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Communication Test Set

STABILOCK 4031

Operating Instructions

Manual Version

9305-358-A

Attention: Only valid for units from serial number 0688xxx

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Chapter 2 —— Description

Chapter 3 —— Operating STABILOCK 4031

Chapter 4 —— Standard Measurements

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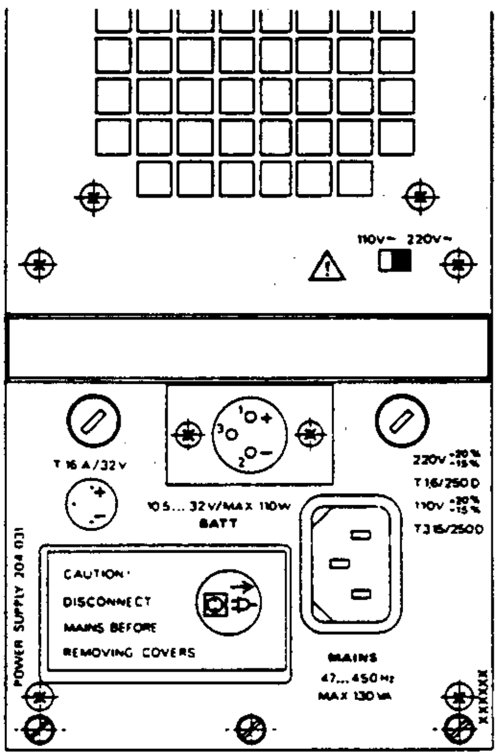
First-time Use

Contents

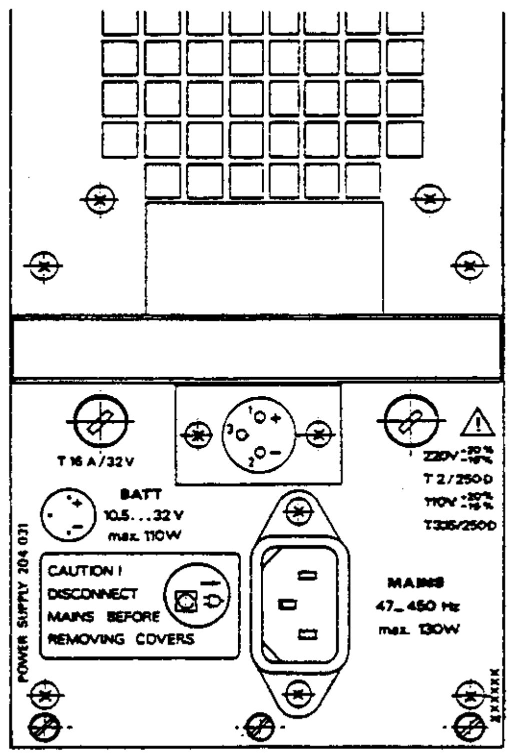
Preparations for First Startup

Preparations for Mains Powering

Before switching STABILOCK 4031 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.



Power supply with 110/220 V selector



Power supply without selector

Selection of mains voltage

Power supply without selector
The set will adjust itself automatically to 110 V or 220 V (see also "Selection of mains fuse").

Power supply with selector
The sliding switch on the rear of the POWER SUPPLY module has to be set to 110 V or 220 V.
Warning: If a STABILOCK 4031 that is set for 110 V is connected to 220 V, the power supply will be destroyed.

Setting 110 V --- mains operation on 94 to 132 Vac
Setting 220 V --- mains operation on 187 to 264 Vac

Selection of mains fuse

Power supply without selector
Depending on the mains voltage the following fuse link will be required in the righthand fuse holder:

110 V --- T3.15/250D (slow; 3.15 A; 5.2 mm x 20 mm)
220 V --- T2/250D (slow; 2 A; 5.2 mm x 20 mm)

Power supply with selector
Any change of the switch setting also makes it necessary to change the miniature mains fuse (righthand fuse holder of the POWER SUPPLY module). So check - with the power disconnected - the rating of the miniature fuse that is inserted. The following fuses (standard accessories) will be needed, depending on the setting of the switch:

Setting 110 V --- T3.15/250D (slow; 3.15 A; 5.2 mm x 20 mm)
Setting 220 V --- T1.6/250D (slow; 1.6 A; 5.2 mm x 20 mm)

Mains/battery in parallel

When STABILOCK 4031 is being mains-powered, this does not mean that an external battery has to be disconnected. This parallel mode of operation will not endanger either the battery or the 4031. The mains takes priority, so the battery is neither discharged nor charged.

Preparations for Battery Powering

Feed-in point

In mobile use STABILOCK 4031 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. The matching battery connector is supplied with the equipment.

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. These values are practically independent of the configuration because even when the 4031 is fully fitted with options, its power consumption is only about 10 W more than that of the standard version, which requires about 90 W.

Fuse

There is a miniature fuse T16/250E (slow; 16 A; format 6.3 mm x 32 mm) in the lefthand fuse holder. 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. 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 4031. 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/mains in parallel

If an external battery is connected to STABILOCK 4031, the unit can still be fed from the mains. The mains takes priority, so the battery will not be discharged in parallel mode, but it will not be charged either.

Notes on Safety

STABILOCK 4031 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:

Mains voltage

- Before you switch on, make sure that the operating voltage set on the instrument is the same as the mains voltage. Only use fuses of the type stated. Do NOT patch your fuses or short the fuse holder.

Earthing

The mains plug of STABILOCK 4031 may only be connected to a socket with an earthing contact. The protection (earthing) that this produces may not be cancelled by using an extension cable that has no safety earth conductor. Nor is it permissible to intentionally interrupt the safety earth conductor either inside or outside the instrument (eg by undoing the connection for the safety earth conductor).

Caution: If there is no earthing through the safety conductor and a defect occurs, the housing of STABILOCK 4031 could become live, which is highly dangerous!

Shutdown upon defect

If you suspect that the 4031 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 SCHLUMBERGER service agency.

Maintenance

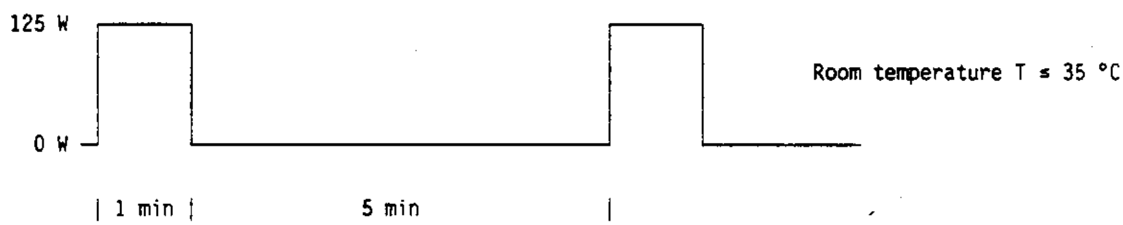
Maintenance or repairs on the instrument while it is switched on should only be performed by someone who is well aware of the dangers involved by this.

Permissible RF input power

The permissible input power of STABILOCK 4031 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. If the serial number of your STABILOCK 4031 begins with 0588 or if higher, 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 (cooling-off phase for the internal power attenuator)

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.

Caution: When the message *REDUCE RF POWER* appears on the monitor, you must immediately reduce the applied power to P_{av} ≤ 50 W. Otherwise the internal power attenuator will be destroyed. Furthermore: For as long as power of P_{av} ≥ 50 W is applied, STABILOCK 4031 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 4031 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 4031 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 4031 for 20 to 25 min, the momentarily displayed mask will be replaced by a message prompting you to press any key. The position of the message constantly changes, which safeguards the monitor against burns, especially if the display is set very bright. 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 12).

Now you should familiarize yourself with the "Notation Rules" in Chapter 3. After that there are two ways of getting acquainted with STABILOCK 4031.

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 4031 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 12. 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 12 contains foldouts showing the various masks of the 4031. 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 "Training with Screen Masks" in Chapter 11. This is a course made up of different lessons that teach the essentials of operating STABILOCK 4031.

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 4031.

Description

Contents

Equipment Supplied

Your STABILOCK 4031 is delivered to you with the following standard accessories:

- Set of miniature mains fuses
- Mains cable
- TNC/BNC adapter
- Front-panel cover
- Headphones plug
- Connector for battery cable
- Memory card (32 kbytes, blank)
- Operating manual

The ordered options are usually already incorporated in the Communication Test Set. You can see what options are in your 4031 at any time by calling up the socalled status mask on the screen. The callup of the status mask is described in the foldout of the same name in Chapter 12.

Controls (Foldout "Front panel")

Please open the "Front Panel" foldout. The control you want to find out more about is identified by a number. The function of the particular control is explained in this section under the same number.

Things you need to know to help you understand: Chapter 3 "Notation Rules" and "Operating Rules".

Meaning of Keys

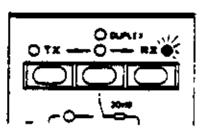
1 **TX**

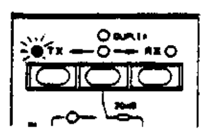
Calls up the basic TX mask (transmitter measurement). <TX> also takes you to the basic TX mask if a submask has been called up. In this case <TX> substitutes for multiple operation of the softkey *RETURN*.

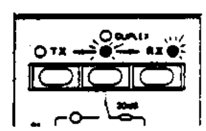
2 **Unnamed**

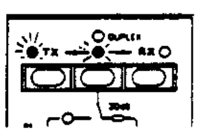
This is repeatedly tapped to select the modes SIMPLEX, AUTO-SIMPLEX and optionally DUPLEX (basic DUPLEX mask). SIMPLEX = manual switchover between TX and RX; AUTO-SIMPLEX = automatic switchover from RX to TX if the RF power fed in is $\geq$ approx. 30 mW.

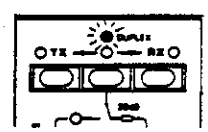
Illuminating LEDs signal the mode selected:


SIMPLEX (RX)


SIMPLEX (TX)


AUTO-SIMPLEX (RX)


AUTO-SIMPLEX (TX)


DUPLEX

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**

a) 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>.

b) 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**

a) Calls up the SINAD meter on the screen if the RX or DUPLEX mask is present.

b) 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).

c) 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 4031 (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 4031 (RMS/dBr/AF POWER, DIST or SINAD). 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 foldout "OPTION CARD" in Chapter 12).

8 **VOLTM**

Conducts the signal from the input socket of the same name VOLTM to the momentarily called AF instruments (RMS/dBr/AF POWER, DIST or SINAD). The VOLTM key is interlocked with the DEMOD and RX MOD/MOD GEN keys.

9 **DEMOD**

Conducts the demodulated signal from the 4031 test receiver internally to the momentarily called AF instruments (RMS/dBr/AF POWER, DIST or SINAD). 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 (RMS/dBr/AF POWER, DIST or SINAD). 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 <u>or</u> 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.*). a) 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). b) If the RX signal path is switched (green LED illuminated), the modulation signal feeds the modulator of the 4031 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 <u>or</u> 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 9).
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 <u>or</u> 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 4031 but without deleting the set test parameters. <CLEAR> will generally eliminate any blockage of the internal digital signal processing. <OFF> + <CLEAR> eliminates stubborn blockages, but replaces test parameters set by the user with works settings (defaults) and calls up the status mask.

15 HELP

a) 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.

b) 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 4031 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:

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

19 ANALYZER

a) Calls up the spectrum analyzer (entry fields and panoramic display) on the screen if the TX mask is selected.
b) 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 4031. 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 the current RF input/output; at the same time the softkey shows RF as the new function that can be called.**

22 Cursor block

a) 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 cursor key produces a repeat function).

b) 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 4031. 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.

<OFF> + <POWER> (total reset) replaces all settings on the 4031 with works settings (defaults) and causes the status mask to be called up.

24 + (plus)

a) 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.

> <FREQUENCY> + < + > —> offset field is opened with plus sign

b) 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> + <FREQUENCY> + <150 (MHz)> + <ENTER> + <FREQUENCY> + <STEP> + <20> + <ENTER> + *< + > —> every time < + > is tapped, the frequency of the 4031 signal generator is incremented by 20 kHz: 150.02 MHz, 150.04 MHz, etc

c) Issues the plus sign if the RF level is to be set with dBm or dBµ units, ie provided that the *Level* field is open.

d) 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 - (minus)

This function is analogous to < + >.

26 STEP

a) Displays the *STEP* entry field for defining a stepping width (see also point 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

b) 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.

c) 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.

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

b) 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

c) 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**

a) Removes a *STEP* entry field from the screen that has been fetched with <STEP>, ie provided that the STEP field has been opened.

b) Cuts out the 4031 signal generator, ie provided that the *Level* entry field has been opened. Switch on again (with original level value) using <LEVEL>.

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 (dBµ, µV/mV or dBm), ie provided that the entry in the *Level* field was terminated immediately beforehand with <ENTER>.

<RX> + <LEVEL> + <12 (mV)> + <ENTER> + *<UNIT/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 **FREQUENCY**

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**

a) 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.

b) Opens numeric fields without altering their content.

Meaning of Rotary Knobs

35 **INTENS**

Adjusts the intensity of the screen display. Automatic cutout 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 GENERAL PARAMETERS foldout).

36 **Unnamed**

Volume control; effective when monitoring a current AF signal or a frequency offset (cf point 6). 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.

a) 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 alteration of the level value in the *Lev* entry field (with the handwheel) is immediately shown on the RMS meter

b) 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 4031 (RMS/dBr/AF POWER, DIST or SINAD) 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 4031 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

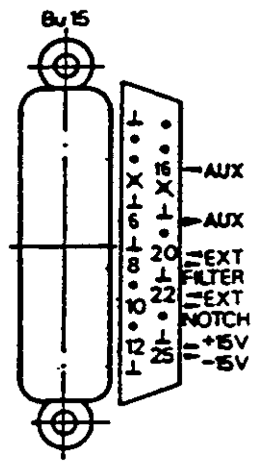
49	**SYM**	Determines whether the earthy pole of the VOLTM socket is connected to ground (unbalanced input) or not (balanced input).
50	**600 Ω/100 kΩ**	Puts the input impedance of the VOLTM socket on 600 Ω or on 100 kΩ.
51	**600 Ω/10 Ω**	Puts the output impedance of the MOD GEN socket on 600 Ω or on 10 Ω.
52	**600 Ω/VAR >35kΩ**	Puts the input impedance of the EXT MOD socket on 600 Ω or on 35 kΩ. In the VAR >35kΩ 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 (Back Panel foldout)

Please open the "Back Panel" foldout. This shows the back panel of STABILOCK 4031 with all the modules inserted here (including options) and the 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 8, 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)

Socket Bu 15: Pinning

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

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

OPTION CARD (module 2)

Socket 90 (Bu 90): Interface (AF and control signals) for connecting the OPTION CARD to module 1.

Socket 95 (Bu 95): AF input (AF EXT) for optional DTMF module (see also Chapter 8).
$0.1\ V \le V_{rms} \le 1\ V$
$R_i = > 10\ k\Omega$

Socket 94 (Bu 94): GND terminal for Bu 93.

Socket 93 (Bu 93): DC voltage test input of optional module DC-V/A meter.
$V_{max} = 42\ V$
$R_i = 850\ k\Omega$ to $5.6\ M\Omega$ (depending on test range; see Chapter 8).

Socket 92 (Bu 92):
Socket 91 (Bu 91): The 10-mΩ precision resistor of the ammeter (optional module DC-V/A meter) is across Bu 92 and Bu 91. Both sockets are floating (see also "AF Signal Paths" foldout).
$I_{max} = 15\ A$

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.

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)
$R_i = 600\ \Omega$

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 4031 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).

MOD GENERATOR B (module 5)

Socket 39 (Bu 39): DC-coupled output for the modulation signal of GEN B in TX mode (transmitter testing). Even with modulation overlay, only the GEN B signal is on Bu 39 (no sum signal). In RX mode the signal on Bu 39 is undefined (see also Chapter 8).

CONTROL INTERFACE A, B or C (module 6)

Note: CONTROL INTERFACE B no longer available.

Socket 19 (Bu 19): Bu 19 is present with all three interfaces but differently pinned:

Control interface A: relay contacts of switchover relays 1 to 8
Control interface B: relay contacts of switchover relays 1 to 12
Control interface C: relay contacts of switchover relays 1 to 12 + TTL control outputs 1 to 10

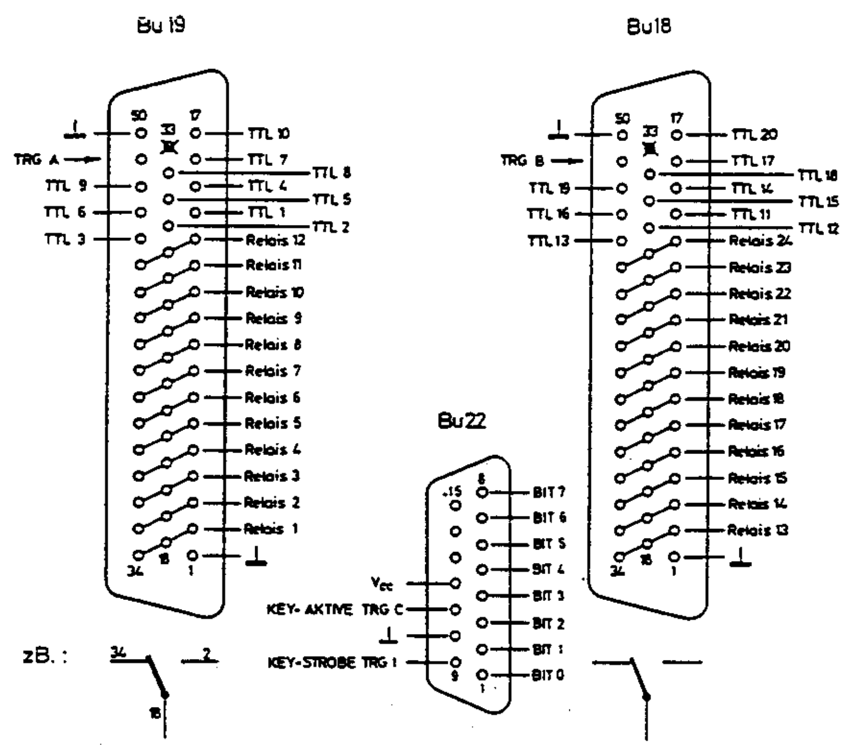
Pin 49 (Bu 19) = trigger input (all interfaces)

Socket 18 (Bu 18): Bu 18 is only present on interfaces B and C:

Control interface B: relay contacts of switchover relays 13 to 24
Control interface C: relay contacts of switchover relays 13 to 24 + TTL control outputs 11 to 20

Pin 49 (Bu 18) = trigger input (interface B + C)

Socket 22 (Bu 22): Bu 22 (connector for ASCII keyboard) is present on all interfaces. If the ASCII keyboard is not connected, Bu 22 can be used as an input for 8 TTL control signals.



Bu 18 to Bu 22: pinning

SLAVE COMPUTER (module 7)

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

DATA MODULE (module 8)

The data module is the hardware required for testing radio-data systems and cellular radiotelephones with the software options. It performs the generation and decoding of the system-specific signals.

Socket 97 (Bu 97):	Output for the "DATA" signaling of cellular radiotelephones. The signal is identical to the one fed internally to the FM modulator of the 4031 (1 V_p = 10 kHz deviation).
Socket 98 (Bu 98):	Conducts the synchronization signal "C-SYNC" for testing Network C radiotelephones.
Socket 99 (Bu 99):	Input for the demodulated "DATA" signaling of cellular radiotelephones (R_i = 100 kΩ). The DATA signal on Bu 99 can be decoded as an alternative to the TX DEMOD signal (see also foldout "AF Signal Paths").
S 101:	Selector switch for the input voltage on Bu 99.
	Setting 0 V: ±0.5 to ±5 V_p
	Setting TTL: Bu 99 as a TTL-compatible input

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 4031. 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
STABILOCK 4031

Contents

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

You will recognize a prompt to operate a key by the fact that the name of the key appears between pointed brackets. If there are several such prompts in succession, they are strung together with the plus sign or, in the case of longish strings, the prompts will be numbered. If the pointed brackets are missing, just the key itself is meant without any prompt to operate it.

If there is just lower-case text between pointed brackets, there is <u>no</u> 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.

Value input

<FREQUENCY>

Operate the FREQUENCY key.

<FREQUENCY> + <value> + <ENTER>

This string means that first you press the FREQUENCY key and then, using the keys of the numeric cluster, enter the required (frequency) value. Finally you transfer the value to the 4031 with <ENTER>. <value> can also mean that you only have to alter a previously entered value with the handwheel.

1. <FREQUENCY>
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.

<FREQUENCY> + <158> + <ENTER> You are prompted to enter the (frequency) value 158 MHz and transfer it to the 4031 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, GEN B, 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.

Operating a Key Several Times

In some operations you may have to tap a key (eg UNIT/SCROLL) several times in succession in order to achieve your purpose; this purpose is shown by the nature of the operation. Such a procedure is identified by an asterisk.

<AM FM ΦM> + *<UNIT/SCROLL>

In this string the UNIT/SCROLL key has to be operated several times until the abbreviation for the required class of modulation appears in the header of the mask.

Operating Two Keys Simultaneously

If two keys have to be pressed temporary at the same time, this is indicated by underlining the names of the keys.

<OFF> + <CLEAR>

Press the OFF key, keep it depressed and press the CLEAR key in addition for a moment.

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

To make sure that text and numeric values which appear on the screen of the 4031 are clearly recognized when mentioned in the running text of the operating instructions, they are written in the running text in *italics*.

> **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.**

Abbreviations

FuG .... Radio/mobile

Operating Rules (Foldout "Basic RX Mask")

The operating rules for correct working with the 4031 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" foldout 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 only accessible to the 4031 itself. 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: FREQUENCY, LEVEL, MOD FREQ or AM FM 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 4031 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 4031 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 4031 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 4031 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 <FREQUENCY> 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 4031 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 <FREQUENCY> 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 4031 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 4031 are to be tuned to random frequencies (no forced duplex spacing), the *NOT* variable must have been selected.

Entry Examples

Example 1: Setting signal generator to 50.00055 MHz

1. <RX> + <FREQUENCY> + <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.

Example 2: Setting output level of signal generator to EMF

1. <RX> + <*EMF*> (*EMF* is alternative function to *50Ω*)

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*.

Example 3: 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>.

Example 4: 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>.

Example 5: Increasing tuned frequency of test receiver in 20-kHz increments

Starting frequency = 153.0100 MHz

```
1. <TX> + <FREQUENCY> + <153.0100 (MHz)> + <ENTER>
2. <FREQUENCY> + <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 <FREQUENCY> 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.

Example 6: Setting test receiver for AM demodulation

```
1. <TX> + <AM FM 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.

Example 7: Listening to FM modulation of received 100-MHz signal

```
1. <TX> + <AM FM ΦM> + *<UNIT/SCROLL> + <ENTER>
2. <FREQUENCY> + <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.

Example 8: 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).

Example 9: Generating 345-MHz signal with 2.8 kHz FM deviation (f_{mod} = 2 kHz)

1. <RX> + <FREQUENCY> + <345 (MHz)> + <ENTER>
2. <AM FM 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). <AM FM 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).

Standard Measurements

Contents

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 4031, 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 4031. If the 4031 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.

> Note: 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 4031 retains these values. In the course of series of measurements therefore, only the remaining relevant entry instructions have to be followed.

To enable you to distinguish them better from conventional keys (eg GEN A), softkeys are written in *italics* in the entry instructions (eg *RF DIR*).

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.

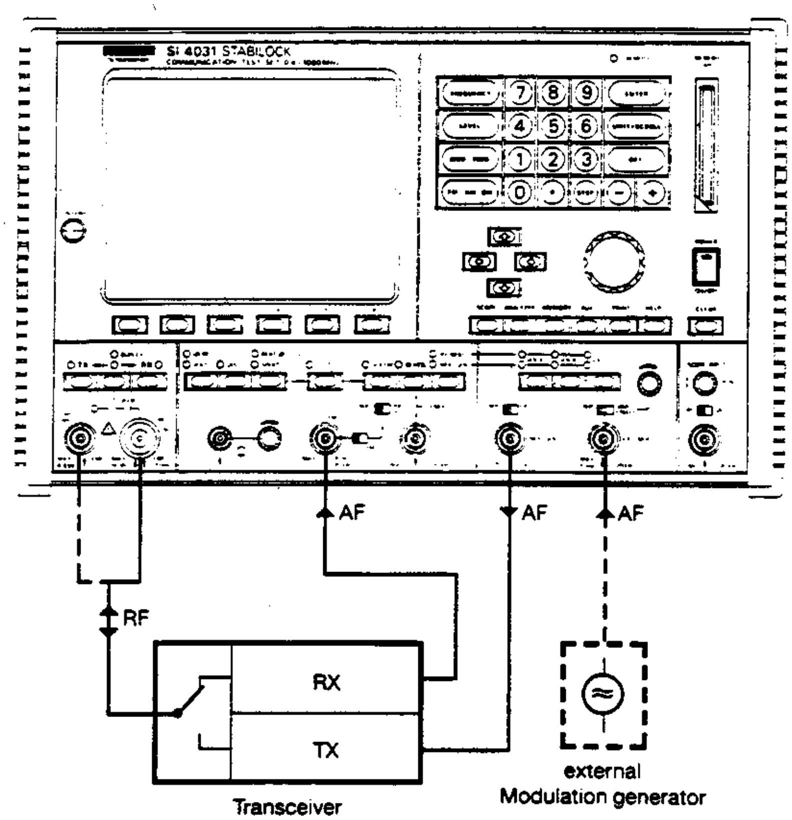
Test modulation = 60 % of the maximum permissible frequency deviation (f_{mod} = 1 kHz).

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 (see data sheet) 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 4031 continue to apply. For precise details of the minimum and maximum values on the two RF input/output sockets, refer to the data sheet.



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).

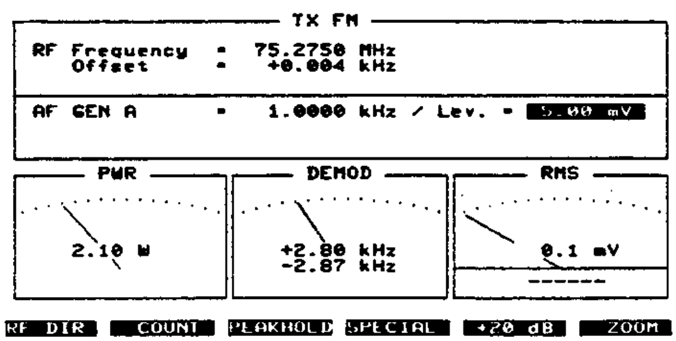
Basic TX Settings

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. <FREQUENCY> + <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. <AM FM 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 4031: 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.



<u>Basic TX setting</u>: The following operating parameters are declared in the mask for example: channel frequency = 75.2750 MHz, f_{mod} = 1 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**

Note: 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 signalled 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**	

Note: 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 4031 is automatically tuned to the measured frequency.

>>>

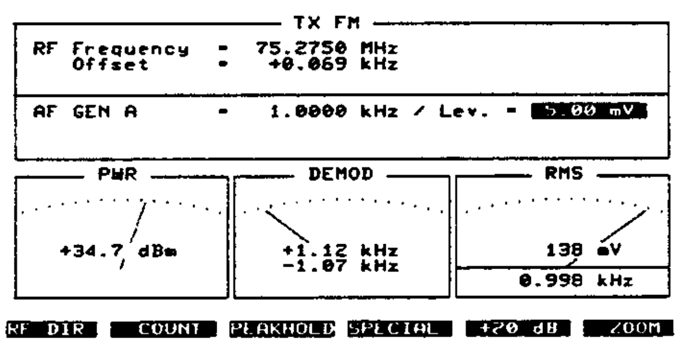
Purpose of measurement

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.

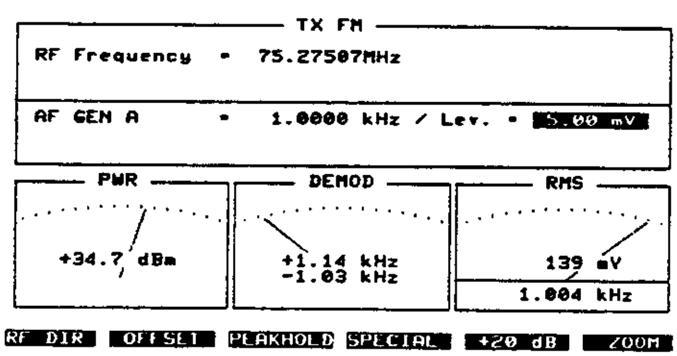
Typical limit values

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 to 50 MHz	±0.60 kHz
50 to 100 MHz	±1.35 kHz
100 to 300 MHz	±2.00 kHz
300 to 1000 MHz	±2.50 kHz



Frequency offset: The *Offset* display field indicates that the carrier frequency of the device under test deviates from the rated channel frequency



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, on sets with serial numbers ≥ 0588000, 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 —> Carrier power

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

Note: 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" foldout).

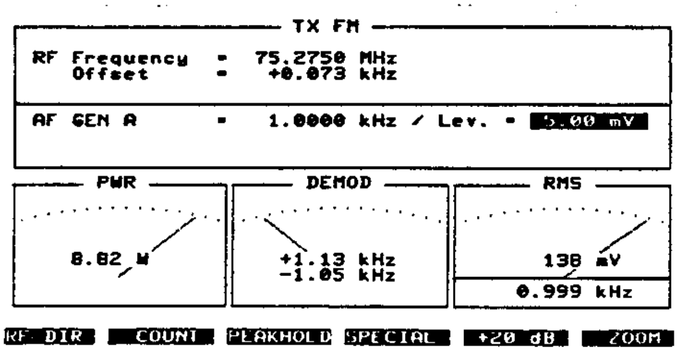
CAUTION: If the *REDUCE RF POWER* message appears on the monitor for P > 50 W, immediately reduce the applied power to P ≤ 50 W (see also Chapter 1, "Permissible RF input power").

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.



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.

RF Power (test bandwidth 3 MHz)

Boundary conditions

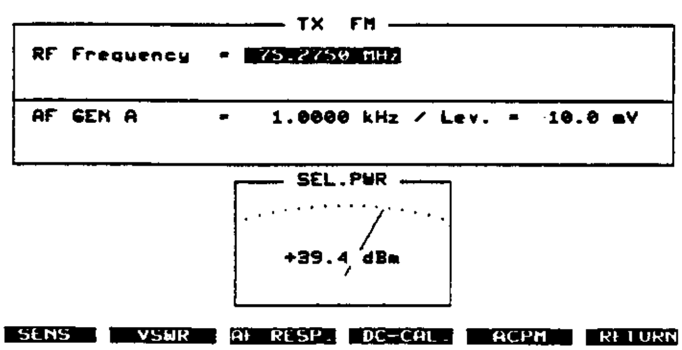
- Carrier unmodulated
- Level > 0 dBm —> apply signal to RF socket
- Level < 0 dBm —> apply signal to RF DIRECT socket
- Warning: P > 500 mW on RF DIRECT will destroy input stage!
- Check setting of pre-attenuation

Measurement —> RF power, selective

1. Check basic TX settings	
2. *<COUNT>*	Tune 4031 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	

Note: 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 "General Parameters" foldout).

CAUTION: 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").



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

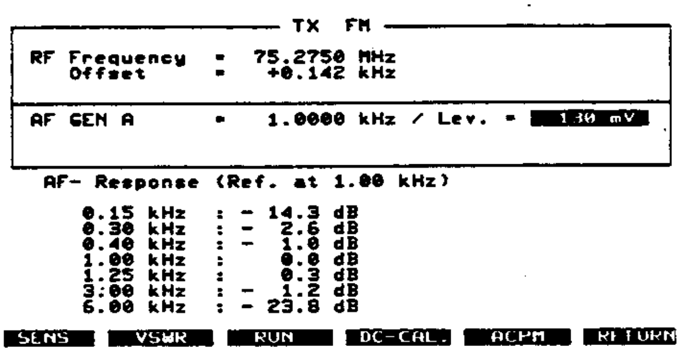
Boundary conditions

- 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 —> Modulation frequency response

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	

Note: 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.



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.

Measurement —> Modulation frequency response (manual)

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}, eg between 0.3 and 6 kHz (best with handwheel).
5. During step 4. read on dBr meter whether dB tolerance range is maintained	

Note: 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.

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} = 0.3 to 3 kHz:	+1 to -3 dB
f_{mod} = >3 to <6 kHz:	The level may not exceed the value measured at 3 kHz
f_{mod} = 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 —> Modulation sensitivity

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	

Note: 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.

Measurement —> Modulation sensitivity (manual)

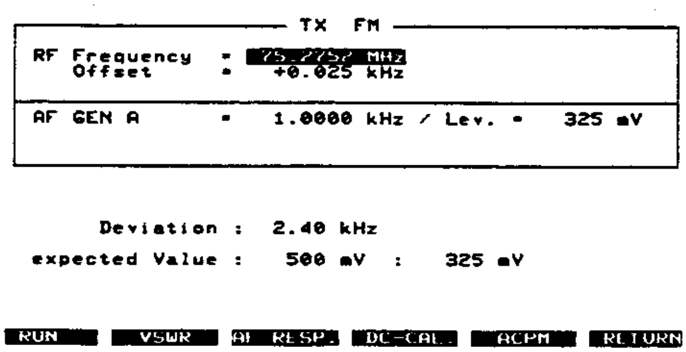
1. Check basic TX settings	
2. <value>	Alter modulation level (*Lev* field) with handwheel until DEMOD meter shows required modulation (eg test modulation).
3. Read AF level in *Lev* field	

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.



Modulation sensitivity: The Special *SENS* was started with the test parameters *Deviation: 2.4 kHz* and *Expected Value: 500 mV*. The result shows that the device under test has modulation sensitivity of 325 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 —> Modulation distortion

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	

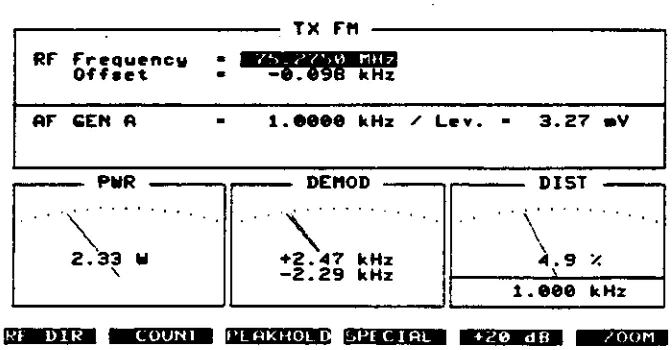
Note: The OPTION CARD, fitted with the variable notch filter, is required (see Chapter 8) for measuring modulation distortion with modulation frequencies between 200 and 600 Hz (to CEPT).

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.



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 —> Residual modulation

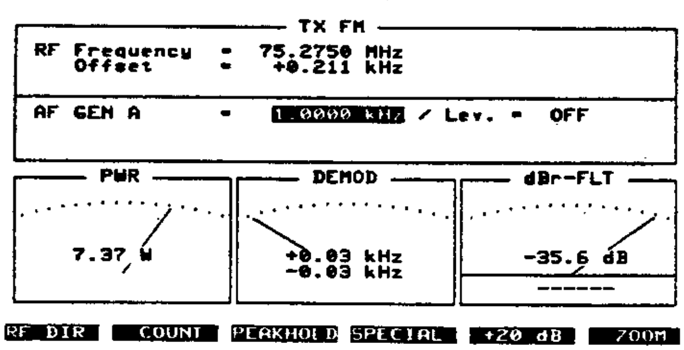
1. Check basic TX settings	
2. <value>	Alter modulation level (*Lev* field) with handwheel until DEMOD meter shows test modulation.
3. <CCITT>	Cut in weighting filter.
4. <dB REL>	AF level (at test modulation) becomes reference level (0 dB) for dBr meter.
5. <GEN A>	Cut out modulation generator GEN A.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



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 -35.6 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 ---> Deviation limiting

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	

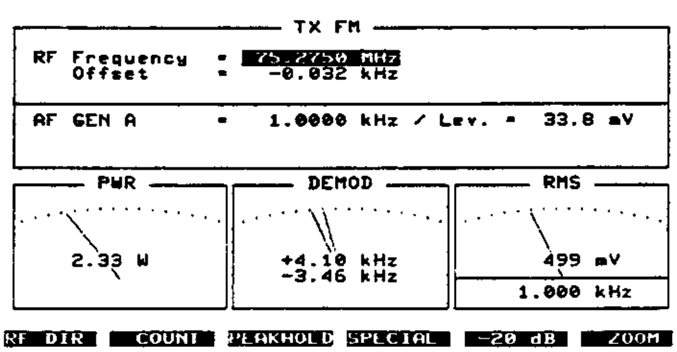
Note: After the measurement <*-20 dB*> restores the original test modulation. If the DEMOD meter will not permit a clear reading on frequency-modulated signals because of superimposed interference, the RMS meter can be used for a "steady" display of the average value of the frequency deviation (see Chapter 12, GENERAL PARAMETERS foldout, *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.



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 ---> Harmonics

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)	

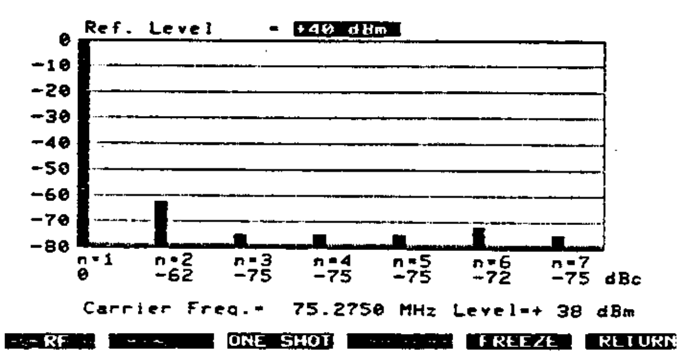
Note: The first seven harmonics are always detected up to a fundamental frequency of 142.79 MHz. At higher fundamental frequencies the analyzer only measures harmonics up to 999.9999 MHz. Details of harmonics measurement are given in Chapter 6.

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.



Harmonics: The harmonics measurement shows an absolute level of +38 dBm for the fundamental (75.2750 MHz), a relative level of -62 dBc for the second harmonic, -75 dBc for the third harmonic, etc. With 4 µW (+38 dBm - 62 dBc = -24 dBm) the second harmonic exceeds the permissible limit.

`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].

4

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.

Basic RX Settings

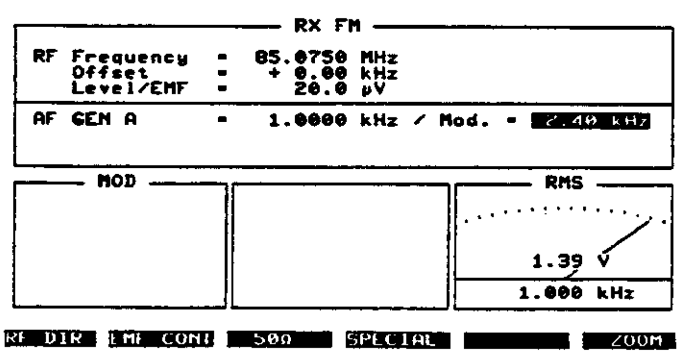
The basic RX settings are the foundation for all standard receiver measurements. It is sufficient to perform these basic settings once before starting the actual receiver measurements. In the course of receiver measurements the basic settings will normally be maintained unaltered, meaning that only a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

1. <RX>	Call up RX mask.
2. <*RF*> or <*RF DIR*>	Connect to appropriate input socket.
3. <FREQUENCY> + <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, %, rad); GEN A is 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.

NOTE: 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*.



Basic RX setting: In the RX mask the following operating parameters are declared here: RF is the active RF socket, RF level = 20 µV/EMF, channel frequency = 85.075 MHz, f_{mod} = 1 kHz, FM modulation, test modulation = 2.4 kHz.

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 —> Sensitivity

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), then enter S/N or SINAD reference value in left field (numeric field) and choose required unit in right field (scroll field).
5. *<RUN>*	Start measuring routine.
6. Read measured result from Special mask field	

Note: 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.

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	

Note: 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

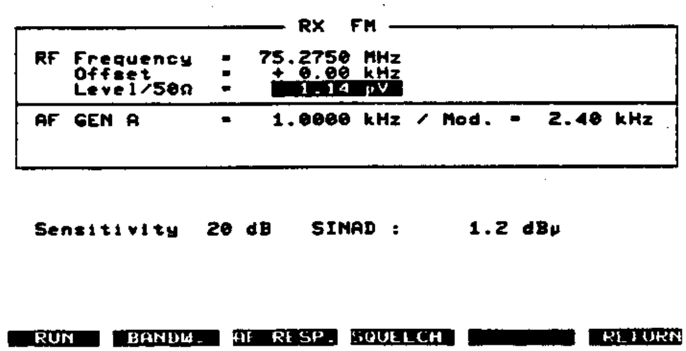
To determine what RF level is required on the antenna input of the radio set so that the AF signal on the loudspeaker output of the radio set exhibits a specific signal quality, characterized by the S/N or SINAD.

$$S/N = 20 \log \frac{\text{Signal level}}{\text{Noise level}}$$

$$SINAD = 20 \log \frac{\text{Signal level + Noise level + Harmonic level}}{\text{Noise level + Harmonic level}}$$

Typical limit values

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



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).

AF Frequency Response

Boundary conditions

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

Special Measurement —> AF frequency response

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)	

Note: 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.

Measurement —> AF frequency response (manual)

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	

>>>

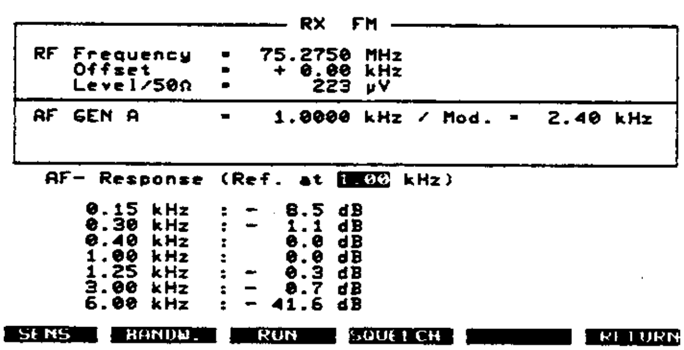
Purpose of measurement

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} = 0.3 to 3 kHz:	+1 to -3 dB
f_{mod} = >3 to <6 kHz:	The level may not exceed the value measured at 3 kHz
f_{mod} = 6 kHz:	The level must be at least 6 dB below the value measured at 1 kHz



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 kHz has been declared as the 0-dB reference frequency.

Demodulation Distortion (f_{mod} = 1 kHz)

Boundary conditions

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

Measurement —> Demodulation distortion

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

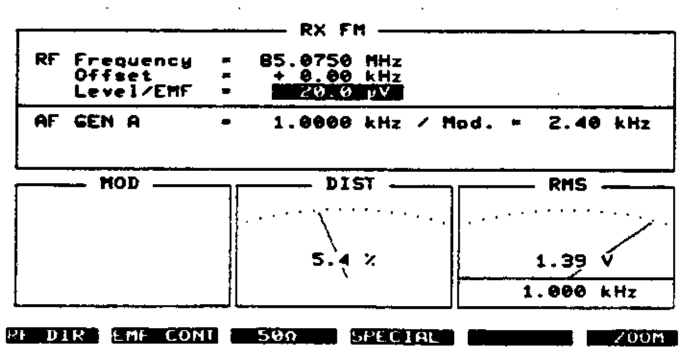
Note: The OPTION CARD, fitted with the variable notch filter, is required for measuring demodulation distortion with modulation frequencies between 200 and 600 Hz.

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.



Demodulation distortion: The DIST meter shows a distortion factor of 5.4 % for the device under test.

IF Bandwidth and Centre-frequency Offset

Boundary conditions

- Cut out squelch on radio set

Special Measurement —> IF bandwidth and centre-frequency offset

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	

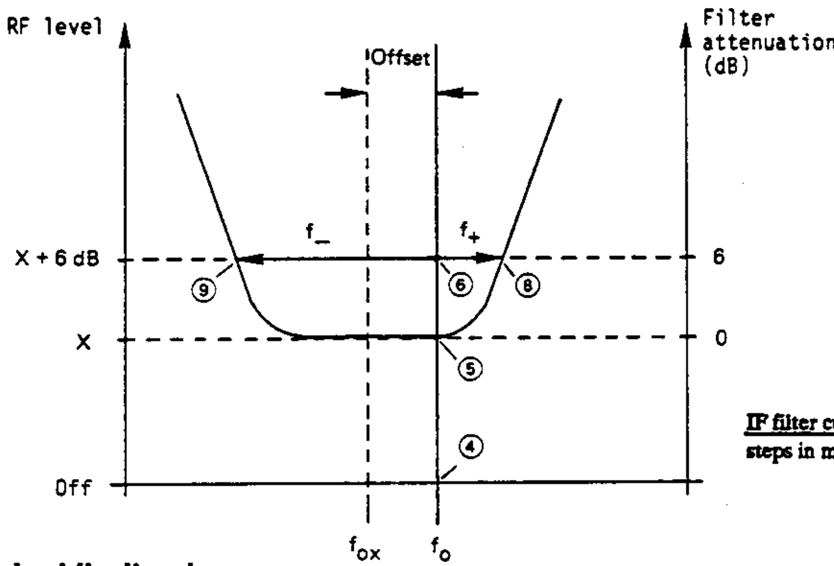
Note: If the measured IF bandwidth is greater than 51 kHz, the displayed result is "------".

Measurement —> IF bandwidth and centre-frequency offset (manual)

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. <FREQUENCY> + <+> + <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

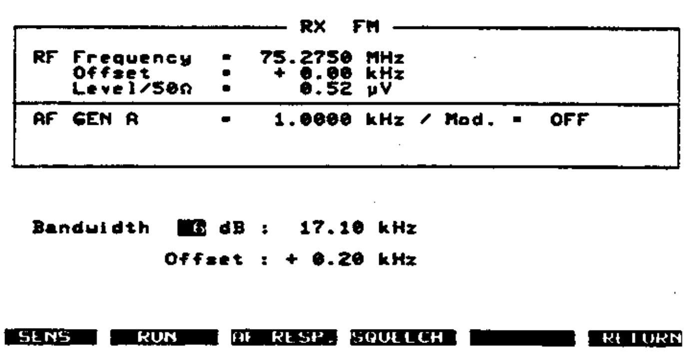
The measurement determines indirectly the bandwidth of the IF filter and its centre-frequency offset. Too small a bandwidth reduces the standard of intelligibility, too large a bandwidth reduces adjacent-channel selectivity and thus sensitivity. Highly unbalanced IF filters (large centre-frequency offset)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



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.



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 (17.10 kHz) and centre-frequency offset (+0.2 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 —> Squelch characteristic

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), and in right field select required unit for measured value.
4. *<RUN>*	Start measuring routine.
5. Read measured values for switching threshold and hysteresis	

Note: 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.

Measurement —> Squelch characteristic (manual)

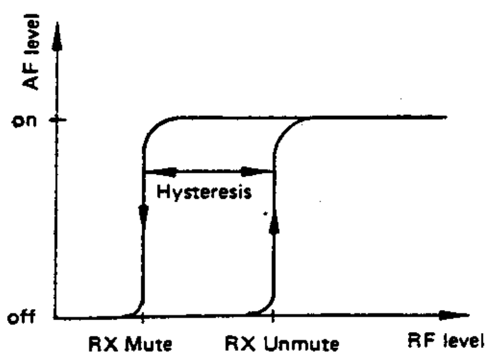
1. Check basic RX settings	
2. <LEVEL> + <value>	Reduce RF output level with handwheel until AF signal drops abruptly: note RF level (RX Mute).
3. <value>	Increase RF level with handwheel until AF signal abruptly appears: note RF level (RX Unmute).
4. Difference between levels is squelch hysteresis	

>>>

<u>Note</u>: 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 <u>continuously</u> 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*.

Purpose of measurement

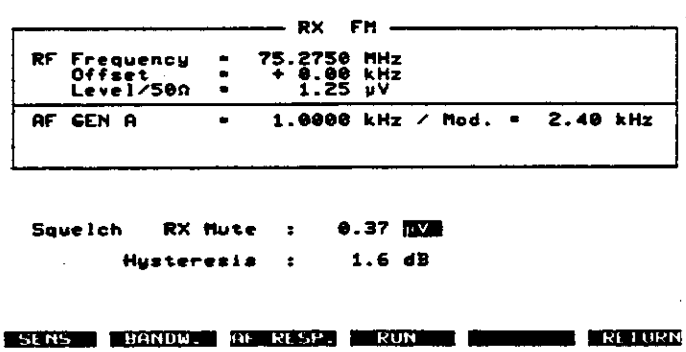
To determine at what RF level on the antenna input of the radio set the receiver blocks the AF signal path (muting threshold) and enables it again (unmuting threshold). The difference between the two RF levels is the squelch hysteresis in dB. If the muting threshold is set too high, it will spoil the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



<u>Squelch characteristic</u>: 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.

Typical limit values

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



<u>Squelch characteristic</u>: Here the Special *SQUELCH* showed 0.37 µV as the muting threshold (*RX Mute*) of the squelch. The hysteresis is 1.6 dB.

Limiter Characteristic

Boundary conditions

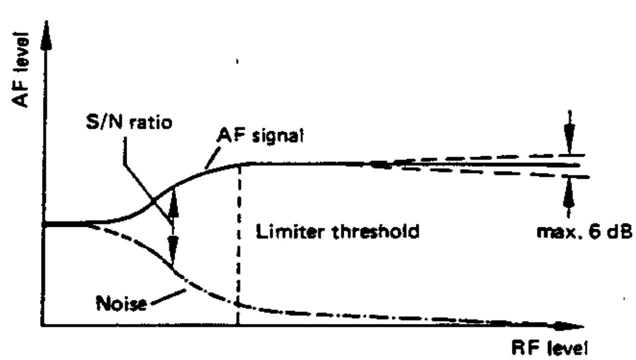
- Call up AF POWER meter; first locate GENERAL PARAMETERS mask
- Use RF DIRECT socket

Measurement —> Limiter characteristic

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.

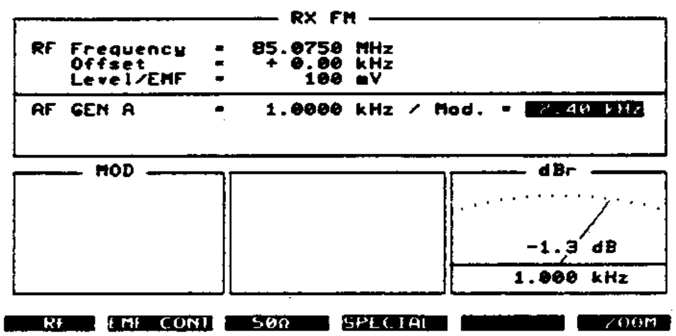


Limiter characteristic: The AF output level of the radio set is virtually independent of the RF input level after the limiter has responded.

>>>

Typical limit values

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



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.

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 GENERAL PARAMETERS foldout).

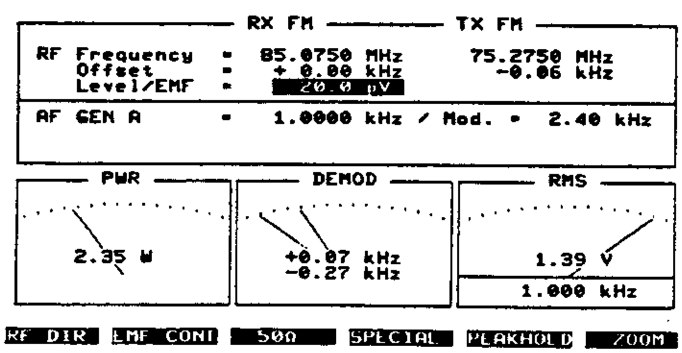
Note: <STEP> changes the lower and upper sideband (see also Chapter 12, section "Controls".

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).



Basic DUPLEX setting: Here the following parameters are specified in the DUPLEX mask: RF is the active socket, f_{TX} = 85.075 MHz, f_{RX} = 75.275 MHz, RF level = 20 µV, f_{mod} = 1 kHz, FM modulation, test modulation = 2.4 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 —> Signal transfer

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.

