activated on SYSTEM CARDs so that the 4032 can read the content of the GENERAL PARAMETERS mask, for example, to the memory card at any time. The advantage of this is that when a system program is repeatedly loaded, standard entries do not have to be made again.

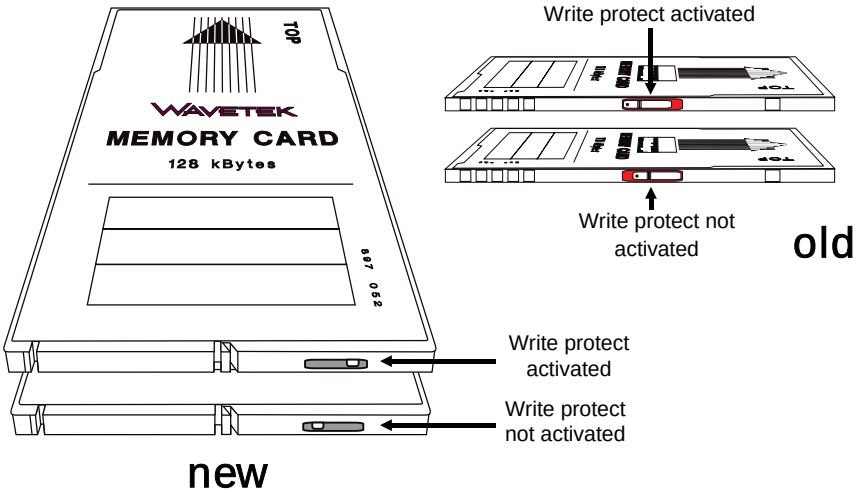


Fig. 7.12: When set correctly, the write-protect switch will reliably safeguard the files on a memory card against accidental erasure or overwriting. The slide switch on the new memory card (left) is different to that on the old one.

Storing and Recalling Setups

STABILOCK 4032 will automatically store its momentary settings if the set is switched off with [POWER] or switched from one of the three basic masks to another. If you have to interrupt a transmitter test because of a receiver test for instance, the Communication Test Set will immediately adopt the settings that it had before when you return to the TX mask (values in the entry fields, called up instruments and so on).

Furthermore, the Communication Test Set can store 13 other setups quite independently of one another on a memory card. And what is more, including the conventions agreed in the GENERAL PARAMETERS mask. In this way STABILOCK 4032 can be set up very speedily for different test applications that are constantly recurring.

Storing a setup

1. Set up the operating status that is to be saved (eg select the mask, fill in the entry fields of the mask, choose instruments and modulation generators, call up the scope, etc). If required, extra conventions that are relevant for the operating status can be made in the GENERAL PARAMETERS mask.
2. Insert the memory card.
3. Call up the MEMORY mask with [MEMORY].
4. Move the cursor bar to a vacant or an occupied SET location.
5. Start the storage of the device setup with [STORE].
6. If you have marked an occupied SET location, the 4032 will ask `OVERWRITE ???`. Answer [YES] if the new setup is to replace the old one, or [NO] if you want to stop the storage procedure.
7. Give the SET entry a name (see section "Naming Files"). Confirm the entry with [ENTER] and then the operating status or setup is stored.

Recalling a setup

1. Mark the required SET entry in the directory `FILES ON MEMORY CARD` with the cursor bar.
2. Load the marked setup with [RECALL]. As soon as the setup is loaded, the Communication Test Set will adopt exactly that status which it had when the setup was stored.

Modifying a stored setup

1. Mark the set up that is to be altered in the directory `FILES ON MEMORY CARD` with the cursor bar.
2. Call up this setup with (RECALL).
3. Modify the operating status as required.
4. Call up the MEMORY mask again with [MEMORY].
5. Make sure that the cursor bar is still on the name of the setup that is to be altered and start the saving of this operating status with (STORE).
6. When the screen asks `OVERWRITE ???` answer with (YES).
7. Change the name of the setup (see section "Naming Files") or adopt it unaltered with [ENTER].

Storing and Printing Screen Content

Storing screen content

1. Insert the memory card.
2. Call up the MEMORY mask with [MEMORY].
3. Mark any blank entry in the righthand column of the directory `FILES ON MEMORY CARD` with the cursor bar. If the directory shows a PIC entry that may be overwritten, this will have to be marked. An AUT, EXE or RES file cannot be overwritten by a PIC file (delete AUT, EXE or RES file with (ERASE)).
4. Strike the `STORE` softkey.
5. If you mark a blank entry, answer the question on the screen about what is to be stored with (PICTURE). This puts the 4032 into the text entry mode (see section "Naming Files"). If you mark a PIC entry, the 4032 will ask `OVERWRITE ????`, which can be answered with (YES) or (NO). (YES) calls up the text entry mode, (NO) terminates the storage routine. After confirmation of the file name with [ENTER], the 4032 reports: `NEXT HARDCOPY WILL BE STORED ON CARD.`
6. Leave the MEMORY mask and set the Communication Test Set so that the monitor shows the required picture (eg measured results, scope or analyzer display).
7. [PRINT] will save the screen content shown at the moment the key is struck. The storage procedure is confirmed by the message `STORING PICTURE ON CARD` in the status line and is terminated when this message extinguishes.

If a 32-Kbyte memory card on which a PIC file is to be stored already contains an AUT or EXE file, the RAM of the 4032 can be used to save the AUT or EXE file. To do this, load the file into the RAM (see section "Storing and Loading AUTORUN Program") before it is deleted on the memory card with (ERASE). Now the PIC file can be stored. If the PIC file is deleted after the screen content has been printed out, the AUT or EXE file can be stored again on the memory card.

Printing stored screen content

1. Insert the memory card.
2. Make sure that the IEEE-bus printer is ready and that the correct printer driver is set in the `Printer` field of the GENERAL PARAMETERS mask.
3. Call up the MEMORY mask with [MEMORY].
4. Mark the PIC entry with the cursor bar.
5. (RECALL) produces a question: whether the stored display should be shown first on the screen (answer (YES)) or printed immediately (answer (NO)). If the stored display is shown on the screen, the status line tells you `Screen shows a restored hardcopy` and the next question is `PRINT THIS PICTURE`. If you answer this question with (YES), the screen content is printed out. A (NO) answer takes you back to the MEMORY mask.

Loading System Programs

System programs stored on SYSTEM CARDs can only be loaded. Loading followed by storage on a memory card is not possible. A total reset erases the system program in the 4032's RAM. If the Communication Test Set is switched off or disconnected from the power line the system program is not lost.

The RAM of the 4032 can only hold one system program. If the directory `EXECUTABLE PROGRAMS` reports a loaded AUT or EXE file, then the system program can be loaded in addition to it.

If a SYSTEM CARD is inserted, the system program that is stored on it will be loaded and started automatically when the DATA mask is called up ([AUX] + [DATA]). If a system program is supplied on a number of memory cards, place the first card in the slot and start the load operation. `Insert next card` will appear to tell you to insert the next system card. But a SYS file can be loaded like any other file:

1. Insert the SYSTEM CARD.
2. Call up the MEMORY mask with [MEMORY].
3. Move the cursor bar onto SYS file in the directory `FILES ON MEMORY CARD`.
4. Use [RECALL] to load the program into the RAM of the 4032. If a system program is supplied on a number of memory cards, place the first card in the slot and start the load operation. `Insert next card` will appear to tell you to insert the next system card. The loading procedure is ended as soon as the program name appears in the directory `EXECUTABLE PROGRAMS`.

The loaded system program starts automatically as soon as the DATA mask is called up to test a radio-data set (requires normally the DATA module hardware option).

AUTORUN
and
Use of IEEE-bus Controller

Introduction

Rationalized testing with AUTORUN programs

AUTORUN programs turn STABILOCK 4032 into a fully automatic radio test set for just about any task. Controlled by an AUTORUN program the set will execute a series of tests without any human intervention, for example, and at the same time produce a report with evaluation of the measured results. It is also possible for an AUTORUN program to stop what it is doing and show you entry or adjustment instructions on the display of STABILOCK 4032. Once you have responded to these, the program will continue with the new entries or adjustments.

```
10 SETTX
20 MODULation
30 FOR I=100 mV TO 1000 mV STEP 20 mV
40 KEY 1 TO 6,"CONTINUE",GOTO 80
50 GENAL #I
60 IF M_RMS > 220 mV GOTO 100
70 KEY RUN
80 NEXT I
90 END
```

Fig. 8.1: Listing of AUTORUN program. BASIC commands make sure your program runs in the required sequence, IEEE commands take care of setting up the equipment and retrieving the measured results.

AUTORUN programs can automatically reproduce virtually all manual functions of STABILOCK 4032, from connecting the RF sockets to calling up a special test routine.

AUTORUN programs are a particular advantage if you want to take care of extensive tests - that keep occurring - in a speedy and thorough fashion. Typical examples of these are automatic acceptance tests after repairs or regular routine checks as part of maintenance.

Requirements

1 x STABILOCK 4032
1 x Keyboard (recommended accessory) Ordering code: 248 192
or AUTORUN Editor ARE (software option) Ordering code: 897 100

AUTORUN programs are normally entered into the main memory of STABILOCK 4032 with the keyboard (ASCII). One of the control interfaces is necessary for connecting the keyboard.

If you often have to write extensive programs, you are better off with AUTORUN Editor ARE instead of the keyboard. ARE is a powerful, menu-prompted editor for program development on IBM-compatible PCs. By way of an IEEE interface card of the type PC II A (National Instruments) the PC transfers an AUTORUN program to STABILOCK 4032 for execution. Here are some of the features of ARE:

- The block function; this shifts, copies, prints and stores any parts of the program.
- An expandable library holds program modules that are frequently required.
- ARE manages line numbers automatically, even for goto statements.
- AUTORUN programs can also be copied from STABILOCK 4032 to the PC on the IEEE interface. This permits convenient revising of existing AUTORUN programs.

AUTORUN = BASIC + IEEE

AUTORUN programs use two different kinds of commands, which will be looked at more closely later on in the sections "BASIC Commands" and "IEEE Commands":

BASIC commands BASIC commands (BASIC: Beginner's Allpurpose Symbolic Instruction Code) provide for the required program sequence. They also enable the further processing of measured results, the entry of numeric values and character strings (texts) and the formatted output of reports on a printer.

IEEE commands IEEE commands are used for setting STABILOCK 4032 and for retrieving measured results. The effect of these commands can be grasped intuitively. For example, the IEEE commands for calling up the basic TX mask and retrieving the measured RMS value are simply SETTX and M_RMS.

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AUTORUN Mask

The AUTORUN mask is the basic starting point for all AUTORUN functions:

- Write program
- Edit program
- Execute program

Calling up AUTORUN mask

Preparation

❍ Call up the MEMORY mask with (MEMORY) and check that it shows the (AUTORUN) softkey (if not, switch to the next softkey level of the MEMORY mask with (ETC) (**Fig.** 8.2)).

❍ Check whether the main memory (RAM) of Test Set already contains an AUTORUN program. If so, the MEMORY mask will indicate the name of the program (with AUT label) in the directory of main memory.

Callup

Case 1: RAM contains an AUTORUN program.
Striking the (AUTORUN) softkey calls up the AUTORUN mask (**Fig.** 8.3). The name of the program appears in the mask header. You can now edit the program or start it with (RUN).

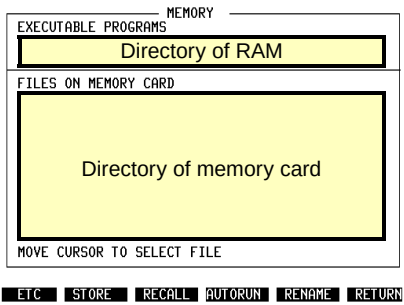


Fig. 8.2: This is what the MEMORY mask looks like when there is no memory card in the slot and main memory is entirely empty. (ETC) takes you to the next softkey level.

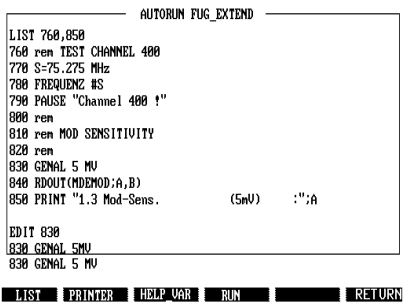
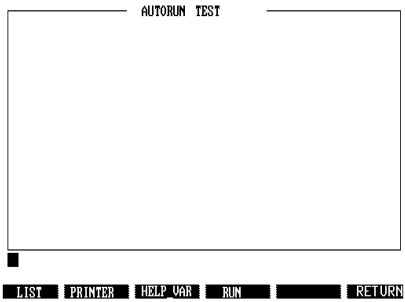


Fig. 8.3: The AUTORUN mask shows a listing of the current program as soon as you call it up. Requirement: program (here FUG_EXTEND) must first be filed in main memory.

Callup
(continued)

Case 2: RAM contains no AUTORUN program.
After you strike the (AUTORUN) softkey, STABILOCK 4032 does *not* show the AUTORUN mask but waits for the entry of a program name (see box). Reason: STABILOCK 4032 assumes that a new program is to be written. This requires entry of the program name in advance. Immediately after confirmation of the entry, the display shows the AUTORUN mask (**Fig.** 8.4). Now you can start writing the new program.

Fig. 8.4: The AUTORUN mask immediately after callup (case 2). The declared program name is TEST.



Return

(RETURN) takes you back to the MEMORY mask. The loaded AUTORUN program is kept in main memory.

Issuing a new program name

If the RAM contains no AUTORUN program, striking the (AUTORUN) softkey will assign the softkeys of the MEMORY mask the letters of the alphabet, first in groups of six letters each. In the directory of RAM the cursor flashes in the entry field for the program name.

To enter a letter, first strike the softkey whose group contains the required letter (eg softkey (GHIJKL) for the letter "H"). This labels the six softkeys with the six letters of the chosen group.

Striking a softkey enters the assigned letter at the position of the cursor in the entry field, and the softkeys again offer you the letter groups for entering the next character. Always confirm entry of the name with [ENTER].

Tips: If the program may have the standard name AUTORUN, simply strike the [ENTER] key after the (AUTORUN) softkey. To enter spaces, move the cursor on by one position. Incorrect letters are just overwritten. [OFF] deletes all characters to the right of the cursor. Abort an entry with [MEMORY]. For changing an existing name, see Chapter 7.

☞ Once the screen shows the AUTORUN mask, the keys of STABILOCK 4032 are disabled. Exceptions: all softkeys, [PRINT], [HELP] and [CLEAR].

The AUTORUN mask is divided up into three areas, each of which has a precisely defined purpose (**Fig.** 8.5).

Display field

The display field of the AUTORUN mask constantly shows the listing during the *entry* of a program. During the *execution* of a program the PRINT commands produce the output of values or text in the display field (output to a printer is extra).

The display field comprises 16 lines of 49 characters each. If a program listing has more than 16 lines for example, the listing is automatically "scrolled": each new program line shifts the topmost line out of the display field.

Editing line

Below the display field is the editing line (**Fig.** 8.6). This is for entering new program lines and socalled direct commands (BASIC commands without a line number that are executed as soon as they are entered: eg `PRINT "TEST"`). For the subsequent editing of program lines that already exist in the editing line there are editing functions (see section "Editing programs"). The momentary write position is marked by a flashing cursor (after you call up the AUTORUN mask the cursor does not become visible until you first strike a key).

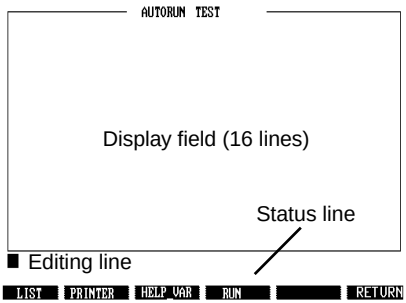


Fig. 8.5: The AUTORUN mask is split into three areas. All of these are relevant when you are developing a program. During the execution of a program the editing line is of no significance.

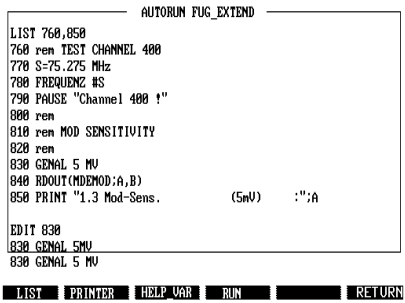


Fig. 8.6: Here the ready program line 830 was fetched back into the editing line with the EDIT command. Program lines can only be modified there.

Entries in the editing line are only possible with the keyboard. Each entry (program line, direct command) must be terminated by pressing the [RCL/RET] key on the keyboard. This transfers the current contents of the editing line to the display field. At the same time the editing line is prepared for the next entry.

Status line

The status line (directly above the softkeys) is reserved exclusively for error messages. Thus, for example, an attempt to execute the wrong direct command `PRONT "Test"` will immediately produce an error message.

Softkeys of AUTORUN mask

(LIST) Produces a complete list of the AUTORUN program currently in main memory (always starting with the first program line). If the listing is of more than ten lines, it will automatically be scrolled until the last program line appears in the display field. During this listing the (LIST) softkey takes on a STOP function (stops the scrolling of the listing). Listing of a specific section of a program is possible with the LIST editing command (see section "Editing commands"). Lines subsequently inserted in a program do not appear at the right place in the listing until after (LIST).

(PRINTER) This offers the choice of whether or not a printer is to log all entries during editing. Repeated striking of the softkey activates/deactivates this function, accompanied by acknowledgement messages:

```
Edit mode Printing On
Edit mode Printing Off
```

(PRINTER) is only effective when you are editing programs; PRINT commands in programs are not affected by this function.

(RETURN) Takes you back to the MEMORY mask.

(RUN) This starts the AUTORUN program currently in main memory. [OFF] terminates program execution (press the key until termination).

(HELP VAR) As long as this softkey is pressed, the display will show the mask that was visible immediately before calling up the MEMORY mask. All *entry fields* of this mask have "identification numbers" assigned to them. You need these to enter new values in the entry fields with the IEEE command `WRTVAriable`.

Editing Programs

You need the keyboard or the AUTORUN editor ARE for editing programs (see under "Requirements"). The AUTORUN editor comes with its own operating instructions. So here we will concentrate on editing with the keyboard.

The keyboard has keys for editing program lines when they are in the editing line. There are also editing commands that affect defined sections of a program (eg deleting whole program blocks or renumeration).

Editing keys

There are keys on the keyboard for six editing functions (**Fig.** 8.7). The second occupancy of the keys (upper symbol) is valid if you hold one of the two SHIFT keys depressed and then press the particular editing key.

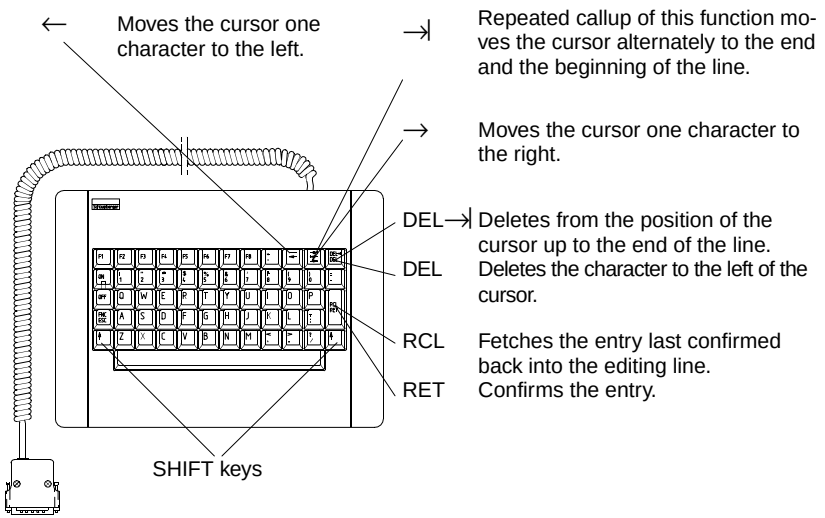


Fig. 8.7: For editing the momentary program line the keyboard offers six editing functions, partly accessed through SHIFT.

Editing commands

The editing commands must be entered letter by letter as direct commands from the keyboard and confirmed with [RCL/RET]. Instead of the full name of the command you may also just enter the first three letters (eg DEL instead of DELETE).

AUTO Automatically issues line numbers.

`AUTO x,y`	x = first line number, y = increment

If you do not enter parameters x and y, they both default to 10. If an automatically issued line number is the same as one that already exists, the new program line will replace the previous one. The AUTO function is disabled if you do not enter a program line after a line number but immediately strike [RCL/RET].

Example: AUTO 100,5

After entry of the command, the line number 100 is in the editing line and you can start entering the program line. As soon as this is terminated with [RCL/RET], the next line number (105) appears in the editing line.

DELETE Permits deletion of specific program lines or whole program blocks.

`DELETE x`	Deletes the program line with line number x.
`DELETE x,`	Deletes all program lines from line number x onwards.
`DELETE x,y`	Deletes all program lines from line number x through y.
`DELETE ,y`	Deletes all program lines up to line number y.

As an alternative to the `DELETE x` command, a program line will also be deleted if you press the [RCL/RET] key immediately after entering the particular line number.

EDIT Fetches a completed program line back into the editing line.

`EDIT x`	x = number of program line to be edited.

The program line can be altered in any way and confirmation with [RCL/RET] will then put it straight back into the program. But: the altered program line does not appear in the listing until you list the program again with [LIST].

LIST Offers the function of the softkey of the same name in the AUTO-RUN mask plus the possibility of listing specific program blocks.

`LIST`	Lists complete program.
`LIST x`	Lists program line x.
`LIST x,`	Lists program from line x to end.
`LIST x,y`	Lists program from line x through y.
`LIST ,y`	Lists program from first line through line y.

When the LIST command is used, the (LIST) softkey adopts the STOP function, ie so that you can terminate the listing.

RENUM Issues new line numbers for an entire program. This command is particularly useful if a program block has to be inserted between two program lines, but there are no longer enough vacant line numbers available. The destinations of GOTO and GOSUB commands are corrected automatically.

`RENUM`	Renumbers program with increment 10. 1st line number = 10.
`RENUM x,y`	Renumbers program with increment y. 1st line number = x.

Example: The following program is renumbered first with RENUM, then with RENUM 30,20.

Original numbering of program	Numbering after command RENUM	Numbering after command RENUM 30,20

`5 SETRX`
`10 PRINT "RX-TEST"`
`15 SOFT_SPECIAL`
`20 SOFT_SENS`
`25 GOTO 5`
	`10 SETRX`
	`20 PRINT "RX-TEST"`
	`30 SOFT_SPECIAL`
	`40 SOFT_SENS`
	`50 GOTO 10`
		`30 SETRX`
		`50 PRINT "RX-TEST"`
		`70 SOFT_SPECIAL`
		`90 SOFT_SENS`
		`110 GOTO 30`

RUN Starts the program, like the softkey of the same name, and also permits starting the program onwards from a certain program line.

`RUN`	Starts program from first program line.
`RUN x`	Starts program from line x.

Writing Programs

An AUTORUN program is a logical series of commands that are executed in the given sequence after the program is started. The short programs in the sections "BASIC Commands" and "IEEE Commands" give a wealth of examples. We will not be giving you a thorough course in programming here because, firstly, we do not want the manual to become too "heavy" and, secondly, there are a lot of good books on this subject on the market anyway.

Fundamentals

Program lines

- Permissible line numbers: 1 through 9999
- Maximum line length: 49 characters
- Each completed program line must be transfered from the editing line into the display field of the AUTORUN mask with the [RCL/RET] key of the keyboard.
- A program line may include several IEEE and BASIC commands. As delimiters you need a colon *after* BASIC commands and a semicolon *after* IEEE commands.

Example:
```
10 SETTX;PRINT A:PRINT"DEMO":SETRX
20 LET A=MPOWEr:PRINT A
```

Program size

- Maximum 16 Kbytes (if this is not enough, you can load "continuations" of a program from memory card with the BASIC command CHAIN).

Syntax rules

- After line numbers you need not enter a space, although you can for the sake of clarity.
- A BASIC command must be followed by either a non-alphabetic character or (at least) one space (eg `PRINT A` or `PRINT"DEMO"`). This does not apply to the commands CLS, END and TRACE.
- For commands you can use upper-case and lower-case notation (eg `PRINT=print`, `SETTX=settx`).
- With variables *no* distinction is made between upper-case and lower-case notation.
- BASIC commands and numeric values must not be interrupted by spaces.
- When entering IEEE commands, you can use the short form (first five letters), eg `WRTVA` instead of `WRTVAria-ble`.
- When entering BASIC commands, you can use the short form (first three letters), eg `PRI A` instead of `PRINT A`.
  Exception: The command ONERROR GOTO must *not* be abbreviated.

Direct commands

- The BASIC commands BEEP, CLS, LET, PRINT and TRACE can also be executed directly. Thus, for example, you can enter `PRINT A` (without a line number) if you want to know the current contents of the variable A. IEEE commands *cannot* be executed directly.

Arithmetic

- Only the four basic arithmetic operations are permissible (eg `PRINT (3*4)/2-3+1`).

Syntax check

The syntax check is handled by interpreters. In other words, after the start of the program each line is interpreted one after the other and the appropriate action is initiated. If the BASIC interpreter comes across a command in a program line that it cannot interpret, this command is automatically assumed to be an IEEE command and is handed over to the IEEE interpreter. If this cannot interpret the command either, there must be a syntax error.

☞ When a program line is transfered from the editing line to the display field, there is *no* syntax check. This is always made after the start of the program. A detected syntax error causes the program to be aborted and leads to an error message indicating the erroneous program line (exception: branch to an error routine, triggered by the BASIC command ONERROR GOTO).

Incorrectly entered direct commands or commands that are not admissible as direct commands will lead to the error message:
`0201: FUNCTION NOT AVAILABLE IN IMMEDIATE MODE`.

When the AUTORUN mask has been selected, [HELP] lists condensed usful information, about the syntax of the editing commands.

Variables and units

Permissible variables

The 260 variables A0 (A=A0) through Z9 may be used in AUTORUN programs for storing numeric values.

Permissible units

A variable may be assigned a numeric value or a numeric value with one of the following units:

f	T	m	R	P	V	I	Level
MHz	s	%	ohm	W	V	A	dBm
kHz	ms	rad		mW	mV	mA	dBµ
Hz	µs	kHz		µW	µV		dB

```
10 A=5
20 B=5 MHZ
30 C=-15dBm
```

Line 10 assigns the numeric value 5 to variable A. A space between the numeric value and the units is permissible but not necessary (line 20). In the units you can use upper-case and lower-case letters (line 30).

Variables in IEEE commands

If variables are used in IEEE commands, the variable must be preceded by a double sharp #. The units of a numeric value can either be declared simultaneously with the variable or stated explicitly in the IEEE command (see example). Missing or impermissible units (eg MODAF 2.5 mA) trigger an error message.

```
10 SETRX
20 MODAF 2.5 kHZ
30 F=3.5 kHZ
40 MODAF #F
50 F=4.5
60 MODAF #F kHZ
```

First the program calls up the RX mask (line 10) and sets AF generator GEN A to 2.5 kHz with IEEE command MODAF (line 20). Then GEN is set by a variable assignment with units to 3.5 kHz (line 30 and 40) and finally by a variable assignment without units to 4.5 kHz (line 50 and 60).

String variables

Character strings may consist of a series of characters between inverted commas (the string itself must contain *no* inverted commas). Examples of strings are persons' names, equipment designations, adjustment instructions or any messages. AUTORUN programs can show these strings on the display, print them out or check to see if they correspond to a reference string.

Permissible string variables

STABILOCK 4032 provides the 26 string variables A$ through Z$ for storing character strings (string variable M$ has a special function). Each string variable can hold strings of maximally 49 characters.

```
10 A$="TEST PROGRAM"
20 PRINT A$
```

The string TEST PROGRAM is first saved in string variable A$ and then printed out.

Internally used string variable M$

☞ String variable M$ has a meaning of its own: each IEEE command of the type "test job" automatically files the measured result in string variable M$. The original contents of M$ are then irrevocably lost!

```
10 LET A=M_RMS
20 PRINT A
30 PRINT M$
```

The IEEE command M_RMS (query of RMS meter) passes the measured result to variable A in line 10. The result is also automatically contained in string variable M$. So both outputs (lines 20 and 30) lead to the same result!

When used with the IEEE command SER_In M$ is the only string variable that reads in a string of up to 1000 characters on the RS 232 interface (option). In this case too the content of M$ is overwritten by following measuring assignments, so it is advisable to assign the content immediately to other string variables by splitting the strings (see example):

```
M$=SER_In
A$=M$(1,49)
B$=M$(50,98)
C$=M$(99,147)
```

String variables in IEEE commands

Just like with variables, string variables in IEEE commands must also be preceded by a double sharp #.

```
10 A$="TEST "
20 DISP_#A$
30 DISP_#A$PROGRAM
```

The IEEE command DISP in line 20 produces display of the text TEST. Line 30 displays the text TEST PROGRAM.

Splitting and joining strings

Parts of a string variable can be isolated by stating the start and end position of that part of the string which is to be isolated in brackets after the string variable.

```
    1234567890123
A$="CHANNEL = 142"
PRINT A$(11,13)
```

The channel number 142 adopts positions 11 through 13 in string A$. So the PRINT command will only output the channel number.

A number of string variables can be joined with the "+" operator. But the resulting string must not be longer than 49 characters.

```
A$="Serial No. = "
B$="6788954"
C$=A$+B$
PRINT C$
```

The string variables A$ and B$ are joined to form string variable C$. The total string Serial No. = 6788954 is output.

Permissible operands

Many BASIC commands require the entry of socalled operands, different kinds being permissible:

Numeric operands	
Operand	**Example**
Numeric value without units	4, -2.5
Numeric value with units	5 MHz, 4 V
Variable A0 to Z9 (see "Variables and Units")	B
IEEE command of type "test job"	M_RMS
BASIC command leading to numeric value	LEN, HEX
String operands	
String	"TEST"
String variable	A$
BASIC command leading to string	CHR$

☞ In the explanation of the commands in the "BASIC Commands" section, only the permissible type of operand is stated. You should then use one of the operands listed above.

Joining operands

Numeric operands may be joined with the following operators:

+ Addition (also valid for joining string operands)
– Subtraction
✳ Multiplication
/ Division

All operators have the same priority. A superordinate priority is only possible with bracketed expressions.

Examples:

1+2✳3+4=11 (1+2)✳(3+4)=21 2 V+3 V=5 V M_RMS+2 mV=eg 12 mV

☞ If numeric operands show units, there are special rules for joining them:

- Operands with different units must not be joined (error message: `DIMENSION MISMATCH. Eg MHz and uV ?`).
- Operands with and without units may be joined. The result always takes the units of the operand to the *right* of the operator. If this operand has no units, the result will not have any units either.

```
10 A=5
20 B=10 kHz
30 PRINT A+B
40 PRINT B+A
```

Here an operand without units (A) and an operand with units (B) are joined by the operator "+". Line 30 produces as the result `15.0000 kHz`, but line 40 only `15` (different number of places: see BASIC command "PRINT").

When memory gets scarce

The main memory of STABILOCK 4032 offers maximally 16 Kbytes for AUTO-RUN programs. Longer programs are only possible by joining subroutines with the BASIC command CHAIN. Sometimes, however, a program will only be a few bytes too long. In such cases it is better to take another close look at the listing and try to relieve it of "ballast". Basically you can say that each character takes up one byte. There are the following ways of cutting down on program:

1. Use the short forms of the commands all the way through (for BASIC commands only the first three letters, for IEEE commands only the first five letters).
2. Shorten comments in REM lines.
3. Fit several commands into one program line (saves line numbers and control characters CR+LF).
4. Delete spaces in PRINT commands that are only inserted to make the expression look "pretty" (formatting). Eight of these spaces can be replaced by the separator "," without any loss of clarity (saves seven bytes). Example: `PRINT,"POWER"` instead of `PRINT"  POWER"`
5. Delete spaces that are only inserted for the clarity of the listing. These also include spaces between a line number and the first command of the program line.

Executing Programs

Start

AUTORUN programs are started with the (RUN) softkey or with the command RUN x (x = line number). Communication monitor will then begin to execute the program line by line.

Execution

All setting instructions of an AUTORUN program can be followed on the screen if this is not deactivated by the IEEE command CRT_OFF. If the basic RX mask is called up with IEEE command SETRX for example, this really will show the RX mask on the display.

As long as an AUTORUN program is running, the display will show the script AUTORUN in the top left corner. This enables a clear distinction between operating states set by the program and those set manually.

