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Solartron Instruments

Communications Test Set

STABILOCK 4040

Operating Manual

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Contents

AUTOTEST

IEEE 488 Bus

APPLICATION NOTES

FUNCTION DESCRIPTION

Installation Instruction

GENERAL

This set has been constructed and tested in conformity with DIN 57411 Part 1 / VDE 0411 Part 1, Protective Measures for Electronic Measuring Equipment, and was passed as safe before leaving our works. To maintain this condition and to ensure no hazards arise in service, the user must adhere to the information and warnings contained in these operating instructions.

Should the power plug be replaced with another type, please make sure that the yellow / green conductor is connected to the ground contact of the plug.

Warning: Interrupting or removing the ground cable inside or outside the set may cause the set to become a hazard. Intentionally interrupting the ground connection is not permissible.

Before switching on, ensure that the operating voltage set at the unit agrees with your power voltage.

If there is any reason for assuming that safe operation may no longer be possible, the set must be taken out of service and secured against unintentional operation.

The operating temperature range should be between +5 °C and +45 °C (+35 °F and +57 °F) ambient, the storage temperature between -25 °C and +70 °C (+18 °F and +71 °F) ambient.

POWER OPERATION

The STABILOCK 4040 can be operated with the following power voltages:

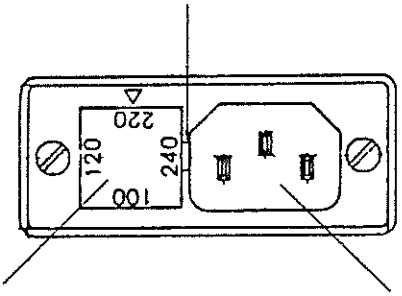
97...140 V or 180...260 V, 47 to 440 Hz

The equipment is set in the Works to 180...260 V (220 mark on voltage selector).

Adjusting power voltage:

1. Disconnect power plug

2. Lift out voltage selector on rear of set with screwdriver



Power fuse in voltage selector

Power connection

3. Fuse corresponding to power voltage:
   97...140 V: T3,15/250 B (3.15 A)
   180...260 V: T1,6 /250 B (1.6 A)

4. Insert voltage selector so that white arrow on selector is pointed toward the desired power voltage:
   97...140 V: 100 mark on voltage selector
   180...260 V: 220 mark on voltage selector

5. Re-connect power plug

Replacing powerfuse:
Sequence of operations as for altering power voltage

BATTERY OPERATION

The STABILOCK 4040 can be operated with an external battery.
The connection is on the rear panel and has its own fuse.
It is not possible to charge the battery with the STABILOCK 4040.

Battery voltage 11...33 V
Power consumption approx. 6 A at 12 V
approx. 3 A at 24 V
Fuse: T16/250 E (16A)

Connection by means of:

Battery connector
reference number 300 642

SOFTWARE STATUS

Software status readout is provided in display ⟨1⟩ after entering [ON] [64].

Example:

3.15 — — A22
Software status	IEC bus address

Switching off with FUNCTION or RESET key.

SWITCHING ON

The unit is switched on and off with the POWER button both when operated from the power or from a battery. The LINE/BATT light diode is on if the power or battery is connected to the 4040, also when the set is switched off.

STANDBY mode is not provided since the unit achieves a frequency accuracy better than 1×10^{-7} within 15 minutes after switch-on (Ta = 20 °C).

EXTERNAL SYNCHRONISATION

If the accuracy of the crystal oscillator in the STABILOCK 4040 is not adequate for particular applications, pulling synchronisation is possible by an external reference signal to socket 12 on the rear of the unit:

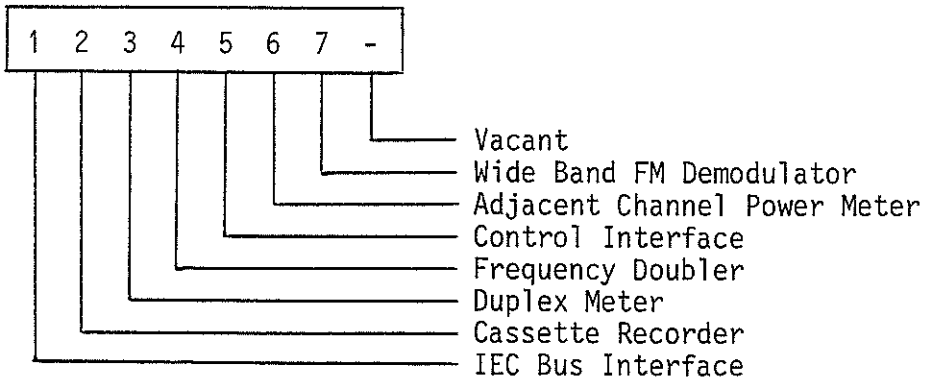
Required signal: f = 10 MHz, $\geqslant$0.2 V into 200 Ω
pulling range approx. 1×10^{-6}

CRYSTAL CORRECTION

If the STABILOCK 4040 has an excessive frequency error due to aging of the integral crystal normal, this can be adjusted by means of an adjusting potentiometer above socket 13 on the rear of the unit.

DISPLAY OF OPTIONS BUILT IN

The readout of the options fitted to the unit is provided in display ◇1◇ after entering [ON] [65]:



For missing options a hyphen appears in place of the corresponding number.

Switch off display by depressing the RESET key.

REAR PANEL CONNECTIONS

10 MHz Synchronisation Bu12

Synchronisation of internal reference oscillator
Required signal:
10 MHz, 0.2 V into 200 Ω
Pulling range approx. 1×10^{-6}

10 MHz Output Bu13

Output of internal reference oscillator
Output level approx. 4 mW into 50 Ω

AF Detector Bu15

This socket performs the following functions:

Insertion of an external AF filter
See SPECIAL 21, page 3-31

RX/TX Switchover by external TTL signal
Only in AUTO mode of STABILOCK 4040

RX/TX Message from STABILOCK 4040 by a TTL signal

DC Measuring inputs for polling test points
Controlled with SPECIAL 22, page 3-31

Pin occupancy Bu15:

Function	Pin
4040: max 10 Vpp, Ri 10 Ω ⟶ Ri >1 kΩ ⟶ Ext. filter ⟶ ≈	8
4040: ground	7
4040: max 10 Vpp, Ri 1 MΩ ⟵ Ext. filter ⟵ ≈	20
4040: ground	21
+15 V, <10 mA, Ri 68 Ω for external filter ⟶	12
-15 V, " " " " " ⟶	25
Ground	13
RX/TX Switchover ⟵ RX = 1, TX = 0	23
RX/TX Message, RX = 1, TX = 0 ⟶	"
Ground	24
DC Measuring input 3 ⟵	16
4 "	3
5 "	15
6 "	2
7 "	14
ground "	1
"	5
"	18
Notch Filter 248 076 200 - 600 Hz	10 22 4

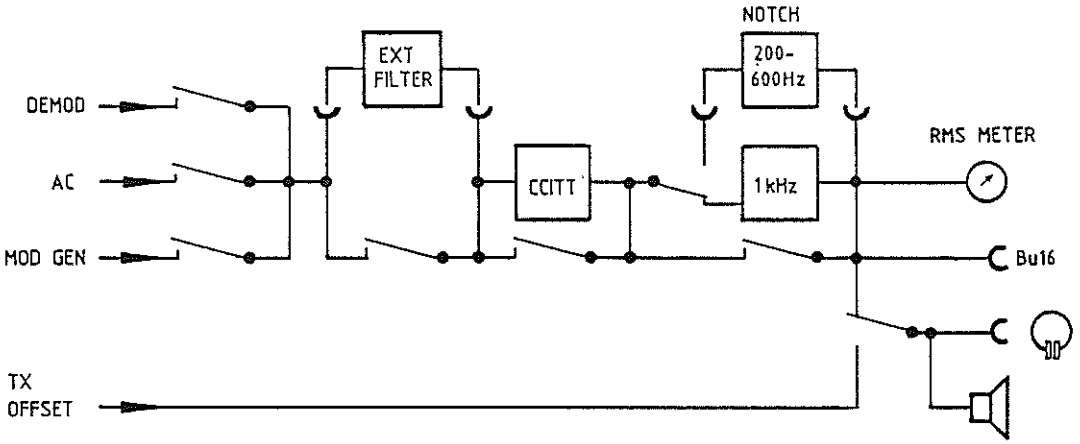
Mating plug for Bu15: Subminiature Plug Series D, DB-25 P
Reference number 300 641

Monitor Output Bu16

The monitor output enables the signal to be observed and analysed at the input of the RMS meter using an oscilloscope and RF analysers. Depending on operating modes the integral speaker and headphone outlet on the front panel are located parallel to Bu16.

See also SPECIAL 26 (page 3-34): AF Voltmeter Autorange

Monitor Signals



Double Modulation Bu17

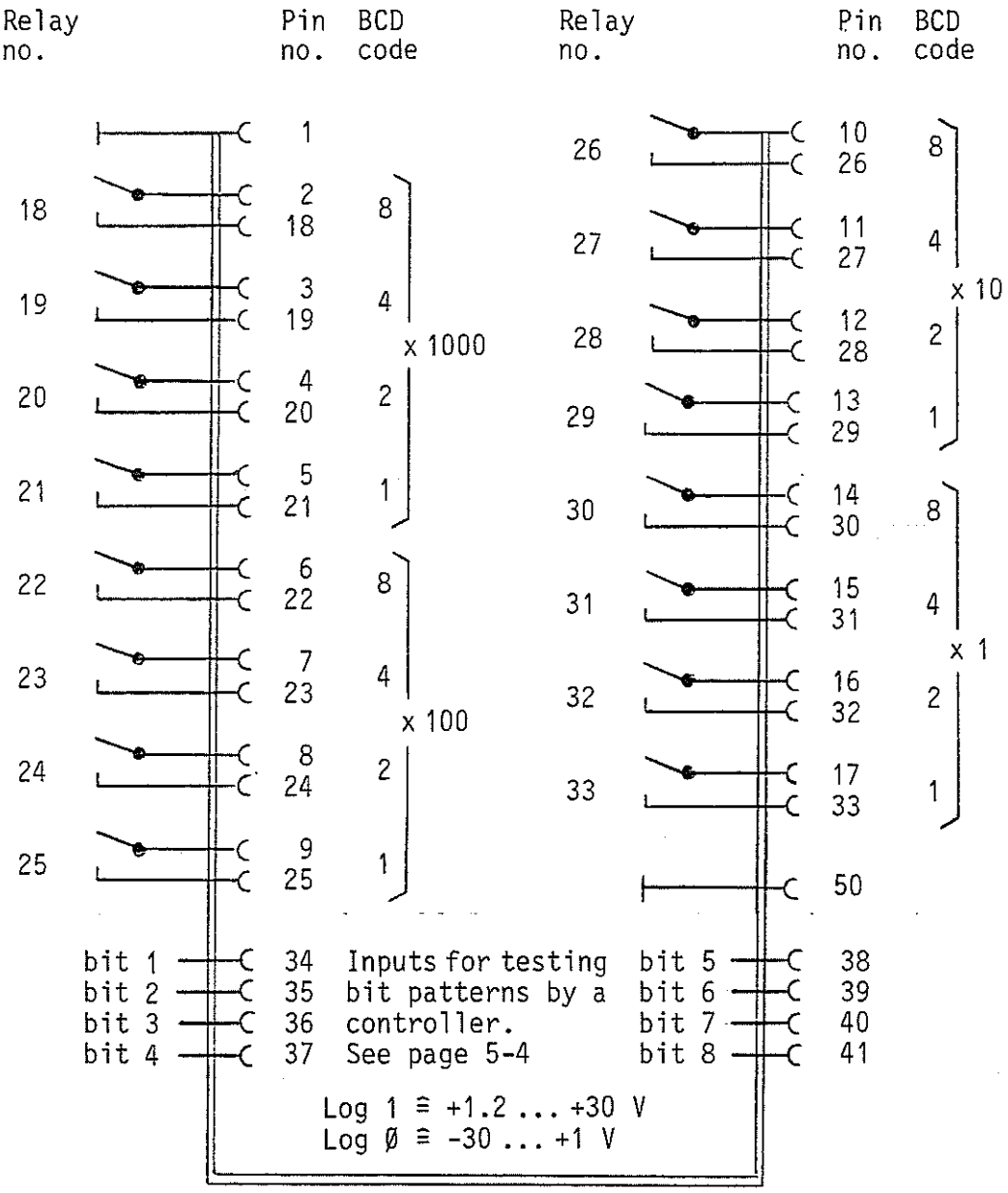
See p. 3-10

Control Interface Bu18

236 041: 16 relays with OFF/ON contacts
Relays not available with type 236 042
Maximum permissible contact load: see data sheet

Relay control by SPECIAL 28 and 29, see page 3-35

Pin occupancy Bu18:



Drawing shows non-operative positions of relays

Mating plug for Bu18:

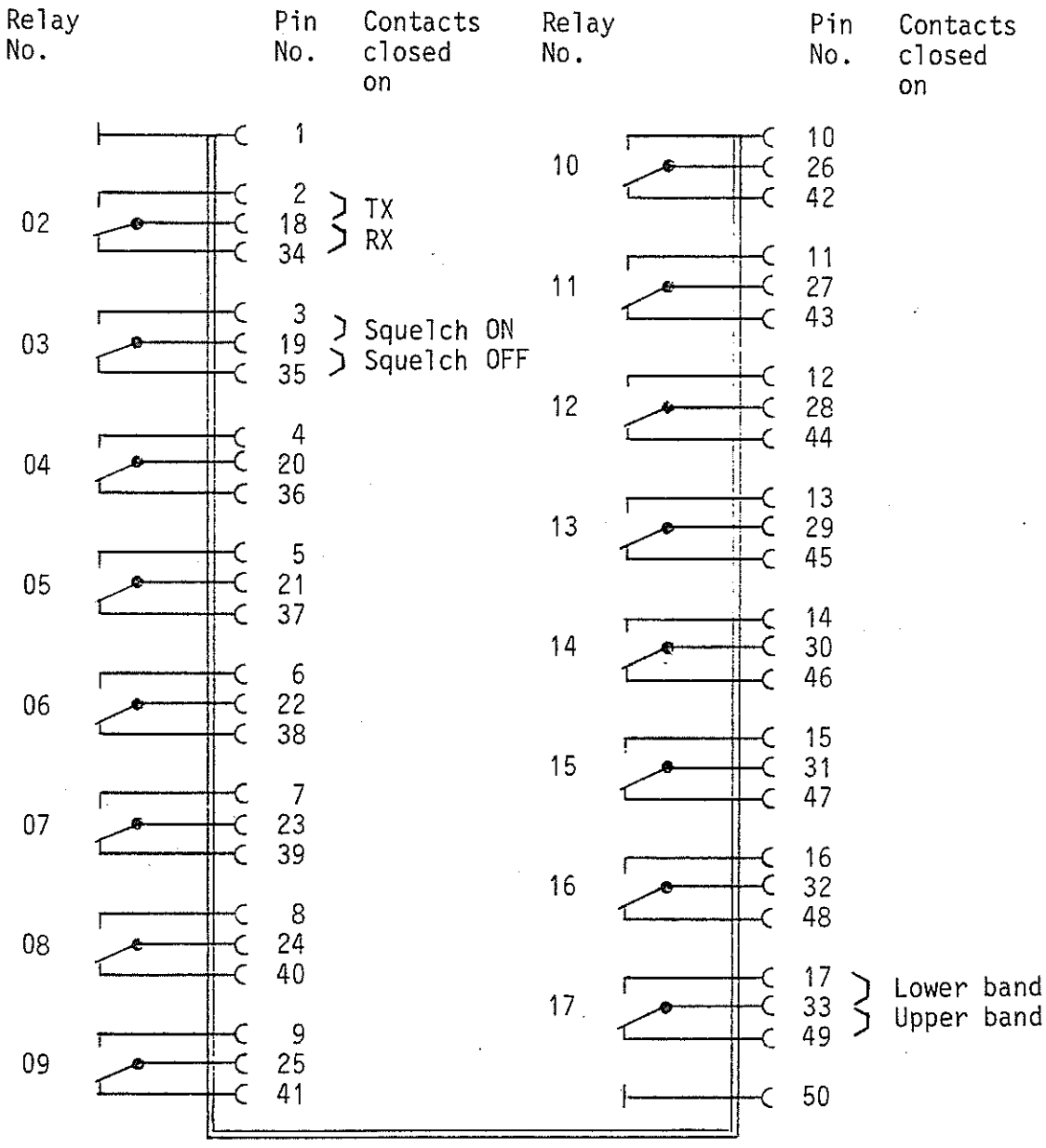
50 pin miniatur plug series D, reference no. 300 643

Control Interface Bu19

236 041: 16 relays with switchover contacts
236 042: equipped with relays no. 02 to 05 and 17 only
Maximum permissible contact load: see data sheet

Relay control by SPECIAL 28, see page 3-35

Pin occupancy Bu19:



Drawing shows non-operative positions of relays

Mating plug for Bu19:

50 Pin miniature plug series D, reference no. 300 643

AM Output Bu36

DC-coupled demodulator output DC...20 kHz
DC content corresponding to carrier mean value with AM demodulation in 4 dB steps regulated to approx. +3 to +5.5 V
100 % AM ≙ 8.5 to 15.6 V peak-to-peak
With FM and ΦM demodulation Bu36 can be used as a linear level output
Internal resistance 600 Ω

FM Output Bu37

DC-coupled discriminator output DC...20 kHz
Output voltage 2.8 V with 20 kHz frequency deviation
Internal resistance 600 Ω

IF Output Bu38

Linear output
IF with RF DIRECT button pressed (remote reception) 450 kHz, Bandwidth 30 kHz
IF range through RF input (RF DIRECT off) approx. 30 kHz to 2 MHz
Output level max. 1 mW into 50 Ω

Printer Connection Bu20

Any printers with IEEE 488 interface can be used for printing out measuring results. The IEEE 488 Interface Option 236 040 is required with the STABILOCK 4040.
The printer has to be set to LISTEN ONLY and the STABILOCK 4040 to TALK ONLY. This can be performed by means of the bus address switch on the rear panel of the 4040.

Wide Band FM Demod Bu40

See 3-15

Operating Instruction

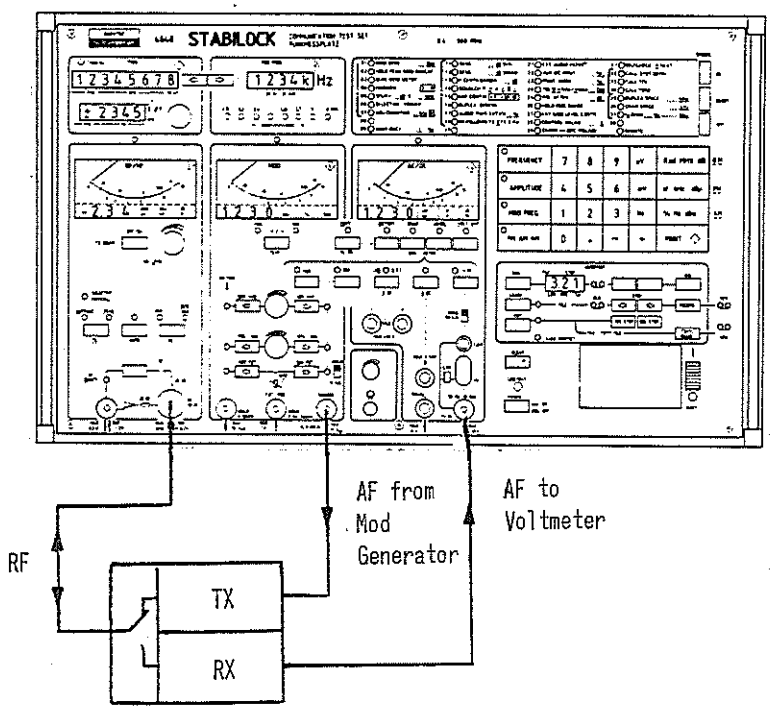
SHORT FORM OPERATING INSTRUCTION

A short form operating instruction is located at the end of this manual.

CONNECTING THE TEST TRANSCEIVER

3 cable connections between the transceiver under test and the STABILOCK 4040 are usually sufficient to carry out all measurements required:

1. Cable with N plug for RF connection.
   The RF socket of the 4040 can not be changed.
2. Cable with BNC plug for connecting transceiver AF input to 4040 modulation generator.
3. Cable with BNC plug for connecting the AF voltmeter of the 4040 to the transceiver AF output.



SWITCH-ON STATUS

After switching on the 4040 it adopts the status existing when it was switched off.

Reset Functions

Function keys

Wrong numerical entries can be cleared by the corresponding function key.

RESET key

Used for clearing blocked entries. The modes existing before blocking are reset. The contents of the AUTOTEST memory remain preserved.

Total reset

Rare cases of blocked entries may occur which cannot be cleared with the RESET key alone. In such cases any other random key must be depressed and held while simultaneously pressing the RESET key. The 4040 then adopts the following basic status:

Automatic RX/TX selection (AUTO)
Frequency 150 MHz
EMF 10 µV
Modulation frequency 1 kHz
Voltmeter to AC and VOLT/AMP
CCITT filter switched off

The contents of the AUTOTEST memory are cancelled and the measuring conditions of the SPECIAL routines are reset to ex works status.

Total clear does not influence the stored selective call test parameters (refer to 3-41)

FREQUENCY SETTING

Setting without Fine Detuning

The frequency is entered by the keyboard and indicated in display ◇1◇. If frequencies <0.4 and >960 MHz are entered a warning signal sounds and the previous value remains in the display. A 3fold signal sounds if the RF signal is out of synchronization.

The entry has to be in MHz, decimal point included. Except with frequencies <1 MHz it is not necessary to enter previous and subsequent zeros.

Procedure:

1. [FREQUENCY] LED in the key lights up.
2. Enter numerical MHz value with decimal point
3. [Rad MHz dB]

Fine Detuning

Variation of the frequency set in ◇1◇ up to ±99.99 kHz by knob Δf. Display in ◇2◇. Variation is also possible if the LED in the FREQUENCY key is off.

Selecting the direction of variation:

1. [FREQUENCY] if LED in the key is off
2. Select direction by keys [+] or [-]

Decadic Variation

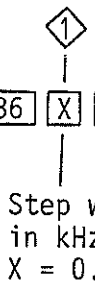
Any decade of the frequency indicated in ◇1◇ can be varied by means of the [+] [-] keys. On overranging a warning signal sounds.

Procedure:

1. [FREQUENCY] if LED in the key is off
2. Move cursor into decade to be varied with [⇦] [⇨]
3. Vary with [+] or [-] key
4. Switch off variation facility: [FREQUENCY]

Step Variation

1. Enter step width: CONDIT 36 X W kHz dBµ



2. Vary: ON 36 FREQUENCY + or - → 1
3. Switch off variation facility: OFF 36

RF OUTPUT LEVEL

Set

The RF level can be set optionally in µV, mV, dBµV or dBm with the keyboard.
The RF level with effective unit is indicated in ④.

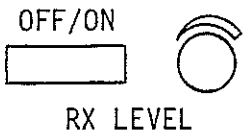
Procedure:

1. [AMPLITUDE] LED in the key comes on
2. Enter numerical value with decimal point
3. Enter unit [µV]
   or [mV]
   or [W kHz dBµ]
   or [% Hz dBm]

Alter unit:

1. [AMPLITUDE]
2. Depress key of desired unit

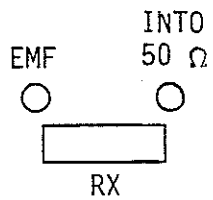
Vary and Switch Off



The output level dispayed in ④ can be varied by turning the RX LEVEL knob and switched off and on again by the OFF/ON key. This can also be done if the LED in the AMPLITIDE key is off.

When the output is switched off [----] appears in display ④.

Terminal Voltage



Switching over from EMF to terminal voltage and vice-versa is possible with the RX key. Inpedendent of the load resistor applied the level display shows half of the EMF value or -6 dB respectively.

dB Addition or Subtraction

Altering of the output level displayed in ◇4◇ by a defined dB value:

1. [AMPLITUDE]
2. Enter difference with sign: [+] ([-]) [DATA] [Rad MHz dB]
3. New value displayed in ◇4◇

RF DIRECT Output

The output level at RF DIRECT socket (2 V max.) is 20 dB higher than at RF socket (0.2 V max.).

Switching over between RF and RF DIRECT outputs with the RF DIRECT key. The higher level is indicated in ◇4◇ if the LED RF DIRECT is on.

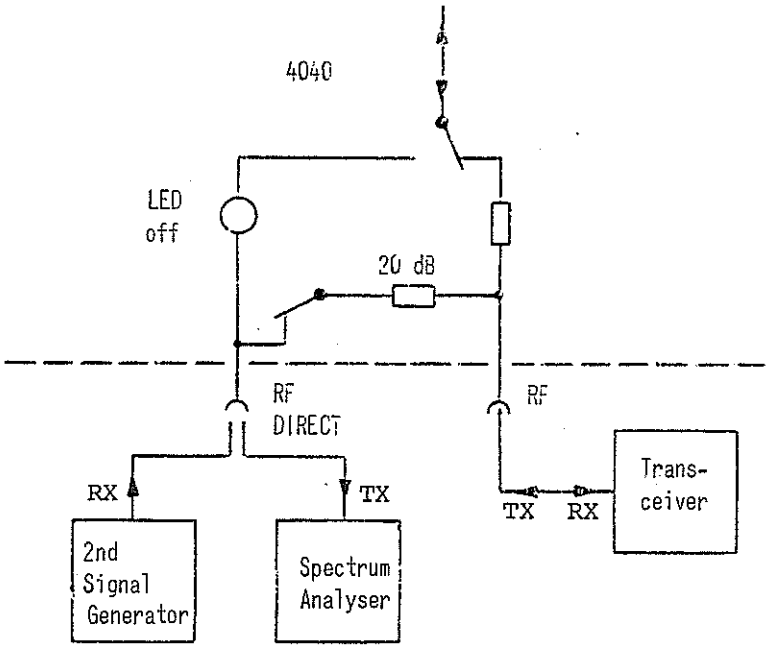
Caution: the RF DIRECT socket is not protected against overload. The maximum permissible load at the RF DIRECT socket is 0.5 W or 5 V, respectively.

2nd Signal Generator, Spectrum Analyser

The 4040 features an integral RF junction for connection of a 2nd signal generator for two signal receiver measurements or for connection of a spectrum analyser or other devices on transmitter measurements.

By the RF junction the signals from the signal generator or to the spectrum analyser are attenuated by 20 dB.

The RF DIRECT LED has to be off.



SETTING MODULATION

Internal Modulation

The 4040 provides two internal modulation generators the signals of which can be superimposed (see: 3-9).

The generator designated MOD VAR has a continuous frequency range from 30 Hz to 30 kHz or 8 fixed frequencies alternatively.

The second modulation generator generates 1 kHz with very low distortion.

Procedure:

1. Select modulation generator by MOD VAR [⇦] or MOD 1 kHz [⇦] keys. Switch off with same keys.

   The MOD VAR generator is also switched on by depressing the [MOD FREQ] key.

2. Set modulation frequency:

   [MOD FREQ] [DATA] [% Hz dBm] or [W kHz dBµ]

   Fixed frequencies: [MOD FREQ] [+] [-]

   Back to DATA entry: [MOD FREQ] ...

   Modulation frequency indication as numerical value or by 8 LEDs in ③.

3. Set modulation:

   [FM AM ΦM] [DATA] [W kHz dBµ] for FM or
   " " [% Hz dBm] " AM "
   " " [Rad MHz dB] " ΦM

   Modulation indication in ⑤.

   Vary modulation

   By knobs MOD VAR or MOD 1 kHz. This is also possible when the LED in the FM AM ΦM key is off.

   Vary modulation frequency

   1. Define decade to be varied in ③:
      [MOD FREQ] [⇦] [⇨]
   2. Vary by [+] or [-]
   3. Switch off variation facility: [MOD FREQ]

External Modulation

Without setting facility

Modulation sensitivity at EXT MOD input on the front panel:
0.1 V peak ≙ 2.5 kHz FM, 10 % AM or 1.00 rad ΦM

1. Switch on and off with the MOD EXT [⇦] key
2. Select type of modulation:

[AM FM ΦM]	[W kHz dBµ]	for FM, display in ⟨5⟩
	[% Hz dBm]	" AM " " "
	[Rad MHz dB]	" ΦM " " "

With setting facility

1. and 2. as above
3. SPECIAL [ON] [27]
4. Set modulation by knob MOD 1 kHz, display ⟨5⟩

   Or enter modulation by the keyboard or by remote control with 1 V peak at the EXT MOD socket (600 Ω).