```
------------------ RX FM ----------- TX FM ------------
RF Frequency  =  85.0750 MHz     75.2750 MHz
   Offset     =   + 0.00 kHz
   Level/50Ω  =  -110.6 dBm
--------------------------------------------------------
AF GEN A      =   1.0000 kHz / Mod. =  2.40 kHz

     Desens  20 dB   SINAD :     1.6 dB

 RUN          AF RESP.  DC-CAL.            RETURN
```

Duplex signal transfer: The Special *DESENS* was used to test a device with the parameters *SINAD* (test method) and *20 dB* (reference value). Result: 1.6 dB duplex signal transfer.

Testing
of Selective-call Sets

Contents

Selective-call encoder and decoder

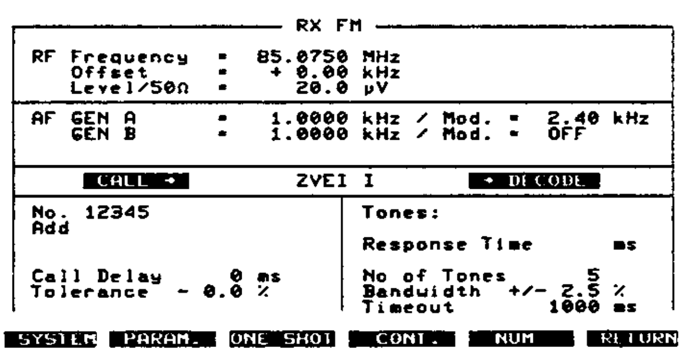
The standard STABILOCK 4031 comes with a selective-call encoder and decoder. Common standard tone sequences can be used whose parameters (frequency, tone duration, pause) permit variation (user tone sequences). A user tone sequence can be stored. What are called "sequential masks" are used to operate the encoder and decoder and to display the measured results.

Technical data

See data sheet

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 <FREQUENCY>.



<u>Basic sequential mask:</u> 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/PhM stage). The option reduces the switching time to approx. 15 ms.

Notes: If the generator of the 4031 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/PhM 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 (4031) 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/PhM 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

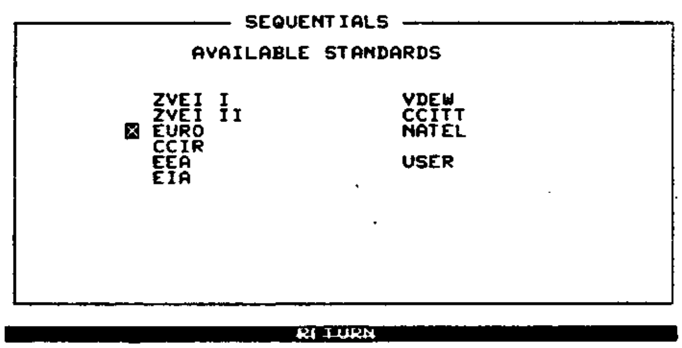
In the *CALL* and *CALL --> DECODE* modes carrier keying is possible if the signal generator of the 4031 is first switched off in the RX or DUPLEX mask with <LEVEL> + <OFF>. The encoder then keys the signal generator automatically. Following any carrier delay that is set (content of *Call Delay* field) 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.



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 4031 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.

PARAMETER ZVEI I

TONE No.	FREQ. (Hz)		TIME (ms)	PAUSE (ms)
0	2400.0	First Tone	70	0
1	1060.0	2.	70	0
2	1160.0	3.	70	0
3	1270.0	4.	70	0
4	1400.0	5.	70	0
5	1530.0	6.	70	0
6	1670.0	7.	70	0
7	1830.0	8.	70	0
8	2000.0	9.	70	0
9	2200.0	10.	70	0
A	2800.0	11.	70	0
B	810.0	12.	70	0
C	970.0	13.	70	0
D	886.0	14.	70	0
E	2600.0	15.	70	0
F	0.0	16.-30.	70	0
R	E			

STD | STORE TO USER | ALL LIKE CURSOR | RETURN

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

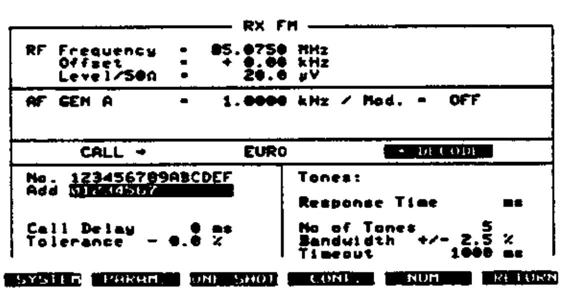
As long as only modulation generator GEN A is available, *Add* is a common text field with an associated numeric field. If the 4031 contains the GEN B option however, *Add* is a scroll field with the scroll variables *Add* and *2nd*:

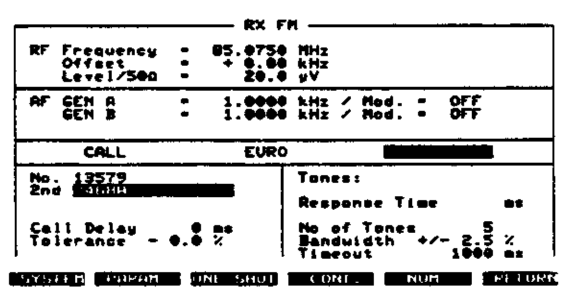
Add Encoder generates single-tone sequence with maximally 30 tones
2nd Encoder generates double-tone sequence with maximally 15 tones

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.

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 (figure left). 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 (figure right).





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

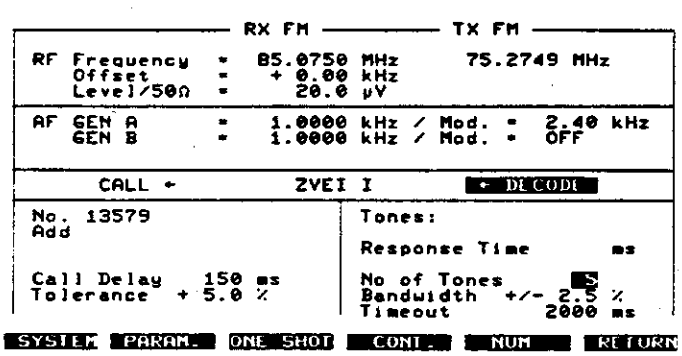
The value in the *No. of Tones* field specifies how many call tones of an incoming tone sequence are to be decoded by the decoder (permissible value: 0 to 30).

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.



Test parameters: Here, for example, the declared test parameters are call delay = 150 ms, encoder tolerance = +5 %, number of decoded tones = 5, decoder tolerance = ±2.5 % and 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 4031 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 set:	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 4031 against rapid wear.
DECODE set:	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 4031 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 4031. 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 4031 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 4031 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/PhM option.

The 4031 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.

DECODING EURO

NR	FREQ. (Hz)	DEV. (%)	TIME (ms)	PAUSE (ms)
1	903.4	+ 0.0	105.1	2.1
2	832.5	+ 0.0	98.4	2.8
5	652.0	+ 0.0	99.6	2.5
4	707.4	+ 0.0	98.9	3.4
7	554.0	+ 0.0	101.0	2.5
4	707.4	+ 0.0	98.9	2.8
5	652.0	+ 0.0	99.6	3.0
6	601.0	+ 0.0	99.8	>>>>.>

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

DECODING submask: In this mask the 4031 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 >>>>.>

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 and Oscilloscope

Contents

Spectrum Analyzer

With the spectrum analyzer of STABILOCK 4031 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.

Technical Data

See data sheet

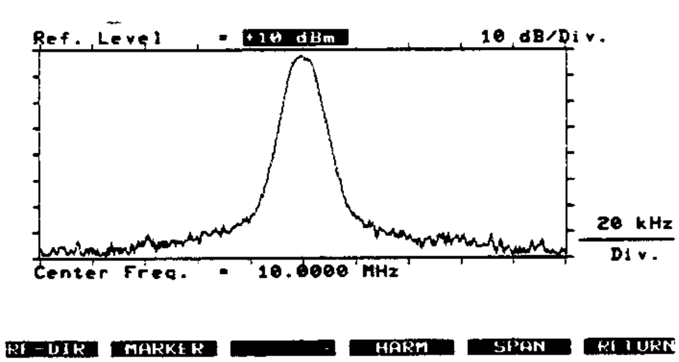
Basic Analyzer Mask

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) (see Chapter 3).

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.



<u>Basic analyzer mask:</u> 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.

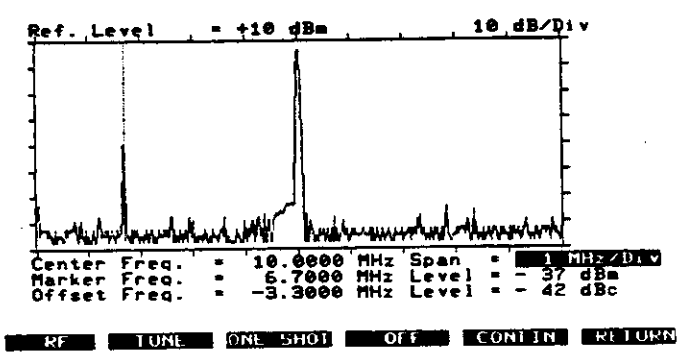
Marker level: the *Level* display field shows the level of the marked spectral component.

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.



Marker submask: The marker (vertical dotted line) has been set with the handwheel to 6.7 MHz. The level of the corresponding spectral component reaches -37 dBm. The marker is offset from the centre frequency (10 MHz) by -3.3 MHz; the level measured at the marker frequency is -42 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.

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.

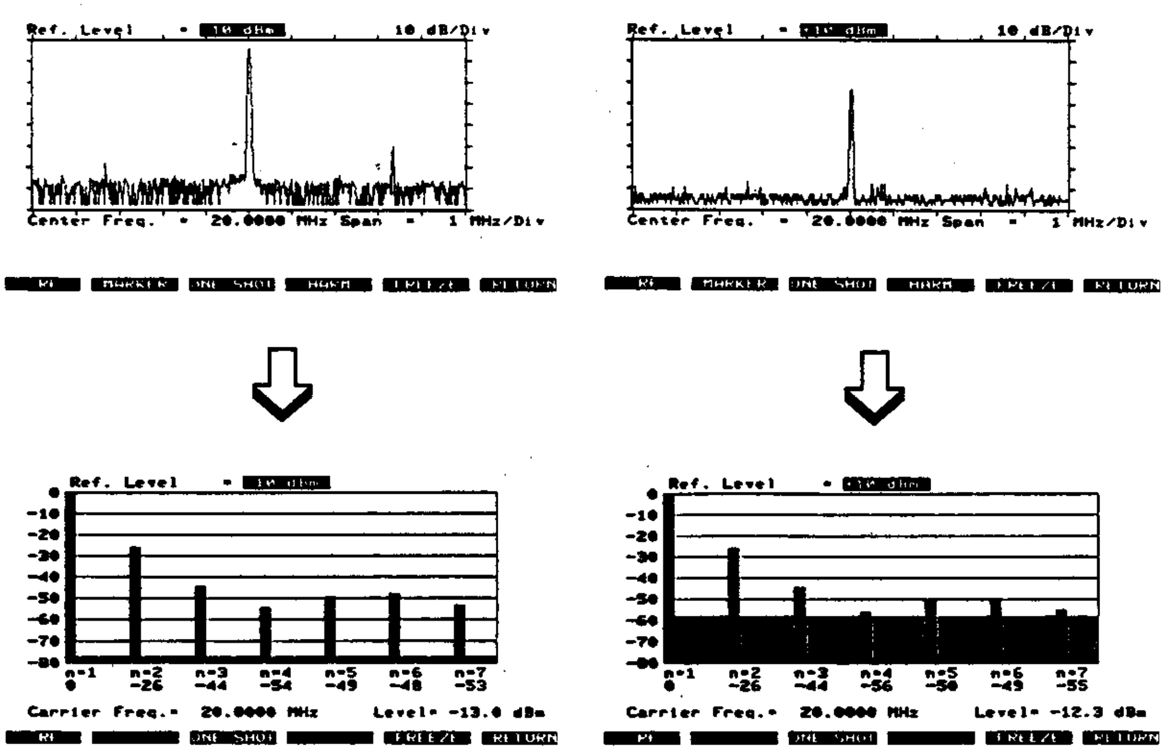
Setting Reference Level

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.

<u>Effect of reference level:</u> 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 4031 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.

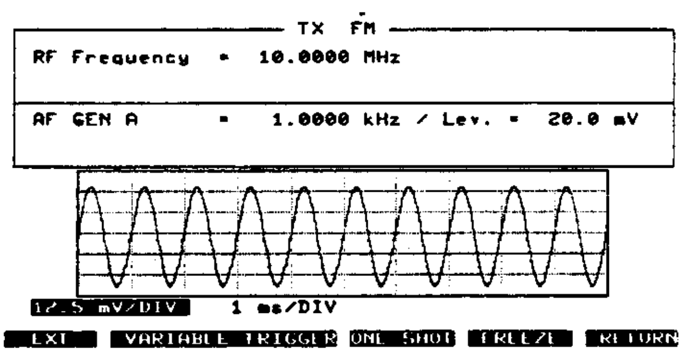
Technical Data

See data sheet

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, as described in Chapter 3, 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.



<u>AUTOTRIG mask:</u> 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 V_{pp}. 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.

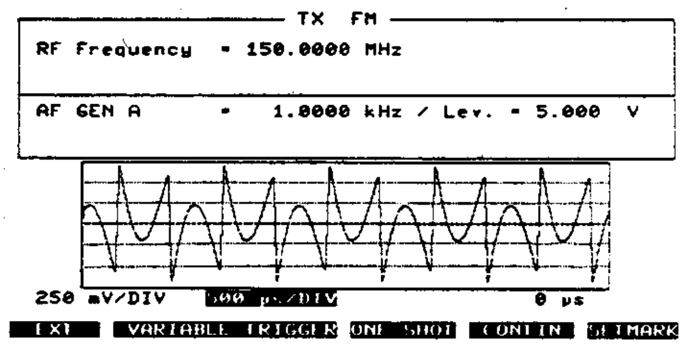
Inserting a filter

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 OPTION CARD foldout). 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.



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.

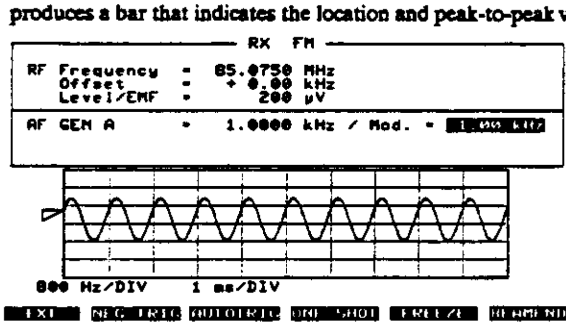
If the trigger condition is not satisfied, <*BEAMFND*> produces a narrow brightened up bar at the left edge of the screen. The location and the vertical extension of the bar correspond to the location of the signal and the peak-to-peak value. The bar display is updated by <*BEAMFND*>. Thus the bar will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

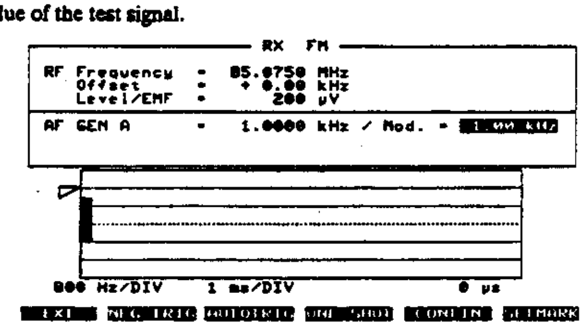
There are the following possibilities for satisfying the trigger condition:

- 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.

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").

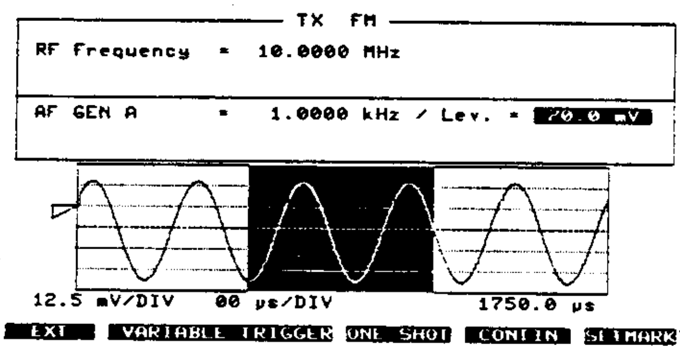
FREEZE Function

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 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.



<u>Timing measurement</u>: 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 1750 µs.

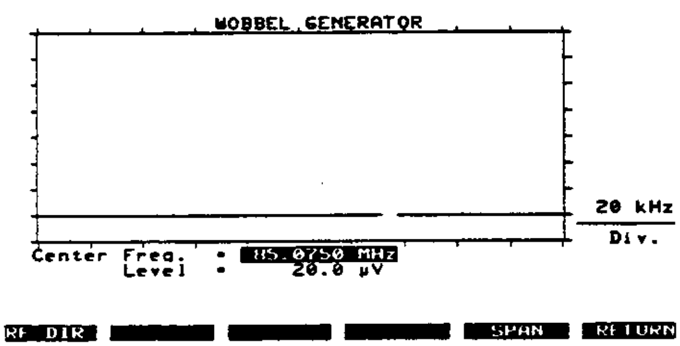
Sweep Generator

It is possible to sweep the output signal of the 4031 signal generator.

Callup of sweep generator

<RX> + <ANALYZER> calls up the SWEEP GENERATOR mask. After a brief pause the sweep generator starts to sweep the output signal of the 4031 signal generator. The sweep process can be recognized by the fact that a marker (space) moves on the frequency axis of the mask. The momentary position of the marker corresponds to the current signal frequency. The speed of the marker and the direction in which it moves are determined by the sweep signal.

The centre frequency, output level and sweep width of the RF signal can be altered in the SWEEP GENERATOR mask.



SWEEP GENERATOR: When the monitor shows this mask, the output signal of the 4031 signal generator is swept, here for example with 200 kHz sweep width (20 kHz/div x 10 div). Parallel to the sweep process a marker (space) moves on the frequency axis that appears at the bottom of the window, the position of which indicates the current signal frequency.

Setting of sweep generator

Setting centre frequency

Enter the value of the required centre frequency in the *Center Freq.* numeric field. Like each numeric field, this one too can be located with the cursor keys. When the SWEEP GENERATOR mask is called up, it initially adopts the value that is entered in the *RF Frequency* field of the RX mask.

The value of the centre frequency f_c determines the direction of the sweep signal:

$f_c \geq$ 125 MHz —> from left to right, ie from lower to higher carrier frequency).
$f_c <$ 125 MHz —> from right to left, ie from higher to lower carrier frequency).

Selecting output socket

The required output socket RF or RF DIRECT is connected as usual with <*RF*> or <*RF DIR*>.

Setting output level

The *Level* numeric field permits setting of the RF output level. When the SWEEP GENERATOR mask is called up, it initially adopts the value that is entered in the *Level* field of the RX mask. The *EMF* or *50* Ω setting is also adopted, though not displayed.

Setting sweep width

By repeatedly striking the *SPAN* softkey the sweep width can be set to 20 kHz/div, 200 kHz/div or 1 MHz/div. This results in sweep widths of 200 kHz, 2 MHz or 10 MHz. The momentarily valid sweep width per scale division appears in the bottom right corner of the display.

MEMORY

Contents

Introduction

"MEMORY" is a special mode of the 4031 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 4031 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 AUTORUN 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 9.

MEMORY CARD

The MEMORY CARDs contain RAM chips for data storage, an integrated lithium battery ensuring that the data are not lost. The MEMORY CARDs listed on the right are available:

Memory capacity	Battery life	Ordering code
32 Kbytes	4 years	897 050
64 Kbytes	2 years	897 051
128 Kbytes	1 year	897 052

MEMORY CARD with regular integrated battery

One version of the MEMORY CARDs has a regular integrated buffer battery. In this case the data have to be copied to a card with a fresh battery in good time before a battery runs out (see "Copying MEMORY CARDs").

MEMORY CARD with replaceable battery

For MEMORY CARDs with a replaceable battery the stored data are preserved in the following way: Start up STABILOCK 4031. Insert the MEMORY CARD in the slot on the 4031. Open the battery compartment and replace the used up battery with a fresh one. Close the battery compartment again, withdraw the card and enter the new expiry date of the battery on the rear of the card (ordering code of battery: 859 006).

SYSTEM CARDs

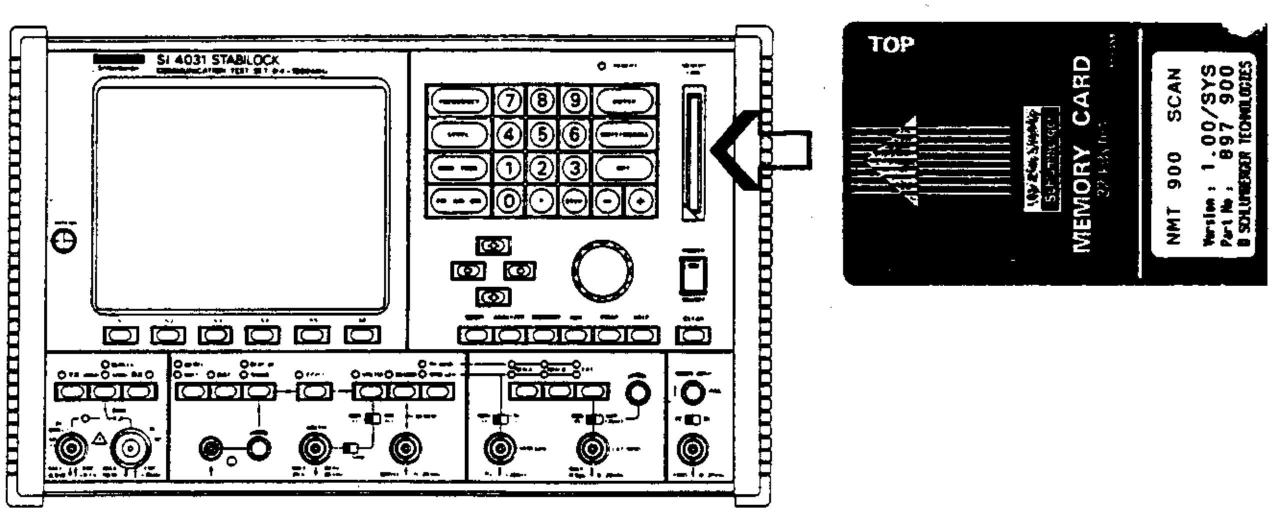
MEMORY CARDs that are supplied ready with a system program are called SYSTEM CARDs to distinguish them from the normal MEMORY CARDs. SYSTEM CARDs are identical technically to MEMORY CARDs but cannot be copied. For this reason these memory cards - if they do not permit the battery to be replaced - have to be replaced by new cards before the battery expires (replacement by the factory or a sales agency).

> Caution: There should be no MEMORY CARD in the slot on the 4031 when it is switched on or off (risk of losing data, noticable by sudden appearance of error message, eg *CHECKSUM WRONG*).

Battery disposal

The lithium cells that are used here are not considered to be an environmental risk if they are randomly disposed of. But to eliminate the possibility of any environmental pollution, we recommend that used batteries be taken to your local battery disposal bank. They can also be returned for proper disposal to Schlumberger Technologies GmbH, Munich or your local sales agency.

The picture shows how a MEMORY CARD should be inserted in the slot on the 4031. Mechanical coding prevents it from being inserted in the wrong way.



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.

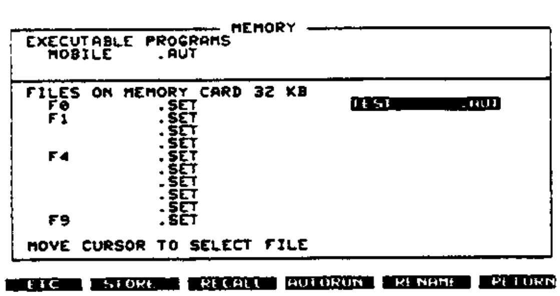
Calling up Directory

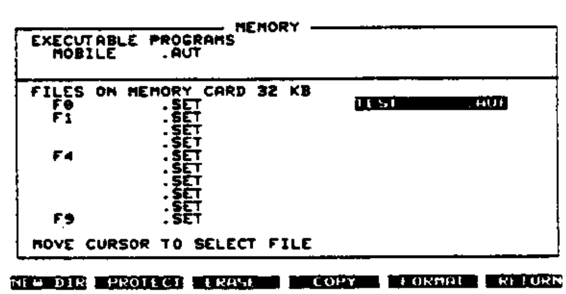
After the MEMORY mask has been called up with <MEMORY>, it always shows a directory of ready loaded programs plus the contents of the currently adapted MEMORY CARD and its memory capacity. The names of loaded programs are listed in the two screen lines beneath the text field *EXECUTABLE PROGRAMS*. The directory shows maximally two entries because the RAM of the 4031 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.

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.





<u>The two pages of the MEMORY mask:</u> 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*.

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]	1[2]
64 Kbytes	10	3[1]	1[2]
128 Kbytes	10	7[1]	1[2]

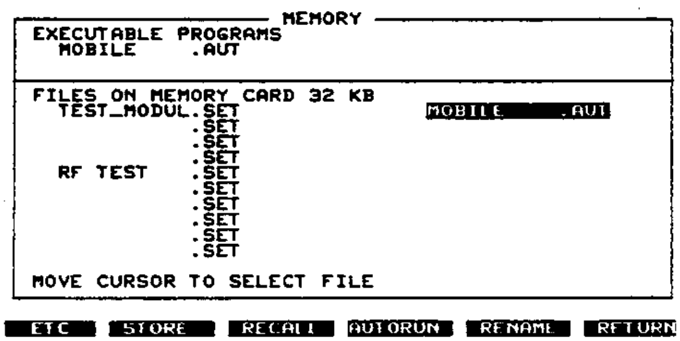
[1]) The number is the sum of the AUT, EXE, PIC and 16-Kbyte RES files that can be stored. So it is possible to store either one AUT or one EXE or one PIC or one 16-Kbyte RES file on a 32-Kbyte card; a 64-Kbyte card on the other hand can hold one AUT, one EXE and one PIC file for example (any combinations permissible)..

[2]) On each MEMORY CARD a 4-Kbyte RES file can be stored in addition (see Chapter "Storing Test Reports"). This corresponds roughly to a full page of A4 format.

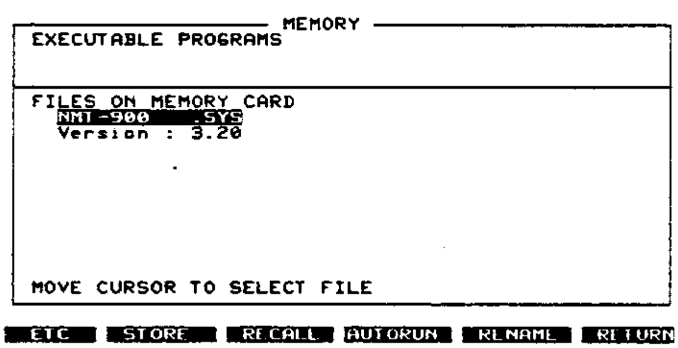
The capacity of the adapted MEMORY CARD is shown in the *MEMORY* mask next to the text field *FILES ON MEMORY CARD*.

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 4031. Setups are executed immediately after they have been loaded, and screen contents are immediately printed out.



<u>Directory of MEMORY CARD:</u> 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 4031; therefore *MOBILE.AUT* also appears in the directory *EXECUTABLE PROGRAMS*.



<u>Directory of SYSTEM CARD:</u> The RAM of the 4031 contains no AUTORUN program. The inserted SYSTEM CARD contains the system program *NMT-900.SYS*, which can be loaded into main memory.

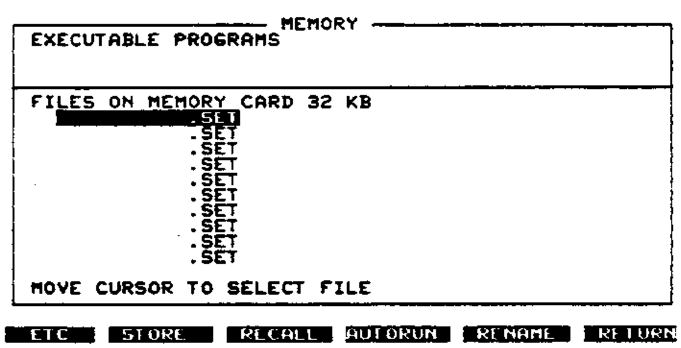
Formatting MEMORY CARDs

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.



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 4031 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 4031, 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.
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.

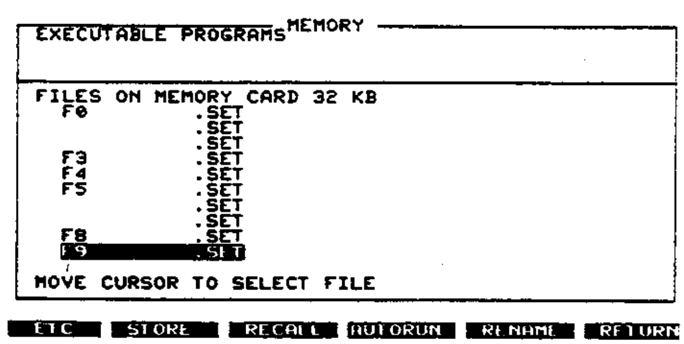
A name may have no more than ten characters, and spaces also count as characters. After entering the last character you must strike <ENTER> to leave the text entry mode.

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 4031 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).

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.

When the files shown here were stored, they were not given individual names, their naming was left to the 4031.



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>.

Storing and Recalling Setups

STABILOCK 4031 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 4031 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 4031 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.

<u>Note:</u> Setups created with software versions < 2.55 should be checked before use with the current software version, corrected if necessary and then stored again. If the submask of a basic mask is to be stored as a setup, then the related basic mask will also have to be stored as a setup. When you recall them, first load the basic mask and then the submask. Reason: when you load a submask, althoug the original parameters of the basic mask appear in the top half of the display, it is nevertheless those basic-mask parameters that are entered in the basic mask at the time of loading the submask that will be effective!

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 4031 into the text entry mode (see section "Naming Files").
   • If you mark a PIC entry, the 4031 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 4031 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 4031 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 4031'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 4031 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 4031. 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 Mask

Why Write AUTORUN Programs?

AUTORUN programs turn STABILOCK 4031 into a fully automated Communication Test Set. By fully automated we mean that, after the appropriate program has been started, the 4031 can, for example, execute a complete test routine and list the results without any manual entries being necessary. An AUTORUN program can also stop, output entry prompts and adjustment prompts on the screen and then continue with the new values. Every 4031 function, from selecting the required RF input/output connector to calling up a Special or calling a stored setup in a program, can be used.

Effective testing with AUTORUN programs

AUTORUN programs for the 4031 are a very powerful way of performing repetitive, complex tests with the utmost reliability (no operator errors) in the shortest time possible. The user can give his creativity free rein as he searches for the optimal programming solution.

AUTORUN Editor ARE (ordering code 897 100)

If you frequently develop extensive AUTORUN programs, it is very advisable to create an ergonomic and efficient development environment for the purpose. ARE is a powerful, menu-driven editor for use on conventional PCs.

Some of its features:

- A block function enables parts of a program to be shifted, copied, printed and stored.
- Program building blocks that you often need are ready on call in an expandable library.
- ARE manages line numbers, even in branch instructions. All you have to enter is labels.
- AUTORUN programs are transfered from a PC to STABILOCK 4031 and vice versa via the IEEE interface. In this way existing AUTORUN programs can be edited conveniently.

Simple programming language

The requirement that the language for AUTORUN programs be both easy-to-learn and problem-oriented led to the creation of a new programming language that was based on a popular model: IEEE-488 commands are used for all device-oriented settings, all other commands such as print commands, subprogram calls or branches resemble BASIC commands (Beginner's All-purpose Symbolic Instruction Code).

The IEEE commands are summarized in Chapter 10. They have basically the same effect as the analogous, manual front-panel entries (eg SETRX = <RX> = basic RX mask call). The BASIC commands are just as easy to understand; the commands themselves and their use with IEEE commands are fully explained in this section and illustrated with lots of examples.

Mask Description

The AUTORUN mask is the starting point for the two elementary AUTORUN functions:

- Writing and editing programs (the ASCII keyboard option is required for the edit mode)
- Running programs (run mode)

Callup of AUTORUN mask

The AUTORUN mask is always called up from the first page of the MEMORY mask with <*AUTORUN*>. This entry can produce two different reactions:

1) Immediate callup of the AUTORUN mask. This is always the case when there is already an AUTORUN program in the RAM of the 4031 (AUT or EXE entry in the *EXECUTABLE PROGRAMS* directory). The AUT or EXE file may have been loaded beforehand from the MEMORY CARD for instance (see "Storing and Loading AUTORUN Programs"). The name of the program appears in the mask header. The program can then be edited (corrected) or started with <*RUN*>.

2) If there is no AUTORUN program in the RAM of the 4031 when the AUTORUN mask is called up, it is assumed that a new program has to be written. In this case calling up the mask first produces a prompt to enter the name of the program (see "Naming Files"). The screen will not show the AUTORUN mask until the name entry has been confirmed with <ENTER>. Then you can start to enter the new program. If the name "AUTORUN" is sufficient as a preliminary working title for the program, <ENTER> immediately after the entry <MEMORY> + <*AUTORUN*> will call up the AUTORUN mask. If the program is later stored under the working title on the MEMORY CARD, it can nevertheless be renamed with <*RENAME*>.

If, when the AUTORUN mask is called, the RAM of STABILOCK 4031 is empty or an AUTORUN program with the extension AUT is loaded in the RAM, all the 4031 keys - with the exception of the softkeys, the HELP and CLEAR keys - are disabled. If an AUTORUN program with the extension EXE is loaded, only the <*RUN*> softkey will be active.

Display field

The framed area of the AUTORUN mask is called the display field. It is used to display program listings and status messages. PRINT commands in a program also output their results (numerical or text) in the display field (this information may also be output on a printer).

The display field contains 16 lines of 49 characters each. If, for example, a program listing is more than 16 lines long, scrolling takes place automatically: each new line of the program pushes the top line out of the display field.

Status line

As with all other masks, the status line in the AUTORUN mask is directly above the softkey line. The status line contains error messages, info messages and, when a program is running, the output from PRINT commands.

Editing line

The editing line is immediately below the display field. It is used to enter new program lines, to edit lines that already exist and to enter direct commands (commands without a line number which are to be executed immediately). After the AUTORUN mask has been called, a flashing cursor at the begining of the editing line indicates that entries may be made.

The ASCII keyboard option is required for all entries in the editing line (see Chapter 8). Each entry must be terminated by pressing the RET key on the ASCII keyboard. This transfers the entry to the display field. When you are writing a program, the display field therefore shows the complete listing or the last 16 lines of the program that has already been written.

Softkeys for AUTORUN mask

LIST — This lists the loaded AUTORUN program in the display field. If the listing is longer than 16 lines, it is automatically scrolled until the last program line in the display field appears. Striking the *LIST* softkey again stops the listing. It is possible to list a particular program section by entering the LIST command on the ASCII keyboard (see "Edit Commands"). Any new lines entered in a program will only appear in their correct place in the listing after <*LIST*>.

PRINTER — Pressing this softkey produces the status message *Edit Mode Printing On* or *Edit Mode Printing Off*. In this way you can determine whether a printer is to log all entries during editing (printer matching: GENERAL PARAMETERS mask, *Printer* field). Independently of the printing status, a printer will automatically produce all outputs in run mode. If this is not required, the BASIC commands PRINT ON/OFF enable specific outputs.

HELP_VAR — This briefly shows the mask that was active directly before the MEMORY mask was called up and indicates the identification numbers of the entry fields (important for the special IEEE command WRTVAriable, see Chapter 10)

RUN — Starts the loaded AUTORUN program. Striking the OFF key aborts program execution.

RETURN — Takes you back to the MEMORY mask.