During program execution all keys of STABILOCK 4032 are normally disabled (exceptions: [CLEAR] and [OFF]). Commands like KEY and PAUSE will enable the softkeys however; the INPUT command permits extra entries on the numeric keypad.

End

As soon as a program is ended, the display shows the AUTORUN mask. Otherwise the test set retains its last operating state. The display field shows the results of the PRINT commands executed by the program (if a program has a lot of PRINT commands, printed reports are preferable because the display field with its 16 lines can only show the last PRINT outputs).

Abort

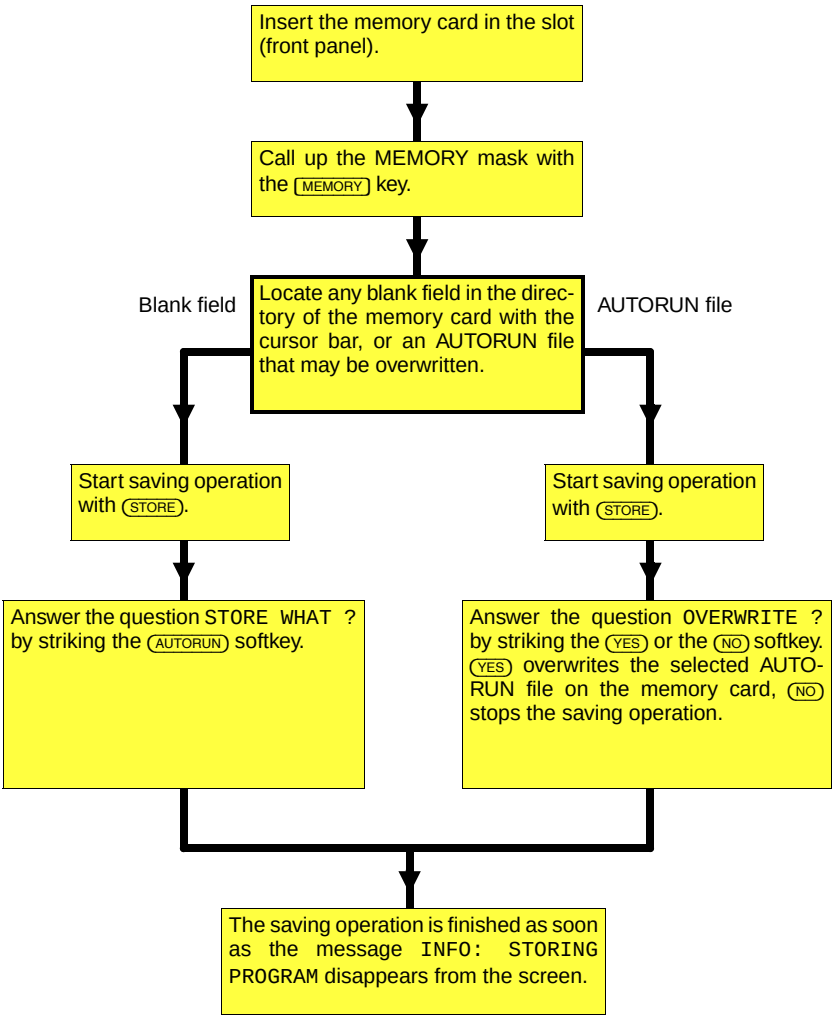
[OFF] interrupts execution of the program (keep the key pressed until the program aborts).

Reset

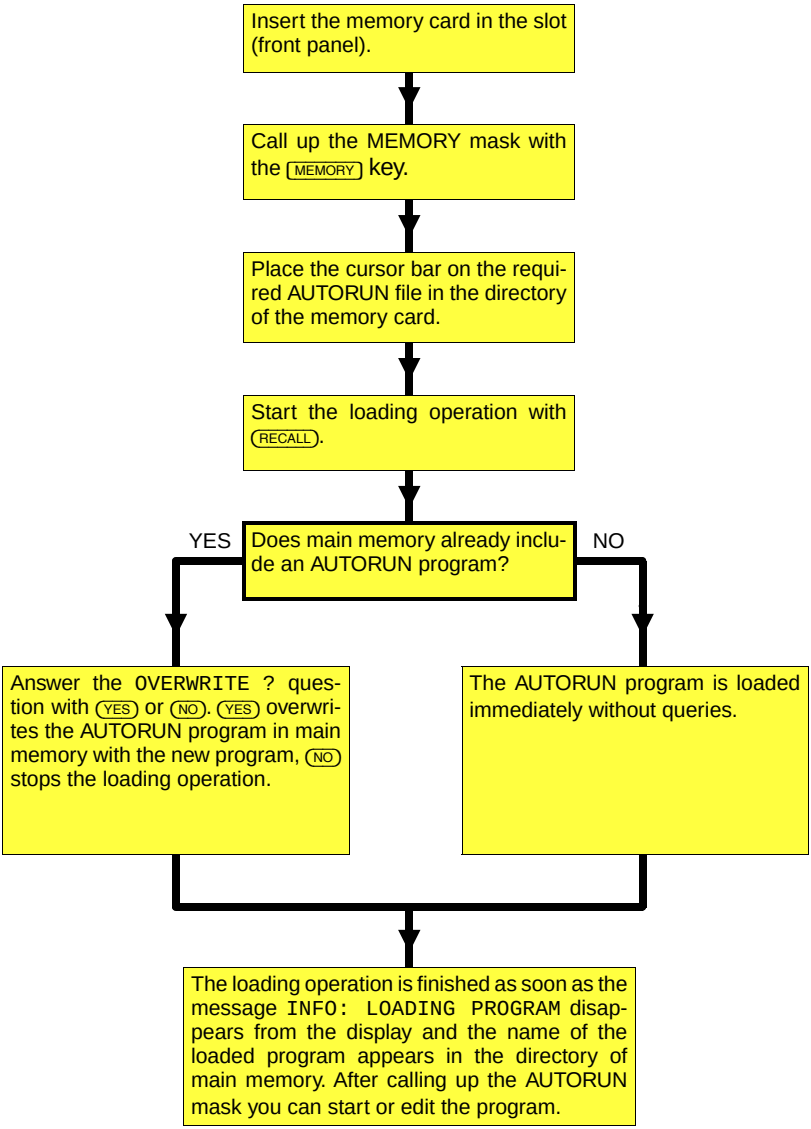
[CLEAR] eliminates a blockade of the internal data processing, but without deleting the program. The AUTORUN mask must then be called up again. A total reset clears the program in main memory.

Saving Programs

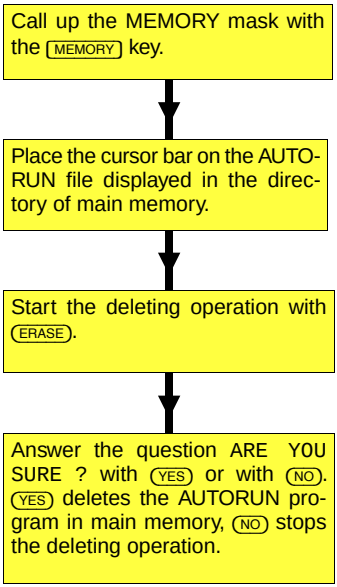
The RAM of STABILOCK 4032 can only hold a single AUTORUN program. This program is overwritten when you enter a new program or another AUTORUN program is loaded from a memory card. So AUTORUN programs should always be saved on memory cards. The procedure for this is as follows:



Loading Programs



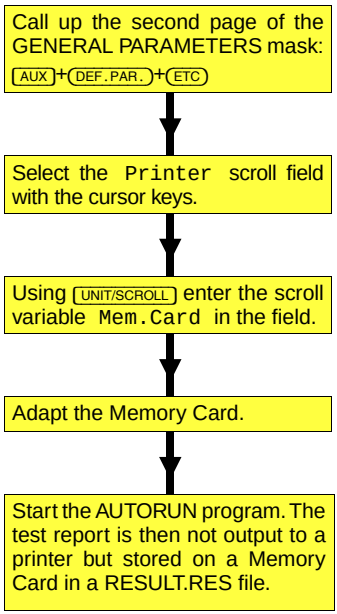
Deleting Program in RAM



AUTORUN Test Reports

The results of AUTORUN programs are usually test reports on paper. For this you need a printer. But if you do not have one available (eg when servicing in the field), you can still carry out AUTORUN programs, because every test report can also be stored on a Memory Card and printed out later.

Storing AUTORUN test reports



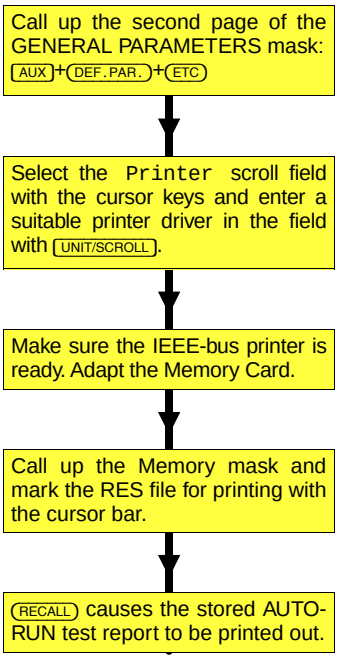
After the start of an AUTORUN program, the name RESULT.RES is automatically given to the RES file. At the same time 4 or 16 Kbytes (depending on the vacant capacity of the Memory Card) are reserved for the file.

If the test report is too large for the reserved memory, a second RES file is created automatically. This is then given the name RESULT.RES, while the first RES file is renamed RESULTFULL.RES.

If an AUTORUN test report is written to a Memory Card that already contains a RESULT.RES file, the data of the new AUTORUN test report will be added to this file. To prevent this happening, the RESULT.RES file and, if there is one, the RESULTFULL.RES file should always be renamed before starting another AUTORUN program (see Chapter 7, section "Renaming Files").

☞ If you want to store an AUTORUN test report, there must be sufficient capacity available on the adapted Memory Card. If there is not enough, the AUTORUN program is halted and an error message appears. After remedying this error (eg by deleting unwanted files or adapting another Memory Card), you have to start the AUTORUN program again.

Printing AUTORUN test reports



BASIC Commands

Command	Purpose
BEEP	Generate alarm tone
CHAIN	Join two or more AUTORUN programs
CHR$	Convert numeric code into ASCII characters
CLS	Clear display contents
END	Terminate program execution
FOR-NEXT	Execute program section several times
GET	Include measured figure in string variable
GOSUB	Call up subroutine
GOTO	Skip program section
HEX	Convert hexadecimal to decimal
HEX$	Convert decimal figure to hexadecimal
IF-INLIMIT	Relation-dependent program branch
IF-OUTLIMIT	Relation-dependent program branch
IF-THEN	Relation-dependent program branch
INPUT	Request user input
KEY	Softkey-dependent program branch
LEN	Determine length of string
LET	Variable assignment
ONERROR GOTO	Program branch upon error message
PAUSE	Interrupt program until user responds
PRINT	Output texts and values (on display and printer)
RDOUT	Transfer measured value to variable
RDXY	Read values from the screen
REMARK	Insert remarks in programs
SETUP	Load setup from Memory Card
TIMEOUT	Program branch if time overrun
TRACE	Troubleshooting in programs
VAL	Convert string to numeric value
VAL$	Convert numeric value to string
WAIT	Interrupt program for defined period

BEEP

Purpose Generate alarm tone.

Syntax **BEEP**

Effect Each BEEP command generates an alarm tone (f = 2.8 kHz) lasting 250 ms.

Example

```
10 BEEP: BEEP: BEEP
20 WAIT 1000
30 BEEP: PAUSE "ADJUST SIGNAL"
40 INPUT A
50 IF A>20 THEN BEEP
```

Line 10 triggers the beep three times. Then the program waits 1 s (line 20) before, accompanied by a further beep, reading out the message `ADJUST SIGNAL` on the display (line 30). In line 40 the program requests the user to enter a numeric value; if the entered value is greater than 20, the entry is acknowledged with a beep (line 50).

CHAIN

Purpose Join two or more AUTORUN programs. If the capacity of main memory (16 Kbytes) is too small for a program for instance, the program can be split up into subroutines of 16 Kbytes each. At the end of one subroutine CHAIN calls up the following one.

Syntax **CHAIN** [file name]
or
CHAIN # [string variable]

[file name]	Name of AUTORUN program stored on Memory Card
[string variable]	eg A$, where A$ must include name of AUTORUN program stored on Memory Card

Effect CHAIN stops further program execution, loads the specified AUTORUN program from the Memory Card in the slot and starts this program. The new program clears the original one in main memory!

CHAIN resets the count variable of FOR...NEXT loops to the initial value. The contents of all other variables are preserved, however, and can continue to be used by the new program. If the CHAIN command is in a subroutine (GOSUB), there is no return to the main program.

Example

```
10 INPUT"DATE = ?",A$
20 INPUT"UNIT TYPE = ?",B$
30 INP"CHOOSE PROGRAM: 1=RX TEST 2=TX TEST",A
40 IF A>2 GOTO 30
50 C$="TX TEST"
60 IF A=1 THEN C$="RX TEST"
70 CHAIN #C$
80 PRINT"NO COMMAND AFTER CHAIN"
```

This program (start menu) first requests the user to enter the date (line 10) and the type of equipment (line 20). The entered replies are saved in two string variables (A$ and B$). Line 30 offers the user a choice between receiver and transmitter tests. Depending on the entry (variable A), the string variable C$ in line 50 or 60 is assigned the name of the appropriate AUTORUN program, ie RX TEST or TX TEST (without the .AUT extension). Both programs must (in this example) be on the Memory Card presently in the slot. The CHAIN command (line 70) loads the required program and starts it automatically. The start menu in main memory is cleared so that line 80 of the start menu can no longer be executed.

The newly loaded AUTORUN program can evaluate the contents of the adopted string variable (A$, B$) and print them out in the test report for example.

CHR$

Purpose Output of control characters to printer.

Syntax **CHR$(** [list] **)**

[list]	A number (not a variable) or several numbers separated by commas between 0 and 255 (ASCII numeric codes)

Effect CHR$ permits, in particular, the output of control characters that *cannot* be generated directly with the keyboard (characters with the ASCII numeric codes 0 to 32). If characters with the numeric codes 33 to 127 are output, the display field shows the corresponding ASCII characters (standard ASCII characters with a few exceptions). This output on the display is of no significance however.

Normally the CHR$ command is also responsible for showing special characters on the display. In STABILOCK 4032 this is unnecessary because all special characters (eg Ω) can be generated directly with the keyboard (see box).

Example

```
10 PRINT CHR$(27,38,107,49,83)
20 PRINT "HEADLINE"
30 PRINT CHR$(27,38,107,48,83)
```

The program outputs with the CHR$ command socalled escape sequences for the HP-2225 printer (accessory). Line 10 doubles the print width, so line 20 prints the word `H E A D L I N E` with double width. Line 30 switches back to normal print width. You can find out more about escape sequences in the printer manual.

Special characters

To enter special characters, first strike [FNC/ESC] key and release again. Then strike key shown in table.

Key	m	t	u	p	r	d	l	o
Special character	μ	Δ	↑	Φ	→	↓	←	Ω

CLS

Purpose Clear display contents, eg to free the display field for new text after several PRINT commands.

Syntax **CLS**

Effect CLS only clears the contents of the display field; the command has no effect on the program itself.

Example

```
10 PRINT "1. LINE"
20 PRINT "2. LINE": WAIT 1000
30 CLS
40 PRINT "3. LINE"
```

The program shows the texts `1. LINE` and `2. LINE` for 1 s in the display field. Then the contents of the display are cleared and only the text `3. LINE` is shown.

END

Purpose Terminate program execution.

Syntax **END**

Effect END commands can appear anywhere in the program. Thus AUTORUN programs can easily be tested section by section by inserting the command (temporarily) where the next section of a program begins. END always returns to the AUTORUN mask.

Example

```
10 SETTX
20 PRINT "COMMAND before END"
30 WAIT 1000
40 END
50 PRINT "COMMAND after END"
```

The program first calls up the basic TX mask (line 10). Then line 20 enters a text in the display field of the AUTORUN mask. This text is not visible at first however, because the display still shows the basic TX mask for 1 s (line 30). Line 40 terminates the program and returns to the AUTORUN mask, which now shows the text `COMMAND before END`. Line 50 is no longer executed.

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FOR...NEXT

Purpose Execute certain program section several times, the number of repeats being defined.

Syntax **FOR** [VAR]=[EXP1] **TO** [EXP2] **STEP** [EXP3]
...
program section
...
NEXT [VAR]

[VAR]	Count variable (A to Z)
[EXP1]	Start value (numeric operand)
[EXP2]	End value (numeric operand)
STEP [EXP3]	Step width (numeric operand) **optional**

Effect If the BASIC interpreter finds a FOR command, count variable VAR is assigned the start value EXP1 and then the following section of the program is executed up to the NEXT command. The NEXT command increments the value of the count variable by the value of the defined step width (if STEP [EXP3] is not stated, the step width is automatically 1). Then the interpreter checks whether the new value of the count variable is greater than the defined end value EXP2.

- If so, the FOR...NEXT loop is ended. The program is continued with the command that follows the NEXT command. The count variable now has a value equivalent to the sum of the value last assigned and the step width!
- If not, the section of the program in the FOR...NEXT loop is executed again.

If the step width EXP3 is negative, this reduces the value of count variable VAR. In this case the end value EXP2 must be smaller than the start value EXP1.

☞ If the capacity of main memory permits it, as many as 26 FOR...NEXT loops can be nested within one another. Each loop must be given a differently worded count variable.

FOR...NEXT loops must not overlap. So a subordinate loop must always be ended with NEXT before the superordinate loop may be ended.

Examples

```
10 FOR K=-4 TO 4
20 BEEP: PRINT K
30 NEXT K
40 PRINT "Actual Value for K = ";K
```

This FOR...NEXT loop is run through nine times; it shows all values of count variable K (-4 to +4) in the display field. The PRINT command in line 40, however, reads out the value of the count variable, last incremented by +1 (step width), as 5.

```
10 FOR I=1kHz TO 3kHz STEP 0.5kHz
20 PRINT I
30 NEXT I
```

The operands of a loop may also include one of the permitted units. The PRINT command adopts the units and here reads out the values `1.0000 kHz` to `3.000 kHz`.

```
10 A=-5:B=5:C=2.5
20 FOR I=A TO B STEP C
30 PRINT I
40 NEXT I
```

The start and end value as well as the step width of the loop may also be defined with variables.

```
10 FOR K=1 TO 4
20 PRINT "FIRST LOOP K = ";K
30 FOR J=1 TO 3
40 PRINT "SECOND LOOP J = ";J
50 NEXT J
60 NEXT K
```

Here one loop is nested in another. The inner loop (variable J) is executed twelve times (4×3), the outer loop (variable K) four times. What is important is that the inner loop always be ended before the outer loop.

GET

Purpose Transfer result of IEEE command to string variable

Syntax **GET** ([IEEE command]; [S-VAR])

[IEEE command]	IEEE command that produces result
[S-VAR]	String variable (A$ to Z$)

Effect After GET the agreed string variable contains the result of the IEEE command. If the IEEE command produces no result, an error message is output.

Example

```
10 GET (PRXFR;A$)
20 PRINT "RX frequency = ";A$
```

In line 10 the set RX frequency is queried (PRXFR) and transferred to string variable A$. The PRINT command in line 20 outputs the string "`RX frequency =`" and the content of string variable A$ (the RX frequency).

GOSUB...RETURN

Purpose Call up subroutine.

Syntax **GOSUB** [branch destination]
...
start of subroutine
...
RETURN

[branch destination]	Actually existent line number.

Effect When a main program finds a GOSUB command, program execution is continued in the line stated as the branch destination (start of subroutine). When the subroutine reaches the RETURN command, there is a return to the main program. Program execution continues there with the command following the GOSUB command.

Normally subroutines come at the end of a main program. When the main program reaches this point, the first subroutine is executed unintentionally before the interpreter can abort with the error message `RETURN WITHOUT GOSUB`. An END or GOTO command before the first subroutine prevents this malfunction.

Subroutines may call up further subroutines. Depending on available memory, a maximum of 25 subroutine levels is possible. RDOUT commands and open FOR...NEXT loops, ie those not yet completed, reduce this figure. Each subroutine must be terminated with RETURN.

Examples

```
10 PRINT "LINE 10"
20 GOSUB 50
30 PRINT "LINE 30"
40 END
50 PRINT "LINE 50"
60 RETURN
```

The main program (lines 10 through 40) calls up in line 20 a subroutine (lines 50 and 60). So the PRINT command in line 50 is executed before the PRINT command in line 30. Line 40 prevents the subroutine from being executed again and causing an error message.

```
10 PRINT "MAIN PROGRAM"
20 GOSUB 40
30 END
40 PRINT "Subroutine 1"
50 GOSUB 70
60 RETURN
70 PRINT "Subroutine 2"
80 RETURN
```

The main program (lines 10 through 30) calls up in line 20 a subroutine (lines 40 through 60), which in turn calls up subroutine 2 (lines 70 to 80). Line 80 returns to line 60 and this returns to the main program (line 30).

GOTO

Purpose Program continuation from a defined line number.

Syntax **GOTO** [branch destination]

[branch destination]	Actually existent line number.

Effect When the BASIC interpreter finds a GOTO command, execution of the program is continued in the line stated as the branch destination.

GOTO in conjunction with the IF...THEN command, for example, permits a program branch as a function of the value of a measured result.

GOTO should always be the last command in a line.

Examples

```
10 BEEP
20 GOTO 10
```

Once it is started, this program is executed until you halt it with the [OFF] key.

```
10 FOR I=1 TO 10
20 PRINT I
30 IF I=5 THEN GOTO 50
40 NEXT I
50 PRINT "END"
```

The branch to program line 50 is not made until the count variable I of the FOR...NEXT loop becomes 5.

HEX

Purpose Convert hexadecimal to decimal.

Syntax **HEX(**[EXP]**)**

[EXP]	String operand representing a single

Effect HEX converts hexadecimal numbers (0 to FFFF) into the corresponding decimal numbers 0 to 65535 (from decimal number 9999 onwards, output of large numbers as exponents, eg 1.2345000E+04 instead of 12345). For hexadecimal numbers of >FFFF the result of conversion is always 0.

Example

```
10 C$="FC0"
20 B$="STABILOCK "
30 PRINT B$;HEX(C$)
```

The hexadecimal number FC0 is converted by the HEX command of line 30 into the decimal number 4032.

HEX$

Purpose Convert decimal figure to hexadecimal

Syntax **HEX$(**[EXP]**)**

[EXP]	Numeric operand representing decimal number between 0 and 1048575

Effect HEX$ converts decimal numbers (0 to 1048575) into a corresponding string with the hexadecimal number (00000 to FFFFF). For decimal numbers > 1048575 the result of conversion is always "00000" (the string always contains five characters).

Example

```
10 C=4032
20 B$="STABILOCK "
30 PRINT B$;HEX$(C)
```

The decimal number 4032 is converted by the HEX$ command of line 30 into the string with the hexadecimal number `00FC0`.

IF...THEN

Purpose Program branch depending on result of relational operation.

Syntax **IF** [EXP1] [relational operator] [EXP2] **THEN** [command]

Compare numeric operands (numeric values)							
[EXP1] and [EXP2]	Numeric operand.						
Relational operator	<	>	<=	>=	<>	=	
[command]	BASIC or IEEE command.						
Compare string operands (character strings)							
[EXP1] and [EXP2]	String operand.						
Relational operator	<>	=					
[command]	BASIC or IEEE command.						

Effect The IF command compares the two operands EXP1 and EXP2 according to the declared relational condition:

- If the relational condition is fulfilled, the command after THEN is executed.
- If the relational condition is not fulfilled, the command after THEN is ignored and the program continues with the next line.

The naming of THEN is optional (entry not necessary).

When string operands are compared, a distinction is also made between upper case and lower case!

☞ If numeric operands with units are compared, you must ensure that both operands have the *same* units. The dimension of the units may be different however (eg `IF 500 mV < 3V THEN`...).

☞ If an IEEE command of the type "test job" produces no result (`----`), overflow (>>>>) or underflow (<<<<), these results satisfy *every* relational condition (command after THEN is executed).

Examples

```
10 FOR K=1 TO 10
20 IF K <= 8 THEN GOTO 60
40 PRINT "K>8"
50 GOTO 70
60 PRINT "K=";K
70 NEXT K
```

As long as the count variable K satisfies the relational condition <= 8 (line 20), the PRINT command in line 60 outputs the current value of the count variable. As soon as K is > 8, the PRINT command in line 40 is valid.

```
10 INPUT "ENTER STATUS: PASS OR FAIL",A$
20 IF A$="PASS" THEN GOTO 40
30 GOTO 10
40 PRINT "TEST FINISHED": END
```

If the input request in line 10 is answered with PASS, then TEST FINISHED is output on the display. Any other entry (even pass) returns you to line 10.

IF OUTLIMIT / IF INLIMIT

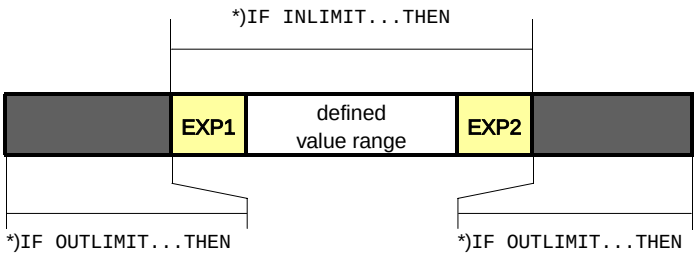
Purpose Check whether a measured value is outside or inside a defined range.

Syntax **IF OUTLIMIT(**[READ]**,**[EXP1]**,**[EXP2]**)THEN** [command]
or
IF INLIMIT([READ]**,**[EXP1]**,**[EXP2]**)THEN** [command]

[READ]	Variable or result of IEEE command of type "test job"
[EXP1]	Lower limit (numeric operand)
[EXP2]	Upper limit (numeric operand)
[command]	BASIC or IEEE command

Effect IF OUTLIMIT and IF INLIMIT are special forms of the IF...THEN command. The commands check whether the value of READ is outside/inside the range defined by the two limits EXP1 and EXP2. Depending on the result of the check, either the command after THEN is executed or it is ignored and the program continues with the next program line.

The following schematic illustrates for both commands what values READ must have so that the command after THEN is executed:



*) Only if READ appears in one of these ranges, is the command after THEN executed. The two limits EXP1 and EXP2 are only part of the defined range for IF INLIMIT.

The naming of THEN is optional (entry not necessary).

☞ If numeric operands with units are compared, you must ensure that both operands have the *same* units.
The dimension of the units may be different however (eg `IF INLIMIT (M_RMS,200 mV,1.2 V) THEN...`).

If an IEEE command of the type "test job" produces no result (`----`), overflow (`>>>>`) or underflow (`<<<<`), these results satisfy *every* relational condition (command after THEN is executed).

Examples

```
10 FOR A=1 V TO 7 V
20 REM Valid values = 1 V and 5 to 7 V
30 IF OUTLIMIT(A,2V,4V)GOTO 50
40 PRINT "A=";A:GOTO 60
50 PRINT "VALID VALUE = ";A
60 NEXT A
```

The FOR...NEXT loop (lines 10 through 60) assigns the values 1 V to 7 V to variable A. In line 30 the OUTLIMIT command checks whether the condition 2 V < A < 4 V applies (because OUTLIMIT, without the limits 2 V and 4 V). Only if this is so, is the PRINT command in line 50 executed.

```
10 IF INLIMIT(M_RMS,0.1 V,0.2 V)GOTO 50
20 C$="MEASURED:"+VAL$(M_RMS)+"...ADJUST!"
30 PAUSE C$
40 GOTO 10
50 PRINT "YOU are the GREATEST"
60 END
```

As long as the result of the IEEE test job M_RMS does not fulfil the condition 0.1 V ≤ M_RMS ≤ 0.2 V (because INLIMIT, including the limits 0.1 V and 0.2 V), the current measured value and the request `ADJUST!` are shown on the display (line 30). The program will not reach line 50 until the AF test signal is within the limits, and then it rewards you for successful adjustment with the message `YOU are the GREATEST`.

INPUT

Purpose Request user input.

Syntax **INPUT "**[text]**",** [VAR]
or
INPUT "[text]**",** [S-VAR]

[text]	Message to be shown on display (**optional**).
[VAR]	Variable (A0 to Z9) for taking numeric value.
[S-VAR]	String variable (A$ to Z$) for taking text.

Effect INPUT shows the declared message and expects the entry of a numeric value or text in a field shown on the display (entry by keyboard or directly on the test set).

Entry of numeric value: maximum ten places.

- Once the numeric value has been entered, it can be assigned units with [UNIT/SELECT].
- Incorrect entries can be overwritten until continuation of the program is triggered with the [CONTINUE] softkey.

Entry of text: maximum 40 characters.

- When entering text from the keyboard, open the entry field by striking the [ENTER] key on STABILOCK 4032. As soon as the cursor in the entry field flashes, you can start entry on the keyboard. Always complete an entry with [RCL/RET].
- When entering text on the test set, strike the [ENTER] key to start. This assigns the softkeys the letters of the alphabet. Text entry is just like issuing program names (see section "Calling up AUTORUN mask"). Always complete an entry with [ENTER].
- Incorrect entries can be overwritten until continuation of the program is triggered with the [CONTINUE] softkey.

Examples

```
10 INPUT "SERIAL NO ?",A$
20 PRINT A$
```

Line 10 requires entry of a serial number. The entered numeric value is saved in string variable A$ and printed out.

```
10 SETRX
20 INPUT "ENTER FREQUENCY and UNIT",F
30 FREQU #F
```

Line 20 expects the entry of a frequency including the units (eg 45 MHz). Line 30 enters the value in the RF Frequency field of the RX mask and tunes the signal generator with it.

```
10 SETTX
20 INPUT "ENTER CORRECTION VALUE",K
30 IF K+MPOWE > 3 W THEN PRINT "FAILURE"
40 PRINT "POWER = ";MPOWE
```

The entered correction value K (eg 1 W) is added to the measured RF power (MPOWE). If the result is greater than 3 W, the measured value is output with the comment FAILURE.

KEY

Purpose Program branch triggered by softkeys.

Syntax **KEY** [softkey number]**,"**[text]**",** [command]
...
program section (**optional**)
...
KEY WAIT or **KEY RUN**

[softkey number]	Number (1 to 6) of required softkey (1 = first softkey from left).
[text]	Softkey designation (max. eight characters; only left and right softkey max. seven characters).
[command]	BASIC command GOTO, GOSUB or CHAIN.

Effect Initially KEY only assigns the name declared under [text] internally to a softkey. Then the program is continued until the interpreter detects KEY WAIT or KEY RUN:

- KEY WAIT stops execution of the program and calls up the AUTORUN mask. Only here does the softkey have the declared label. If PRINT commands were issued in the program section directly before KEY WAIT, the display will show these outputs (eg user notes). If you now strike a softkey, the program will execute the declared BASIC command. At the same time the display again shows the mask that was current before the interruption.
- KEY RUN also stops execution of the program, not showing the declared softkeys in the AUTORUN mask however, but in the current mask instead. Interactive user guidance with PRINT commands is not possible in this case. However, an instrument can be observed directly for instance and, depending on the measured value, a program branch can be made by softkey.

KEY 1 TO 6

If seven or eight characters are not enough for the required softkey designation, a useful variant of the KEY command can help you out. The KEY 1 TO 6 command comprises all softkeys into a single softkey and assigns this a designation of up to 51 characters. Otherwise this command has the same effect as KEY.

Syntax: **KEY 1 TO 6,"**[text]**",** [command]

☞ KEY command with GOSUB branch: after the subroutine has been worked, the main program is continued in the program line following the KEY WAIT or KEY RUN command.