   Voltage calibration:

   Enter 10 kHz FM by keyboard and adjust the voltage of the external modulation generator for 10 kHz FM indication in ⟨5⟩. With this voltage all following modulation entries by the keyboard or by remote control are valid.
5. Switch off setting facility: [OFF] [27]

Superimposing Modulation

The modulation sources MOD VAR, MOD 1 kHz and MOD EXT (front panel) can be superimposed for the same type of modulation. With that e.g. testing of a receiver with subaudio squelch is possible with the MOD VAR generator set to the squelch frequency and the MOD 1 kHz generator used as test modulation.

Modulation intensity and modulation frequency have to be set separately for each modulation source while the two others are switched off.

Double Modulation

By a signal applied to Bu17 at the rear panel of the 4040 following modulation combinations are possible. The type of modulation at Bu17 is determined by selection of the type of internal modulation.

Internal Modulation	Modulation at Bu17
AM	FM
FM	AM
ΦM	AM

The internal modulation can be composed of MOD VAR, MOD 1 kHz and MOD EXT (front panel).

Modulation sensitivity at Bu17:

10 V peak into 600 Ω ≙ 20 kHz FM or 100 % AM
Modulation frequency range as for internal modulation

TRANSMITTER MEASUREMENTS

Frequency OFFSET Measurement

Measuring frequency offset of a transmitter signal at the RF socket to the nominal transmitter frequency set in ◇1◇. The beat frequency can also be monitored by the integral loudspeaker of the 4040.

Procedure:

1. Enter nominal frequency: [FREQUENCY] [DATA] [Rad MHz dB]
2. Offset frequency display with sign: ◇2◇
   [-----] appears if offset >100 kHz or signal too weak
3. Monitoring: Depress VDC key and adjust volume
   Caution: The sound is disturbed with offset >10 kHz.

The specified measurement error is valid up to 30 % AM only.

Measuring error with FM modulated signals:

$$\text{Error} = \frac{\text{FM deviation}}{\pi \cdot \text{clock time} \cdot \text{fmod}}$$, clock time = 250 ms

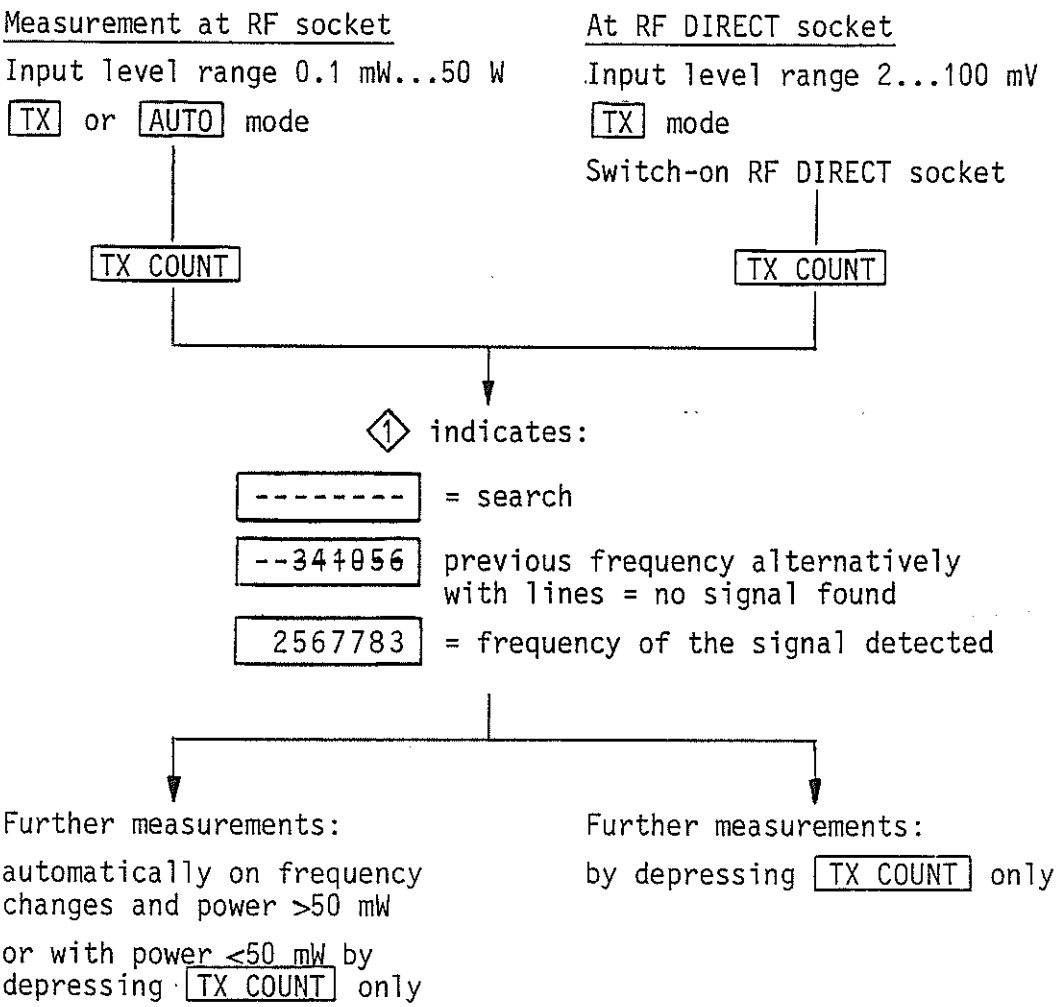
Example: FM deviation 2.8 kHz, fmod 1 kHz

$$\text{Error} = \frac{2800}{\pi \cdot 0.25 \cdot 1000} = \pm 3.6 \text{ kHz}$$

Transmitter Frequency Measurement

The measurement is performed by a selective frequency counter requiring a search time of up to 5 seconds.
The specified measurement error is valid up to 30 % AM only.

Procedure:



The measured frequency is now the reference frequency for the following TX modulation and offset measurements.

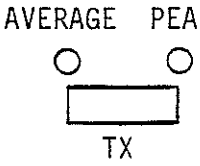
On RX measurement the signal frequency present before the TX measurement is effective again.

With ON 18 set the frequency measured by TX COUNT is also effective in the RX mode.

Transmitter Power

Measurement at RF socket only

Select average or peak power indication by the TX key:



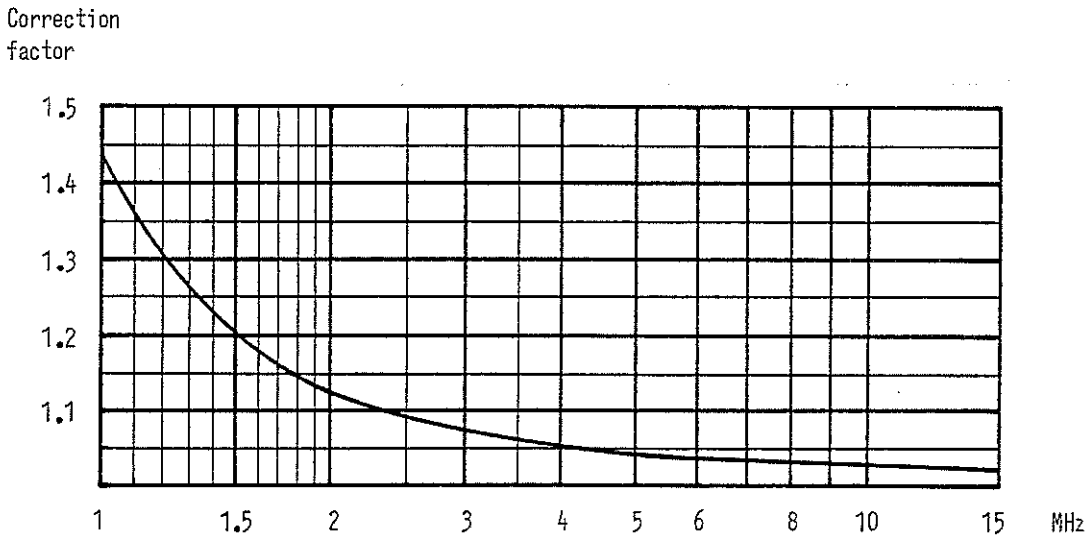
indication in ◇4◇ in W

AVERAGE: for FM/ΦM transmitters.
On AM the average carrier power is indicated

PEAK: indication of envelope peak power

Frequency range 1...15 MHz

In order to provide a measuring error <8 % in this frequency range, the value read from the power meter must be multiplied with the correction factor given below:



Modulation Measurement

The modulation measurement accuracy as specified on the data sheet is valid for the RF input. According to the smaller bandwidth of 30 kHz of the RF DIRECT input the result may be falsified when this socket is used. Faultless AM measurements can be performed with fmod ≤3 kHz only.

1. Select demodulation mode:

   [AM FM ΦM] [W kHz dBµ] for FM, display in ◇5
   or [% Hz dBm] " AM, " " "
   " [Rad MHz dB] " ΦM, " " "

2. Select measurement mode by repeated depressing of the PEAK key:

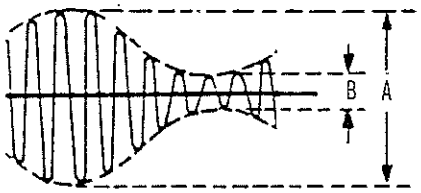
   POS +/- NEG
   ○ ○
   [ ]
   PEAK

   POS LED on: measurement of positive modulation

   NEG LED on: measurement of negative modulation

   Both LEDs off: on FM and ΦM average of positive and negative modulation, on AM measurement of the "true AM":

$$m = \frac{A - B}{A + B} \times 100$$

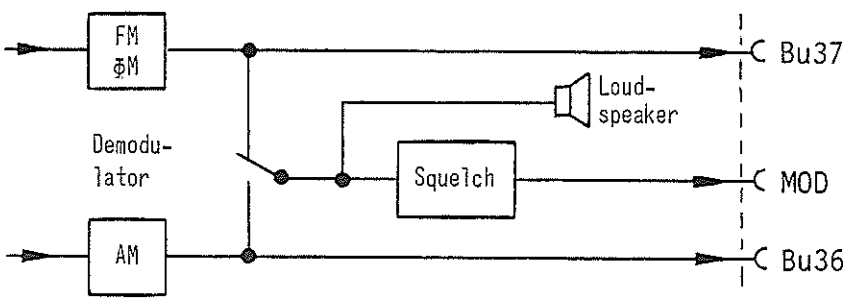


3. Monitoring modulation:

   Depress the [MOD] key and adjust loudspeaker volume.

4. Demodulated signal:

   The demodulated signal is available at sockets Bu36 and Bu37 on the rear panel (see page 2-10) and at the MOD socket on the front panel. It can be used for observing transient responses or for selective call evaluation and so on. The front panel output is DC coupled and in order to avoid faulty evaluations provided with a squelch.



Residual Modulation Measurement

True rms measurement of residual modulation.
Measuring bandwidth 30 Hz...16 kHz or CCITT-P53.

Residual FM, AM or ΦM relative to the test modulation

1. Modulate transmitter with test modulation and select demodulation mode of the 4040:

[FM AM ΦM]	[W kHz dBμ]	for FM, indication in ⟨5⟩
	[% Hz dBm]	" AM " " "
	[Rad MHz dB]	" ΦM " " "

2. Test modulation indication by the AF voltmeter:
   [MOD] [VOLT/AM] indication in ⟨6⟩
3. Set test modulation as reference value: [dB REL]
4. Switch off test modulation and read off dB ratio of test modulation to residual modulation from the AF voltmeter ⟨6⟩.
5. Demodulated signal: refer to page 3-14

Residual FM or ΦM in Hz or mrad units

1. Transmitter unmodulated
2. Depress [MOD] and [VOLT/AMP] keys
3. Calculate residual FM or ΦM from the voltmeter reading ⟨6⟩ using the following relations:

   0.141 mV ≙ 1 Hz
   0.707 mV ≙ 1 mrad

Wide Band FM Demodulator

By using this option, FM demodulation and measurement can be performed with modulation frequencies from DC to 140 kHz if the RF input is used. At the RF DIRECT input the bandwidth is limited to 30 kHz.
Further specifications: see data sheet

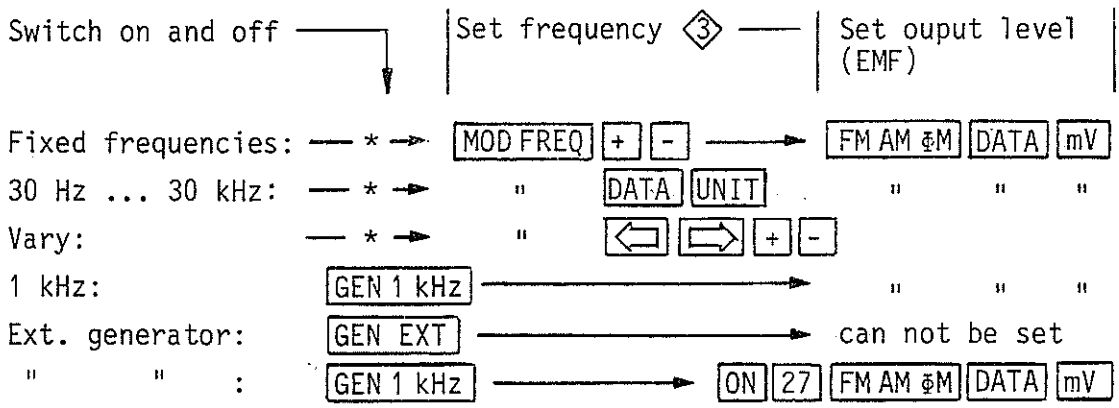
The demodulated signal is available at Bu40 on the rear panel:

EMF: 10 V peak at 50 kHz FM deviation
Source resistance 600 Ω

MODULATION GENERATOR

Output MOD GEN

With TX mode the following signals can be fed to the MOD GEN output and can be super superimposed:



* The MOD VAR generator is switched on by depressing the MOD FREQ key. Switching off by depressing the MOD VAR key.

By means of knobs beside the corresponding keys the output level can also be varied continuously.

After setting SPECIAL 27 the level of a generator applied to the EXT MOD input can also be set through the 1 kHz path. As a result the 1 kHz modulation generator is switched off. An input of 1 V peak at the EXT MOD input (600 Ω) is reqired for correct level setting by the keyboard.

Amplification factor EXT MOD input → MOD GEN output (EMF) without SPECIAL 27 = 1.

The MOD GEN output is transformer coupled.
Source resistance <3 or 600 Ω. See specifications

Output level display: GEN VOLT/AMP → ⑥

Not the EMF but the terminal voltage at the MOD GEN socket is displayed.

Output MOD

For some applications, the frequency response of the transformer coupled MOD GEN output may be too poor.

With RX mode the signal from the Modulation Generator is also available at the MOD socket providing a better frequency response.

Output via MOD socket with RX mode:

Frequency response ±0.3 dB from 10 Hz to 30 kHz
Maximum available EMF 5.6 V
Source resistance 600 Ω unbalanced

EMF setting:

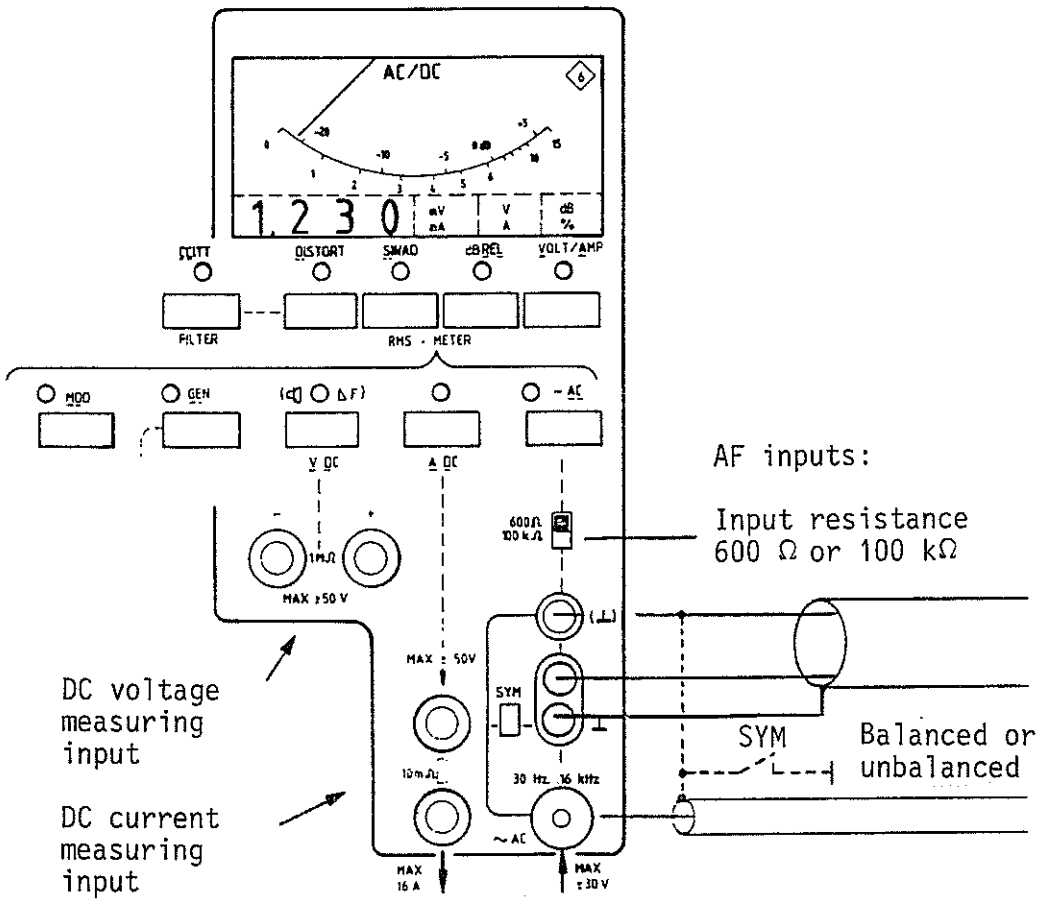
By setting FM as for receiver measurement, see page 3-8:

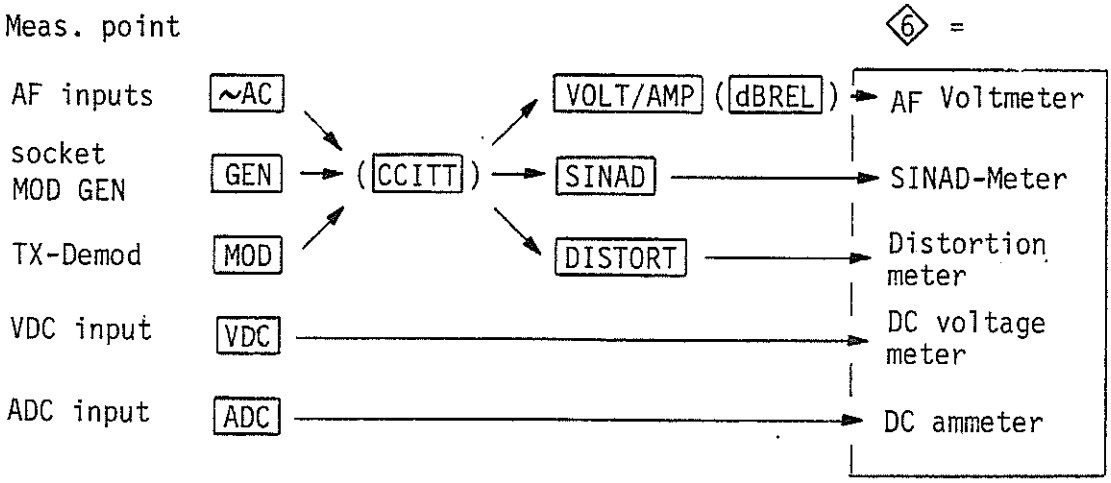
$$2.8\ V \triangleq 10\ kHz\ FM \text{ or } 3.57\ \frac{kHz}{V}$$

Setting resolution:

10 Hz or 2.8 mV at FM <4 kHz
100 Hz or 28 mV at FM >4 kHz

AC/DC METER





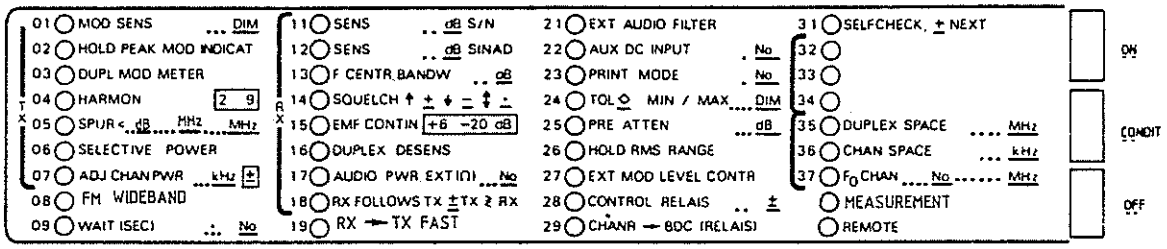
Distortion Measurement 200 to 600 Hz

Connect the automatically tuned Notch Filter 248 076 to Bu15 and switch on with entry [ON] [21]. Switch off: [OFF] [21]

SPECIALS

General

By means of the SPECIALs transceiver test routines and special measurement modes can be called up. All SPECIALs are indicated on the front panel with the corresponding code number.



The special measurement modes can be called up and reset by ON and OFF keys in conjunction with the code number. An LED indicates that the selected function is called up. In the case of routines the LED extinguishes when the routine is over.

Measuring Conditions

Some SPECIALs, marked by one or several points on the front panel, require the presetting of measuring conditions. If no conditions are entered, the routine applies standard conditions stored in the 4040 microprocessor after it is called up by ON X (X = SPECIAL number). After being called up by

[CONDIT] [X] valid conditions are shown in display ⟨1⟩

e.g. [20 -X]

20 = numerical value of condition, X = SPECIAL number

The second part of multisectional conditions, e.g. 24, 37, is displayed after depressing any other random key. The condition indicated can be replaced by entering new values stored from now. After Total Reset (see page 3-2) all measuring conditions are reset to the ex works status.

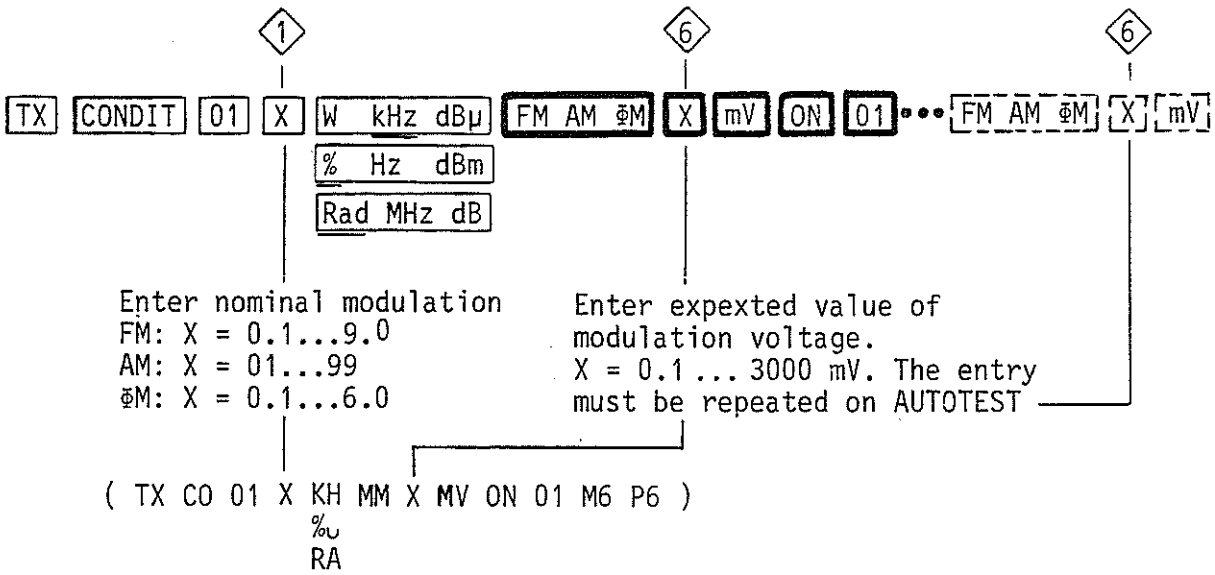
SPECIALs via IEEE 488 Bus

Bus commands corresponding to the front panel operations are given in the following pages in parentheses.

IEEE 488 bus command = (--------)

01 Modulation Sensitivity

Procedure:



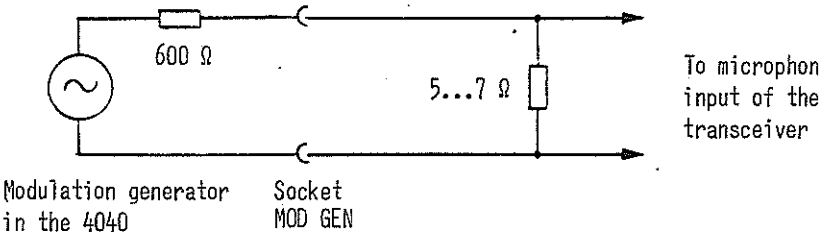
Result ⟨6⟩ = AF voltage at the microphone input of the transceiver for nominal modulation.

When the routine is recalled, the expected modulation voltage has to be entered again while the nominal modulation remains stored.

Recall: FM AM ΦM X mV ON 01 (MM X MV ON 01 M6 P6)

Test configuration for high modulation sensitivity:

For measuring modulation sensitivity near 1 mV the level resolution of the modulation generator (0.1 mV) may be to coarse.
The resolution can be improved by means of the test arrangement below. When SPECIAL Ø1 is set, the 4040 measures the attenuation of the arrangement and takes it into account automatically.
Caution: not effective for level setting without SPECIAL Ø1.



Maximum AF level of the arrangement: 30 mV

Modulation Sensitivity with Subaudible Squelch

Measuring modulation sensitivity during simultaneous subaudio tone modulation (e.g. 150 Hz).

1. Measure FM of the subaudible tone
2. [CONDIT] [01] → Enter overall FM:

   Overall FM = useful FM (fmod 1 kHz) + subaudible FM

   Example: Useful FM = 3 kHz
   Measured subaudible FM = 2.54 kHz
   Enter: 3 + 2.54 = 5.54 kHz
3. Switch in CCITT filter for separation of the useful frequency from the subaudible tone
4. Enter expected modulation voltage for the 1 kHz signal
5. [ON] [01]

   The routine aligns for overall modulation, but due to the separating efficiency of the CCITT filter, only the modulation sensitivity of the 1 kHz signal is displayed.

   Since the subaudible tone is not suppressed completely by the CCITT filter, the modulation sensitivity indicated is 6 % too high.

02 Hold Peak Modulation Indication

Switch on measurement mode: [ON] [02] (ON 02)

Switch off: [OFF] [02] (OF 02)

03 Duplex Modulation Meter

Measurement procedure:

Measure transmitter power and frequency error with TX mode of the 4040.

Set output signal for the receiver of the duplex transceiver in RX mode of the 4040 and switch on the Duplex Modulation Meter:

[ON] [03] → ◇5 = modulation of the duplex transmitter (ON 03 M5 P5)

Switch off Duplex Modulation Meter: [OFF] [03] (OF 03)

04 Transmitter Harmonics

Measuring ratio in dB between fundamental and selected harmonic frequency of transmitter output signal.
Maximum harmonic frequency = 960 MHz

Transmitter unmodulated, 4040 tuned to fundamental frequency.

Procedure:

◇1

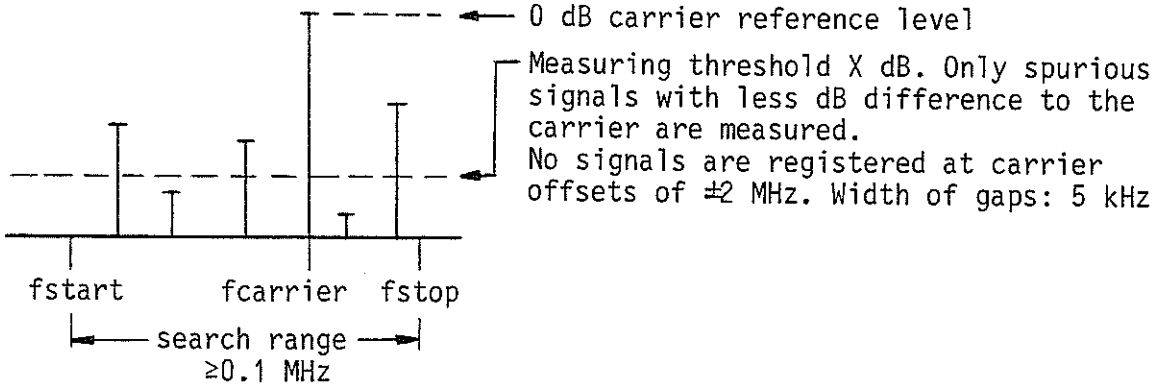
[ON] [04] [n] → ◇4 = dB ratio (ON 04 n M1 P1)

◇3 ◇5 ◇6 : no reading

n = 2-9
Order number of the harmonic.
With front panel control n can be changed without entering ON 04 again.