```
------------------ AUTORUN FUG_EXTEND ------------------
LIST 760,850
760 rem TEST CHANNEL 400
770 S=75.275 MHZ
780 FREQUENZ #S
790 PAUSE "Channel 400 !"
800 rem
810 rem MOD SENSITIVITY
820 rem
830 GENAL 5 MV
840 RDOUT(MDEMOD:A,B)
850 PRINT "1.3 Mod-Sens.      (5mV)     :",A

EDIT 830
830 GENAL 5 MV

830 GENAL 5 MV

LIST  PRINTER  HELP_VAR  RUN          RETURN
```

AUTORUN mask: The display field shows the listing of the program FUG_EXTEND and the direct commands last entered. Program line 830 is in the editing line.

AUTORUN Programs

AUTORUN programs may contain the BASIC commands explained under "BASIC Commands and Functions" as well as many **IEEE-488 commands** (see Chapter 10).

General Remarks

- Legal line numbers for AUTORUN programs: 1 to 9999.
- Each program line must be terminated with <RET> on ASCII keyboard.
- Each BASIC command must be followed by a space or a non-alphabetic character (eg PRINT A or PRINT"DEMO").
- BASIC commands and numbers must contain no embedded spaces.
- Shortform entry of BASIC commands is possible (the first three letters of the command, eg PRI A instead of PRINT A). Exception: ONERR for ONERRORGOTO.
- A program line may contain several IEEE and BASIC commands. A colon must be used as a delimiter after BASIC commands and a semicolon after IEEE commands (eg 10 SETTX;PRINT A:PRI"DEMO":SETRX). Maximum line length = 49 characters.
- BASIC commands can also be executed directly. The entry PRINT A (without a line number) immediately prints out the contents of variable A in the display field.
- The four basic arithmetical operations are available (eg PRINT (3*4)/2-3+1).

Syntax check

When a program line is transferred from the editing line into the display field, there is no syntax check. Syntax checking is carried out after the start of the program. If a syntax error is found, the program is aborted and an error message is produced indicating the error and in which line it occurred.

Two interpreters are used to execute the program. When the program is run, each line in the program is interpreted one after the other and the appropriate action taken. If the BASIC interpreter finds a command in a program line that it cannot interpret, this command is automatically taken to be an IEEE command and handed over to the IEEE interpreter. If this interpreter cannot interpret the command there must be a syntax error.

Working with Variables and Units

260 variables A0 to A9 through Z0 to Z9 may be used in AUTORUN programs for storing numeric values. If just a letter without a digit is entered as a variable, this will be interpreted as a variable with the digit 0 (eg A = A0). Therfore you can continue to use existing AUTORUN programs. (Firmware versions < 3.58: 26 variables A through Z.)

All variables are basically used to store REAL numbers in IEEE double-precision format. Results are also converted to this format before they are stored.

As well as assigning only a pure number to a variable, it is also possible to assign a number and one of the units listed below:

MHz, kHz, Hz	s, ms, s	%, rad, ohm	A, mA
W, mW, W	V, mV, V	dBm, dB , dB	

Measured results fetched by an IEEE command always have one of the named units.

```
10 A=5
20 B=5 MHZ
30 C=-15dBm
```

A space may be left between the number and the unit but is not necessary. The unit may contain upper-case and lower-case letters.

```
10 PRINT M_RMS
```

The printed-out measured result of the IEEE command M_RMS is 3.96 V for example.

Operators can be used to link an operand with a unit to an operand without a unit. The result is assigned the unit of the operand on the <u>right</u> of the operator. If this operand does not have a unit, the result will also have no unit.

```
10 A=5
20 B=10 kHz
30 PRINT A+B
40 PRINT B+A
```

Output format:

```
···15.0000 kHz
·15
```

Character Strings and String Variables

Character strings may consist of a series of characters between inverted commas. Strings are persons' names for example, equipment designations, adjustment instructions or any messages. AUTORUN programs show these strings on the screen, for instance, or check for correspondence with a reference string.

String variables are used for storing character strings. 26 string variables are available: A$ to Z$. The string variable STR$ is also permissible, but this is identical to D$ and so should not be used for new AUTORUN programs. STR$ was only retained for reasons of continued use of earlier AUTORUN programs.

Note: For firmware versions < 3.58 there are only six string variables available: A$ through F$ and M$.

Example:

```
A$="TEST PROGRAM"
PRINT A$
```

The character string `TEST PROGRAM` is stored and printed out in the string variable A$.

String variables can hold strings of maximally 49 characters in length, ie with the exception of M$ (maximally 1000 characters).

Splitting and Chaining Strings

Parts of a string can be isolated from a string variable by stating after the string variable in parentheses the start and end location of the string part that is to be isolated.

Example:

```
A$="CHANNEL = 142"
PRINT A$(11,13)
```

Output:

```
142
```

A number of strings can be joined together by chaining the string variables.

Example:

```
A$="Serial Number = "
B$="6788954"
C$=A$+B$
PRINT C$
```

Output:

```
Serial Number = 6788954
```

Caution when Using M$

The string variable M$ has a special meaning: each IEEE command of the type "Measuring Assignments" or "Output of Setting Parameters" (see Chapter 10) automatically puts the measured result or the determined setting parameter in the variable M$.

`10 LET A=M_RMS`	Output example:
`20 PRINT A`	`167.0000 mV`
`30 PRINT M$`	`167 mV`

(There is more about the different output formats of the PRINT command in the description of the commands in the section "BASIC Commands and Functions".)

When used with the IEEE command SER_In (see Chapter 10) 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.

Example:

```
M$=SER_In
A$=M$(1,49)
B$=M$(50,98)
C$=M$(99,147)
```

Use of Variables in IEEE Commands

Numeric values and strings (texts) in IEEE commands may be replaced by variables or string variables if these are preceded by a sharp sign #. The unit of a numeric value can either be declared at the same time as the variable or it is explicitly defined in the IEEE command. Illegal units (eg MODAF 2.5 mA) produce an error message.

Examples:

```
10 SETTX
20 MODAF 2.5 KHZ
```

Line 20 = usual IEEE command for tuning GEN A to 2.5 kHz

```
10 SETTX
20 F=2.5 KHZ
30 MODAF #F
```

#F is replaced by 2.5 KHZ

```
10 SETTX
20 F=2.5
30 MODAF #F KHZ
```

#F is replaced by 2.5

```
10 A$="TEST PROGRAM: ADJUST "
20 ZOOM_3,300 MV,50:#A$ TRIMMER TR3
```

The IEEE command ZOOM displays the RMS meter in full format on the screen. At the same time the following adjustment prompt appears in the status line of the screen:
`TEST PROGRAM: ADJUST TRIMMER TR3`

Permissible Operands

Many BASIC commands require the entry of socalled operands. There are different types of operands:

Numeric operands
- Pure numbers (eg 4, -2.5, 150)
- Numeric values with units (eg 5 MHZ, 4.5 V)
- Variables (A to Z) with or without unit
- IEEE commands which have an output (eg M_RMS)
- Functions (eg RDXY, LEN, HEX, VAL)

String operands
- String (eg "TEST")
- String variable (eg A$)
- String function (eg CHR$)

Numeric operands can be linked with the operators + (addition), - (subtraction), * (multiplication) and / (division) . All operators have the same priority. Only expressions in parentheses are given greater priority.

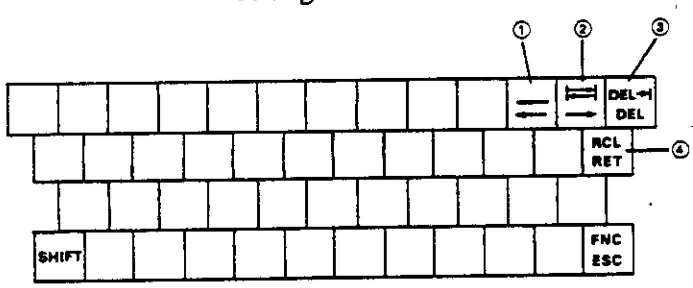
Example: 1+2*3+4=13   (1+2)*(3+4)=21   2 V + 3 V=5 V   M_RMS+2 mV=eg 12 mV

Note: The two BASIC commands CHAIN and SETUP allow string variables as an operand. By way of exception the string variable that is used is to be preceded by a sharp sign #, which is otherwise only required in IEEE commands.

Editing Commands

As long as a program line is in the editing line on the screen, the usual line editor functions are available. In the diagram showing the ASCII keyboard, numbers are used to mark the corresponding edit keys. The second keyboard assignment (top symbol) is activated when the SHIFT key and an edit key are both pressed.

1	Each time this key is pressed the cursor moves one character to the left.
2	Each time this key is pressed the cursor moves one character to the right.
2 + SHIFT	If key 2 is pressed repeatedly, the cursor moves to the end of the line or to the beginning of the line.
3	Erases the character to the left of the cursor.
3 + SHIFT	Erases the text between the cursor and the end of the line.
4 + SHIFT	Recalls the last entry to be terminated with <RET> to the editing line.



To directly edit the current program line the ASCII keyboard has six editing functions, some of which can be activated with SHIFT.

As well as the editing functions, which are executed immediately, AUTORUN BASIC also has five editing commands. These commands must be entered letter by letter as direct commands via the ASCII keyboard option and terminated with <RET>. Editing commands can also be entered in short form (the first three letters).

AUTO

AUTO automatically assigns line numbers.

AUTO x,y x = first line number, y = increment

If the parameters x and y are omitted, x the first line number and y the increment are both equal to 10. If an automatically assigned line number already exists, the new program line replaces the old one. The AUTO function is switched off again if you press <RET> when a new line number appears.

Example: AUTO 151,1

If the program has already been written and a line increment of 10 has been used, the lines 151 to 159 can be inserted for example.

DELETE

DELETE is used to erase single program lines or whole program blocks.

DELETE x	erases the program line with the line number x.
DELETE x,	erases all program lines from line number x.
DELETE x,y	erases all program lines from line number x to line number y.
DELETE ,y	erases all program lines to line number y.

Instead of using DELETE x to erase a program line, you can also enter the line number and then press <RET>.

EDIT

EDIT is used to fetch a stored program line back into the editing line. The program line can then be changed in any way required before being stored again. The new line is substituted for the old (incorrect) program line and appears in the listing.

EDIT x	x = number of the program line which is to be edited.

LIST

LIST has the same function as the softkey with this name, but in addition permits the listing of program blocks.

LIST	lists the complete program.
LIST x	lists program line x.
LIST x,	lists the program from line x to the last line.
LIST x,y	lists the program from line x to line y.
LIST ,y	lists the program from the first line to line y.

Striking the *LIST* softkey stops the program listing.

RENUM

RENUMBER assigns new line numbers to a whole program. This command is particularly useful if you want to write a new program block between two lines but there is not enough room. The branch destinations of GOTO and GOSUB commands are automatically corrected.

RENUM	renumbers program in increments of 10. First line number = 10.
RENUM x,y	renumbers program in increments of y. First line number = x.

Example:

```
5 SETRX                          10 SETRX                             30 SETRX
10 PRINT "RX TEST"               20 PRINT "RX TEST"                   50 PRINT "RX TEST"
15 SOFT_SPECIAL    --> RENUM --> 30 SOFT_SPECIAL  --> RENUM 30,20 --> 70 SOFT_SPECIAL
20 SOFT_SENS                     40 SOFT_SENS                         90 SOFT_SENS
25 GOTO 5                        50 GOTO 10                           110 GOTO 30
```

RUN

RUN starts the program like the softkey of the same name, but it also permits a program start onwards from a certain program line.

RUN	Program start from first program line.
RUN x	Program start from program line x.

HELP key

When the the AUTORUN mask has been selected, <HELP> lists condensed useful information, about the syntax of the editing commands.

Running AUTORUN Programs

Immediately after an AUTORUN program is started with <*RUN*>, the softkey function *RETURN* is carried out twice. This has the same effect as the manual <*RETURN*> - return to the MEMORY mask and then return to the last valid mask. Program execution then begins.

All setting instructions of an AUTORUN program can be followed on the screen if this is not deactivated by the IEEE command CRT_OFF (see also Chapter 10, "Use of IEEE-bus Controller"). If the basic RX mask is called up with SETRX for example, the RX mask is actually displayed on the screen.

When an AUTORUN program is running, nearly all 4031 keys are disabled. Exception: the BASIC command INPUT does make it possible to enter numbers or text. So it is advisable to be able to tell the difference between masks that have been called by an AUTORUN program and masks that have been called manually: so *AUTORUN* is displayed next to the mask heading.

<OFF> interrupts execution of a program.

<CLEAR> is also used with AUTORUN programs when internal data processing gets hung up. The AUTORUN mask must be called again afterwards, but the program is preserved in the RAM. The same applies when the Communication Test Set is switched off. But the program in the RAM will be deleted by a total reset with <OFF> + <CLEAR>.

As soon as a program has been executed, the AUTORUN mask is automatically called again. The last operating status of the Communication Test Set is not lost.

Storing, Loading, Erasing AUTORUN Programs

Only one AUT file can be stored in the 4031's RAM. This file is not lost when the instrument is switched off or disconnected from the power line. A total reset erases the program in the 4031's RAM.

Storing AUTORUN programs

1. When the AUTORUN program is ready, *<RETURN>* brings you back to the MEMORY mask.
2. Mark any blank entry in the directory *FILES ON MEMORY CARD*. If the card already contains an AUT file which can be overwritten, this AUT entry must be marked.
3. Call the memory routine with *<STORE>*.
4. • If a blank entry has been marked, the question on the screen about what is to be stored must be answered with *<AUTORUN>*. This stores the AUT file on the MEMORY CARD. The storage procedure is terminated when the file name appears in the directory *FILES ON MEMORY CARD*.
   • If an AUT entry has been marked, the 4031 asks *OVERWRITE ????*, which can be answered with *<YES>* or *<NO>*. *<YES>* overwrites the old AUT entry on the card, *<NO>* aborts the storage routine.

Loading AUTORUN programs

1. Insert the MEMORY CARD.
2. Call up the MEMORY mask with *<MEMORY>*.
3. Mark the AUT entry in the directory *FILES ON MEMORY CARD* with the cursor.
4. Call up the load routine with *<RECALL>*.
5. If there is already an AUT file in the 4031's RAM, the question *OVERWRITE ????* is output. The answer *<YES>* causes the old AUT file in the 4031's RAM to be overwritten, *<NO>* aborts the load routine.
6. The AUT file is loaded as soon as the (new) file name is entered in the directory *EXECUTABLE PROGRAMS*.
7. Call the AUTORUN mask with *<AUTORUN>*.

Erasing AUTORUN programs in 4031

1. Mark the AUT entry in the directory *EXECUTABLE PROGRAMS* with the cursor.
2. Call up the second page of the MEMORY mask with *<ETC>*.
3. Press *<ERASE>* and answer the question *ARE YOU SURE ???* with *<YES>*.

Storing 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

1. Call up the second page of the GENERAL PARAMETERS mask (<AUX> + <*DEF.PAR.*> + <*ETC*>).
2. Select the *Printer* scroll field with the cursor keys.
3. Using <UNIT/SCROLL> enter the scroll variable *Mem.Card* in the field.
4. Adapt the MEMORY CARD.
5. Start the AUTORUN program. The test report is then not output to a printer but stored on a MEMORY CARD in a RESULT.RES file.

Printing AUTORUN test reports

1. Call up the second page of the GENERAL PARAMETERS mask.
2. Make sure the IEEE-bus printer is ready.
3. Select the *Printer* scroll field with the cursor keys and enter a suitable printer driver in the field with <UNIT/SCROLL>.
4. Call up the MEMORY mask with <MEMORY> and mark the RES file for printing with the cursor bar.
5. <*RECALL*> causes the stored AUTORUN test report to be printed out.

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 section "Renaming Files").

Attention: 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.

BASIC Commands and Functions

BEEP	CHAIN	CHR$	CLS	END
FOR-NEXT	GOSUB	GOTO	HEX	IF-INLIMIT
IF-OUTLIMIT	IF-THEN	INPUT	KEY	LEN
LET	ONERRORGOTO	PAUSE	PRINT	RDOUT
RDXY	REMARK	SETUP	TRACE	WAIT
VAL	VAL$			

In AUTORUN programs many IEEE commands can also be used (Chapter 10).

BEEP

Syntax: BEEP

BEEP produces a short signal tone. The command is particularly useful if you want to draw the attention of the operator to a message on the screen for instance.

Examples:

`10 BEEP:BEEP:BEEP`	Produces the signal tone three times.
`10 BEEP: PAUSE "ADJUST SIGNAL"`	A signal tone draws your attention to the ADJUST SIGNAL prompt which appears on the screen.

CHAIN

Syntax: CHAIN [file name] or CHAIN [#string variable]

[file name] : name of an AUTORUN program stored on a MEMORY CARD.
[#string variable] : eg #A$, where A$ must contain the name of an AUTORUN program.

If the CHAIN command is reached in the course of executing an AUTORUN program, the program will be aborted immediately. The 4031 then loads the AUTORUN program named in the CHAIN command from a MEMORY CARD and starts it. If no change of card is to be made, the CHAIN command is only worthwhile if there is more than one AUTORUN program on a MEMORY CARD (ie MEMORY CARDs of > 32 Kbytes).

All variable contents of the aborted program are preserved and can still be used by the new program. But CHAIN resets the control variables of FOR-NEXT loops to the start value and does not trigger any return to the original program if the command appears in a subroutine (GOSUB).

The CHAIN command enables different AUTORUN programs to be linked together. Thus a single AUTORUN program can present a start menu on the screen for instance. Branching to another AUTORUN program will then depend on the entries made by the user.

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$="TX TEST"
60 IF A<2 THEN C$="RX TEST"
70 CHAIN #C$
80 PRINT"COMMAND AFTER CHAIN"
```

This program might be stored under the name MENU. First it asks for the date and the equipment type in the start menu and stores the answers in two string variables. Then the user can decide whether to carry out receiver or transmitter testing. Depending on the entry the string variable C$ is assigned the name of the AUTORUN program RX TEST.AUT or TX TEST.AUT.

Both programs must be on the momentarily inserted MEMORY CARD. The CHAIN command in line 70 loads the required program and starts it automatically. Line 80 is no longer executed. The newly loaded AUTORUN program can then immediately evaluate (eg print out) the content of the string variables A$ and B$. A return to the MENU program is possible if the CHAIN MENU command appears at the end of the RX TEST.AUT program for instance.

CHR$

Syntax: CHR$([list])

[list] : a number or several numbers separated by commas between 0 and 255 (numeric codes)

The numeric code or codes are converted into a single character or sequence of characters. The ASCII character set applies for numeric codes from 0 to 127. CHR$ serves for reading control characters (eg page feed) to the printer. Refer to the printer manual for details of the effect of control characters.

Example:

```
10 PRINT ON
20 PRINT CHR$(27,38,107,49,83)
30 PRINT "HEADLINE"
40 PRINT CHR$(27,38,107,48,83)
```

On printer HP-2225 (accessory) the text width is doubled, the text HEADLINE is printed and then there is a return to normal text width.

CLS

Syntax: CLS

CLS clears the screen (display field). CLS is particularly useful as a direct command for removing unwanted listings or error messages from the screen.

END

Syntax: END

END halts the execution of a program. The command is ideal for testing programs section by section - simply insert END at the appropriate position.

Example:

```
50 PRINT A
60 GOSUB 80: REM DISTORTION
61 END
70 GOSUB 90: REM OFFSET
```

The program runs to line 61 (inserted after the program proper has been written) and then stops.

FOR-NEXT

Syntax: FOR [VAR] = [EXP1] TO [EXP2] STEP [EXP3]
AUTORUN program section
NEXT [VAR]

[VAR] : index variable (A to Z).
[EXP1] : initial value (numeric operand).
[EXP2] : final value (numeric operand).
[EXP3] : increment (numeric operand).

Program loops are written with the FOR-NEXT command. The initial value, final value and increment determine how often a loop is executed. The program section which is to be executed several times is inserted between the FOR and NEXT commands.

If there is enough free capacity in the working memory, nesting of up to 26 FOR-NEXT loops is possible. Each loop must have a different index. FOR-NEXT loops must not overlap. This means that lower-order loops must always be closed with NEXT before higher-order loops are.

If no STEP entry [EXP3] is made, the default increment is 1.

Examples:

```
10 FOR I=-5 TO 5
20 BEEP:PRINT I
30 NEXT I
```

This simple FOR-NEXT loop is executed eleven times; all the index values I are shown in the display field (-5 to +5).

```
10 FOR I=1KHZ TO 3KHZ STEP 0.5KHZ
20 PRINT I
30 NEXT I
```

All the EXPs in a loop may also contain units. The PRINT command accepts the unit and in the example produces the display 1.0000 KHZ to 3.0000 KHZ.

```
10 A=-5:B=5:C=2.5
20 FOR I=A TO B STEP C
30 PRINT I
40 NEXT I
```

The initial value, the final value and the increment for the loop can also be defined using variables.

```
10 FOR I=1 TO 4
20 PRINT "FIRST LOOP I = ";I
30 FOR J=1 TO 3
40 PRINT "SECOND LOOP J = ";J
50 NEXT J
60 NEXT I
```

Here two loops have been nested. The second loop is executed twelve times, the first loop four times. The second loop is closed before the first loop, so the program will run correctly without overlapping of the loops.

GOSUB-RETURN

Syntax: GOSUB [line number]
subroutine
RETURN

GOSUB branches to a subroutine located at any position in the main program. When the program finds a GOSUB command, the program continues at the line specified in the command (subroutine). The branch destination [line number] must refer to an actual line number. When the subroutine reaches the RETURN command, program execution returns to the main program. The main program then continues at the command after the GOSUB.

Subroutines may also call other subroutines. A maximum of about 25 subroutine levels are possible. Active FOR-NEXT loops and RDOUT commands reduce this value. For each GOSUB command there must be a RETURN command at the end of the subroutine in question.

Examples:

```
10 PRINT "LINE 10"
20 GOSUB 50
30 PRINT "LINE 30"
40 END
50 PRINT "LINE 50"
60 RETURN
```

The subroutine (lines 50 + 60) is executed before the main program reaches the command in line 30. Line 40 stops the subroutine from being executed again. If it were executed again, an error message (RETURN without GOSUB) would be output.

```
10 PRINT "LINE 10"
20 GOSUB 40
30 END
40 PRINT "LINE 40"
50 GOSUB 70
60 RETURN
70 PRINT "LINE 70"
80 RETURN
```

The main program (lines 10 to 30) calls subroutine 1 (lines 40 to 60), which in turn calls subroutine 2 (lines 70 to 80). Line 80 is the return to line 60 and this is the return to the main program (line 30).

GOTO

Syntax: GOTO [line number]

GOTO continues the program at the line number stated by the command. This makes it possible to repeatedly execute a program. In conjunction with the IF-THEN command, the GOTO command can be used, for example, to make program branches according to a result. The branch destination [line number] must be an actual line number. If the GOTO command is used with other commands in a single program line, GOTO should be the last command.

Examples:

```
10 BEEP
20 GOTO 10
```

Once started, this program will run until you stop it by pressing OFF.

```
10 FOR I=1 TO 10
20 PRINT I
30 IF I=5 THEN GOTO 50
40 NEXT I
50 PRINT "END"
```

The jump in line 50 will only be executed if the index I for the FOR-NEXT loop is equal to 5.

HEX

Syntax: HEX([EXP])

[EXP] : string operand

The string operand, which must be a hexadecimal, is converted into the corresponding decimal.

Example:

```
10 C$="20"
20 H=HEX(C$)
30 PRINT H
```

The hexadecimal 20 is read out on the monitor as the decimal 32.

IF-THEN

Syntax: IF [EXP1] [relational operator] [EXP2] THEN [command]

[EXP1] and [EXP2]	: numeric operand.
[relational operator]	: <, >, < =, > =, < >, =
[command]	: BASIC or IEEE command.

[EXP1] and [EXP2]	: string operand.
[relational operator]	: < >,=
[command]	: BASIC or IEEE command.

The IF-THEN command first compares the two expressions [EXP1] and [EXP2]. If the result satisfies the condition, the command that comes after THEN is executed. If the result does not meet the condition, the command in the next line is executed.

THEN is optional (the entry is not absolutely essential).

Numeric and string operands can be compared. String operands can only be checked for equals or not equals. Equals means that the string operands are completely identical, a distinction also being made between upper-case and lower-case notation.

If operands are assigned a unit, you should note that the comparison can only be made on operands with the <u>same</u> unit (eg IF M_RMS-30 mV > 10 mV THEN...). The dimensions of the units need not be the same (eg IF 500 mV < 0.6 V THEN...). If an IEEE test produces no result (----), too high (>>>>) or too low (<<<<), this result will satisfy any comparison.

Examples:

```
10 FOR I=1 TO 10
20 IF I<=8 THEN GOTO 60
40 PRINT "I>8"
50 GOTO 70
60 PRINT "I=";I
70 NEXT I
```

As long as index I meets the condition < =8, the PRINT command in line 60 prints the current value of the variable. Once I=9, the PRINT command in line 40 comes into effect.

```
10 INPUT "ENTER STATUS",A$
20 IF A$="PASS" THEN GOTO 40
30 GOTO 10
40 PRINT "TEST FINISHED": END
```

If the input request is answered with "PASS", TEST FINISHED will be printed. Any other entry, also "pass", takes you back to line 10.

IF-OUTLIMIT and IF-INLIMIT

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 "measuring assignment" or "output of setting parameters".
[EXP1]	:	lower limit (numeric operand).
[EXP2]	:	upper limit (numeric operand).
[command]	:	BASIC or IEEE command.