Examples

```
10 CLS
20 KEY 3,"ENDLESS", GOTO 10
30 KEY 2,"END", GOTO 60
40 PRINT "PRESS SOFTKEY"
50 KEY WAIT
60 PRINT "END of PROGRAM"
```

The program stays in an endless loop if the user strikes the (ENDLESS) softkey. In this case line 10 prevents the display from gradually being filled with the request PRESS SOFTKEY: the CLS command clears the preceding message so that the next one again appears at the upper edge.

```
10 CLS
20 INPUT "MENU? NO=1  YES=0",A
30 KEY 1,"RXTEST", GOSUB 200
40 KEY 2,"TXTEST", GOSUB 310
50 KEY 3,"SELFCHEK",CHAIN SELFCHECK
60 KEY 4,"SPEC",CHAIN SPECIAL
70 KEY 5,"EXIT",GOTO 120
80 IF A<>0 THEN GOTO 200
90 PRINT "PRESS SOFTKEY to SELECT PROGRAM"
100 KEY WAIT
110 GOTO 10
120 END
200 REM RXTEST
    ...
300 RETURN
310 REM TXTEST
    ...
800 RETURN
```

First the program asks whether the "softkey menu" is to be offered (line 20). Entries other than 0 are understood as no (line 80). Only if A=0 will the program reach the PRINT command in line 90 and the following KEY WAIT command. The display now shows the occupancy of the softkeys declared in lines 30 to 70. Softkey 1 calls up the RXTEST subroutine for example. The return from this subroutine takes you to line 110, which causes the main program to start again.

Examples (continued)

```
10 SETTX
20 MODULation
30 FOR I=100 mV TO 1000 mV STEP 20 mV
40 KEY 1 TO 5,"CONTINUE",GOTO 80
50 GENAL #I
60 IF M_RMS > 220 mV GOTO 100
70 KEY RUN
80 NEXT I
90 END
100 PRINT "V > 220 mV !"
```

Line 10 calls up the basic TX mask, line 20 selects the internal AF generators as the signal source for the RMS instrument (corresponds to striking the [RX MOD/MODGEN] key). Then a FOR...NEXT loop begins. The purpose of this is to increase the output level of generator GEN in 20-mV increments from 100 mV to 1000 mV (line 50). Each increase in level must be initiated by the user by striking the (CONTINUE) softkey. If the level measured by the RMS instrument exceeds 220 mV (line 60), the FOR...NEXT loop is aborted by a branch to line 100. The actions of the program are easy to observe in the TX mask (change of level in Gen line, display of RMS instrument).

LEN

Purpose Determine length of string (number of characters).

Syntax **LEN(**[S-EXP]**)**

[S-EXP]	String operand.

Effect The LEN command outputs the length of the examined string as a decimal number.

Examples

```
10 A$ = "STABILOCK 4032"
20 L = LEN(A$)
30 PRINT L
40 PRINT LEN("LONGJOHNS")
```

The number of characters of A$ (14) are assigned to variable L (line 20) and output (line 30). Line 40 shows that the string operand must not always be a string variable but can also be a string for example.

```
10 INPUT A$
20 PRINT "String Length",LEN(A$)
```

Line 10 enables the entry of a random string. Its length is determined in line 20 and output.

LET

Purpose Variable assignment (**optional**).

Syntax **LET** [VAR]**=**[EXP]
or
LET [S-VAR]**=**[S-EXP]

[VAR]	Variable (A0 to Z9).
[EXP]	Numeric operand.
[S-VAR]	String variable (A$ to Z$).
[S-EXP]	String operand.

Effect LET is *not* necessary for a variable assignment (assigning a variable an operand). The only benefit of the command is the greater clarity of program listings.

Example

```
10 LET A=5*3
20 PRINT A-5
30 C$="Frequency = "
40 LET B=5 kHz
50 PRINT C$;B
```

Whether this listing does not look very "pretty" because of line 40 is purely a matter of taste. At any rate, LET commands have no effect at all on the functionality of programs.

ONERROR GOTO

Purpose Program branch when error messages appear.

Syntax **ONERROR GOTO** [branch destination]

[branch destination]	Actually existent line number.

Effect If the BASIC or IEEE interpreter detects an error during the execution of a program, it will normally be aborted straight away and an error message is output. ONERROR GOTO prevents an abort upon error and causes the program to be continued from the declared branch destination (error routine).

☞ Disabling error routine: if the BASIC interpreter only finds ONERROR GOTO (without entry of a line number!), aborting the program with an error message is permitted again from this program line onwards.

The short form is not permitted for this command.

Example

```
10 ONERROR GOTO 20
20 INPUT "Frequency 250...300 MHz",F
30 IF OUTLIMIT(F,250 MHz,300 MHz) GOTO 20
40 ONERROR GOTO
50 PRINT F
```

Line 20 tells you to enter a frequency value, which line 30 checks. If the wrong units are used in line 20, the program would normally be aborted. The branch in line 10 prevents this and instead repeats the request for entry. Line 40 cuts out the error routine.

PAUSE

Purpose Interrupt program execution and wait for user reaction.

Syntax **PAUSE** [S-EXP1]**,** [S-EXP2]**,** [S-EXP3]

[S-EXPx]	String operand (max. 30 characters each).

Effect PAUSE interrupts execution of the program and shows the texts contained in S-EXPx on the display (between zero and three string operands can be declared). Strike the (CONTINUE) softkey to continue the program.

Examples

```
10 SETTX
20 IF MPOWE > 0.5 W GOTO 50
30 BEEP:BEEP:PAUSE "TRANSMITTER ON"
40 GOTO 20
50 PRINT MPOWE
```

Line 20 contains an IEEE test job for RF power. If the measured result is less than 0.5 W, the message `TRANSMITTER ON` accompanied by two beeps tells you to switch on the transmitter of the test item.

```
10 A$="TEST PROGRAM"
20 B$="------------"
30 PAUSE A$,B$,"STABILOCK 4032"
```

This program shows the following three-liner on the display, the PAUSE command automatically inserting the blank lines:

```
TEST PROGRAM

------------

STABILOCK 4032
```

PRINT

Purpose Output numeric values, texts or measured results on display or to printer.

Syntax **PRINT** [output list]

[output list]	Any number of numeric operands and string operands; commas and semicolons are permissible as separators between operands.

Effect PRINT outputs every single item of the output list to the display and simultaneously to a printer. If the display does not show the AUTORUN mask during program execution, the PRINT outputs are not visible on the display until after the program has ended (if there are a lot of PRINT instructions only the last ones, however, because of the limited number of lines on the display).

Output of numeric values: here there are the following variants:

- **IEEE test jobs** are output as a numeric value with units. If the IEEE test job is directly in the PRINT command (eg `PRINT M_RMS`), the output will be in the same form as the particular instrument shows the measured result. If you place emphasis on well formatted test reports, it is better to assign the measured result first to a variable and then output its contents (see examples). In this case the output is as described under "Numeric values with units". If a test job does not produce a valid result, the PRINT command will produce "`-----`" (no test signal), ">>>>" (overflow) or "<<<<" (underflow).
  `PRINT M_RMS` → `123 mV` (for example)
  `A=M_RMS:PRINT A` → `123.0000 mV`
- **Numeric values without units:** values between 0 and 9999 are shown with maximally four places before and after the point (fourth place after the point rounded). Larger numeric values are output in scientific notation with one place before and seven after the decimal point plus a two-place exponent.
  `PRINT 1234.1234567` → `1234.1235`
  `PRINT 12` → `12`
  `PRINT 123456` → `1.2345600E+05`
- **Numeric values with units:** output with maximally four places before the decimal point and always four following it (fourth place after the point rounded). Leading zeroes are replaced by spaces so that orientation is always on the decimal point. For numeric values greater than 9999.9999 no value is output but instead the overflow symbol (>>>>). Remedy: choose the next biggest dimension.

```
PRINT 1234.1234567 kHz →1234.1235 kHz
PRINT 12 kHz           →  12.0000 kHz
PRINT 1234567 kHz      →  >>>>
```

Blank lines: each PRINT command without an output list produces a blank line on the display and in the printout.

Preventing output on printer: `PRINT OFF` disables print output for all following PRINT commands (readout on display is kept). You cancel this with `PRINT ON`.

Formatting output: the separators in the output list produce a formatted output:

- Semicolon: places an output immediately after the preceding one. With positive numeric values a space is left because of the (invisible) sign.
  `PRINT "WILL";"TEK" → WILLTEK`
  `PRINT 123;456 → 123 456`
- Comma: splits each text line on the display/printer into zones of eight characters. Consecutive outputs are put at the beginning of the *next* zone *that can be reached*.
  `PRINT "WILL","TEK" → WILL TEK`

1.								2.								3.			Zone
1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2		Characters
W	I	L	L					T	E	K									Display

Examples

```
10 PRINT "12345678123456781234567 8"
20 PRINT 10,-20,30;45
30 PRINT -1000,0.2523
40 PRINT "A","B","C"
50 PRINT "A";"B";"C":PRINT
60 PRINT 150 MHz,"C"
```

```
1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8
  1 0           - 2 0           3 0   4 5
- 1 0 0 0         0 . 2 5 2 3
A               B               C
A B C
1 5 0 . 0 0 0 0   M H z   C
```

Output in lines and columns of display.

Examples (continued)

```
10 PRINT"LINE A":PRINT:PRINT"LINE B";
20 PRINT"LINE C"
```

Output on display:

```
LINE A

LINE BLINE C
```

As a result of the final semicolon in line 10, the PRINT command of line 20 adds the text `LINE C` immediately onto the text output before (`LINE B`).

```
10 SETTX
20 PRINT M_RMS
30 FOR A=1 TO 3
40 B=M_RMS
50 PRINT B
60 NEXT A
```

Output on display (assumed values):

```
 3.96 V
3.9600 V
3.5600 V
3.2800 V
```

At the instant of the measurement, the RMS instrument in the basic TX mask showed `3.96 V`. So the IEEE test job M_RMS directly in the PRINT command (line 20) produces the same output `3.96 V`. Such unforeseeable output formats can be avoided if you assign the result of a test job to a variable and output its contents first (lines 40 and 50). Then all outputs of measured values have a format oriented on the decimal point.

RDOUT

Purpose Assign results of IEEE command of type "test job" to variables. The two results of the IEEE test job MDEMOD (sampling of modulation meter), for example, can only be further processed with RDOUT.

Syntax **RDOUT(**[command]**;**[VAR]**)**

[command]	IEEE command of type "test job".
[VAR]	Single variable (eg A) or list of variables separated by commas (eg A,B).

Effect RDOUT adopts the result(s) of an IEEE test job in the declared variable(s). If there are more measured values than variables, no error message is produced. But if more variables are declared than there are measured values, this will trigger an error message.

Examples

```
10 SETRX
20 MODULation
30 RXAFM 4 kHZ
40 RDOUT(MDEMOd;A,B)
50 PRINT "MOD =";A,,,B
```

Line 10 calls up the RX mask. Line 20 couples the modulation meter MOD to the modulator. Line 30 causes the carrier signal of the signal generator to be modulated with ±4 kHz FM deviation. In line 40 MDEMOd (IEEE command) takes over the deviation measurement. The resulting measured values (positive and negative peak deviation) are adopted in variables A and B and then output (line 50).

RDXY

Purpose Using the RDXY function it is possible to read values and their units from the screen.

Syntax **RDXY(**[xx]**,**[yy]**,**[ll]**)**

[xx]	screen line (xx = 01 to 21; 01 = mask header, 21 = softkey line)
[yy]	screen column (yy = 01 to 51; 02 = first column, 50 = last column in mask frame)
[ll]	number of characters in entry field (length of field)

Effect Entry fields may be accessed but not display fields. The coordinates [xx] and [yy] define the initial position of the field containing the value. If the coordinates do not correspond to the field, the result of the function is zero.

Examples

```
10 SETRX
20 FREQUENCY 275.250 MHz
30 PRINT RDXY(03,19,12)
40 A=RDXY(03,19,12) 50 PRI A
```

The program reads the value in the `RF Frequency` field (length of field is 12). Its initial coordinates are the third screen line and the 19th column. Although RDXY(03,20,12) is in the field, the complete value would not be read (75.250 MHz). Line 40 shows that the result produced by the function can also be assigned to a variable. This program can be formulated shorter with the IEEE command PRXFR.

REMARK

Purpose Insert remarks in program listing.

Syntax **REMARK** [remark]

[remark]	Random character sequence.

Effect Program lines starting with a REM command are not executed but are output in the listing.

GOTO or GOSUB commands may have REM lines as a branch destination. The program is then continued with the program line after the REM line.

Example

```
10 REM *******
20 REM TX-TEST
30 REM *******
40 SETTX
50 FREQUENCY 275.250 MHz: REM Setting
   ...
   ...
```

The REM lines 10 through 30 in the listing make it clear that this program is to take a good look at the transmitter of a radio set. Even "proper" program lines like line 50 may have REMarks at the end (*not* at the beginning).

SETUP

Purpose Call up a setup stored on Memory Card.

Syntax **SETUP** [file name]
or
SETUP #[S-VAR]

[file name]	Name of required setup.
[S-VAR]	String variable containing name of setup.

Effect The SETUP command calls up stored instrument settings. These must be held as a SET file on the Memory Card in the slot.

The effect of the SETUP command is the same as in manual callup of a setup.

Example

```
10 REM TX TEST
20 SETUP TX MODE:GOSUB 100
30 REM SPECTRAL TEST
40 A$="ANALYZER"
50 SETUP #A$:GOSUB 800
60 END
```

This program first calls up the "TX MODE.SET" setup file in line 20 and then branches to line 100 (TX test). After this test the "ANALYZER.SET" setup file is called up and the program continues in line 800.

TIMEOUT

Purpose Program branch if time overrun

Syntax **TIMEOUT(**[Time]**,**[Branch destination]**)** Start timer
or **TIMEOUT** Stop timer

[Time]	Time in seconds (0 to 999)
[Branch destination]	Actually existent line number

Effect **TIMEOUT(**[Time]**,**[Branch destination]**)** starts a timer. The timer triggers an error if the stated time is exceeded before reaching the command **TIMEOUT** (without parameters). The actually valid command is aborted, the timer reset and there is a jump to the line declared in the branch destination.

Example

```
10 TIMEOUT (60,200)
20 SOFT_MOBILE
30 TIMEOUT

200 SOFT_STOP
210 PRINT "Mobile defective, test aborted after
1 minute!"
```

In line 10 the timer is set to 60 seconds. If the TIMEOUT command (without parameters) is not reached within this time, there is a jump to line 200. In line 20 a call to a mobile is started. If the connection is not set up within 60 seconds, the command is aborted (line 200) and an error message is output (line 210). If the connection is set up within time, the timer is reset in line 30.

TRACE

Purpose Troubleshooting in programs.

Syntax **TRACE**

Effect The TRACE command outputs to a printer the number of the program line that has just been processed during the execution of a program. The resulting report shows in what sequence the program lines were processed.

If the contents of the display are not cleared with CLS, the TRACE report will also be visible on the display (AUTORUN mask). But there it may be overwritten in part by PRINT commands of the examined program and thus become useless.

TRACE acts like a switch: repeated issuing of the command switches the function alternately on and off (acknowledgement message: `Trace On` / `Trace Off`).

TRACE can be used both as a direct command and in programs.

Example

```
10 SETTX;V_RMS;GENA_TX;MODUL
20 FREQUENCY 10 MHz
21 TRACE
30 FOR I=1 TO 5
40 INPUT "ENTER RMS VALUE",V
50 IF V>=5 V GOTO 90
60 PRI "VALUE =";V
70 NEXT I
80 GOTO 100
90 PRI "ERROR"
100 TRACE
101 END
```

The TRACE command in line 21 documents the following branches and loops in the program. Line 100 switches the function off again. Without line 100 the function would remain switched on and would be switched off unintentionally the next time the program is started (line 21).

VAL

Purpose Convert number in string to numeric value.

Syntax **VAL(** [S-EXP] **)**

[S-EXP]	String operand containing only a number or beginning with one.

Effect VAL extracts the number contained in the string operand (end criterion: first character that is no numeral or decimal point). If the string operand starts with a letter, there will be an error message. If the number in the string operand is assigned units, these will not be separated by VAL.

VAL does the opposite of the VAL$ command.

Example

```
10 A$="123TEST"
20 B$="1.24TEST"
30 C$="5,6"
40 A=VAL(A$):B=VAL(B$):C=VAL(C$):D=VAL("12 V")
50 PRINT A,B,C,D
60 PRINT A+B
```

Output on display:

```
123       1.24       5       12.0000 V
124.24
```

VAL$

Purpose Convert numeric value to string.

Syntax **VAL$(**[EXP]**)**

[EXP]	Numeric operand

Effect VAL$ does the opposite of the VAL command.

Example

```
10 A$="STABILOCK "
20 B$=VAL$(4032)
30 C$=A$+B$
40 PRINT C$
```

The numeric value 4032 is converted into a string in line 20. Line 30 chains the strings B$ and A$, line 60 outputs the result: `STABILOCK 4032`.

WAIT

Purpose Stop program execution for a certain time.

Syntax **WAIT** [time]

[time]	Queuing time in milliseconds (1 to 9999 ms).

Effect WAIT stops the execution of a program for the duration of the declared queuing time.

Example

```
10 SETTX
20 WAIT 5000
30 SETRX
40 WAIT 5000
50 GOSUB 1000
```

The program waits 5 s after the TX mask is called up before calling up the RX mask. This also remains visible for 5 s before the program continues with line 50.

IEEE Commands

The IEEE-488 Bus

Up to the mid-1960s remotely controllable test equipment featured special-to-company interfaces for external control of its operation. If you wanted to create a test system out of units from different producers, you first had to overcome the incompatibility of these interfaces by using extra interface circuits.

History

In 1965 Hewlett-Packard presented the HP-IB (Hewlett-Packard interface bus) as a company standard. Within a very short time this interface had been accepted worldwide. Ten years later it became an industry standard, the IEEE 488. IEEE 488 defines the electrical, mechanical and functional characteristics of a "bus system". Units fitted with such an interface can be connected to one another directly and be remotely controlled. The IEEE-488 standard is known under different names, like HP-IB or GPIB (general-purpose interface bus). In Europe the interface is standardized as IEC 625, with a slight difference in the definition of the subminiature D connector: IEEE 488 prescribes a 24-way and IEC 625 a 25-way connector. The interface of STABILOCK 4032 is based on the IEEE-488 standard and consequently has a 24-way connector.

REMOTE

As soon as STABILOCK 4032 is remotely controlled on the IEEE-488 bus, the "REMOTE" LED on its front panel lights up. The keys of the Communication Monitor are then disabled. Exceptions: [OFF] switches to manual operation, [RESET] resets the microcomputer of STABILOCK 4032.

Bus structure

The IEEE-488 bus consists of eight data lines (data bus), three control lines for data exchange (handshake bus) and five superordinate control lines (control bus).

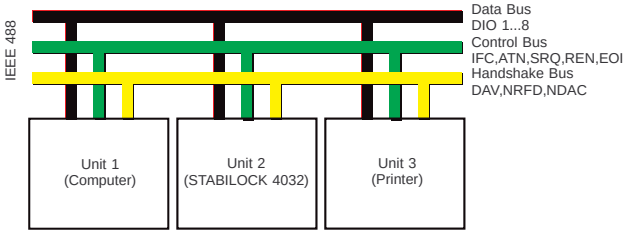


Fig. 8.8: Structure of IEEE-488-Bus.

Units fitted with an IEEE-488 interface always belong to one of the following groups:

Listener: These are units that only "listen", ie only receive data. Typical members of this group are printers, like the ink-jet printer offered as an accessory for STABILOCK 4032.

Talker: These units only "talk" (eg frequency counters or clocks) and have now become fairly rare.

Talker & Listener: These are units that can talk and listen, ie send and receive data. STABILOCK 4032 belongs to this group. The received data are measurement jobs, for example, and the sent data can be the measured results.

Controller: Units that can talk, listen and control are called controllers. In most cases they are computers specially designed for this purpose. Of late more and more personal computers (PCs) with a built-in IEEE interface card are being used. A controller regulates the entire measurement procedure, sending measurement jobs, receiving the measured results, calculating values, keeping statistics and lots more besides.

The exchange of data on the eight data lines of the IEEE bus is usually performed with ASCII-coded characters (ASCII: American standard code for information interchange). Proper data exchange between talkers and listeners is managed by the handshake bus with its three control lines. This ensures correct transfer of every character (data byte) and quite independently of the processing speed of the units connected to a bus: the slowest device that is involved in the *momentary* data exchange determines the rate of data transfer.

Basically the handshake data exchange works as follows. A talker sends a data byte and signals by the **DAV** (data valid) line that there is a data byte ready for collection on the data bus. As soon as a listener has collected the data byte, it signals reception of the character and its readiness to receive further characters by the **NDAC** (not data accepted) line and the **NRFD** (not ready for data) line. The procedure is the same when a data byte is intended for several listeners.

The data transmitted on the bus fall into two categories:

Management messages: these decide, before data exchange for example, which unit is the talker and which unit or units the listener. The resetting of a unit can also be ordered by a management message.
Device-dependent messages: these include setting commands for individual units for instance, measurement jobs and measured results.

Creating IEEE-488 system

To integrate STABILOCK 4032 into an existing IEEE-488 system, all you need is an IEEE cable. Two configurations come into mind for a minimal system:

STABILOCK 4032 and IEEE controller,
STABILOCK 4032 and IEEE printer.

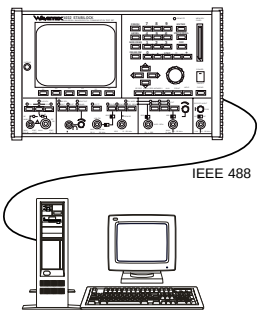


Fig. 8.9: IEEE-488 system consisting of STABILOCK 4032 and controller.

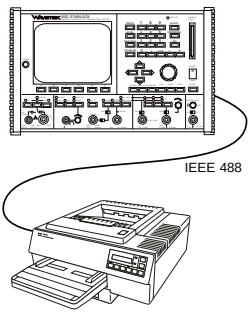


Fig. 8.10: IEEE-488 system consisting of STABILOCK 4032 and printer.

What settings are necessary ?

An IEEE-488 system requires harmonization of the following parameters for all units integrated into a system. With STABILOCK 4032 all these parameters can be set in the status mask (see Chapter 4).

Address: Just like a specific subscriber can be reached by his telephone number, an IEEE-488 device must also be uniquely identifiable. This is done by means of addresses. STABILOCK 4032 is set to a standard address of 25, but it can be set to any other address between 1 and 31 in the status mask.

End of string (EOS): One or two control characters, added by a talker to the end of each message, tell a listener that this is the end of the message. But this will only work if the same control characters are set on the talker and listener. In the course of time the following control characters have become customary for this purpose: CR (carriage return) and LF (line feed). These control characters are normally used in the combination CR or CR+LF.

End or identify (EOI): EOI is one of the five superordinate control lines. This line is set by a talker simultaneously to the transmission of the last character of a message. EOI permits the transfer of messages if there are EOS characters contained in the message itself. If STABILOCK 4032 outputs the contents of a display (mask) for instance, these will be binary data which, depending on the display contents, can comprise all possible 255 bit combinations from 00_h to FF_h. If the combinations for CR ($0D_h$) and LF ($0A_h$) are also among them, they could be mistaken for genuine EOS characters. But by scanning the EOI line, the listener avoids this error.

Talk & listen: This is the device mode. The "talk & listen" setting should always be chosen if there is a controller in the IEEE-488 system. The "talk only" setting is necessary if there is only a printer connected to STABILOCK 4032. The printer will then be set for "listen always".

When IEEE and when AUTORUN ?

Remote control by IEEE-488 bus is always necessary if more than one device is required for automatically testing an item. AUTORUN (see Chapter 9) also loses out if you want to collect test statistics or a number of test setups want to access a shared database. An example of this would be the alignment of radios at different temperatures (climatic chamber) and on different supply voltages (power-supply unit) with simultaneous measurement of their quality (database). AUTORUN is an advantage if the testing capabilities and possibilities offered by STABILOCK 4032 for further processing of measured data are quite sufficient for your test application. It is the ideal way to handle tests that keep recurring.

How to create an IEEE program

The commands that produce the required running of an IEEE program differ from controller to controller. A controller can initiate output to the data bus with the command WRT or with OUTPUT or with IBWRT. The command for collecting data can be RED or ENTER or IBRD. You can find precise details about this type of command in the manual to your controller.

The IEEE commands for remotely controlling STABILOCK 4032 are quite independent of the controller that is used. These commands – they were devised by Willtek – can be divided into two groups:

IEEE and STABILOCK 4032
IEEE programming of Communication Test Set STABILOCK 4032 is just as simple as manual operation. For every key there is a corresponding IEEE command and the softkeys are also operated by an IEEE command. Of course, you can only operate those softkeys that are current. Orientation on manual operation simplifies programming for you. First carry out the test you want to program manually, and note down all your actions. At the end of the test your notes will be a schematic for the IEEE program. All you have to do is to change key operations into the appropriate IEEE commands.

Setting commands: These put STABILOCK 4032 into the operating status required for a particular test.

Test jobs: These tell STABILOCK 4032 to perform a certain test. Test jobs usually produce measured results. In other words, after issuing a test job the controller must first collect the result before it can issue further commands.

☞ Virtually all IEEE remote-control commands are also permissible for AUTORUN programs; this is why Chapter 9 describes the IEEE commands that may be used in AUTORUN programs *and* in IEEE programs. At the end of this chapter you will find a list of the few IEEE commands that you can only use in IEEE programs.

The syntax and performance of IEEE remote-control commands are based on the following needs:

Use of the terms common in RF test engineering.
Relationship between manual operation and IEEE programming.
Commands to enable extension and matching to future demands.

Programming examples

Set TX frequency:	`OUTPUT 725,"TXFREquency 123.456 MHZ"`
Set RF level:	`OUTPUT 725,"AMPLItude -78.9 DBM"`
Call up TX mode:	`OUTPUT 725,"SETTX"`

The above examples apply to controllers from Hewlett-Packard: OUTPUT produces an output, 7xx says that output is on the IEEE interface and 25 is the IEEE address of the recipient of the output (in this case STABILOCK 4032).

Here is the same example, but written for a PC with an IEEE card from National Instruments:

```
TEXT$ = "TXFREquency 123.456 MHZ" CALL IBWRT (STABI%,TEXT$)
TEXT$ = "AMPLItude -78.9 DBM" CALL IBWRT (STABI%,TEXT$)
TEXT$ = "SETTX" CALL IBWRT (STABI%,TEXT$)
```

Here STABI% is the device identification including its address.

A number of commands can be comprised into a command string using the character ";" (reduces programming effort):

Single commands

```
OUTPUT 725,"SETRX"
OUTPUT 725,"RXFRE 123.4567 MHZ"
OUTPUT 725,"AMPLI -80.0DBM"
```

Command string

```
OUTPUT 725,"SETRX;RXFRE 123.4567 MHZ;AMPLI -80.0 DBM"
```

Tips & tricks

A command string may only contain *one* measurement job. This measurement job must come at the end of the command string, otherwise the following commands will be ignored.
The execution of a command starts straight after receipt of the end character EOS or, for a command string, after the semicolon. Depending on the command, more or less time will be required for its complete execution. Incorrect measurements can result if a device has not yet executed a setting command completely and another device already produces a measured result that is dependent on this setting. Errors of this kind are avoided by terminating setting commands with a semicolon. This causes command execution to be brought forward. After execution the EOS character(s) is(are) read and only then is the bus enabled.

Notation
Each IEEE command for remote control consists of at least five characters, further characters may be added but are not evaluated. This possibility of adding characters makes the commands more intelligible, is useful for program documentation and simplifies program housekeeping. The same applies to blanks: they can be inserted but are unnecessary for correct execution of a command. Upper-case or lower-case notation is also optional.

Example: The following program is continued immediately after arrival of the setting command for STABILOCK 4032 in case a). The subsequent frequency measurement can therefore produce an incorrect value. In case b) however the measurement is not performed until the Communication Monitor has set the required frequency correctly.

Case a)
```
OUTPUT 725,"FREQU 123.4567 MHZ"
OUTPUT 703,"Measure_frequency"
ENTER  703,A$
```

Case b)
```
OUTPUT 725,"FREQU 123.4567 MHZ;"
OUTPUT 703,"Measure_frequency"
ENTER  703,A$
```

IEEE programming conventions

Only the first five characters are relevant for recognizing an IEEE command (when a command is named, these characters are shown in capitals). To enable better understanding of a program however, any number of characters can be added to a command (eg SETDUPLEX instead of `setdu`). No distinction is made between upper-case and lower-case letters.

Many IEEE commands require the entry of parameters. These can be numeric values with and without units, softkey designations or states (on/off). The parameters necessary for a command are stated along with the explanation of the particular command (terms in brackets, eg `[value] [unit]`). If different entries are permissible for a parameter (eg different units), all possible entries are listed and separated by "|".

In the details of the different parameters the permissible short form is shown by capitals. For the parameter `[state]`, for example, the following entries are possible: oN|oFf. In other words, instead of `ON` you can enter just `N`. But be careful, always enter units in full (no short forms).

Masks called up with IEEE commands differ in one point from those that are called up manually: the instruments are *not* activated. First you must issue a test job before the appropriate instrument is polled and briefly activated. The instrument then shows the result on the display until the next test job, producing a new result.

☞ An IEEE command line may be maximally 100 characters in length.

Basic setting

ERASE Produces the basic setting and erases the RAM. This command may not appear within a command string but only at the end or singly.

Note: This command is not available in AUTORUN mode. (Alternative: execute total clear, store this status as a SET file and call up when needed with the BASIC command SETUP).

DEVICE CLEAR Warm start, cold start or stop function. Depending on what has been declared in the status mask, the Communication Test Set executes either a reset or a total reset after a Device Clear command. Exception: If a (STOP) softkey is displayed, Device Clear will execute this stop function (this simplifies the termination of tests).

A pause of at least 500 ms must be maintained between Device Clear and the following command (not necessary if the stop function is executed). In this time the IEEE device of the Communication Test Set is initialized, ie the IEEE bus is in a non-defined status.

☞ DEVICE CLEAR is a controller command. The notation of the command depends on the controller that is used.

Entry of Special Characters

Special characters are generally entered by striking ESC and then typing in a letter.

↑	=	ESC U	For entry on controller enter ASCII code $94_{decimal}$ = ^; eg WRTVA5,^ sets scroll variable Channel no. in GENERAL PARAMETERS mask.
↓	=	ESC D	for entry on controller enter ASCII code 124decimal = |.
→	=	ESC R	for entry on controller enter >; eg CALL> = CALL --> DECODE
←	=	ESC L	for entry on controller enter <
Ω	=		special character omitted (eg SOFT_50 = SOFT_50Ω)
µ	=	u	Eg AMPLI 33 uV = AMPLI 33 µV.