Switch off: [OFF] [04] (OF 04)

05 Spurious Signals



Search time: appr. 2 s for establishing the reference value on carrier frequency + appr. 9 s/MHz

Procedure:

1. Enter measuring conditions:

[CONDIT] [05] [X] [Rad MHz dB] [X] [Rad MHz dB] [X] [Rad MHz dB]

Measuring threshold X = 0...99.9 dB	Start frequency in MHz	Stop frequency in MHz

(CO 05 X DB X MH X MH)

2. Set carrier frequency with keyboard or by carrier frequency measurement (see 3-12).

3. [ON] [05] → ◇1◇ Continuous readout of actual search frequency

   Result readout when spurious is found → ◇4◇ dB

   ◇3◇ ◇5◇ ◇6◇ : no reading

   Continue search: [+] (+)

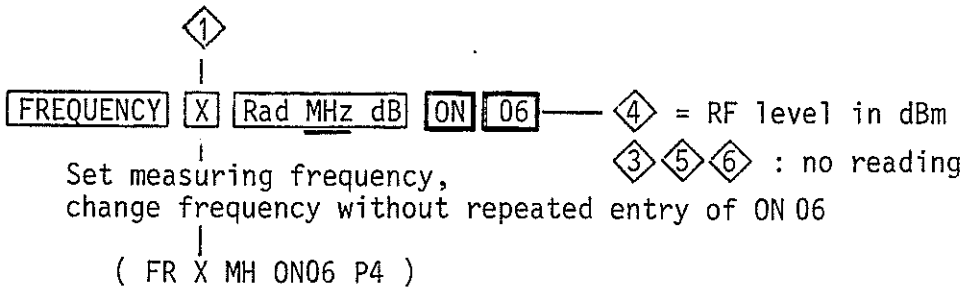
   When a printer or controller is connected the frequency and level of detected spurious signals are printed out and the search continued automatically up to the stop frequency.

   If harmonics are detected, these result in incorrect measurements. Only measure harmonics with SPECIAL 04.

4. Switch off routine: [OFF] [05] (OF 05)

06 Selective Level Measurement

Measuring range and bandwidth: see data sheet

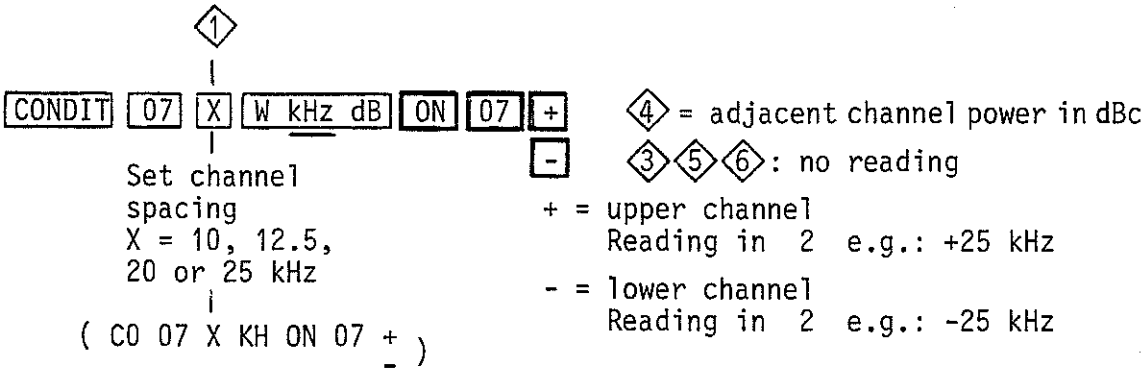


Recommended accessory for level measurements: RF Probe 860 108
Allow for possible pre-attenuation of the RF Probe: see SPECIAL 25.

Switch off level measurement mode: OFF 06

07 Adjacent Channel Power

The microprocessor calculates the adjacent channel power by adding the values from a corresponding number of measurements set over the total bandwidth of the adjacent channel.



The signal from the MOD VAR generator for setting transmitter modulation can be varied when SPECIAL 07 is set.

08 Wide Band FM at Receiver Measurement Mode RX

Switch on: ON 08 (ON 08) Switch off: OFF 08 (OF 08)

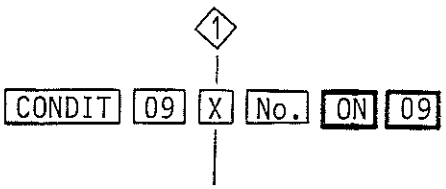
Frequency range	0.4 — 60	— 120	— 250	— 500	— 960	MHz
Max. int. FM deviation	80	20	40	80	80	kHz
Max. ext. FM deviation	80	20	40	80	160	kHz

Input level for maximum FM deviation at socket EXT MOD: 0.8 V peak

09 Waiting Times

Entry of waiting times on AUTOTEST (see chapter 4) required for the building up period of test objects. When waiting time is set, the next measuring step follows automatically.

Entry:

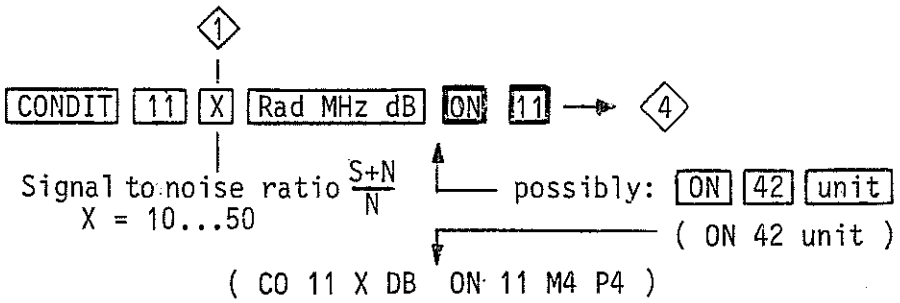


(CO 09 X NO ON 09)

Switch off waiting time: OFF 09 (OF 09)

11 S/N Sensitivity

Routine for measuring receiver sensitivity by the S/N method. Test modulation comes from the MOD 1 kHz generator, MOD VAR can be switched in additionally as pilot tone.



4 = EMF for the preset $\frac{S+N}{N}$ ratio in µV. Other units through ON 42 .

12 SINAD Sensitivity

Like SPECIAL 11 with SINAD ratio as measuring condition.

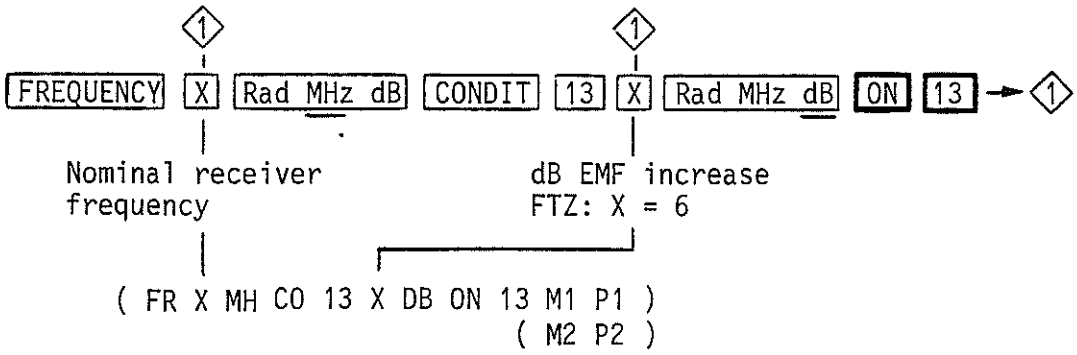
$$SINAD = \frac{Signal + Noise + Distortion}{Noise + Distortion}$$

13 Bandwidth and Center Frequency Error

Measurement according to FTZ method:

The routine measures the EMF for 10 dB noise suppression. After increasing this EMF by 6 dB the routine determines the corner frequencies which give again 10 dB noise suppression. Then the routine calibrates the bandwidth and center frequency error from the corner frequencies.

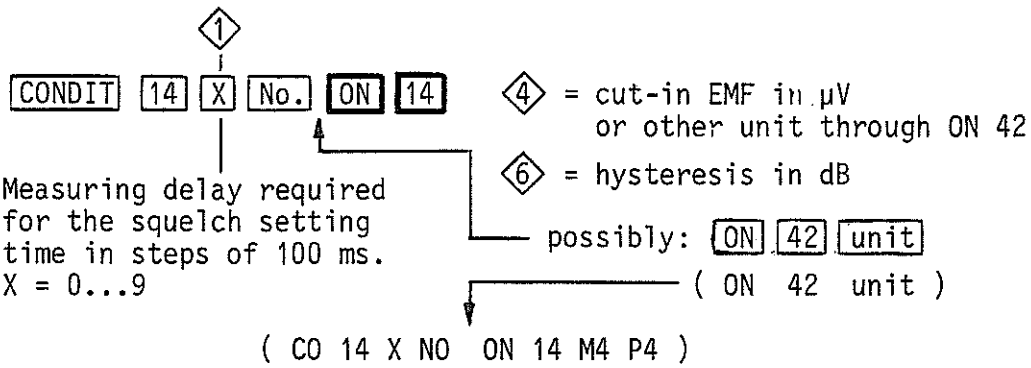
Procedure:



Result ① = bandwidth, ② = center frequency error

14 Squelch level

The routine ascertains the cut-in EMF at which the squelch clears the AF path and the squelch hysteresis. Test modulation comes from the MOD 1 kHz generator, MOD VAR can be switched in additionally as pilot tone.



If the cut-out EMF (blocks the AF path) is desired instead of the cut-in EMF the routine has to be called up as follows:

ON 41 ON 14 (ON 41 ON 14 M4 P4)

ON 41 remaines set. Switching off by OFF 41. (OF 41)

The squelch of the receiver can be activated automatically by means of the Control Interface (see 2-9).

15 Interruption Free Level Range

Operating mode for interruption free setting of the RF output level.

Switch on:

[ON] [15] → ◇4◇ Digital display = reference level (ON 15)
→ ◇4◇ Meter reading = setting range

Set interruption free output level by knob RF LEVEL: 

or by keyboard entry: [AMPLITUDE] [X] [Rad MHz dB] (AP X DB)

Setting range
X = -20.0 to +6.0 dB

Change reference level: [AMPLITUDE] [X] [unit]

Unit = dBµV, µV or mV. After entering a new reference level, the pointer in ◇1◇ is positioned at 0 dB. Alteration of the unit without entering a numerical value is not possible.

With SPECIAL 15 ON amplitude modulation with limited specifications also can be set at EMF >0.1 V (RF output) or >1 V (RF DIRECT).

Switch off interruption free level range: [OFF] [15] (OF 15)

16 Duplex Desensitisation and Duplex Filter Adjustment

Routine for determining the reduction of receiver sensitivity caused by the transmitter output power in the duplex channel.

◇4◇ = Sensitivity

[RX] [ON] [11] — [CONDIT] [16Ø] — switch on transmitter - [ON] [16] → ◇6◇ = Desensitisation in dB

(RX ON 11 CO 16Ø — switch on transmitter — ON 16 M6 P6)

Duplex Filter Adjustment:

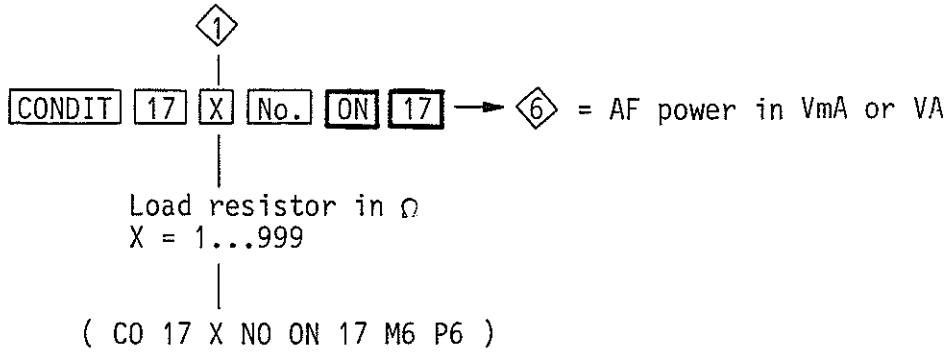
[CONDIT] [161] — switch on transmitter - [ON] [16] → ◇4◇ Analog reading = transmitter power
→ ◇4◇ Digital reading = EMF at the receiver

Automatic switching-on of the transmitter: see 2-9

17 AF Power

Terminate AF output of the receiver with nominal load.
The 4040 calculates the AF power from the voltage measured and the resistance value entered by keyboard.

Procedure:



18 Frequency Transfer

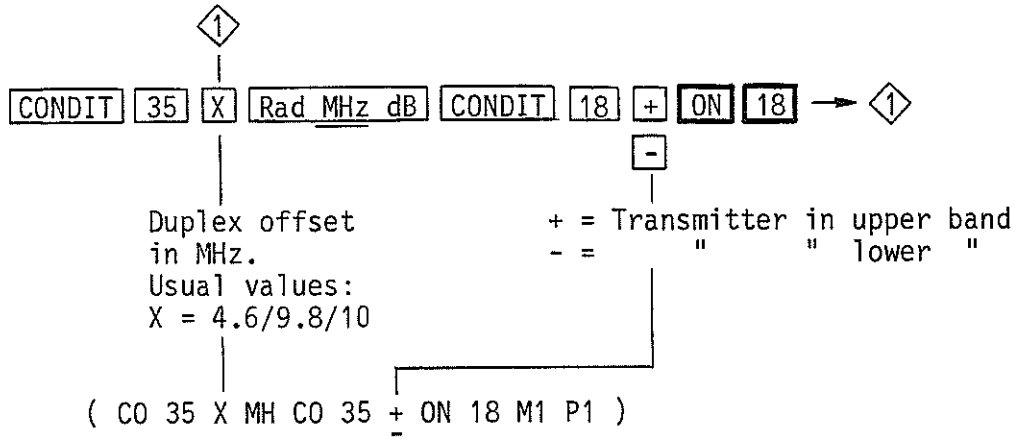
With SPECIAL 18 the frequency set in RX mode is also effective in TX mode and vice-versa. Duplex offset is taken into account. In conjunction with TX COUNT (page 3-12) the set can be automatically tuned to the transmitter frequency of the transceiver.

Entry with simplex:

ON 18 → 1 (ON 18)

1 = measured transmitter frequency. For all following TX and RX measurements the transmitter frequency will be automatically the reference frequency.

Entry with duplex:



Switch off operating mode: OFF 18 (OF 18)

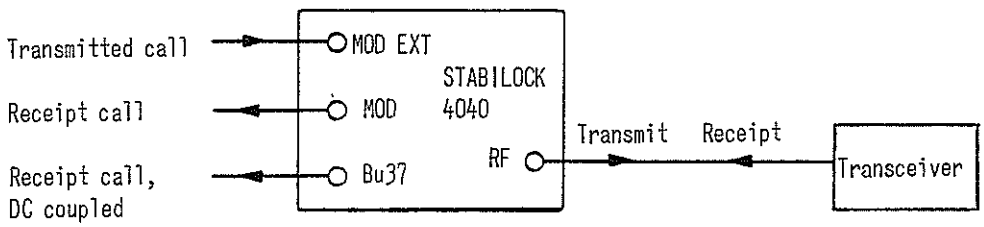
19 Fast RX/TX Switching Over

This operating mode provides fast switching-over from RX to TX measurement mode of the 4040 for receipt call measurement if an external Selective Call Coder/Decoder is used.

The RF output level of the 4040 is fixed to -60 dBm.
The switch-over of the 4040 caused by the output power of the transceiver is performed in less than 10 ms.

Procedure:

1. Set frequencies separateley for RX and TX duplex transceivers
2. Select the [RX] mode (RX)
3. Feed the call to be transmitted into the EXT MOD socket and set modulation
4. [ON] [19] (ON 19)
5. Release the call. When the transmitter replies, the demodulated transmitter signal will be available within <10 ms at the MOD socket or at Bu37 (DC coupled) on the rear panel of the 4040
6. The 4040 has to be prepared by [ON] [19] for each measurement (ON 19)



21 External AF Filter

Insertion of external AF filters into the AF path of the 4040. For distortion measurements on frequencies other than 1 kHz or for suppressing certain frequency ranges e.g. the subaudible range.

Connection conditions for filter: see page 2-6

Insert filter: [ON] [21] (ON 21)

By pass filter: [OFF] [21] (OF 21)

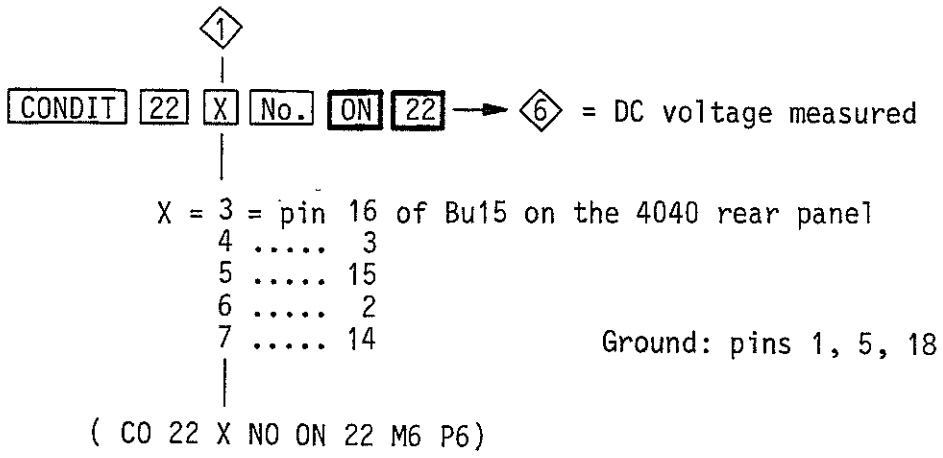
The 200 to 600 Hz Notchfilter 248 076 can be switched on by setting SPECIAL 21 and DISTORT.

22 DC Measuring Inputs

Connection of 5 DC measuring inputs to the DC voltmeter of the 4040.

Measuring range 0 to +5 V
Resolution 5 mV
Maximum permissible input ±20 V

Selection of input:



Switch off input: [OFF] [22] (OF 22)

23 Printout Mode

If on AUTOTEST only the print command [PRINT◇] [X] is entered for the particular measuring step (see p. 4-7), the result is printed out with unit but without any further comment.

Further printout modes can be selected with SPECIAL 23:

[CONDIT] [23] [X] [No.] [ON] [23] (CO 23 X ON 23)

Printout:

X = 0	Without comment,	---------- all results
1	" " ,	---------- if out of limit only
2	With result field no. P◇ ,	all results
3	" " " " " ,	if out of limit only
4	With Text (see page 4-10) ,	all results
5	" " " ,	if out of limit only
9	Program will stop at out of limit	

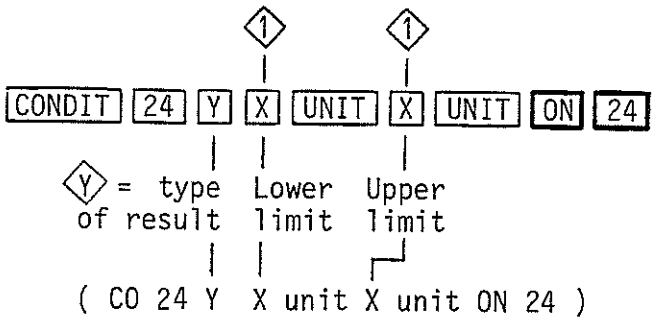
Entry of tolerances: see 3-33

If tolerances are exceeded, >>>> or <<<< is printed beside the result.

24 Entering Tolerance Limits

Entry of tolerance limits for the results ◇Y◇ = 1...6 as a criterion for the print out mode (see SPECIAL 23).
On AUTOTEST the tolerances must be entered separately for each step.

Entry:



The entry is independent of the set operating mode and valid for the specified unit only. Tolerance comparision is not possible if the sign changes. Tolerance entries can be made for the following results:

Y	Result	Unit by keyboard	Unit via IEC bus
◇2◇	Frequency offset	kHz	(KH)
◇3◇	AF frequency	kHz, Hz	(KH, HZ)
◇4◇	Transm. power	W	(Wu)
	RF level	µV, mV, dBµV, dBm	(UV, MV, DU, DM)
◇5◇	Modulation	kHz, %, rad	(KH, %u, RA)
◇6◇	AF level	mV, V (SINAD), dBREL	(MV, Vu, RL)
	Distortion	%	(%u)
	DC voltage	mV, V (SINAD)	(MV, Vu)
	DC current	mA (dBREL), A (VOLT/AMP)	(MA, Au)
	SINAD	dB	(DB)
	AF power	mW (DISTORT), W	(mW, Wu)

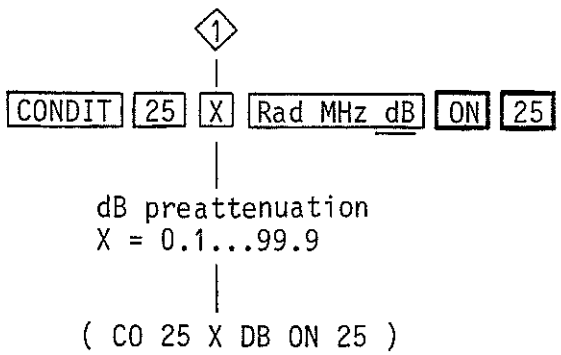
Double function keys:

DISTORT	SINAD	dBREL	VOLT/AMP
mW	V	mA	A

25 RF Attenuator

With SPECIAL 25 allowance is made for the preattenuation of a power attenuator pad (e.g. 4911) or of an RF probe by the power meter and by the RF level meter.

Allow for preattenuation:



Switch off allowance: OFF 25 (OF 25)

26 Autoranging off

In order to allow interruption free monitoring of the demodulated signal at the MOD output and at Bu16 (rear panel) the autoranging function of the AF Voltmeter can be switched off by SPECIAL 26.

Switch off autoranging: ON 26 (ON 26)

Overranging is indicated by -------

Switch on autoranging again: OFF 26 (OF 26)

27 External Modulation Setability

Setting external modulation by knob MOD 1kHz or by keyboard entry and remote control.
Input level required: 1 V peak into 600 Ω (see 3-9)

Switch on setability: ON 27 (ON 27)

Switch off setability: OFF 27 (OF 27)

28...29 Control Interface

By SPECIAL 28 and 29 relay functions of the Control Interface can be called up. There are two groups of relays:

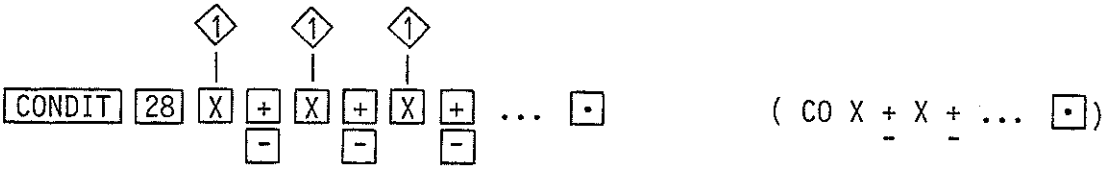
1. 16 relays with two-way contacts. When SPECIAL 28 is set three of these relays are activated automatically depending on the operating modes RX/TX, squelch on/off and upper/lower band. The other relays can be called up separately.

   Connection diagram: Bu19, page 2-9

2. 16 relays with on-off contacts. This relays can be called up separately or can be used for BCD code output of channel numbers according to SPECIAL 37.

   Connection diagram: Bu18, page 2-8

Set relays:



X = relay no. see page 2-8, 2-9
\+ = set relay
\- = reset relay

Cancelling of all relays set: CONDIT 28 .

Switch relays to the operative position: ON 28 (ON 28)
Non-operative position: OFF 28 (OF 28)

Output of channel number: ON 29 (ON 29)
Reset output of channel number: OFF 29 (OF 29)

31 Selfcheck

Start selfcheck routine: [ON] [31] (ON 31)

Continue routine after error indication: [+]

If no error is found , the frequency indication appears in display ⟨1⟩. If a fault in the 4040 is determined, the unit number in which the error occurs and the kind of error are indicated in ⟨1⟩. The designations used in the display for the interchangable units are also printed on the rear panels of the units, e.g. U2 for the Output Unit. If a repair is required it is important to report all errors indicated by the selfcheck routine to the service department.

Immediately after switching-on the display may indicate a fault caused by the warm-up period of the test set not being finished. External signals or too low load resistances at the front panel sockets may cause wrong error messages.

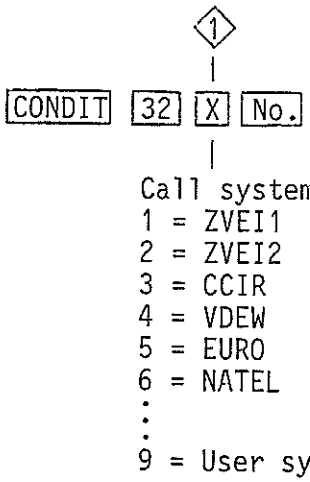
Survey of possible fault indications: see next page

Survey of possible faults:

Display ⓘ	Fault in:	Faulty:
Err U 1.1	Power Supply 204 040	Supply voltages
Err U 2.1	Output Unit 230 040	Level control ALC
Err U 3.1	UHF Synthesis 213 040	Oscillator
.2		Divider
.3		Osc. + Div.
Err U 4.1	80 MHz Spectrum 224 040	Synchronization (Sync)
.2		Spectrum oscillator
.3		Sync + Sp.Osc.
.4		Thermostat
.5		Thermost. + Sync
.6		Thermost. + Sp.Osc.
.7		Thermost. + Sp.Osc. + Sync
Err U 5.1	Decade Synth. 210 040	10 Hz Decade
.2		100 kHz Decade
.3		10 Hz Dec. + 100 kHz Dec.
.4		Unsync >0.5 sec at 0.40123 MHz
		or 1.23456 MHz
		or 1.56789 MHz
.5		Unsync >0.5 sec at 0.45100 MHz
Err U 6.1	IF Unit 229 040	Counter 10 Hz resolution
.2		" 1 Hz "
.3		AM Demodulator
.4		FM Demodulator
.5		ΦM Demodulator/Deemphasis
Err U 7.1	Mod Generator 208 040	1 kHz Generator Frequency
.2		" " Amplifier
.3		" " Level DAC
.3		" " Distortion
.4		Variable Gen. Frequency
.5		" " Amplifier
.6		" " Level DAC
.7		" " Distortion
.8		Output amplifier
Err U11.1	AF Detector 209 040	RMS Detector
.2		Notchfilter
.3		CCITT filter
.4		Pos. DC peak detector
.5		Neg. "
.6		RF level control 10+8 bit DAC
Err U13.1	Attenuator 226 040	Att Rls1 (Bu RF) <Att Rls8(20 dB)
.2		" Rls2 (20 dB) ≠ " "
.4		" Rls4 " ≠ " "
.6		" Rls6 " ≠ " "
.7		" Rls7 (8 dB) > " Rls5(16 dB)
		or < " Rls3(4 dB)
.9		" Rls5+3(16+4dB)≠ " Rls8(20 dB)
Err U14.1	RF Detector 229 043	Zero drift
Err U16.1	Adjacent 229 042	1 MHz Oscillator/Adj.Ch.P.Meter
.2	Channel Power Meter	1 MHz Oscillator switch

SELECTIVE CALL TEST

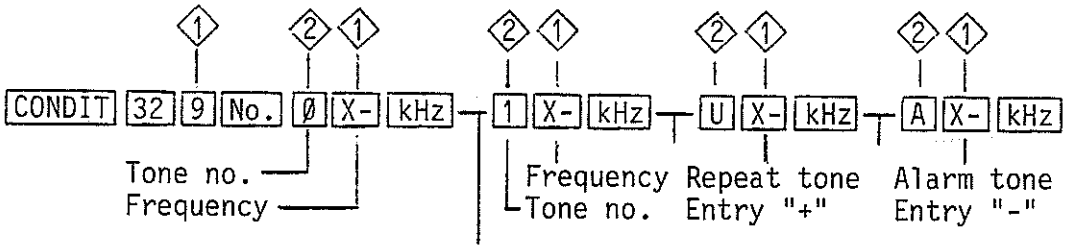
32 Selection of the Call System



(CO 32 X NO)

The ZVEI1 call system can also be selected by using the "Basic Setting for Selective Call Test" (see 3-41).