IF-OUTLIMIT and IF-INLIMIT are special forms of the IF-THEN command. [READ] is compared with the two limits [EXP1] and [EXP2]. If the result is outside the limits for IF-OUTLIMIT or inside the limits for IF-INLIMIT, the program executes the command that comes after THEN. Otherwise the command in the next line of the program is executed.

If [READ] matches one of the limits, the command after THEN is executed for IF-INLIMIT and the command in the next line for IF-OUTLIMIT.

If the operands have units, you should note that comparisons can only be performed on operands with the same unit (eg IF OUTLIMIT(M_DCA,0.1 A,0.2 A). The dimension of the units need not be the same (eg ...M_DCA,100 mA,0.2 A). If [READ] outputs the result ----, >>>> or <<<<, the command that comes after THEN is executed. This is also the case when [READ] outputs a correct result but the unit of the result is not the same as the unit in the expressions [EXP1], [EXP2] (eg ...M_DCA,0.1 V,0.2 V).

THEN is optional.

Examples:

```
10 FOR I=1 TO 3
20 INPUT "ENTER A!",A
30 IF OUTLIMIT(A,10,20)GOTO 50
40 PRI "A=";A:GOTO 60
50 PRI"OUTLIMIT"
60 NEXT I
```

The program outputs prompts for number entry three times. If the entry satisfies the condition $10 \leq A \leq 20$, line 40 outputs the value of A. All other values cause OUTLIMIT to be output.

```
10 IF INLIMIT(M_RMS,0.1 V,0.2 V)GOTO 40
20 PAUSE "ADJUST!"
30 GOTO 10
40 PRINT M_RMS
50 END
```

The IEEE measuring assignment M_RMS is repeated with the adjustment instruction ADJUST! on the monitor until the result is between 0.1 V and 0.2 V. Only then is the result read out.

INPUT

Syntax: INPUT ["text",][VAR]
INPUT ["text",][S-VAR]

[VAR]	:	variable (A to Z) for numbers.
["text",]	:	any text (optional) between inverted commas with delimiting comma.
[S-VAR]	:	string variable for text.

INPUT interrupts the program, outputs the text string on the screen and waits for an entry. The type of entry depends on the INPUT variable declarations: [VAR] requires a number, [S-VAR] a text entry (max. 40 characters). A unit can be assigned to a numeric entry (4031 keyboard) with * <UNIT/SCROLL> before it is transferred with <ENTER>. If a text entry is expected, <ENTER> must be pressed first. This assigns the softkeys the letters of the alphabet and special characters. Text entries, which may also contain numbers, are handled as described in the section "Naming Files".

After the entry has been acknowledged with <ENTER>, the program can be restarted with <*CONTINUE*>. The INPUT variable then produces the expected reaction.

Examples:

```
10 SETTX
20 INPUT "ENTER CORRECTION FACTOR",C
30 IF C+MPOWE>3 W THEN PRINT "FAILURE"
40 PRINT MPOWE
```

The entered correction factor C (eg 1 W) is added to the measured RF power (MPOWE). If the result exceeds 3 W, the measured value is read out with the comment FAILURE.

```
10 SETRX
20 INPUT "ENTER FREQUENCY",F
30 FREQU #F
```

The program expects entry of a frequency value and the unit (eg 45 MHz). The effect of line 30 is to enter the value of the *RF Frequency* field of the RX mask and to set the signal- generator frequency.

```
10 INPUT "UNIT ?",A$
20 PRINT A$
```

This is a way of entering the type of radio set under test, for example, in the heading of a test report.

```
10 INPUT A
20 PRINT A
```

The "text" in the INPUT command can be omitted.

KEY

Syntax: KEY [softkey number],["text"],[command] or KEY 1 TO 6,["text"],[command]
KEY WAIT or KEY RUN

[softkey number]	:	number between 1 and 6.
["text"]	:	plain text (between inverted commas) with max. seven or eight characters.
[command]	:	BASIC command GOTO, GOSUB or CHAIN

The KEY command can be used to assign any softkey a name declared under "text". When the softkey is operated, the program executes the stated [command]. KEY 1 TO 6 on the other hand comprises all softkeys into a single softkey, gives this a "text" of maximally 32 characters and also allocates the softkey a [command].

KEY WAIT means that the individual softkey names are shown on the monitor until you strike a softkey. Then the program executes the declared command. At the same time the original softkey names apply again. During KEY WAIT the last PRINT outputs stay on the monitor (max. 16 text lines). In this way more explanation of the function of the individual softkeys can be given for example.

KEY RUN is an alternative to KEY WAIT. KEY RUN also waits for operation of a softkey. But in contrast to KEY WAIT the current mask appears on the monitor and is constantly updated (eg analyzer mask). For user information there is now only one line available on the monitor.

Examples:

```
10 PRINT OFF
20 PRINT "SELECT TEST PROGRAM"
30 KEY 1,"RX TEST", GOSUB 100
40 KEY 2,"TX TEST", GOSUB 200
50 KEY 3,"SELFCHEK",CHAIN SELFCHEK
60 KEY 6,"EXIT",GOTO 90
70 PRINT ON
80 KEY WAIT:GOTO 10
90 END
100 REM RX TEST
200 REM TX TEST
```

After the start this program shows the text SELECT TEST PROGRAM in the display field. At the same time the softkeys 1, 2, 3 and 6 have the allocated designations. If softkey 2 is tapped for example, there is a jump to a subroutine beginning with line 200. After the return the main program executes the instructions that follow the KEY WAIT command.

```
10 SETTX:ANALZ
20 KEY 1 TO 6,"CONTINUE",GOTO 40
30 KEY RUN
40 REM next task
```

The program calls up the analyzer and does not continue with line 40 until a softkey is tapped.

LEN

Syntax: LEN([S-EXP])

[S-EXP] : string operand.

This BASIC function determines how many characters there are in the string operand (length of string).

Examples:

```
10 INPUT A$
20 PRINT "String Length",LEN(A$)
```

A string is read in and its length is printed out.

```
10 M$=SER_In
20 L=LEN(M$)
30 IF L>49 THEN A$=M$(1,49):B$=M$(50,L)
```

A string is read into M$ on the RS 232 interface (option). If the string is longer than 49 characters, the first 49 characters are assigned to the string variable A$ and the remainder to B$.

LET

Syntax: LET [VAR] = [EXP] or LET [S-VAR] = [S-EXP]

[VAR]	:	variable (A to Z).
[EXP]	:	numeric operand.
[S-VAR]	:	string variable (A$ to D$, M$).
[S-EXP]	:	string operand.

LET is used to assign content to a variable or string variable. The command is optional; in other words an assignment can be made without it being preceded by the LET command.

Examples:

```
10 PRINT "1234567812345678"
20 LET A=5*3
30 PRINT A-5
40 LET B=5 kHz
50 PRINT B
60 C=30 kHz-B
70 PRINT C
```

Output format:

```
1234567812345678
·10
····5.0000 kHz
···25.0000 kHz
```

```
10 LET C$="CHAN"
20 LET D$=C$+VAL$(410)
30 PRINT D$
```

Output format:

```
CHAN·410
```

ONERRORGOTO

Syntax: ONERRORGOTO [line number]
AUTORUN program section
ONERRORGOTO

After ONERRORGOTO [line number] the execution of the program continues at the [line number] if there is an error that would normally cause the program to be aborted.

ONERRORGOTO (without line number) permits the program to be aborted as soon as this is wished.

The ONERRORGOTO command may be abbreviated to the first five letters.

Example:

```
10 ONERRORGOTO 20
20 INPUT "Frequency 250...300 MHz",F
30 IF OUTLIMIT(F,250 MHz,300 MHz) GOTO 20
40 ONERRORGOTO
```

The input prompt in line 20 is repeated if the permissible frequency range is violated in entry or the MHz unit is forgotten.

PAUSE

Syntax: PAUSE [S-EXP],[S-EXP],[S-EXP]

[S-EXP] : string operand.

PAUSE interrupts execution of the program and displays text on the monitor of twice the normal height. At the same time the softkeys are assigned the *CONTINUE* function. <*CONTINUE*> causes the program to continue. The PAUSE command may be followed by up to three string operands with commas as delimiters. A blank line is inserted on the monitor between the text lines.

Examples:

```
10 SETTX
20 IF MPOWE > 0.5 W GOTO 40
30 BEEP:BEEP:PAUSE "TRANSMITTER ON"
40 PRINT MPOWE
```

If the measured RF power is less than 0.5 W, the prompt TRANSMITTER ON and two signal tones are output to indicate that the transmitter must be switched on.

```
10 A$="TEST PROGRAM"
20 B$="------------"
30 PRINT A$,B$,"STABILOCK 4031"
```

Output format:

```
TEST·PROGRAM
............
------------
..............
STABILOCK·4031
```

PRINT

Syntax: PRINT [list] and PRINT ON or PRINT OFF

[list] : output list. This may contain numeric operands, string operands and IEEE commands of the type "measuring assignment" or "output of setting parameters". A comma or a semicolon can be used as a delimiter.

PRINT ON/OFF are special forms of the PRINT command. Their only purpose is to permit or prohibit print output. After every program start print output is automatically permitted.

PRINT outputs each item in the output list on the screen (display field) and if required on a printer. This output is only seen after the program run is over. While the program is running, the output can be seen in the status line until the following output.

The delimiters "," and ";" can be used to format outputs. For this purpose the display field and the print field are divided up into socalled print zones which are eight characters long. If outputs in the output list are separated with a comma, PRINT always starts each output at the beginning of the next available print zone. The semicolon causes each output to be read out immediately after the last one.

Numeric values without unit between 0.001 and 9999 are read out in the normal notation (eg 15). Outside of this range the output of numeric values without unit is made in the format of the scientific notation with one place before and seven after the decimal point (eg 1.1234567E + 90). Numeric values may not be entered in scientific notation.

Numeric values with associated unit are read out with maximally four places before the decimal point and always with four after the decimal point (eg 50.0000 kHz). Unused places before the decimal point are read out as spaces. If a numeric value exceeds the permissible number of places (eg 12345 kHz), the PRINT instruction produces output of the overflow symbol (>>>>). Then the number of places has to be reduced by choosing the next highest unit.

PRINT instructions read out **measured results** including the unit. If a measurement fails to produce a valid result, the PRINT command outputs "-----" (no test signal), ">>>>" (above measurement range) or "<<<<" (below measurement range) instead of the result.

Examples:

```
10 PRINT "1234567812345678"
20 PRINT 10,20
30 PRINT -1000,0.2523
```

Output format:

```
1234567812345678
·10······20
-1000····0.2523
```

Program	Output

`10 PRINT "12345678123456781"`
`20 PRINT "A","B","C"`
`30 PRINT "A";"B";"C"`
`40 PRINT 150 MHz,"C"`
	Output format:
	`12345678123456781`
	`A·······B·······C`
	`ABC`
	`··150.0000 MHz··C`

`10 PRI"LINE A":PRI:PRI"LINE B";`
`20 PRI"LINE C"`
	Output format:
	`LINE·A`
	`······`
	`LINE·BLINE·C`

`10 SETTX;A=M_RMS:PRINT M_RMS`
`20 PRI A`
	Output format (example)
	`·····3.96··V`
	`····3.9600··V`

RDOUT

Syntax: RDOUT([command];[VAR])

[command] : IEEE command.
[VAR] : single variable (eg S) or variables separated by commas (eg A,B).

If an IEEE command outputs one or more results, RDOUT transfers the results to the declared variables. If there are more declared variables than results, an error message is output.

Examples:

```
10 SETRX;V_RMS;MODUL
20 GENA_RX;RXAFM 4 kHz
30 PRINT "LEVEL =";M_RMS
40 RDOUT(MDEMO;A,B)
50 PRINT "MOD =";A,B
```

The program calls the RX mask. The result of this is that the carrier from the signal generator is modulated with an FM deviation of ±4 kHz. RDOUT assigns both results from the IEEE command MDEMO (positive and negative peak deviation) to the variables A and B.

```
10 SETRX
20 SOFT_SPECIAL;SOFT_SENS
30 RDOUT(SOFT_RUN;S)
40 PRINT "SENSITIVITY =";S
50 SOFT_BANDW.
60 RDOUT(SOFT_RUN;B,O)
70 PRINT "BANDW.+OFFSET =";B,O
80 SOFT_RETURN
```

First the program calls the RX special *SENS* and outputs the result (S). Then both the results from the *BANDW.* special are output.

RDXY

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).

Using the RDXY function it is possible to read values and their units from the screen. 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.

Example:

```
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 (see Chapter 10).

REMARK

Syntax: REMARK text

REMARK is used to make a program clearer by adding explanatory comments (text). The REM lines do not affect program execution in any way.

Example:

```
10 REM *******
20 REM TX TEST
30 REM *******
40 SETTX
50 FREQUENCY 275.250 MHz
```

The REM lines make it quite clear that the program is checking the transmitter section of a transceiver.

SETUP

Syntax: SETUP [file name] or SETUP [#string variable]

`[file name]` : name of setup (instrument setting) stored on MEMORY CARD.
`[#string variable]` : eg #A$, where A$ must contain name of setup.

SETUP enables any instrument setting stored as a SET file to be recalled. The result of a SETUP command is the same as for manual callup of a setup (see "Storing and Recalling Setups"). This simplifies preparation of the Communication Test Set for a particular measuring task in AUTORUN programs.

Example:

```
10 REM TX TEST
20 SETUP TX MODE:GOSUB 100
30 SETUP ANALYZER:GOSUB 800
40 END
```

TRACE

Syntax: TRACE

TRACE makes it easier to debug a program. When the command is activated, the number of the line which is being processed is displayed in the status line and may also be output on a printer. After the program has been run, the display field shows each line in the order it was executed.

TRACE is a toggle function, ie once TRACE has been activated, calling it again switches the function off. It is therefore best to use TRACE as a direct command. The TRACE status is shown on the screen when the command is entered.

Example:

```
10 SETTX;V_RMS;GENA_TX;MODULE
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 END
90 PRI "ERROR"
100 END
```

From line 30 TRACE documents the various branches taken as the program is executed.

VAL

Syntax: VAL([S-EXP])

[S-EXP] : string operand.

The string operand, which may only consist of a numeric value or a numeric value with unit, is converted into a numeric value.

Example:

```
10 A$=SER_In
20 IF VAL(A$)>15.2 THEN PRINT "FAIL"
```

If a measured result read in on the RS 232 interface (option) exceeds the value 15.2, "FAIL" will be read out on the monitor.

VAL$

Syntax: VAL$([EXP])

[EXP] : numeric operand.

A numeric operand with or without unit is converted into a string.

Example:

```
10 C=25
20 C$="CHAN"+VAL$(C)
30 PRINT C$
```

CHAN · 25 is read out on the monitor.

WAIT

Syntax: WAIT [time]

[time] : delay in milliseconds (1 to 9999).

WAIT interrupts the program for a certain time. While it is waiting, the 4031 maintains its current operating status.

Example:

```
10 SETTX
20 WAIT 1000
30 SETRX
40 WAIT 1000
50 GOTO 10
```

After the first mask has been called, the program waits 1 s each time before calling another mask.

Error Messages

```
GENERAL ERRORS

0200: AUTORUN ERROR.
0201: FUNCTION NOT AVAILABLE IN IMMEDIATE MODE.
0202: FUNCTION 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: PROGRAM MEMORY FULL.
0214: CORRUPT PROGRAM. RELOAD.
0215: RENUMBER  INCREMENT FACTOR TOO LARGE.
0216: RENUMBER  UNMATCHED GOTO/GOSUB LINE NUMBERS.

SYNTAX

0220: BAD SEPARATOR.
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: OUTLIMIT 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 OPERAND INVALID.  Value not integer ?
0235: BAD STRING TYPE. Eg  a$..d$ "text" m$(3,4)

RUN-TIME

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.

IEEE COMMAND (See chapter 10)

0260: BAD IEEE VARIABLE INSERTION SYNTAX
0261: IEEE SYNTAX ERROR.
0262: COMMAND EXPECTED.
0263: MEASUREMENT EXPECTED.
0264: IEEE KEYWORD EXPECTED. Unknown keyword.
```

Options and Accessories

Contents

Overview

Chapter 8 describes the use and incorporation of the hardware options. As a rule the options will be ready installed if you ordered them together with your STABILOCK 4031. The OPTIONS mask (see "Status Mask" foldout) shows what options your 4031 contains. Software options (simulation of radio-data systems) are described in Chapter 9.

Options

Duplex FM-PhM stage

Necessary for testing duplex radio sets. Installation: in equipment chassis (underside).

Modulation generator GEN B

Permits modulation overlaying, for example, with the signal of the standard generator GEN A. Installation: in rear of unit.

Control interface A

Eight relays for remotely controlling a radio set (RX/TX switchover, squelch on/off, etc). Eight TTL inputs, one trigger input. Installation: in rear of unit.

Control interface B

24 relays for remotely controlling a radio set.
Eight TTL inputs, two trigger inputs.
Installation: in rear of unit.

Control interface C

24 relays and 20 TTL outputs for remotely controlling a radio set. Eight TTL inputs, two trigger inputs.
Installation: in rear of unit.

Note: Only one control interface can be used at a time.

OPTION CARD

Carrier board for the following optional modules:

300-Hz highpass filter
300-Hz lowpass filter
3-kHz lowpass filter
4-kHz bandpass filter
Variable notch filter (200 to 600 Hz)
DC voltmeter/ammeter
DTMF device
C-Net expander

Note: The OPTION CARD can hold up to six optional modules. Apart from the variable notch filter, two of the other.

AF filters can be used on it at the same time.

Installation of OPTION CARD: in rear of unit.

VSWR measuring head	Permits measurement of the voltage standing-wave ratio of radio antennas together with the VSWR function of the 4031. Connection: on RF and RF DIRECT sockets.
ASCII keyboard	External keyboard for entering AUTORUN programs (automatic measurements, see Chapter 7) and for entering text accompaniments to test reports. Connection: on control interface A, B or C.
DATA module	Hardware requirement for using the software options (see Chapter 9). The software options permit the simulation of conventional radio-data and mobile-telephone systems (eg NMT 450/900, Radiocom 2000, C Net). The software options come on "memory cards" (battery-buffered RAM modules in cheque-card format). Installation of DATA module: in rear of unit.
SSB stage	Required for testing SSB radio sets.

Note: The incorporation of an option can in many cases have an effect on a mask. New display fields may appear, for example, or the lockout of a softkey may be cancelled. The notes on operation that follow below apply to cases where the option is actually incorporated.

Extra accessories

The data sheet will tell you about the many different accessories that are available for STABILOCK 4031. In addition to these there are various adapters especially for maintenance and service of the 4031 plug-in stages:

AF service adapter	248 182
RF service adapter	248 183
Power-supply adapter	248 184

The prices of the options and accessories are stated in the current price list, which you can obtain from the works or from your nearest representative.

Check list: testing chores and options required

Order number	860 182	236 035	236 037	206 032	229 033	236 033	248 199	248 174	248 175	248 179	248 171	248 118	248 172	248 104	236 034	229 034	248 192	248 154	229 035	
Option / Measuring task	IEEE-488 interface PC II A	Control interface A	Control interface C	Audio generator GEN B	Duplex FM/ΦM stage	OPTION CARD	300 Hz high-pass filter	300 Hz low-pass filter	4 kHz band-pass filter 1)	variable notch filter	DTMF module	Netz-C expander module	DC voltage/ammeter	VSWR directional coupler	Data module	Tracking IF stage 3)	Keyboard 2)	SSB kit	ACPM kit 4)	Memory Card containing system software
Control of radio under test with 8 relays		●																		
Control of radio under test with 24 relays + 20 TTL output			●																	
Simulation of fast answer back systems (response time < 100 ms)					●															
Distortion measurement 200 to 600 Hz						●				●										
DC voltage/current measurements						●							●							
DTMF signal encoding/decoding						●					●									
Subaudio squelch tones (CTCSS) and double tone signaling				●																
Measurement on squelch tone radios						●	●	●												
Program controlled measurements (AUTORUN)																	●			
ARE: Software package for PC based development of AUTORUN programs	●																			
Tracking (graphic display of filter curves)					●											●				
Measuring result explanatory text																	●			
VSWR measurement														●						
Measurements on SSB radios						●												●		
Adjacent-channel power measurement																			●	
Cellular system NMT 450/900 (Scandinavia)					●	●			●						●					897 900
Cellular system NMT France					●				●						●					897 925
Cellular system NMT Benelux					●	●			●						●					897 920
Cellular system NMT 450 Universal					●				●						●					897 915
Cellular system NMT Base-Station Test					●										●					897 905
Cellular system NMT Turkey					●				●						●					897 901
Cellular system NATEL C (Switzerland)					●	●			●						●					897 930
Cellular system C-Netz (Austria)					●	●			●						●					897 910
Cellular system Netz-C (FRG)					●	●						●			●					897 960
Cellular system Network C (Portugal)					●	●						●			●					897 062
Cellular system C-Net SAPO					●	●						●			●					897 063
Cellular system EAMPS					●										●					897 950
Cellular system ETACS UK					●										●					897 940
Cellular system ETACS Japan (JTACS)					●										●					897 945
Cellular system RADIOCOM 2000 HD					●										●					897 970
FMS					●										●					897 082
VDEW direct dialing					●	●					●									897 086
VDEW digital					●										●					897 090
ZVEI binary					●										●					897 084
ZVEI binary (600 baud)					●										●					897 085
POCSAG (FFSK)															●					897 081
POCSAG (NRZ)															●					897 080
Cityruf															●					897 083
Trunking / MPT 1327					●										●					897 089
Trunking PAA 2424					●										●					897 087
Combiner Test																				897 985
US Signalling Formats					●										●					897 092
LTR + US Signalling					●										●					897 093

1) Required for SAT measurements only.
2) The use of the keyboard needs a control interface.
3) When option 229 035 is used the tracking IF stage 229 054 is necessary.
4) Includes duplex FM/ΦM stage 229 062.

Duplex FM/PhM Stage

The standard synthesizer of STABILOCK 4031 is used either by the signal generator (RX operating mode) or by the test receiver (TX operating mode) of the Communication Test Set. In the DUPLEX operating mode, which calls for transmission and reception at the same time, the signal generator works with the standard synthesizer. So a second synthesizer is necessary for the test receiver. Besides this synthesizer the duplex stage includes a mixer and its own IF conditioning. Demodulation and other signal conditioning are handled by the test receiver like in the simplex TX mode. The received duplex signal is coupled out directly following the RF socket.

Technical data

See data sheet

Operation

Once the duplex stage has been incorporated, the basic DUPLEX mask can be called up. The "Basic DUPLEX Mask" foldout (Chapter 12) tells you how to call up the mask and the meanings of the fields and softkeys. The usual operating rules apply; but with <FREQUENCY> you can only access the *RF Frequency* entry field in the RX part of the mask. The corresponding field in the TX part of the mask (tuning frequency of the test receiver) can only be accessed with the cursor keys.

Cross-references:
Chapter 3, Operating Rules, "Working with channel numbers, DUPLEX mode".
Chapter 4, Duplex Measurements, "Basic DUPLEX Settings".
Chapter 11, Training with DUPLEX Mask.
Chapter 12, foldouts "Basic DUPLEX Mask", "DUPLEX Specials".

Installation of duplex stage

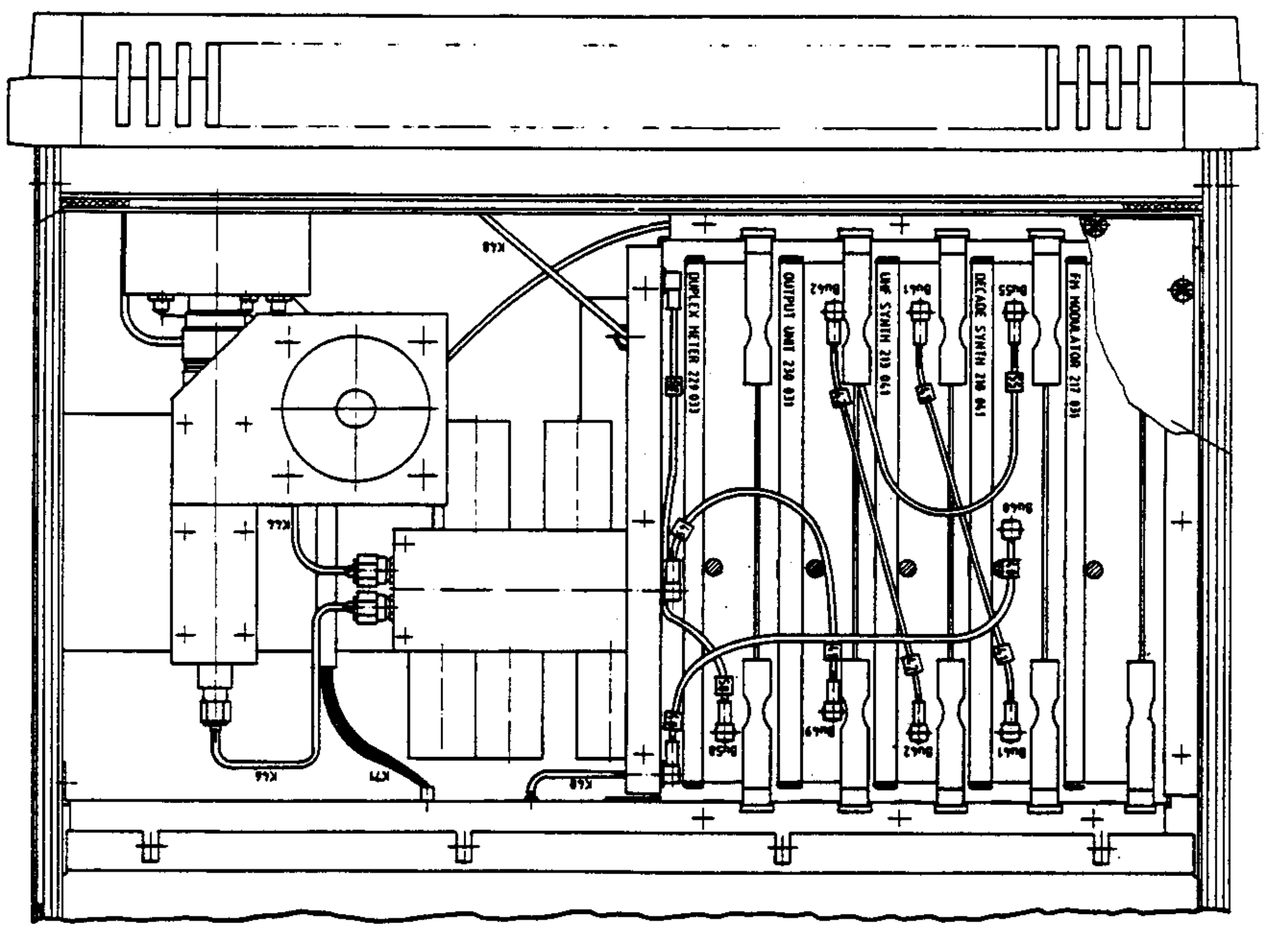
1. Switch off the Communication Test Set and withdraw the power cable.
2. Tip STABILOCK 4031 so that it is resting on the rubber reinforcement on its rear.
3. Undo the retaining screws of the bottom half of the unit's shell and remove the shell.
4. Unscrew the cover plate that you can see on the right next to the loudspeaker.
5. Withdraw cables 40 and 49 from sockets Bu 40 and Bu 49 (see figure).
6. Connect cable 58 (duplex connecting cable) to the socket in the chassis (see figure).
7. Slide the duplex stage as far as it will go into the slot that is provided for it.
8. Press the clamps down firmly and join cables 40, 49, 58 to their corresponding sockets. Replace the cover plate and the bottom half of the unit's shell.
9. Reconnect the power cable.

Operational check

1. Switch the unit on with <u><OFF> + <POWER</u>>.
2. Call up the OPTIONS mask with <*OPTIONS*> and check whether the installation of the duplex stage is indicated.
3. Call up the DUPLEX mask (see "Basic DUPLEX Mask" foldout).

Ordering details

Ordering code 229 033; items supplied: duplex stage, connecting cable.



Partial view of chassis with bottom half of shell and cover plate removed. Cables 40 and 49 have to be undone to install the duplex stage.

Modulation Generator GEN B

Modulation generator GEN B is virtually identical to the standard AF generator GEN A. What are missing are the summing amplifiers with which GEN A can overlay its own AF signal with the signal from GEN B and another modulation signal.

Technical data

Identical to those of generator GEN A, see data sheet.

Operation

GEN B is switched on and off with <B/SAT> in the RX and TX operating modes. Once the generator is installed, the following fields appear in the basic mask:

GEN B	Entry field for signal frequency
Mod	Entry field for modulation level (RX mask)
Lev	Entry field for signal level (TX mask)

The fields are accessed as usual with the cursor keys if no entry field is open. As soon as GEN A is cut out, the fields can also be moved to with the keys for rapid access (<MOD FREQ> and <AM FM ΦM>).

GEN B signal paths

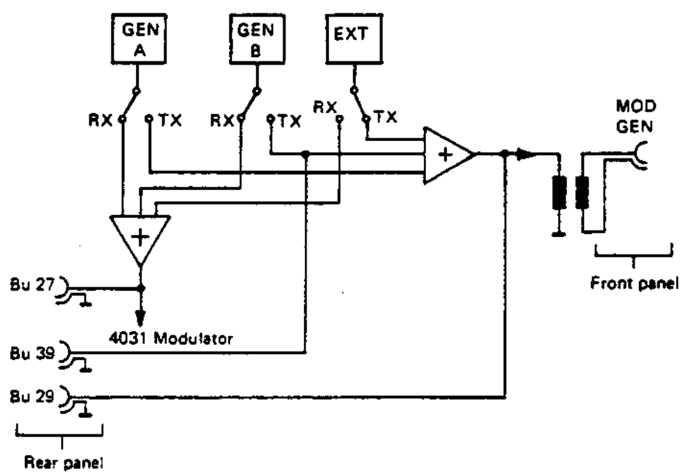
RX mode
In the RX mode the RX or TX signal path can be switched for GEN B by repeatedly striking <B/SAT>.

• When the RX signal path is switched (front panel, green LED illuminated above B/SAT key), GEN B feeds the modulator of the 4031 signal generator. If generator GEN A is also switched on or an external modulation signal is coupled in with <EXT>, there will be overlaying of the modulation. In this case the "MOD" meter shows the peak values of the sum modulation. You can also display the sum modulation as a curve by using the scope function of the 4031.

• When the TX signal path is switched (front panel, red LED illuminated), the signal from GEN B appears AC-coupled on the MOD GEN socket (front panel).

TX mode
In the TX mode the TX signal path is always switched for GEN B, ie the AF signal appears AC-coupled on the MOD GEN socket (front panel). If other modulation-signal sources are active, the signal on the MOD GEN socket will be a sum signal, which can likewise be displayed using the scope function.

DUPLEX mode
In the DUPLEX mode too, GEN B can be switched to the RX or TX signal path by repeatedly striking <B/SAT>. The signal path that is actually selected is again shown by the LEDs. Only in the DUPLEX mode does this switching of the RX/TX signal path also govern the coupling of an external modulation signal with <EXT>. Generator GEN A is firmly switched to the RX signal path in the DUPLEX mode. For modulation overlaying the situation is as follows: all sources that are switched to the RX signal path feed the 4031 modulator; signals that are switched to the TX signal path appear as a sum signal on the MOD GEN socket (see figure).



Signal paths of modulation signals in the DUPLEX mode (symbolic representation)

Signal output on socket Bu 39
As soon as the TX signal path is switched for GEN B, the signal of the generator also appears on socket Bu 39 (back panel). Bu 39 is DC-coupled and only carries the signal from GEN B even when other modulation-signal sources are active. In this case the signals on Bu 39 and socket MOD GEN are no longer identical.
When GEN B is switched to the RX signal, the signal on Bu 39 is undefined.

Installation of generator stage GEN B

1. Switch off the Communication Test Set and withdraw the power cable.
2. Unscrew the cover plate at location 5 on the back panel (see "Back Panel" foldout).
3. Slide the GEN B stage along the guide as far as it will go into the slot that is provided (refer to the foldout for the correct position).
4. Screw the stage firmly to the chassis.
5. Reconnect the power cable.

Operational check

1. Switch the unit on with <OFF> + <POWER>.
2. Call up the OPTIONS mask with *<OPTIONS>* and check whether the installation of GEN B is indicated.
3. Call up the RX mask. Switch GEN A off and GEN B on. Call up the RMS meter with <VOLT> and connect to the RX signal path with <RX MOD/MOD GEN>.
4. Enter values in the mask fields *GEN B* and *Mod* ---> RMS meter must indicate f_{mod} and a level value.

Ordering details

Ordering code 208 032; items supplied: GEN B stage, ready for installation.

Control Interface A, B, C

Note: Control interface B no longer available.

Technical data

Relays	bistable (switched state is maintained even when deenergized). Control interface A: 8 relays (contacts brought out on socket Bu 19) Control interface B: 24 relays (contacts brought out on sockets Bu 19/Bu 18) Control interface C: 24 relays (contacts brought out on sockets Bu 19/Bu 18) Contact rating: continuous current 1 A max. switching voltage 30 V
TTL inputs (socket Bu 22)	$V \geq +1.5\ V = H$ $V \leq +0.5\ V = L$ approx. 4 kΩ input impedance ±30 V dielectric strength The TTL inputs are only available if the socket concerned (Bu 22) is not occupied by the optional ASCII keyboard.
TTL outputs (only for interface C)	open-collector (pullup resistor 1 kΩ); fanout = 1 (standard TTL) The outputs are brought out on sockets Bu 19 + Bu 18.

Application

Remote control of radio sets (RX/TX switchover, channel selection, squelch on/off, etc). In conjunction with the AUTORUN function of the 4031 it is possible to test radio sets fully automatically for example.

Operation

The control interface can be operated manually or by program (see Chapter 10). The automatic control can also be set by certain 4031 functions. The declarations necessary for this require callup of the CONTROL INTERFACE mask.

Callup of CONTROL INTERFACE mask

<AUX> + <*CONTROL*>

The mask can only be called up if a control interface is actually installed.

Meaning of mask fields

The following details apply fully to control interface C. They also apply to a large extent to the other control interfaces as long as you remember that these have no TTL outputs or less relays. The appropriate mask fields will then be missing in the CONTROL INTERFACE mask.

As usual, <HELP> briefly brightens up all entry fields in the CONTROL INTERFACE mask. Each entry field can be moved to with the cursor keys.

Automatic setting of relays 1 through 4
Depending on the operating mode, relays 1 through 4 are set or reset automatically if the scroll variable *X* is entered in the *AUTO 1..4* scroll field:

Relay 1 **TX/RX switchover**: As soon as the TX mask is called up, relay 1 is set (Bu 19, pins 18 and 2 connected). With the callup of the RX mask relay 1 is reset (pins 18 and 34 connected).

Relay 2 **UB/LB switchover** (upper band/lower band): Relay 2 is set (Bu 19, pins 19 and 3 connected) if an upper-band channel *(NoU)* is set in the *RF Frequency* field of a basic mask. The setting of a lower-band channel (*NoL*) produces resetting of the relay (pins 19 and 35 connected).

Relay 3 **TONES** (call tone sequence): If an incoming tone sequence is decoded in the testing of selective-call sets, relay 3 will be set for the duration of the decoding (Bu 19, pins 20 and 4 connected). Following decoding the relay is reset (pins 20 and 36 connected).

Relay 4 **SQUELCH** (Special): Relay 4 is set for the duration of the RX Special *SQUELCH* (Bu 19, pins 21 and 5 connected). The RX Specials *BANDW.* and *SENS* always reset relay 4. As long as the relay is reset, pins 21 and 37 are connected.