The following special characters can be displayed by the monitor (eg in entry instructions); these characters are not accepted by the printer however:

Ω	=	ESC O	Δ	=	ESC T
Φ	=	ESC P	µ	=	ESC M

Standard Commands

Key	IEEE command	Meaning
Select mode		
RX	**SETRX**	Calls up basic RX mask.
TX	**SETTX**	Calls up basic TX mask.
DUPL	**SETDUplex**	Calls up basic DUPLEX mask.
SCOPE	**SCOPE**	Calls up storage oscilloscope. Start measurement with special command LOCAL.
MEMORY	**MEMORy**	Calls up MEMORY mask.
AUX	**AUXILiary**	Calls up OPTION CARD mask.
ANALYZER	**ANALZer**	Calls up spectrum analyzer. Start measurement with special command LOCAL.
Operate softkey		
??????	**SOFT_[name]**	Operates declared softkey. Before a softkey can be operated, the mask showing the declared softkey must be called up.
	[name] = designation of softkey	SOFT_FREEZE SOFT_RF DIR
	GOTO_[name]	Only in controller programs permissible.Simplifies the analysis of a controller program if a submask and not a function is called up.
Set RF parameter		
FREQUENCY	**FREQU [value] [unit]**	Sets RF frequency in RX and TX modes. Don't use command FREQU to set channel numbers (use TXFRE and RXFRE).
	TXFRE [value] [unit]	Sets TX frequency in DUPLEX mode (or TX).
	RXFRE [value] [unit]	Sets RX frequency in DUPLEX mode (or RX).
	[value] = numeric value [unit] = MHz|NoL|NoU	FREQU 75.234 MHz TXFRE 4 NoL
LEVEL	**AMPLI [value] [unit]**	Sets RF output level.
	RFLEVel [state]	Switches signal generator on/off.
	[value] = level (numeric) [unit] = dBm|dBu|uV|mV [state] = oN|oFf	Examples AMPLI -60 dBm RFLEV N or RFLEV F

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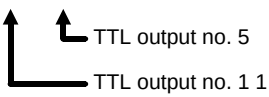
Key	IEEE command	Meaning
Set modulation (RX or DUPLEX mode)		
FM AM ΦM	**RXAFM [value] kHz** **RXBFM [value] kHz**	FM modulation with GEN A FM modulation with GEN B
	RXAPM [value] Rad **RXBPM [value] Rad**	ΦM modulation with GEN A ΦM modulation with GEN B
	RXAAM [value] % **RXBAM [value] %**	AM modulation with GEN A AM modulation with GEN B
	[value] = modulation (numeric) RXBFM 2.8 kHz	
Set demodulation (TX or DUPLEX mode)		
FM AM ΦM	**TX_AM, TX_FM, TX_ΦM**	
Modulator DC coupled		
none	**DC_[state]**	
	[state] = ON|OFf DC_ON	
General functions		
BEAT	**BEAT_[state]**	Select BEAT function
	[state] = oN|oFf	
Cursor	**CURUP** **CURDOwn** **CURLEft** **CURRIght** **CURHOme**	Cursor up Cursor down Cursor left Cursor right Cursor home
ENTER	**ENTER**	
STEP	not available	
OFF	not available	
Relay set/reset		
none	**RELAY [no] [state]**	
	[no] = number of relay (1 to 24) [state] = oN|oFF (see also TTL output set/reset)	
TTL output set/reset		
none	**TTLOUt [no] [state]**	
	[no] = number of TTL output (1 to 20) [state] = oN|oFF	
	If a value 99 is entered instead of the actual number of the relay or TTL output, as many as 24 relays or 20 TTL outputs can be adressed simultaneously (1 = set, 0 = reset, X = no change). Example: TTLOUt 99 10X11  	

Key	IEEE command	Meaning
Switch AF generators on/off		
GEN A	**GENA_[state]**	Switch generator GEN A on/off.
B/SAT	**GENB_[state]**	Switch generator GEN B on/off.
EXT	**GENE_[state]**	Connect and disconnect signal applied to EXT MOD socket.
	`[state] = RX|TX|oFf`	
	Examples	`GENB_OFF` `GENA_RX`
Set AF frequency		
MODFREQ	**MODAF [value] kHz** **MODBF [value] kHz**	Set generator GEN A frequency. Set generator GEN B frequency.
	`[value] =` frequency (numeric)	`MODAF 3.8 kHz`
Set AF output level (TX or DUPLEX mode)		
FM AM ΦM	**GENAL [value] [unit]** **GENBL [value] [unit]**	Level setting GEN A Level setting GEN B

	`[value] =` level (numeric)
	`[unit] = mV|V|dBm`
		Examples
		`GENAL 120 mV`
		`GENBL -20 dBm`

Select AF test signal		
VOLTM	**VOLTMeter**	Connects VOLTM input socket to AF signal analyzer.
DEMOD	**DEMODulation**	Connects demodulated received signal to AF signal analyzer.
RXMOD	**MODULation**	Connects all AF generators to internal AF signal analyzer.
Call up AF test instruments		
dB REL	**DBREL**	Calls up relative-level meter.
VOLT	**V_RMS**	Calls up RMS meter.
SINAD	**SINAD**	Calls up SINAD meter.
DIST	**DISTOrtion**	Calls up distortion-factor meter.
Switch filters on/off		
CCITT	**CCITT [state]**	Select CCITT filter
External filters	**EXTERnal [state]**	Select filter on OPTION CARD
	`[state] = oN|oFf`	
	see IEEE command FILTEr	

Key	IEEE command
Fill in any entry fields	
none	**WRTVA [code],[input]** Enters declared entry [input] in field defined by [code]. Mask must have been called up first that contains required entry field. With the WRTVA command you can fill in all entry fields, also those that are directly accessible with commands like FREQU or AMPLI (fast access). [code] = Identification number of entry field. The identification number is found as follows: first call up the mask and immediately afterwards the AUTORUN mask. (HELP VAR) shows the mask again. The entry fields are now brightened up and show the identification numbers required for the WRTVA command. Alternatively you can directly look to the identification number by pressing [HELP] in the corresponding mask. [input] = Numeric with/without units or text (depending on entry field). Examples WRTVA 25,S/N — The scroll variable S/N is entered in field 25 (sensitivity measurement SINAD or S/N) of the special SENS of the RX mask. WRTVA 03,66 uV — Sets RF level (field 3 in RX mask) to 66 µV. **Note:** The level input fields of the three AF signal generators have different identification numbers depending on the operating modes of the Test Set. **Caution:** If Mem.Card is selected in AUTORUN mode instead of a printer and you change during the program with WRTVA to a printer, until then collected data can be lost. Remedy: store the collected data (before change to the printer driver) on memory card with the IEEE command CLOSE.

Key	IEEE command
Fill in ZOOM masks	

(ZOOM)	**ZOOM_[z],[c],[r]:[text]**
	
	Calls up required ZOOM mask and defines center scale plus scale ends. To continue program, operate one of softkeys.
	
	[z] = 1 = RF Power
	= 2 = Modulation
	= 3 = RMS
	= 4 = AF Power
	= 5 = Offset (only for TX or DUPLEX)
	= 6 = DC Voltmeter
	= 7 = DC Ammeter
	[c] = Center scale (numeric with units)
	[r] = Scale end (numeric)
	[text]= Any text (max. 50 characters) to be shown in the status line. The softkeys have the function (CONTINUE).
	
	Example:
	
	`10 SETTX`
	`20 ZOOM_1,9.00 W,3.00:Adjust RF POWER!`
	`30 L=MPOWER:PRINT L`
	
	The program calls up the RF power meter PWR with a defined measurement range in full format (line 20). `Adjust RF POWER!` tells you to adjust the transmitted power. Operate any softkey after adjustment and the RF power is measured and its value read out (line 30).

Test jobs

IEEE test jobs poll the required test instrument and at the same time produce the result. This can be evaluated directly (eg `PRINT MPOWER`) or assigned to a variable (`A=MPOWER`).

IEEE command	Measured result
RF frequency	

`MTXFReq`	Frequency of RF signal applied (tuned frequency of test receiver).
	
	`10 SETTX`
	`20 A=MTXFReq`
	`30 PRINT A`
	
	After callup of the TX mask the frequency of the RF signal is measured and the result output.

Frequency offset	

`MTXOFfset`	Offset of actual carrier frequency from tuned frequency of test receiver
	
	`10 SETTX`
	`20 TXFRE 27.205 MHz`
	`30 B=MTXOFfset`
	`40 PRINT B`
	
	Line 20 tunes the test receiver to 27.205 MHz. Then the offset of the RF signal applied there is measured and the result output.

RF power (broadband)	

`MPOWEr`	Mean value of applied RF power.
	
	`10 SETTX`
	`20 C=MPOWER`
	`30 PRINT C`
	
	Caution: In AUTORUN and controller modes in particular, observe the maximum permissible RF input power because the warning `REDUCE RF-POWER` does not appear on screen in these modes.

RF power (test bandwidth 3 MHz)	
`MSPOWer`	Mean value of applied RF power. Before measurement, test receiver must be tuned to test signal.

IEEE command	Measured result
Voltage (RMS)	

M_RMS	Root-mean-square value of momentarily connected AF signal.
	
	`10 SETRX;MODULation`
	`20 GENA_RX;MODAF 2 kHz;RXAFM 2.4 kHz`
	`30 F=M_RMS:PRINT F`
	
	Line 10 calls up the RX mask and connects the AF generators to the AF signal analyzer. Generator GEN A feeds the signal generator with an AF signal that produces 2.4 kHz FM deviation. The level of the AF signal is determined by the test job in line 40.

MFRMS	Root-mean-square (rms) figure of the coupled AF signal. Function like M_RMS but three to four times faster. Important: only suitable for stable signals not corrupted by noise
AF frequency	

MAFFReq	Frequency of momentarily connected AF signal
	
	`10 SETTX`
	`20 GENA_TX;MODAF 2.22 kHz; GENAL 100 mV`
	`30 MODGEn`
	`40 K=MAFFReq:PRINT K`
	
	Generator GEN A is set to 2.22 kHz in TX mode. Then line 30 connects the internal generators to the AF signal analyzer so that GEN A feeds the AF frequency counter. The test job in line 40 therefore applies to the signal of the generator (result `2.2200 kHz`).

Modulation	

MDEMOd	Peak value of modulation, measured with modulation meters DEMOD (TX mode) or MOD (RX mode)
	
	`10 SETTX;TXFRE 27.205 MHz`
	`20 TX_FM`
	`30 D=MDEMOd:PRINT D`
	
	First the test receiver is tuned and then FM demodulation is set. After that the peak FM deviation of the RF signal is measured and output.
	
	`10 SETRX`
	`20 GENA_RX;MODAF 2 kHz;RXAFM 2.4 kHz`
	`30 MODULation`
	`40 D=MDEMOd:PRINT D`
	
	The generator GEN A feeds the signal generator with a 2-kHz signal that produces FM deviation of 2.4 kHz. As a deviation check, line 30 connects the modulator to the modulation meter MOD, which is then polled and transfers the result to the variable D.

IEEE command	Measured result
DC measurements	
M_DCV **M_DCA**	Measurement results of DC voltmeter and DC ammeter (options).
TTL Inputs	
MTRIG	Logic signal of the different TTL inputs (see also control interfaces).
VSWR	
MVSWR	VSWR measured with option "VSWR Measuring Head".
Display fields (poll contents)	
RESULt [number]	[number] = identification number of result field The command outputs the content of special result fields. Applies to the masks of the software options (see Chapter 10) and to the DTMF and sequential masks (Chapters 9 and 4). The descriptions of these options give you the identification numbers of the corresponding result fields.

Output of Setting Parameters

With the following IEEE commands you can output the content of important entry fields.

Parameter	IEEE command
RF Frequency RX	**PRXFRequency**
RF Frequency TX	**PTXFRequency**
RX-RF-Offset	**PRXOFfset**
RF Level	**PRXLEvel**
GEN A Frequenz	**PGAFRequency**
GEN B Frequenz	**PGBFRequency**
GEN A Level	**PGALEvel**
GEN B Level	**PGBLEvel**
CONT RF Level	**PCONTinuous**
STEP RF Frequency	**PSTFRequency**
STEP RF Level	**PSTLEvel**

Special Commands

The following commands can be used in controller programs and in part in AUTORUN programs too.

Set/reset blanking-screen commands	
CRT_CONTROL x	[x] = ON or OFF CRT_CONTROL x only affects the CRT_x commands of a program (blanking of the monitor). CRT_CONTROL ON: CRT_x commands are effective. CRT_CONTROL OFF: CRT_x commands are not effective. CRT_CONTROL OFF is the automatic default, even if the command is not expressly issued. CRT_x commands are only effective if the command CRT_CONTROL ON is expressly issued. **Application:** disabling of all CRT_x commands during program development so that the entire course of the program can be followed on the monitor. Examples of use of command in AUTORUN programs : 10 CRT_CONTROL ON 20 CRT_OFF 30 SETRX 40 SETTX 50 FREQUENCY 110.0000 MHz 60 CRT_ON : Program line 10 causes the following CRT_x commands to be executed, ie CRT_OFF blanks the screen (line 20). So the callup of the RX and TX mask as well as the entry in the RF Frequency field can : 10 CRT_CONTROL OFF 20 CRT_OFF 30 SETRX 40 SETTX 50 FREQUENCY 110.0000 MHz 60 CRT_ON : Here program line 10 prevents execution of the following CRT_x commands (the line is optional because CRT_CONTROL OFF is the automatic default anyway). The screen is not blanked and the actions of the program can all be followed onscreen.

Blanking screen	
CRT_x	[X] = ON or OFF CRT_OFF blanks the screen until it is brightened up again by CRT_ON. The blanking is useful when the actions in the program are unimportant for the user (eg callup of masks, setting of scroll variables). **Note:** CRT_x commands are only executed if the command CRT_CONTROL ON is issued beforehand. The commands INPUT, PAUSE, ZOOM and LOCAL always produce blanking of the screen. Example of use of command in AUTORUN programs : 10 CRT_CONTROL ON 20 CRT_OFF 30 SETRX 40 SETTX 50 FREQUENCY 110.0000 MHz 60 CRT_ON : Program line 10 causes the following CRT_x commands to be executed. So CRT_OFF initially blanks the screen.
Output of text on screen	
DISP_text	text = character string to be output (max. 120 characters) Permits the output of text onscreen (pointer or other message for a user). The text is shown in three lines of 40 characters each in a separate mask. Shorter texts are filled out with blanks. Press a softkey to continue the program. Example of use of command in controller programs : 1230 OUTPUT 725; "DISP_Connect mobile!" : **Note:** This command is not available in AUTORUN mode, but it corresponds to the BASIC command PAUSE.

Placement of text on screen	
DISPx,text	[x] = number of line, x = 1–9, A–H; x = 1 corresponds to line 1, x = H corresponds to line 17 text = character string to be output Permits the placement of text onscreen (pointer or other message for a user). The text is output in the current mask in line x. If there is already text in the output line defined by x, it will be overwritten. In the SCOPE and ANALYZER mask no text should be placed in the windows because these are overwritten by each measurement cycle. Note: Important messages from the Communication Test Set can be overwritten unintentionally by the DISPx,text command. Example of use of command in controller programs : 1250 OUTPUT 725; "DISP3,measurement started" 1260 OUTPUT 725; "DISPB,measurement 1" : Example of use of command in AUTORUN programs : 50 DISP3,measurement started 60 DISPB,measurement 1 : The text "measurement started" is read out in line 3, the text "measurement 1" in line 11 of the current mask.
DISP0	Clears the screen.
Switch filter on or off	
FILTERabcde	a = Option, 0=out, 1=on b = Filter 2, 0=out, 1=on c = Filter 1, 0=out, 1=on d = Var. notch, 0=out, 1=on e = Loop filter into signal path to DEMOD meter, 0=out, 1=on Loops the filter into the signal path (only possible if the Communication Test Set is fitted with the filter). The command corresponds to filter selection on the OPTION CARD mask. It is independent of the mask currently displayed. Note: After looping in a filter, a command may be necessary to switch the measurement range (eg MDEMOd).

Printing defined areas of masks	
HCOPYaaa,bbb	aaa = start line, aaa = 1–255 bbb = end line, bbb = 2–256 This command prints a defined area of the current mask. The start line and the end line are to be entered. These values are pixel lines; a text line on the screen comprises twelve pixel lines (eg `HCOPY013,024` prints the second text line). The output will be in the printer format as selected under GENERAL PARAMETERS (`Printer` field).
Read out of entered messages	
INPUT	Replaces the status line with an entry field for maximally 40 characters. Digits can be entered with the numeric keypad, letters with the softkeys. After confirmation with ENTER the content of the entry field is read out on the controller.

Check whether a key is stuck

KEYBOard WAIT x

x = ON or OFF

The command checks whether a key on the Communication Test Set is struck and outputs a character assigned to this key to the controller. The struck key can be identified from the following table.

KEYBOard WAIT ON halts the program until a key is struck on the Communication Test Set.

KEYBOard WAIT OFF does not halt the program. If no key is struck at the moment of testing, the "@" character is output to the controller.

Note: This command is not available in AUTORUN mode.

Key	Charac.	Key	Charac.
cursor l	Space	PRINT	K
cursor u	!	OFF	L
cursor r	"	DIST	M
cursor d	#	STEP	O
+ (Plus)	+	Frequency	P
– (Minus)	–	AMPLITUDE	Q
. (Punkt)	.	MOD FREQ	R
0...9	0...9	FM AM ΦM	S
S1	:	BEAT/SINAD	T
S2	;	HELP	V
S3	<	CCITT	W
S4	=	DIM	X
S5	>	SCOPE	Y
S6	?	ANALYZER	Z
TX	A	MEMORY	[
RX	B	AUX	\
DUPLEX	C	Spinweel	
VOLTM	D	turned left	p
DEMOD	E	Spinweel	
RX MOD/MOD GEN	F	turned right	q
VOLT/dB REL	G	ENTER	_
GEN A	H		
B/SAT	I	No key pressed	@
EXT	J		

Disable LOCAL mode	
LOCKK	Disables the [OFF] key in remote mode. The Communication Test Set can no longer be switched from remote to local mode. LOCKK is canceled by the LOCAL command or by striking the [CLEAR] key. **Note:** This command is not available in AUTORUN mode.
Switch to manual operation	

LOCAL:text	`text` = character string to be output
	
	Switches the 4032 to manual operation. The monitor shows the mask last called up. The text of the LOCAL command appears in the status line (max. 50 characters). The softkeys have the function [CONTINUE], ie the program (IEEE or AUTORUN) is continued as soon as you strike a softkey.
	
	Example of use of command in controller programs
	`:`
	`60 OUTPUT 725; "LOCAL:Adjust PWR=5.0 W THEN CONTINUE"`
	`70 OUTPUT 725; "M_POWER"`
	`80 ENTER 725; A$`
	`:`
	The user is asked to set the radio set to output power of 5.0 W in the ongoing mask and then strike a softkey.

Label softkeys	

NSOFTx,text	`x` = number of softkey
	`text` = field label of softkey (max. 51 characters)
	
	Command for labeling softkey fields. The softkey fields 1 and 6 can hold maximally seven and all others maximally eight characters. If the text is longer than permitted, the field of the following softkey will also be occupied without a space. The text across all six softkey fields may not be more than 51 characters.
	
	Example of use of command in AUTORUN programs
	`:`
	`40 NSOFT1,RETURN`
	`50 NSOFT4,Connect new mobile to RF`
	`:`
	Softkey field 1 is labeled with the text [RETURN], softkey fields 4-6 with the text [Connect new mobile to RF]. Softkey fields 2 and 3 remain unaltered.
	
	Note: This command is only useful in combination with IEEE command `KEYBOard WAIT`.

Output string to Centronics interface	
PAR_Out:text	text = character string to be output length in controller programs: 80 characters length in AUTORUN programs: 49 characters minus space for line number and command This command outputs the character string "text" to the Centronics interface (option). If the last character of the string is ":", there will be no line and page feed after text output. Example of use of command in controller programs : 1450 OUTPUT 725; "PAR_Out:result" 1460 OUTPUT 725; "PAR_Out:+A$" : Example of use of command in AUTORUN programs : 50 PAR_Out:result 60 PAR_Out:A$: First the text result and then the content of the variable A$ is output on the Centronics interface.
Read content of entry fields	
RDXY_xx,yy,ll	xx = start-line coordinate of field yy = start-column coordinate of field ll = length of field (1–49) Reads contents of entry fields only. **Note:** This command is not available in AUTORUN mode (but see BASIC command RDXY).
RESET control	
RESET	Query whether a reset or total reset was executed while the program was running on STABILOCK 4032. If so a "Y", otherwise an "N", is output as the result to the controller. At the same time the flag queried with the command is reset. **Note:** This command is not available in AUTORUN mode.

SER_IN with wait function	
SER_IN_FT	Modification of the SER_IN command. Reads in a character string (max. 1000 characters) with the declared communication protocol on the RS-232 interface (option). The end of the character string can be seen from the marking that was also declared on the second page of the GENERAL PARAMETERS mask (normally CR+LF). **Application:** for base stations that continuously transmit character strings terminated with an end marker, the beginning of the next character string is **waited for** and this character string is then read in up to the end marker.
Output string to RS-232 interface	

SER_Out:text	`text` = character string to be read out
	
	Produces readout of the character string "text" (max. 50 characters) on the RS-232 interface (option). The communication protocol declared on the second page of the GENERAL PARAMETERS mask will apply for this. A timeout declared under GENERAL PARAMETERS will prevent blockades if declared handshake characters fail to appear (see special commands WRITE or SLAVE).
	
	Examples of use of command in AUTORUN programs
	`:`
	`50 SER_O:CHAN053`
	`:`
	The text "CHAN053" could be a control instruction for a test item, for example, to set channel 53.
	`:`
	`50 A$="CHAN"+VAL$(c)`
	`60 B$="TRAFFIC"`
	`70 SER_O:#A$+B$`
	`:`
	Instead of "text" it is also possible to use a string variable preceded by a sharp sign (only use # once).

Read string on RS-232 interface	

SER_In	Reads in a character string (max. 1000 characters) with the declared communication protocol on the RS 232 interface (option). The end of the character string can be seen from the marking (terminator) that was also declared on the second page of the mask GENERAL PARAMETERS (normally CR+LF). A timeout declared under GENERAL PARAMETERS will prevent blockades if no terminator is detected (see special commands WRITE or SLAVE).
	
	Only in AUTORUN programs: character strings of max. 49 characters can be loaded into any available string variable. Longer character strings can only be loaded into the string variable. M$ is also used as a buffer for measured results however, so it is advisable to immediately allocate important contents of M$ portion by portion to other string variables (see Chapter7).
	
	Examples of use of command in AUTORUN programs
	`:`
	`50 PRINT SER_I`
	`:`
	The read-in character string has 124 characters for example. The first 49 characters appear on the screen and all characters are also output to a printer. Whether this actually prints all the characters will depend on the particular printer. If the character string is distributed to a number of string variables in portions of max. 49 characters each (see following example), the characters 50 through 99 can also be shown on the screen for instance.
	`:`
	`50 M$=SER_I`
	`60 A$=M$(1,49):B$=M$(50,98)`
	`70 C$=M$(99,124)`
	`80 PRINT B$`
	`:`
	The string variable M$ is loaded with 124 characters for example. Split up in three portions, these characters are allocated to other string variables.
	`:`
	`50 B$=SER_I`
	`60 IF B$="OK" PRINT "PASS"`
	`:`
	The read-in character string is loaded into string variable B$ and undergoes a comparison operation.
	`:`
	`10 M$=SER_I`
	`20 C$=M$(80,83)`
	`30 IF C$="1502" PRINT "PASS"`
	`:`
	The read-in character string is checked to see if it contains the substring in the 80th through 83rd places.

Output and read string on RS-232 interface (full-duplex mode)[1)]	

SEROI:text	`text` = character string to be output
	
	The SEROI command[1)] puts the RS-232 interface (option) into full-duplex mode. This means that the communication tester can output a character string and receive another at the same time (max. 1000 characters). This is necessary, for example, when a base station is being tested that starts to respond on the serial interface while the communication tester is still sending a character string with instructions to the base station. Reception of a character string is ended as soon as the communication tester detects the declared `Serial Input Terminator` (see GENERAL PARAMETERS mask). So the duration of readiness to receive does not depend on the length of the character string to be output. A timeout declared under GENERAL PARAMETERS will prevent blockades if no terminator is detected or declared handshake characters fail to appear (see special commands WRITE or SLAVE).
	
	Note: The character string received by the communication tester is first buffered by the RS-232 interface. The character string cannot be evaluated until it is fetched from the interface by the special command SER_In.
	
	Example of use of command in AUTORUN programs:
	:
	`50 SEROI:A1CCF8...`
	`60 M$=SER_I`
	:
	Line 50 causes the character string `A1CCF8...` to be output on pin 2 of the serial interface (eg control instructions for a base station). At the beginning of output, the communication tester is ready to receive (pin 3 of interface) a character string output by the base station. The declared serial input terminator determines whether reception is ended upon detection of the character sequence CR+LF for instance. The command SER_I loads the received character string into the string variable M$ (line 60) for further processing.

Query unit identity	
UNIT_ **UNITS**	UNIT_ always produces the string 4031 as a result (important for ARE). UNITS produces the complete identification of the set, ie the model (4032) and seven-digit serial number (separated by space). Further internal version information can be called up with the special `IDENTity` command from firmware version 6.13 onwards.

Query version information

IDENTity

The special IDENTity command produces a string with the following information:

Place	Information
01 to 08	Company name (space at end).
09 to 18	STABILOCK (space at end).
19 to 23	403X (space at end).
24 to 31	Serial number of Communication Test Set (space at end).
32	Character "(" initiates output of version identification of software-controlled modules. Note comma (delimiter) at end of each identification. If module is missing, version identification is replaced by spaces.
33 to 37	HOST-MCU version (firmware).
38 to 42	CRT-MCU version (firmware).
43 to 47	RF/AF-MCU version (firmware).
48 to 52	CELL-ANA version (DATA module).
53 to 57	CELL-GEN version (DATA module).
58 to 62	IFC-MCU version (RS-232/Centronics).
63 to 67	DIG-MCU version (NADC, GSM, DECT, etc).
68 to 72	OPT-MCU version (2nd RF generator).
73 to 87	Name of currently loaded system program including extension.
88 to 97	Version of currently loaded system program.
98	Character ")" closes output of version identification.

Change RS-232 interface parameters (terminators/handshake)[1)]

WRITE[300012X]
or
SLAVE300012X

X = setting instruction for following parameters:
- serial input terminator
- serial output terminator
- handshake characters within character string
- handshake characters at end of character string

Normally the declarations made in the GENERAL PARAMETERS mask apply for the parameters of the RS-232 interface. But the scroll variables offered there are only good for standard requirements. Using the commands WRITE and SLAVE[1)] on the other hand, the parameters in question can be assigned any values between 01 and 7F.

Only use WRITE for controller programs.
Only use SLAVE for AUTORUN programs.

Continuation next page

Continuation

Command syntax for parameter setting:

WRITE[300012AABBCCDD]
SLAVE300012AABBCCDD (no brackets!)

300012 = **Control sequence required internally**

AA = **Serial input terminator** (2 bytes, hexadecimal)

- 00 = Standard value declared in GENERAL PARAMETERS mask
- 01-7F = Permissible values if standard values do not satisfy requirements

BB = **Serial output terminator** (2 bytes, hexadecimal)

- 00 = Standard value declared in GENERAL PARAMETERS mask (output terminator = input terminator)
- 01-7F = Permissible values if standard values do not satisfy requirements
- 80 = No output terminator

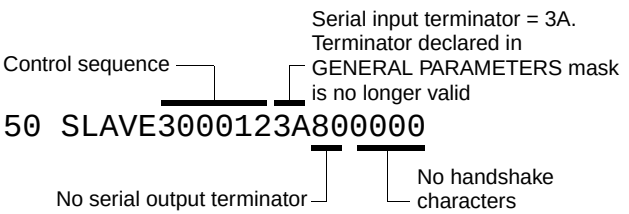
CC = **Handshake characters within character string** (2 bytes, hexadecimal)

- 00 = No handshake characters
- 01-7F = Permissible handshake characters
- 80 = Data byte being output is expected back as handshake characters (echo handshake)
- 90 = Any character is accepted as handshake character

DD = **Handshake characters at end of character string** (2 bytes, hexadecimal)

- 00 = No handshake characters
- 01-7F = Permissible handshake characters
- 80 = Data byte being output is expected back as handshake characters (echo handshake)
- 90 = Any character is accepted as handshake character

Example of use of command in AUTORUN programs:



Continuation	Command syntax for recalling standard parameters: **WRITE[300013]** **SLAVE300013** (no brackets!) These command sequences make the interface parameters valid again that were declared in the GENERAL PARAMETERS mask. The result is the same if you switch the communication tester off and on again, or if you strike [CLEAR].
Output hexadecimal zero on RS-232 interface[2)]	
WRITE[300014X] or **SLAVE300014X**	X = number of hex 0s that should be output (permissible figures: 00 to 99). Only use WRITE for controller programs. Only use SLAVE for AUTORUN programs. Special applications require output of hex 0 (control character). This is not possible with the SER_Out command because SER_Out:0 outputs an ASCII zero for example (corresponds to hex 30). Example: `WRITE[30001412]` outputs the hex 0 character twelve times in succession on the RS-232 interface.
Store string on Memory Card	
STOREdata	`data` = character string to be stored (max. 100 characters) The command creates the file RESULT.RES on a Memory Card and stores the character string in this file. Depending on the available capacity, 16 or 4 Kbytes are reserved for the file. If there is already a RESULT.RES file, the character string is added to the end of the file. If there is no more reserved space available, the RESULT.RES file is renamed RESULTFULL.RES and a new RESULT.RES file is created (see also "AUTORUN Test Reports"). If there is no more memory available on Memory Card or no Memory Card adapted, an error message will appear and the program is halted. **Note:** This command is not available in AUTORUN mode.

Output Format

The output format of the 4032 offers two different modes of presentation:

PRSTRing	Decimal format (standard)
PREXPonential	Exponential format (IEEE format)

Note: Neither command is available in AUTORUN mode. In some measurements (eg MDEMO) two values are output (format: value 1 SPACES value 2 CRLF). ">>>>": overflow), "<<<<": underflow, "- - - -": no test signal, "????": measuring without sense.

Exponential output format

Character 1	Sign of mantissa
Characters 2-11	Mantissa
Character 12	"E"
Character 13	Sign of exponent
Characters 14-15	Exponent
Characters 16-17	Two Spaces
Characters 18-20	Dimension (left-justified)
Characters 21-22	CRLF

Decimal output format

Characters 1-9	Measured value (right-justified, max. 9 places, filled out with spaces)
Characters 10-11	Two spaces
Characters 12-14	Dimension (left-justified)
Characters 15-16	CRLF

Service Request

The SRQ is enabled by the SMASK command (Set SRQ Mask, not available in AUTORUN mode). Values between 00 and 3F are legal.

The meaning of the individual bits is as follows:

Bit 0	Error occurred (message in status line)
Bit 1	Synthesis unsynchronized
Bit 2	Wrong command (syntax error or control character in string)
Bit 3-5	Always 0 (reserved for later use)
Bit 6	SRQ bit, always 1
Bit 7	Always 0 (reserved for later use)

Error Messages

GENERAL ERRORS
0200: AUTORUN ERROR
0201: FUNCTION NOT AVAILABLE IN IMMEDIATE MODE.
0202: FUNKTION NOT IMPLEMENTED.
0203: USER STOP EXECUTED.

EDIT
0210: LINE TOO LONG.
0211: BAD LINE NUMBER. Legal Range 1..9999.
0212: BAD GOTO/GOSUB STATEMENT. Bad line number ?
0213: PROGRAMM MEMORY FULL.
0214: CORRUPT PROGRAMM. RELOAD.
0215: RENUMBER INCREMENT FACTOR TOO LARGE.
0216: RENUMBER UNMATCHED GOTO/GOSUB LINE NUMBERS.

SYNTAX
0220: BAD SEPERATOR.
0221: BAD NUMBER.
0222: BAD STRING. Eg a$..d$,m$ "text" 'string
0223: BAD CONDITIONAL EXPRESSION. (= <> < <= > >=)
0224: DELIMITER EXPECTED.
0225: VARIABLE EXPECTED
0226: EQUAL CHARACTER EXPECTED.
0227: TO EXPECTED. Incorrect FOR syntax.
0228: 0UTLIMIT SYNTAX INCORRECT. out(mmeas,lo,hi)
0229. BAD RDOUT LIST SYNTAX. Eg rdout(mmess;a,b)
0230: KEY SYNTAX INCORRECT. Eg num, 'text',cmd
0231: KEY WAIT or KEY RUN. NO KEYS PROGRAMMED.
0232: BAD MID SYNTAX. Eg A$(3, 5) is from 3 to 5
0233: BAD NUMBER. Eg B$(start, end). Max is 49.
0234: STRING 0PERAND INVALID. Value not lnteger ?
0235: BAD STRING TYPE. Eg a$..d$ "text" m$(3,4)
0236: SYNTAX ERROR

RUN TIME ERROR
0240: RETURN WITHOUT GOSUB.
0241: AUTORUN STACK FULL. Too many gosubs ?
0242: NO MATCHING FOR STATEMENT.
0243: DIMENSION MISMATCH. Eg MHz with uV.
0244: MISSING OR EXCESS BRACKETS.
0245: MATHS ERROR.
0246: RDOUT VARIABLE NOT USED.
0247: UNEXPECTED END. FOR or GOSUB still active.

Error messages with IEEE COMMAND

0011: received IEEE command line too long (max. 100 characters permitted).
0012: received character cannot be shown
(characet number was smaller than 20 hex and no CR of LF).
0013: unknown IEEE command.

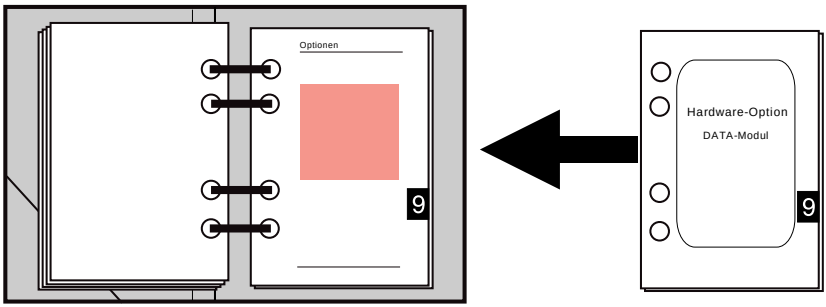
The error messages 0011 to 0012 appear in the status line as follows: error number, received IEEE command line (in as much as it can be shown).