For the no. 9 system the user can allocate arbitrary tone frequencies to the tone numbers by the following entry:



(CO 32 9 NO Ø X KH ┬ 1 X KH ┬ U X KH ┬ A X KH)
X (Ending of entry by character X)

Frequency allocations (Hz):

Tone no.	ZVEI1	ZVEI2	CCIR	VDEW	EURO	NATEL	User
Ø	2400	2200	1981	2280	980	1633	
1	1060	970	1124	370	903	631	
2	1160	1060	1197	450	833	697	
3	1270	1160	1275	550	767	770	
4	1400	1270	1358	675	707	852	
5	1530	1400	1446	825	652	941	
6	1670	1530	1540	1010	601	1040	
7	1830	1670	1640	1240	554	1209	
8	2000	1830	1747	1520	511	1336	
9	2200	2000	1860	1860	471	1477	
10 U "+"	2600	2400	2110		1063	200	
11 A "-"	2800	2600	2400		1153	1805	

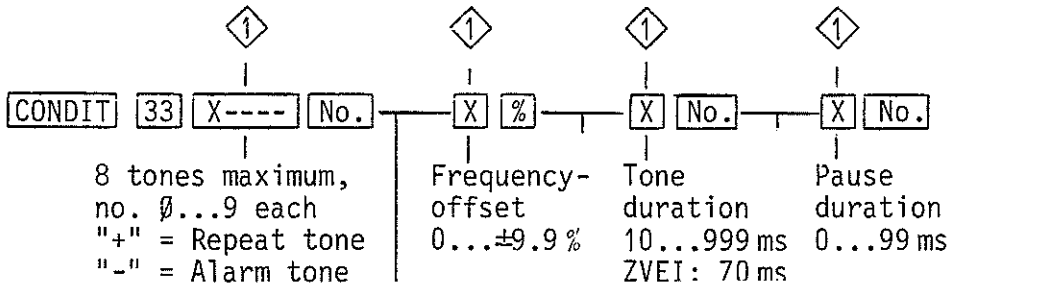
U "+" = Repeat tone
A "-" = Alarm tone

Rounded up or down according to 1 Hz frequency resolution of the AF generator

33 Encoder

Select the Call System (see 3-38)

Enter call tones and call tone parameters:



(CO 33 X NO X %∪ X NO X NO)

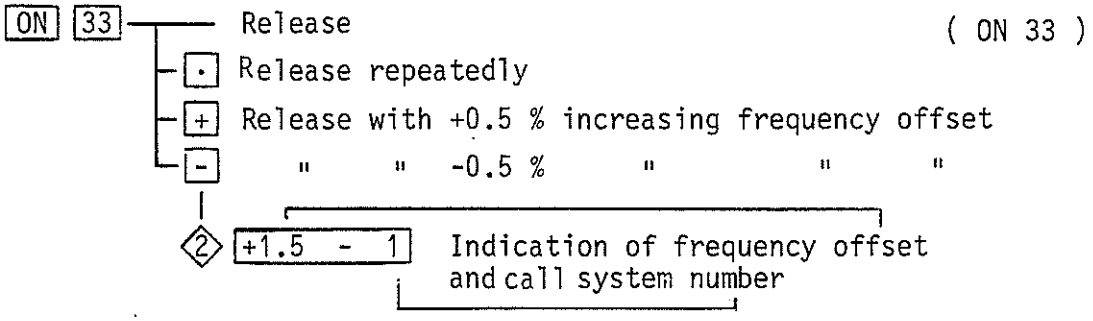
X (Ending of entry by character X)

Entry of the repeat tone in first place only. The repeat tone is sent automatically when a tone is entered twice in sequence.

Tone duration extension:

By entering [·] after one of the first four tones the duration of this tone is extended by ten.

Releasing the tone sequence:



During ON 33 only the keys [+] [-] [·] can be activated. Depressing any other key will interrupt the routine.

By ON 33 relay 05 of the Control Interface (see 2-9) is activated 200 ms before the first tone (transmitter advance time).

Set call tone deviation for receiver measurement:

MOD VAR | FM AM ΦM | value | W kHz dBm ⟶ Display in ◇5

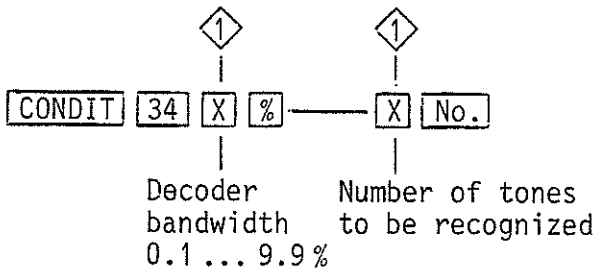
Set output level at socket MOD GEN :

GEN VAR | FM AM ΦM | value | mV | MOD ⟶ Display in ◇6

34 Decoder

Select the Call System (see 3-38)

Enter the decoder parameters:



(CO 34 X %∪ NO)

Set decoder to waiting position:

ON 34 (ON 34)

The numbers of recognized tones of the call system selected by CONDIT 32 are indicated in ◇1◇ (recognition decoder).

Tones out of bandwidth are not recognized

Tones which are shorter than 0.7 times of the tone duration set through CONDIT 33 are not recognized

At pause durations >200 ms after receiving the first tone the decoding is interrupted

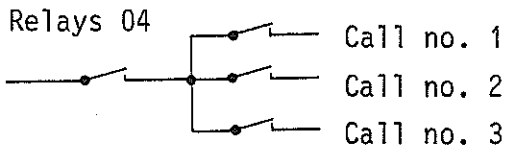
"-" appears at tones not recognized

"A" appears for the alarm tone

"U" appears for the repeat tone in first place

By ON 34 relay 04 of the Control Interface (see 2-9) is activated (Calling key)

Various calls can be released from the transceiver by use of further relays of the Control Interface:



Pin occupancy: 2-9
Setting of the relay: 3-35

During waiting position ON 34 alterations of the measured values are not registrated.

End waiting position: by depressing any arbitrary key (X)

Entry for indication of the call tone deviation:

ON 02 ⟶ ◇5◇ (ON 02 FM M5 P5)

32 Receipt Call

Operation:

1. Select the call sytem number: CONDIT 32 ..., page 3-38
2. Set Encoder: CONDIT 33 ..., page 3-39
3. Set Decoder: CONDIT 34 ..., page 3-40
4. Release a call: [RX] [ON] [32] (RX ON 32 P1)

After releasing the call, the test set switches over to transmitter measurement mode TX in less than 10 ms. The call tone sequence received is indicated in ◇1.

Basic Setting for Selective Call Testing

The selective call test parameters stored cannot be cancelled by the reset functions given on page 3-2. They can be changed only by overwriting.

The following basic parameters can be set by depressing the [OFF] key while the [RESET] key is held depressed (not possible by IEEE488 bus control):

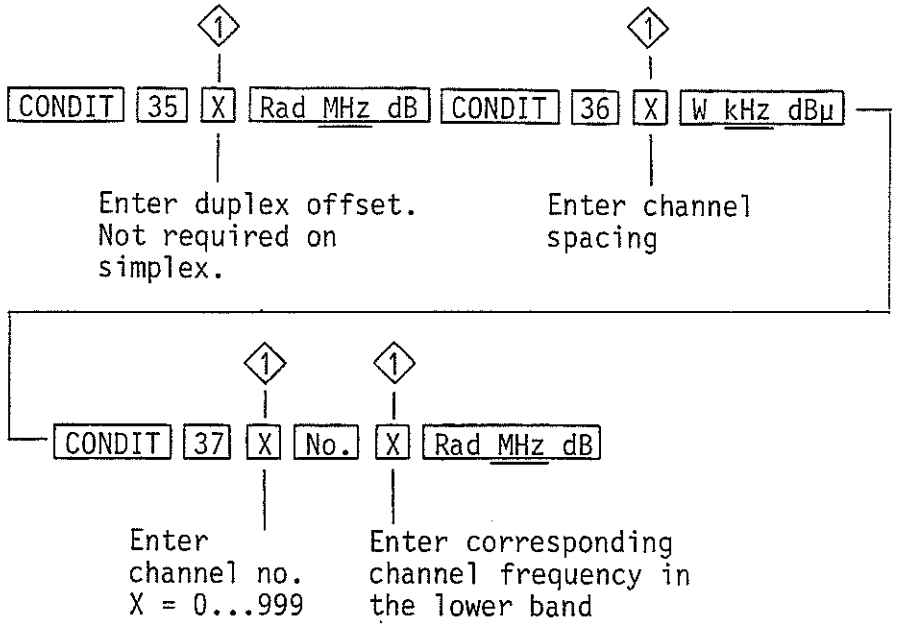
ZVEI1
5 tones
70 ms tone duration
Ø ms pause duration
Ø % frequency offset
User system cancelled

35 ... 37 Channel Number

Permits calling up channel frequencies by entering channel numbers.

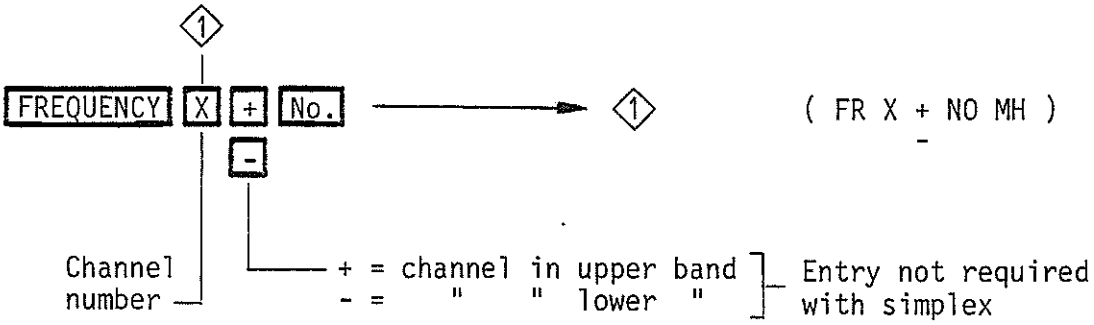
The channels can be numbered in ascending or in descending order. For descending order (channel no. 1 = channel with highest frequency) [ON] [44] (ON 44) must be set in conjunc-tin with SPECIAL 35 ... 37.

Enter channel pattern:



(CO 35 X MH CO 36 X KH CO 37 X NO X MH)

Calling up channel frequencies by the channel number:



Change-over to frequency display: [Rad MHz dB]

Back to number display: [No.]

The channel numbers called up can be output by the Control Interface and used for frequency control of the transceiver under test (see SPECIAL 29, page 3-35).

43 S/N Measurement

When [ON] [43] is set, the signal to noise ratio of the receiver depending on the RF level applied to its input is measured and displayed in ◇6◇ (not possible by IEEE488 bus control).

IEEE 488 Bus

GENERAL DATA

The STABILOCK 4040 is upgraded to feature a GPIB interface by means of the IEEE 488 Interface Option 236 040. The interface fulfils all functions of the IEEE 488 and IEC 625 standards. The 24-pin connector is located at the rear of the Unit (Bu 20).

All the functions of the interface are handled by the Motorola module M68488 in combination with pre-connected data drivers.
Available functions: AH1, SH1, L2, T2, SR1, RL1, DC1.

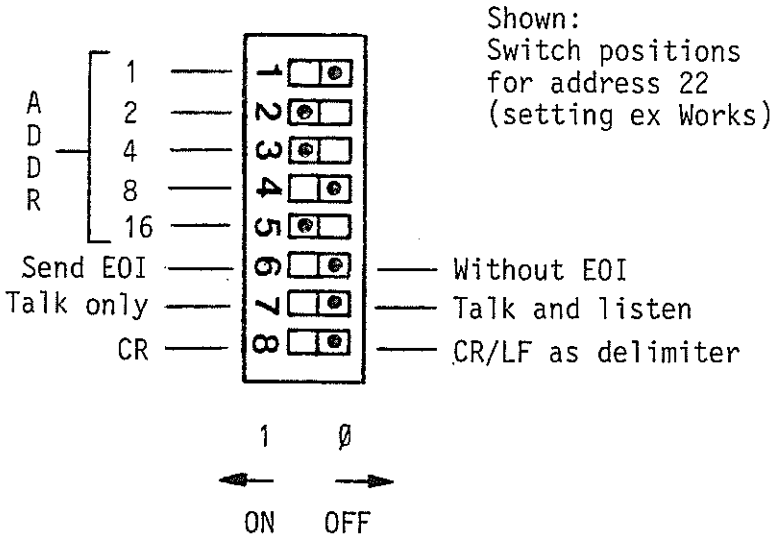
If the GPIB is activated by the control processor, the REMOTE display on the 4040 lights up and all front panel control elements are inoperable. The numerical and mode displays remain in operation.

The 4040 is operated with the IEEE 488 Bus by using 2-letter codes which are extremely easy to learn since they are closely related to the clear text used on the front panel of the 4040. The code letters are underscored on the front panel.

ADDRESS SWITCH

The bus address of the STABILOCK 4040 is set at a dip switch on the IEEE 488 Interface 236 040 on the rear panel of the unit using the code table on page 5-3.

Address switch:



The bus address set can be displayed in field ◇1 by entering [ON] [64].

Example with address 22: [3.15 – – A22]

The reading is by 64 higher as the set address, if the TALK ONLY mode is switched on. In the example above the reading would be A86.

Switch off address display with FUNCTION or RESET key.

Further functions of the address switch:

Switch 6: printout with or without sending EOI

Switch 7: for setting the TALK ONLY mode of the STABILOCK 4040. The TALK ONLY mode has to be switched off, if the 4040 works in conjunction with a controller.

Switch 8: determines if CR/LF or CR (Commodore) is used as delimiter of the print strings.

Address Coding

Address Switch Positions (1 = ON)					Talk Address Character	Listen Address Character	Address Numbers (5 Bit Decimal Value)
Switch No.							
5	4	3	2	1			
0	0	0	0	0	@	SP	00
0	0	0	0	1	A	!	01
0	0	0	1	0	B	"	02
0	0	0	1	1	C	#	03
0	0	1	0	0	D	$	04
0	0	1	0	1	E	%	05
0	0	1	1	0	F	&	06
0	0	1	1	1	G	'	07
0	1	0	0	0	H	(	08
0	1	0	0	1	I	)	09
0	1	0	1	0	J	*	10
0	1	0	1	1	K	+	11
0	1	1	0	0	L	,	12
0	1	1	0	1	M	–	13
0	1	1	1	0	N	.	14
0	1	1	1	1	O	/	15
1	0	0	0	0	P	0	16
1	0	0	0	1	Q	1	17
1	0	0	1	0	R	2	18
1	0	0	1	1	S	3	19
1	0	1	0	0	T	4	20
1	0	1	0	1	U	5	21
1	0	1	1	0	V	6	22
1	0	1	1	1	W	7	23
1	1	0	0	0	X	8	24
1	1	0	0	1	Y	9	25
1	1	0	1	0	Z	:	26
1	1	0	1	1	[	;	27
1	1	1	0	0	\	<	28
1	1	1	0	1	]	=	29
1	1	1	1	0	^	>	30

BUS COMMANDS FOR THE STABILOCK 4040

The GPIB can be used to perform all of the possible mode and numerical settings available on the front panel of the STABILOCK 4040, the AUTO operating mode excepted.

The commands for setting modes consist of one or more code designations each of 2 letters. Numerical values are entered together with the related function and unit of measure.

Examples:	Bus Command
Preparing frequency deviation measurement (TX)	MM KH or also FM
Display of positive modulation peak	PO
Retrieving frequency deviation measurement	M5 P5
Frequency setting (RX)	FR 151.65 MH
Frequency deviation setting	MM 2.8 KH
Retrieving frequency setting	P1

General Commands:

Signification	Bus Command
Request to the STABILOCK 4040 to perform the measurement. Display of the measured value in field Y = 1...6. The execution of measurements called up is confirmed by the MEASUREMENT lamp in the SPECIAL field lighting up.	MY
Retrieving measured values or existing settings on 4040.	PY
Request for cyclical measurements without transfering the measured values to the controller.	MA
End cyclical measurement. End sel call test	Xu
Examination of the bit pattern test inputs (see 2-8) and result presentation e.g. bit 8 — 01110001 — bit 1	P9

Transmitter and Receiver Measurements:

A survey of the bus commands for the STABILOCK 4040 corresponding to the appropriate measuring tasks is given on pp. 5-5 and 5-6.

SPECIALs:

The bus commands for operating SPECIALs are given in the description of front panel operation from page 3-20 on in parentheses.

Bus Commands for the STABILOCK 4040

4040 Settings and Calling up Measuring Results	Bus Command (υ = space)
Operating mode AUTO (automatic RX/TX selection)	not via bus
TRANSMITTER MEASUREMENT	TX (1x for all following transmitter measurements)
Transmitter output:	
Average power	AV
Envelope peak power	PK
Call up result	M4 P4
Transmitter frequency:	
Set nominal frequency	FR DATA MH
Call up frequency offset	M2 P2
Measure and call up transmitter frequency	M1 P1
Output of Modulation Generators:	
Set frequency 30 Hz...30 kHz	GR ON MF DATA KH or HZ
Set output level (mV)	MM DATA MV
Switch on 1 kHz Generator	GK ON
Set output level	MM DATA MV
Switch on EXT MOD input	GX ON
Set EXT MOD	ON 27 MM DATA MV
Switch off generators	GR OF, GK OF, GX OF
Modulation measurement:	
FM	MM KH or FM
AM	MM %υ " AM
ΦM	MM RA " PM
Positive modulation	PO
Negative modulation	NE
Average modulation	PE
Call up result	M5 P5
Measure and call up modulation distortion	MO DI M6 P6
Relative residual modulation:	
Set useful reference modulation	MO RL
Switch off modulation	GR OF or GK OF
Call up residual modulation (CCITT)	CC ON M6 P6
Transmitter measurement via RF DIRECT socket	DR ON
Again via RF socket	DR OF

4040 Settings and Calling up Measuring Results	Bus Commands
RECEIVER MEASUREMENTS	RX (1x for all following receiver measurements)
Set frequency	FR DATA MH
Set frequency by the channel number (see SPECIAL 35...37)	FR NO (+/-) MH
Set frequency offset	FR +/- DATA KH
RF output level:	
Set EMF in µV	EM AP DATA UV
" " " mV	" " " MV
" " " dBµV	" " " DU
Set into 50 Ω voltage in µV	IN " " UV
" " " " " mV	" " " MV
" " " " " dBµV	" " " DU
Set output power in dBm	" " " DM
Switch off output level	LE OF
Switch on again	LE ON
Call up set value	P4
Modulation:	
Set mod. frequency 30 Hz...30 kHz	MR ON MF DATA KH or HZ
Set FM	MM DATA KH
" AM	" " %υ
" ΦM	" " RA
Switch on 1 kHz Mod. Generator	MK ON
Set modulation	as for 30 Hz...30 kHz
Switch on EXT MOD	MX ON
Set EXT MOD	ON 27 MM DATA KH, %υ or RA
Call up set value	P5
Switch off Mod. Generators	MR OF, MK OF, MX OF
AF Voltmeter:	independent of RX/TX
Measure AF level from receiver	AC VA
" distortion	AC DI
Measure mod. frequency response:	
Reference level (fmod 1 kHz)	AC VA RL
Relative measurement	MF DATA (mod. frequ.) KH
Set SINAD display mode	AC SI
Set CCITT weighting	CC ON, CC OF
Call up result	M6 P6
AF frequency measurement	M3 P3
DC Measurement:	
DC voltage	VD
DC current	AD
Call up result	M6 P6

Service Request

The commands below can be used to determine the operating Statuses in which STABILOCK 4040 should send SRQ:

[ON] [49] [X] (ON 49 X)

X = 1 SRQ at end of measurement
X = 2 SRQ with selfcheck error message
X = 3 SRQ if synthesizer not synchronous

Combination of several operating statuses by addition, for example SRQ at end of a measurement and with selfcheck message: X = 3

Switching off the SRQ function:

[OFF] [49] (OF 49)

Output Format

Output format of STABILOCK 4040 with IEEE 488 bus

String length: 24 characters + CR LF

Format:

Position

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
10 spaces for perforation										Measured value Right-justified Maximum 9 positions Filling up with spaces, e.g.:									2 spaces		Unit Left-justified			CR/LF
␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	1	2	3	.	2	5	0	0	0	␣	␣	M	H	Z		
␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	.	3	␣	␣	M	V	␣		
␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	1	7	.	2	7	␣	␣	W	␣	␣		

Application Notes

STABILOCK 4040

Contents

RECEIVER MEASUREMENTS

TRANSMITTER MEASUREMENTS

Receiver sensitivity is the EMF of 4040 at the receiver input, which produces a defined signal/noise ratio (S/N) with standard modulation on the nominal frequency of the receiver at the AF receiver output. Common signal/noise ratios are:
With FM/ΦM= 20 dB S/N, with AM = 10 dB S/N - which are normally measured weighted (CCITTP53 filter).

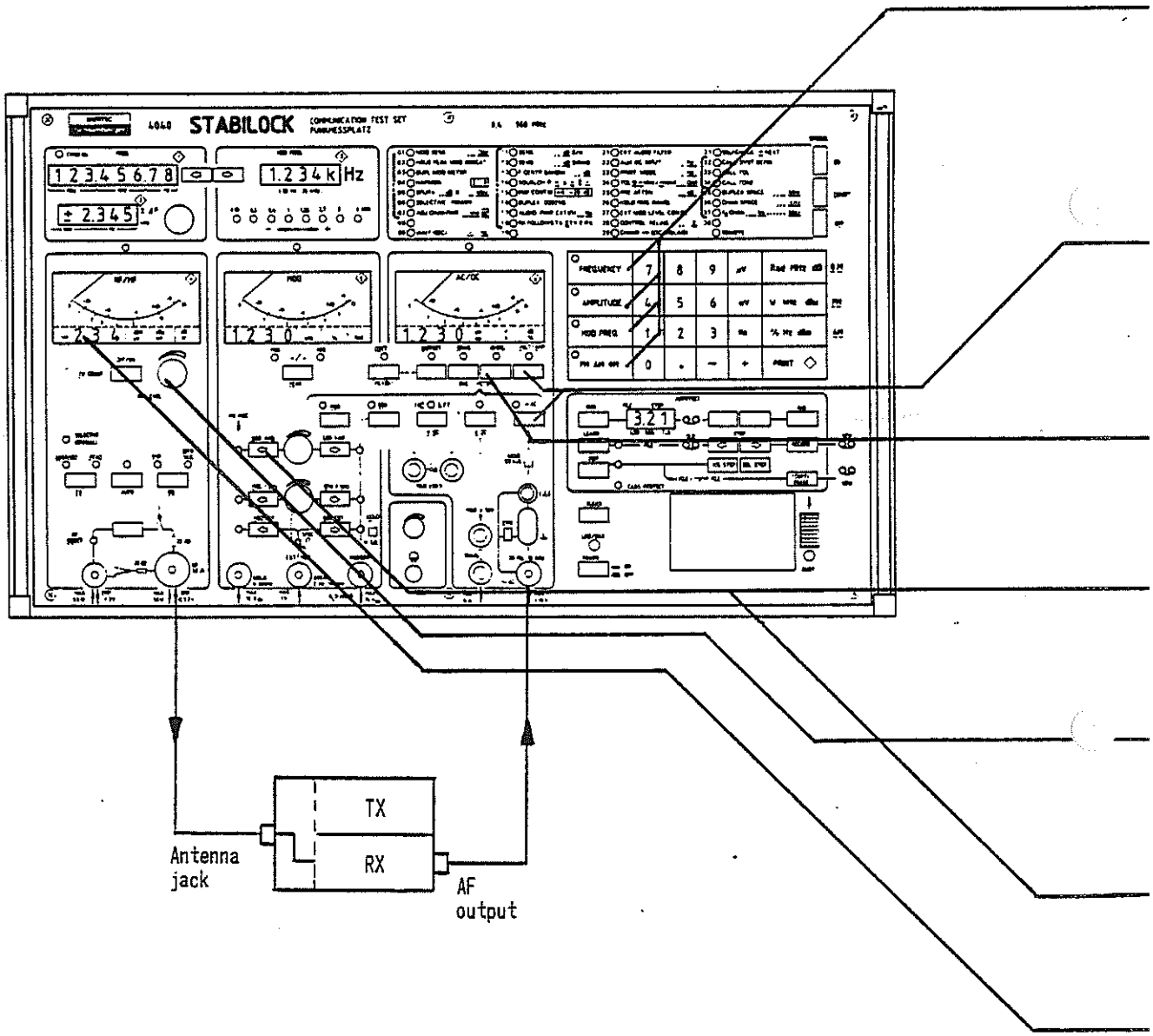


Fig. 1:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations
Connect radiotelephony set and 4040 as shown in Fig. 1. Mode RX or AUTO	Are the cables ok? Ensure short RF connections, cable attenuation falsifies your measuring results - use double screened (dense) RF cables!
Set: Nominal frequency EMF 10 µV standard modulation	Initial EMF and standard modulation are set as specified in the applicable regulations or specifications. Example: EMF 10µV, modulation frequency 1 kHz, frequency deviation 2.8 kHz
Voltmeter to: VOLT/AMP ~AC	Voltmeter ⑥ indicates receiver AF voltage - does this voltage correspond to your specification? Correct with the volume control of your receiver. If you have to measure weighted - switch on CCITT filter.
Voltmeter to dB REL	Voltmeter indicates "0 dB". The AF voltage of the receiver (useful signal) is thus the reference value for the signal/noise ratio.
Switch off modulation	The S/N ratio for the initial EMF is indicated on the voltmeter: e.g. -40 dB
Reduce EMF until voltmeter indicates desired S/N value.	The voltmeter indicates the signal/noise ratio you desire e.g. -20 dB. Following this, the reference value must be checked.
Switch on modulation. Does voltmeter indicate 0 dB?	Check whether the receiver is still adequately limiting - if not - redefine reference.
No → Yes	
Read off EMF. EMF is sensitivity!	The EMF reading is the receiver sensitivity for the defined signal/noise ratio.

Receiver sensitivity is the EMF of 4040 at the receiver input, which produces a defined signal/noise ratio (S/N) with standard modulation on the nominal frequency of the receiver at the AF receiver output.
Common signal/noise ratios are:
With FM/ΦM= 20 dB S/N, with AM = 10 dB S/N - which are normally measured weighted (CCITTP53 filter).