```
------------- CONTROL INTERFACE C ---------------------
AUTO        NO  Status      NO  Status       NO  Status

TX/RX       1   RX           9               17
UB/LB       2   LB          10               18   ON
TONES       3               11               19
SQUELCH     4               12               20
            5               13   ON          21
            6               14   ON          22
            7               15               23   ON
            8               16               24

AUTO 1..4            X   CH NO --> BCD

 SET   RESET   CLRALL   UPDATE   TTL I/O   RETURN
```

Mask CONTROL INTERFACE C:
The relays 9 to 24 can represent the current channel number, eg BCD encoded (here: channel number 0324).

Relay-coded output of channel number
For remotely controlled channel selection on radio sets, the 4031 offers the possibility of relay-coded output of the channel number. Here the relays 9 through 24 are set or reset according to the selected coding of the channel number (BCD, BCD inverted or hexadecimal).

Relays 9 through 24 are assigned to channel-number output if the scroll variable *X* is entered in the *CH NO* scroll field. The *HEX* scroll field permits selection of the coding with the scroll variables *HEX*, *BCD* and *BCD INV*.

As soon as the *RF Frequency* field is switched to channel-number entry in one of the basic masks, the relays concerned are switched appropriately when the entered channel number is acknowledged.

Coding of maximally 4-digit channel number

1st place				2nd place				3rd place				4th place				
1	2	4	8	1	2	4	8	1	2	4	8	1	2	4	8	Weighting factor
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Relays

Example: channel number 124 BCD-coded; 4th place = 4, 3rd place = 2, 2nd place = 1, 1st place = 0; ie relays 13, 18 and 23 are set. In inverted BCD coding these relays would be reset and all others set; hexadecimal coding is identical to BCD coding.

Manually setting or resetting all relays
All relays can be operated manually if the scroll variable *X* is entered in neither of the scroll fields *AUTO 1..4* and *CH NO*. To set a relay, move to the entry field next to the corresponding relay identification and strike the *SET* softkey.

<*RESET*> produces resetting of the particular relay. <*CLRALL*> resets all relays. A total reset (eg <OFF> + <CLEAR>) will also cause all relays to be reset.

<*UPDATE*> sets or resets all relays according to the entry that is made. The entries may not be made by <*SET*> or <*RESET*> but instead by turning the spinwheel. These entries are not effective to begin with however, they are only produced with <*UPDATE*>.

With relays 5 through 24 the *ON* entry in the entry field confirms that the relay concerned is set. The entry fields of relays 1 through 4, on the other hand, show the following entries, offering better association with the particular function:

	<*SET*>	<*RESET*>
Relay 1	*TX*	*RX*
Relay 2	*UB*	*LB*
Relay 3	*active*	
Relay 4	*active*	

<*RESET*> produces resetting of the particular relay. <*CLRALL*> resets all relays. A total reset (eg <OFF> + <CLEAR>) will also reset all relays.

Operative and normal position of relays

	Operative	Normal	Socket		Operative	Normal	Socket
Relay 1	18/2	18/34	19	Relay 13	18/2	18/34	18
Relay 2	19/3	19/35	19	Relay 14	19/3	19/35	18
Relay 3	20/4	20/36	19	Relay 15	20/4	20/36	18
Relay 4	21/5	21/37	19	Relay 16	21/5	21/37	18
Relay 5	22/6	22/38	19	Relay 17	22/6	22/38	18
Relay 6	23/7	23/39	19	Relay 18	23/7	23/39	18
Relay 7	24/8	24/40	19	Relay 19	24/8	24/40	18
Relay 8	25/9	25/41	19	Relay 20	25/9	25/41	18
Relay 9	26/10	26/42	19	Relay 21	26/10	26/42	18
Relay 10	27/11	27/43	19	Relay 22	27/11	27/43	18
Relay 11	28/12	28/44	19	Relay 23	28/12	28/44	18
Relay 12	29/13	29/45	19	Relay 24	29/13	29/45	18

Example: relay 3 set = pins 20 and 4 are connected; relay 3 not set = pins 20 and 36 are connected; active socket = Bu 19 (control interface).

TTL outputs/inputs

Control interface C offers 20 TTL outputs, which can be set and reset just like the relays. For this purpose call up the appropriate submask with <*TTL I/O*>. The functions *AUTO 1..4* and *CH NO* have the same effect as in the basic mask.

If socket Bu 22 is not occupied by the optional ASCII keyboard, eight TTL signals can be applied here and sampled by an IEEE-bus command. In addition, each socket of the control interface offers a further "TTL trigger input" (see pin assignments in Chapter 2). The *TTL INPUTS* mask field in the OPTION CARD mask shows the logic levels on the different TTL inputs.

Installation

1. Switch off the Communication Test Set and withdraw the power cable.
2. Unscrew the cover plate at location 6 on the back panel (see "Back Panel" foldout).
3. Slide the control interface along the guide as far as it will go into the slot that is provided (refer to the foldout for the correct position).
4. Screw the control interface firmly to the chassis.
5. Reconnect the power cable.

Meaning of sockets

See Chapter 2

Ordering details

Control interface A, ready for installation: 236 035
Control interface B, ready for installation: 236 036
Control interface C, ready for installation: 236 037

OPTION CARD

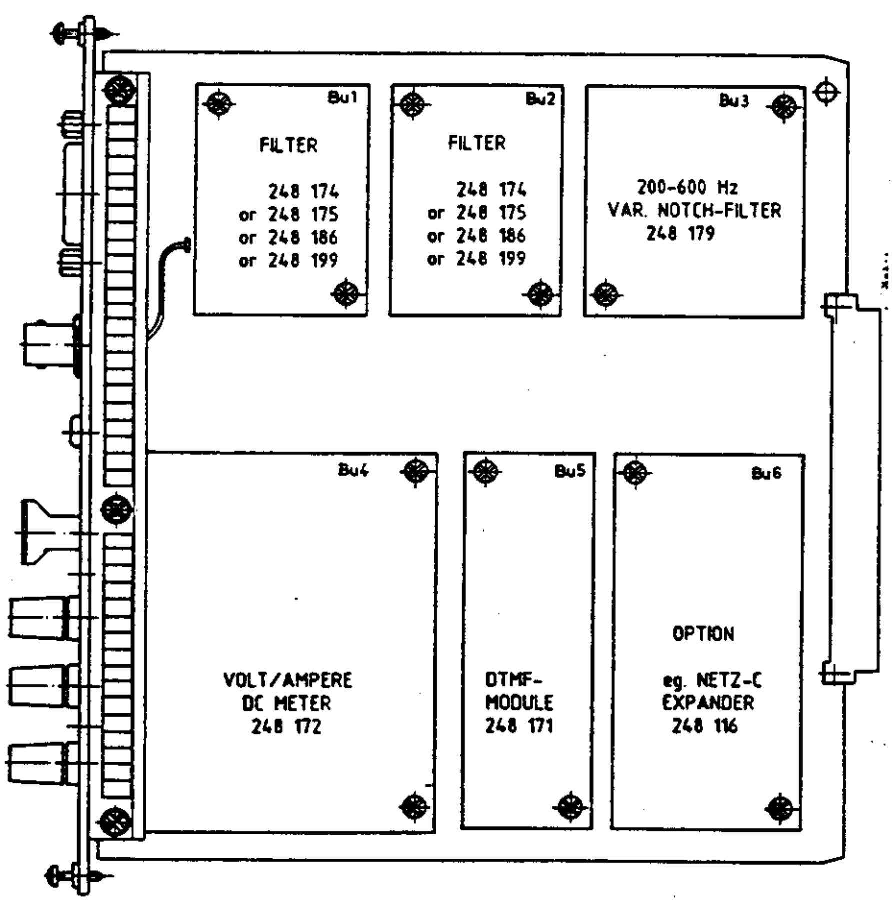
The OPTION CARD can hold up to six optional modules at the same time, this OPTION CARD merely being the motherboard for the individual modules. As soon as an optional module is installed, it can be cut into the appropriate signal path of the 4031 by means of the OPTION CARD mask (callup with <AUX>) or taken out of it again (see also foldouts "AF-signal Processing" and "OPTION CARD"). The following optional modules are presently available:

Optional modules

300-Hz highpass filter	300-Hz lowpass filter	Var. notch filter	DC V/A meter
3-kHz lowpass filter	4-kHz bandpass filter	DTMF device	C-Net expander [1]

[1]) Special option

Fitting on OPTION CARD



The various modules have locations on the OPTION CARD (figure). Only locations Bu 1, Bu 2 and Bu 6 offer a choice: Bu 1 and Bu 2 can each hold one of the four AF filters, Bu 6 can hold the C-Net expander or another special option. For making contact, each module has a plug connector that uniquely matches the corresponding socket connector on the OPTION CARD. Before installing the DC V/A meter, first remove the shield from the OPTION CARD that covers the leadthrough of the connecting sockets.

Installation of OPTION CARD

1. Switch off the Communication Test Set and withdraw the power cable.
2. Unscrew the cover plate at location 2 on the back panel (see "Back Panel" foldout).
3. Slide the OPTION CARD along the guide as far as it will go into the slot that is provided (refer to the foldout for the correct position).
4. Screw the OPTION CARD firmly to the chassis.
5. If the OPTION CARD is fitted with one of the four AF filters or the variable notch filter: join socket 90 (OPTION CARD) and socket 15 (AF DETECTOR) with the adapter cable (see "Back Panel" foldout).
6. Reconnect the power cable.

Meaning of sockets

See Chapter 2

Operational check

1. Switch the unit on with <OFF> + <POWER>.
2. Call up the OPTIONS mask with <*OPTIONS*> and check whether the installation of the OPTION CARD and its optional modules is indicated.
3. Call up the OPTION CARD mask with <AUX> and check whether the availability of the optional modules is indicated there too.

Ordering details

	Ordering code
OPTION CARD	236 033 (including adapter cable 384 752)
Optional modules	
300-Hz highpass filter	248 199 [1]) [2])
300-Hz lowpass filter	248 174 [1]) [2])
3-kHz lowpass filter	248 186 [1]) [2])
4-kHz bandpass filter	248 175 [1]) [2])
Variable notch filter	248 179 [1]) [2])
DC V-A meter	248 172 [1])
DTMF device	248 171 [1])
C-Net expander	248 116 [1])

[1]) Requires 1 x OPTION CARD 236 033
[2]) Requires connection of stage 1 and stage 2 with supplied adapter cable 384 752

300-Hz Highpass Filter

Technical data

Filter type .... 5-pole Chebishev-Cauer filter
3-dB cutoff frequency .... 280 Hz
Stopband attenuation........................... 27 dB
Ripple .... +0.2 dB to -1.3 dB (in passband)

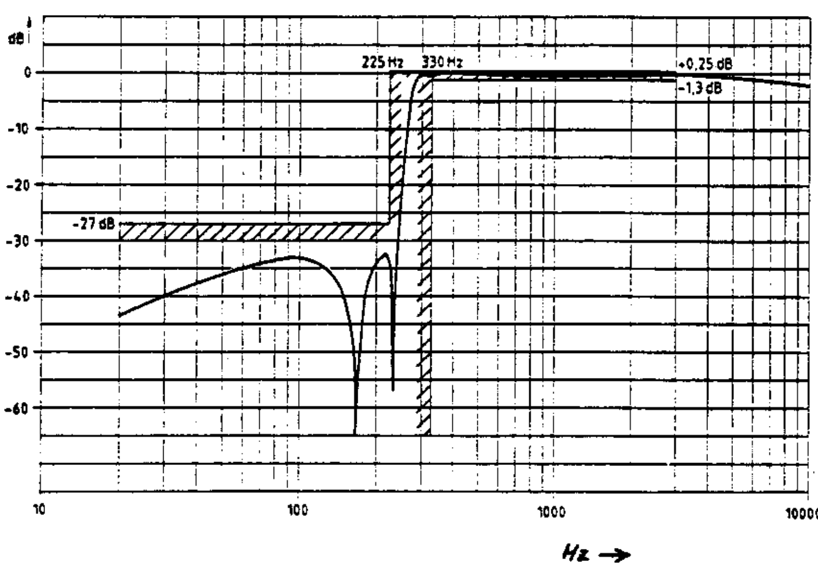
Application

Elimination of system hum or low-frequency SAT (supervisory audio tone, pilot tone) from AF signal.

Operation

Call up the OPTION CARD mask with <AUX>. Depending on the slot in which the highpass filter is inserted (Bu 1 or Bu 2), the appropriate mask text field indicates for example *Filter 1 : 300 Hz HP.* <HELP> shows that there is a scroll field following the colon of the text field (see also "OPTION CARD" foldout). This field can be accessed with the cursor keys. If the filter is to be cut into the AF signal path of the 4031 (see "AF-signal Paths" foldout), enter the scroll variable *X* in the field ("crossing" of the scroll field) by turning the handwheel for example. The filter can be cut out of the signal path again by selecting the second scroll variable (space). In both cases the switching function occurs as you leave the OPTION CARD mask.

If the second slot is also fitted with a filter, the two filters are connected in series if both scroll fields are crossed at the same time in the OPTION CARD mask.



300-Hz Highpass Filter

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Stopband attenuation.......................... 27 dB
Ripple .... +0.2 dB to -1.3 dB (in passband)

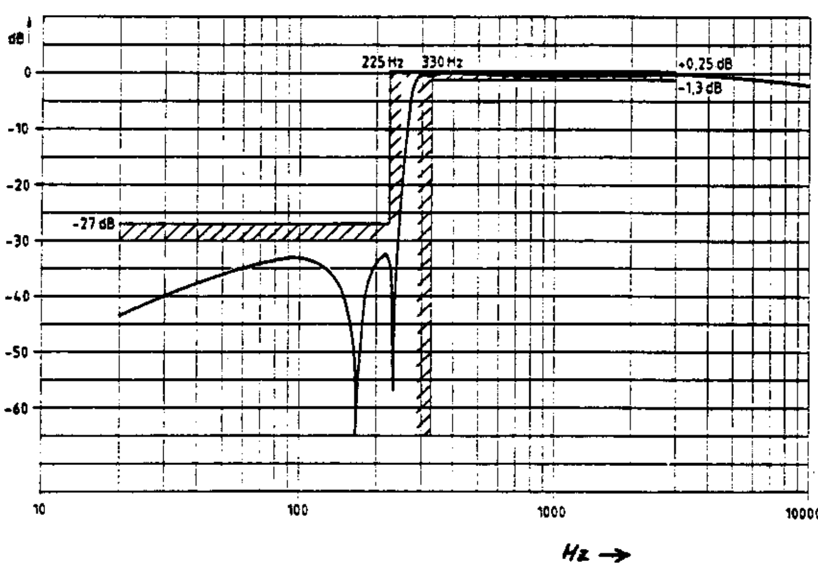
Application

Elimination of system hum or low-frequency SAT (supervisory audio tone, pilot tone) from AF signal.

Operation

Call up the OPTION CARD mask with <AUX>. Depending on the slot in which the highpass filter is inserted (Bu 1 or Bu 2), the appropriate mask text field indicates for example *Filter 1 : 300 Hz HP.* <HELP> shows that there is a scroll field following the colon of the text field (see also "OPTION CARD" foldout). This field can be accessed with the cursor keys. If the filter is to be cut into the AF signal path of the 4031 (see "AF-signal Paths" foldout), enter the scroll variable *X* in the field ("crossing" of the scroll field) by turning the handwheel for example. The filter can be cut out of the signal path again by selecting the second scroll variable (space). In both cases the switching function occurs as you leave the OPTION CARD mask.

If the second slot is also fitted with a filter, the two filters are connected in series if both scroll fields are crossed at the same time in the OPTION CARD mask.



300-Hz Lowpass Filter

Technical data

Filter type .... 2nd-order Butterworth filter
3-dB cutoff frequency .... 338 Hz ±15 Hz
Insertion loss .... 0 dB ±0.5 dB
Stopband attenuation .... 40 dB (at 3 kHz)

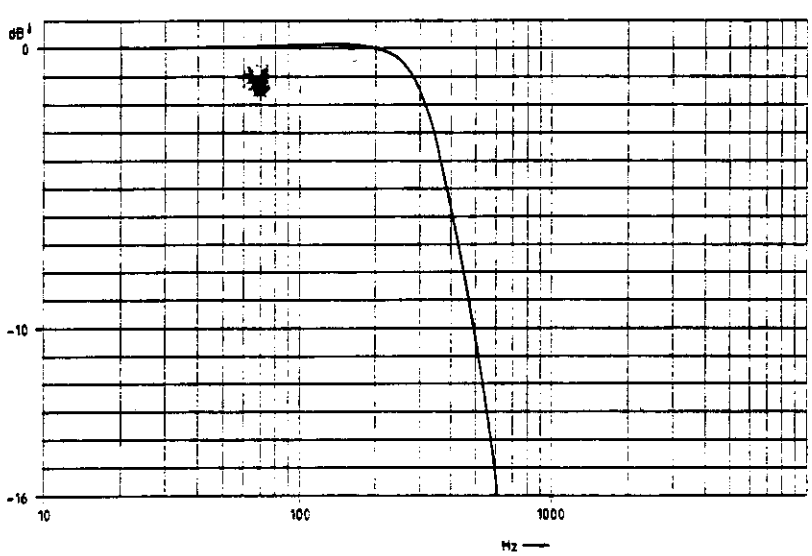
Application

Suppression of higher-frequency interference components when measuring pilot tones (SAT).

Operation

Call up the OPTION CARD mask with <AUX>. Depending on the slot in which the lowpass filter is inserted (Bu 1 or Bu 2), the appropriate mask text field indicates for example *Filter 2 : 300 Hz TP*. <HELP> shows that there is a scroll field following the colon of the text field (see also "OPTION CARD" foldout). This field can be accessed with the cursor keys. If the filter is to be cut into the AF signal path of the 4031 (see "AF-signal Paths" foldout), enter the scroll variable *X* in the field ("crossing" of the scroll field) by turning the handwheel for example. The filter can be cut out of the signal path again by selecting the second scroll variable (space). In both cases the switching function occurs as you leave the OPTION CARD mask.

If the second slot is also fitted with a filter, the two filters are connected in series if both scroll fields are crossed at the same time in the OPTION CARD mask.



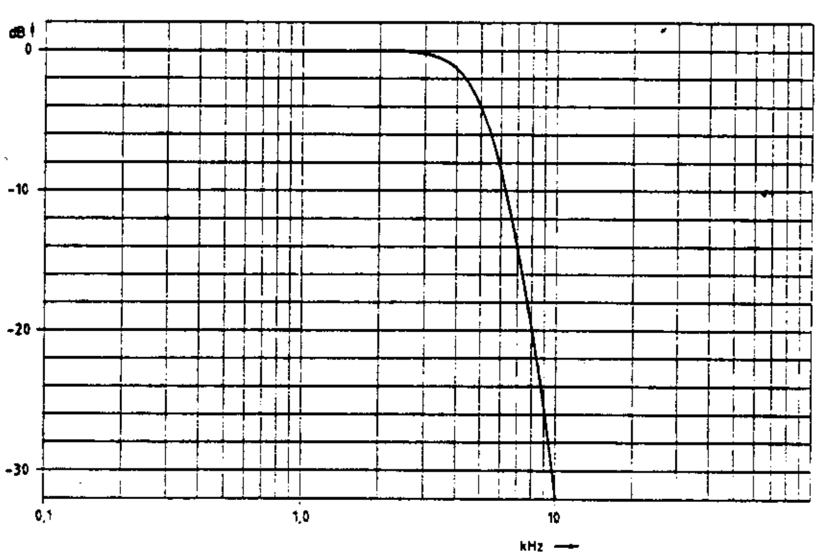
3-kHz Lowpass Filter

Technical data
Filter type .... 6th-order Butterworth filter
3-dB cutoff frequency .... 4.75 kHz ± 100 Hz
Insertion loss .... 0 dB ± 0.5 dB
Stopband attenuation .... min. 50 dB (at 15 kHz)

Application
Elimination of higher-frequency interference components from speech band.

Operation
Call up the OPTION CARD mask with <AUX>. Depending on the slot in which the lowpass filter is inserted (Bu 1 or Bu 2), the appropriate mask text field indicates for example *Filter 1 : 3 kHz TP*. <HELP> shows that there is a scroll field following the colon of the text field (see also "OPTION CARD" foldout). This field can be accessed with the cursor keys. If the filter is to be cut into the AF signal path of the 4031 (see "AF-signal Paths" foldout), enter the scroll variable *X* in the field ("crossing" of the scroll field) by turning the handwheel for example. The filter can be cut out of the signal path again by selecting the second scroll variable (space). In both cases the switching function occurs as you leave the OPTION CARD mask.

If the second slot is also fitted with a filter, the two filters are connected in series if both scroll fields are crossed at the same time in the OPTION CARD mask.



4-kHz Bandpass Filter

Technical data

Filter type .... asymmetrical H section
Insertion loss.. 0 dB ±0.2 dB (at centre frequency 4 kHz)
Ripple .... ≤ 0.2 dB (at 4 kHz ±54 Hz)
Bandwidth. .... ±100 Hz (-3 dB) or ±180 Hz (-6 dB)
Far-off attenuation................................ -28 dB (for f < 2 kHz and f > 7 kHz)

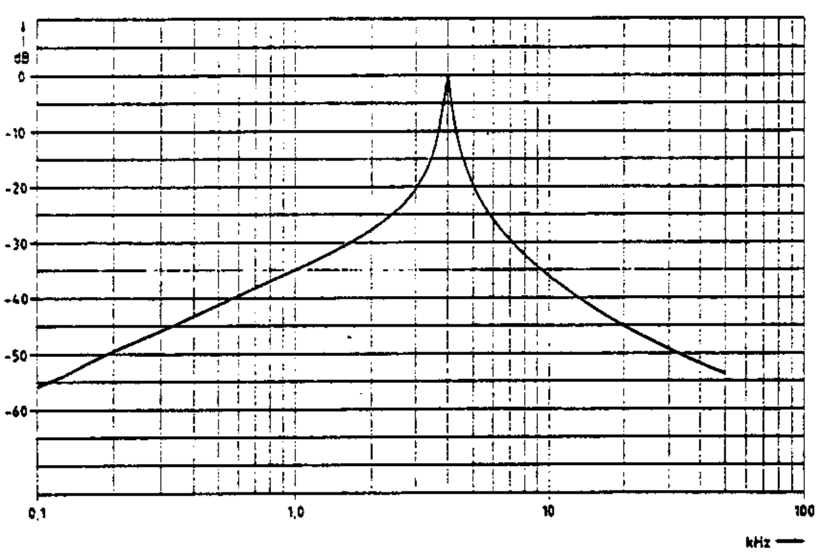
Application

Measurement of the pilot tone (SAT) in NMT radio-data systems.

Operation

Call up the OPTION CARD mask with <AUX>. Depending on the slot in which the bandpass filter is inserted (Bu 1 or Bu 2), the appropriate mask text field indicates for example *Filter 2 : 4 kHz BP.* <HELP> shows that there is a scroll field following the colon of the text field (see also "OPTION CARD" foldout). This field can be accessed with the cursor keys. If the filter is to be cut into the AF signal path of the 4031 (see "AF Signal Paths" foldout), enter the scroll variable *X* in the field ("crossing" of the scroll field) by turning the handwheel for example. The filter can be cut out of the signal path again by selecting the second scroll variable (space). In both cases the switching function occurs as you leave the OPTION CARD mask.

If the second slot is also fitted with a filter, the two filters are connected in series if both scroll fields are crossed at the same time in the OPTION CARD mask.



Variable Notch Filter

Technical data

Filter type .... self-tuning digital filter
Tuning band .... 200 to 600 Hz
Measuring range (-3dB) .... 50 Hz to 5.5 kHz
Insertion loss .... 0 dB
Minimum attenuation
in notch band .... typ. 60 dB
Collar width (-3 dB) .... $\pm 0.2 \cdot f_{notch}$

Application

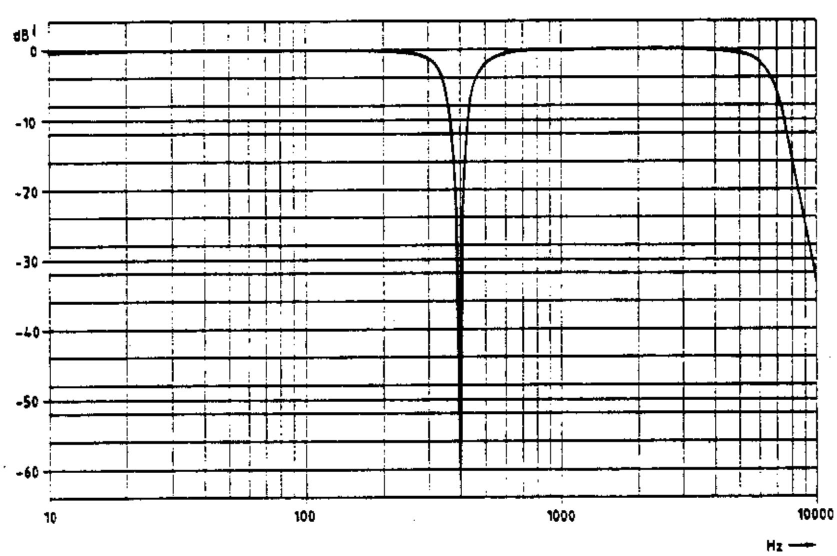
Measurement of distortion at fundamental frequencies between 200 and 600 Hz.

Operation

Call up the OPTION CARD mask with <AUX>. <HELP> shows that there is a scroll field following the colon of the text field *Var. Notch:* (see also "OPTION CARD" foldout). This field can be accessed with the cursor keys. If the filter is to be cut into the AF signal path of the 4031 (see "AF-signal Paths" foldout), enter the scroll variable *X* in the field ("crossing" of the scroll field) by turning the handwheel for example. The filter can be cut out of the signal path again by selecting the second scroll variable (space).

The variable notch filter replaces the standard 1-kHz notch filter in the AF signal path if the appropriate scroll variable has been crossed and the DIST meter is called up with <DIST> after returning to a basic mask (eg RX or TX). The filter tunes automatically to the fundamental of the current AF signal as long as the frequency of the fundamental is within the tuning range of the filter. The distortion that is determined is read off the DIST meter just like in standard distortion measurement.

Caution: When you measure with the variable notch filter, none of the other AF filters may be cut in, because these are in series with the notch filter and would falsify the measured result.



DC Voltmeter/Ammeter

Technical data

Voltmeter

V_{max} = 42 V
Measuring error ≤1% ±1 digit

Measuring ranges		Resolution	Input impedance
V ≤ 400 mV	--->	100 µV	5.6 MΩ
V ≤ 4 V	--->	1 mV	910 kΩ
V ≤ 40 V	--->	10 mV	850 kΩ
V > 40 V	--->	100 mV	850 kΩ

Ammeter

I_{max} = 15 A
Measuring error ≤4% ±10 mA

Measuring ranges		Resolution
I ≤ 0.8 A	--->	1 mA
I ≤ 1 A	--->	2 mA
I ≤ 8 A	--->	10 mA
I ≤ 10 A	--->	20 mA
I > 10 A	--->	100 mA

Precision resistor: 10 mΩ

The voltmeter and ammeter appear in the OPTION CARD mask (callup with <AUX>) as simulated pointer meters with an additional digital display. Both meters work with automatic range switching.

Application
DC voltage measurements, eg operating voltage of a radio set.

Test inputs
Back panel of OPTION CARD (see also "Back Panel" foldout)
Bu 91 - Bu 92 Ammeter (both sockets floating)
Bu 93 - Bu 94 Voltmeter (Bu 94 = ground)

DTMF Device

Application

Generation and evaluation of dual tones as necessary for checking telephones in the VDEW network for example (DTMF: dual-tone multi-frequency).

Functional description

The DTMF device consists of an analyzer and a generator. The input signal for the analyzer is normally the demodulated received signal (see also "AF-signal Paths" foldout), but an externally derived AF signal (AF EXT) can also be applied to socket Bu 95 of the OPTION CARD (back panel).
In the AF signal the analyzer separates the upper frequency-band group from the lower one and determines the DTMF frequencies. If the comparison with the 16 standard DTMF frequencies shows that a tone has been correctly detected, this tone will be evaluated.
Upon an enabling pulse from the RF/AF microprocessor the generator feeds the modulator of the 4031 with dual tones (all standard frequencies). The upper and lower tones are generated separately and fed to a summing amplifier.

Operation

Following selection of the basic RX/TX parameters (transmit frequency, transmit level, modulation, receive frequency, etc), first call up the OPTION CARD mask with <AUX>. Then branch from there with <*DTMF*> to the DTMF mask (figure). This branching is only possible if the OPTION CARD is fitted with the DTMF device.

```
                              DTMF
DTMF-Generator      :

 2.8 kHz Deviation
  35 ms  Time
  35 ms  Pause

Call No.        : 1502916FC0000000

DTMF-Analyzer       :

1000 ms  Timeout
   5     Number of Tones
TX-Demod Analyzer-Input

Received No. :