0260: BAD IEEE VARIABLE INSERTION SYNTAX.
0261: IEEE SYNTAX ERROR.
0262: COMMAND EXPECTED.
0263: MEASUREMENT EXPECTED.
0264: IEEE KEYWORD EXPECTED. Unknown keyword.

Hardware Options and Accessories

Introduction

Chapter 9 is reserved for describing the hardware options. When you order one of these hardware options, you will receive the pages that describe its us. You can then file them under this chapter.



In the list of contents under chapter 9 you will find the hardware options listed. Cross the appropriate field if you add the description of a hardware option to the operating instructions.

As a rule the options will be ready installed if you ordered them together with your STABILOCK 4032. The OPTIONS mask (see chapter 4) shows what options your 4032 contains. Software options (simulation of radio-data systems) are described in Chapter 10.

Extra accessories

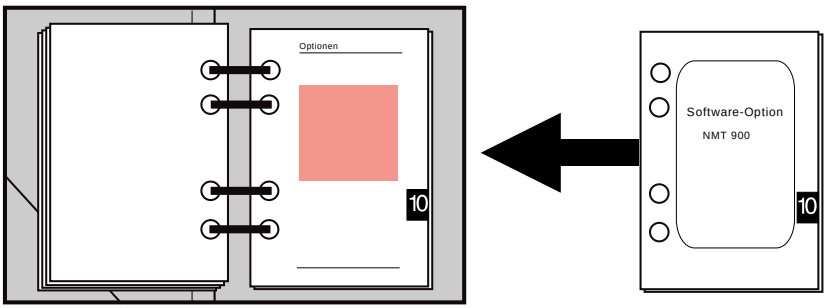
The data sheet will tell you about the many different accessories that are available for STABILOCK 4032. In addition to these there are various adapters especially for maintenance and service of the 4032 plug-in stages:

AF service adapter	248 182
RF service adapter	248 183
Power-supply adapter	248 184

Software Options

Introduction

Chapter 10 is reserved for the descriptions of the software options. Whenyou order a software option, the appropriate instruction are supplied with it. Insert these instructions in this chapter.



In the list of contents you will find all the available software options under chapter 10. Cross the appropriate field if you add a description to the operating instructions.

General Description

The available memory cards, containing test software for cellular radios of the various systems such as NMT 450, NMT 900, AMPS, E-TACS, RC 2000, C-NETZ FRG, etc, perform the following basic function tests of the corresponding mobile stations (MS).

a) Mobile initiated call

b) MTX initiated call

c) Handoff to any traffic channel during call in progress

d) Changing Mobile power on traffic channel

Note: In the space provided for this chapter (subdirectory), insert the text that comes with the software option (Memory Card)

Additional or different test procedures are described in the appropriate system description. All the tests are started by pressing the corresponding softkey. The softkey depressed will then be displayed inverted until the test is completed. The softkey (RETURN) becomes simultaneously the (STOP) key (also inverted display) in order to interrupt the test procedure in the event of a defective Mobile.

Connection setup

The 4032, upon loading a program, switches to duplex operation mode and simulates the base station (BS). To establish a connection with the Mobile, the 4032 first starts a system-specific handshake procedure with the Mobile and then commands the Mobile to the preset traffic channel. When the call procedure is completed the digital data exchange has successfully been tested and then the measurement results of frequency offset, deviation and power of the Mobile are continuously displayed.

Background signaling

Manual switching to the DUPLEX mask takes you out of the test mask, and further typical radio measurements can then be performed. The signaling is continued that is necessary to maintain the Mobile-BS call connection. The green LED of the modulation generator GEN B illuminates to show that the signaling is generated in the background. The LED also illuminates if GEN B was switched off beforehand or this modulation generator (option) is not installed.

Pressing the [B/SAT] key stops the background signaling. This can be recognized by the fact that the LED extinguishes and that the message "Data module generator stopped" appears in the status line of the screen. The absence of the signaling leads shortly afterwards to termination of the connection between the 4032 and the radio set. How long the connection can be maintained by a radio set without background signaling depends on the cellular system.

Test Setup

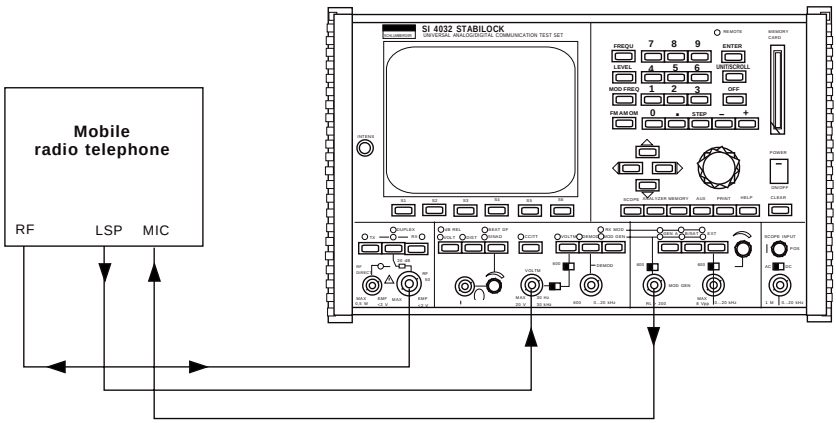


Fig. 10.1: Cable connections: 4032 (MOD GEN) → microphone input MIC of mobile; for measuring the modulation characteristics of the mobile transmitter. AF output (LSP) of mobile → 4032 (VOLTM); for measuring the sensitivity and demodulation characteristics of the mobile receiver. RF ↔ RF = RF signal path.

Checking background parameters

All system programs that allow the entry of channel numbers use the GENERAL PARAMETERS mask for entering special-to-system values. So you must expect that, just by calling up a system program, declarations originally made in the GENERAL PARAMETERS mask will be overwritten. These original declarations are rapidly restored if they are stored as a setup and loaded after working with the system program.

SAT Loop Measurement

The SAT loop measurement is necessary in cellular-radio systems if they work with a pilot tone (SAT) (eg NMT systems). The pilot tone (f = 4 kHz) is usually emitted from the base station with 300 Hz shift, received by the mobile and then transmitted back to the base station with as little alteration as possible (without amplification/attenuation). Whether the base station then sends the mobile a message to increase or reduce transmitting power, for example, will depend on the shift of the "mirrored" SAT. The procedure requires that the mobile should in fact "reflect" the SAT unaltered. This can be determined by a SAT loop measurement.

Boundary conditions

- Software option (NMT system or similar) on SYSTEM CARD
- OPTION CARD fitted with 4-kHz bandpass filter

Measurement → SAT loop

1. Load system program, fill in entry fields and set up radio connection (by (MTX) or (MOBILE)).
2. Switch to DUPLEX mask.
3. Activate 4-kHz bandpass filter on OPTION CARD and cut into TX-DEMOD signal path (see also foldout "OPTION CARD").
4. With [RX MOD/MOD GEN] and then calling up dBr meter 4032 SAT shift (300 Hz) is set to 0 dB (reference value).
5. With [DEMOD] apply the demodulated SAT shift of the mobile to the dBr meter.
6. dBr meter shows every deviation of the mirrored SAT from the nominal value of 0 dB.

Training

Introduction

The purpose of the chapter "Training" is to familiarize you step by step with elementary operating rules of the 4032. This is best done in close contact with the instrument itself and will take about three to four hours. Before starting the course however, first read the sections "Preparations for Startup" and "Notation Rules" (Chapters 1 and 3).

Do not worry if you feel things are getting on top of you when you are in the middle of training: you can always turn to the operating rules in Chapter 3 for quick reference. Chapter 4 provide you with details of the different screen masks. The course itself is not meant to be a reference source. Just work through it once and then it has fulfilled its purpose.

Status Mask

Objectives

- Familiarization with status mask
- Recognizing, opening and closing entry fields
- Correcting false entries
- Enquiring for permissible entry limits
- Moving to further entry fields
- Enquiring for scroll variables
- Familiarization with softkeys

Callup of status mask

Following startup with [POWER] the monitor of the 4032 very likely does not yet show the status mask, so you will have to call it up. Press the [OFF] key, keep it depressed and additionallypress the [CLEAR] key. The 4032 acknowledges this with a signal tone, clears the mask on its screen and calls the status mask up on the screen after a brief pause.

If you do not make any entries on the STABILOCK 4032 for a longish period of time, the mask that is momentarily displayed will be replaced by the screen saver. In this way the monitor is protected against burns, especially if the display is set very bright. As soon as you press a key, the monitor will again show the mask that was originally on the screen. The screen saver can switched off in the GENERAL PARAMETER mask.

Messages of status mask

The status mask provides you with important information about the current status of your 4032. After the Mode message TALK & LISTEN indicates the operating mode of the IEEE bus that is set ex works. CR&LF is likewise a setting ex works that concerns remotely controlled operation of the 4032 (control command). You will learn in this lesson how to alter these ex-works settings.

From the message Software-Versions you can see with what software versions your 4032 is presently fitted. The identifying numbers of the software follow the brief designations of the associated microprocessors. CRC (cyclic redundancy check) checksums of the software are also indicated. In the event of servicing these checksums help to identify an error in the system software.

You do not have to pay any attention yet to the brightened up fields at the bottom edge of the screen. There is a special reason for these fields that you will learn about further on in this lesson.

The terms "Mask" and "Entry field"

The status mask is one of several masks (screen pages) that the 4032 - depending on the operating mode - is able to show on its screen. The term "Mask" indicates that the appearance of the individual screen pages is largely determined by the 4032 (display fields). Certain parts of the mask (entry fields) are left blank however: these are the only fields that the user may access; the remaining fields on the screen (text fields) may not be accessed. The 4032 offers you two different kinds of entry field:

- entry fields for numeric values (numeric fields)
- entry fields with given variables (scroll fields)

The vast majority of entry fields are numeric fields. You will soon learn about one of these fields together with two scroll fields. But first note that there are "pure" numeric fields, "mixed" numeric fields and "hidden" numeric fields. You will learn more about these later on when training with the RX mask.

Display of entry fields

The status mask shows you how the 4032 presents entry fields: following the text field `IEEE-488 ADR.` the IEEE-bus address is displayed on the screen inverted (dark script on a bright background). This is in the entry field that is currently active. To be more precise, this is a pure numeric field because it only contains numerics.

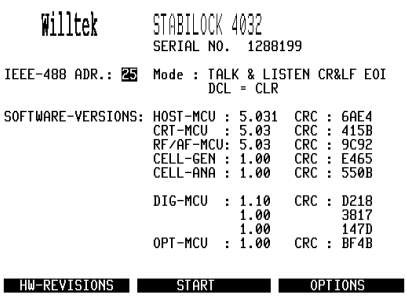


Fig. 11.1: The `Mode` text field is followed by four scroll fields `TALK & LISTEN`, `CR&LF` , `EOI` and `DCL = CLR`. The `IEEE-488 ADR.` field is inverted here, ie it is the current entry field.

The 4032 always marks the momentarily valid entry field by showing it inverted and expects a reaction on your part to this field (exception: the inverted fields at the bottom edge of the screen are **not** entry fields). You then have the choice of "opening" the marked numeric field with an entry or of moving to another entry field.

Normally a text field is assigned either just a numeric field or just a scroll field, the text field providing information about the meaning of the particular field. In such cases the operating instructions refer to both of the fields under the designation of the text field. If the numeric field `IEEE-488 ADR.` is being spoken of for example, the numeric field is meant that follows the text field of the same name. If a text field is followed by several entry fields however, the latter will have to be named after their content.

Opening numeric field

In the case at hand the field indicates the IEEE-bus address of the 4032 that is set ex works. You may now alter this address, but first you must open the numeric field. There are two ways of doing this:

- Opening of numeric field by entering number
- Opening of numeric field with [ENTER]

Choose the first method by entering any two-digit value on the keys of the numerics block.

Correcting entry

Wrong entries can be corrected at any time with the cursor keys as long as a numeric field is open. An opened numeric field can always be recognized by the flashing cursor.

If you have entered the first digit of the new bus address incorrectly for instance, just tap the cursor key pointing to the left so that the cursor marks the wrong digit. Then you can enter the correct digit. For longish numeric fields there is a possibility for correction that you will learn to appreciate, namely the auto-repeat function of the cursor keys: keeping one of the keys depressed produces the same result as striking it several times.

Within an **opened** numeric field you can only move the cursor with the key pointing to the left or to the right.

Closing numeric field

Simply entering the new bus address does not complete the entry procedure. The entry is not completed until you have decided that the entered value is correct and transferred it to the 4032 by striking [ENTER]. [ENTER] closes an opened numeric field. You recognize this by the fact that the flashing cursor disappears. A closed numeric field can also be opened again with [ENTER] to make a subsequent correction for example.

Before transferring your entry of the IEEE-bus address to the 4032, correct it to 45. This will help you to follow a demonstration that shows how the 4032 deals with illegal entries.

Rejecting illegal entries

The 4032 reacts to the transfer of the bus address "45" with a warning tone and ignores it. Reason: the set always checks whether an entered value is within the permissible range. Legal values are always between the limits (see data sheet) for which the 4032 is specified.

Every attempt to transfer an illegal value produces a warning tone; at the same time the numeric field again shows the value that it contained before the illegal entry.

Enquiring for permissible entry limits

If you are now wondering what values are permissible for the bus address, the Communication Test Set itself will help you. Only the appropriate numeric field must be open. Then the 4032 automatically assigns the [HELP] key the task of presenting the permissible entry limits on the screen. Just try it: open the numeric field for the bus address again with [ENTER] and then strike the [HELP] key. The 4032 will immediately show you at the bottom of the screen, in the socalled "Notice line", between what valid bus addresses you may select. Now enter the required value or again choose the address set ex works and close the field with [ENTER].

Finding further entry fields

You may not be able to see them yet, but the status mask has three more entry fields (scroll fields) to offer you. You can reveal these entry fields with [HELP], but not until the numeric field of the bus address has been properly closed. Because in this way the 4032 realizes that you are not trying to find out what the permissible entry limits are.

> As long as you have not opened a numeric field, [HELP] will briefly mark all entry fields of a mask, except for hidden numeric fields.

So tap the [HELP] key again: straight away the 4032 will then briefly mark the `Mode` fields by inverting them. These are the scroll fields you are looking for and they are all assigned to the `Mode` text field. Consequently these scroll fields are named after their content. In contrast to numeric fields you cannot enter values in scroll fields but instead must select one of the several fixed scroll variables.

All entry fields show a number between 0 and 99 after [HELP] for purposes of identification. This identification is important if the entry fields are assigned new contents by an AUTORUN program (see Chapter 8) or the controller.

Revealing the entry fields of a mask is an aid to your memory and does not necessarily have to be done before moving to the next entry field.

Moving to next entry field

The next entry field is to the right of the one that is still active, so the cursor key pointing to the right takes you to the TALK & LISTEN scroll field. First you must have closed the numeric field for the bus address. Otherwise the cursor keys, as already described, would govern the cursor within the numeric field.

With other masks you will find that you have to use the other cursor keys too when moving to other entry fields. Basically it can be said that every entry field can be reached with the cursor keys as long as you have not opened a numeric field. The entry field that is momentarily active can always be recognized by its inverted display.

Using the vertical cursor keys you can also leave a numeric field if it has not been closed with [ENTER]. However the numeric field then keeps the value that you last confirmed with [ENTER].

Enquiring for scroll variables

TALK & LISTEN is the first scroll variable of the scroll field that is set ex works. This says that the 4032 can transmit and receive data together with external devices in bus operation. The other scroll variables that the entry field has to offer are revealed with the [UNIT/SCROLL] key. Strike this key and the 4032 will present TALK ONLY as the second scroll variable. The 4032 is then exclusively a transmitter of data. Repeated operation of the [UNIT/SCROLL] key produces the scroll variables in an endless sequence in the scroll field (scrolling). If you try this, you will see that only the active entry field presents the two variables mentioned. Now use [UNIT/SCROLL] to select TALK & LISTEN again.

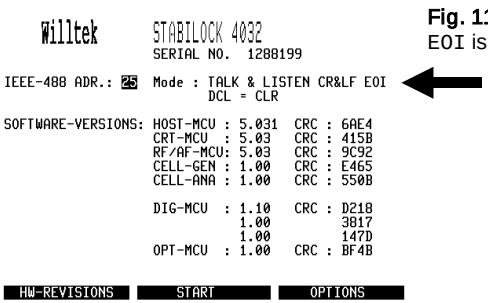


Fig. 11.2: The alternative to scroll variable EOI is a blank field.

Scroll fields do not have to be opened and then closed again for the selection of a variable. As soon as you have declared such a field as the active field, the required scroll variable can be called up immediately with (UNIT/SCROLL). Afterwards you can exit from the field straight away by moving to another field, for example, or even by calling up another mask: the selected scroll variable is preserved.

Perform moving to the other two scroll fields and calling up the scroll variables by yourself. You will find details about the meaning of the scroll variables in chapter 4.

Familiarization with softkeys

Now it is time to look at the exception mentioned above, ie the inverted fields at the bottom edge of the screen. These fields show the functions that are momentarily offered for the keys S1 through S6 (softkeys) further below. The name "softkeys" already indicates that the functions of the keys are determined by the software of the 4032. And this is done in such a way that the keys always have the functions that are necessary for the selected operating mode. The appropriate key simply has to be tapped to call up a function. The softkey functions represent to a certain extent individual labeling of the keys S1 through S6, so the different functions are always named in requests to operate softkeys, eg (OPTIONS). The italics indicate that a softkey will be operated.

The six softkeys replace a large number of conventional keys. Thus the clear and straightforward front panel of the 4032, which enables you to work speedily and minimizes the risk of incorrect operation.

One and the same function can be assigned with equal priority to several softkeys. In the status mask, for example, each of the functions is assigned to two keys, it being irrelevant which of the two you strike to call up the function concerned. The softkeys of the status mask are assigned the following three functions:

(HW-REVISIONS) Takes you to a mask that states the development status of the different stages of the 4032. The codes quickly help to produce a common basis for understanding if you telephone for advice.

(SELF-CHECK) Takes you to another mask permitting the start of a self-diagnosis program. For further details see "SELF-CHECK" in Chapter 4.

(START) Calls up the RX mask, ie puts the 4032 into the mode for receiver measurements.

(OPTIONS) Calls up a mask that provides closer details of any options that are incorporated - in particular the OPTION CARD.

If you want to, take a look at the three masks HW-REVISIONS, SELF-CHECK and OPTIONS and then return to the status mask with RETURN. But wait a while before calling up the RX mask.

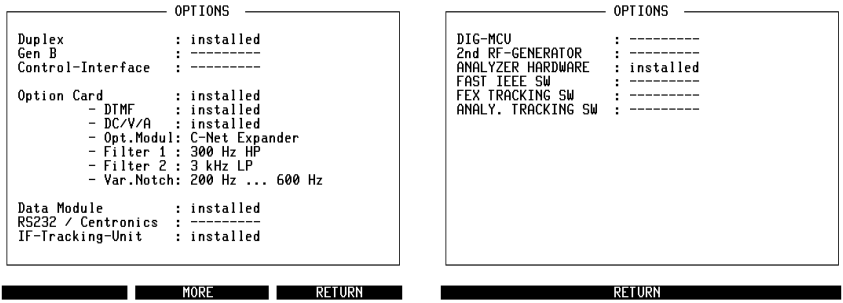


Fig. 11.3: The two pages of the OPTIONS mask show what hardware options your 4032 is fitted with. MORE takes you from the first page to the second.[5)]

What are "default" settings?

Default has the meaning of a placeholder or ex-works setting. These placeholders appear in the 4032 when a setting is possible but you have not yet altered anything. Default settings are, for example, the contents assigned ex works to the entry fields. But the functions of the softkeys and the other keys also have default settings. They all simply serve the purpose of creating a reproducible, initial operating status for the 4032.

Total Reset

A total reset (master reset) produces all default settings compulsorily ans calls up the status mask. This deletes irrevocably all settings selected beforehand by the user!

To execute a total reset, press the OFF key, keep it depressed and additionally press the CLEAR key for a short time or switch on the STABILOCK 4032 with POWER.

Switching on/off

If you only switch the 4032 on and off with POWER, the settings that you have selected are preserved. The entries in the entry fields will not be deleted for example. What is more, the 4032 will immediately present after switch-on the basic mask that was active before switch-off. Thus an interrupted measuring routine can quickly be resumed. The operating status is stored by a battery-buffered RAM, so it is possible to continue working straight away even after power outages.

RX Mask

Objectives

- Familiarization with RX mask
- Fast access to entry fields
- Working with handwheel
- Presetting stepping width for frequency and level
- Familiarization with hidden and mixed numeric fields
- Correct working with softkeys
- First contact with RX Specials

Callup of RX mask

The RX mask is one of the three basic masks of the 4032. The other two basic masks are the TX mask and the DUPLEX mask that is linked with the optional duplex FM/M demodulator. Call up the RX mask with (START) or [RX]. This is the basic mask for all receiver measurements. But to begin with it is only to be your training partner for getting acquainted with further elementary operating rules. Once you can master the operating rules of this mask, you will already know most of the operating rules for working with the TX and DUPLEX mask.

LEDs mark operating status

Calling up the RX mask activates a number of LEDs on the front panel of the Communication Test Set. Thus the 4032 shows its operating status, which at the moment is solely determined by default settings. An illuminated LED means that the function assigned to it has been selected. Certain functions can only be called up in the RX mode and others only in the TX mode; then there are functions which are independent of the operating mode. The colours of the LEDs indicate these relations.

Green: function in RX mode
Red: function in TX mode
Yellow: function independent of mode

At the moment the LEDs signal the following operating status:

Key	LED	Meaning
[RX]	(green)	RX mode selected (receiver measurement)
[VOLT]	(yellow)	RMS voltmeter activated
[VOLTM]	(yellow)	VOLTM socket is input of voltmeter
[GEN A]	(green)	Modulation generator GEN A is activated in RX mode

Switching GEN A to RX/TX signal path

When the RX mask is called up, GEN A can be switched to the RX or TX signal path by repeatedly striking the key of the same name. When the RX signal path is switched (green LED illuminates), the modulation signal feeds the modulator of the 4032 signal generator. In this case the modulation signal can only be brought out on socket Bu 27 (back panel). If the TX signal path is switched on the other hand (red LED illuminated), the signal from GEN A appears AC-coupled on the MOD GEN socket and additionally DC-coupled on socket Bu 29 (back panel). This RX/TX signal-path switching is also possible if you have called up the DUPLEX mask (option).

The GEN B (key [B/SAT]) option also reacts like GEN A. If both generators are switched to the RX signal path, the modulator is fed with the sum signal when the RX mask is called up. With [EXT] it is also possible to add a signal fed into the EXT MOD socket. The general rule for the RX and DUPLEX mask is as follows: all signal sources "switched green" feed the RX signal path, all signal sources "switched red" feed the TX signal path. By the way, in the TX mask - which you will learn about in the next lesson - you can switch the three modulation-signal sources only to the TX signal path, because the 4032 signal generator is then no longer active.

A voyage of discovery

Now you can go ahead and try out what you have learnt about entry fields with the status mask: see how many entry fields the RX mask has, move to the different entry fields, open and close them, enter random values, alter single digits here and there and have the permissible entry limits displayed to you.

Now call up the RX mask after an total reset to recreate a defined starting point.

Fast access to entry fields

Darting backwards and forwards in a mask with the cursor keys to find an entry field that may then have to be opened is a procedure that may be fun at first but is too awkward for everyday testing of radio sets. Therefore the 4032 offers the possibility of fast access to the appropriate entry fields for the more common settings. Tap the keys [FREQUENCY], [LEVEL], [MOD FREQ] and [FM AM ΦM] at will. This will immediately lead to opening of the particular entry field:

[FREQUENCY] opens the RF Frequency field, which is relevant in the RX mask for the carrier frequency of the signal generator.

[LEVEL] opens = the Level field, which momentarily determines the level of the signal generator (–60 dBm into 50 Ω). [OFF] switches the signal generator off when the Level field is opened. [LEVEL] causes it to switch on again.

[MOD FREQ] opens the AF GEN A field (modulation generator GEN A) and permits entry of the modulation frequency. [MOD FREQ] also compulsorily switches on GEN A.

[FM AM ΦM] opens the Mod. field, which expects entry of the required frequency deviation (FM is the default setting). The selected type of modulation is shown in the mask header (here: RX FM). [FM AM ΦM] also compulsorily switches on generator GEN A.

If you type values into the entry fields and transfer them with [ENTER], this immediately triggers the corresponding reaction: the signal generator and the modulation generator are set according to the entries. The same applies to all other entry fields: the transfer of a valid value leads immediately to the corresponding setting on the 4032.

The four keys for fast access require consistent adherence to the operating rule, namely that entries in numeric fields have to be terminated with [ENTER]. If you strike the [FREQU] key for instance while the Mod. field is open, the Mod. field is left and the RF Frequency field is opened. But if the Mod. field was open because you had begun to enter a value with the numeric keys, this value will be rejected. Reason: no confirmation with [ENTER].

Access to offset field

Fast access is also possible to the `Offset` field. A value entered in this field detunes the carrier frequency finely as is necessary for determining the IF bandwidth of a receiver for example. Fast access to the `Offset` field presumes that the `RF Frequency` field is currently active. Then it is sufficient to initiate the entry of the offset value by striking the minus or plus key: the `Offset` field is opened automatically and the sign of the offset is entered correctly at the same time.

A frequency offset entered in the `Offset` field produces no reaction in the `RF Frequency` field. Here the originally selected carrier frequency is always displayed.

Handwheel instead of numerics block

If you prefer to make settings in analog manner with a handwheel, you can still do so. As a tribute to analog engineering the 4032 offers a quasianalog handwheel for varying entered values. In actual fact however, this is not just a modern copy of a good old handwheel but a multifunctional control that assumes the tasks of the numerics block, of the [ENTER] key and in part also those of the [UNIT/SCROLL] key.

Now declare the RF `Frequency` field to be the active **and** opened field. If you then slowly (!) turn the handwheel, this changes the value of the location marked by the cursor, carry-overs being allowed for also. The position of the cursor determines the degree of continuous frequency alteration by the handwheel: if the cursor is far to the left, the resolution will be coarse, and if it is far to the right, the resolution will be fine. Try it out just once for yourself, even though it may seem trivial.

If you were thorough, you will now know that the finest resolution was not more than 100 Hz. For carrier frequencies below 500 MHz, however, the data sheet guarantees 50 Hz resolution. This is where the `Offset` field helps again. You can open it with [+] (positiv offset) or [-] (negative offset).

"Multifunctional" would be an exaggeration if the quasianalog variation did not offer a further speciality: variations of numeric values made with the handwheel are valid immediately. So they require no confirmation with [ENTER], even if the flashing cursor seems to indicate the opposite. This characteristic of the handwheel is of particular benefit if you wish to observe the effect of continuous variation of the entry value on a measured result.

With each operation of the handwheel the entry confirmation [ENTER] is implicitly executed. Striking the [ENTER] key is only necessary if you wish to move to another entry field in the same line with the cursor keys. With the handwheel you can access any numeric field that you have declared to be the active field. If the current field is a scroll field, slow turning of the handwheel (left/right) calls up the individual scroll variables.

Stepped alteration of frequency

To make your testing routines more rationalized, it would be of advantage if you could alter the carrier frequency in any stepping width - the currently applicable channel spacing for instance - simply by striking a key. And this is exactly what the [STEP] key offers you. But to avoid any operator error, it does not react until the RF Frequency field has been opened. If you have done this, with [FREQU] for example, and then strike the [STEP] key, the 4032 will show the new STEP field with the default value 0 kHz. For the first time you have thus discovered a hidden numeric field. The flashing cursor indicates as usual that you can make an entry in the field. So enter 20 for example and close the field:

<20> + [ENTER]

If you now tap the [+] or [-] key several times, the carrier frequency in the RF Frequency field will increase or decrease by 20 kHz each time. At the same time the STEP field opens again so that the stepping width could immediately be changed. The value that was valid before is not replaced, however, until the new value has been properly transferred with [ENTER].

The STEP mode of the two sign keys is maintained for as long as the STEP field is shown inverted, ie is active. [HELP] produces no reaction with hidden numeric fields.

When you want to leave the STEP field, you can do so as usual with the cursor keys but also with the keys for fast access. Just use [STEP] to move back to it. If you think you will not be needing the STEP field for a longish period, you can remove it from the mask with [OFF]. When it is called up again, STEP is given the stepping width that was last valid. To make sure the field is not removed from the mask by mistake, this can only be done while STEP is open.

Another way of quickly altering the carrier frequency in increments of the channel spacing is to use channel numbers. The lesson "Training with DUPLEX Mask" tells you more about this.

Stepped alteration of level

The STEP mode can also be assigned to the Level field for alteration of the output level with a defined stepping width (in dB). The operating rules described above apply in the same way. So to call up the STEP field, first the Level field has to be opened, and then [STEP] will present you with the default value 0 dB.

The hidden numeric field STEP cannot be allocated simultaneously to the RF Frequency and Level fields.

Mixed numeric fields

Now it is time to find out about the last type of numeric field: select `Level` as the active field and then strike the [UNIT/SCROLL] key several times. This opens the field and shows in alternating fashion the values `223 µV`, `–60.0 dBm` and `47.0 dBµ`: the value of `-60 dBm` originally selected is converted into `dBµ` and `dbm` units. So you can have the level shown in the units you are accustomed to using. The selected units are kept until you change them again. `Level` is a mixed numeric field, meaning that you can determine both the numeric value **and** the units.

If you want to key a numeric value into the `Level` field, you do not necessarily have to select the required units µV/mV, dBm or dBµ beforehand with [UNIT/SCROLL]. It is also possible to call up the matching units with [UNIT/SCROLL] after the numeric value has been entered. In this case there is no conversion. Conversion is only made as long as you have not yet started to enter a numeric value in the `Level` field. This conversion mode, by the way, is an exclusive feature of the `Level` field, it is not a general feature of mixed numeric fields.

`Mod.` is also a mixed numeric field. If you move to it with [FM AM ΦM] for example and then enquire with [UNIT/SCROLL], it will alternately show `2.40 rad`, `30.0 %` and `2.40 kHz`. These are the default values of phase deviation, modulation depth and frequency deviation. By selecting the units (radian, percent or kilohertz) you specify the type of modulation that is valid. In the mask header, corresponding to the units, the abbreviation of the selected modulation (`ΦM`, `AM` or `FM`) appears after RX. In this field too it is possible to enter the numeric value first and then to assign the units with [UNIT/SCROLL].

As mentioned before, one of the specialities of the RX and DUPLEX mask is that you can switch the AF generator to the RX or TX signal path by repeatedly tapping [GEN A]. When the TX signal path is switched through, the numeric field `Lev.` replaces the `Mod.` field and now influences the level of GEN A directly (not indirectly by way of the required modulation). But now the signal generator is no longer modulated, instead the AF signal is output on the MOD GEN socket (front panel) and on socket 29 (rear panel). Find out more about the `Lev.` field in the next lesson.

If you want to, now try to track down the third mixed numeric field of the RX mask. All you have to do is to see whether an active field reacts in the typical manner to [UNIT/SCROLL] by changing its units.

No doubt you will soon find out that it is the RF Frequency field, which betrays itself as a mixed numeric field with the "units" NoL, NoU and MHz. NoL and NoU have to do with duplex operation of a radio set (communication in both directions at the same time). The abbreviation NoL indicates a channel in the Lower band and NoU one in the Upper band. So you can enter a channel spacing on the 4032 and then (in any basic mask) work with channel numbers instead of frequency values. Further details of this (see "Training with DUPLEX Mask") are unimportant at the moment.

Now you know all the different entry fields of the 4032 and most of the controls of the front panel, so you are well on the way to using the 4032 for your first tests.

Softkeys of RX mask

To restore the STABILOCK 4032 to a defined initial status, it is best if you now start it up again with a total reset and call up the RX mask. When you change from the status mask to the RX mask, you can see very easily how the softkeys are assigned different functions. Reminder: the brightened up fields at the bottom edge of the screen show the functions of the softkeys that are momentarily **offered**. This means that an offered function does not become effective until you tap the softkey associated with it. This seemingly banal rule of operation is very important for proper use of the 4032. And an example will show why this is so:

Softkey S1
If you tap softkey S1 several times, the function associated with it will change from (RF DIR) to (RF) and back again. At the same time the display in the numeric field Level changes between, for example, 10 µV and 100 µV. Reason: with S1 you couple in the RF field (front panel) either the RF DIRECT socket or the RF socket to the RF input/output stage of the 4032. A 20-dB attenuator in the signal path to the RF socket causes the jump in level that you have observed in the Level field.