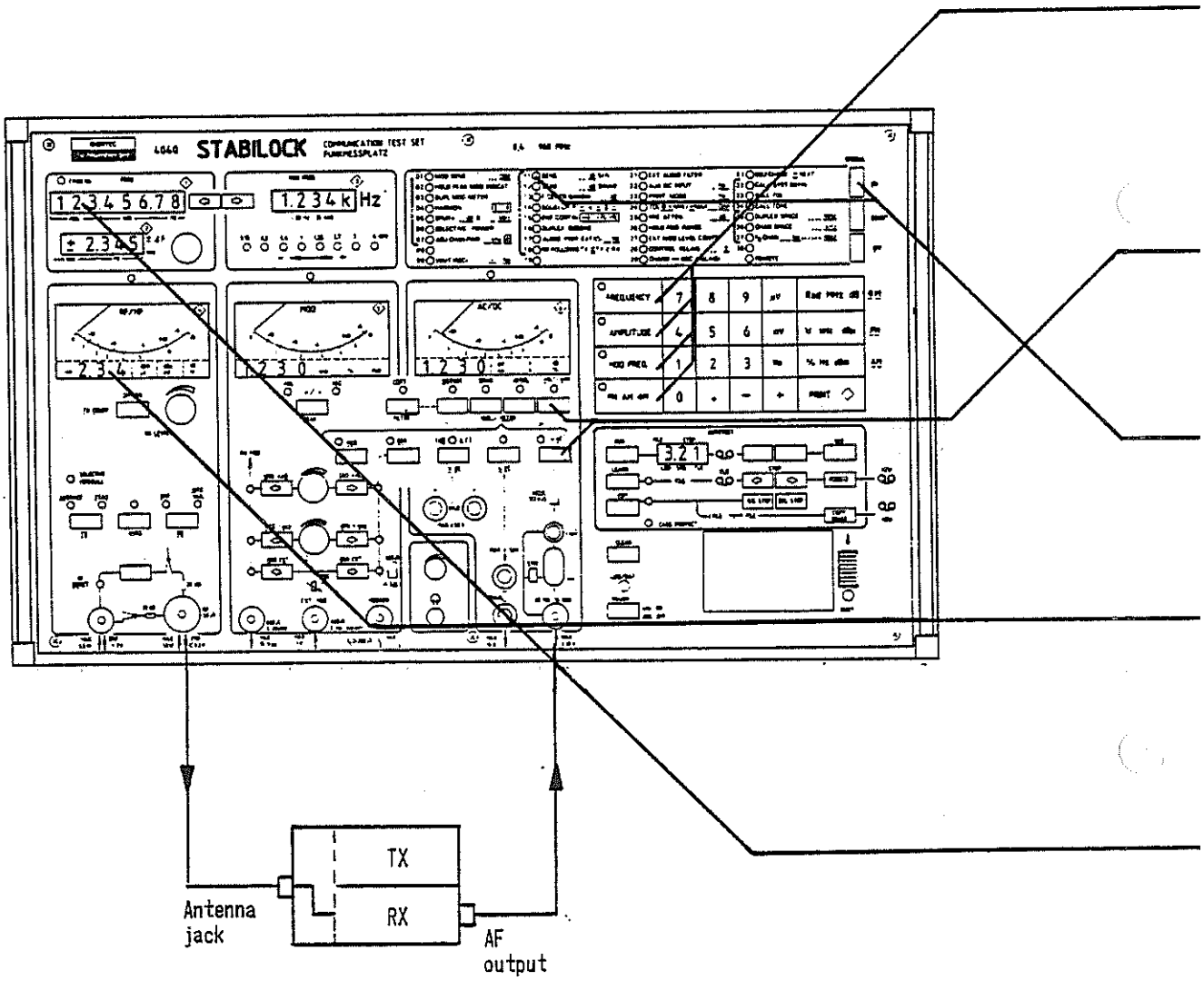
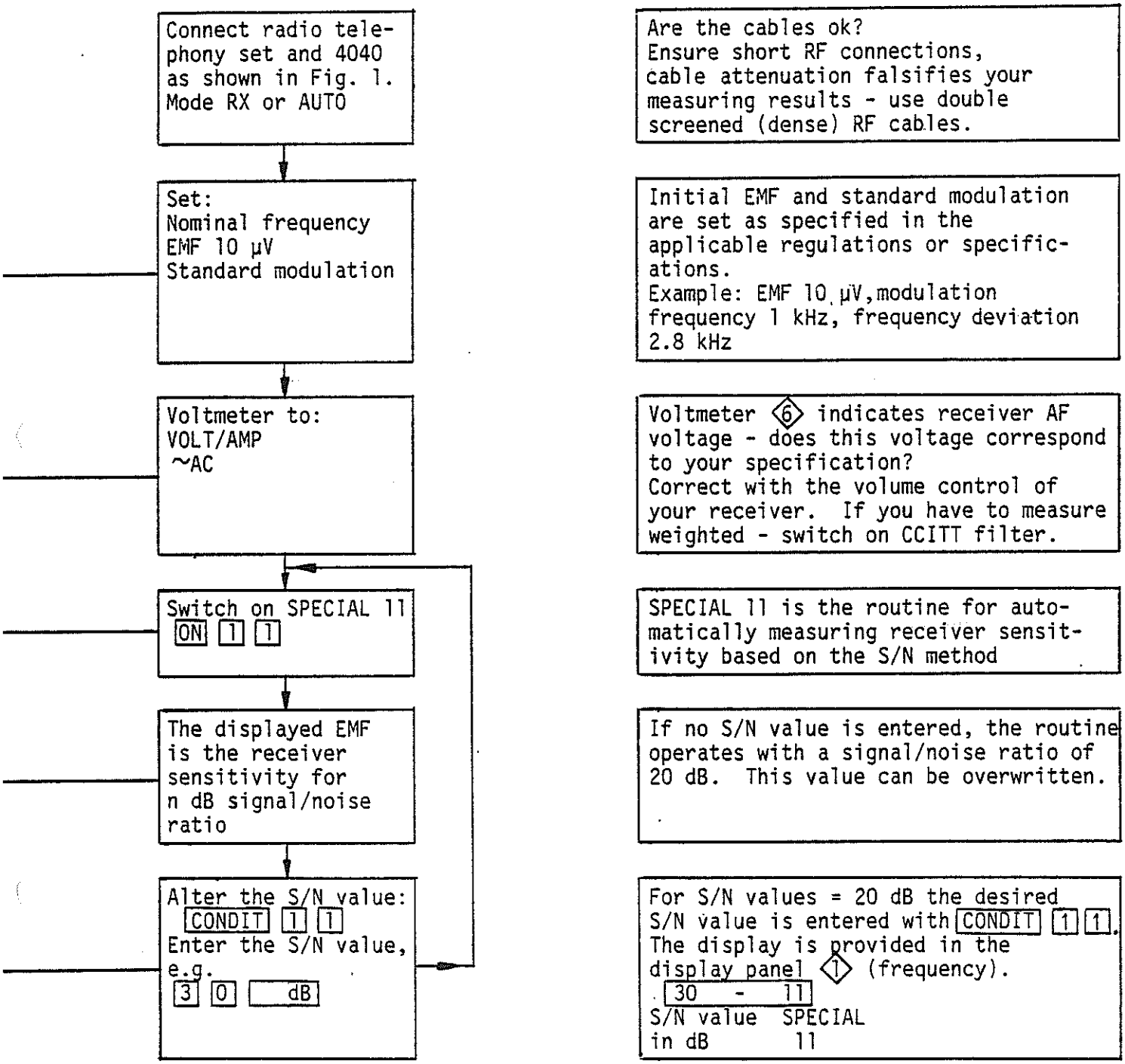


Fig. 1:
Test Configuration for Receiver Measurements


Connect radio telephony set and 4040 as shown in Fig. 1. Mode RX or AUTO
Are the cables ok? Ensure short RF connections, cable attenuation falsifies your measuring results - use double screened (dense) RF cables.
Set: Nominal frequency EMF 10 µV Standard modulation
Initial EMF and standard modulation are set as specified in the applicable regulations or specifications. Example: EMF 10 µV, modulation frequency 1 kHz, frequency deviation 2.8 kHz
Voltmeter to: VOLT/AMP ~AC
Voltmeter 6 indicates receiver AF voltage - does this voltage correspond to your specification? Correct with the volume control of your receiver. If you have to measure weighted - switch on CCITT filter.
Switch on SPECIAL 11 ON 1 1
SPECIAL 11 is the routine for automatically measuring receiver sensitivity based on the S/N method
The displayed EMF is the receiver sensitivity for n dB signal/noise ratio
If no S/N value is entered, the routine operates with a signal/noise ratio of 20 dB. This value can be overwritten.
Alter the S/N value: CONDIT 1 1 Enter the S/N value, e.g. 3 0 dB
For S/N values = 20 dB the desired S/N value is entered with CONDIT 1 1. The display is provided in the display panel 1 (frequency). 30 - 11 S/N value in dB SPECIAL 11

Receiver sensitivity is the EMF of 4040 at the receiver input, which produces a defined SINAD (SND/ND) ratio with standard modulation on the nominal frequency of the receiver at the AF receiver output.

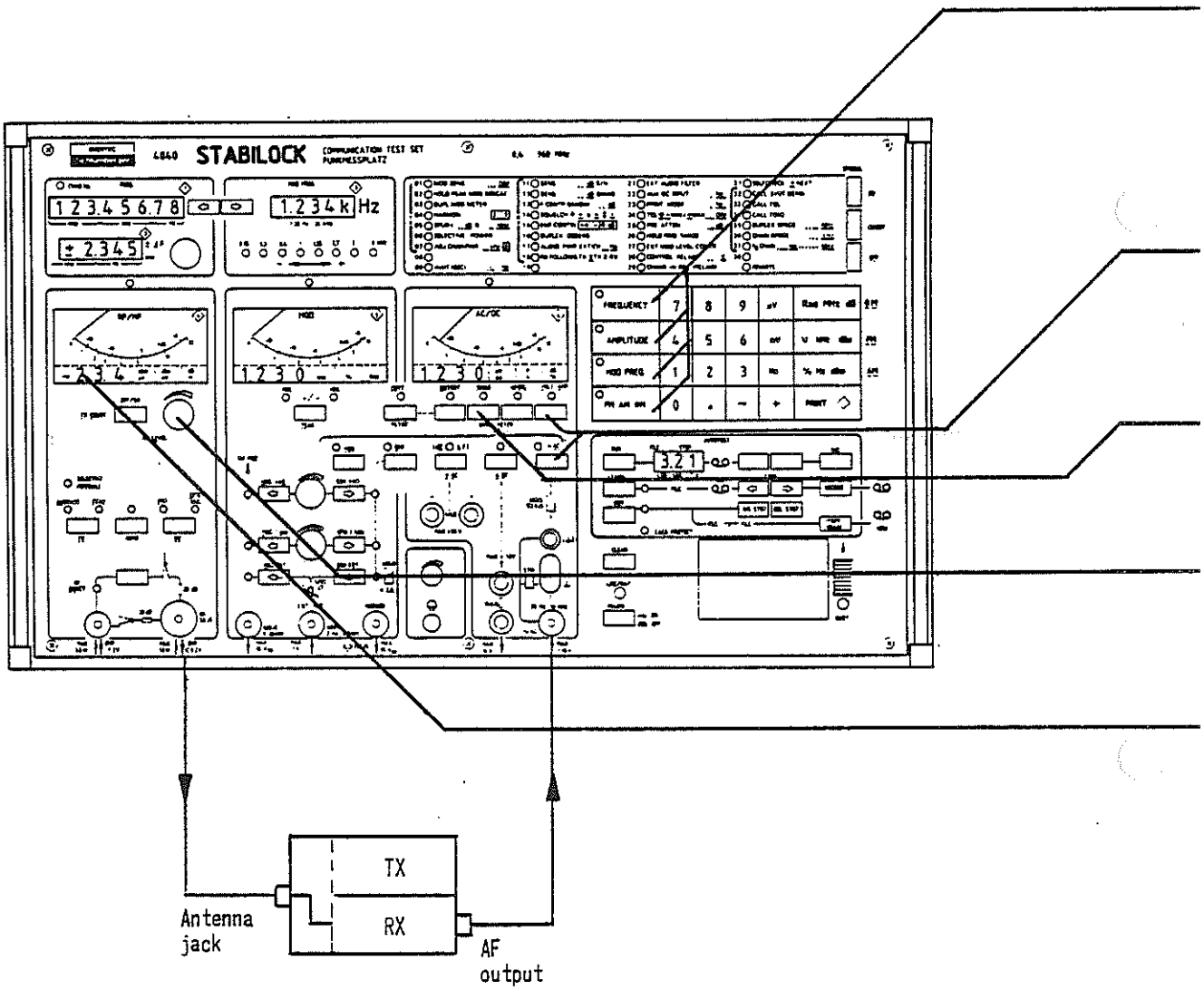


Fig. 1:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations
Connect radiotelephony set and 4040 as shown in Fig. 1. Mode RX or AUTO	Are the cables ok? Ensure short RF connections, cable attenuation falsifies your measuring results - use double screened (dense) RF cables!
Set: Nominal frequency EMF 10 µV standard modulation	Initial EMF and standard modulation are set as specified in the applicable regulations or specifications. Example: EMF 10 uV,modulation frequency 1 kHz, frequency deviation 2.8 kHz
Voltmeter to: VOLT/AMP ~AC	Voltmeter ⟨6⟩ indicates receiver AF voltage - does this voltage correspond to your specification? Correct with the volume control of your receiver. If you have to measure weighted - switch on CCITT filter.
Voltmeter to SINAD	The voltmeter becomes the SINAD meter: S+N+D/N+D
Reduce EMF until the voltmeter indicates the desired SINAD ratio	Common SINAD ratios are: 20 dB or 12 dB. Please use the analog display of the voltmeter.
Read off EMF. EMF = sensitivity	The EMF reading in the EMF panel ⟨4⟩ is the receiver sensitivity for the SINAD ratio you desire.

Receiver sensitivity is the EMF of 4040 at the receiver input, which produces a defined SINAD ratio with standard modulation on the nominal frequency of the receiver at the AF receiver output.

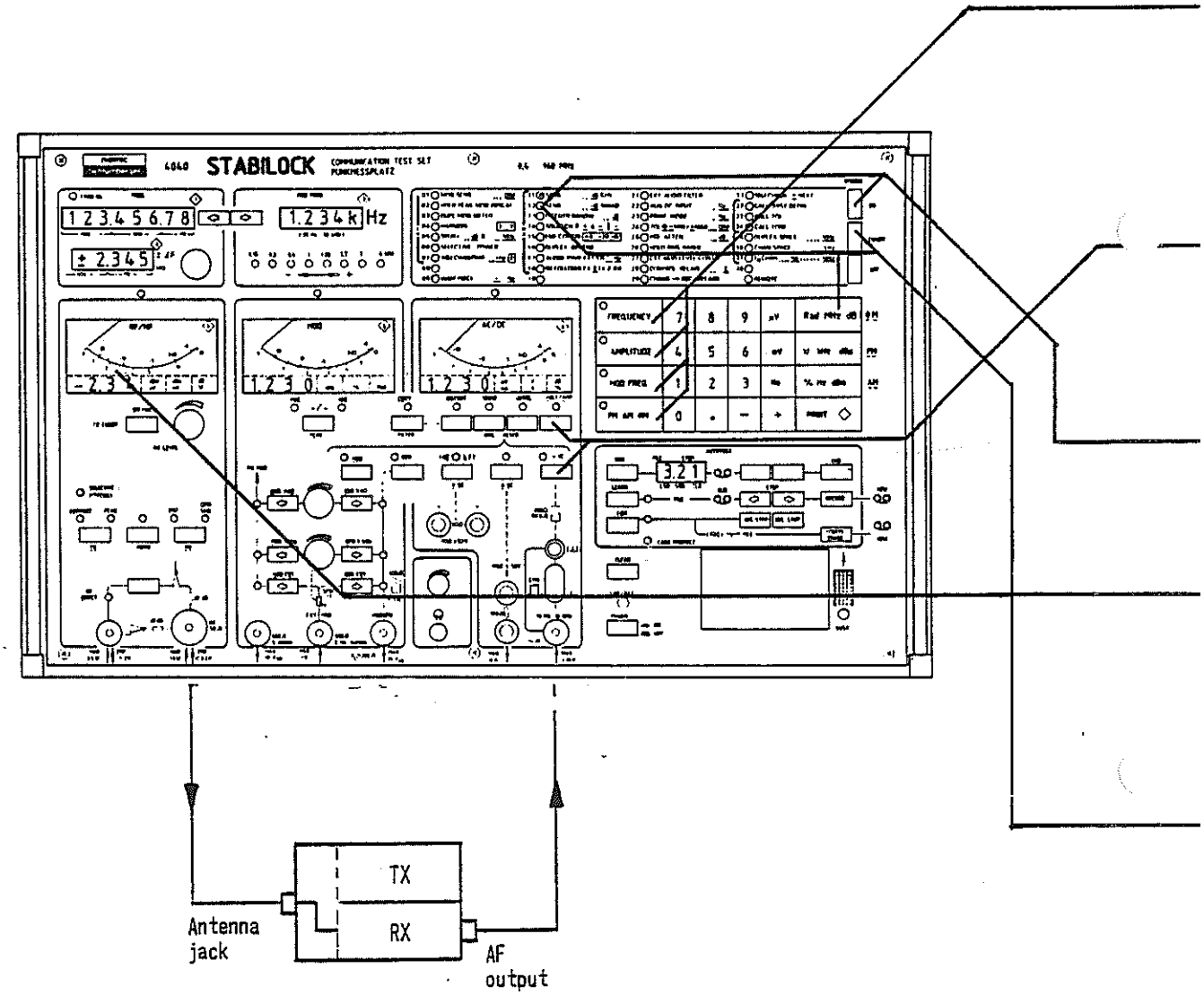
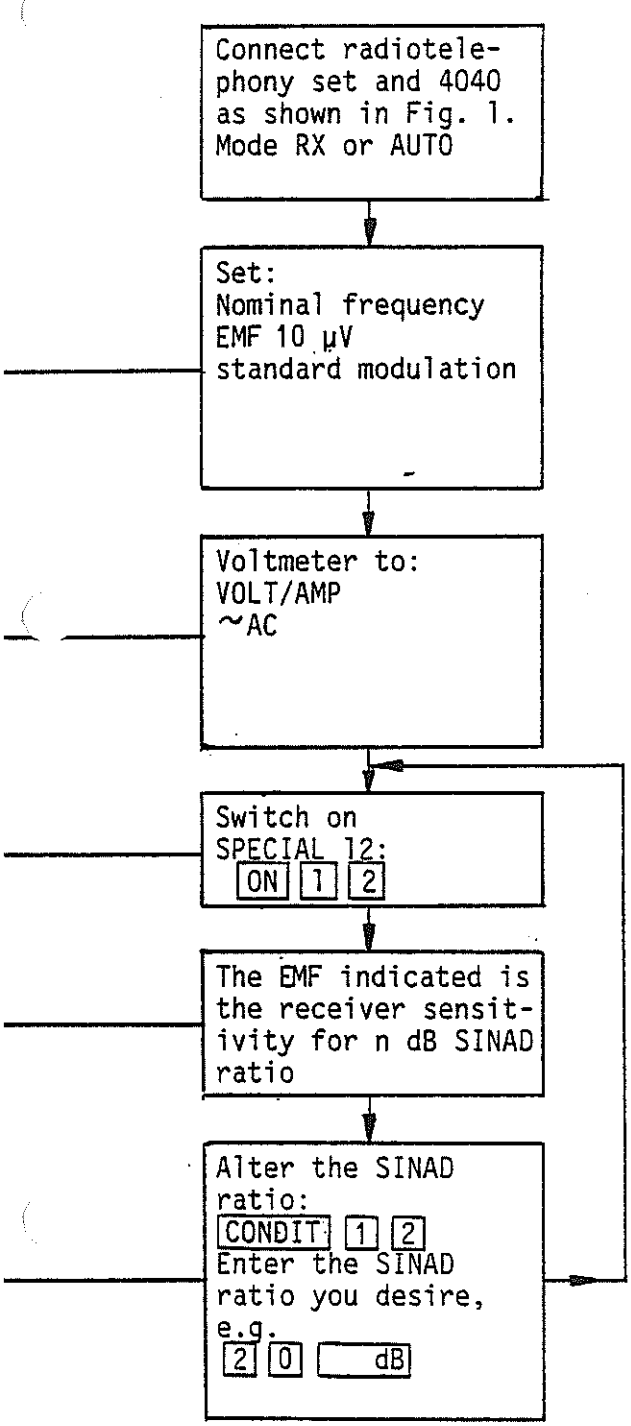


Fig. 1:
Test Configuration for Receiver Measurements



Are the cables ok?
Ensure short RF connections, cable attenuation falsifies your measuring results - use double screened (dense) RF cables!

Initial EMF and standard modulation are set as specified in the applicable regulations or specifications.
Example: EMF 10 µV, modulation frequency 1 kHz, frequency deviation 2.8 kHz

Voltmeter ◇6◇ indicates receiver AF voltage - does this voltage correspond to your specification?
Correct with the volume control of your receiver. If you have to measure weighted - switch on CCITT filter.

Special 12 is the routine for automatically measuring receiver sensitivity based on the SINAD method.

If no SINAD value is entered, the routine operates with a SINAD ratio of 12 dB. This SINAD ratio can be altered.

With a SINAD ratio = 12 dB, the desired SINAD value is entered with CONDIT 1 2. This Display is provided in the display panel ◇1◇ (frequency)

20 - 12	
SINAD-Ratio 20 dB	SPECIAL 12

The signal/noise ratio or the SINAD ratio, respectively, is measured at a specified EMF.

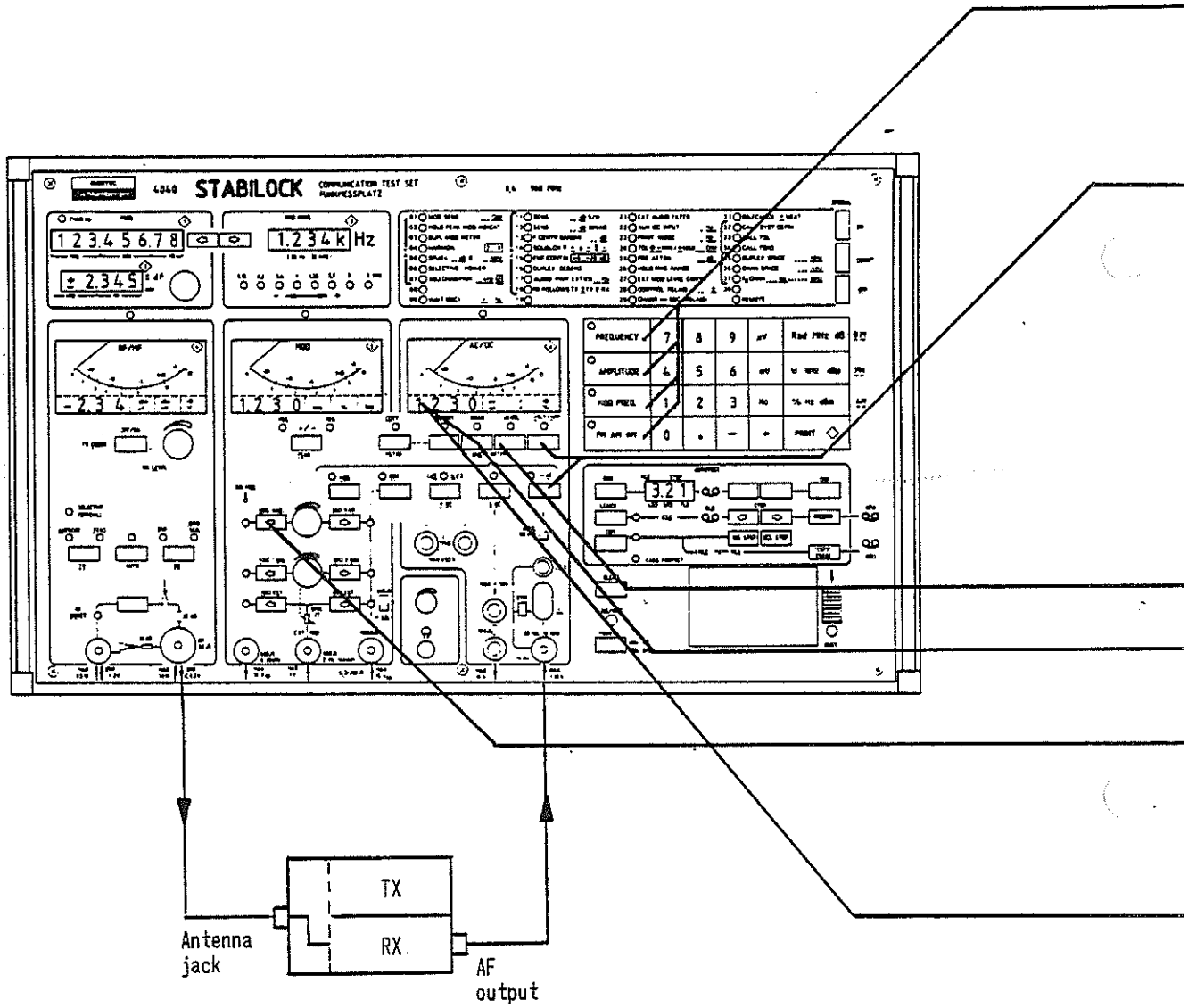
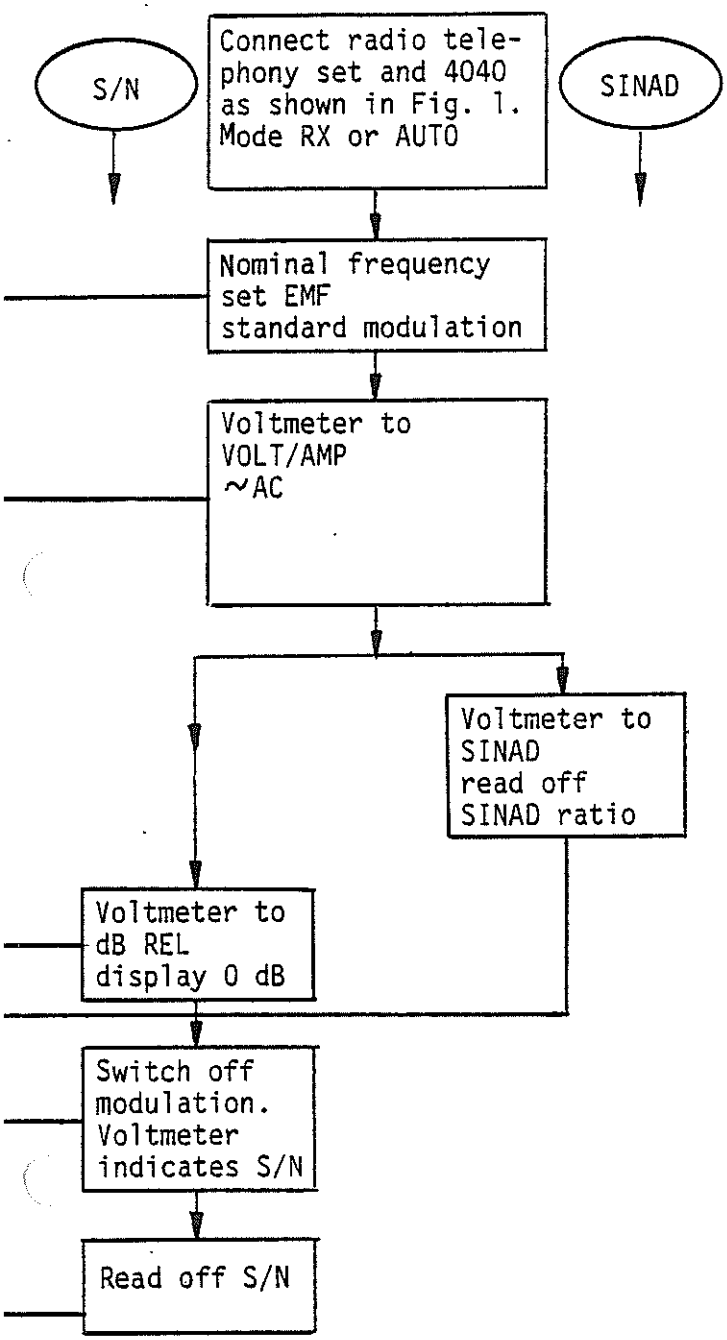


Fig. 1.:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations
	Are the cables ok? Ensure short RF connections, cable attenuation falsifies your test result - use double screened (dense) RF cables. Set specified EMF (e.g. 2 µV, 20 µV etc.). for SINAD measurement, 1 kHz modulation frequency must be set. Voltmeter ◇6◇ indicates receiver AF voltage - does this voltage correspond to your specification? Correct with the volume control of your receiver. If you have to measure weighted - switch on CCITT filter The SINAD ratio indicated on the voltmeter is the measuring result sought. Use the analog display of the voltmeter The S/N ratio reading is the one sought at the specified EMF

The receiver bandwidth is the total of the amounts of the positive and negative frequency detuning of the 4040 related to the nominal frequency of the receiver which, after an increase in EMF of +6 dB, produce the same AF level at the receiver output as existed before increasing the EMF to the nominal frequency. $B = |\Delta f1| + |\Delta f2|$
The centre frequency offset is half the difference of the amounts of the frequency detuning. Centre frequency offset = $\frac{\Delta f1 - \Delta f2}{2}$