------ RECEIVE ------- SEND-- ------- RETURN
```

<u>DTMF mask:</u> In this mask the essential parameters are defined for transmitting and receiving DTMF-coded call numbers. The *Call No.* field (call number to be transmitted) shows that the call number may also contain the hex digits A through F.

In the upper half of the DTMF mask it is possible to set parameters for transmitting a call number (*DTMF Generator*), and in the lower half of the mask the corresponding parameters for receiving a call number (*DTMF Analyzer*). If you are not yet familiar with the locations of the entry fields, <HELP> will briefly brighten up all available entry fields. Each field can be accessed with the cursor keys. Entries in numeric fields must be terminated as usual with <ENTER>. The meanings of the individual entry fields are as follows:

Deviation.................. (pure numeric field); determines the FM deviation with which the DTMF signals are transmitted on the carrier frequency of the 4031 signal generator (setting in RX mask).

Time .... (pure numeric field); specifies the duration of the individual dual tones.

Pause .... (pure numeric field); specifies the duration of the pauses between the individual dual tones.

Call No. .... (pure hexadecimal numeric field); entry field for the maximally 16-digit call number that is to be transmitted. Entry of the decimal digits on the numeric cluster and of the hexadecimal digits on the softkeys. Incorrect entries can be changed by moving back to them with the cursor and overwriting them.

Timeout..................... (pure numeric field); defines the waiting time that starts after the arrival of the first dual tone. When this timeout has elapsed, the evaluation of the DTMF signals is terminated.

Number of tones....... (pure numeric field); specifies how many of the arriving dual tones are actually evaluated (permissible values: 0 to 16).

Analyzer Input .... (scroll field); the two scroll variables determine with what signal the DTMF analyzer is fed (see also "AF Signal Paths" foldout):

TX-Demod	Evaluation of demodulated received signal
AF-EXT	Evaluation of signal applied to socket Bu 95 (OPTION CARD, back panel)

Received No. .... (display field); shows the received call number.

<*SEND*> produces one-time transmission of the entered call number with the appropriate parameters. As long as transmission is being made, the softkey has the alternative function *STOP* for terminating transmission.

<*RECEIVE*> sets up the DTMF analyzer for the arrival of dual tones. As long as the analyzer is waiting for dual tones, the softkey has the alternative function *STOP*. In this way the analysis mode can still be exited from when the very first dual tone fails to appear.

Results readout on controller

The digits of a decoded call number (content of *Received No.* field) can be read to a controller with the IEEE command RESULt1.

C-Net Expander

Application
C-Net radiotelephones: removal of the "burst signaling" from the demodulated signal and expansion of the signal (compressed at the transmitting end). The resulting pure AF signal can be examined in the customary manner; the usual conclusions can be drawn about the modulation characteristics of the radio set's transmitter.

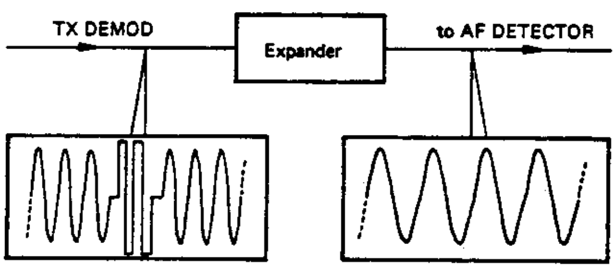
Functional description
The C-Net expander is fed with the demodulated received signal TX DEMOD (see "AF Signal Paths" foldout). The signal has been compressed at the transmitting end (radio set) by a factor of 0.1. This has produced a time slot of 1.136 ms into which the radio set has inserted part of the data-block sequence (burst signaling). The expander digitizes the TX DEMOD signal with an 8-bit A/D converter and loads the data that do not fall into the time slot into a first-in-first-out buffer. The synchronization is performed by control pulses derived from the DATA module. The data are then read out of the buffer more slowly by a factor of 0.1 than they were written in. In this way the burst signaling is removed from the signal and the latter is expanded. For restoring the original form of the signal, it is applied to a D/A converter and filters before being transferred to the AF DETECTOR for evaluation. The inherent distortion of the C-Net expander is less than 1 % for full modulation in the frequency range 300 Hz through 3 kHz.

Operation
Call up the OPTION CARD mask with <AUX>. If location Bu 6 on the OPTION CARD is fitted with the expander, the mask will indicate this with *Option : C-Net Expander* (see also "OPTION CARD" foldout). For activating the expander, enter the scroll variable *X* in the scroll field following the colon (see also "OPTION CARD" foldout). If you then call up the basic TX mask, the usual measurements will be possible of the modulation characteristics of the subscriber set (eg modulation distortion and modulation frequency response). The results are no longer falsified by the burst signaling.

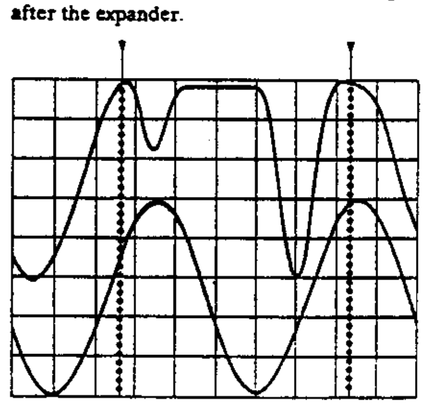
Note: If the C-Net Expander is fed with an AF signal without "burst signaling", it will block this signal (no output signal).

To disconnect the expander, enter the scroll variable " " (space) following the text field *Option :* in the OPTION CARD mask.

The expander eliminates burst signaling from the AF signal and closes the signal gap by expanding the signal.



AF signal with burst signaling (between marking lines) before the expander and without signaling after the expander.



VSWR Measuring Head

The VSWR measuring head, in conjunction with the VSWR function of STABILOCK 4031, permits measurement of the voltage standing-wave ratio of an antenna (antenna matching). For this purpose a directional coupler determines the forward and reflected power, which is measured selectively, ie at the tuned frequency of the test receiver. The VSWR function then computes the VSWR from the two measured values.

Technical data of VSWR measuring head

Frequency range .... 25 to 500 MHz
Characteristic impedance .... 50 Ω (VSWR ≤ 1.07)
Connectors .... N sockets for radio set and antenna
VSWR measuring range .... 1.07 to 9.99
Permissible forward power .... 1 to 50 W
Maximum measuring error .... $\frac{(VSWR - 0.9)}{3}$

The technical data only refer to the measuring head. If a different directional coupler is used, its own specifications will apply. In this case the limits given by the 4031 must be observed:

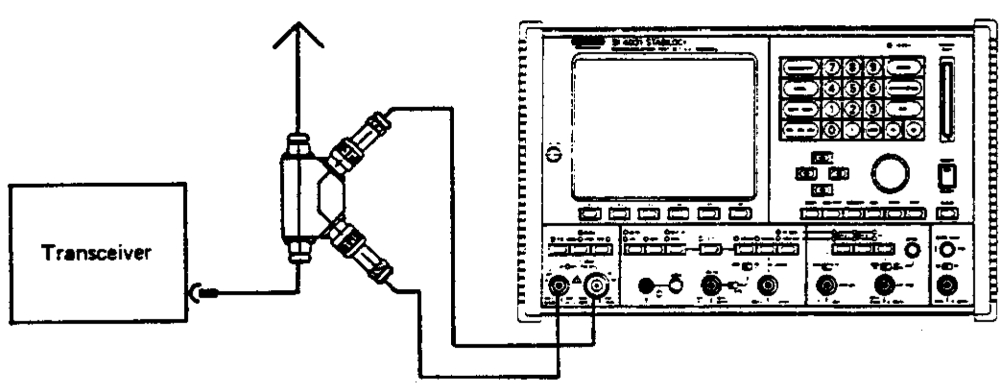
Frequency range .... 2 MHz to 1 GHz
P_{min} on RF socket .... -45 dBm (forward input power after deduction of coupling attenuation, etc)

Ordering details

Ordering code 248 104; items supplied: directional coupler, two 10-dB attenuator pads, two connecting cables (6 m).

Connection

The directional coupler is connected by way of the two 10-dB attenuator pads to the RF and RF DIRECT sockets of the Communication Test Set.



VSWR measurement

Boundary conditions

- Carrier unmodulated

Measurement —> VSWR

1.	Basic TX settings	(see Chapter 4)
2.	*<SPECIAL>*	Call up menu of TX Specials
3.	*<VSWR>*	Call up VSWR function (alternative function to *SEL.PWR*)
4.	**Read VSWR on VSWR display field**	

Note: The VSWR function first connects the RF socket and will then possibly wait with the selective measurement of the forward power (P1) until the transmitter of the radio set is swuitched on. After that, the VSWR function automatically connects the RF DIRECT socket and continues to selectively measure the reflected power (P2). These measured values are balanced against the value measured for forward power and displayed as the VSWR:

$$VSWR = \frac{1 + \sqrt{P2/P1}}{1 - \sqrt{P2/P1}}$$

Purpose of measurement

To check whether an antenna is optimally matched to the output stage of its transmitter. A mismatch will reduce the transmitting power that is actually effective (loss of range); a substantial mismatch can endanger the output stage. An antenna is optimally matched when the VSWR is as close as possible to the ideal value of 1.

ASCII Keyboard

In the AUTORUN mode (Chapter 7) the 4031 executes test programs written by the user. The ASCII keyboard is required for entering the programs. If the program produces readout of a test report (with the extra accessory IEEE-bus printer), the keyboard can also be used to produce alphanumeric text in the report (eg titles, explanations).

Technical data

Supply voltage	5 V (via control interface)		
Coding	7-bit ASCII		
Pin assignments	Pin 1	=	D0
	Pin 2	=	D1
	Pin 3	=	D2
	Pin 4	=	D3
	Pin 5	=	D4
	Pin 6	=	D5
	Pin 7	=	D6
	Pin 10	=	GND
	Pin 12	=	+5 V
	Pin 9/11	=	"H" (when key pressed)

Ordering details

Ordering code 248 141; items supplied: keyboard, complete with connecting cable. Connection is only possible if the optional control interface A, B or C is being used (see section on "Control Interface...").

Connection

The ASCII keyboard is connected to socket Bu 22 of control interface A, B or C (see also "Back Panel" foldout).

DATA Module

The DATA module is necessary for testing cellular radiotelephones. It simulates and decodes the FFSK, NRZ and RZ signaling that is exchanged between the base stations and mobiles of cellular-radio networks.

The DATA module is given the specific functions for the different cellular-radio networks by the system program (software option on MEMORY CARD). So cellular radiotelephones can only be tested if, in addition to the DATA module, the appropriate software option is available. The system software is automatically loaded by the generator and analyzer processor (DATA module) and by the HOST processor when the DATA mask is called up (see also Chapter 7).

Installation of DATA module

1. Switch off the Communication Test Set and withdraw the power cable.
2. Unscrew the cover plate at location 8 on the back panel (see "Back Panel" foldout).
3. Slide the DATA module along the guide as far as it will go into the slot that is provided (refer to the foldout for the correct position).
4. Screw the DATA module firmly to the chassis.
5. Reconnect the power cable.

Meaning of sockets

See Chapter 2

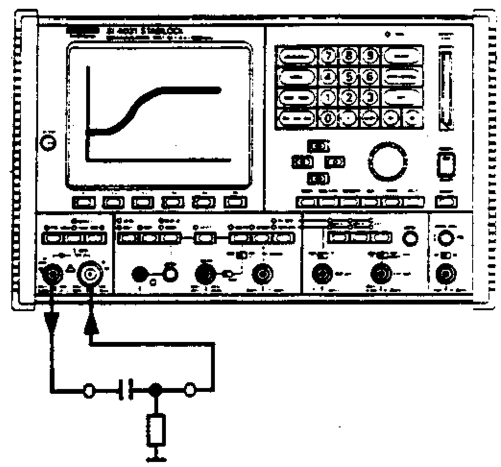
Operational check

1. Switch the unit on with <OFF> + <POWER>.
2. Check whether the display fields *CELL-GEN* and *CELL-ANA* in the status mask indicate the version numbers of the software.

Ordering details

Ordering code 236 034; items supplied: DATA module, ready for installation. Note: use of the DATA module calls for a system program on MEMORY CARD (software option).

Tracking IF Stage



If STABILOCK 4031 is fitted with a tracking IF stage, frequency-related network analyses can be performed, eg graphic display of a filter curve. 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 4031 as a function of frequency. The RF DIRECT socket is the signal source and the RF socket is the test input.

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 to 999.9999 MHz
Minimum sweep width	1 MHz
Maximum sweep width	972.9999 MHz
Maximum frequency resolution	5 kHz

Incorporation of tracking IF stage

1. Switch the Communication Test Set off.
2. Take the existing IF stage (position 3) out of the chassis. Caution: The earlier IF stage and the new one can easily be confused.
3. Slide the new tracking IF stage all the way into the compartment.
4. Screw the stage firmly to the chassis.

Working check

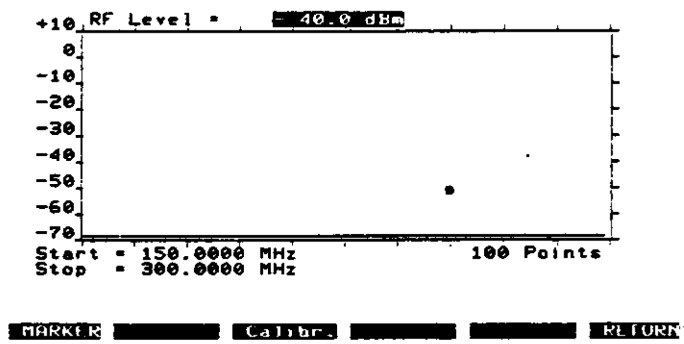
Set the Communication Test Set for DUPLEX mode and press the ANALYZER key. The tracking mask should then appear on the monitor (see "Operation").

Ordering data

Ordering code 229 034 tracking; comprises: tracking IF stage, ready for installation. Note: To work with the tracking IF stage you also need the optional duplex FM/PhM stage.

Operation

Callup of tracking mask



First set STABILOCK 4031 to duplex mode (see Chapter 12, "Basic Duplex Mask" foldout). Then tap the ANALYZER key. This no longer leads to the message *Analyzer only on TX possible*, but instead 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>.

Setting RF output level

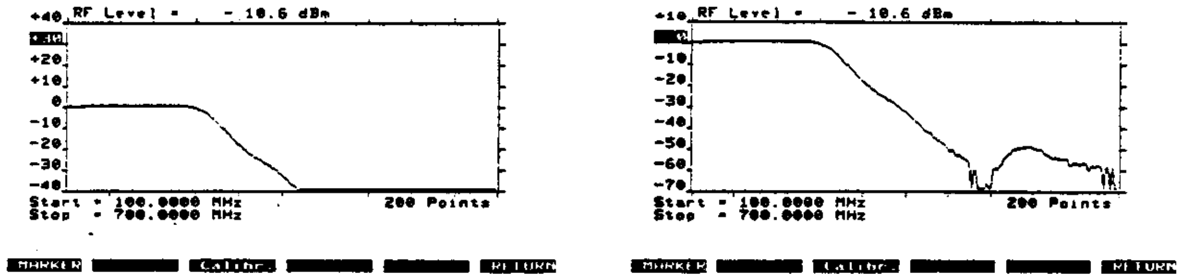
The numeric field *RF Level* at the top edge of the mask is for setting the RF output level on the RF DIRECT socket. Select the unit (dBm, dBμ, μV/mV) as in the basic RX mask. There is no limit to the RF output level, ie as long as the RF input level on the RF socket remains below -10 dBm. Higher input 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 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 in later software versions of the 4031 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).



Lowpass-filter curves plotted with the tracking function: 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

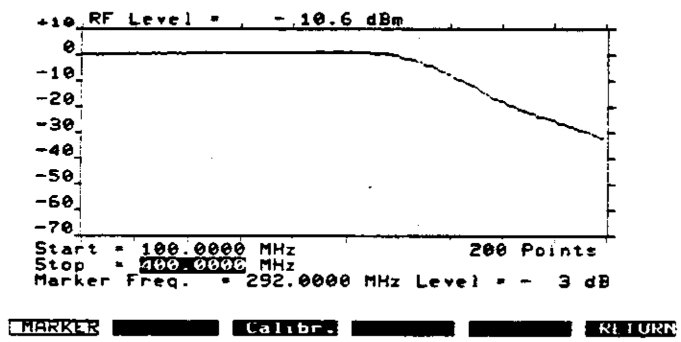
After every alteration in the start/stop frequency the *Calculating* message appears for a few seconds in the status line before display of the curve commences. If inadmissible values are entered or if the sweep width (difference between start and stop frequency) is not at least 1 MHz, an error message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



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.

RS-232/Centronics Interface

From software version 2.50 onwards STABILOCK 4031 can support the RS-232/Centronics Interface option. This interface is primarily for printing out masks/measurement protocols with conventional printers (output format: Epson Graphic). But it is also possible to run serial data communication via the RS-232 branch of the interface with the test item or any other item of equipment that is also fitted with an RS-232 interface.

All settings for the RS-232/Centronics Interface (printer selection, protocol of the data communication) are described in the GENERAL PARAMETERS foldout (Chapter 12). In Chapter 10 in the section "Special Commands for Easier Programming" you will find the input and output commands that are necessary for data communication.

Technical Data

Baud rate.. 110/150/300/600/1200/2400/4800/9600 Bd
Transfer protocol .... 7/8 bits, even/odd parity, 1/2 stop bits
Socket connectors .... 25-way, submin D

Installation of interface

1. Switch the Communication Test Set off.
2. Unscrew the cover plate from locations 6 or 8 on the rear (see "Rear Panel" foldout). If these slots are already occupied by a Control Interface (slot 6) or the Data Module (slot 8), you will have to remove one of them. The Control Interface can continue in operation in slot 5. If this slot is also occupied already (Mod Generator B), one of the options will have to be dispensed with.
3. Slide the RS-232/Centronics Interface into slot 6 or 8 as far as it will go and screw it in place.

Performance check

1. Call up the Status mask with <AUX> + <*DEF.PAR*> + <*STATUS*>.
2. Call up the Options mask with <*OPTIONS*> and check that the installation of the interface is acknowledged by the message *installed*.

Ordering details

Ordering code: 236 043; equipment supplied: RS-232/Centronics Interface ready for installation.

SSB Stage

Requirements for SSB testing

Your STABILOCK 4031 must be fitted as follows:

1. SSB kit (ordering code 248 154) consisting of:
   1 SSB MODULE .... (ordering code 219 004)
   1 SYSTEM CARD "SSB" .... (ordering code 897 065)
   1 adapter cable .... (ordering code 384 779)
   1 variable notch filter 200-1200 Hz ... (ordering code 248 195)
   1 SSB installation instructions .... (ordering code 248 154V)
2. OPTION CARD .... (ordering code 236 033)
3. Firmware version ≥ 2.55
   5 host EPROMs HP0-HP5 (host MCU) ...... (ordering code 893 335)
   2 slave EPROMs SP0-SP1 (RF/AF MCU) .... (ordering code 893 336)
   1 monitor EPROM CP0 (CRT MCU) .... (ordering code 893 345)

The firmware version of your STABILOCK 4031 appears in the status mask. The status mask is brought onscreen with <AUX> + *<DEF.PAR.>* + *<STATUS>*.

Technical data

TX tests

Frequency range:	2 to 999.999 MHz
RF power:	1 mW to 125 W
Measuring error:	see data sheet
Preselectable intermodulation for power measurement:	0 to 45 dB
Test tones/frequency:	2/freely selectable
Frequency offset:	±1 kHz
AF bandwidth:	10 Hz to 30 kHz
Carrier suppression:	0 to 60 dB at f = 1 kHz
Opposite sideband suppression:	0 to 60 dB at f = 1 kHz
Measuring error:	0 to 40 dB ±1 dB 0 to 60 dB ±2 dB

RX tests

Carrier-frequency range:	0.4 to 999.9999 MHz
SSB modulation:	0 to 30 kHz
Resolution:	10 Hz
Accuracy:	like reference oscillator
Intermodulation measurement range for intermodulation product 2.3 or 2.7 kHz:	0 to 50 dB
Measuring error:	±2 dB
Measurable sensitivity:	selectable up to 10 dB SINAD
Measuring error:	see data sheet
Max. RF level	
on socket RF DIR:	+13 dBm
in socket RF:	-7 dBm
Max. RF level for intermodulation measurement	
on socket RF DIR:	-15.5 dBm
on socket RF:	-35.5 dBm
AGC delay time:	0 to 9999 ms

Cabling

1. Switch off the Communication Test Set.
2. Connect socket 15 (AF DETECTOR) and socket 90 (OPTION CARD) with adapter cable (ordering code 384 752) (see "Back Panel" foldout).
3. Connect socket 15 (AF DETECTOR) and socket 99 (SSB stage) with adapter cable (ordering code 384 779). The connector of the adapter cable (ordering code 384 779) is mounted on the connector of the other adapter cable (ordering code 384 752).
4. Switch on the Communication Test Set.
5. Adapt the SYSTEM CARD SSB (ordering code 897 065) and load the SSB software by calling up the DATA mask (<AUX> + <*DATA*>) (see also Chapter 7, "Loading System Programs").

Test setup

You can perform all standard TX SSB and RX SSB measurements with the test setup illustrated in Chapter 4.

Whether the radio set is connected to the RF or RF DIRECT socket for RX SSB measurements will depend on the required RF output level.

For TX SSB measurements always connect the radio set to the RF socket.

Caution: If the radio set is connected to the RF DIRECT socket, make sure not to exceed the maximum permissible level, otherwise your STABILOCK 4031 will be destroyed.

Operation

TX SSB tests

Connect the radio set *before* calling up the TX SSB mask and operate it as a transmitter, because the setting of the attenuator of the Communication Test Set for TX SSB tests is made with the calling of the TX SSB mask. For this purpose the microphone input of the radio set is automatically fed for 2 s with f = 1 kHz and V = 100 mV. The attenuator is set according to the resultant transmitting power of the radio set and this status is "frozen".

Subsequent switching of the attenuator is possible with <*SET ATT.*> in the TX SSB mask. When a radio set is connected to socket RF or RF DIRECT, the attenuator must be set by calling up the TX SSB mask, otherwise it could be destroyed.

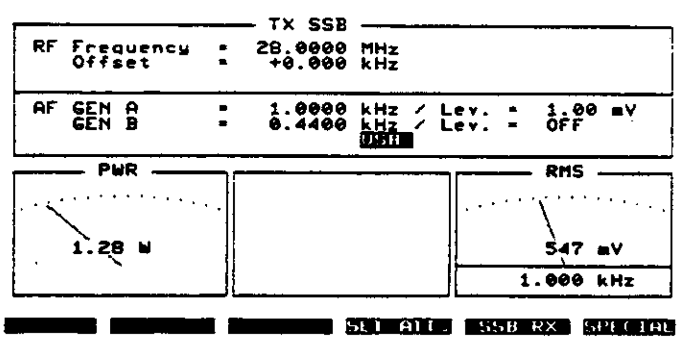
Caution: P_{av} = 500 mW on socket RF DIRECT and P_{av} = 50 W (continuous) or, for sets with serial numbers ≥ 0588000, P_{av} = 125 W for maximally 1 min on socket RF must not be exceeded.

Basic TX SSB setting

The basic TX SSB setting is the basis for all standard transmitter tests. You only have to carry out this basic setting once before starting to test. In the course of your TX SSB tests the basic setting will normally remain unaltered and only a few extra entries are necessary.

1. Cut in the variable notch filter	The variable notch filter has to be cut in by entering the scroll variable *X* in the *Var Notch* field of the OPTION CARD mask.
2. Connect radio set, switch on and set sending mode .	
3. <TX>	Call up TX mask.
4. Adapt SYSTEM CARD SSB.	
5. <AUX> + <*DATA*>	Load SSB software.
6. Withdraw SYSTEM CARD SSB.	
7. <FREQUENCY> + <value> + <ENTER>	Tune test receiver to channel frequency of radio set and confirm entry.
8. <MOD FREQ> + <1> + <ENTER>	f_{mod} = 1 kHz (GEN A)
9. <DEMOD>	Demodulated signal is connected through to AF meters.
10. <FM AM ΦM> + <value> + <ENTER>	Switch on GEN A and set modulation level in *Lev.* field.
11. <cursor d> + *<UNIT/SCROLL>	Select USB or LSB.

Note: With <*SSB RX*> you can change to the RX SSB mask. <RX> or <TX> terminates SSB testing and takes you to the RX or TX mask.



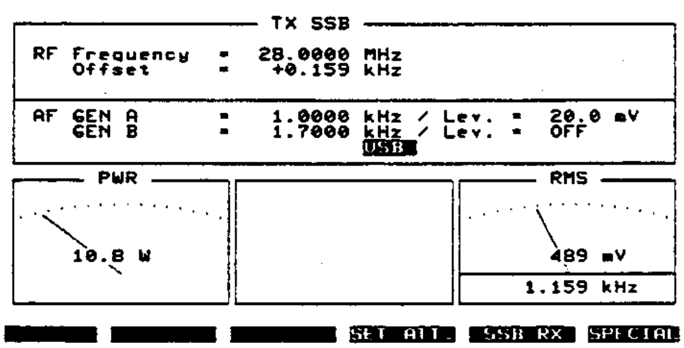
TX mask: the instrument is set for 28 MHz channel frequency, the upper sideband is selected and the modulation level of generator GEN A is 1 mV for a modulation frequency of f_{mod} = 1 kHz.

Frequency offset

Measurement —> Frequency offset

1.	Make basic TX SSB setting.
2.	**Read frequency offset in *OFFSET* field.**

Note: The frequency offset is measured up to the specified value with the accuracy stated in the data sheet. This accuracy is no longer guaranteed for larger values. Overflow of the measurement range is indicated by ">>>>>" or "-----" in the Offset field.



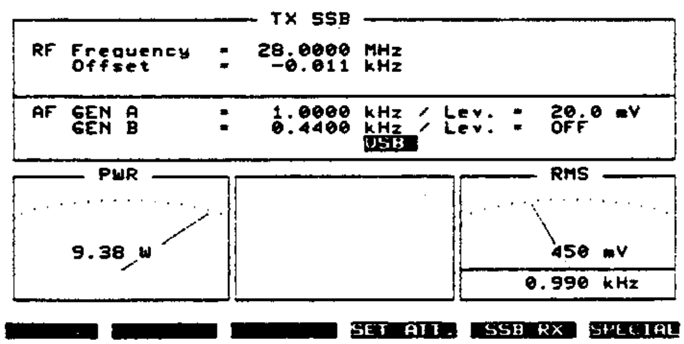
Frequency offset: in the Offset field you can read the difference between the measured RF frequency and the figure entered in the *RF Frequency* field.

RF power (average power)

Measurement —> RF power

1.	Make basic TX SSB setting.
2.	**Read RF power on PWR meter.**

Note: Measurement of power is broadband with the specification stated in the data sheet. You choose the units (W or dBm) in the GENERAL PARAMETERS mask, *RF-Power* field. Falsification of the measured value because of known preattenuation (attenuator, cable loss) can be compensated automatically by entering the appropriate value of attenuation in the GENERAL PARAMETERS mask, *Pre-attenuation* field. The indication *ATT* in the header of the PWR meter tells you that the display has been corrected by the factor of the preattenuation (see also GENERAL PARAMETERS foldout).



RF power: the PWR meter shows the average carrier power of the radio set. Measurement is broadband, so the channel frequency (*RF Frequency* field) is unimportant.

Distortion factor

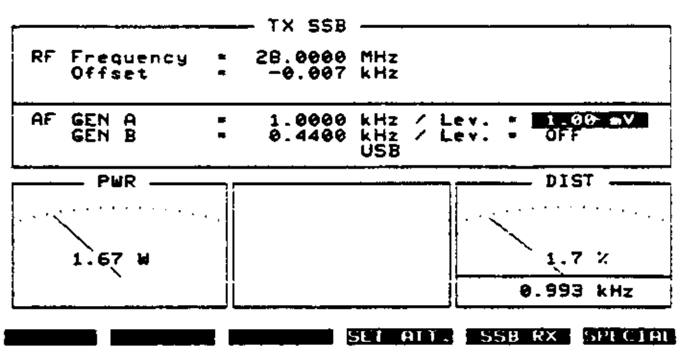
Boundary conditions

- Disconnect CCITT filter
- Disconnect filters 1 and 2 (enter blanks in scroll fields *Filter 1* and *Filter 2* of OPTION CARD mask)
- f_{mod} = 1 kHz

Measurement —> Distortion factor

1.	Make basic TX SSB setting.	
2.	<FM AM ΦM> + <value> + <ENTER>	Enter modulation level in *Lev.* field.
3.	<DIST>	Call up DIST meter.
4.	**Read distortion factor on DIST meter.**	

Note: To measure the distortion factor with modulation frequencies between f_{mod} = 200 Hz and 1200 Hz, the variable notch filter has to be cut in by entering the scroll variable *X* in the *Var Notch* field of the OPTION CARD mask.



Distortion factor: the distortion factor of the test item can be read on the DIST meter.

Noise voltage - spurious modulation

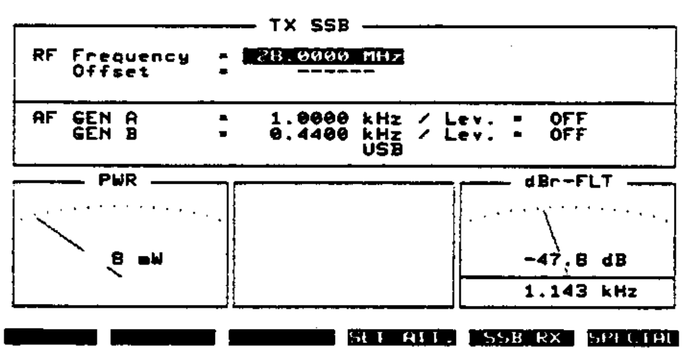
Boundary conditions

- Disconnect filters 1 and 2 (enter blanks in scroll fields *Filter 1* and *Filter 2* of OPTION CARD mask)

Measurement —> Spurious modulation

1.	Make basic TX SSB setting.	
2.	<FM AM ΦM> + <value> + <ENTER>	Enter modulation level in *Lev.* field.
3.	<CCITT>	Activate weighting filter.
4.	<dB REL>	Current AF level is reference level (0 dB) for dBr meter.
5.	<GEN A>	Disconnect modulation generator GEN A.
6.	**Read noise voltage on dBr meter.**	

Note: The indication *FLT* in the header of the dBr meter tells you that the CCITT filter is activated.



Spurious modulation: on the dBr meter you can read the noise voltage with CCITT weighting.

Suppression of carrier and opposite sideband

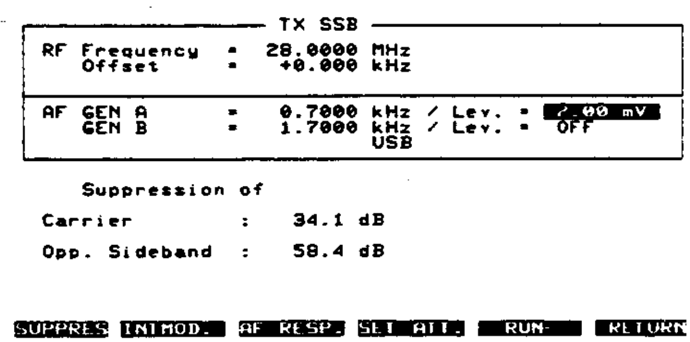
Boundary conditions

- Level of demodulated SSB signal is reference level
- f_{mod} = 1 kHz

Measurement —> Suppression of carrier and opposite sideband

1.	Make basic TX SSB setting.	
2.	*<SPECIAL>*	Call up menu of TX SSB Specials.
3.	*<SUPPRES>*	Call up Special for suppression.
4.	<FM AM ΦM> + <value> + <ENTER>	Enter modulation level in *Lev.* field.
5.	*<RUN>*	Start test.
6.	**Read suppression of carrier in *Carrier* field and suppression of opposite sideband in *Opp. Sideband* field.**	

Note: The transmitter should be fully driven by the modulation level but not overdriven.



Suppression of carrier and opposite sideband: the suppression of the carrier is 34.1 dB, that of the opposite sideband 58.4 dB.

3rd-order intermodulation product

Boundary conditions

- Upper and lower intermodulation frequencies are calculated automatically from frequency of generator GEN A (A) and frequency of generator GEN B (B):

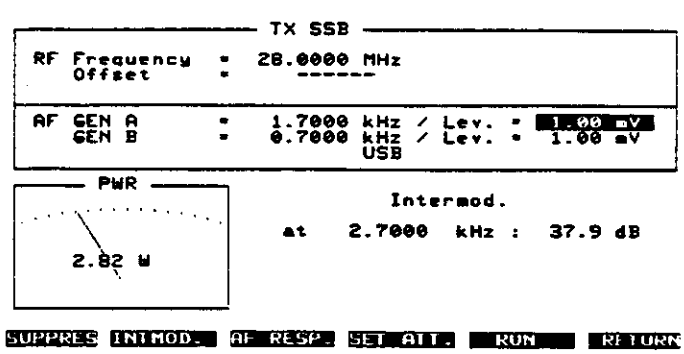
  upper intermodulation frequency $= 2 \cdot A + B$
  lower intermodulation frequency $= 2 \cdot A - B$

- Note: The frequency of GEN B must not be an integral multiple of the frequency of GEN A

Measurement ---> Intermodulation product

1.	Make basic TX SSB setting.	
2.	*<SPECIAL>*	Call up menu of TX SSB Specials.
3.	*<INTMOD.>*	Call up Special for intermodulation.
4.	<MOD FREQ> + <value> + <ENTER>	Enter frequency of generator GEN A in *GEN A* field.
5.	<cursor d> + <value> + <ENTER>	Enter frequency of generator GEN B in *GEN B* field.
6.	<cursor d> + <cursor d>	Select field of calculated intermodulation frequency.
7.	*<UNIT/SCROLL>	Select upper or lower intermodulation frequency.
8.	<FM AM ΦM) + <value> + <ENTER>	Enter modulation level in *Lev.* field.
9.	*<RUN>*	Start test.
10.	**Read intermodulation product in *INTERMOD.* field.**	

Note: Following *<RUN>* the intermodulation product is continuously measured and displayed. The modulation level (*Lev.* field) of GEN A can be varied during the measurement by turning the handwheel. The modulation level of GEN B is automatically matched to that of GEN A.
The value displayed by the PWR meter corresponds to the average power. If you multiply this by a factor of 2 (modulation with two frequencies), you get the peak envelope power.
Overflow of the measurement range is indicated in the *INTERMOD.* field by a display ">>>>>>" or "------".



Intermodulation: in the *INTERMOD.* field you can read the 3rd-order intermodulation product.

Modulation frequency response

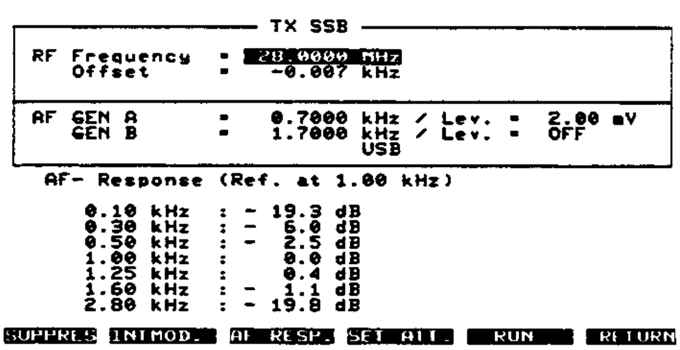
Boundary conditions

- Disconnect CCITT filter
- Disconnect filters 1 and 2 (enter blanks in scroll fields *Filter 1* and *Filter 2* of OPTION CARD mask)

Measurement —> Modulation frequency response

1.	Make basic TX SSB setting.	
2.	<FM AM ΦM> + <value> + <ENTER>	Set modulation level (*Lev.* field).
3.	*<SPECIAL>*	Call up menu of TX SSB Specials.
4.	*<AF RESP.>*	Call up Special for modulation frequency response.
5.	<cursor d> + <cursor d>	Select field for 0 dB reference frequency.
6.	<value> + <ENTER>	Enter 0 dB reference frequency.
7.	<cursor d> + <value> + <ENTER>	Alter f_{mod} (seven reference values) as required.
8.	*<RUN>*	Start test.
9.	**Read modulation frequency response (seven reference values).**	

Note: If the radio set is unable to follow the changes of frequency that are necessary for measurement during the Special, the modulation frequency response will have to be measured manually (see also Chapter 4).



Modulation frequency response: for the modulation frequency response of the test item there are seven reference values. The 0-dB reference frequency is 1 kHz.

RX SSB tests

Basic RX SSB setting

The basic RX SSB setting is the basis for all standard receiver tests. You only have to carry out this basic setting once before starting to test. In the course of your RX SSB tests the basic setting will normally remain unaltered and only a few extra entries are necessary.

1.	Cut in the variable notch filter	The variable notch filter has to be cut in by entering the scroll variable *X* in the *Var Notch* field of the OPTION CARD mask.
2.	<RX>	Call up RX mask.
3.	Adapt SYSTEM CARD SSB.	
4.	<AUX> + <*DATA*>	Load SSB software.
5.	Withdraw SYSTEM CARD SSB.	
6.	<*RF*> or <*RF DIR*>	Connect output socket.
7.	<FREQUENCY> + <value> + <ENTER>	Tune signal generator to channel frequency of radio set.
8.	<LEVEL> + <20 (µV)> + <ENTER>	Set RF output level to 20 µV (EMF).
9.	<MOD FREQ> + <1> + <ENTER>	f_{mod} = 1 kHz (GEN A)
10.	<cursor r> + *<UNIT/SCROLL>	Select USB or LSB.
11.	<VOLTM>	Connect VOLTM socket (AF input).
12.	Switch on receiver of radio set.	

Note: In the case of SSB with carrier suppression there is no RF signal on the RF or RF DIR socket after switching off generator GEN A.

Boundary conditions

In SSB mode the carrier is detuned by the AF frequency. The synthesized frequency is calculated from the RF frequency (RF), the offset (Of) and the frequency of generator GEN A (A):

USB synthesized frequency = RF + Of + A
LSB synthesized frequency = RF + Of - A

The calculated synthesized frequency must be between 400 kHz and 999.999 MHz, otherwise the frequency last entered will not be accepted.
In RX SSB measurements the variable notch filter 200-1200 Hz is cut in automatically.

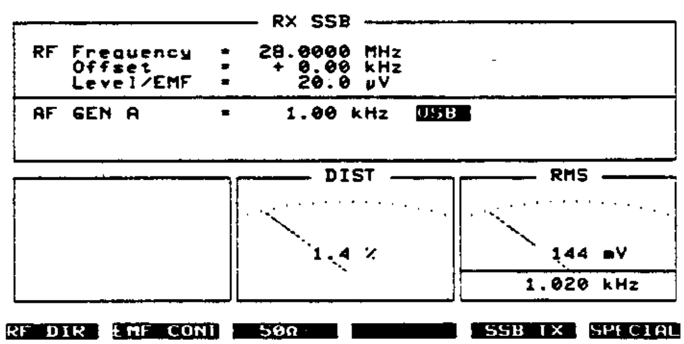
Distortion factor

Boundary conditions

- Disconnect CCITT filter
- Disconnect filters 1 and 2 (enter blanks in scroll fields *Filter 1* and *Filter 2* of OPTION CARD mask)
- f_{mod} = 1 kHz

Measurement —> Distortion factor

1.	Make basic RX SSB setting.	
2.	<DIST>	Call up DIST meter.
3.	**Read distortion factor on DIST meter.**	



<u>Distortion factor:</u> the distortion factor of the test item can be read on the DIST meter.

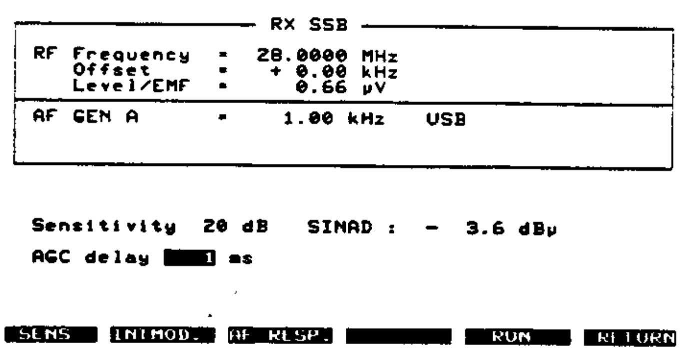
Receiver sensitivity (SINAD)

Boundary conditions

- Disconnect filters 1 and 2 (enter blanks in scroll fields *Filter 1* and *Filter 2* of OPTION CARD mask)
- f_{mod} = 1 kHz

Measurement —> Sensitivity

1.	Make basic RX-SSB setting.	
2.	<CCITT>	Activate weighting filter.
3.	*<SPECIAL>*	Call up menu of RX SSB Specials.
4.	*<SENS>*	Call up Special for sensitivity.
5.	<MOD FREQ> + <cursor d>	Select *Sensitivity* field.
6.	<value> + <ENTER>	Enter sensitivity.
7.	<cursor r> + *<UNIT/SCROLL>	Select units for test result.
8.	<cursor d> + <value> + <ENTER>	Enter AGC delay (in ms).
9.	*<RUN>*	Start test.
10.	**Read SINAD in *SINAD* field.**	



<u>Sensitivity:</u> the sensitivity is read out in the *SINAD* field.

Intermodulation

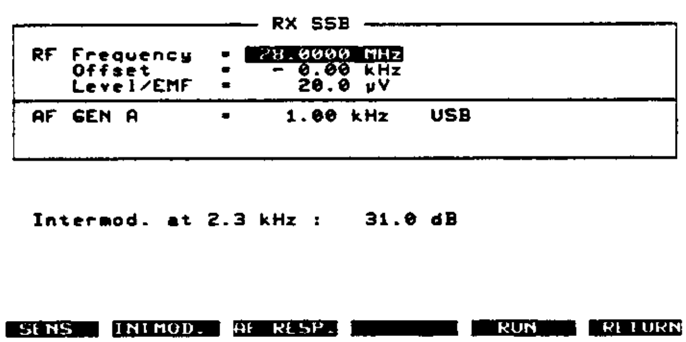
Boundary conditions

- Intermodulation frequency f = 2.3 kHz or f = 2.7 kHz

Measurement ---> Intermodulation

1.	Make basic RX SSB setting.	
2.	<*SPECIAL*>	Call up menu of RX SSB Specials.
3.	<*INTMOD.*>	Call up Special for intermodulation.
4.	<MOD FREQ> + <cursor d>	Select field of intermodulation frequency.
5.	*<UNIT/SCROLL>	Select intermodulation frequency (2.3 kHz or 2.7 kHz).
6.	<*RUN*>	Start test.
7.	**Read intermodulation product in *Intermod.* field.**	

Note: Overflow of the measurement range is indicated in the *INTERMOD.* field by a display ">>>>>>" or "------".



Intermodulation: the *Intermod.* field shows the intermodulation product at 2.3 kHz or 2.7 kHz.

AF frequency response

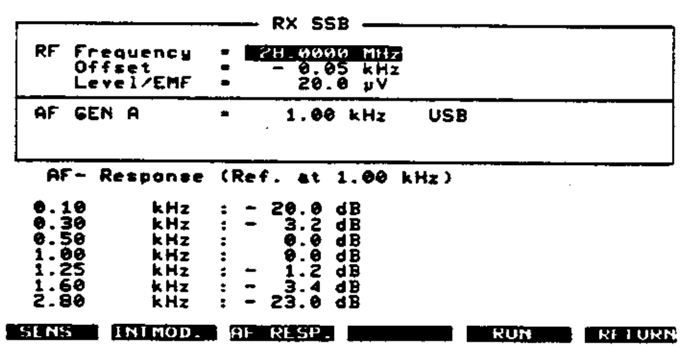
Boundary conditions

- Disconnect CCITT filter
- Disconnect filters 1 and 2 (enter blanks in scroll fields *Filter 1* and *Filter 2* of OPTION CARD mask)
- f_{mod} = 1 kHz

Measurement —> AF frequency response

1. Make basic RX SSB setting.	
2. *<SPECIAL>*	Call up menu of RX SSB Specials.
3. *<AF RESP.>*	Call up Special for AF frequency response.
4. <MOD FREQ> + <cursor d>	Select field for 0 dB reference frequency.
5. <value> + <ENTER>	Enter 0 dB reference frequency.
6. <cursor d> + <value> + <ENTER>	Alter f_{mod} (seven reference values) as required.
7. *<RUN>*	Start test.
8. Read AF frequency response (seven reference values).	

Note: If the radio set is unable to follow the changes of frequency that are necessary for measurement during the Special, the AF frequency response will have to be measured manually (see also Chapter 4).



Frequency response: the AF frequency response of the test item is shown in the form of seven reference values. The 0-dB reference frequency is 1 kHz.

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).

ACPM (NKL)

Adjacent-channel power is that part of the transmitted power which is emitted as noise power in each of the two adjacent channels.

Connection

Connect the RF jack of the radio unit to the RF jack of the STABILOCK 4031. Connect the NF jack of the radio unit to the MOD GEN jack of the STABILOCK 4031.

Boundary conditions

- Input power > 100 mW

Measurement —> adjacent channel power

1.	<TX> + *<FM AM ΦM>	Access TX mask and set to FM mode.
2.	*<SPECIAL>* + *<ACPM>*	Access menu of TX special ACPM.
3.	<RF>	Connect input jack.
4.	<FREQUENCY> + <wert> + <ENTER>	Adjust measuring receiver to channel frequency of radio unit and confirm the entry.
5.	<MOD FREQ> + <wert> + <ENTER>	Set modulation frequency.
6.	<FM AM ΦM> + <wert> + <ENTER>	Set modulation level in *Lev* field and activate GEN A.
7.	<cursor d> + *<UNIT/SCROLL>	Position cursor in *Channel Space* field and select channel spacing (10 kHz, 12.5 kHz, 25 kHz and 30 kHz).
8.	<cursor d> + *<UNIT/SCROLL>	Position cursor in *adjacent Channel* field. Select adjacent channel for wich ACPM is to measured and displayed (*Both Channels*, *Upper Channel* or *Lower Channel*).
9.	<RUN>	Start the measurement. The measurement is repeated until <STOP> is pressed.
10.	Read adjacent channel power value displayed in ACPM field. If *Both Channels* is selected in the *Adjacent Channel* field, the adjacent channel power of the upper channel is displayed in the upper half of the field, and the adjacent channel power of the lower channel appears in the lower half.	

Note: The frequency offset of the input signal from the set frequency is displayed in the *Offset* field. In AUTORUN or remote mode the adjacent-channel power is not measured continuously, instead one-shot measurements are made.

Measurements

on Mobile Radiotelephones

and Radio-data Sets

Contents

Subdirectory
(part of software options)

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, Radiocom 2000, C-NETZ FRG etc, perform the following basic function tests of the corresponding mobile stations (MS).

a) MS initiated call
b) BS initiated call
c) Handoff to any traffic channel during call in progress
d) Changing MS power on traffic channel

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 MS.

Connection setup

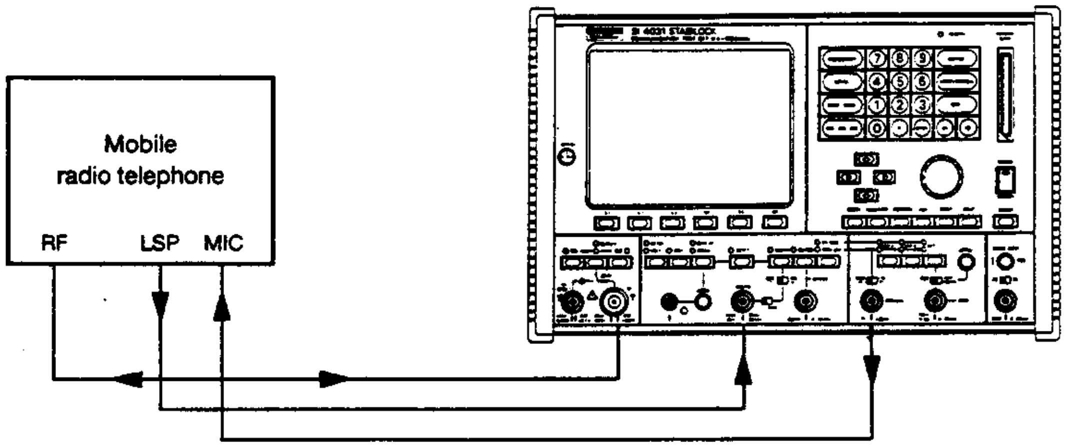
Thereby the 4031, upon loading a program, switches to duplex operation mode and simulates the base station (BS). To establish a connection with the MS, the 4031 first starts a system-specific handshake procedure with the MS and then commands the MS to the preset traffic channel. When the call procedure is completed the digital data exchange has successfully been tested and now the measurement results of frequency offset, deviation, and power of the MS 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 MS-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 4031 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



Cable connections: 4031 (MOD GEN) ---> microphone input MIC of mobile; for measuring the modulation characteristics of the mobile transmitter. AF output (LSP) of mobile ---> 4031 (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 4031 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**

Use of
IEEE-bus Controller

Contents

IEEE-488 Commands for the 4031

The IEEE commands largely have the same effect as the corresponding manual entries on the keys or softkeys. With each command the upper-case letters are significant. Lower-case letters within the commands can be omitted or entered as lower-case or upper-case letters (but: units like MHz must be entered complete). Spaces are ignored. There are examples of entries in Chapter 7.

One of the addition records given in brackets is to be entered. Decimal points are only permissible in numeric values. The semicolon is used as a delimiter between two commands.

Keyboard	IEEE command
RX	SETRX
TX	SETTX
DUPLEX	SETDUplex
dB REL	DBRELative
VOLT	V_RMS
DIST	DISTOrtion
SINAD	SINAD
BEAT	BEAT_ [oN,ofF]
CCITT filter	CCITT [oN,ofF]
External filter (on OPTION CARD)	EXTERnal [oN,ofF]
VOLTM	VOLTMeter
DEMOD	DEMODulation
RX MOD/MOD GEN	MODULation
GEN A	GENA_ [Rx,Tx,oFf]
GEN B	GENB_ [Rx,Tx,oFf]
EXT	GENE_ [Rx,Tx,oFf]
FREQUENCY	FREQUency (numeric value) MHz or RXFREquency (numeric value) MHz or TXFREquency (numeric value) MHz (only for duplex)
LEVEL	AMPLItude (numeric value) Dimension [dBm,dBμ,μV,mV]
Mod. frequ. GENA	MODAF (numeric value) kHz
Mod. frequ. GENB	MODBF (numeric value) kHz
RX Mod. level GEN A	RXAAM (numeric value) % RXAFM (numeric value) kHz RXAPM (numeric value) rad

Keyboard	IEEE command
RX Mod. level GEN B	RXBAM (numeric value) %
	RXBFM (numeric value) kHz
	RXBPM (numeric value) rad
TX demod.	TX_AM
	TX_FM
	TX_PM
TX level GEN A	GENAL (numeric value) [mV,V]
TX level GEN B	GENBL (numeric value) [mV,V]
DC-FM on	DC_ON
DC-FM off	DCOFF
ENTER	ENTER
Softkey 1 Softkey 2 Softkey 3 Softkey 4 Softkey 5 Softkey 6	see special command SOFT_softkey name
Cursor up	CURUP
Cursor down	CURDOwn
Cursor left	CURLEft
Cursor right	CURRIght
Cursor home	CURHOme
STEP	Not provided
OFF	Not provided
SCOPE	SCOPE
ANALYZER	ANALZ
MEMORY	MEMORy
AUX	AUXIL
Relay set/reset	RELAY (number of relay : 1 to 24) [oN,offF]
TTL output set/reset	TTLOUt (number of TTL output: 1 to 20) [oN,offF]

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 addressed simultaneously (1 = set, 0 = reset, X = no change).