When the RF DIRECT socket is coupled, this is underscored by a LED allocated to the socket. However, softkey S1 does not present the function (RF DIR), but (RF) instead. This is not a contradiction, because the rule of operation says: ...an offered function does not become effective until you tap the softkey associated with it. So if this is not done, the alternative function remains activated: and the alternative function to (RF) is (RF DIR).

Softkey S2

(EMF CONT) is the default function assigned to softkey S2. If you call this function up with (EMF CONT), the hidden numeric field CONT (default 0 dB) will appear next to the Level field and at the same time the function of softkey S2 is renamed (CONT OFF). A value can now be entered in the numeric field CONT (max.: 20). After confirmation of the entry with [ENTER] the level of the signal generator - starting from the level that is momentarily set - is reduced by the CONT value. What is special about this level reduction is that interruptions, as normally occur in mechanical setting of the attenuator set (chain of precision attenuator pads), are excluded. And that is just what is important when measuring the response of the squelch in a receiver. (CONT OFF) cancels the CONT function and the level takes on its original value. If amplitude modulation is selected (mask header: RX AM), the CONT field cannot be displayed.

The Level field does not react to the level reduction by the CONT field. The actual output level of the signal generator is the sum of the values in the fields Level and CONT, eg –60 dBm + –15 dBm = –75 dBm. If the value in the CONT field is altered with the handwheel, this will produce continuous variation of level.

Softkey S3

The 4032 indicates the momentary output level of the signal generator either as an EMF value or as the terminal voltage into 50 Ω (default setting). A glance at the numeric field Level will show you quite unmistakeably that the default setting is still valid. The alternative display is Level/EMF. If you now try to call up the EMF function with (EMF) however, the 4032 will only react with a warning signal. Reason: the momentary level value is in dBm units. And these units only apply with reference to a defined load impedance (here 50 Ω). The EMF has no relation to the load impedance, so it can never be in dBm units. If you choose one of the other units (eg µV) for the numeric field Level, (EMF) will produce display of the EMF value. [UNIT/SCROLL] will then no longer offer dBm as the units until the function (50 Ω) is called up again with S3.

Softkey S4

If you call up the (SPECIAL) function with S4, you are taken to a mask in which the softkeys are assigned new functions. (SENS), (BANDW), (AF RESP) and (SQUELCH) produce entry fields for setting individual test parameters. (RUN) starts a measurement with the set parameters, (RETURN) takes you back to the basic mask.

The SPECIAL functions automatically execute complete measuring sequences. All necessary settings on the 4032 are produced under programmed control - allowing for the individual test parameters. After just a few seconds you can then read the result of the measurement on the screen. In the testing of receivers the "Specials" perform the following measurements:

(SENS)	Measurement of input sensitivity
(BANDW.)	Measurement of IF bandwidth and centre-frequency offset
(AF RESP.)	Measurement of AF response
(SQUELCH)	Measurement of squelch characteristic

First take a look at the individual entry fields for setting the special test parameters. Just tap alternately the softkeys S1 through S4. (HELP) will then reveal the new entry fields in the bottom half of the RX mask and (UNIT/SCROLL) clarifies whether they are pure or mixed numeric fields or scroll fields. Then call up the basic RX mask again with (RETURN). Practical information about working with the SPECIAL functions is given in Chapters 4.

Softkey S6

The analog indication of a measured value presents the advantage, compared to a numeric digital display, that you can immediately recognize any trend in the way a measured value changes. For this reason the 4032 shows important measured quantities not only numerically but also on simulated analog meters. The 4032 displays as many as three such analog meters in the bottom half of each basic mask. Now try to produce a full-format display of one of these meters with (ZOOM).

First you are taken to the new softkey functions (POWER), (MOD) and (RMS). These are the brief designations of the three meters that you can zoom, ie produce a magnified display of.

If you call up one of these functions, the 4032 will present the appropriate meter in large format, and the softkeys again assume different functions with which you can influence what the meter displays. But do not try this yet, call up the basic RX mask again with (RETURN). The lesson "Analog Instruments" goes into the details of this later on.

TX Mask

Objectives

- Familiarization with TX mask
- "Switching" between RX and TX masks
- Performing frequency measurements
- Familiarization with influence of squelch
- Initial contact with "TX Specials"

Callup of TX mask

Start up the 4032 anew with a total reset and - as soon as the status mask appears - press the [TX] key on the RF field. Now you have called up the TX mask (with its default settings). From this point on you can change between the RX mask and the TX mask at any time simply by striking the [RX] or [TX] key on the RF field.

When you change between the basic masks RX, TX and DUPLEX (option), the 4032 stores important entered values and device settings before each such change. When a mask is called up again therefore, the Communication Test Set always takes on the same operating status that was current before the same mask was exited from.

Indication of operating status

The LEDs on the front panel signal the default settings of the 4032 for transmitter measurements:

Key	LED	Meaning
[TX]	(red)	TX mode selected (transmitter measurement)
[VOLT]	(yellow)	RMS voltmeter activated
[VOLTM]	(yellow)	VOLTM socket is input of voltmeter
[GEN A]	(green)	Modulation generator GEN A is activated in TX mode; signal is on MOD GEN socket (see lines on front panel)

Entry fields of TX mask

[HELP] shows that, as usual, you can access three entry fields in the TX mask:

`RF Frequency` This mixed numeric field determines the receive frequency to which the internal test receiver is tuned. [UNIT/SCROLL] produces here too a change between `MHz`, `NoU` and `NoL`.

`AF GEN A` This pure numeric field is again decisive for the frequency of the modulation signal (GEN A). The signal of the generator is now output on the MOD GEN socket; it modulates the carrier signal of the device under test.

`Lev.` Your entry in this mixed numeric field determines the level of the modulation signal (GEN A). [UNIT/SCROLL] permits, **before** transfer of the level value with [ENTER], selection between `mV`, `V` or `dBm`. After transfer of the value (field closed) [UNIT/SCROLL] can be used to select the type of demodulation (TX FM, TX ΦM or TX AM).

Just like in the RX mask, the opened `RF Frequency` field can be assigned the hidden `STEP` numeric field. The operating rules are the same.

Offset field of TX mask

In contrast to the RX mask, the `Offset` field of the TX mask is not an entry field but a display field. What it displays is the frequency offset of the applied signal (RF or RF DIRECT socket) referred to the frequency to which the internal test receiver is tuned (`RF Frequency` field). The offset field indicates frequency offsets up to about ±100 kHz with the accuracy stated in the data sheet. If there is no input signal, as is the case at the moment, the display field will only show dashes (----).

The following applies to each mask: if a display field or a simulated analog meter indicates just dashes instead of a measured value, then either the test signal is missing or its level is too small for correct measurement. The display >>>>>> on the other hand means that the measurement range is exceeded.

If the RF DIRECT socket is coupled, the test receiver of the 4032 is very sensitive. When the RF DIRECT socket is open-circuit therefore, completely random values may be indicated, eg in the offset field.

RF frequency measurement

The offset field is not the only display field of the TX mask: the numeric field RF Frequency may also become a display field and show the frequency of the RF signal applied to the RF socket (see data sheet for specifications of RF frequency counter). The RF frequency counter is called up with (COUNT). If COUNT is selected, you can access the remaining entry fields of the TX mask in the usual manner. The alternative function to (COUNT) is (OFFSET); this takes you back to the measurement of offset.

As long as COUNT is activated, the test receiver of the 4032 is automatically retuned to the measured frequency. When the frequency counter is switched off with (OFFSET) therefore, the frequency last measured is taken into the numeric field RF Frequency. In this way you can tune the test receiver precisely to the frequency of an (unknown) RF input signal. The offset field may afterwards still show a residual offset of up to ±40 Hz. This residual offset is a result of the different resolution of the frequency counter compared to the format for frequency entry in the RF Frequency field.

The risk of the frequency counter indicating the frequency of an harmonic instead of the frequency of the fundamental is very slight. There is only danger of an erroneous measurement of this kind if three boundary conditions are simultaneously fulfilled:

1) the input signal contains a lot of harmonics;
2) the frequency of the input signal is an even-numbered fraction of the tuned frequency of the test receiver;
3) the boundary condition described under 2) does not occur until **after** the COUNT function is called up.

Any doubt about the correctness of a frequency measurement can thus be eliminated with (OFFSET) + (COUNT). The brief switching off of the frequency counter means that the third boundary condition for an erroneous measurement is no longer fulfilled when the measurement is repeated.

Internal squelch

If you have selected the RF socket, an internal squelch is active when the TX FM or TX ΦM mask (frequency and phase modulation) is called up. The squelch blocks the input signal if it goes below a level of about -40 dBm (2.23 mV). The risk of erroneous measurements is thus eliminated and bothersome acoustics are suppressed. This squelch is not effective in TX AM measurements, and it is always cut out when you use the RF DIRECT socket.

Softkeys of TX mask

You are already acquainted with the softkeys RF DIR and ZOOM because both have the same effect as in the RX mask. And the function of the COUNT softkey (S2) has just been dealt with under "RF frequency measurement".

Softkey S3

(PEAKHOLD) Refers to the DEMOD pointer meter (indicates the modulation deviation or depth of an RF input signal). (PEAKHOLD) causes the largest value measured to be stored. There are more details of this in the lesson "Training with Analog Instruments".

Softkey S4

(SPECIAL) Takes you, just as in the RX mask, to a submask with new softkey functions. Two of these functions again enable complete measuring sequences to be executed under program control:

(SENS) Measurement of modulation sensitivity

(AF RESP) Measurement of modulation frequency response

(SEL.PWR) Produces the display of an analog meter of the same name in the submask. This instrument shows in analog and numeric form the result of a selective, low-power RF measurement. SEL.PWR has the alternative function VSWR, which displays the voltage standing-wave ratio.

(DC-CAL.) Produces DC zero adjustment of the FM demodulator in the 4032. This adjustment is necessary if the zero of the demodulated signal is of importance. A shift in the zero means, in the transmission of data telegrams by an NRZ method (C Net radiotelephones) for example, that the data bits 1 and 0 can no longer be clearly distinguished.

Softkey S5

(+20 dB) Increases the level of modulation generator GEN A by a factor of 10. (-20 dB) (alternative function) reduces the level again to its original value. The level indicated in the Lev. entry field follows both jumps in level. The +20 dB function simplifies the checking of deviation limiting in transmitter tests.

Analog Instruments

Objectives

- Specifying display of individual instruments
- Feeding instruments with test signals
- "Zooming" instruments and selecting measurement ranges

In the top half of each basic mask you primarily make **settings** on the instrumentation of the 4032. The bottom half of a basic mask on the other hand is reserved for the presentation of the **measured results**. Here the 4032 - depending on the basic mask that is selected - can display as many as three different measured values simultaneously on simulated pointer meters. The following table shows for what measured values you can produce a quasianalog indication (in brackets: instrument designations):

RX mask		TX mask		DUPLEX mask	
AF level	(RMS/dBr)	AF level	(RMS/dBr)	AF level	(RMS/dBr)
Distortion	(DIST)	Distortion	(DIST)	Distortion	(DIST)
Modulation	(MOD)	Modulation	(DEMOD)	Modulation	(DEMOD)
SINAD	(SINAD)	RF power	(PWR)	RF power	(PWR)
RF power	(PWR)	Offset	(OFFSET)	Offset	(OFFSET)
				SINAD	(SINAD)

You yourself determine for the most part what instruments are displayed in a mask. Note: each instrument displayed is immediately operative and does not have to be "switched on" first.

Instruments of RX mask

The RX mask can display three instruments, but after startup with a total reset only the RMS instrument (dBr is an alternative designation) is shown initially (default).

RMS/dBr instrument

The RMS meter is one of the AF instruments of the 4032. It indicates the voltage (RMS value) of the momentary AF test signal (see data sheet for specifications of voltmeter). The measured value is presented simultaneously in quasianalog and numeric form by the meter; it also indicates the frequency of the test signal.

In the AF field (front panel) of the 4032 you can determine with the three keys [VOLTM], [DEMOD] and [RX MOD/MOD GEN] what AF test signal goes to the AF meters RMS/dBr, DIST and SINAD. These interlocked keys are assigned LEDs that show which of the three signals is being measured at any time:

[VOLTM]	(default setting) selects - independently of the basic mask (RX, TX or DUPLEX) - the signal that is fed in on the socket of the same name in the AF field. Normally the VOLTM socket will be connected to the AF output of a receiver.
[DEMOD]	selects the internally demodulated signal that - in transmitter testing - results from a modulated carrier signal fed in on the RF or RF DIRECT socket (RF field). So DEMOD cannot be activated in receiver testing (RX mask).
[RX MOD/MOD GEN]	selects the modulation signal of the activated modulation-signal source(s) (GEN A and EXT plus optionally GEN B).

Tap the [RX MOD/MOD GEN] key. If an uncomfortably loud 1-kHz signal then sounds, turn the control in the AF field of the front panel to the left. The RMS meter will then show the AF level (approx. 335 mV) plus the frequency (1.000 kHz) of modulation generator GEN A an. Now why are precisely these values displayed?

If you remember, the activation of GEN A is a default setting that is made when the 4032 is started up with a totel reset. And, because the RX mask with its default values is currently active, the internal modulator must be fed with this 335 mV (RMS) so that the 150-MHz carrier (`RF Frequency` field) is modulated with a deviation of 2.4 kHz (`Mod.` field). This means that any alteration of the frequency deviation will also alter the level of modulation generator GEN A.

Try this out for yourself. Alter the frequency deviation (best with the handwheel) in the `Mod.` entry field or the modulation frequency in the `AF GEN A` entry field: the RMS meter will respond to this immediately. And it is the same if you operate the GEN A key in the generator field of the front panel, thus switching off modulation generator GEN A (LED extinguishes). Operating [GEN A] again switches the generator back on.

If more than one modulation generator is activated (superimposed modulation), the RMS voltmeter will show the RMS value of the sum signal.

Level measurement with reference value

The RMS/dBr meter can declare the displayed level to be the reference value and display changes in level in dB referred to this value (relative level measurement). In this way you can very quickly determine the -3-dB point in a level measurement for instance.

You can declare a displayed level as the reference value simply by striking the [dB REL/VOLT] key in the AF field (the request for operation according to the agreed notation is [dB REL]). This causes the associated LED to illuminate and the RMS meter is renamed "dBr". The meter then automatically sets the 0-dB point at about 75 % of the scale length and also displays in numeric form the relative level value plus the frequency of the test signal. Any change in level of the test signal compared to the reference value can now be read off in dB. Try it yourself by declaring modulation generator GEN A to be the signal source with [RX MOD/MOD GEN], switching to relative level measurement with [dB REL] and then again altering the level of the modulation generator indirectly by way of the frequency deviation (Mod. entry field). In condensed form, according to the agreed notation, this relatively complex operation is thus as follows:

1. [RX MOD/MOD GEN]	GEN A becomes test-signal source.
2. [dB REL]	Switch RMS voltmeter to dBr.
3. [FM AM ΦM]	Mod. field becomes active field and GEN A is switched on.
4. <value>	Alter frequency deviation in Mod. field, eg by turning handwheel (then no confirmation necessary with [ENTER]).

If you alter the frequency deviation by a considerable amount, you can clearly observe on the dBr meter the automatic range switching of the quasianalog result display. All analog instruments of the 4032 have this automatic range switching as a default setting.

[VOLT] changes the name of the dBr meter back to "RMS", the reference level of the dBr measurement being deleted. This means that if you call up the dBr meter again with [dB REL], the level last shown by the RMS meter will be the new reference value.

Instrument zooming

The 4032 offers expanded display of the simulated analog meters especially for on-the-job servicing. This can be particularly useful if the Communication Test Set cannot be set down right next to the device under test because there is not enough space. The full-format display of the meter that is required at any time can be read quite accurately from some distance away.

In training with the RX mask it was already mentioned that the magnification of a meter is initiated with (ZOOM). Before you start to zoom, make sure that the initial situation is as follows:

Modulation generator GEN A is the signal source; the RMS voltmeter indicates approx. 335 mV_{rms} (corresponding to 2.4 kHz frequency deviation). (ZOOM) then takes you to the new softkey functions (POWER), (MOD) and (RMS) (or (dBr) if the dBr meter is called up). (RETURN) is for returning to the softkey functions of the basic RX mask.

With (POWER), (MOD) or (RMS) you can now display the appropriate meter in full format on the screen. But first simply strike (RMS).

Defining measurement range

The RMS meter now occupies almost the whole screen and the softkeys are assigned the new functions (RANGE) and (AUTO). (RETURN), as usual, takes you back to the basic mask.

First to the field in the bottom right corner of the zoom display: this is the entry field that was last active in the basic RX mask. The zoom display adopts this field, which still permits entries, eg altering values with the handwheel. In this way it is possible to observe the effect of any change of parameter on the full-format pointer meter.

If you now call up the (AUTO) function (automatic selection of measurement range) with (AUTO), you will not notice any reaction. For good reason, because the function is the default and therefore already active. The purpose of this is to make the pointer of the meter always show the value that is actually measured, ie the pointer never gets stuck at the ends of the scale. Sometimes it is best not to have automatic range switching however. For example, when the rated value for an adjustment is better in the middle of the scale. The 4032 satisfies this requirement with the softkey (RANGE).

As soon as you call up the RANGE function with (RANGE), the two numeric fields `Center` (mixed numeric field) and `Range +/-` (pure numeric field) appear in the top part of the meter. You can access both fields as usual with the cursor keys.

The value in the Center entry field tells the RMS meter at what level the pointer is at centre scale. After entry of the numeric value the units V or mV can be selected with (UNIT/SCROLL). To start with, enter a value in the CENTER field that is 10 mV larger than the level momentarily displayed in numeric form (entered value approx. 345 mV). Then confirm this entry with (ENTER). The pointer of the meter will immediately go to the lefthand stop.

Reason: in the Range +/- field there is still the default value 1.00. This means that the RMS meter momentarily has a measurement range of 345 mV ±1.00 mV (lefthand stop 344 mV, righthand stop 346 mV). So open the Range +/- field to match the measurement range to the momentary level of approx. 335 mV. <20> + (ENTER), for example, would be the entry to expand the measurement range to 325 through 365 mV. The RANGE function thus offers you the possibility of adapting the resolution of a meter to your requirements at any time.

If you return to the basic mask with (RETURN) on the other hand, the automatic range switching becomes compulsory again. The defined measurement range is maintained for the large-format display. You can easily check this by zooming the RMS meter again. Nor is the measurement range deleted if you subsequently call up the (AUTO) function, because (RANGE) always restores the old status. The values can only be deleted by selecting a new measurement range.

Each analog instrument of the 4032 can be shown on the screen in full format (see also chapter 4). The large-format presentation can always be linked with a measurement range of your choice. Exception: the OFFSET meter (TX or DUPLEX mask) only offers automatic range switching.

DIST instrument

The DIST (distortion) meter is displayed in the RX mask in addition to the RMS meter as soon as you strike the [DIST] key in the AF field of the front panel (the associated LED illuminates, the VOLT LED extinguishes). The distortion that is then indicated in analog and numeric form must be clearly below 1 % because the meter is showing the distortion of the signal from modulation generator GEN A (according to the data sheet < 1 %). You have already selected this generator as the signal source for the RMS meter. That means:

> The current AF signal source simultaneously feeds all AF instruments displayed by a basic mask. So you always have - in the RX mask in particular - the major parameters of an AF signal within view. Regardless of the basic mask the AF instruments have the designations "RMS/dBr", "DIST" and "SINAD".

The DIST meter measures the distortion (see data sheet for specifications of distortion meter) referred to a notch frequency of 1 kHz. For this reason the momentary measurement is correct because, according to the frequency display on the RMS meter, the signal of the modulation generator (fundamental) is exactly 1 kHz (defined in the AF GEN A field). Furthermore, the level of approximately 335 mV is clearly above the minimum called for in the data sheet. Measurement of the distortion is possible at other notch frequencies with the OPTION CARD (fitted with a variable notch filter).

After (ZOOM) the softkeys change to (POWER), (MOD) and (DIST) and do not show the former functions (POWER), (MOD) and (RMS). It is obvious that (DIST) enlarges the meter DIST to full screen size and (RANGE) defines the measuring range. So far so good - but how can we now zoom the RMS meter having no softkey function (RMS) available? No problem, because the [VOLT] key will do the job. In the basic mask the former softkey functions are available after [VOLT] + (ZOOM).

However, you do not necessarily need to return to the basic mask. If, for instance, you choose the zoomed display of the DIST meter, [VOLT] will then directly zoom in the RMS meter. This direct access requires the following condition: One of the meters dBr, RMS, DIST, or SINAD has to be zoomed in, if another meter needs to be displayed in zoomed mode using the corresponding keys of the AF section (front panel).

SINAD instrument

You have now found out the level, the frequency and the distortion of the "test signal" produced by generator GEN A. If you next call up the SINAD function ([BEAT/SINAD] key), the 4032 will also present the SINAD ratio of the test signal. The SINAD (**Si**gnal **N**oise **a**nd **D**istortion) ratio is related to the S/N (**S**ignal to **N**oise) ratio but makes special allowance for the distortion of the test signal.

SINAD causes the associated green LED to illuminate because the measurement is only necessary in the RX or DUPLEX mode (the alternative function BEAT can only be called up in the TX mode). At the same time the yellow LED associated with DIST extinguishes and the DIST meter is replaced on the screen by the SINAD meter. The RMS meter is not affected in any way by this change.

You can observe the effect of the distortion on this measurement by gradually altering the AF frequency (AF GEN A field), which again is best done with the handwheel. This seems to increase the distortion because the notch frequency of the now hidden but active distortion meter remains fixed at 1 kHz. You can check the increase in distortion in between by switching off the SINAD meter and switching on the DIST meter with [DIST]. Of course the SINAD meter can also be zoomed in the usual way and a measurement range can be defined with [RANGE].

The RMS or the dBr meter is always displayed in the basic RX mask. As a second AF meter you may choose either the DIST **or** SINAD meter. Other possible combinations are explained for each basic mask in Chapter 4.

MOD instrument

The MOD meter shows the modulation depth or deviation of the generator signal depending on the selected modulation (AM, FM, ΦM). The numeric display indicates the positive and negative peaks, the analog display shows the amounts of these values. If the modulation is exactly balanced therefore, only one pointer will be seen on the MOD meter. Unbalanced modulation produces a two-pointer display.

The sources of the modulation signals are the modulation generators GEN A, GEN B (option) or an external modulation generator (EXT). These three sources can also feed the internal modulator simultaneously (superimposed modulation). The MOD meter then shows the resulting modulation peaks.

Up to now the MOD meter has been rare in the RX mask, simply offering the softkey function (MOD) every time you called up (ZOOM). But now zoom the MOD meter. In large format you will see the value of the momentary peak deviation (about 2.4 kHz). Actually this is superfluous because this deviation is held as a setting value anyway in the Mod. entry field of the RX mask. And that is why the RX mask only shows the MOD meter when the following condition applies:

When the input for an external modulation signal (EXT MOD socket) is activated with [EXT] (generator field) and therefore the indicated peak value no longer necessarily corresponds to the set value.

Try it by striking the EXT key. The associated LED will illuminate green and the MOD meter will move into place. But seeing as there is no external modulation generator connected, the meter will still show 2.4 kHz deviation because of the internal modulation generator GEN A.

In receiver measurements (RX mask) you can call up the MOD meter quite independently of the selected AF signal source, ie also when the signal fed in on the VOLTM socket is relevant for the AF meters. In this way it is possible to examine the AF output signal of a radio set together with the - likewise displayed - modulation of the generator signal.

EXT has - no doubt you have noticed it - caused the new entry field EXT to appear in the top half of the RX mask (check with HELP). This is a scroll field with the scroll variables `DC coupled` and `AC coupled`. So by selecting a scroll variable you can specify whether the external modulation signal to the modulator is DC coupled or AC coupled. In the TX mode the EXT MOD socket is always AC coupled, so the EXT field in this mask is a display field.

The two-pointer display (unbalanced modulation deviation) can be produced - despite the very slight unbalance of the internal modulator - by showing the MOD meter in full format and selecting very fine resolution with RANGE (suggested entries: `Center` 2.4 kHz; `Range` 0.10).

PWR instrument

The PWR instrument is an RF power meter (see data sheet for specifications; maximum permissible power: see Chapter 1). What is displayed is the average value (in case of AM: peak value) of the power applied to the RF socket (RF field). The meter measures broadband, ie it is independent of the entry in the RF `Frequency` field. The measuring head of the PWR meter directly follows the RF socket; so it does not detect any signals that are applied to the RF DIRECT socket. For the same reason the PWR meter still receives the test signal if a switch is made with softkey S1 to the RF DIRECT socket but the test signal is applied to the RF socket.

Normally no measurement of RF power is necessary in receiver testing (RX mask). But the 4032 can switch automatically from receiver to transmitter test and vice versa (AUTO SIMPLEX mode). This is governed by the RF input power on socket RF: if it exceeds approx. 30 mW the 4032 will switch automatically from the RX mask to the TX mask (transmitter measurement). Then, as soon as the input power falls below 20 mW, the RX mask is called up again without any further ado. So the radio set itself can switch the 4032 to the operating mode that is called for. You will find out more about this later on.

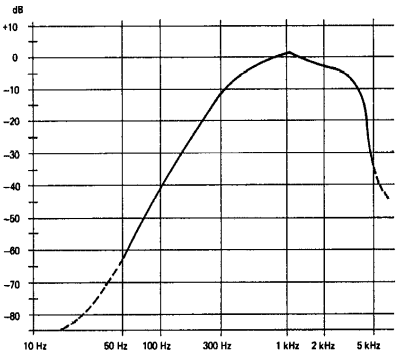
For checking the switching thresholds, the 4032 also shows the RF input power in the RX mode. But since this value is very rarely called for in receiver measurements, you can only zoom the PWR meter and not produce it in the basic RX mask.

When you are specifying a measurement range in the large-format display of the PWR meter, call up the required units with [UNIT/SCROLL] in the `Center` entry field.

Weighting with CCITT filter

The CCITT P53-A filter is responsible for psophometric weighting of an AF signal, ie it allows for the response of human hearing to different frequencies. The ear is considerably more sensitive to signals in the range about 1 kHz, for example, than to signals of say 100 Hz or 10 kHz. The CCITT filter takes this into consideration by attenuating AF signal components of lower and higher frequency with its precisely defined filter curve. Interfering signals that fall within the ranges of attenuation are thus less marked than in an unweighted measurement. A number of measurement specifications, like those for weighted signal/noise ratio, expressly call for a weighted measurement.

Fig. 11.4: CCITT filter curve: The P53-A weighting filter allows for the frequency response of the human ear.



In receiver testing you can, if you wish, perform weighted measurements of level, SINAD and distortion. All you have to do is to tap the [CCITT] key in the AF field of the front panel. The yellow LED will then illuminate; the label FLT is added to the meter designations "RMS" or "dBr", "SINAD" and "DIST" to avoid any confusion with unweighted measurement. Tapping the [CCITT] key once more cuts the filter out of the signal path.

Congratulations. You are now working so well with the analog instruments of the RX mask that the remainder of this lesson is a mere trifle.

Instruments of TX mask

Start up the 4032 anew with a total reset and call up the TX mask with [TX]. This presents you with the new DEMOD meter in addition to the familiar RMS/dBr and PWR meters. The ZOOM function is again assigned to softkey S6. This is reassuring, as is the fact that the keys of the AF and generator fields on the front panel remain virtually unaltered in what they do. There are just two differences from the RX mask:

[DEMOD] additionally selects the transmitter signal demodulated in the 4032 as a test signal for the RMS/dBr and DIST meters. The DEMOD meter, on the other hand, is always fed with the demodulated transmitter signal, independently of the signal source that is selected.

Only the BEAT function can now be called up with the [BEAT/SINAD] key. [BEAT] makes it possible to monitor the beat that results from heterodyning the applied transmitter signal with the signal of the generator. If the function is not called up, the test signal switched through to the AF instruments can be monitored on the loudspeaker. [BEAT] does not produce the display of a meter on the screen.

RMS/dBr instrument

In the TX mask the RMS/dBr meter retains all the functions described before, including that of weighted measurement (CCITT). If you strike the RX MOD/MOD GEN key for example, the RMS meter will indicate about 20 mV_{rms}. Reason: in the TX mask too, modulation generator GEN A is active by default (the red LED is now illuminated) and with [RX MOD/MOD GEN] you have made it the current signal source. The level of 20 mV is again a default value, defined in the mixed numeric field `Lev.` of the TX mask. You can alter the value as usual and observe the reaction on the meter. Whereas before, in the RX mask, you only altered the level indirectly by way of the frequency deviation, you can now do it directly.

DIST instrument

The DIST meter removes the RMS meter following [DIST] and measures the distortion of the AF signal source that is momentarily active (VOLTM, DEMOD or MOD GEN). [CCITT] permits weighted measurement.

DEMOD instrument

On this meter you can read the modulation depth or deviation of the applied transmitter signal (peak values), similarly to the case before with the MOD meter. Speciality: softkey S3 determines for frequency- and phase-modulated signals whether the largest peak deviation that is measured is held on the display (PEAKHOLD function) or the meter always presents the momentary value that is measured (NORM function). For amplitude-modulated signals there is a small restriction with PEAKHOLD: modulation peaks that come in the pause between two samplings by the DEMOD meter are not detected.

For PEAKHOLD the same applies as before: the offered softkey function does not become effective until you strike the softkey. If you can read PEAKHOLD for instance, then NORM is momentarily selected.

The PEAKHOLD function should be called up if modulated signals only appear briefly, as with the tone sequences in selective calling for instance. You can then read the peak deviation on the DEMOD meter even though the modulation has long disappeared.

PWR instrument

The PWR meter has the same function as described before. It only appears on the screen if the RF socket is chosen as the input.

OFFSET instrument

If the frequency of the applied transmit signal deviates from its rating, this results in a frequency offset (difference between rated and actual values). The 4032 indicates the frequency offset numerically in the `Offset` display field. If the frequency offset is to be set to zero in the course of adjustment, you can also call up the OFFSET meter with ZOOM + OFFSET: this shows the offset additionally in quasianalog form, the zero point being in the centre of the scale.

So far so good. You now know virtually all analog instruments of the 4032 and should manage fine with the concrete instructions for measurements in chapter 4. But the subject of analog instruments is by no means finally wrapped up, because you are not yet acquainted with the special mask GENERAL PARAMETERS. But that will soon be taken care of by the lesson "Parameter Mask". Then you will also be able to call up the AF POWER meter.

Training with DUPLEX Mask

Objectives

- Callup of DUPLEX mask
- Callup of AUTO SIMPLEX mode
- Familiarization with DUPLEX mode
- Operating rules for entering channel numbers

You can only call up the DUPLEX mask if your 4032 is fitted with the optional DUPLEX FM/ΦM demodulator. If your set does not have this, you should still take the trouble to work through this lesson. The callup of the AUTO SIMPLEX mode is not specific to the DUPLEX option. And the operating rules for entering channel numbers apply - in very much simplified form - to the RX and TX masks as well.

Main feature of DUPLEX mode

Up to now you have only got to know the simplex mode of the 4032. This means that you could call up **manually** either the RX mask for receiver testing or the TX mask for transmitter testing. These permit all measurements to be made on radio sets that alternately transmit and receive on one and the same channel (simplex communication).

Duplex radio sets transmit and receive on different channels simultaneously (duplex communication). This means that the 4032 must also be able to transmit and receive simultaneously. You select this operating mode of the Communication Test Set by calling up the DUPLEX mask. The mask is to a certain extent composed of the major parts of the RX and TX masks and consequently there are hardly any new operating rules.

Callup of DUPLEX mask

Produce a defined starting situation again with a total reset and, when the status mask appears, briefly strike the key located between the [RX] and [TX] keys. This calls up the DUPLEX mask with the dual designation `RX FM` and `TX FM` in the mask header. The yellow (upper) LED "DUPLEX" in the RF field illuminates to show you have the DUPLEX mask.

Now you can call up one of the other two basic masks with [TX] or [RX] as usual. And the DUPLEX mask can simply be called up from the RX or TX mask by just striking the key in the middle once. But if the DUPLEX mask has already been called up when you strike the middle key, this will put the 4032 (after a brief pause) into the AUTO SIMPLEX mode (automatic switching between the RX and TX masks). This mode is signalled in the RF field by simultaneous illumination of the lower yellow LED and the RX LED.