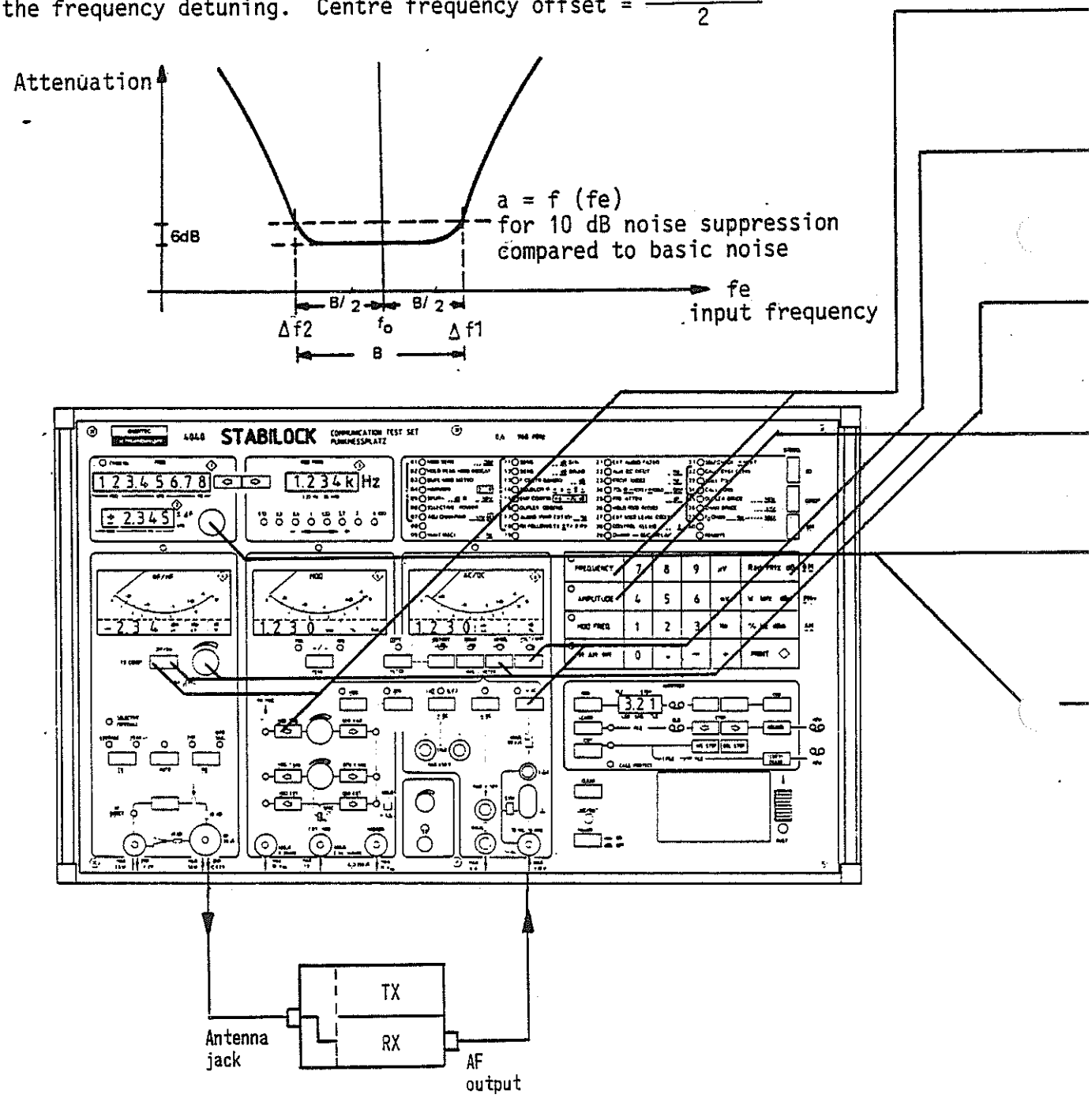


Fig. 1:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations
Connect radio telephony set and 4040 as shown in Fig. 1. Mode RX or AUTO	Are the cables ok? Ensure short RF connections, cable attenuation falsifies your test result - use double screened (dense) RF cables.
Nominal frequency EMF OFF modulation off	Set unmodulated nominal frequency, switch off EMF, switch off receiver squelch.
Voltmeter to VOLT/AMP CCITT filter ~AC	Voltmeter indicates receiver noise voltage, adjust volume if necessary. If you wish to measure unweighted, switch off CCITT filter.
Voltmeter to dB REL. EMF ON and increase until voltmeter to -10 dB	Voltmeter to dB REL - noise voltage = reference, switch on EMF, increase until noise reduced by 10 dB, voltmeter indicates -10 dB.
EMF +6 dB AMPL + 6 dB	Increase EMF by +6 dB (for 6 dB bandwidth), voltmeter shows ≈ -16 dB.
Alter frequency in positive direction until voltmeter to -10 dB → Note Δf1	Alter 4040 frequency in positive direction until voltmeter again indicates -10 dB. This frequency offset is Δf1 - note value.
Alter frequency in negative direction until voltmeter to -10 dB → Note Δf2	Alter 4040 frequency in negative direction until voltmeter again indicates -10 dB. This frequency offset is Δf2 - note value.
Bandwidth $B = \lvert\Delta f1\rvert + \lvert\Delta f2\rvert$ Centre frequency = nominal frequency + $\frac{\lvert\Delta f1\rvert - \lvert\Delta f2\rvert}{2}$	Bandwidth and centre frequency are calculated from $\lvert\Delta f1\rvert$ and $\lvert\Delta f2\rvert$. If you only wish to know the offset of the centre frequency relative to the nominal frequency, then the offset is: $\frac{\lvert\Delta f1\rvert - \lvert\Delta f2\rvert}{2}$

The receiver bandwidth is the total of the amounts of the positive and negative frequency detuning of the 4040 related to the nominal frequency of the receiver which, after an increase in EMF of +6 dB, produce the same AF level at the receiver output as existed before increasing the EMF to the nominal frequency. $B = |\Delta f1| + |\Delta f2|$
The centre frequency offset is half the difference of the amounts of the frequency detuning. Centre frequency offset = $\frac{\Delta f1 - \Delta f2}{2}$

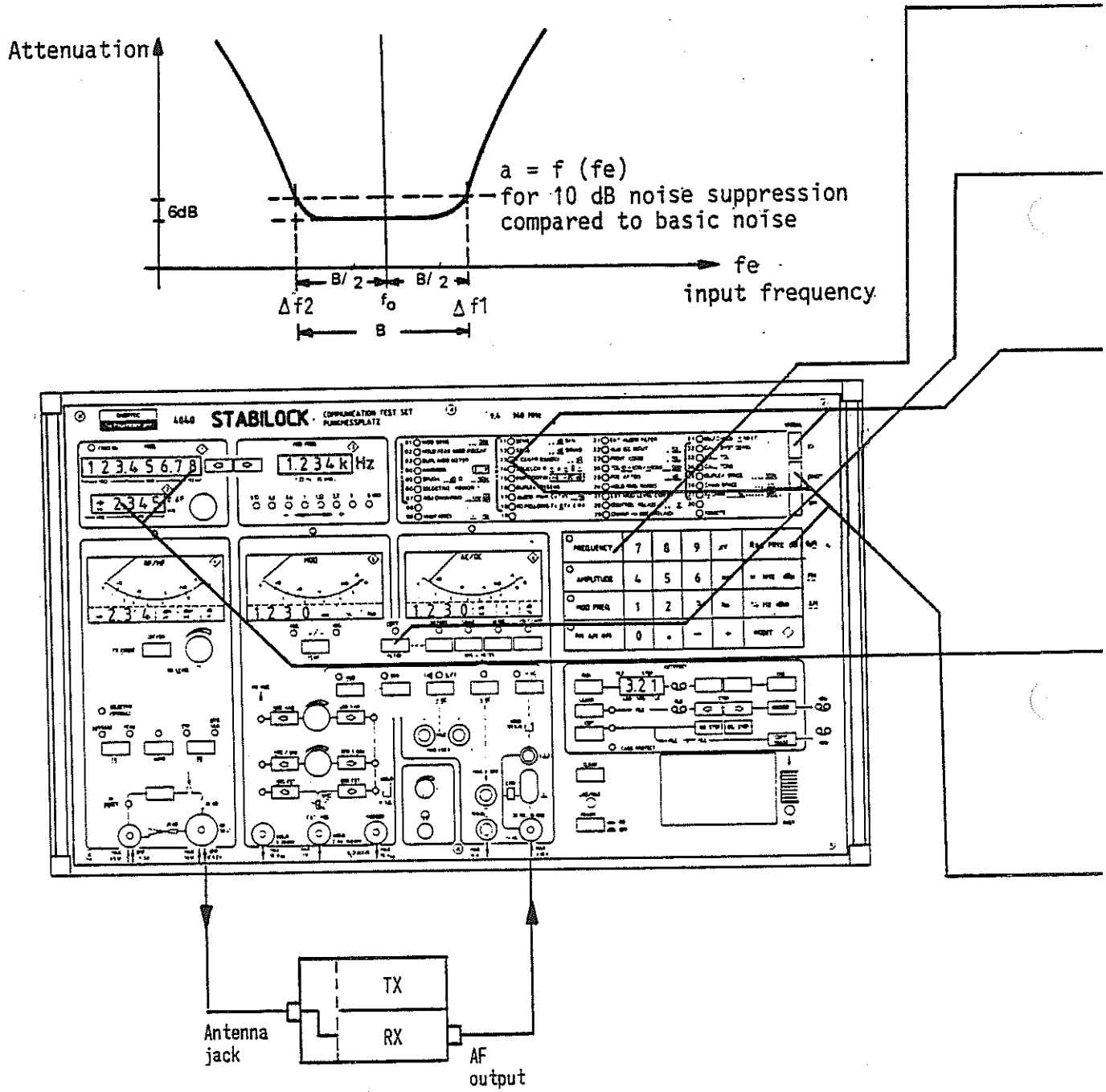
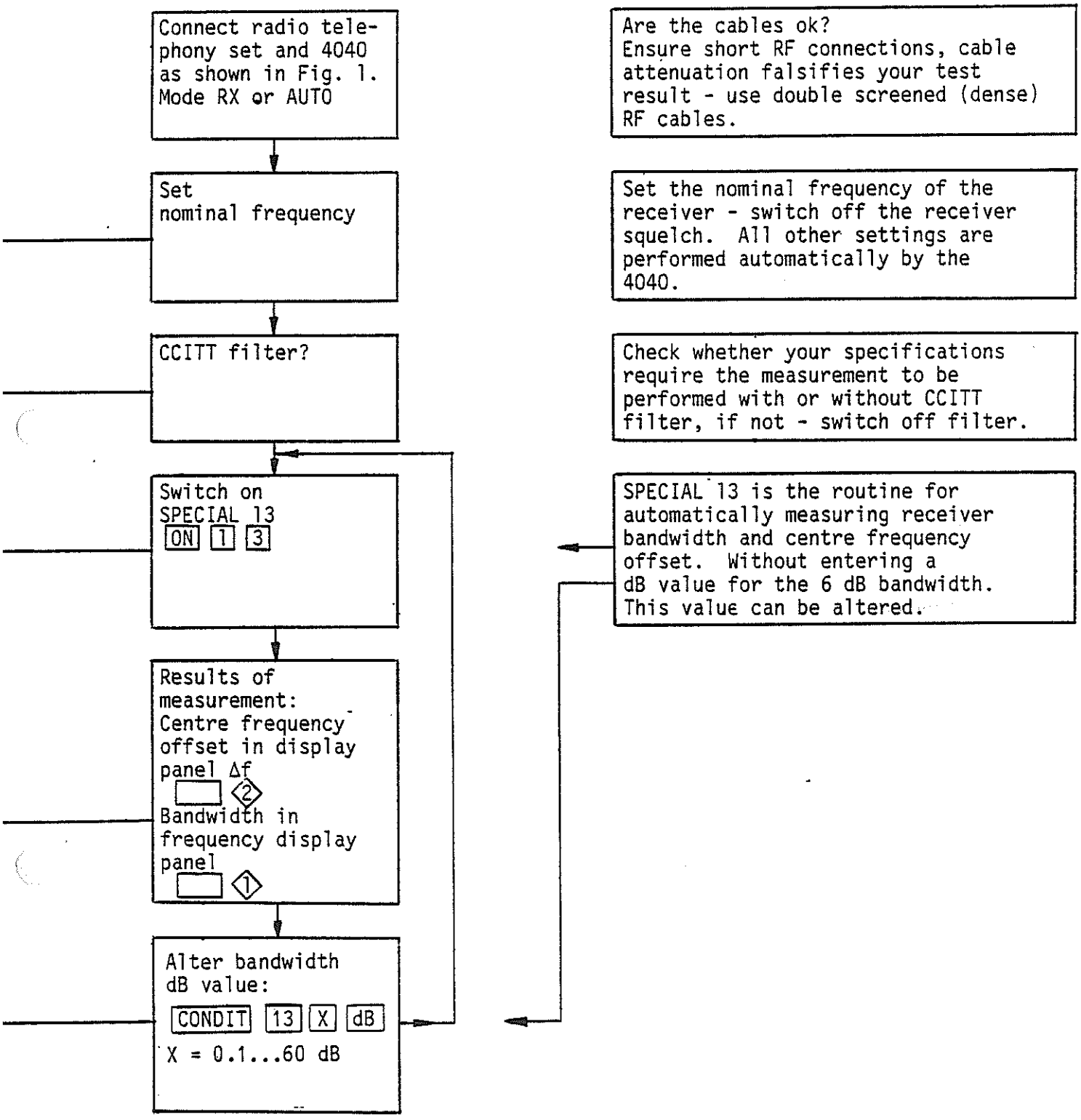


Fig. 1.:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence | Explanations



The MODULATION ACCEPTANCE BANDWIDTH of a receiver is the frequency deviation at an EMF of 6 dB above receiver sensitivity which produces the same SINAD ratio at the receiver output as the standard modulation with the EMF of the receiver sensitivity.

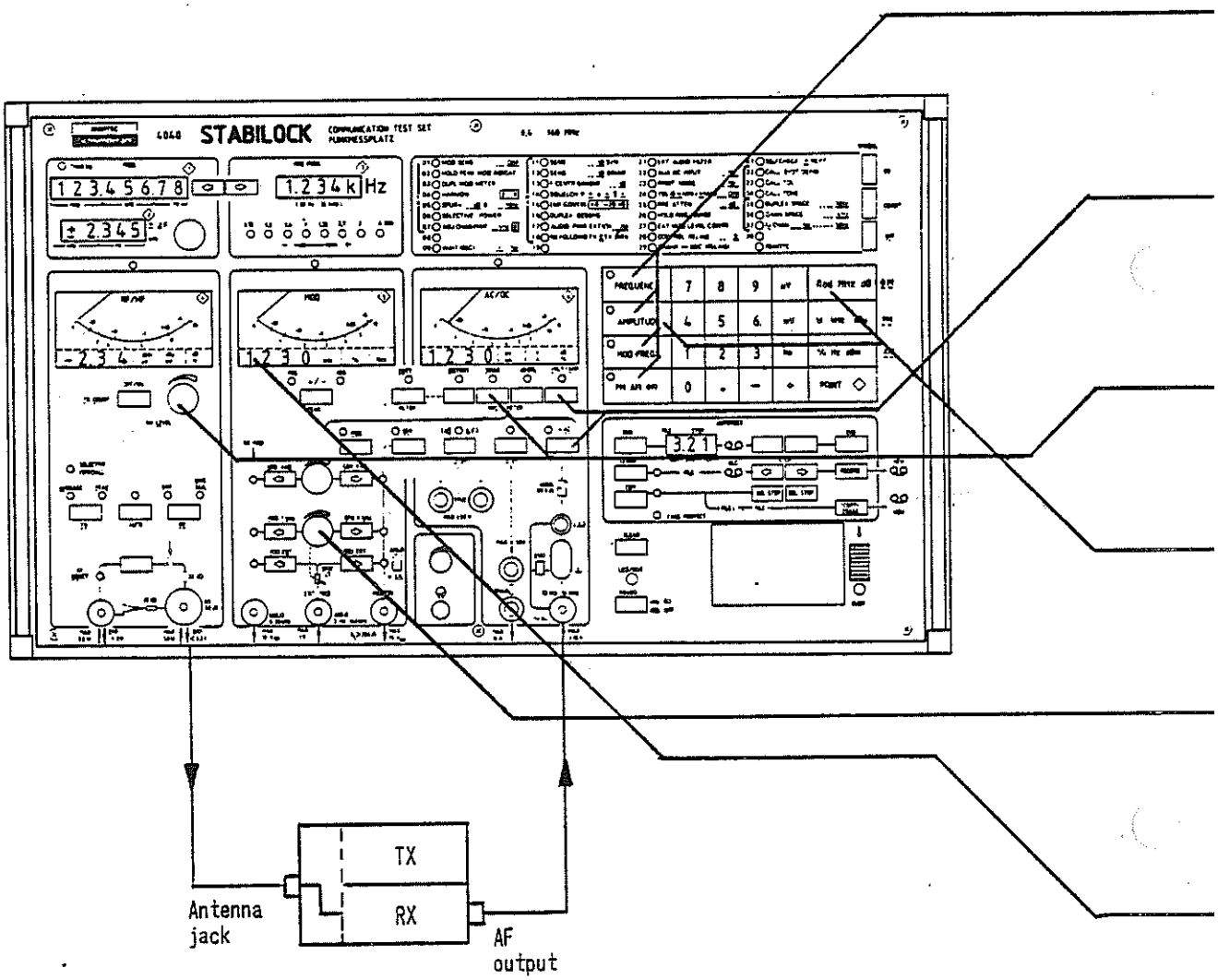


Fig. 1.:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations
Connect radio telephony set and 4040 as shown in Fig. 1. Mode RX or AUTO	Are the cables ok? Ensure short RF connections, cable attenuation falsifies your test result - use double screened (dense) RF cables.
Set nominal frequency EMF 1 mV Standard modulation	Set EMF to 1 mV, set standard modulation, e.g. modulation frequency 1 kHz, frequency deviation 3 kHz.
Voltmeter to VOLT/AMP ~AC	Set volume control of receiver to 10 % of nominal power; if you require to measure weighted - switch on the CCITT filter.
Voltmeter to SINAD. Reduce EMF until 12 dB SINAD is reached.	Reduce the EMF until voltmeter ◇6◇ indicates a SINAD ratio of 12 dB. Use the analog display.
EMF +6 dB [AMPL] [+] [6] [dB]	Increase the EMF by 6 dB SINAD display ≈ 18 dB ◇6◇
Increase modulation until 12 dB SINAD is reached.	
Read off the frequency deviation	The frequency deviation is the MODULATION ACCEPTANCE BANDWIDTH, e.g. 5 kHz. The bandwidth must be ≫ than the nominal deviation in the particular channel pattern.

Squelch level:
EMFI = cut-in EMF at which the squelch clears the AF path.
EMFO = cut-out EMF at which the squelch blocks the AF path.

Hysteresis:
The difference between cut-in and cut-out EMF in dB.

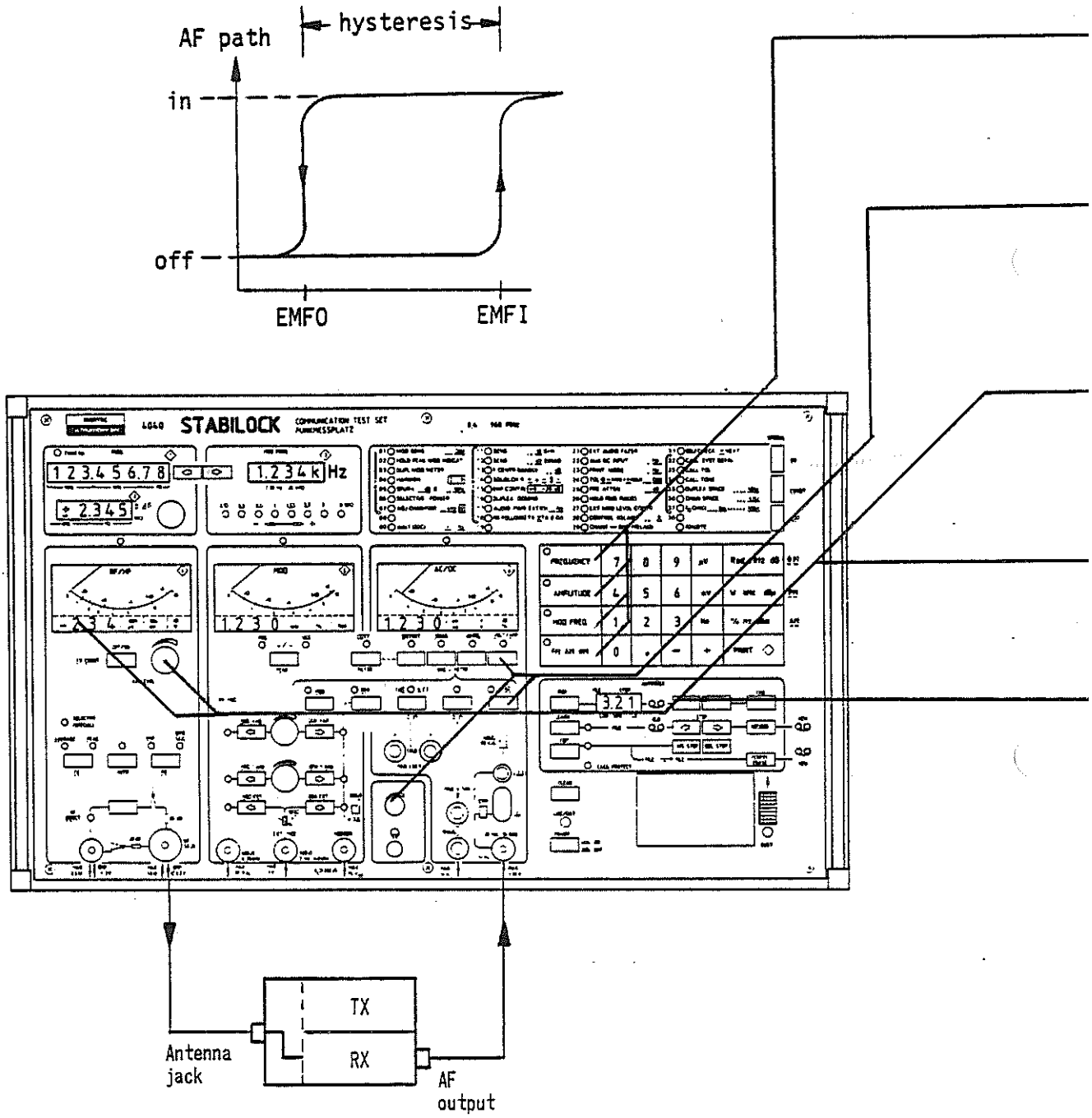
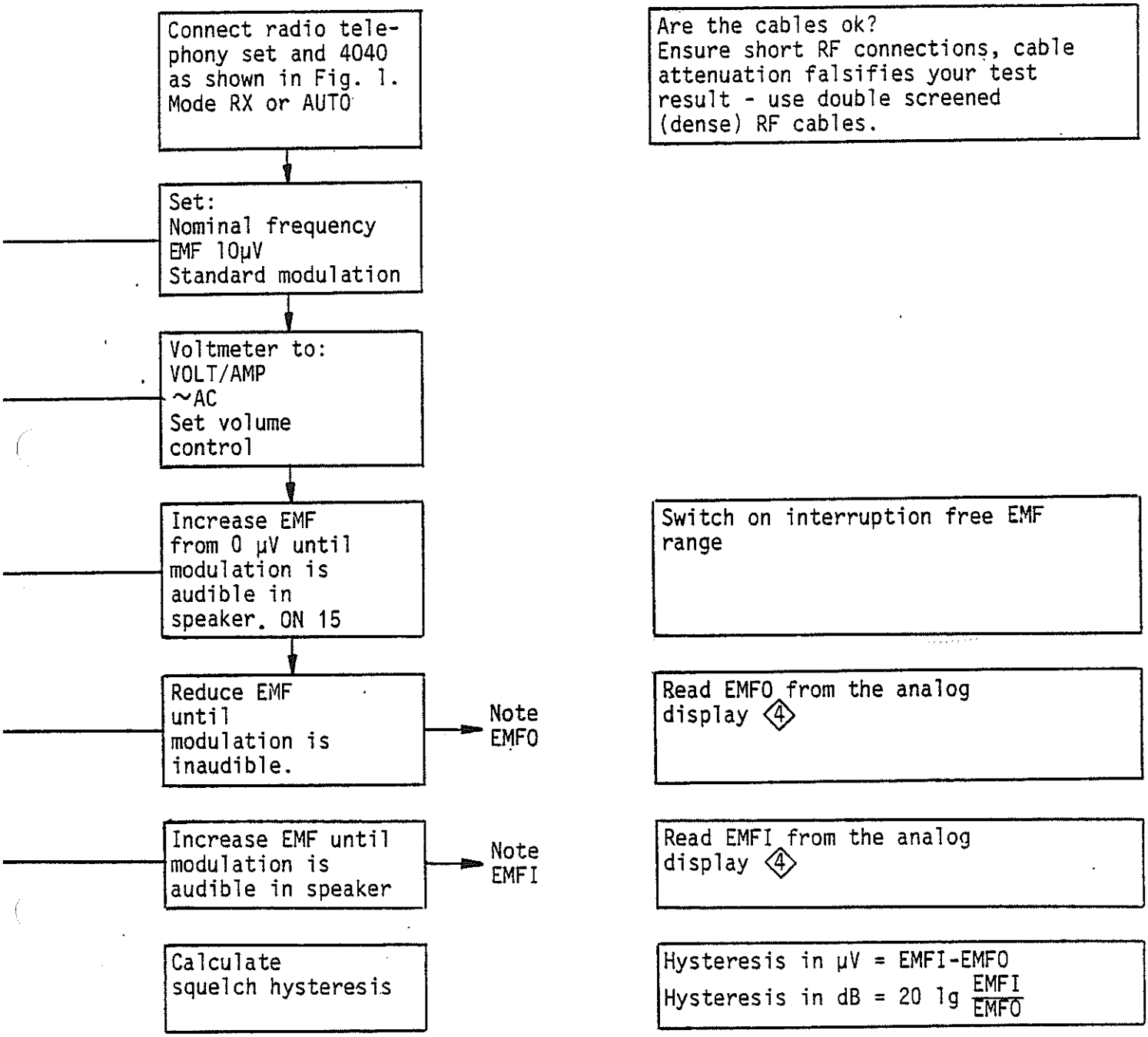


Fig. 1.:
Test Configuration for Receiver Measurements


Connect radio telephony set and 4040 as shown in Fig. 1. Mode RX or AUTO
Are the cables ok? Ensure short RF connections, cable attenuation falsifies your test result - use double screened (dense) RF cables.
Set: Nominal frequency EMF 10µV Standard modulation
Voltmeter to: VOLT/AMP ~AC Set volume control
Increase EMF from 0 µV until modulation is audible in speaker. ON 15
Switch on interruption free EMF range
Reduce EMF until modulation is inaudible.
Note EMFO
Read EMFO from the analog display ④
Increase EMF until modulation is audible in speaker
Note EMFI
Read EMFI from the analog display ④
Calculate squelch hysteresis
Hysteresis in µV = EMFI-EMFO
Hysteresis in dB = 20 lg EMFI/EMFO

Squelch level:
EMFI = cut-in EMF at which the squelch clears the AF path.
EMFO = cut-out EMF at which the squelch blocks the AF path.

Hysteresis:
The difference between cut-in and cut-out EMF in dB.

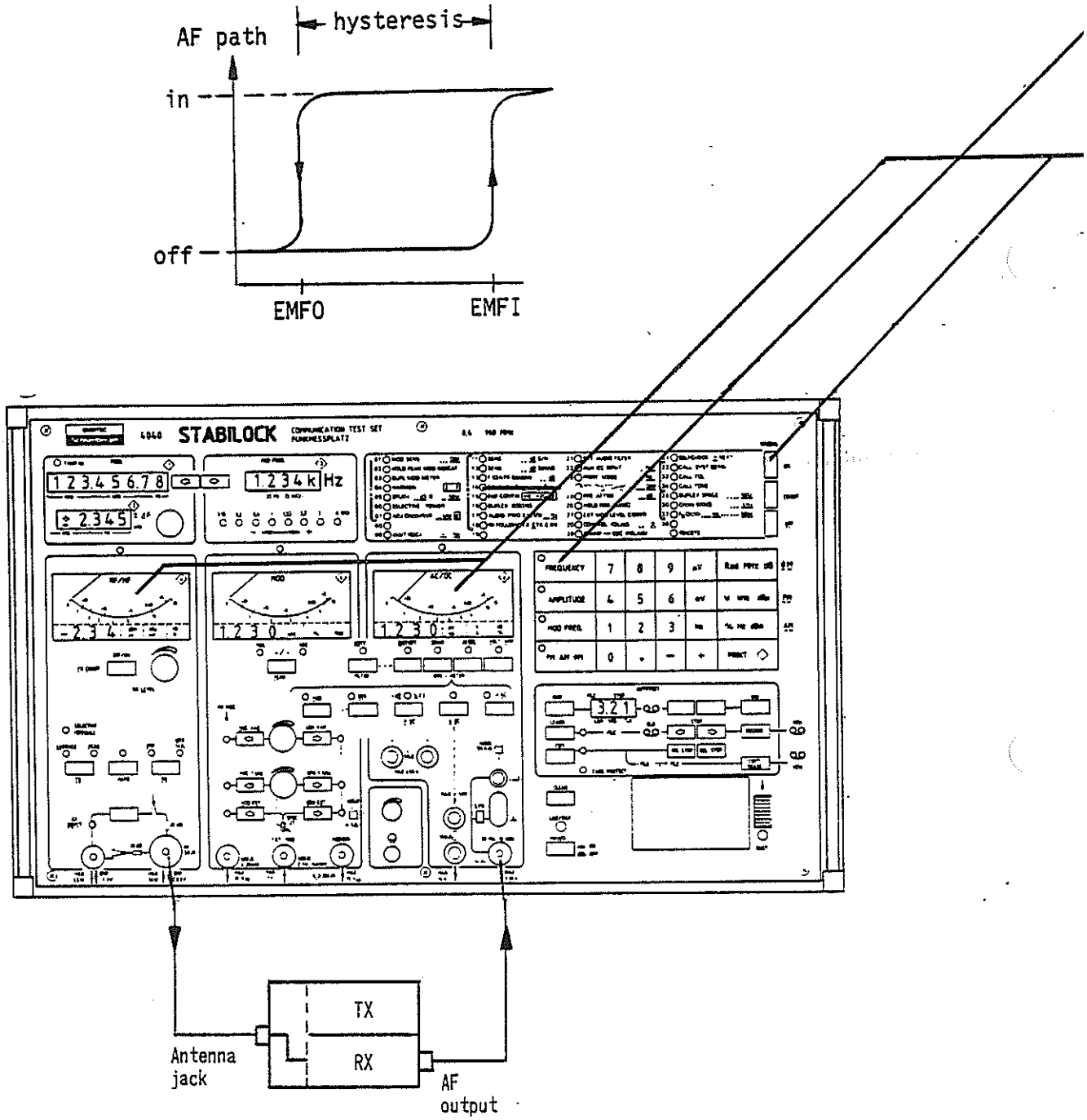


Fig. 1.:
Test Configuration for Receiver Measurements

Connect radio telephony set and 4040 as shown in Fig. 1. Mode RX or AUTO

Are the cables ok?
Ensure short RF connections, cable attenuation falsifies your test result - use double screened (dense) RF cables.