```
Example: TTLOUt 99 10X11
                   | |
                   | └ TTL output no. 5
                   └ TTL output no. 1
```

RF level On/Off	RFLEVel [oN,offF]

Note: After each change of mask, eg from the TX to the RX mask, you should wait about 1.5 s before entering the next command.

Measuring Assignments (individual measurements)		Output of Setting Parameters	
RF frequency	MTXFRequency	RX RF frequency	PRXFRequency
AF frequency	MAFFRequency	TX RF frequency	PTXFRequency
TX offset	MTXOFfset	RX RF offset	PRXOFfset
TX power	MPOWEr*	RF level	PRXLEvel
TX sel. power	MSPOWer	GEN A frequ.	PGAFRequency
Demod.	MDEMOdulation	GEN B frequ.	PGBFRequency
RMS	M_RMS	GEN A level	PGALEvel
DC V	M_DCV	GEN B level	PGBLEvel
DC A	M_DCA	Cont. RF level	PCONTinuous
TTL inputs	MTRIG	Step RF frequ.	PSTFRequency
VSWR	MVSWR	Step RF level	PSTLEvel

*) **Caution!** In AUTORUN and controller modes in particular, observe the maximum permissible RF input power because the warning *REDUCE RF-POWER* (see also Chapter 1) does not appear in these modes.

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 or cold start. Depending on the declaration made in the status mask, the Communication Test Set executes either a reset or a total reset following a Device Clear command. You must wait at least 500 ms after this command before entering another one. During this time the IEEE device of the Test Set is initialized, ie the IEEE bus is in an undefined state.

Note: This is a controller command. Its notation will depend 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 $124_{decimal}$ = ¦)
-->	=	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

`SETXYll,cc,[X, ]`

`ll = line`
`cc = column`

This command permits the setting of functions that are switched on or off by the scroll variables cross or blank. Enter either a blank or a cross. X sets and blank clears the function.

Note: Only available in firmware versions < 2.58/3.58. In new programs use the command WRTVA instead of SETXY.

`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 Chapter 7, "Storing Test Reports").

Note: 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.

This command is not available in AUTORUN mode.

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.

DISPO

Clears the screen.

HCOPYaaa,bbb

aaa : start line,aaa = 1-256
bbb : end line,bbb = 1-256

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).

HELP_

Writes the coordinates of that entry field on which the cursor is positioned into the status line. These coordinates are necessary for the SCRL command.

Note: This command is not available in AUTORUN mode.

`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.

`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.

Table of key/character assignments

Key	Character		Key	Character
cursor l	Blank		PRINT	K
cursor u	!		OFF	L
cursor r	"		DIST	M
cursor d	#		STEP	O
+ (plus)	+		Frequency	P
- (minus)	-		AMPLITUDE	Q
. (point)	.		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		Handwheel turned left	p
VOLTM	D		Handwheel turned right	q
DEMOD	E		ENTER	_
RX MOD/MOD GEN	F			
VOLT/dB REL	G		No key pressed	@
GEN A	H			
GEN B	I			
EXT	J			

`LOCAL:text`

`text` = character string to be output

Switches the 4031 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 *CONTINUE* function, 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.

`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.

`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 not available in AUTORUN mode.

`PAR_Out:text`	`text` = character string to be output length of character string in controller programs: 80 characters length of character string 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.

`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 a screen field.

Note: This command is not available in AUTORUN mode (but see BASIC command RDXY in Chapter 7).

RESET

Query whether a reset or total reset was executed while the program was running on STABILOCK 4031. 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.

`RESULtn`

n = number of result field

Applies to the masks of the software options (Chapter 9) and to the DTMF (Chapter 8) and sequential masks (Chapter 5). The command outputs the content of a result field to the controller (n = number of result field in the mask).

Example of use of command in controller programs

```
 :
1450 OUTPUT 725; "RESULT1"
1460 ENTER 725; A$
 :
```

Example of use of command in AUTORUN programs

```
 :
40 A$ = RESULT1
 :
```

The variable A$ is given the content of result field 1.

`SOFT_softkeyname`
`GOTO_softkeyname`

softkeyname = name of softkey function

These commands enable the programming of functions addressed by softkeys. The effect of the two commands is identical, but only SOFT_... is permissible in AUTORUN programs (GOTO_... simplifies the analysis of a controller program if a submask and not a function is called up). The name of the softkey function and not the number of the softkey is entered. In this way the program documents itself automatically and you are safe against any shifts in the softkeys.
Example: SOFT_RF DIR = coupling of RF DIRECT socket.
GOTO_SPECIAL = calls up Specials menu (only controller program).

`SCRL_ll,cc,svname`
`WRTXYll,cc,svname`

`ll` = line (2-digit)
`cc` = column (2-digit)
`svname` = text of scroll variables

These commands enable the programming of functions that are addressed by scroll variables (eg SINAD or S/N). The effect of the two commands is identical.
Here the entry parameters are line (ll, 2-digit) and first column (cc, 2-digit) of the corresponding entry field plus the name of the required scroll variable (see also HELP command). In this way the controller program documents itself automatically. As an alternative to these two commands the special command WRTVA is also permissible and requires no calculation of coordinates.
Example: SCRL_14,24,SINAD = select scroll variable *SINAD* in field 14/24 (RX Special SENS).

Note: This command will not work for scroll variables that only have a blank or a cross as the variable; in such cases use the special command SETXY or WRTVA.

In new programs use the command WRTVA instead of SCRL and WRTXY.

`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.

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).

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 that was also declared on the second page of the GENERAL PARAMETERS mask (normally CR + LF). Only in AUTORUN programs: character strings of max. 49 characters can be loaded into any available string variable (A$, B$, C$, D$, E$, F$, M$). Longer character strings can only be loaded into the string variable. M$ 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 Chapter 7).

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" "1502"
:
```

The read-in character string is checked to see if it contains the substring in the 80th through 83rd places.

SER_IN_FT

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. 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$. M$ 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 Chapter 7).

Example of use of command in AUTORUN programs

```
  :
50 PRINT SER_IN_FT
  :
```

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.

Note: This command is only available with firmware versions ≥ 2.56 and RS-232 EPROM versions ≥ 1.20.

`SETXYzz,ss,[X, ]`

`zz` = Zeile
`ss` = Spalte

Dieser Befehl ermöglicht das Setzen von Funktionen, die über die Scrollvariablen Kreuz oder Blank ein- oder ausgeschaltet werden. Als Zusatz ist hier entweder ein Blank oder ein X anzugeben. X setzt, Blank löscht die Funktion.

Hinweis: Befehl wird in Firmware-Version ≥ 2.58/3.58 nicht mehr unterstützt. In neu zu erstellenden Programmen statt SETXY das Kommando WRTVA verwenden.

`STOREdaten`

`daten` = abzuspeichernde Zeichenkette (maximal 100 Zeichen)

Das Kommando legt auf MEMORY CARD das File RESULT.RES an und speichert die Zeichenkette in diesem File. Abhängig vom verfügbaren Speicherplatz wird für das File 16 KByte oder 4 KByte Speicherplatz reserviert. Ist bereits ein RESULT.RES-File vorhanden, wird die Zeichenkette an den Inhalt des Files angehängt. Ist kein reservierter Speicherplatz mehr zur Verfügung, wird das File RESULT.RES in RESULTFULL.RES umbenannt und ein neues File RESULT.RES angelegt (siehe auch Kapitel 7, "Meßprotokoll speichern").

Hinweis: Ist kein Speicherplatz mehr auf MEMORY CARD verfügbar, oder keine MEMORY CARD adaptiert wird eine entsprechende Fehlermeldung eingeblendet und das Programm gestoppt.

Achtung: Dieses Kommando ist im AUTORUN-Mode nicht verfügbar.

`WRTVAnn,value`

`nn` = identification number of entry field (visible after <HELP>)
`value` = scroll variable or numeric value with unit or "# variable"

With this command any entry field (numeric or scroll) can be given the required content.

Example: WRTVA03.66 uV sets *Level* (field 3 in RX mask) to 66 μV. Same result with WRTVA03,#V (V = 66 uV).

Example of use of command in controller programs

```
 :
1780 OUTPUT 725; "WRTVA25,S/N"
 :
```

Example of use of command in AUTORUN programs

```
 :
50 WRTVA25,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.

Note: If *Mem.Card* is selected instead of a printer and you change to a printer during the program, previously stored data can be lost. Reason: the Communication Test Set stores data intended for a MEMORY CARD in a buffer. If the buffer is full or if the program is ended, the content of the buffer is transfered to the adapted MEMORY CARD. After you change to the printer, the content of the buffer is no longer transfered and the data are lost.

`ZOOM_z,c,r:text`

`z =`	1 --->	RF power
	2 --->	Modulation
	3 --->	RMS
	4 --->	AF power
	5 --->	Offset (only for TX or duplex)
	6 --->	Voltmeter
	7 --->	Ammeter

`c =` center value with dimension
`r =` range value without dimension
`text =` text of max. 50 characters

The commas and the colon always have to be entered.

This command produces callup of a zoom function in virtually any operating state of the 4031, eg for manual adjustment. The entered "text" is shown in the status line on the screen (eg adjustment instruction). The softkeys have the *CONTINUE* function. The next AUTORUN or IEEE command is not accepted until a softkey is pressed.

Example of use of command in controller programs

```
 :
1950  OUTPUT 725; "SETTX"
1960  OUTPUT 725; "ZOOM_1,5W,2:Adjust to P = 5 W"
 :
```

Example of use of command in AUTORUN programs

```
 :
50  SETTX
60  ZOOM_1,5W,2:Adjust to P = 5 W
 :
```

Display of the zoomed RF power meter (PWR). For P = 5 W the pointer of the meter is midscale. The lower end of the scale is 3 W, the upper end 7 W.

Output Format

The output format of the 4031 offers two different modes of presentation:

`PRSTRing`	Decimal format (standard)
`PREXPotential`	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).

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)
Characters 3-5	Always 0 (reserved for later use)
Bit 6	SRQ bit, always 1
Bit 7	Always 0 (reserved for later use)

Counsellor

Contents

Training with Screen Masks

The purpose of the course "Training with Screen Masks" is to familiarize you step by step with elementary operating rules of the 4031. 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 summary of operating rules in Chapter 3 for quick reference. The foldouts in Chapter 12 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.

Training with Status Mask

Objectives

- Familiarization with status mask
- Correcting false entries
- Moving to further entry fields
- Familiarization with softkeys
- Recognizing, opening and closing entry fields
- Enquiring for permissible entry limits
- Enquiring for scroll variables

Callup of status mask

Following startup with <POWER> the monitor of the 4031 very likely does not yet show the status mask, so you will have to call it up. Press the <OFF> + <CLEAR> combination of keys. The 4031 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.

> Open up the Status Mask foldout in Chapter 12 so that you can look at the illustrated status mask while you are reading this text.

If you do not make any entries on the STABILOCK 4031 for a longish period of time, the mask that is momentarily displayed will be replaced by a message prompting you to press any key. The position of this message constantly changes. 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.

Messages of status mask

The status mask provides you with important information about the current status of your 4031. The brightened up number following *IEEE-488 ADR.* is the IEEE-bus address of the 4031 that is set ex works. And 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 4031 (control command). You will learn in this lesson how to alter these ex-works settings.

From the last message *SOFTWARE-VERSIONS* you can see with what software versions your 4031 is presently fitted. The identifying numbers of the software follow the brief designations of the associated microprocessors *HOST-MCU, CRT-MCU, RF/AF-MCU* as well as *CELL-GEN, CELL-ANA* (DATA module option) and *IFC-MCU* (RS 232/Centronics interface option). *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 4031 - 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 4031 (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 4031 offers you two different kinds of entry field:

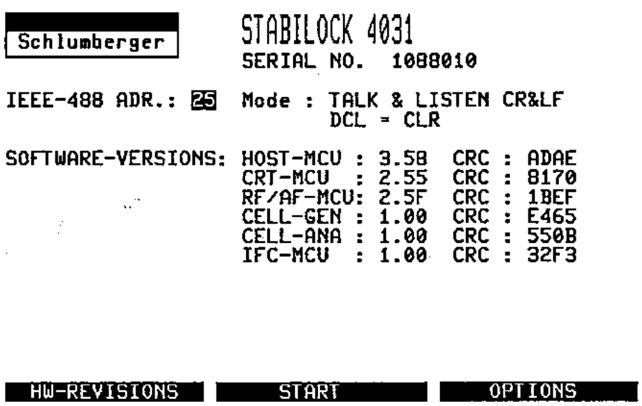
- entry fields for numeric values (numeric fields)
- entry fields with given variables (scroll fields)

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 4031 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.

> 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.



The *Mode* text field is followed by three scroll fields *TALK & LISTEN*, *CR&LF* and *EOI*. The *EOI* field is inverted here, ie it is the current entry field.

The 4031 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.

Opening numeric field

In the case at hand the field indicates the IEEE-bus address (25) of the 4031 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:

<value>

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 with <ENTER>

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 4031 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 4031, correct it to 45. This will help you to follow a demonstration that shows how the 4031 deals with illegal entries.

Rejecting illegal entries

The 4031 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 4031 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 4031 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 4031 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 4031 realizes that you are not trying to find out what the permissible entry limits are.

So tap the HELP key again: straight away the 4031 will then briefly mark the *Mode* fields *TALK & LISTEN, CR&LF* and the following blank field 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 7) or the controller.

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.

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

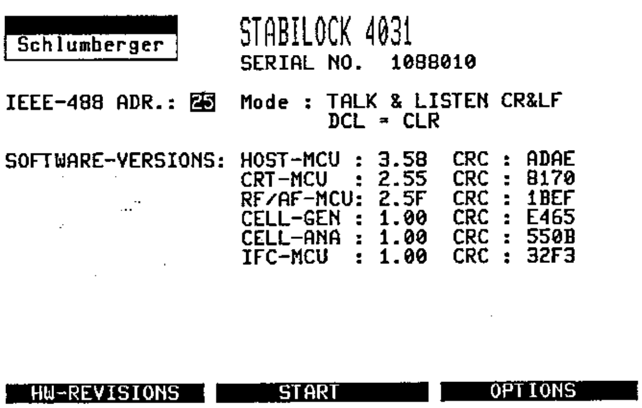
The next entry field is to the right of the one that is still active, so the cursor key pointing to the right takes you to the *TALK & LISTEN* scroll field. First you must have closed the numeric field for the bus address. Otherwise the cursor keys, as already described, would govern the cursor within 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 (entry variant) of the scroll field that is set ex works. This says that the 4031 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 4031 will present *TALK ONLY* as the second scroll variable. The 4031 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.



Here the scroll fields of the status mask have been assigned the alternative scroll variables. The alternative to scroll variable *EOI*, a blank field, is only visible when this field is active.

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 the foldout.

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 4031. 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 4031, 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:

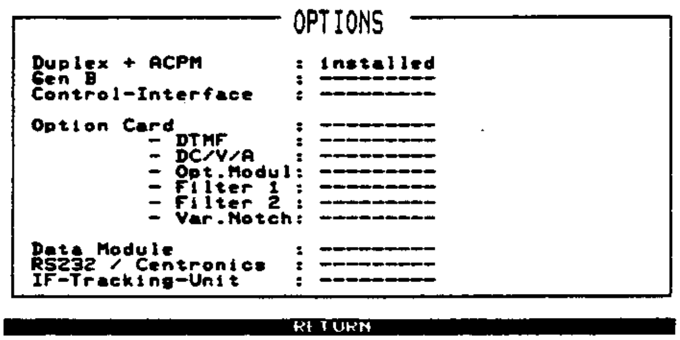
<HW-REVISIONS> takes you to a mask that states the development status of the different stages of the 4031. The codes quickly help to produce a common basis for understanding if you telephone for advice.

<SELF-CHECK> takes you to another mask permitting the start of a self-diagnosis program. For further details see the SELF-CHECK foldout contained in Chapter 12.

<START> calls up the RX mask, ie puts the 4031 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.



The OPTIONS mask shows the hardware options incorporated in your 4031.

What are "default" settings?

Default has the meaning of a placeholder or ex-works setting. These placeholders appear in the 4031 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 4031.

> <OFF> + <CLEAR> or <OFF> + <POWER> (upon startup) produces all default settings compulsorily and calls up the status mask (master reset or total reset). This deletes irrevocably all settings selected beforehand by the user!

Switching on/off with <POWER>

If you only switch the 4031 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 4031 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.

Training with 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 4031. The other two basic masks are the TX mask and the DUPLEX mask that is linked with the optional duplex FM/ØM demodulator. Call up the RX mask with <*START*>. 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.

> Open up the basic RX mask foldout in chapter 12. The differences between the illustration and the RX mask that is visible on the screen are no reason to get uneasy: the differences are of no importance, they stem from the fact that the illustration shows an advanced operating status in receiver measurement.

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 4031 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:

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 4031 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 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 4031 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.

> If you try to track down the variants of scroll fields with <UNIT/SCROLL>, you may occasionally be surprised because *<UNIT/SCROLL> takes you back to the original value or the one that you have entered. You will find out about this unaccustomed function of the UNIT/SCROLL key in this lesson.

Now call up the RX mask anew with <OFF> + <CLEAR> + *<START>* 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 4031 offers the possibility of fast access to the appropriate entry fields for the more common settings. Tap the keys FREQUENCY, LEVEL, MOD FREQ and AM FM 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.
<AM FM 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). <AM FM 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 4031.

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 FREQUENCY 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 4031 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 sign keys, of the ENTER key and in part also those of the UNIT/SCROLL key.

Now declare the *RF Frequency* field to be the active <u>and</u> 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. Close the *RF Frequency* field and immediately turn the handwheel. The *Offset* field is then opened automatically and you can select the sign of the offset, still using the handwheel, before directing the cursor to the location to the right of the decimal point (50 Hz or 100 Hz resolution).

"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. Only the *RF Frequency* field has to be opened extra before operating the handwheel if no fine tuning of the frequency in the *Offset* field is intended. 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 <FREQUENCY> for example, and then strike the STEP key, the 4031 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 plus or minus 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 <u>and</u> 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 <AM FM 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 4031 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 4031 and all the controls of the entry field, so you are well on the way to using the 4031 for your first tests.

Softkeys of RX mask

To restore the STABILOCK 4031 to a defined initial status, it is best if you now start it up again with <OFF> + <CLEAR> and call up the RX mask with <*START*>. 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 4031. 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 4031. 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 DIRECT*.

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 4031 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 4031 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 *50Ω* is called up again with <S3>.

Softkey S4
If you call up the *SPECIAL* function with S4, you are taken to a submask 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 4031 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 and 12.

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 4031 shows important measured quantities not only numerically but also on simulated analog meters. The 4031 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 4031 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 "Training with Analog Instruments" goes into the details of this later on.

Training with 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 4031 anew with <OFF> + <CLEAR> 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 4031 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 4031 for transmitter measurements:

TX	(red)	TX mode selected (transmitter measurement)
VOLT	(yellow)	RMS voltmeter activated
VOLTM	(yellow)	VOLTM socket is input of voltmeter
GEN A	(red)	Modulation generator GEN A is activated in TX mode; signal is on MOD GEN socket (see lines on front panel)

Open up the basic TX mask foldout in chapter 12. The differences between the illustration and the TX mask that is now visible on the screen again stem from the fact that this illustration too shows an advanced operating status (this time in transmitter measurement).

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 4031 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 4031 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
Function *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 4031. 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.

Training with 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 4031. The bottom half of a basic mask on the other hand is reserved for the presentation of the measured results. Here the 4031 - 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 ratio .... (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 <OFF> + <CLEAR> + <RX> 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 4031. 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 4031 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 4031 is started up with <OFF> + <CLEAR> + <RX>. 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. <AM FM 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 4031 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 4031 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 *AUTO* 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 4031 satisfies this requirement with the softkey function *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 4031 can be shown on the screen in full format (see also zoom foldout). 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 <SINAD> (BEAT/SINAD key), the 4031 will also present the SINAD ratio of the test signal. The SINAD (Signal Noise and Distortion) ratio is related to the S/N (Signal to Noise) 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 resp. the dBr meter is always displayed in the basic RX mask. As second AF meter you may either choose the DIST or SINAD meter. Other possible combinations are explained for each basic mask on corresponding fold outs contained in chapter 12.

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 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, "Preparations for Startup"). 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 4031 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 4031 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 4031 to the operating mode that is called for. You will find out more about this later on.

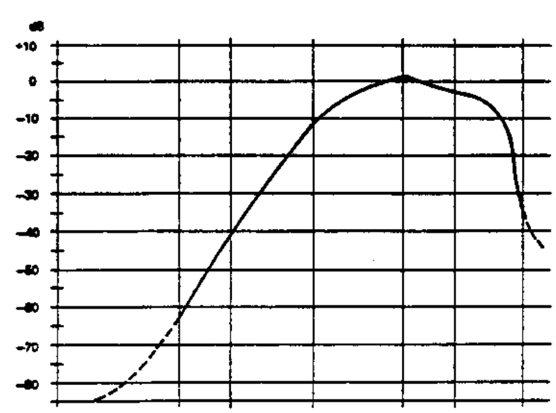
For checking the switching thresholds, the 4031 also shows the RF input power in the RX mode. But since this value is very rarely called for in receiver measurements, you can only zoom the PWR meter and not produce it in the basic RX mask.

> 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.

<u>CCITT filter curve</u>: 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 4031 anew with <OFF> + <CLEAR> 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 4031 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 as before 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 4031 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 4031 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 "Training with 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 (basic DUPLEX mask foldout) if your 4031 is fitted with the optional DUPLEX FM/PhM 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 4031. 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 4031 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 <OFF> + <CLEAR> 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 4031 (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 4031 switches automatically from receiver to transmitter testing. If you now select AUTO SIMPLEX, the 4031 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 4031 returns to the RX mask.

The AUTO SIMPLEX mode of the 4031 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 4031 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 4031 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 4031)
- 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 4031 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 4031 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 4031 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 4031 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 "Training with 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 4031 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 4031 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 4031 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.

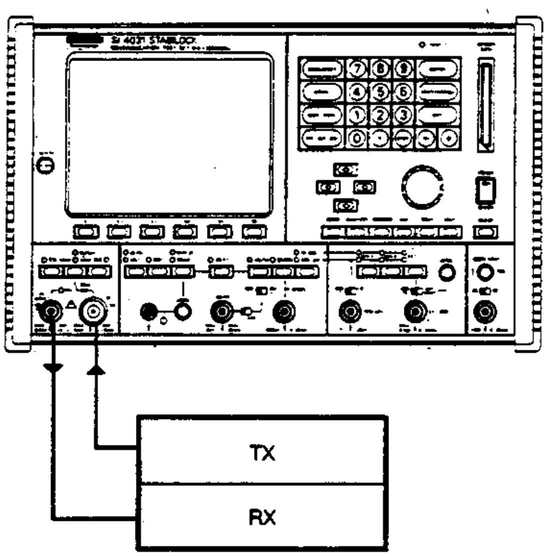
The default setting is the last of these three possibilities. Call up the GENERAL PARAMETERS mask for making a choice.

Measuring duplex signal transfer

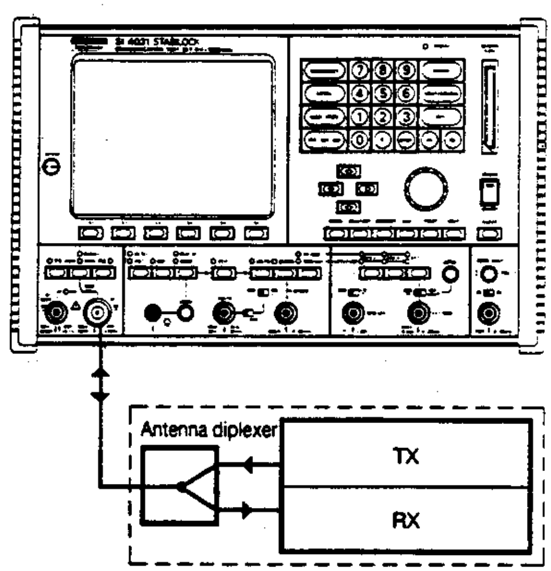
Socalled single-port duplex radio sets use the same antenna for their transmitter and receiver. A duplexer in the radio isolates the signals from one another but cannot entirely prevent the transmitter from influencing the receiver.
For measuring this influence the DUPLEX mask offers the Special *DESENS* (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

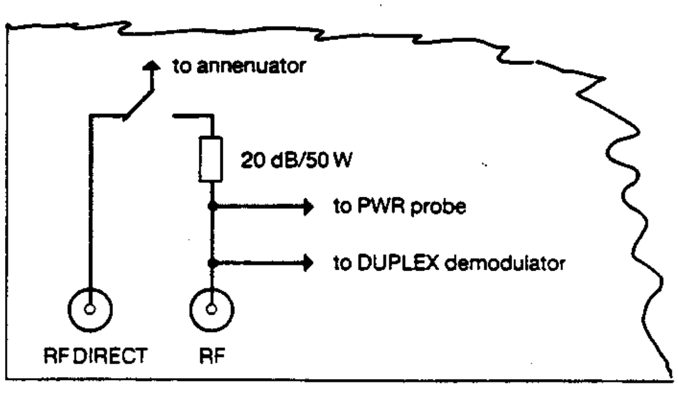
If the device under test is a single-port radio set, use the RF socket as the common input/output. Make sure that the RF output level of the 4031 is at least 60 dB smaller than the transmit level of the radio set (normal case). The duplex demodulator then receives both signals sufficiently isolated.
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.



Dual-Port-Transceiver



Single-Port-Transceiver



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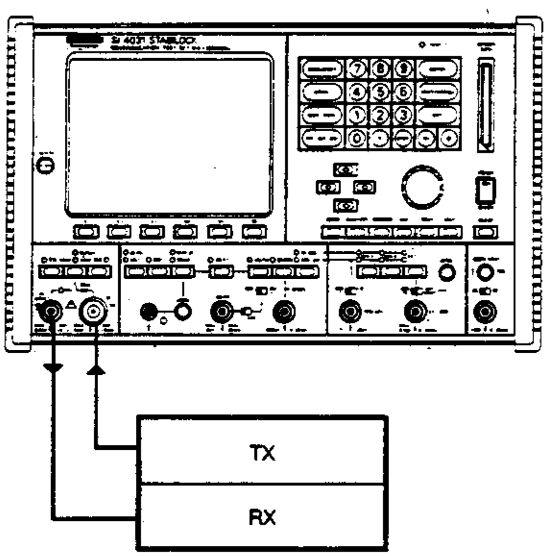
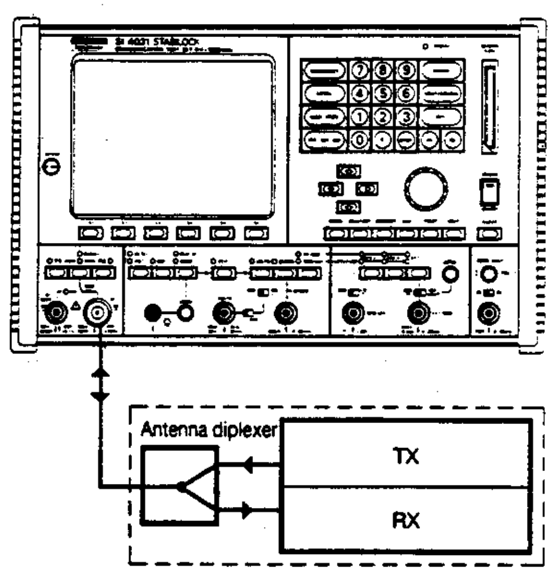
For measuring this influence the DUPLEX mask offers the Special *DESENS* (desensitizing). Similarly to the Specials of the RX and TX masks, *DESENS* is again a complete test routine that is started with *RUN*. You measure the degree to which the transmitter of the radio set reduces the sensitivity of its receiver.

Selection of input/output

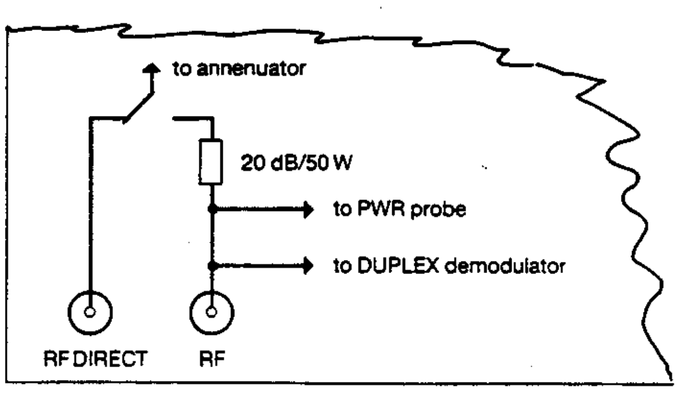
If the device under test is a single-port radio set, use the RF socket as the common input/output. Make sure that the RF output level of the 4031 is at least 60 dB smaller than the transmit level of the radio set (normal case). The duplex demodulator then receives both signals sufficiently isolated.
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.



Dual-Port-Transceiver



Single-Port-Transceiver



Training with 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 (GENERAL PARAMETERS foldout) 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>.

<OFF> + <CLEAR> or <OFF> + <POWER> replaces all entries by default values in the parameter mask too!

If you read the text accompaniment in the foldout, 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 4031 is thus completed. You are well prepared for tackling proper measuring and testing jobs (see Chapter 4). However, you do not yet know all the measuring capabilities of the 4031: but in Chapter 6 you can get acquainted with the oscilloscope and spectrum analyzer.

Foldouts

Contents

Status Mask

The status mask tells you about the current status of the 4031 (RAM test, fitted options, IEEE-bus address, software versions of microprocessors).

Callup of masks

Cold start 1: <OFF> + <POWER>

Cold start 2: <OFF> + <CLEAR>

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 4031 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).

START................a) Calls up the RX mask if the status mask has been called up with cold start 1 or cold start 2.
b) 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).

Meaning of fields

SERIAL NO............(display field); shows the serial number of your particular STABILOCK 4031.

RAM TEST.............(display field); every time you start up and every time the status mask is called up, the 4031 tests the internal RAM for errors. The result is *PASSED* (no RAM errors) or *FAILED* (RAM defective). Note: Only available in firmware versions < 2.58/3.58.

IEEE-488 ADR.........(pure numeric field); content = IEEE-bus address of the 4031.

TALK & LISTEN........(scroll field); the scroll variables specify the IEEE-bus operating mode:
TALK ONLY ---> unidirectional data flow (4031 is talker);
TALK & LISTEN ---> bidirectional data flow (4031 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, like striking <OFF> + <CLEAR>
DCL = CLR --> reset, like striking <CLEAR>

SOFTWARE VERSIONS....(display fields); message from the 4031 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.

```
Schlumberger          STABILOCK 4031
                      SERIAL NO.  1088010

IEEE-488 ADR.: 25     Mode : TALK & LISTEN CR&LF
                             DCL = CLR

SOFTWARE-VERSIONS:    HOST-MCU : 3.58   CRC : ADAE
                      CRT-MCU  : 2.55   CRC : 8170
                      RF/AF-MCU: 2.5F   CRC : 1BEF
                      CELL-GEN : 1.00   CRC : E465
                      CELL-ANA : 1.00   CRC : 550B
                      IFC-MCU  : 1.00   CRC : 32F3

  HW-REVISIONS        START        OPTIONS
```

Hardcopy of STATUS mask; contents of entry fields = default values (settings ex works)

```
OPTIONS

Duplex                  : installed
Gen B                   : ---------
Control-Interface       : ---------

Option Card             : installed
          - DTMF        : installed
          - DC/V/A      : installed
          - Opt.Modul:    ---------
          - Filter 1 :    3 kHz LP
          - Filter 2 :    300 Hz HP
          - Var.Notch:    200 Hz ... 600 Hz

Data Module             : installed
RS232 / Centronics      : installed
IF-Tracking-Unit        : installed

RETURN
```

Reduced hardcopy of OPTIONS mask: installed options are marked "*installed*" or are identified, dashes indicate missing options.