Striking the middle key several times calls up the modes DUPLEX, AUTO SIMPLEX, SIMPLEX one after the other. In the AUTO SIMPLEX mode the lower of the two yellow LEDs in the RF field will illuminate together with the RX or TX LED.

AUTO SIMPLEX mode

The AUTO SIMPLEX mode was briefly mentioned earlier on in conjunction with the PWR meter: what triggers the automatic switchover between the RX and TX masks is the RF input power on the RF socket. If it exceeds about 30 mW, the 4032 switches automatically from receiver to transmitter testing. If you now select AUTO SIMPLEX, the 4032 will automatically present the RX mask as long as the appropriate input signal does not appear on the RF input. Even an attempt to call up the TX mask manually with [TX] will only produce the TX mask briefly before the 4032 returns to the RX mask.

The AUTO SIMPLEX mode of the 4032 is more convenient, compared to the SIMPLEX mode, because you can change the Communication Test Set to the mode you require quite simply with the push-to-talk button of the radio set. Beforehand, the required settings have to be entered in the RX and TX masks in SIMPLEX mode and the meters you need have to be called up.

Details of DUPLEX mode

Duplex communication between radio sets (usually a base station and a mobile station) requires that the use of a frequency pair f_1 and f_2 be agreed between the two sets. If the base station transmits on f_1 for example, the mobile must receive on the same frequency and itself transmit on f_2, thus making f_2 the receive frequency for the base station. The interval between the two frequencies is what is called the duplex spacing.

If the radio sets work on several channels, a whole bunch of f_1/f_2 frequency pairs is needed, and each frequency pair must maintain the duplex spacing. This results in what is called a lower band and an upper band: in the lower band you find all f_1 frequencies separated by the channel spacing, and in the upper band all f_2 frequencies. The upper band is always higher in frequency.

Before measurements are made on duplex radio sets, the following questions have to be clarified:

- What is the channel spacing?
- What is the duplex spacing?
- What assignment is there between channel number and frequency (eg C1 → 150 MHz)?
- Does the frequency increase with a growing number of channels (normally the case) or does it decrease?
- Does the device under test receive in the lower band or the upper band?

According to the default settings of the DUPLEX mask, the 4032 outputs a 150-MHz signal on the RF socket with a level of –60.0 dBm into 50 Ω (RX part of mask). The carrier is frequency-modulated with 1 kHz, the frequency deviation is ±2.4 kHz. The test receiver is also operative and set to a receive frequency of 150 MHz (TX part of mask).

In the bottom part of the DUPLEX mask all analog instruments of the RX and TX masks can be called up. The meanings of the two offset fields have remained the same, as have those of the softkeys. So you can apply all previous operating rules to the DUPLEX mask as well. New are some extra rules for switching on the modulation generators and rules for working with channel numbers.

RX/TX operation of modulation generators

For the generators GEN A and GEN B (option) as well as the external modulation-signal source (EXT) the DUPLEX mask offers selection of the signal path, as already described for the RX mask: repeated striking of the keys [GEN A], [B/SAT] or [EXT] means that the particular modulation signal takes the RX **or** TX signal path (green or red LED illuminated). In contrast to the RX mask the RX/TX switchover is now also enabled for the external modulation-signal source. In this way it is possible, for instance, to feed the 4032 signal generator with two superimposed modulation signals (normal test modulation + subaudio signal) and at the same time to modulate the carrier of the radio set with the third modulation signal.

Juggling with channel numbers

The questions about the duplex parameters at the beginning will be answered provisionally as follows:

- Channel spacing: 20 kHz
- Duplex spacing: 10 MHz
- C1 → 150 MHz (in 4032)
- Frequency increases with channel number
- Radio set receives in lower band

You are now ready to fill in the DUPLEX mask. Declare the entry field of the transmit frequency (RX part) to be the current field and strike the [UNIT/SCROLL] key once. The 4032 then replaces the display `150.0000 MHz` by `1 NoL`. Now you can no longer enter a frequency, only a channel number instead. The frequency entry field in the RX part has become the entry field for the **lower-band receive channel** of the radio set, recognizable by the abbreviation `NoL`. The `1` display is simply a proposal on the part of the 4032 to set the signal generator to channel 1 in the lower band.

Accept this proposal for the time being with [ENTER]. In the TX part of the mask the entry field for the **upper-band transmit channel** of the radio set responds to this without any delay, ie the display changes from `----- NoU` to `1 NoU`. This means that the test receiver of the 4032 is now tuned to channel 1 in the upper band. Strike the [UNIT/SCROLL] key twice to check. The frequency entry fields will promptly show the values 150 MHz and 160 MHz, which is exactly what is specified. The Communication Test Set is thus set ready for duplex measurement with the given parameters; it works on channel 1.

If you do not wish to accept the proposal of `1 NoL`, because you want to examine the radio set on channel 12 for instance, it is sufficient to enter <12> + [ENTER] in the `NoL` field (RX). The 4032 then transmits on 150.2200 MHz and receives on 160.2200 MHz. Both values result from the agreed channel spacing of 20 kHz and the agreed assignment C1 → 150 MHz. You will find out how to make these agreements or declarations and the others in the lesson "Parameter Mask".

If you make a wrong entry, it is best to call up the frequency entry fields, enter 150 MHz in both and start anew.

While maintaining the other conditions, the radio set is now to transmit not in the upper band but in the lower band, eg on channel 4. This means that the 4032 must transmit on channel 4 in the upper band. The entry for the `NoU` field (RX) is therefore <4> + [ENTER]. In the TX part of the mask the entry field `NoL` for the lower-band transmit channel of the radio set automatically adopts this entry. If you now call up the frequency entry fields with [UNIT/SCROLL], these will again show the correct values 160.0600 MHz and 150.0600 MHz.

In the RX part of the DUPLEX mask you can put the **receive channel** of the radio set in the upper or lower band. In the TX part, on the other hand, you select the upper or lower band for the **transmit channel** of the radio set. In entry it is sufficient to assign either the transmit or receive channel to just one band; the other channel is assigned to the other band automatically.

The assignments between channels and frequencies are made by the 4032 automatically according to the declaration (C1 → 150 MHz; 20 kHz channel spacing) up to the channel number 9999. This means that you can enter channel numbers without having to worry about the assignment to frequency.

Let us assume that you want to test on channels 400 through 410, according to these declarations, a radio set that transmits with a duplex spacing of 10 MHz in the lower band. All that is required is an entry <400> + [ENTER] in the NoU field (RX) or in the NoL field (TX). When you call up the DUPLEX mask for this purpose, there may still be some values from previous measurements in the entry fields. Just overwrite the value in the NoU field (RX) for instance. Following [ENTER] the test receiver is also correctly tuned, and [UNIT/SCROLL] confirms that the right values are in the frequency entry fields (RX: 167.98 MHz; TX: 157.98 MHz).

Then call up the entry field for the upper-band transmit channel again and move the cursor to the last position. Using the handwheel the signal generator and the test receiver can now be tuned simultaneously to the channels 401 through 410. [ENTER] is only necessary if you want to leave the channel entry field again to look at the frequency values for instance.

If an RF Frequency field is active, [UNIT/SCROLL] will alternately show the frequency and the channel number corresponding to this frequency in the upper and lower band. One of the channel numbers is thus always the result of a conversion. Dashes instead of a channel number mean that conversion produced a value smaller than 0 or greater than 9999.

You can also work in the RX and TX masks in the manner described with channel numbers instead of frequency values. Frequency values, ie channel numbers, entered in the RX and TX mask are then adopted by the DUPLEX mask (and vice versa).

Of course it is also possible to enter the values of the RX and TX frequencies directly in the appropriate fields. Here the 4032 offers the following possibilities:

- After the entry of one value, the other value, offset upwards by the duplex spacing, is automatically entered.
- After the entry of one value, the other value, offset downwards by the duplex spacing, is automatically entered.
- Any values can be entered in the fields without there being any connection by the duplex spacing.

The default setting is the last of these three possibilities. Call up the GENERAL PARAMETERS mask for making a choice.

Measuring duplex signal transfer

Socalled single-port duplex radio sets use the same antenna for their transmitter and receiver. A duplexer in the radio isolates the signals from one another but cannot entirely prevent the transmitter from influencing the receiver.
For measuring this influence the DUPLEX mask offers the Special DESENS (desensitizing). Similarly to the Specials of the RX and TX masks, DESENS is again a complete test routine that is started with (RUN). You measure the degree to which the transmitter of the radio set reduces the sensitivity of its receiver.

Selection of input/output

If the device under test is a single-port radio set, use the RF socket as the common input/output. Make sure that the RF output level of the 4032 is at least 60 dB smaller than the transmit level of the radio set (normal case). The duplex demodulator then receives both signals sufficiently isolated.

With a dual-port radio set connect its transmitter to the RF socket and its receiver to the RF DIRECT socket. The RF DIRECT socket is coupled with (RF DIR)! The RF socket can nevertheless still be used as an input because the duplex demodulator, like the PWR measuring head, is connected directly behind the RF socket.

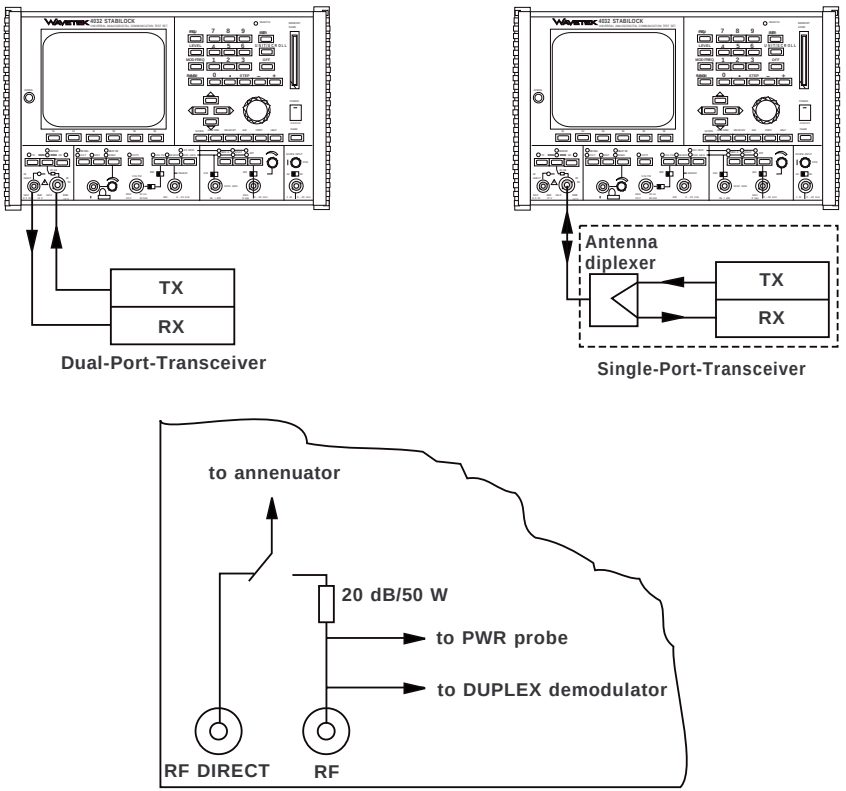


Fig. 11.5: Selection of input/output in the DUPLEX mode.

Parameter Mask

Objectives

- Callup of parameter mask
- Selection of parameters
- Learning meaning of parameters

During training with the DUPLEX mask there was often mention of agreements or declarations like the duplex spacing. Now you can make these declarations yourself, and others, for the RX and TX masks too.

Callup of parameter mask

The way to the parameter mask is via the [AUX] key (auxiliary) in the field of the function keys. You can strike the [AUX] key at any time when you need the parameter mask. [AUX] presents you with the `OPTION CARD` mask with new softkey functions, of which only (DEF.PAR) and (RETURN) are of interest at the moment. (RETURN) has the usual meaning of RETURN, ie it takes you back to the mask that was active immediately before you called up the `OPTION CARD` mask. With (DEF.PAR) you call up the parameter mask (GENERAL PARAMETERS).

Softkeys of parameter mask

The parameter mask (see chapter 4, "GENERAL PARAMETERS") only offers three softkeys: (STATUS) calls up the status mask, (ETC) pages to the second page of the parameter mask and (RETURN) takes you back to the `OPTION CARD` mask. The parameter mask is a submask of the `OPTION CARD` mask, which in turn is a submask of the last basic mask that was active. With (RETURN) you always reach the next highest mask level, so (RETURN) always takes you back to a basic mask. Instead of this you can also return directly to the RX, TX or DUPLEX mask with the keys in the RF field (front panel).

Entry fields of parameter mask

There is nothing to worry about in the parameter mask, it only contains pure numeric fields and scroll fields in which there are as yet no default values entered. You can access each of these fields with the cursor keys. Entries in numeric fields are, as usual, to be terminated with [ENTER].

Atotal reset replaces all entries by default values in the parameter mask too!

If you read the text accompaniment in chapter 4, you will find out all about the entry fields. The questions left unanswered in the two preceding lessons about the AF power meter and declaration of the duplex parameters are answered here too.

Your training with the masks of the 4032 is thus completed. You are well prepared for tackling proper measuring and testing jobs (see Chapter 5). However, you do not yet know all the measuring capabilities of the 4032: but in Chapter 6 you can get acquainted with the oscilloscope and spectrum analyzer.

Appendix

Front panel

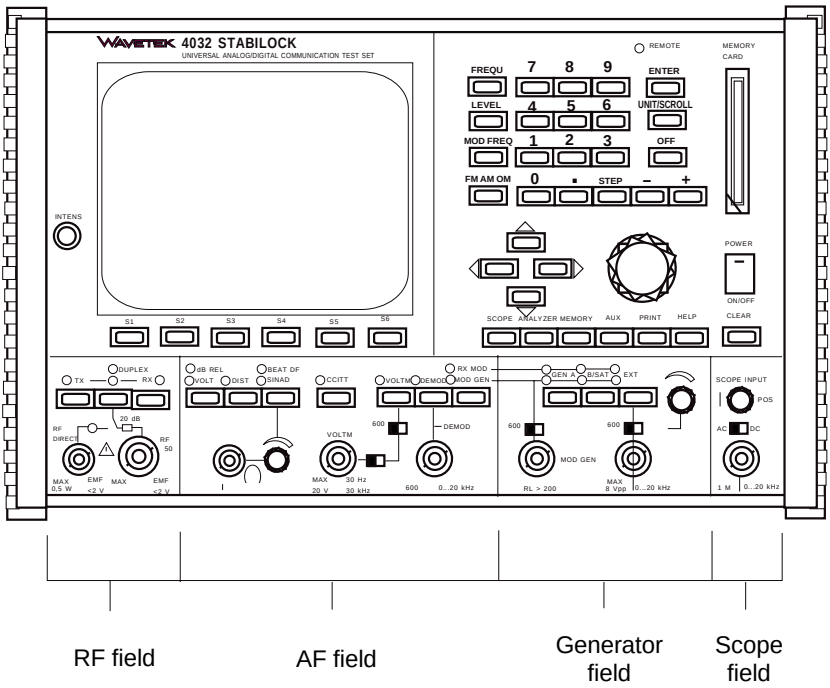


Fig. 12.1: Front panel.

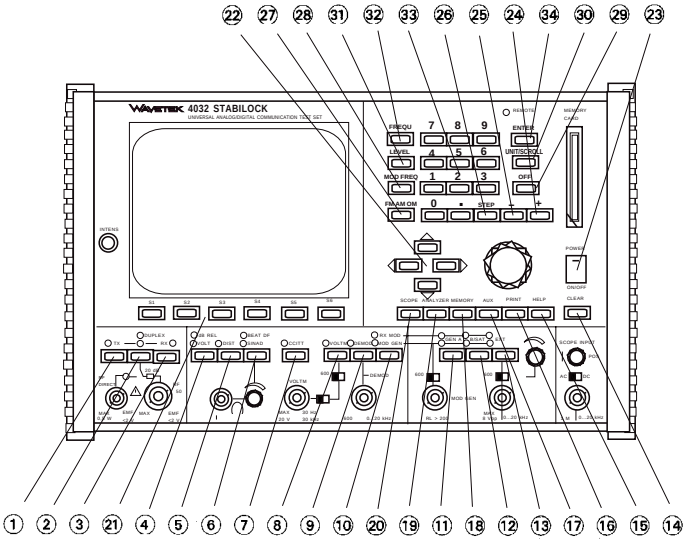


Fig. 12.2: Keys for chapter 2.

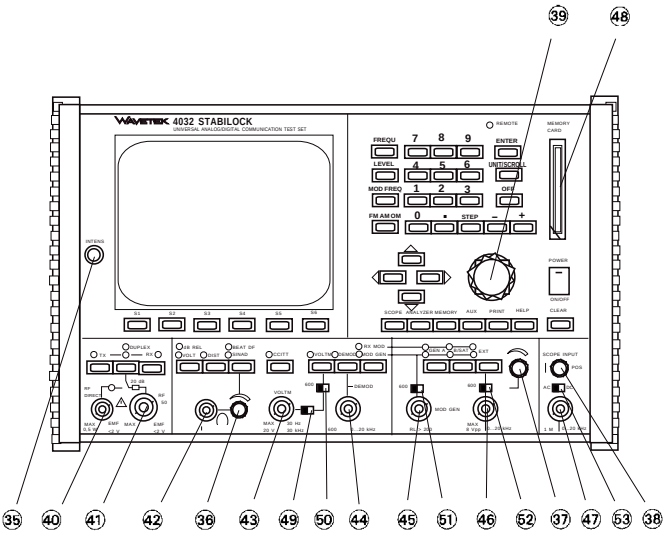


Fig. 12.3: Keys for chapter 2.

AF-signal paths

Note: The block diagram also shows internal electronic switches which cannot be activated directly by keys on the front panel. These switches are activated indirectly by selecting appropriate scroll variables for instance.

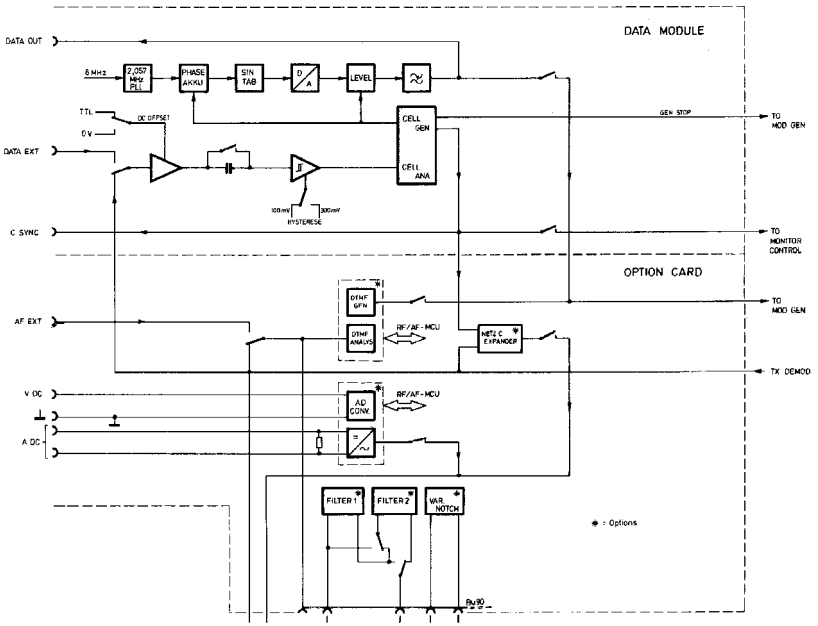


Fig. 12.4: Block diagram DATA MODULE and OPTION CARD.

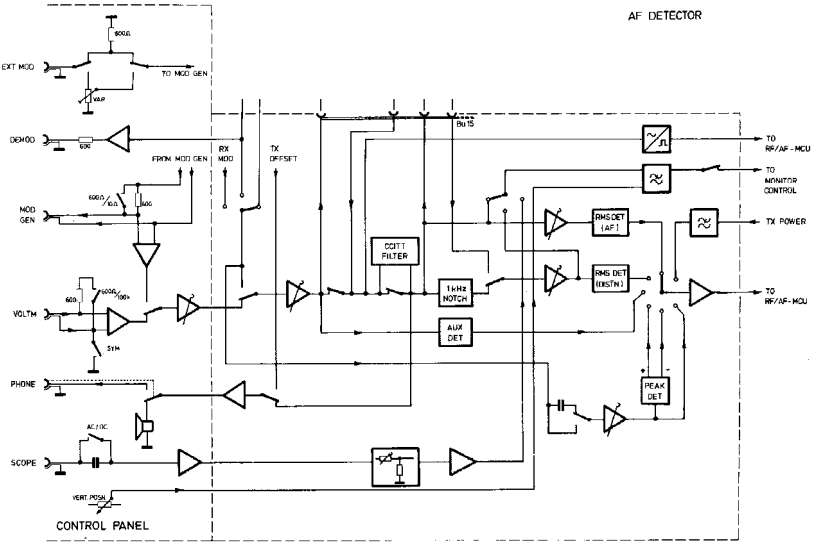


Fig. 12.5: Block diagram AF Detector.

Version status

Some passages in the text of the manual are marked with number indexes. This is to indicate that the particular passage is not universally valid but depends on the software/hardware version of STABILOCK 4032. What the restrictions are can be seen from the explanations to the number indexes below.

1) IEEE commands SEROI and WRITE/SLAVE 300012 (special commands for RS-232 interface) will not become available until firmware version ≥ 5.01. Additionally the driver software on the hardware option "RS-232/Centronics interface" must have the version number ≥ 1.30 (see STATUS mask, field IFC-MCU).

2) The IEEE command WRITE/SLAVE 300014 (special command for output of hex 0 on RS-232 interface) is not available until the STATUS mask shows the following entries: HOST-MCU ≥ 5.01, IFC-MCU ≥ 1.40.

3) A different kind of memory card has been shipped since the end of 1994. The new card uses a different type of battery and the battery compartment and write-protect switch are arranged differently. See Chapter 8 for more details.

4) In firmware versions ≤ 5.02 the message for the D-AMPS module in the STATUS mask is OPT-MCU. From firmware version 5.03 onwards the D-AMPS module is indicated by DIG-MCU, the entry OPT-MCU, if present, now telling you that the RF generator hardware option is connected.

5) In firmware versions ≤ 5.02 the OPTIONS and HW-REVISIONS masks are only one page each.

6) Onwards from units with serial numbers 1388123 (see STATUS mask), STABILOCK 4032 has a more powerful power supply, but without a DC input. A version of the power supply with a DC input (10.5 to 32 V) is available as an option (ordering code 204 033). The new power supplies make sure the Communication Test Set works free of any disturbance when it is fitted with options that draw a lot of power, like the frequency-range extension for example. So older power supplies (ordering code 204 031) must not be used in units fitted with options of this kind.

7) Onwards from units with the serial number 1188 (see STATUS mask), STABILOCK 4032 has a faster memory card interface. This also supports memory cards of 256 Kbytes. You know the new interface is installed if MEMORY 2 appears in the title line of the MEMORY mask and hardware revision 2 is entered under MEMCARD-IFC in the HW-REVISIONS mask.

8) The "Tracking" hardware option (not to be confused with "Fast tracking") can be used again from firmware version 6.13 onwards. Requirement: Communication Test Set fitted with HOST COMPUTER 250 033. Contact Willtek for details about enabling the option.

Executing Firmware Update

A firmware update gives your STABILOCK new features and expands its possibilities of use. Unavoidable small errors are also further eliminated in the new firmware version. A firmware update can affect
– the basic STABILOCK unit or
– one or more hardware options
or both.

When handling the ICs, be sure to observe the usual safeguards for electronic components, especially where electrostatic discharge is concerned. The modules 5/6 and 10 contain storage batteries that can discharge over the tracks on the board, so never place modules on conducting surfaces.

Preserving momentary setup

When it is updated, the Communication Test Set loses the settings last used. Store these settings if you wish to continue using them. To find out how, refer to Chapter 7 "Storing and recalling setups".

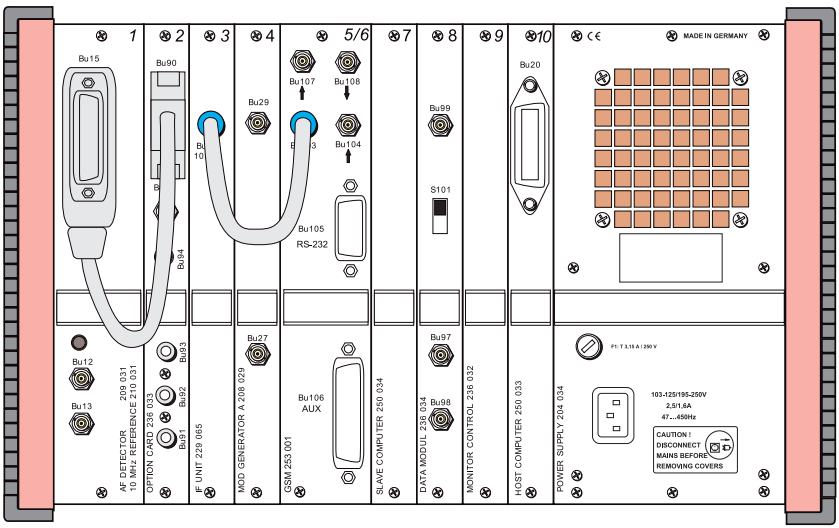


Fig. 12.6: Backplane of STABILOCK 4032. To change EPROMs, undo the two screws and pull out the particular board. The backplane may look different depending on the installed options. Module 5/6 may be split for example.

Exchanging EPROMs

An update of STABILOCK 4032 firmware requires the replacement of several EPROMs on various modules. These may be modules of the basic STABILOCK unit and/or those of hardware options. First ascertain from **Table 12.1** the modules that you have to remove for EPROM replacement. Only take out one module at a time. The slots of the EPROMs supplied to match your Communication Test Set (serial number of unit) can be seen from the illustrations.

		EPROM designation
Modules of basic STABILOCK unit		
Module 7	SLAVE COMPUTER	SP0, SP1
Module 9	MONITOR CONTROL w/o submin D socket	CP0
Module 9	MONITOR CONTROL with submin D socket	P37
Module 10	HOST COMPUTER	HP0, HP1
Modules of hardware options		
Module 5/6	D-AMPS	P14, P15, P18, P26
Module 5/6	GSM	P39, P40, P45, P49
Module 6	RS-232/CENTRONICS INTERFACE	VP0
Module 8	DATA MODULE	AP0, GP0, P11

Table 12.1: EPROM designations for identifying modules affected by **firmware update**

Procedure

1) Power off STABILOCK 4032 and remove all leads including power cable.

2) Undo the two retaining screws of the particular module.

3) Moving the module gently up and down, withdraw it carefully from STABILOCK 4032 and place it on a non-conducting surface.

Risk of destruction! Never withdraw a module while the set is powered on!

Only to replace EPROM CP0 (module 9): undo the two Phillips screws. Push the shielding plate in the direction of the connector strip and remove it.

Only to replace EPROM P26 or P49 (module 5/6, 2nd board): after undoing the four Phillips screws (spacers), the two boards can be swung apart. They remain joined by a ribbon cable.

4) Take one EPROM at a time out of its mount, which is best done with a chip extractor, and put it on one side (be careful not to confuse the old and the new EPROM).

Only for EPROM P37 (module 9): carefully lever the EPROM out of its mount with a pointed object (tweezers). The mount has two notches for this purpose on the corners.

5) Are the pin rows of the new EPROM perpendicular to the IC package? If not, carefully bend the pin rows in the right direction with a clamp or on a flat surface.

6) Insert the new EPROM in the mount (observe package markings).
Only for EPROM P37 (module 9): place the EPROM on the mount (observe package marking: tapered corner) and press it in. Make sure that all pins fit into the mount and that no pin is bent!

Only to replace EPROM CP0 (module 9): replace the shielding plate.

Only to replace EPROM P26 or P49 (module 5/6, 2nd board): fold the boards together so that the screw holes are over the spacer pins. Tighten the four screws.

7) Slide the module along the rails into its slot. Do not use force - the module must click into place in its connector simply by applying gentle pressure.

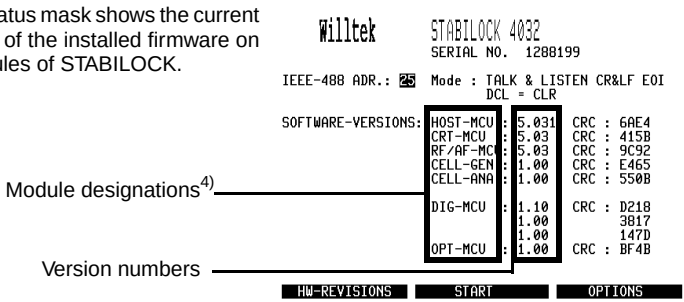
8) Tighten the two retaining screws.

Startup after EPROM replacement

Connect STABILOCK 4032 to the AC outlet again and power it on.

- If the status mask appears, listing the version numbers and checksums of your new firmware, the set will be ready for use after hitting (START). **Table 12.2** shows the labels assigned to the modules in the status mask.
- If no status mask appears, a total reset is necessary. To do this, press [CLEAR], keep it depressed and then hit [OFF]. Hit (START) and the Communication Test Set will be ready for use again.

Fig. 12.7: The status mask shows the current version numbers of the installed firmware on the various modules of STABILOCK.

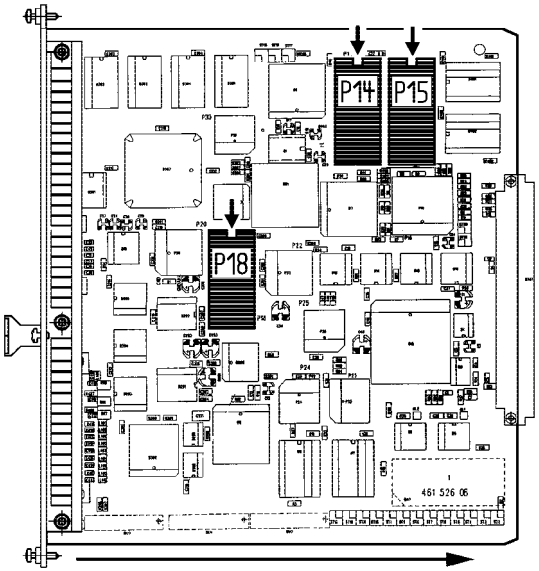


	Module designation in status mask	Module	Module no.
Basic unit	HOST-MCU	HOST COMPUTER	10
	CRT-MCU	MONITOR CONTROL	9
	RF/AF-MCU	SLAVE COMPUTER	7
Options	CELL-GEN, CELL-ANA	DATA MODULE	8
	IFC-MCU	RS-232/CENTRONICS INTERFACE	6
	DIG-MCU4)	D-AMPS or GSM	5/6
	OPT-MCU4)	(external) RF Generator	–

Table 12.2: Names of modules in status mask

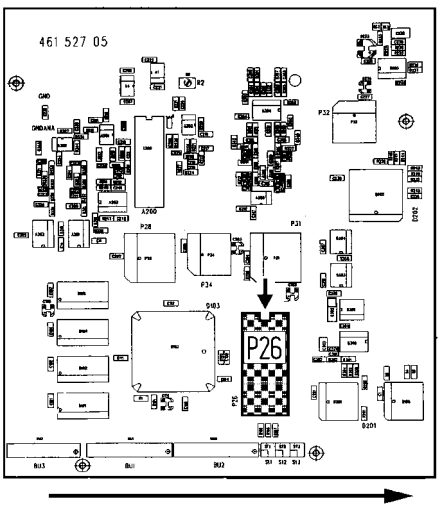
The "Lifeline" at the end of the manual tells you about all major changes in the firmware of the basic STABILOCK unit.

Please send the old EPROMs straight back to the Willtek service point from which you received the new EPROMs. Use the special packing in which the new EPROMs were supplied.