Set nominal frequency

ON 14

Read off EMFI ◇4

Read off hysteresis in dB ◇6

SPECIAL 14 is the routine for automatically measuring the squelch parameters.

The receiver AF frequency response is the change in the AF output level of the receiver dependent on the modulation frequency of the input signal.

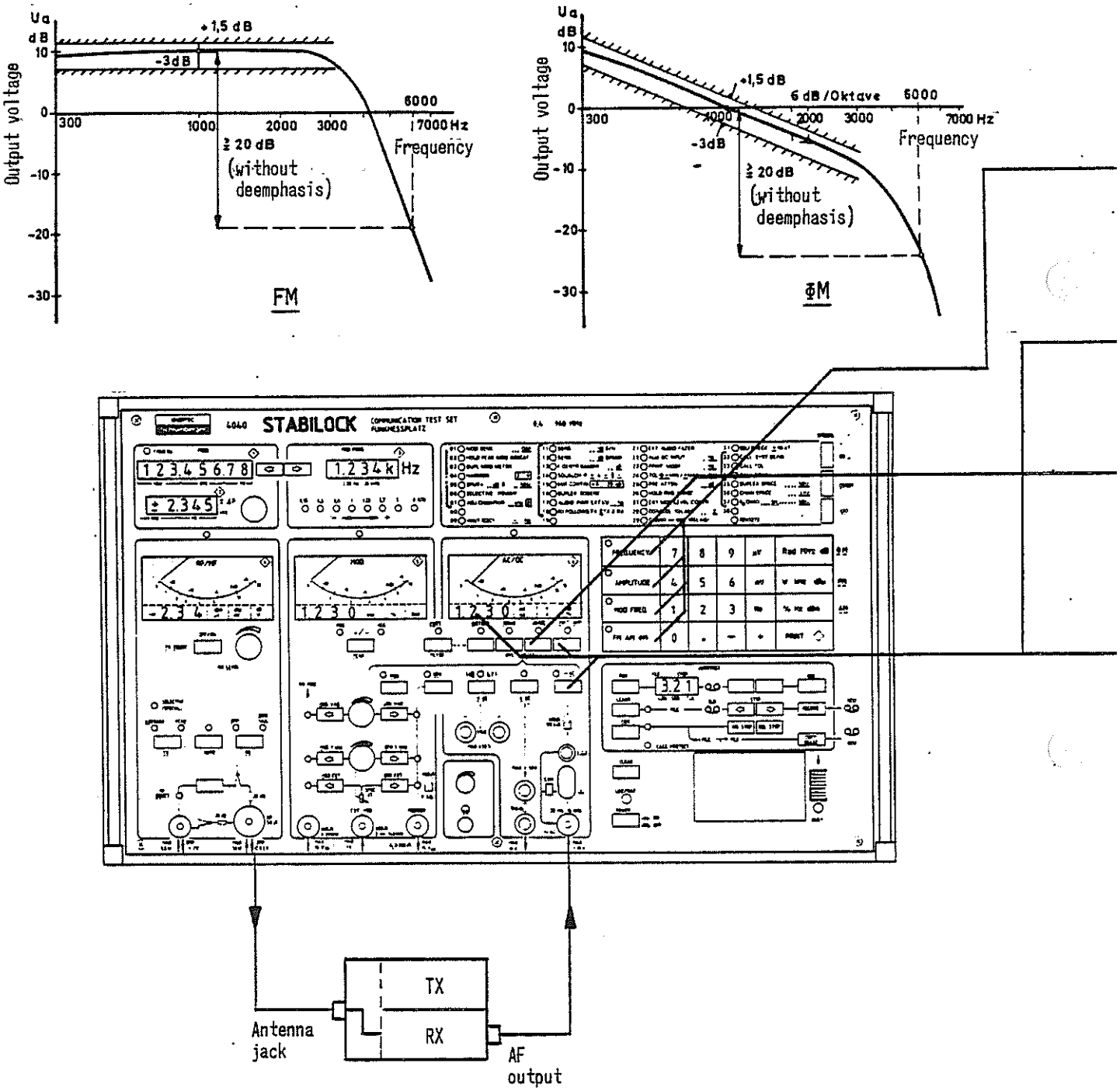


Fig. 1.:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations

Simple and Convenient Using the dB REL Function of the Voltmeter

Connect radio telephony set and 4040 as shown in Fig. 1. Mode RX or AUTO	Are the cables ok? Ensure short RF connections, cable attenuation falsifies your test result - use double screened (dense) RF cables.
Nominal frequency EMF 60 dBµV Modulation 20 % of peak deviation with fMOD 1 kHz	Set the nominal frequency and an EMF of 60 dBµV = 1 mV. Modulate with fMOD 1 kHz and 20 % of peak deviation, e.g. 1 kHz.
Voltmeter to VOLT/AMP, ~AC CCITT off Voltmeter indicates VAF	Set the output level of your receiver to 50 % of nominal AF output (volume control)
Voltmeter to dB REL	The AF output voltage with fMOD 1 kHz is the reference value
Alter the modulation frequency from 0.3...6 kHz and read off the frequency response on the voltmeter in dB.	If special test frequencies are specified, use these. Compare the frequency response with your specifications.

The signal/noise ratio is the ratio in dB between the AF level of the signal with standard modulation and the unmodulated signal at the receiver output with the same EMF.

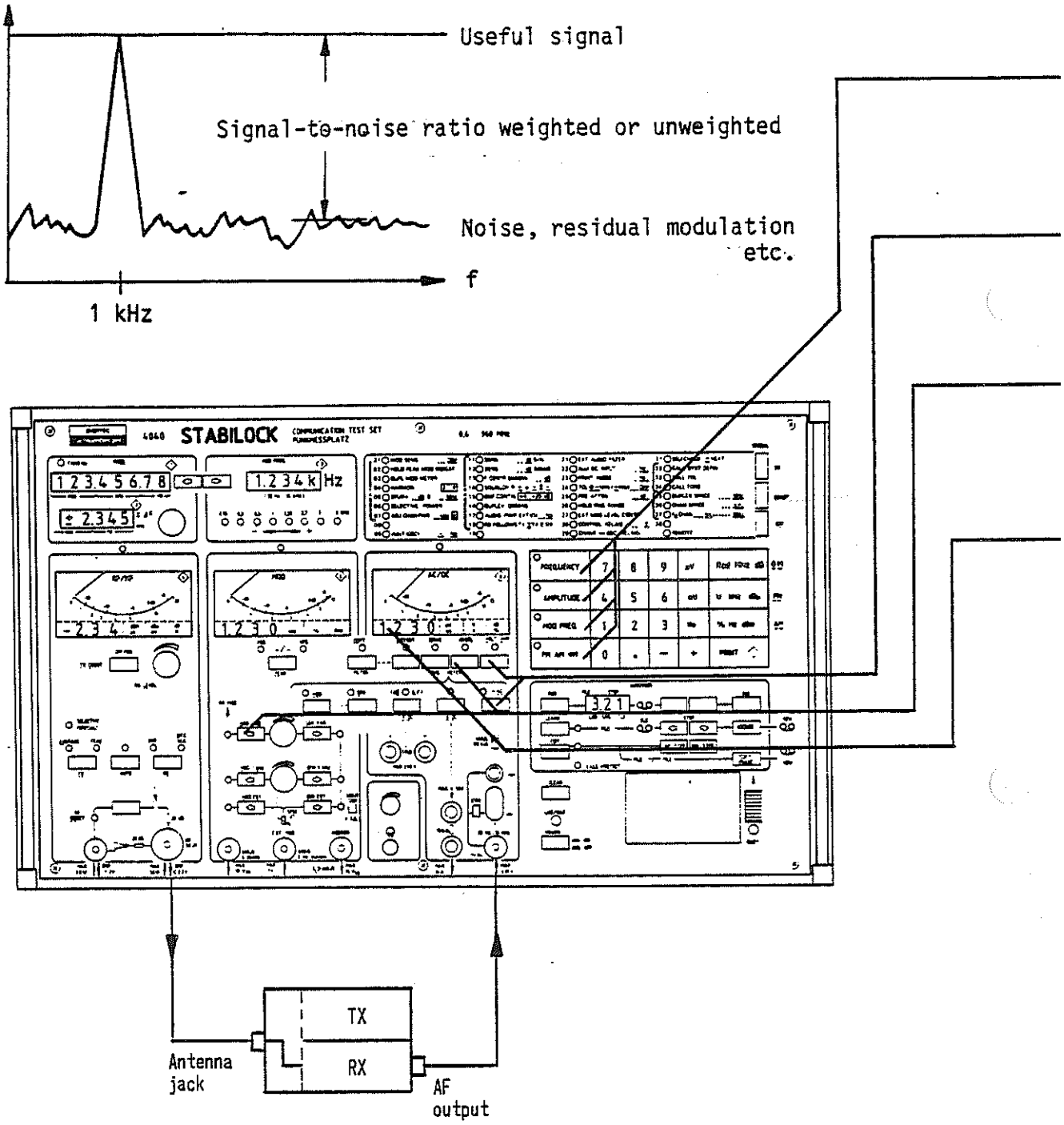


Fig. 1.:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations
Connect radio telephony set and 4040 as shown in Fig. 1. Mode RX or AUTO	Are the cables ok? Ensure short RF connections, table attenuation falsifies your measuring results - use double screened (dense) RF cables.
Nominal frequency EMF 30 dBµV Standard modulation	Set measuring conditions according to your specifications, e.g. EMF 30 dBµV, fMOD 1 kHz, frequency deviation 2.8 kHz.
Voltmeter to: VOLT/AMP ~AC	Do you require to measure weighted? Then switch on CCITT filter. Set volume control of receiver to specified output voltage.
Voltmeter to: dB REL Switch off modulation	The specified AF voltage is the reference value for measuring S/N ratio. Switch off the modulation.
Read off S/N ratio at voltmeter, e.g. -40 dB	

The AF output of a receiver is generally measured at a load resistance of 5 Ω (speaker jack) or 200 Ω (headphone jack). The distortion factor applies to the nominal output specified by the manufacturer and for standard deviation (70 % of peak deviation).

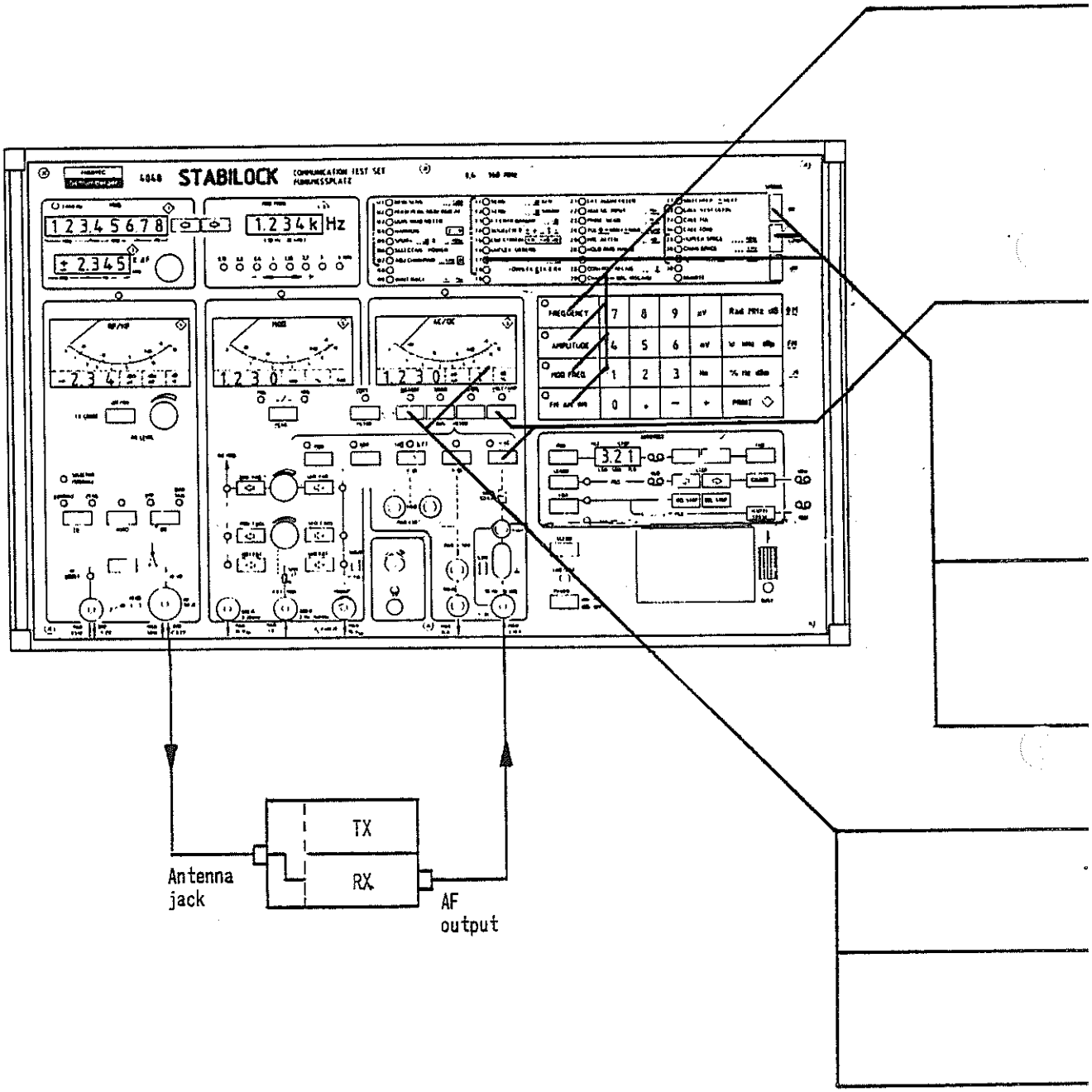
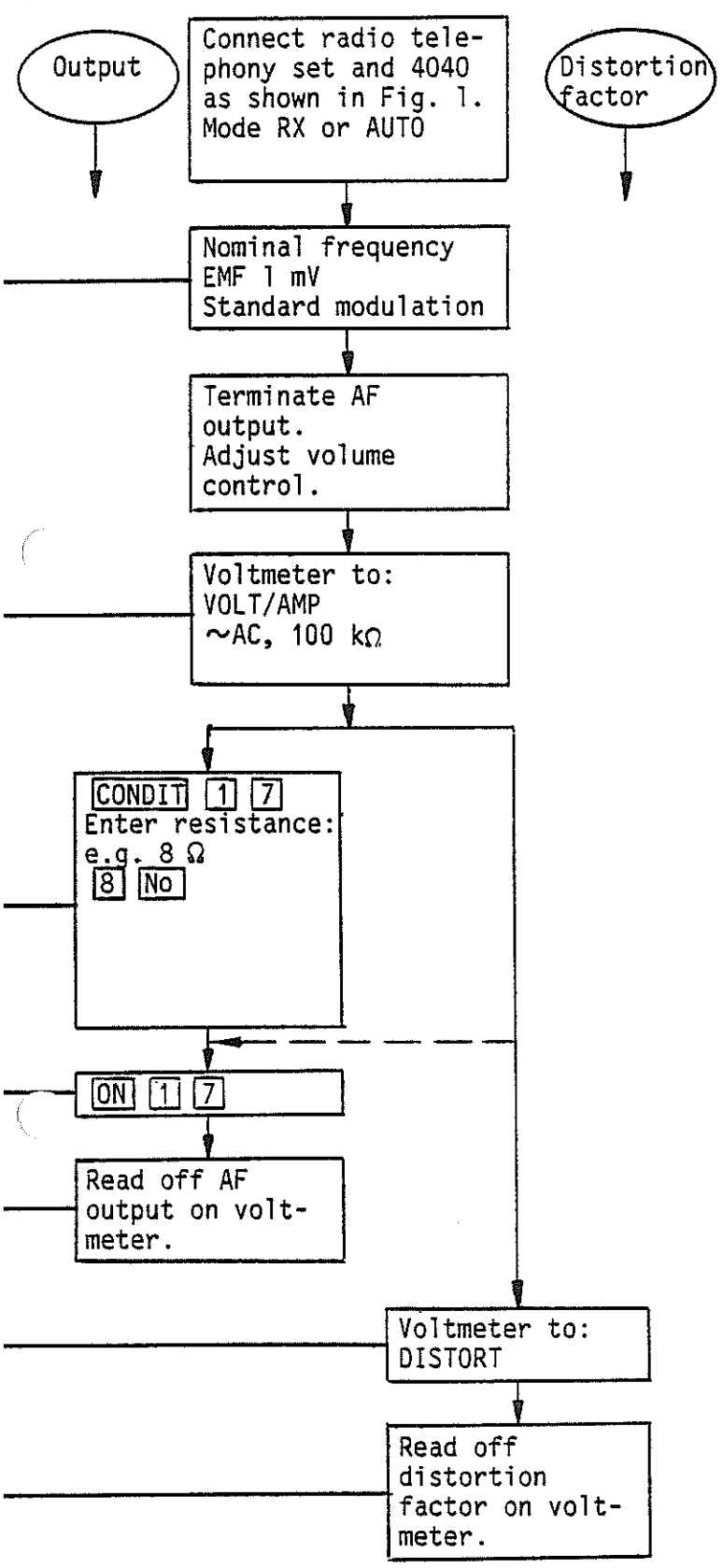


Fig. 1.:
Test Configuration for Receiver Measurements



Are the cables ok? Ensure short RF connections, cable attenuation falsifies your measuring results - use double screened (dense) RF cables.

Set nominal frequency, EMF 1 mV and standard modulation. Refer to your specifications.

Terminate the AF output of receiver with correct load resistance and turn volume control to intended position.

Voltmeter is prepared for output/distortion factor measurement. Is the CCITT filter required? Switch on the CCITT filter.

SPECIAL 17 is the mode for measuring AF output; the load resistance value must first be entered. The value entered remains stored until it is overwritten, i.e. the CONDIT 1 7 step is not required until a different resistance value is entered.

The limiter characteristics state to what extent the AF output level of the receiver alters when its input signal level is altered by a certain value (e.g. from +6 to +100 dBµV). Set value <3 dB. The input signal has standard modulation.

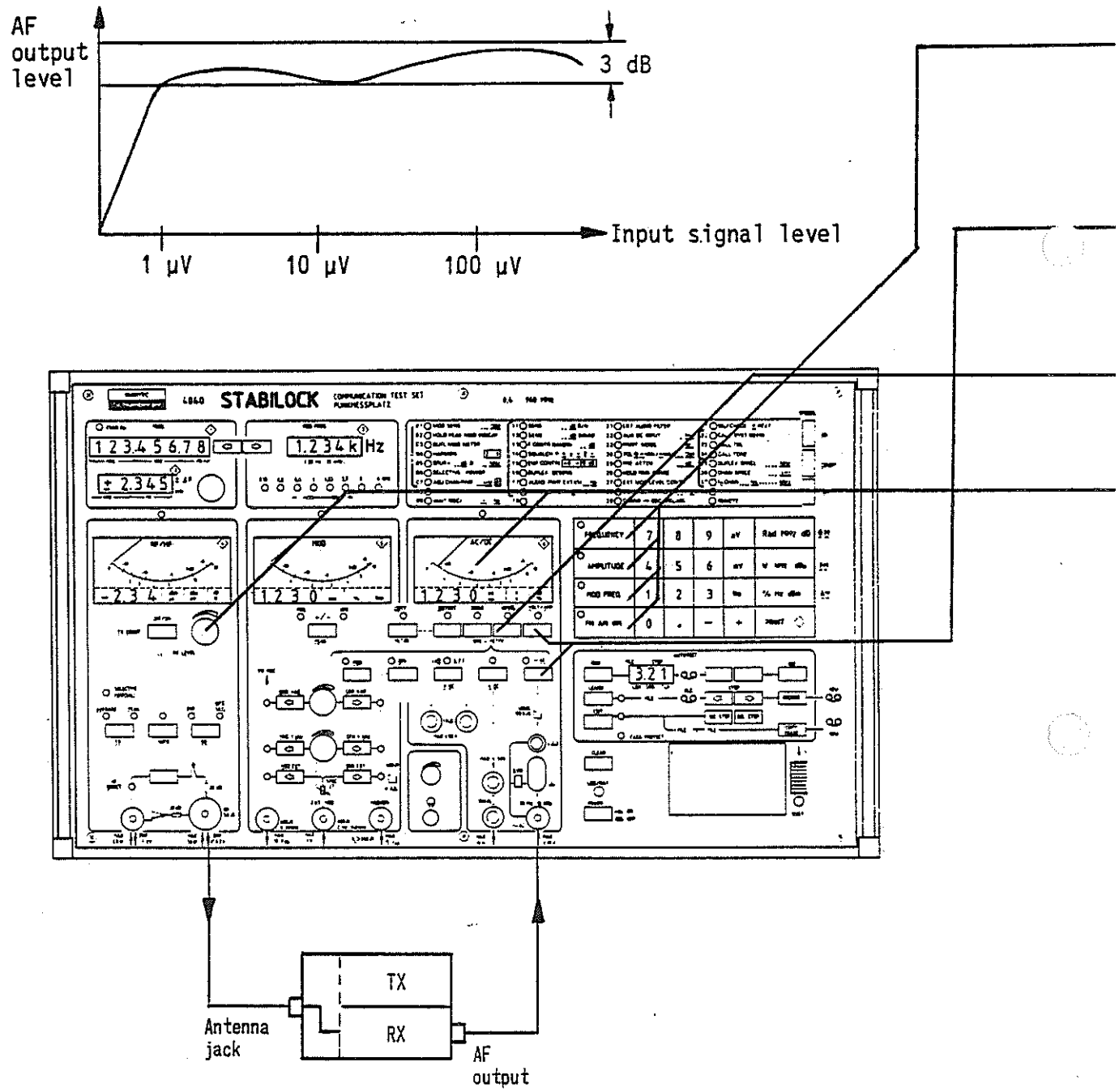


Fig. 1.:
Test Configuration for Receiver Measurements

"Step for Step" Test Sequence	Explanations
Connect radiotelephony set and 4040 as shown in Fig. 1. Mode RX or AUTO	Are the cables ok? Ensure short RF connections, cable attenuation falsifies your measuring results - use double screened (dense) RF cables.
Nominal frequency EMF 2 µV (+6 dBµV) Standard modulation	Set measuring conditions, initial EMF in line with your specifications e.g. +6 dBµV ≙ 2 µV with standard modulation e.g. fMOD 1 kHz, frequency deviation 2.8 kHz.
Voltmeter to: VOLT/AMP ~AC	Set output voltage of receiver to 6 dB below nominal voltage (nominal output). Measuring weighted? Switch on CCITT.
Voltmeter to dB REL	Operate voltmeter as relative level meter.
Alter EMF! Read off change in AF level on voltmeter.	Alter EMF within specified range, e.g. from +6 to +100 dBµV (2 µV to 100 mV) and measure change in AF output level with voltmeter. Change $\leqslant$ 3 dB between minimum and maximum value.

The reduction in sensitivity is the difference of the EMF, with or without transmitters switched on.

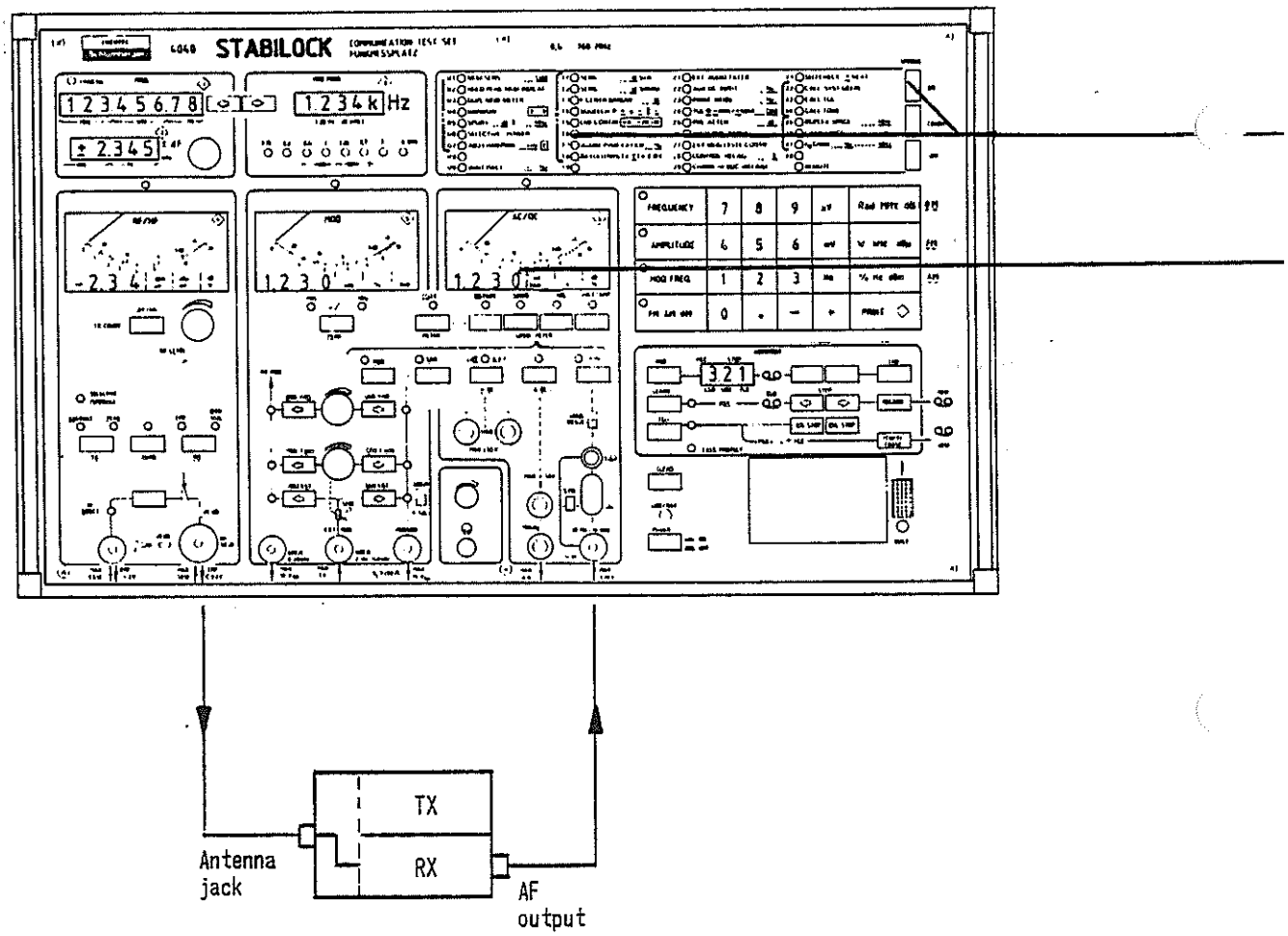
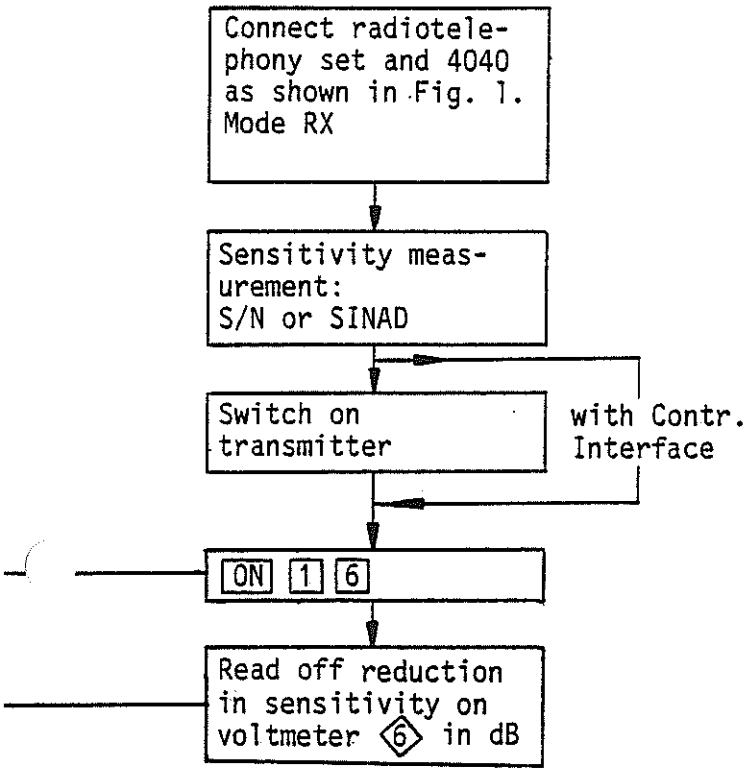


Fig. 1.:
Test Configuration for Receiver Measurements



Are the cables ok?
Ensure short RF connections, cable attenuation falsifies your measuring results - use double screened (dense) RF cables

Measure receiver sensitivity S/N or SINAD. Refer to pp. 6-2 and 6-4

When using the RX/TX relay in the control interface, it is not necessary to switch on the transmitter manually; the transmitter is automatically switched on after ON 1 6 .