```
HW-REVISIONS
Module                         Hardware-Revision
   RF-Counter            :          - 0 -
   Output Unit           :          - 0 -
   UHF Synthese          :          - 0 -
   Dekaden Synthese      :          - 0 -
   FM Modulator          :          - 0 -
   RF Attenuator         :          - 0 -
   RF Mother Board       :          - 0 -
   AF Mother Board       :          - 0 -
 4 Modgenerator A        :          - 0 -
 3 IF-Unit               :          - 2 -
 1 AF Detector           :          - 0 -
 5 Modgenerator B        :          -----
 2 Option Card           :          - 0 -
 6 Control Interface     :          -----
 7 RF/AF-MCU             :          - 0 -

SELF-CHECK          RETURN
```

Reduced hardcopy of HW-REVISIONS mask: the index numbers define the development status of the individual modules.

SELF-CHECK

	Power Supply	:	ok
1	AF Detector	:	ok
3	IF Unit	:	ok
4	Mod Generator A	:	ok
5	Mod Generator B	:	not installed
7	Slave Computer	:	ok
9	Monitor Control	:	ok
	Output-Unit	:	ok
	UHF-Synthese	:	ok
	Dekaden Synthese	:	ok
	FM Modulator	:	ok
	RF Attenuator	:	ok
	RF Count Unit	:	ok
	RF Detector	:	ok
	Duplex	:	ok

Self Check passed ok.

START SELF-CHECK | START LED-TEST | RETURN

Hardcopy of SELF-CHECK mask; all stages tested here are ok

Basic RX Mask

The basic RX mask activates the signal generator of the 4031 for receiver testing.

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: 50Ω); 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 foldout).

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

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 <FREQUENCY> + <+> or <FREQUENCY> + <->. 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.

>>> continued overleaf >>>

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.

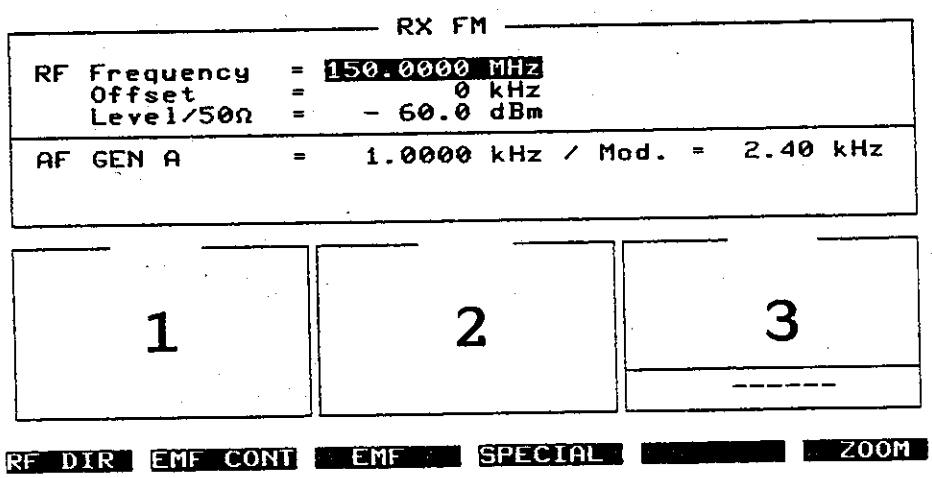
Mod..............(mixed numeric field [rad, %, kHz]); the content of this field determines the modulation of the carrier signal (phase deviation, modulation depth or frequency deviation). As long as an entry has not yet been terminated with <ENTER>, the required units can be assigned to the entered value 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 4031 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

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 4031 for transmitter testing.

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. Warning: 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 foldout).

+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 (see Zoom foldout).

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).

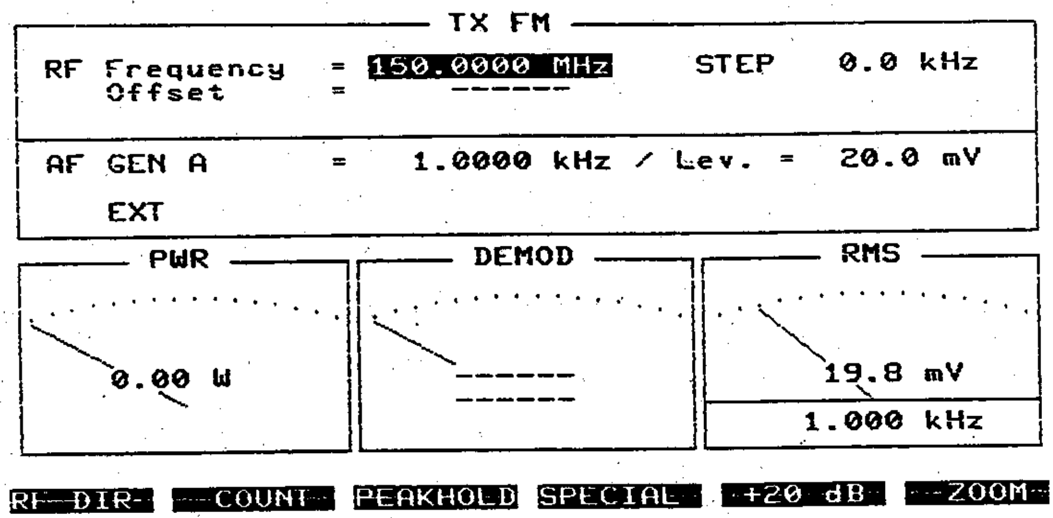
STEP.............(hidden numeric field); can be allocated with <STEP> to the (opened) *RF Frequency* field. As long as the *STEP* field is inverted, the plus/minus keys permit step by step alteration of the carrier frequency (step width = content of *STEP* field). <OFF> blanks the (opened) *STEP* field.

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.

>>> continued overleaf >>>

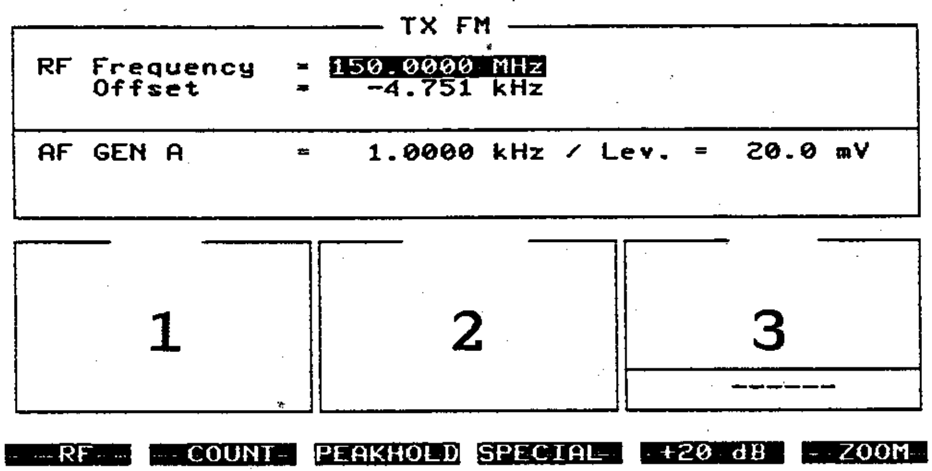


Hardcopy; contents of entry fields = default values (settings ex works)

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

1 = PWR
2 = DEMOD
3 = RMS or 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 4031.

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/PhM 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. Warning: 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: 50Ω); 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 foldout).

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 foldout).

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.

>>> continued overleaf >>>

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.

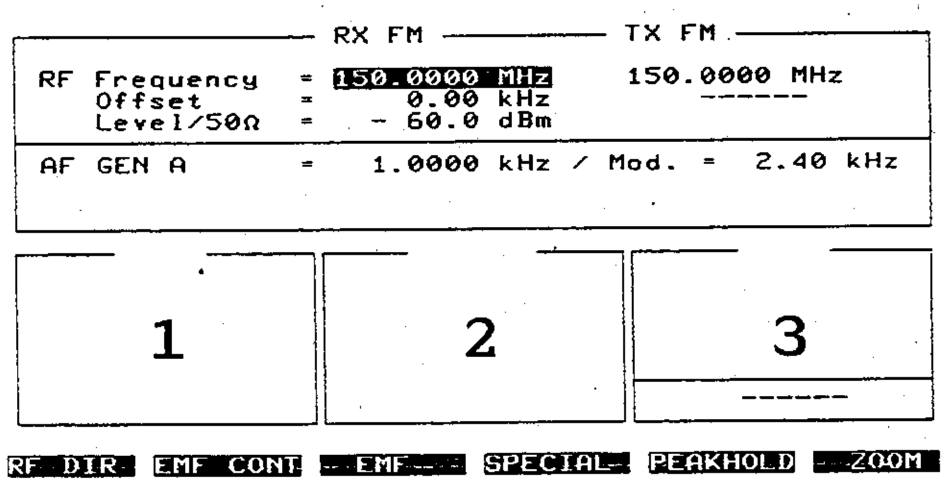
AF GEN A.........(pure numeric field); the entered value defines the modulation frequency of modulation generator GEN A (the same applies to the *GEN B* field when the optional modulation generator GEN B is installed).

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

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

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.

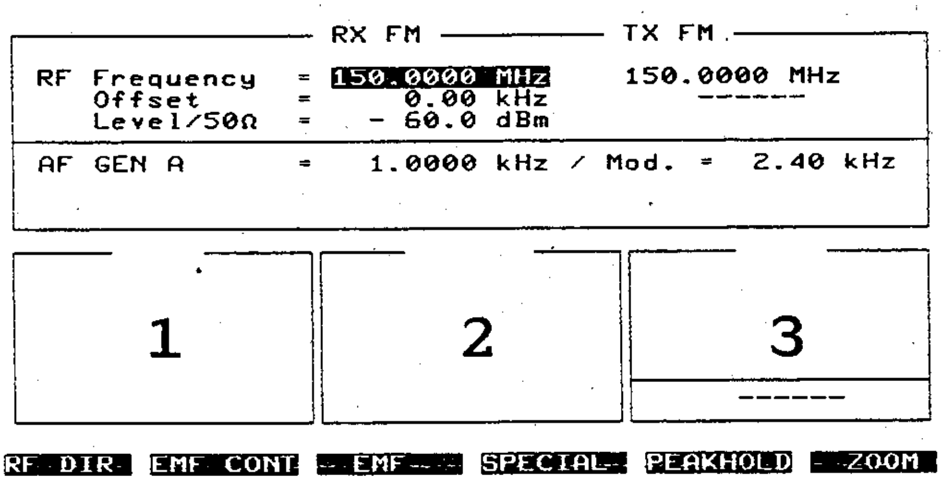
AF GEN A.........(pure numeric field); the entered value defines the modulation frequency of modulation generator GEN A (the same applies to the *GEN B* field when the optional modulation generator GEN B is installed).

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

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. <OFF> + <CLEAR> or <OFF> + <POWER> replace the declarations with the default settings that are made ex works.

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

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).

>>> continued overleaf >>>

```
─────────── GENERAL PARAMETERS ───────────
Channel space          =       20.0 kHz
Duplex  space          =       10.0 MHz
Channel                =          1 No.
Corresp. frequ.        =   150.0000 MHz
Channel no. ↑          =    Freq. ↑
RX <-> TX (MHz)        =         NOT
──────────────────────────────────────────
AF-Meter                   RMS
──────────────────────────────────────────
RF-Power                      WATT
Pre-attenuation        =       0.0 dB
──────────────────────────────────────────
Delay (TX-Sens)        =       100 ms
Delay (Squelch)        =       100 ms
Delay (Decode)         =         0 ms

   STATUS          - ETC -          RETURN
```

```
─────────── GENERAL PARAMETERS ───────────
Printer                          HP-2225
RS232 Config         7 Bits+Even Parity+1 Stop Bit
RS232 Baudrate                   1200 Baud
Serial Input Terminator           CR+LF
Serial Input Handshake            No Handshake
──────────────────────────────────────────
Needle damping     =          10
Demod (RMS Value)  =           mV/V
Screen saver (X=ON)           X

                  RETURN
```

Hardcopy; contents of entry fields = default values (settings ex works)

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 4031 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 10.

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 10). 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.

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 4031 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.

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).

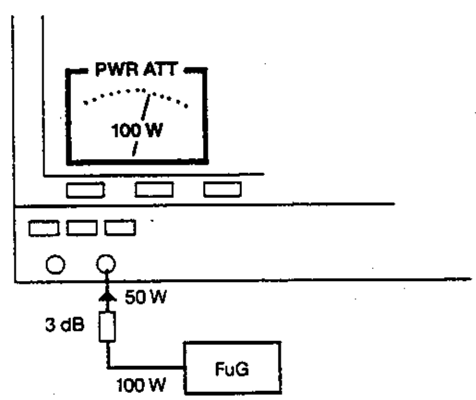
Demod (RMS Value)....(scroll field); the scroll variables *kHz* and *mV/V* define whether, in TX mode, the RMS meter displays the level of the demodulated signal with the unit *mV/V* after <DEMOD> (normal case) or the level is converted to the corresponding frequency deviation (average value) and the 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, INTENS). When the Communication Test Set is switched on again or after <CLEAR>, the screen protection is automatically activated.

Example: Pre-attenuation

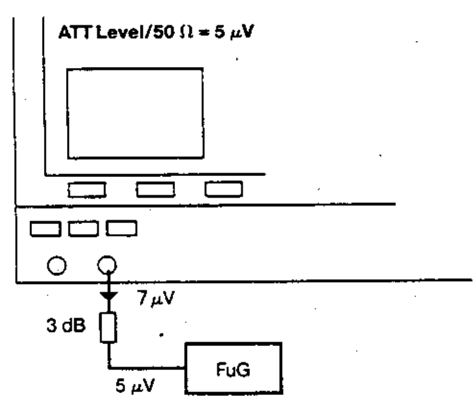
TX measurements:

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 4031 would then indicate 50 W. If you enter the value 3 in the *Pre-attenuation* field, the 4031 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:

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 4031 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!



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.

ZOOM

This foldout 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..............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..............modulation meter RX; indicates the modulation of the 4031 signal generator.
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 4031 test receiver contained in the entry field *RF Frequency*.
DEMOD............modulation meter TX; indicates the modulation of the RF signal applied to the RF or RF DIRECT socket.
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..............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.............distortion-factor meter; the display applies to the same signal sources described for the RMS 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...........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 4031. The following variants are possible:

RX mask..........POWER - MOD - RMS ---> after striking VOLT key (<VOLT>), 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 mask..........POWER - OFFSET - DEMOD - RMS ---> after striking VOLT key (<VOLT>), 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 mask......POWER - OFFSET - DEMOD - RMS ---> after striking VOLT key (<VOLT>), 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).

>>> continued overleaf >>>

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 4031.

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.

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.

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.

>>> continued overleaf >>>

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
to
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.

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.

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 4031.

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 foldout). 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 %.

>>> continued overleaf >>>

DUPLEX SPECIALS

In the DUPLEX mode (option, calls for DUPLEX FM/PhM stage) the 4031 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; more about that at the end of this foldout). 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 Spécial 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.

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
to
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 4031 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/PhM 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.

>>> continued overleaf >>>

OPTION CARD

The OPTION CARD mask enables you to:
a) operate the modules installed on the OPTION CARD (see also Chapter 8);
b) branch to masks of software options loaded from memory card (see also Chapter 7 and 9);
c) call up the mask for operating control interface A, B or C (see also Chapter 8);
d) branch to DTMF mask (see also Chapter 8);
e) branch to mask levels of selective-call systems (see also Chapter 5);
f) call up the GENERAL PARAMETERS submask (see also foldout of the same name).

Attention: a) through d) only with corresponding options installed.

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

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

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 and "AF Signal Paths" foldout).
▒...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 (see "AF Signal Paths" foldout).
Attention: 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 block diagram next page and "AF Signal Paths" foldout).

>>> Continued overleaf >>>

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 block diagram overleaf). 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 AMPERÊ........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 (meaning of ZOOM softkeys: see "ZOOM" foldout).

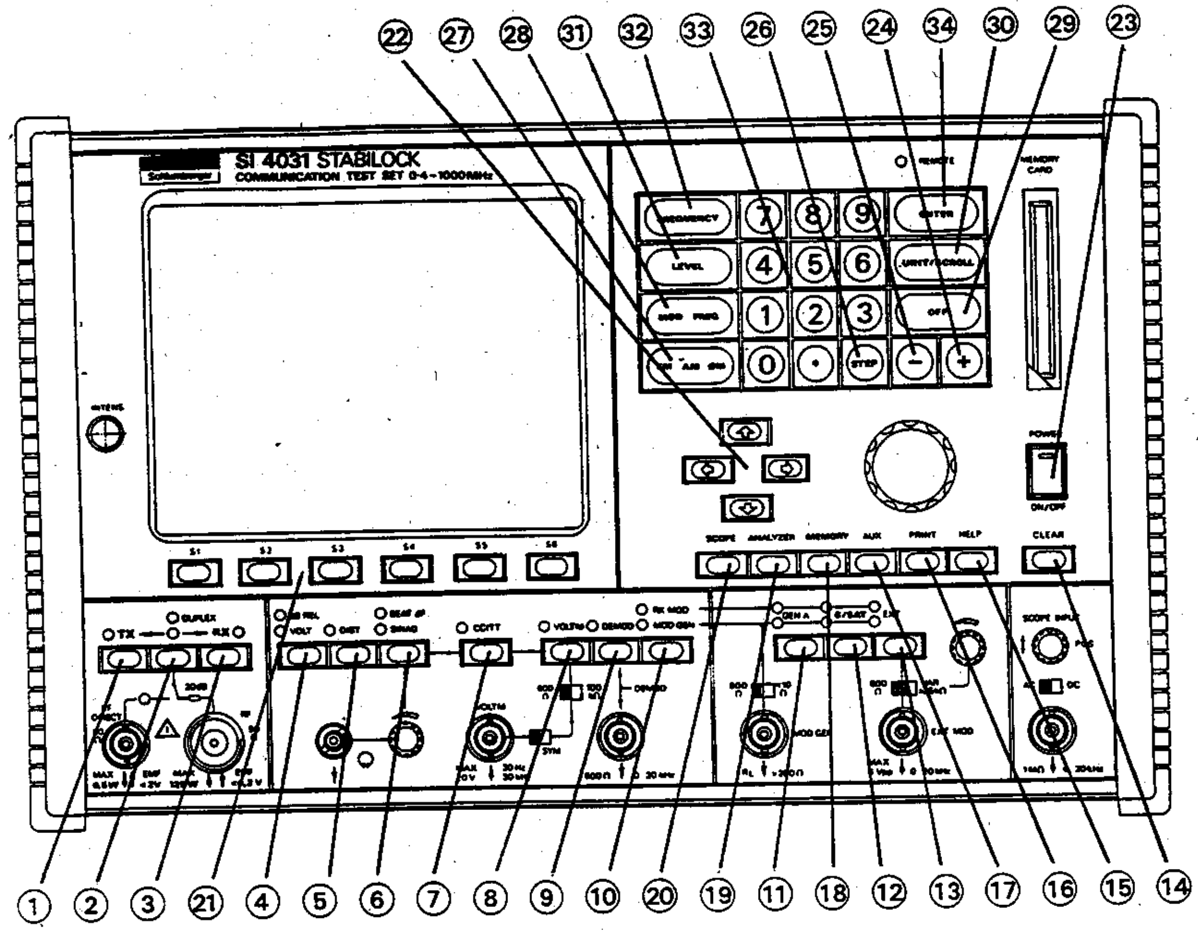
The signal inputs for both meters are on the back panel, OPTION CARD:

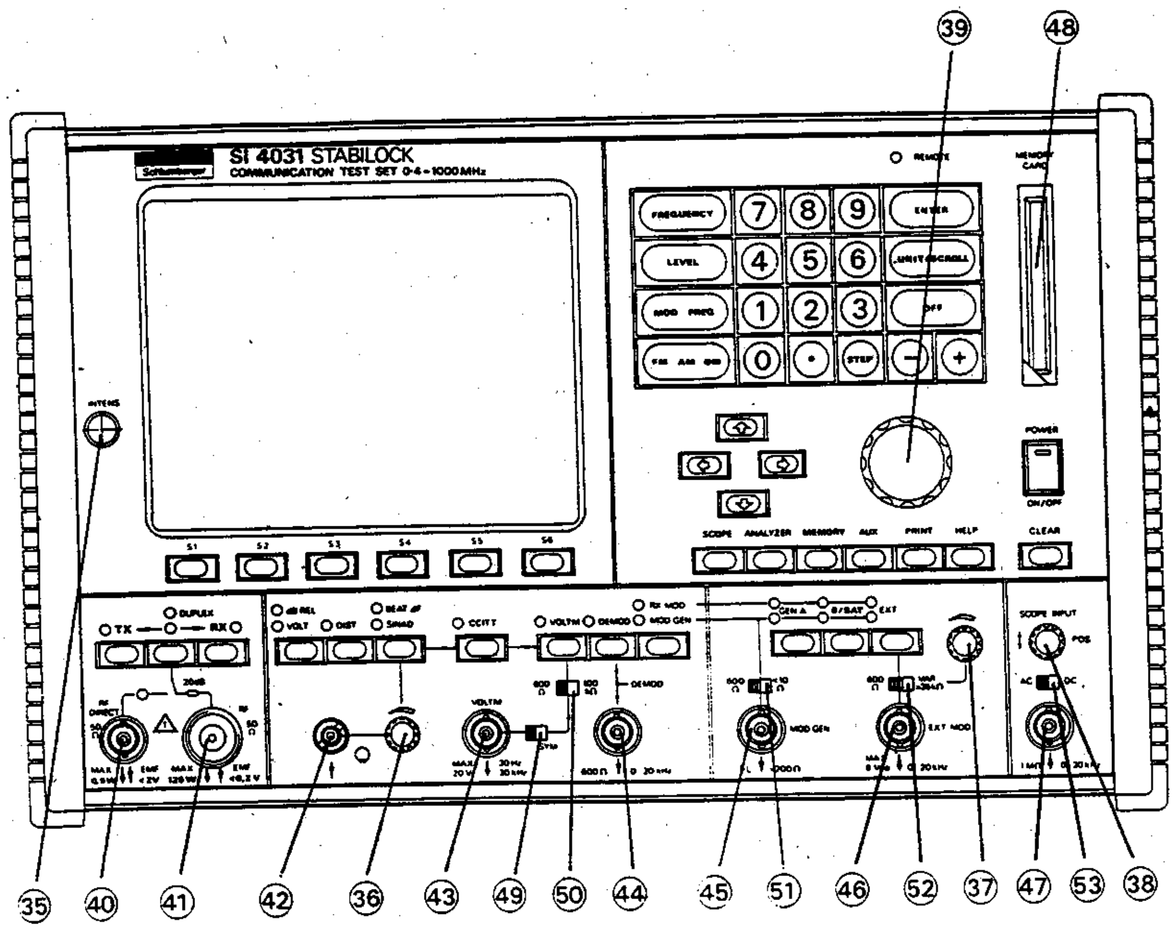
Bu 91 and Bu 92 ammeter
Bu 93 and Bu 94 voltmeter

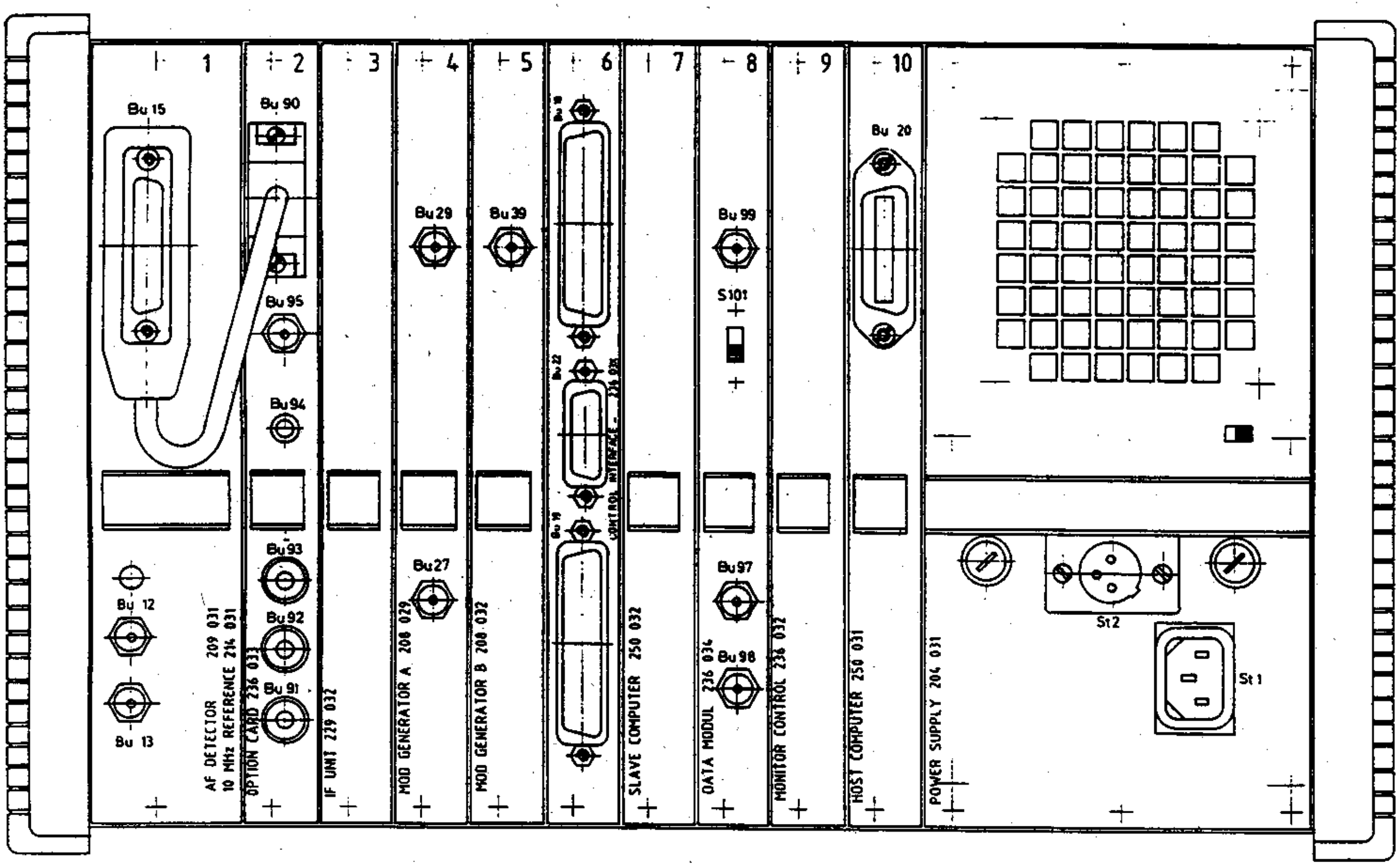
For further information see Chapter 8, DC Voltmeter/Ammeter.

TTL INPUTS

If the 4031 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 8).


SI 4031 STABILOCK
COMMUNICATION TEST SET 0.4-1000MHz
LEVEL
STEP
S1
S2
S3
S4
S5
S6
SCOPE
ANALYZER
MEMORY
AUX
PRINT
HELP
CLEAR
POWER
ON/OFF
CCITT
GEN A
EXT MOD
MOD GEN


SI 4031 STABILOCK
COMMUNICATION TEST SET 0.4-1000MHz
FREQUENCY
LEVEL
MOD FREQ
ENTER
UNIT/SCROLL
OFF
STEP
S1
S2
S3
S4
S5
S6
SCOPE
ANALYZER
MEMORY
AUX
PRINT
HELP
CLEAR
POWER
ON/OFF
DUPLEX
TX
RX
CCITT
VOLTM
DEMOD
GEN A
EXT
MOD GEN
EXT MOD
SCOPE INPUT
POS
AC
DC

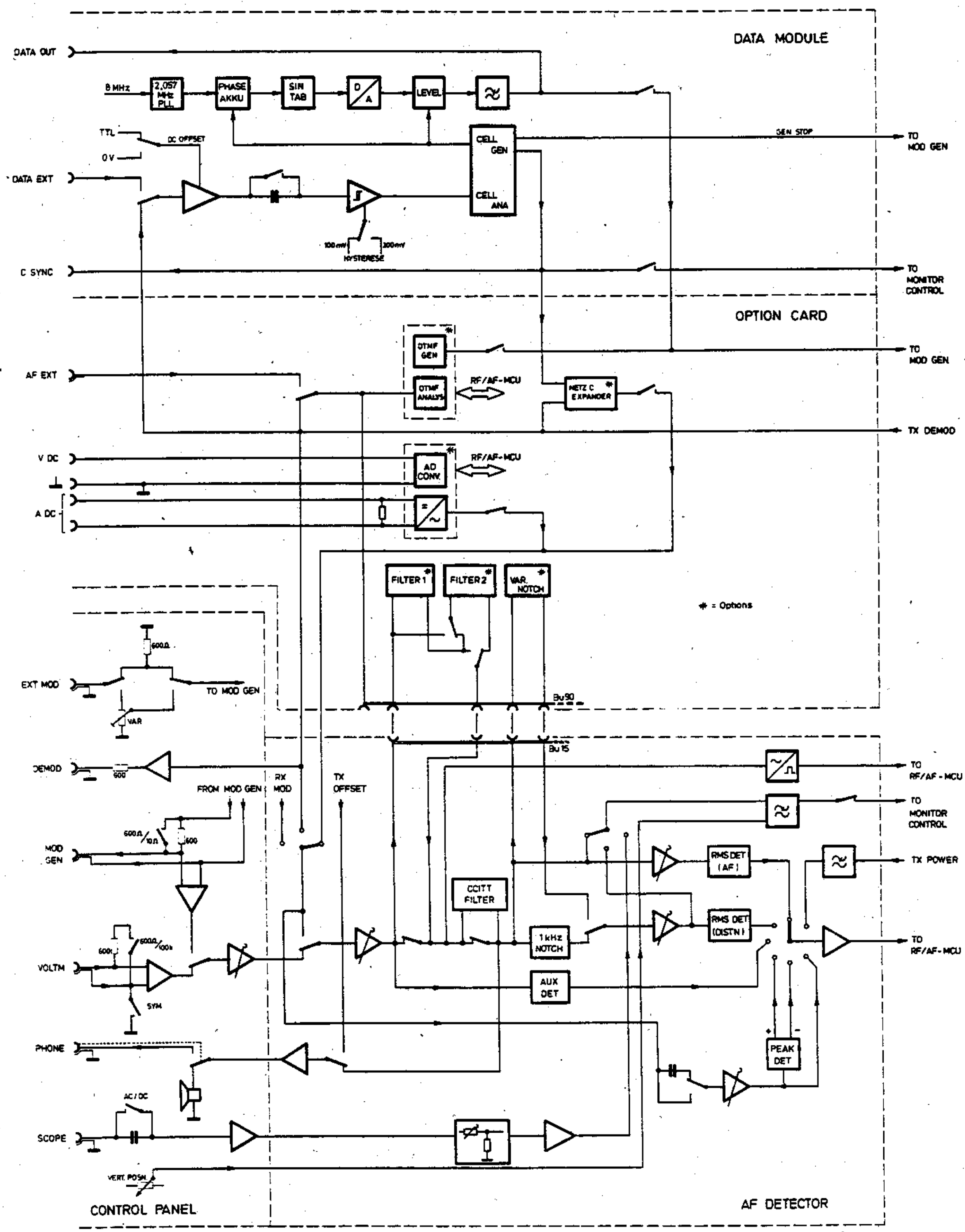


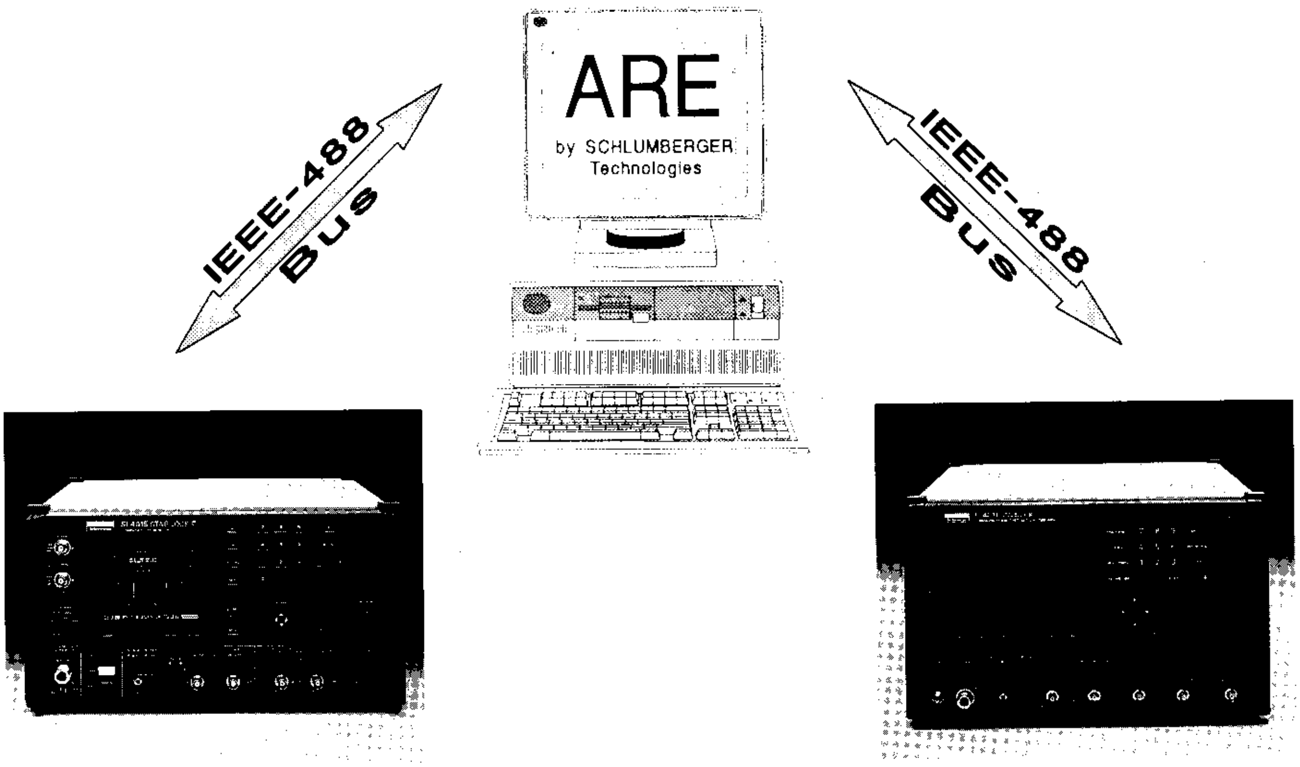
<u>Standard-configuration:</u>

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

<u>Options:</u>

Stage 2 (OPTION CARD)
Stage 5 (MOD GENERATOR B)
Stage 6 (CONTROL INTERFACE)
Stage 8 (DATA MODUL)


DATA MODULE
DATA OUT
8 MHz
2,097 MHz PLL
PHASE AKKU
SIN TAB
D/A
LEVEL
TTL
DC OFFSET
0 V
DATA EXT
CELL GEN
CELL ANA
GEN STOP
TO MOD GEN
100mV
200mV
HYSTERESE
C SYNC
TO MONITOR CONTROL
OPTION CARD
DTMF GEN
DTMF ANALYS
RF/AF-MCU
AF EXT
NETZ C EXPANDER
TX DEMOD
V DC
A DC
AD CONV.
FILTER 1
FILTER 2
VAR. NOTCH
* = Options
EXT MOD
600Ω
VAR
Bu 90
Bu 15
DEMOD
600
TO RF/AF-MCU
FROM MOD GEN
RX MOD
TX OFFSET
MOD GEN
600Ω/10Ω
TO MONITOR CONTROL
RMS DET (AF)
TX POWER
CCITT FILTER
VOLTM
600Ω/100k
1 kHz NOTCH
RMS DET (DISTN)
AUX DET
SYM
PHONE
PEAK DET
AC/DC
SCOPE
VERT. POSN.
CONTROL PANEL
AF DETECTOR



PC programs Communication Test Sets

Do you have the same problem? Do you have to laboriously "type in" automatic programs for your communication test sets on a small keyboard and only with the help of a line editor?
That is hardly ergonomic, or efficient either.

Well, with the ARE (AutoRun Editor) SCHLUMBERGER Technologies has solved the problem. ARE is a powerful, menu-prompted editor that will run on just about any PC. You send the test programs to the IEEE bus. And ARE does this without your having to enter any control codes.

ARE comes to your assistance as early as when you are developing test programs: parts of a program that keep cropping up in a slightly different form can be fetched quite simply from the library. Just make any modification and you are ready.

Forget about the line numbers. Even with GOTO instructions you don't have to state them. Instead of GOTO 3270 you simply type GOTO ˆmain menuˆ. ARE does the rest for you.
No doubt that test programs can be understood much more easily now.

ARE does not take 20 seconds to send even the most extensive test programs over the bus. And while doing this, it checks whether there is an undefined label following a GOTO, GOSUB or ONERRORGOTO instruction.

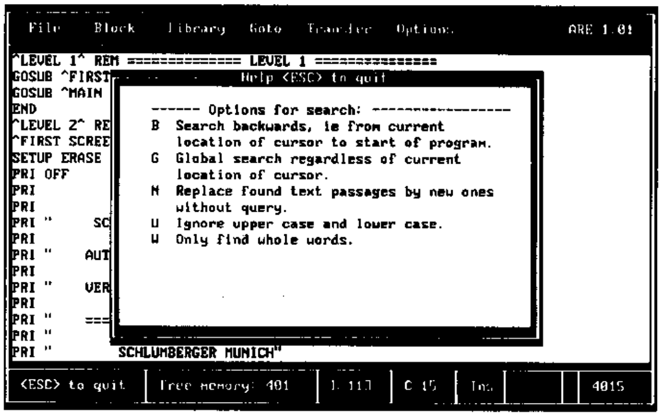
ARE saves space too:
it can fade out REM lines while it is transferring to a communication test set. The documented source text stays on the PC, where you can best maintain and manage it.

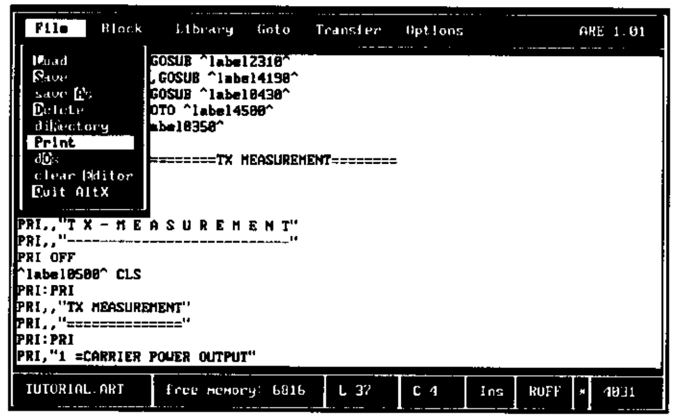
And what is the situation like with existing test programs? ARE will read these on the IEEE bus without any trouble at all, and look after them just as carefully as if they were newly developed test programs.

The fully automatic installation of ARE shows you right from the start that you have a very simple tool in your hands. And, of course, there is ingenious, context-sensitive instant aid at your disposal: there is no tedious paging through help menus with ARE.

Have we nailed your problem?
You can find more about ARE in the data sheet on the opposite page.

ARE – Facts and Features





User interface
SAA interface with menu and status strip. Keyboard control, abbreviated key commands and standard function keys. WordStar-compatible control codes. Instant aid for all menu items and error messages.

Document management
Integrated file manager. Loading of all files and program building blocks by convenient menus. Brief description for all program building blocks.

Import and export
ASCII format (8 bits)

Cursor movement
Character: right/left. Word: right/left. Line: up/down, start/end. Screen page: up/down. Definition of and jumping to markers anywhere within the program.

Block functions
Mark, delete, shift, copy and print.

Search & replace
Single and global search, forwards/backwards, ignore upper case/lower case, labels and markers, only whole words.

Editing functions
Insert and overwrite, delete and insert character or line, undo editing of line.

Labels
Any combinations of letters and digits. Maximum length 32 characters. Coding: ^label^.

Library function
Store program building blocks (max. 16 Kbytes) in library and load from library. Automatic distinction between STABILOCK 4015 and STABILOCK 4031.

Syntax check
ARE detects GOSUBs, GOTOs and ONERRORGOTOs without valid or without any labels. Defined labels which are not used by one of those instructions will also be detected by ARE.

Memory management
Constantly updated calculation of available memory capacity (on communication test set).

File compression
REM lines can be eliminated for transfer.

Re-transfer
Reading of AUTORUN programs from the communication test set.

Transfer rate
Max. 1 Kbyte/s

Supported communication test sets
STABILOCK 4015, STABILOCK 4031

Other
Operating-system window, automatic installation program, ergonomically optimized screen drivers.

Hardware requirements
IBM-compatible PC with IEEE-bus interface card PC II A (National Instruments).

Requirements on STABILOCK 4031
Firmware version ≥ 2.56

Requirements on STABILOCK 4015
Firmware version ≥ 1.12 and option IEEE-488/RS-232C/Keyboard Interface.

Ordering codes

Unit or option	Ordering code
AUTORUN Editor ARE	897 100
IEEE-Bus Interface Card PC II A	860 182
IEEE-488/RS-232C/Keyboard Interface	236 013
IEEE-Bus cable, 2 m long	860 110
Update to Firmware Version ≥ 1.12 for STABILOCK 4015	
Update to Firmware Version ≥ 2.56 for STABILOCK 4031	

Subject to change. Status 11/91