Direction of insertion

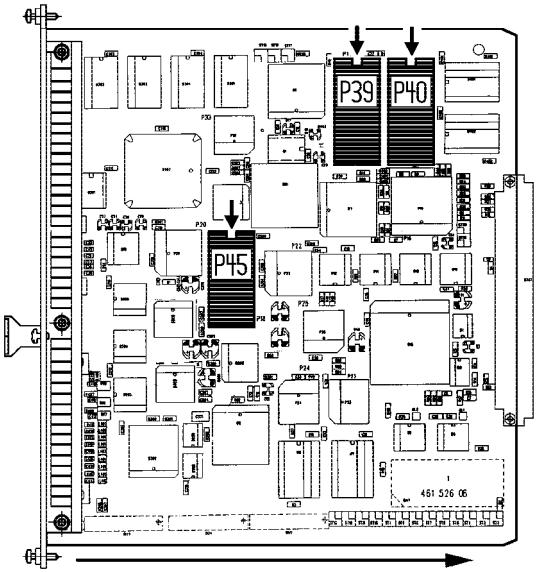
Fig. 12.8:
Module no. 5/6 (D-AMPS, 1st board) with EPROMs P14, P15 and P18.



Direction of insertion

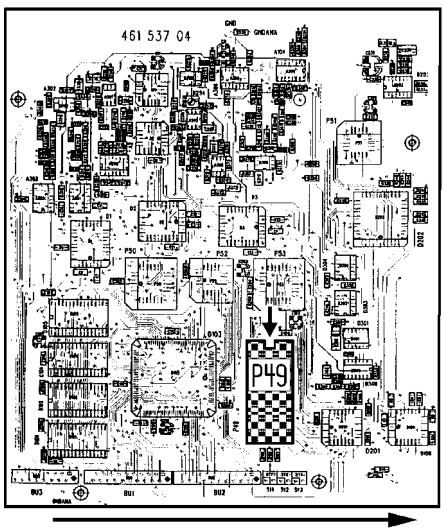
Fig. 12.9:
Module no. 5/6 (D-AMPS, 2nd board) with EPROM P26.

Fig. 12.10:
Module no. 5/6 (GSM, 1st board) with EPROMs P39, P40 and P45.

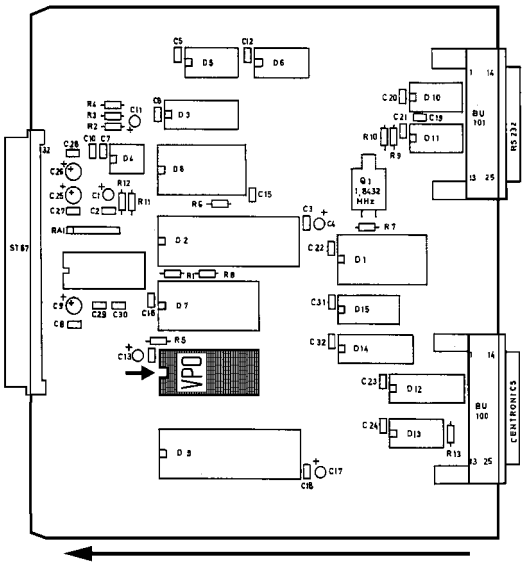


Direction of insertion

Fig. 12.11:
Module no. 5/6 (GSM, 2nd board) with EPROM P49.

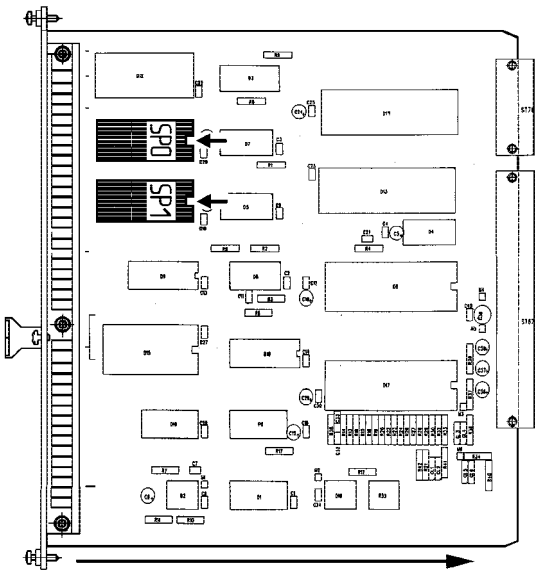


Direction of insertion



Direction of insertion

Fig. 12.12:
Module no. 6 (hardware option RS-232/ CENTRONICS INTERFACE) with EPROM VP0.
Note direction of insertion!



Direction of insertion

Fig. 12.13:
Module no. 7 (SLAVE COMPUTER) with EPROMs SP0 and SP1

Fig. 12.14:
Module no. 8 (DATA MODULE) with EPROMs AP0, GP0 and P11

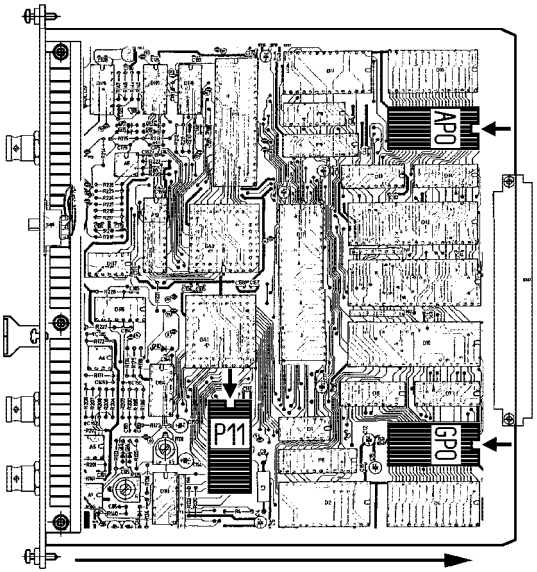
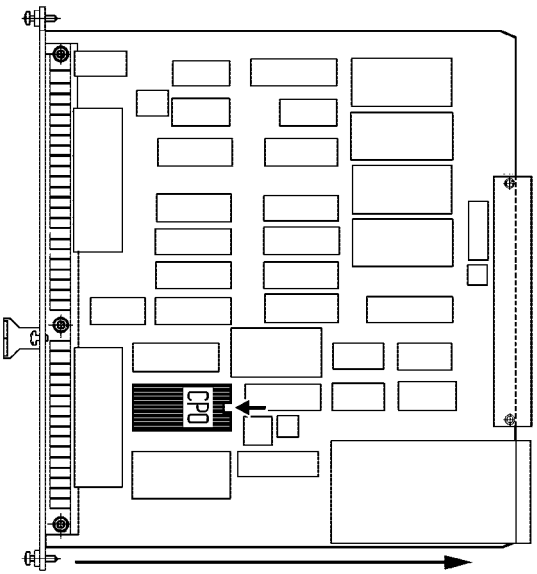
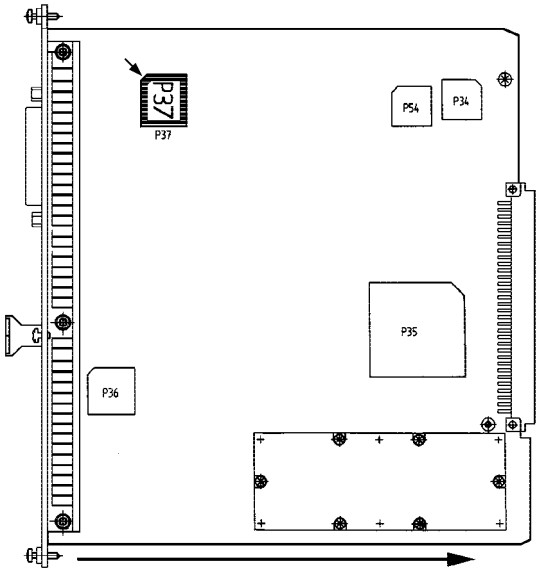


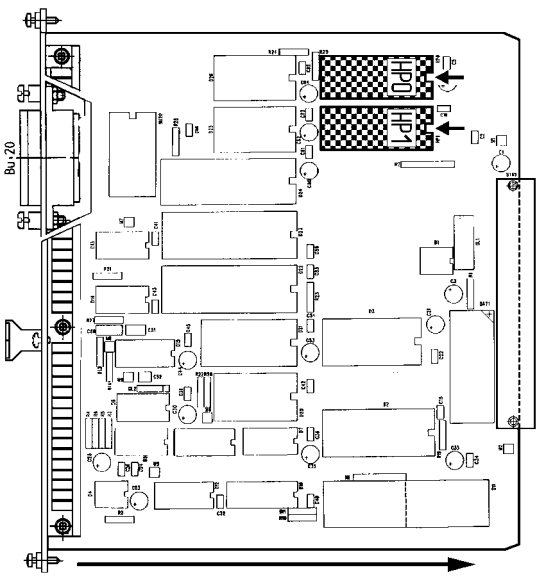
Fig. 12.15:
Module no. 9 (MONITOR CONTROL **without submin D socket**) with EPROM CP0





Direction of insertion

Fig. 12.16:
Module no. 9 (MONITOR CONTROL **with submin D socket**) with EPROM P37



Direction of insertion

Fig. 12.17:
Module no. 10 (HOST COMPUTER) with EPROMs HP0 and HP1

Technical Data

These specifications are valid for STABILOCK 4032 in basic equipment (up to 999.99 MHz). If the FEX option (Frequency Extension) is fitted, please note the passages marked by a ✻ and refer to the section "Frequency extension".

Synthesizer

Spectral purity
- Phase noise (25-kHz offset)
  f < 500 MHz: < –121 dBc/Hz
  f ≥ 500 MHz: < –115 dBc/Hz
- Residual FM
  f < 500 MHz: 4 Hz (rms, CCITT-weighted)
  f ≥ 500 MHz: 8 Hz (rms, CCITT-weighted)
- Nonharmonic spurious signals
  > 500 Hz off carrier: < –55 dBc
- Harmonics
  Level < –15.1 dBm: < –25 dBc
  Level ≥ –15.1 dBm: < –20 dBc
- Residual AM: < 0.02 % (rms, CCITT-weighted)

10-MHz reference oscillator
- Warmup time: < 3 min for frequency error < $5 \cdot 10^{-7}$ (T = 20 °C)
  < 10 min for frequency error < 10^{-7}
- Frequency error: < $1 \cdot 10^{-7}$ (T = 5 to 45 °C)
- Aging: < $5 \cdot 10^{-8}$/month
- Output level: approx. 0.4 V (into 50 Ω)
- Synchronization: 10 MHz, V > 150 mV_{rms} (into 200 Ω)

RF Generator

Carrier frequency
- Frequency range ✻: 0.4 to 999.9999 MHz
- Resolution ✻
  f < 500 MHz: 50 Hz
  f ≥ 500 MHz: 100 Hz
- Frequency error: as reference oscillator

Output level
- RF socket ✻: –142 to –7 dBm (max. –13 dBm with AM)
- RF DIRECT socket ✻: –122 to +13 dBm (max. +7 dBm with AM)
- Resolution: 0.1 dB
- Level error into 50 Ω
  RF socket ✻
  Level ≥ –130 dBm: < 1.3 dB
  Level > –15.0 dBm: < 2 dB
  RF DIRECT socket
  Level ≥ –110 dBm: < 1.6 dB
  Level > +5.0 dBm: < 2.5 dB
- VSWR (50 Ω) RF socket ✻: < 1.1
- EMF setting range without interruption (not with AM): 0 to 15 dB, usable to 20 dB
  Additional level error: 0.1 dB per dB

Modulation

FM (AC-coupled)
- Frequency deviation: 0 to 40 kHz
- Modulation frequency (int. and ext.): 30 Hz to 30 kHz
- Resolution: 10 Hz
- Setting error
  f_{mod} = 300 Hz to 3 kHz: < 5 % + 3 digits
  f_{mod} = 30 Hz to 20 kHz: < 10 % + 3 digits
- Distortion
  dev. < 10 kHz,
  f_{mod} = 300 Hz to 3 kHz: < 1 %
- Ext. mod. input: 20 kHz FM = 0.707 V_{rms} into 600 Ω

FM (external DC-coupled)
- Frequency deviation: 0 to 5 kHz
- Modulation frequency: 0 to 30 kHz
- Centre-frequency error: < 100 Hz + frequency error of reference oscillator

ΦM
- Phase deviation: 0 to 6 rad (f_{mod} · rad ≤ 20 kHz)
- Resolution: 0.01 rad
- Modulation frequency: 200 Hz to 6 kHz
- Setting error
  f_{mod} = 300 Hz to 3 kHz: < 6 % + 0.02 rad
- Distortion
  f_{mod} = 300 Hz to 3 kHz: < 1 %
- Ext. mod. input: 20 rad ΦM = 0.707 V_{rms} into 600 Ω

AM
- Modulation depth: m = 0 to 99.9%
- Resolution: 0.1 %
- Modulation frequency: 30 Hz to 10 kHz
- Setting error for m ≤ 90 %
  f_{mod} = 30 Hz to 10 kHz: < 0.1 · m + 1 digit
- Distortion for m < 50 %
  f_{mod} = 300 Hz to 3 kHz: < 2 %
- Ext. mod. input: 50 % AM = 0.707 V_{rms} into 600 Ω

RF Analyzer

Frequency measurement
- Frequency range ✻: 2 to 999.9999 MHz
- Resolution: 10 Hz
- Admissible input level on RF socket: 0.1 mW to 125 W
- Measuring accuracy: as reference oscillator + 10 Hz

Frequency-offset measurement
- Frequency range 2 to 999.9999 MHz
- Measuring range 0 to ±99.99 kHz
- Resolution
  f < 10 kHz 1 Hz
  f ≥ 10 kHz 10 Hz
- Admissible input level
  on RF socket 2 µW to 125 W
  on RF DIRECT socket 1 mV to 1 V
  (measuring range: 0 to ±15 kHz)
- Measuring accuracy as reference oscillator + 3 Hz
  (+ 1 digit for offset ≥ 10 kHz)

RF-power measurement, RF socket (broadband)
- Frequency range ✻ 2 to 999.9999 MHz
- Measuring range 1 mW to 125 W (average)
- Resolution
  P < 1 W 1 mW
  P < 10 W 10 mW
  P ≥ 10 W 100 mW
- Measuring accuracy ✻ (w/o modulation)
  P > 200 mW 10 % + 1 digit
  (f = 20 to 500 MHz)
  12 % + 1 digit
  (f = 6 to 999.9999 MHz)

RF-power measurement (bandwidth approx. 3 MHz)
- Frequency range 2 to 999.9999 MHz
- Measuring range
  RF socket –45 to +37 dBm
  RF DIRECT socket –65 to +17 dBm
- Measuring accuracy 3 dB
- Resolution 0.1 dBm

Modulation measurement

FM measurement, RF socket (broadband)
- Frequency range 2 to 999.9999 MHz
- Input level 0.1 mW to 125 W
- Measuring range 0 to 25 kHz
- Resolution 10 Hz
- Measuring accuracy (dev. < 10 kHz)
  f_{mod} = 300 Hz to 3 kHz 5 % ±1 digit
  ± peak residual FM
  f_{mod} = 100 Hz to 10 kHz 10 % ±1 digit
  ± peak residual FM
- Demodulation distortion
  f_{mod} = 300 Hz to 3 kHz < 0.5 %
- Peak residual FM < 50 Hz or
  < 10 Hz/100 MHz

FM measurement, RF DIRECT socket (narrowband)
- Frequency range 2 to 999.9999 MHz
- Input level –50 to –20 dBm
- Measuring range 0 to 10 kHz
  (f_{mod} • dev. < 10 kHz)
- Modulation frequency f_{mod} = 0 to 6 kHz
- Resolution 10 Hz
- Sensitivity better than 2 µV (3 kHz FM dev., 10 dB SINAD, CCITT-weighted)
- IF bandwidth 30 kHz

ΦM measurement, RF socket (broadband)
- Frequency range 2 to 999.9999 MHz
- Input level 0.1 mW to 125 W
- Measuring range 0 to 6 rad
  (FM dev. < 50 kHz)
- Resolution 0.01 rad
- Measuring accuracy
  f_{mod} = 300 Hz to 3 kHz 6 % ±2 digits
  f_{mod} = 200 Hz to 10 kHz 10 % ±2 digits
- Demodulation distortion
  f_{mod} = 300 Hz to 3 kHz < 0.5 %

ΦM measurement, RF DIRECT socket (narrowband)
- Frequency range 2 to 999.9999 MHz
- Input level –50 to –20 dBm
- Measuring range 0 to 3 rad
  (f_{mod} • ΦM dev. < 15 kHz)
- Modulation frequency 200 Hz to 6 kHz
- Sensitivity better than 2 µV
  (3 rad ΦM dev., 10 dB SINAD, CCITT-weighted)
- IF bandwidth 30 kHz

AM measurement
- Frequency range 2 to 999.9999 MHz
- Measuring range 0 to 100 %
- Input level
  RF socket 1 mW to 125 W
  RF DIRECT socket 0.01 mW to 0.5 W
- Resolution 0.1 %
- Measuring accuracy (m ≥ 10 %)
  f_{mod} = 200 Hz to 10 kHz 10 % ±2 digits
- Demodulation distortion
  f_{mod} = 300 Hz to 3 kHz < 1 %
- Modulation frequency DC to 10 kHz

Spurious-modulation measurement
- Input level
  RF socket 1 mW to 125 W
  RF DIRECT socket 20 mV to 1 V
- Measuring range 0 to –40 dB
  (CCITT-weighted)
  referred to 3 kHz FM dev.,
  3 rad ΦM dev. or 30 % AM
- Measuring accuracy 1 dB

AF Generator

Modulation generator GEN A
- Frequency range 30 Hz to 30 kHz
- Resolution
  f < 3 kHz 0.1 Hz
  f ≥ 3 kHz 1 Hz
- Frequency error < 0.01 %
- Level range (EMF) 0.1 mV_{rms} to 5 V_{rms}
- Resolution
  EMF ≤ 5 V 10 mV
  EMF ≤ 1 V 1 mV
  EMF ≤ 0.1 V 0.1 mV
  EMF ≤ 10 mV 10 µV

- Level error
  f = 100 Hz to 10 kHz < 3 %
  f = 30 Hz to 30 kHz < 10 %
- Distortion
  f = 30 Hz to 3 kHz < 0.5 %
  f > 3 kHz < 1 %
- Output impedance (balanced)
  f = 300 Hz to 3 kHz < 10 Ω
  f = 30 Hz to 30 kHz < 40 Ω
- Output impedance (unbalanced) 600 Ω ±5 %
- Permissible load impedance > 200 Ω

AF Analyzer

AF voltmeter
- Frequency range 30 Hz to 30 kHz or to CCITT P 53A
- Measuring range 0.1 mV to 20 V
- Resolution
  Level < 0.1 V 0.1 mV
  Level < 1 V 1 mV
  Level < 10 V 10 mV
  Level < 20 V 100 mV
- Measuring accuracy
  f = 300 Hz to 3 kHz 3 %
  f = 50 Hz to 15 kHz 6 %
- Source impedance > 100 kΩ or 600 Ω ±3 %
- Input capacitance 20 pF

AF counter
- Frequency range 30 Hz to 30 kHz
- Input level 5 mV to 20 V
- Resolution
  f < 300 Hz 0.1 Hz
  f < 10 kHz 1 Hz
  f ≥ 10 kHz 10 Hz
- Measuring accuracy 0.01 % ±1 digit

Distortion meter
- Input level 0.1 to 20 V
- Test frequency 1 kHz ±5 Hz
- Measuring range 0 to 99 %
- Resolution 0.1 %
- Measuring accuracy
  d = 1 to 90 % 5 % of meas. value ±3 digits

SINAD meter
- Input level 0.1 to 20 V
- Measuring range 1 to 46 dB
- Resolution
  SINAD < 30 dB 0.1 dB
  SINAD ≥ 30 dB 0.5 dB
- Measuring accuracy
  for SINAD < 30 dB 0.8 dB ±1 digit

Scope & Analyzer

Spectrum analyzer
- Frequency range 2 to 999.9999 MHz
- Frequency accuracy better than 2 % of sweep width
- Input-level range for measuring accuracy
  3 dB in the frequency range $0.5 \cdot f_c \le f \le 2 \cdot f_c$
  RF socket –70 to +47 dBm
  RF DIRECT socket –90 to +13 dBm
- Sweep width 200 kHz, 2 MHz, 10 MHz
- Sweep time
  Sweep width 2 MHz and 10 MHz approx. 500 ms
  Sweep width 200 kHz approx. 2 s
- Evaluation bandwidth
  Sweep width 2 MHz and 10 MHz 30 kHz
  Sweep width 200 kHz 6 kHz
- Inherent noise
  on RF DIRECT socket
  Sweep width 2 MHz and 10 MHz –95 dBm
  Sweep width 200 kHz –105 dBm

Oscilloscope
- Inputs external Z_i = 1 MΩ/40 pF (AC/DC)
- Inputs internal RX mod, TX demod, duplex demod, AF voltmeter, residual distortion
- Frequency range DC (3 Hz) to 20 kHz
- Level error < 10 % + 0.2 div
- Grating 6 x 10 div
- Horizontal deflection 100 µs/div to 500 ms/div
- Vertical deflection 2 mV/div to 10 V/div or 160 Hz/div to 8 kHz/div (FM); 0.16 rad/div to 8 rad/div (ΦM); 0.8 %/div to 40 %/div (AM)
- Trigger ± slope selectable trigger level
- Operating modes auto, norm, one-shot, freeze, time measurement (max. resolution 2.5 µs)

Selective-call encoder and decoder

Standard tone sequences
- ZVEI 1, CCIR, VDEW, ZVEI 2, EEA, NATEL, EIA, EURO, CCITT

User-defined tone sequences
Sequence of up to 30 tones can be stored by user. Also double tones and underlying continuous tone (with GEN B option).

Encoder
Operating modes
- Single-tone sequence (max. 30 tones)
- Double-tone sequence (with GEN B option) (single-tone and double-tone sequences can be transmitted continously)
- Acknowledgement call (max. 15 double tones) from response time of < 100 ms acknowledgement call only possible with optional duplex FM/ΦM stage
- Frequency error $1 \cdot 10^{-4}$ Hz

Decoder
Decoding of each tone of tone sequences (max. 30 tones). Continuous decoding can be set.

General data

Dimensions and weight
- H x W x D 230 mm x 375 mm x 486 mm
- Weight approx. 18.5 kg

Power supply
- AC 94 to 132 V or 187 to 264 V (47 to 450 Hz)
- P_{max} approx. 110 W (incl. options)

Environment
- Operating temperature 5 to 45 °C
- Storage temperature –40 to +70 °C
- Relative humidity max. 90 %

Mechanical strength (to DIN 40046)
- Shock 25 g
- Vibration 5 to 10 Hz for 10 mm amplitude
  10 to 60 Hz, 2 g constant
- EMC conformity EN 55022:1995, class B
  EN 60801:1994, part 2
  test level 1
  ENV 50140:1995, test level 2
  IEC1000-4-4:1995, test level 3
- Safety EN 61010:1995, part 1

IEEE-bus interface
- Standard IEEE 488
- Connector 24-way
- Functions AH1, SH1, L2, T1, SR1, RL1, DC1

Frequency extension ✻

The following specifications apply to the FEX option:

RF Generator

Carrier frequency
- Frequency range 1.0 to 2.3 GHz
- Resolution 1 kHz

Output level
- RF socket –142 to –20 dBm
- RF DIRECT socket –122 to 0 dBm
- Level error into 50 Ω (1.0 to 2.0 GHz)
  RF socket 1.5 dB
  (over range –110 to –20 dBm)
- VSWR (50 Ω) RF socket < 1.2

RF Analyzer

Frequency measurement
- RF Frequency range 1.0 to 2.3 GHz
- Minimum level –5 dBm
  (over range 1.0 to 2.0 GHz)

RF power measurement, RF socket (broadband)
- RF Frequeny range 1.0 to 2.0 GHz
- Measurement accuracy 14 % ± 1 Digit
  (over range –200 mW to 10 W)

Ordering data

STABILOCK 4032	108802
RF-Frequency extension 2.3 GHz (FEX)[4]	248295
GSM/PCN/PCS MS Test Package incl. STABILOCK 4032 RF-Frequency extension 2.3 GHz GSM hardware option Spectrum analyzer GSM/PCN/PCS test software	248296
DECT Package incl. STABILOCK 4032 RF-Frequency extension 2.3 GHz DECT module DECT FP/PP test software	248255
CDMA BS Test Package incl. STABILOCK 4032 CDMA module CDMA 800/1900 MHz test software	248302
IS-136 MS Test Package incl. STABILOCK 4032 RF-Frequency extension 2.3 GHz DAMPS module DATA module IS-136 test software	248304
TETRA-380 MS Test Package incl. TETRA module Duplex und IQ-380 module TETRA MS test software	248307
TETRA/FEX MS Test Package incl. TETRA module RF-Frequency extension 2.3 GHz TETRA MS test software	248308
BATE AMPS BS Test Package	248198
BATE ETACS BS Test Package	248144

Other available options

Duplex FM/ΦM stage	229062
Control interface A (8 relays)	236035
Control interface D (24 relays + 20 TTL)	236038
2nd Modulation generator	208032
Tracking	229076
RS-232/Centronics interface	236043
Keyboard	248192
VSWR directional coupler + access.	248104
VSWR bridge + accessories	248145
Data module	236034
Option card	236033
SSB kit	248154
Adjacent channel power meter (ACPM)	229035
ACPM upgrade kit	248270
Spectrum analyzer upgrade kit for 4031	248290
Spectrum analyzer for 4032	248291
2nd RF generator + Fast Tracking[4]	248293
Network C expander [1]	248116
DTMF module [1]	248171
DC voltmeter/ammeter [1]	248172
300-Hz highpass filter [1] [2]	248199
300-Hz lowpass filter [1] [2]	248174
3-kHz lowpass filter [1] [2]	248186
4-kHz bandpass filter (NMT) [1] [2]	248175
6-kHz bandpass filter [1] [2]	248176
6-kHz bandstop filter (TACS) [1] [2]	248177
50 Hz to 15 kHz bandpass filter [1] [2]	248278
Variable notch filter (200 to 600 Hz)[1]	248179
Variable notch filter (200 to 1200 Hz)[1]	248195
Variable notch filter (150 to 600 Hz)[1] **)	248204
C-Message filter (CCITT weighting)	248235
Filter Adapter*)	248269
AC/DC power supply (new)	204033
NADC 900 MHz hardware option[3]	248271
NADC 450 MHz hardware option [3]	248277
NADC PCM interface (Ericsson BST)	248282
Cable set for Ericsson digital NADC transceiver	248283
GSM hardware option [3]	248274
NADC-/GSM upgrade kit (required if serial number < 1188000)	248281

1) requires 1 x option card 236033
2) max. 2 of the filters may be installed at one time
*) 3 filters with Filter Adapter
**) requires Firmware version ≥ 6.21
3) requires Basic Unit with a serial number ≥ 1188xxx
4) 2nd RF generator and FEX exclude each other

Not all options can be fitted into one STABILOCK.

Some options can only be applied in conjunction with other options.

Software options

NMT 450i/900 Scandinavia	897911
NMT 450i	897916
NMT France	897925
NMT Benelux	897920
NMT Turkey	897901
NMT 450 Universal	897915
NMT 900 Universal	897902
NMT 450/900 Base-Station Test	897905
NATEL-C (Switzerland)	897930
Network C Austria (NMT 450i)	897910
Network C Portugal	897062
Network C SAPO	897063
Tracking	897806
EAMPS	897950
ETACS UK	897940
TACS Japan (JTACS)	897945
PDC MS Test	897909
NAMPS	897903
NTACS	897904
NADC 900 MHz BS Test	897072
NADC 900 MHz MS Test	897073
NADC 450 MHz BS Test	897908
NADC 450 MHz MS Test	897907
NADC MS Test AUTORUN	897917
GSM/DCS 1800/1900 MS Test	897912
GSM MS Test AUTORUN	897078
GSM BS Test	897076
DECT FP/PP Test	897803
IS-136 MS Test	897926
IS-136 DB (down-banded)	897807
CDMA BS Test 800/1900 MHz	897805
RADIOCOM 2000 HD	897970
FMS	897082
VDEW direct dialing	897086
VDEW digital standard	897090
VDEW digital (Bosch)	897095
ZVEI binary	897084
ZVEI binary (600 baud)	897085
POCSAG (NRZ)	897080
POCSAG (FFSK)	897081
Cityruf (German version of 897080)	897083
DIGI-S (includes VDEW digital)	897097
Trunking (MPT 1327 / PAA 2424)	897089
AT&T Microcell	897096
Combiner Test	897985
US-Signalling Formats	897092
LTR + US Signalling	897093
DSAT/DST (of NAMPS)	897094
ATIS	897098
Fast IEEE	897802
2.1 GHz Analyzer Tracking	897928
Tetra MS Test	897808
Tetra BS Test	897942
ARE AUTORUN Editor (5¼ or 3½ disc)	897100

Accessories

Accessories supplied	249032
2 miniature fuses 3,15 A	849037
Power cable	880606
2 protective caps, black	787095
TNC/BNC adapter	886255
TNC terminator cap	886247
Protective front-panel cover	501350
Headphones jack plug	884123
1 memory card (blank, 256 KByte)	897053
Operating manual	290288

Recommended extras

Microphone	248170
Telescopic antenna	248120
Carrying bag	378258
Transport container	300692
Protective back-panel cover	501350
19-inch adapter	378257
Connector set	300690
N/BNC adapter	
2 x 1 m cable BNC/BNC	
1 x 1 m cable N/N	
1 x 1 m cable BNC/banana	
Memory card (256 KByte)	897053
Carrying grip kit	378256
RF probe	860108
Oscilloscope probe	860148
Service manual	291288
Protective edges	248190
GSM/DCS 1800 SIM Card plug-in	860188

Subject to changes without prior notice.

STABILOCK 4032 Lifeline

The chronical lifeline tells you what modifications have been made to the firmware (FW) and the operating instructions. After a firmware 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

FW	Manual Version	Δ pages		Changes
5.00	9401-500-A	all	–	First edition.
5.01	9407-502-A	8-84	NF	New IEEE commands for RS-232-C interface.
		no	NF	Handling of fast analyzer (option 248 290/291) possible.
		no	IN	No screen saver in AUTORUN or remote mode.
5.02	9407-502-A	no	C	Bug fixes.
	9409-502-B	6-19	NF	Description of tracking feature.
		1-3	C	Better position for Notes on Safety.
		6-3	IN	Hint to optional analyzer.
		4-5	C	RAM test displays no more information onscreen.
		4-44	C	Softkey (DTMF) inserted.
		7-11	IN	Source + destination card must have same capacity.
5.03	9501-503-A	all	NF	First edition in Spanish.
		2-16	C	All informations about Hardware Options now in Chapter 9.
		4-4	NF	Masks OPTIONS and HW-REVISIONS: now two pages.
		7-4	NF	New design of Memory Card.
		8-86	NF	Output of hexadecimal 0 possible (RS-232 interface).
		12-9	IN	Description of Firmware Update.
5.031	9502-5032-A	no	C	Bug fixes.
5.032	9502-5032-A	no	C	Bug fixes.
	9507-5032-B	1-5	IN	New standard power supply.
5.032	9507-5032-C	2-16	C	Description of socket 103 (IF stage) added.
		12-17	NF	Technical data added.
6.10	9601-610-A	7-12	NF	New memory card (256 Kbyte) added.
		8-38	NF	BASIC command GET added.
		8-43	NF	BASIC command HEX$ added.
		8-64	NF	BASIC command TIMEOUT added.
		8-69	NF	New description of IEEE-488 bus added.

Code: C = Correction, IN = Important Note, NF = New Feature				
FW	**Manual Version**	**Δ pages**		**Changes**
Continue		8-85	NF	IEEE command MFRMS added.
		8-89	NF	IEEE command FILTErabcd added.
		8-96	NF	IEEE commands UNIT_ and UNITS added.
		8-101 8-102	NF	New error messages added.
6.12	9605-612-A	none	C	Bug fixes.
6.13	9608-613-A	8-97	NF	IEEE command IDENTity added.
		12-7	C	Tracking (Standard) available again[8)].
		none	C	Bug fixes.
6.14	9707-614-A	none	NF	Only relevant for units with FEX/analyzer (new spans).
6.20	9809-620-A	12-17 to 12-22	IN	Technical data and ordering informations updated.
		4-4	NF	OPTION mask now shows installed software options separated from hardware options.
6.21	9811-621-A	none	C	New Variable notch filter 248 204 (150 Hz ... 600 Hz) will be correctly displayed in the AUX mask.
	0112-621-A	–	–	New company name Acterna. Update of software options and accessoires.
	0206-621-A	12-22	C	Power cable 880 604 changed to 880 606.
6.22	0209-622-A	–	–	New company name Willtek. Update of status screen and IDENTity response (IEEE command).

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