The nominal output is the output of the unmodulated transmitter signal.

A power attenuator (4911) must be connected in front of the STABILOCK 4040 for outputs >50 W. In this case, it is possible to achieve a display of the correct output without conversion by entering the preattenuation.

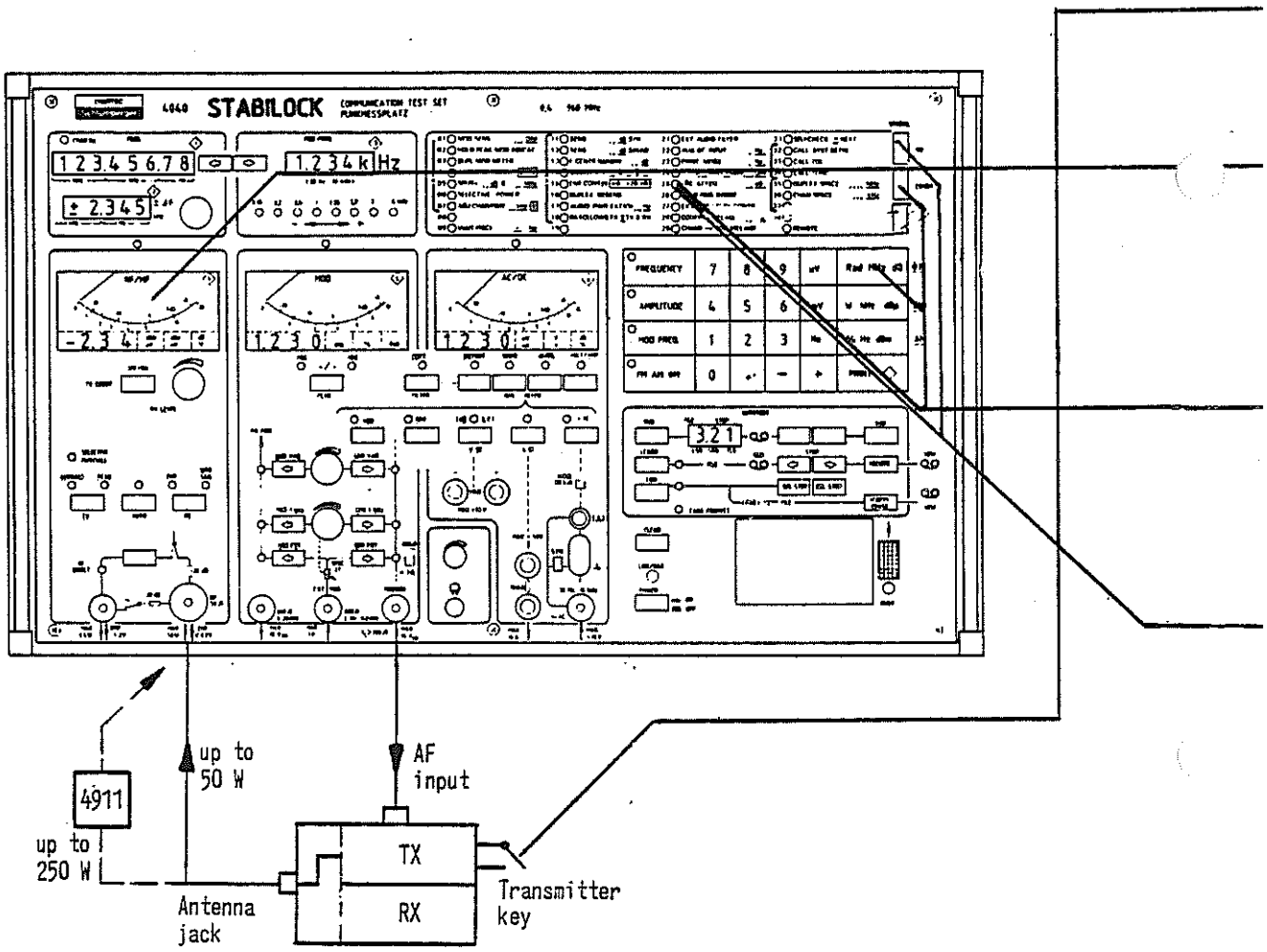
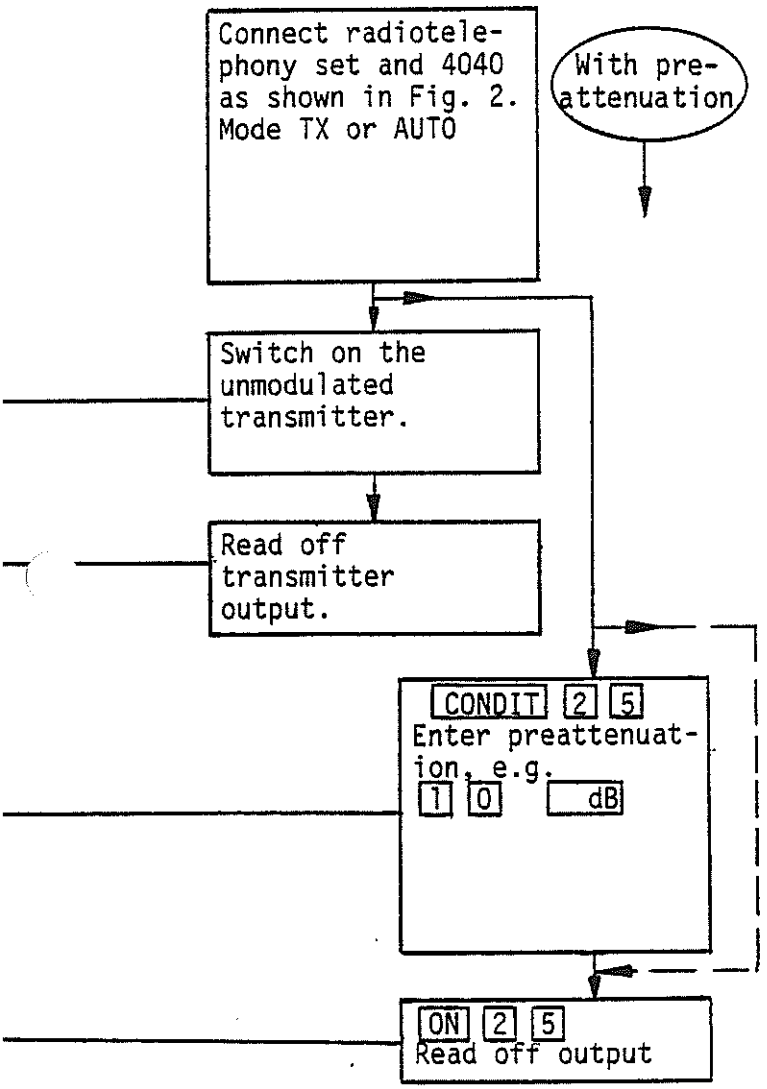


Fig. 2.:
Test Configuration for Transmitter Measurements



All transmitter measurements are performed in the TX or AUTO mode. In the AUTO mode the 4040 automatically switches from the RX mode to TX when the transmitter output is >50 mW. Ensure short RF connection since cable attenuation falsifies measuring results.

Note that the STABILOCK 4040 can measure 50 W. For larger outputs, pre-connect a power attenuator e.g. 4911 for outputs up to 250 W.

Transmitter output is displayed in Watts.

Enter the attenuation level of your power attenuator:
E.g. 10 dB.
This value remains stored until it is overwritten, i.e. the measuring sequence step CONDIT 2 5 is not performed until the preattenuation level is altered.

Due to the measuring principle (selective counter), delay lags ≈3 sec may occur with the initial measurement, ≈0.3 sec with subsequent measurements for frequency spacings <10 MHz.

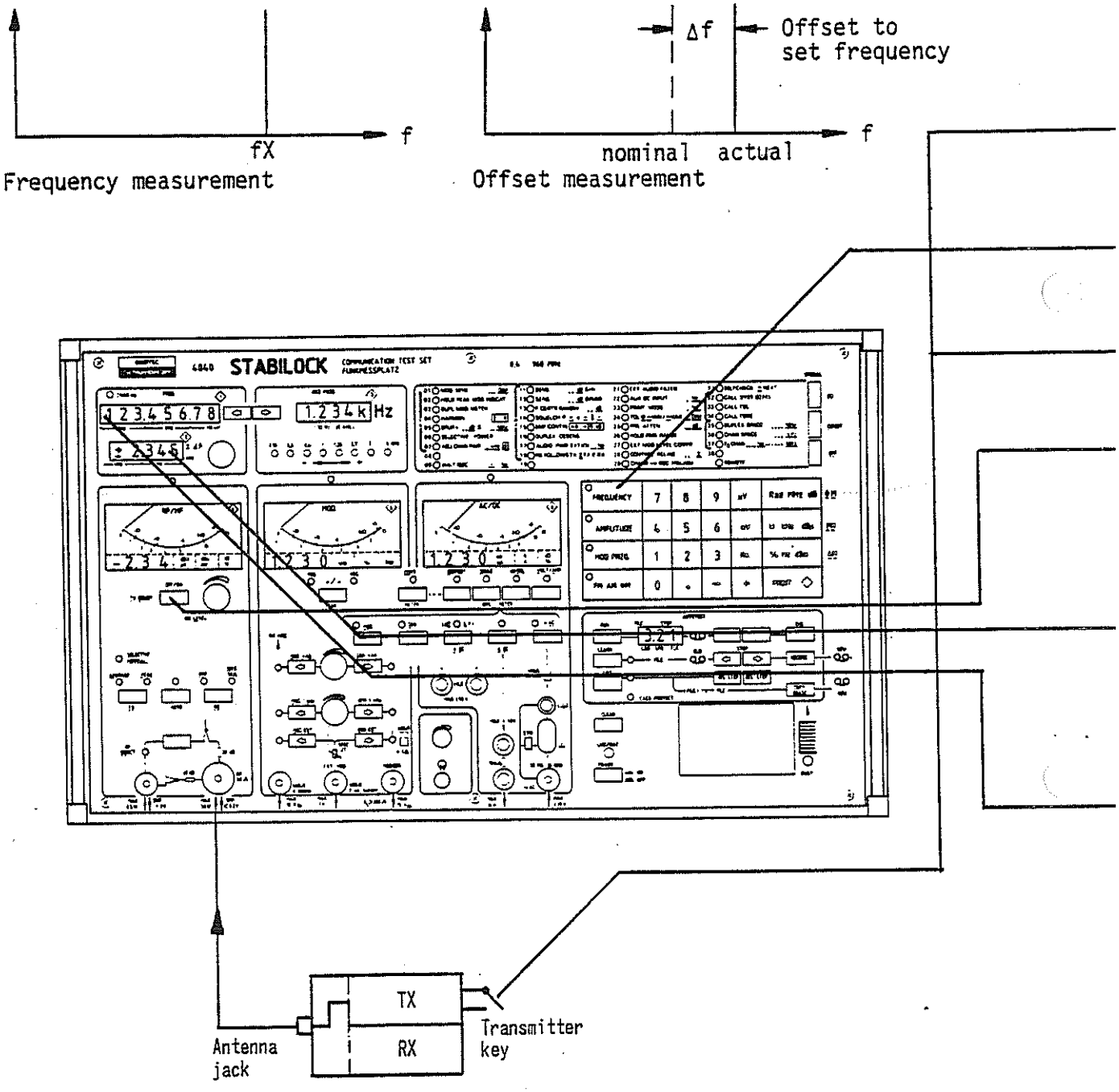
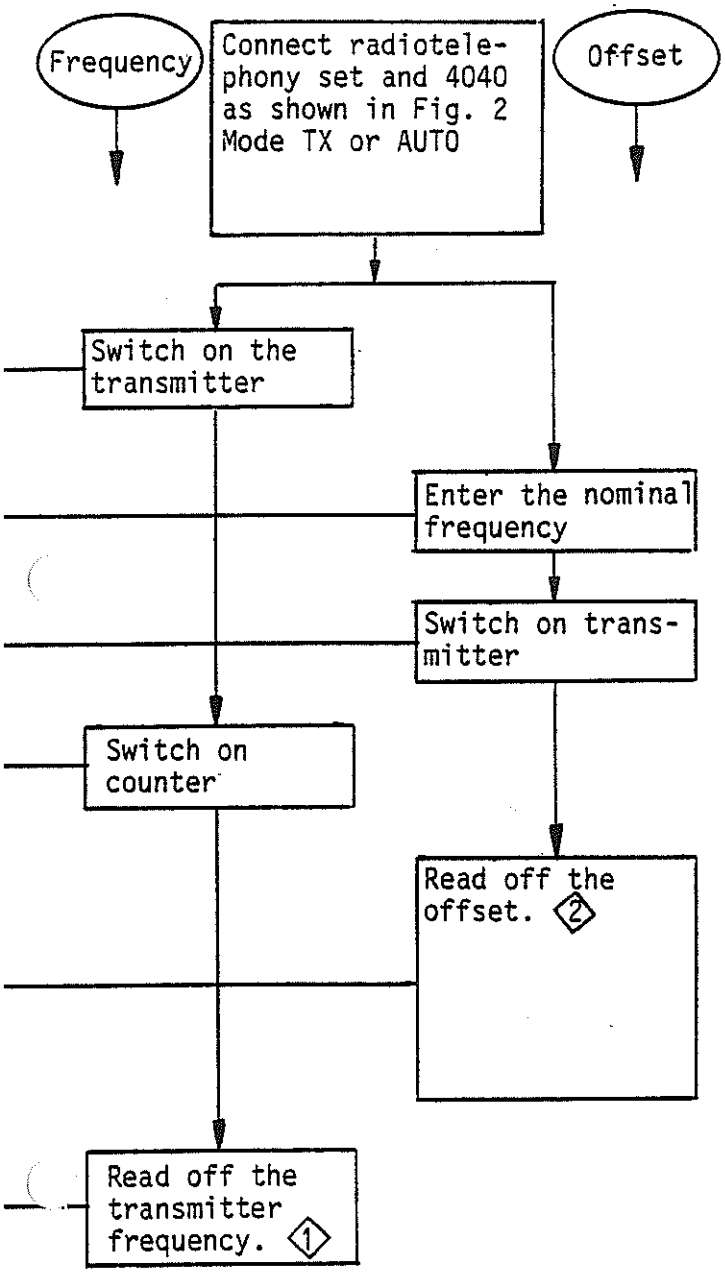


Fig. 2.:
Test Configuration for Transmitter Measurements



All transmitter measurements are performed in the TX or AUTO mode. In the AUTO mode the 4040 automatically switches from the RX mode to TX when the transmitter output is >50 mW.

e.g. 150.610 MHz

Display -9.999 to +9.999 kHz
resolution 1 Hz
-99.99 to +99.99 kHz
resolution 10 Hz
---- if
>100 kHz or level too low

Display -------- counter running
150.611.25 frequency measured

We distinguish between two methods:

1. We are seeking the modulation voltage which produces a desired modulation intensity (frequency deviation, phase deviation, modulation level). This modulation voltage is the modulation sensitivity.

2. We measure the modulation intensity produced by a defined modulation voltage.

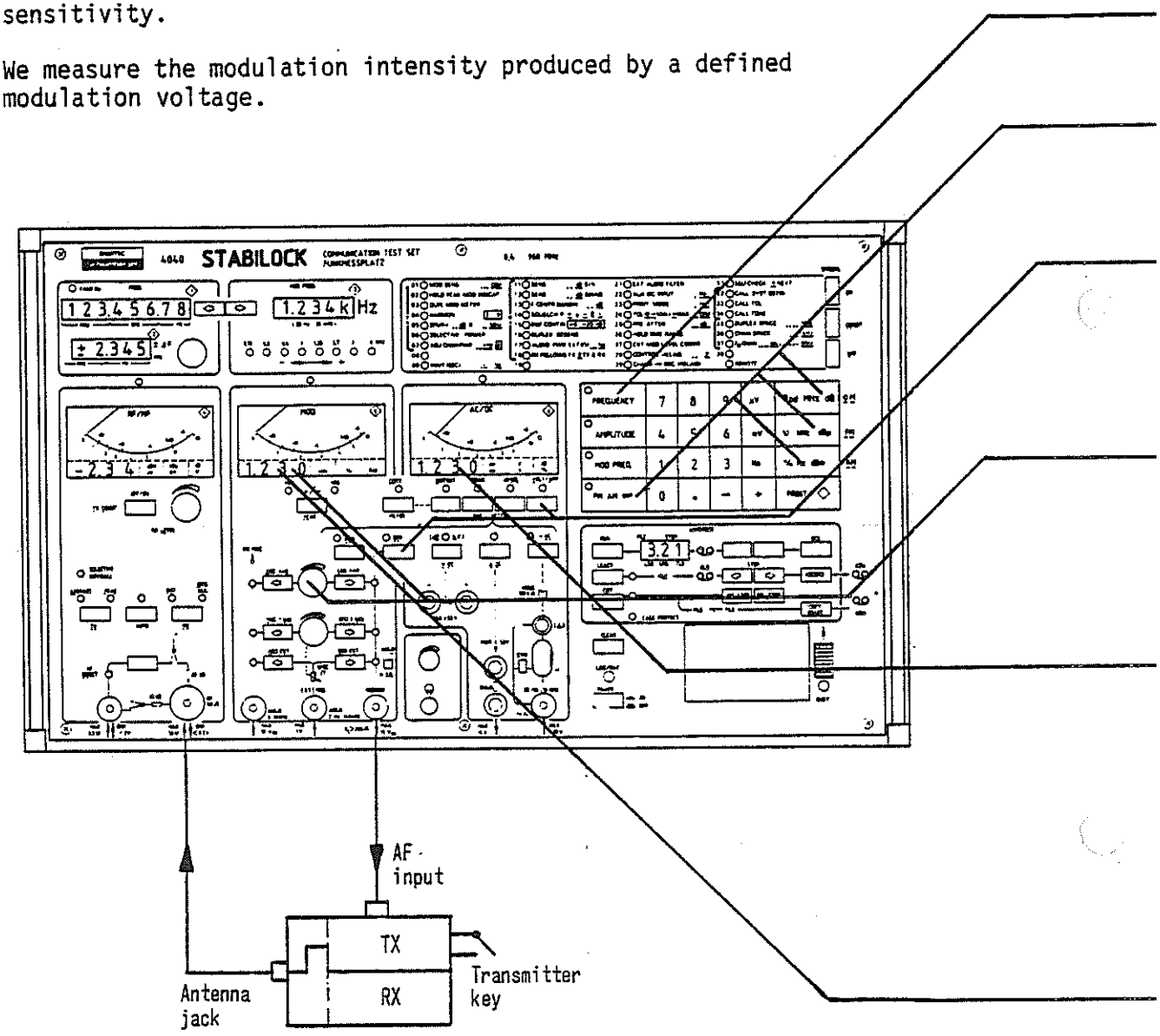


Fig. 2.:
Test Configuration for Transmitter Measurements

"Step for Step" Test Sequence	Explanations
Connection as shown in Fig. 2. Mode TX or AUTO	Ensure short RF/AF connections. In the AUTO mode the 4040 automatically switches to transmitter measurement at outputs >50 mW.
Set transmitter frequency	Set the transmitter frequency on the STABILOCK 4040.
Set type of demodulation	Set the type of demodulation, e.g. FM AM ΦM kHz for FM.
Voltmeter to: VOLT/AMP GEN	The voltmeter measures the terminal voltage of the modulation generator. Switch on the correct internal resistor: Ri = 3 Ω or 600 Ω.
Adjust level of modulation generator until nominal modulation is reached.	Alter the level of the modulation generator until the set modulation is reached. Pay attention to the specified modulation frequency.
Read off AF level on voltmeter = modulation sensitivity	Read off the modulation voltage on the voltmeter. This voltage corresponds to the modulation sensitivity e.g. 4 mV for 2.8 kHz deviation.
Adjust level of modulation generator to set value.	Set the desired modulation voltage. Displayed on voltmeter.
Read off modulation intensity.	Read off the corresponding modulation intensity on the modulation meter.
Method 1	
Method 2	

Measuring method: The modulation voltage is automatically altered until the modulation intensity (deviation or modulation level) defined previously is reached.

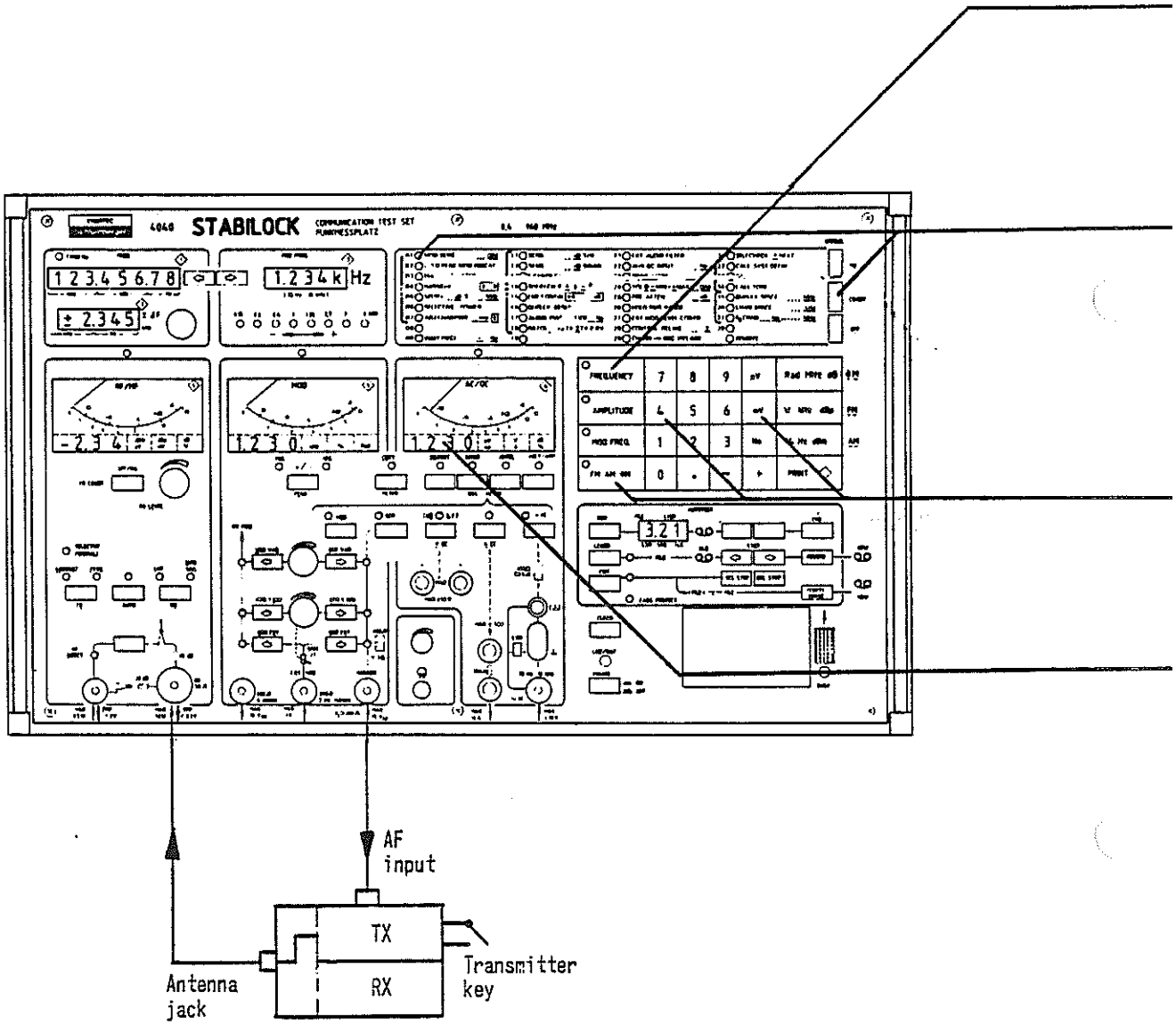
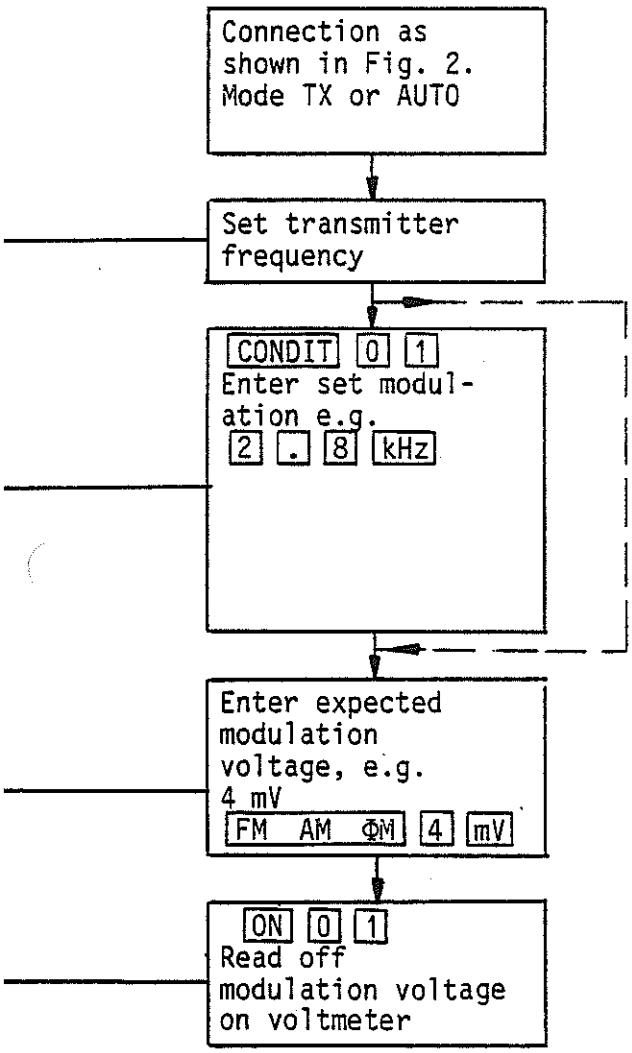


Fig. 2.:
Test Configuration for Transmitter Measurements

"Step for Step" Test Sequence	Explanations



Ensure short RF/AF connections. In the AUTO mode the 4040 automatically switches to transmitter measurement at outputs >50 mW.

Set the transmitter frequency on the STABILOCK 4040.

SPECIAL 01 is the routine for automatically measuring the modulation sensitivity of the transmitter. The set value entered with CONDIT 0 1 remains stored until it is overwritten, i.e. CONDIT 0 1 step is not performed until a different set modulation is entered.

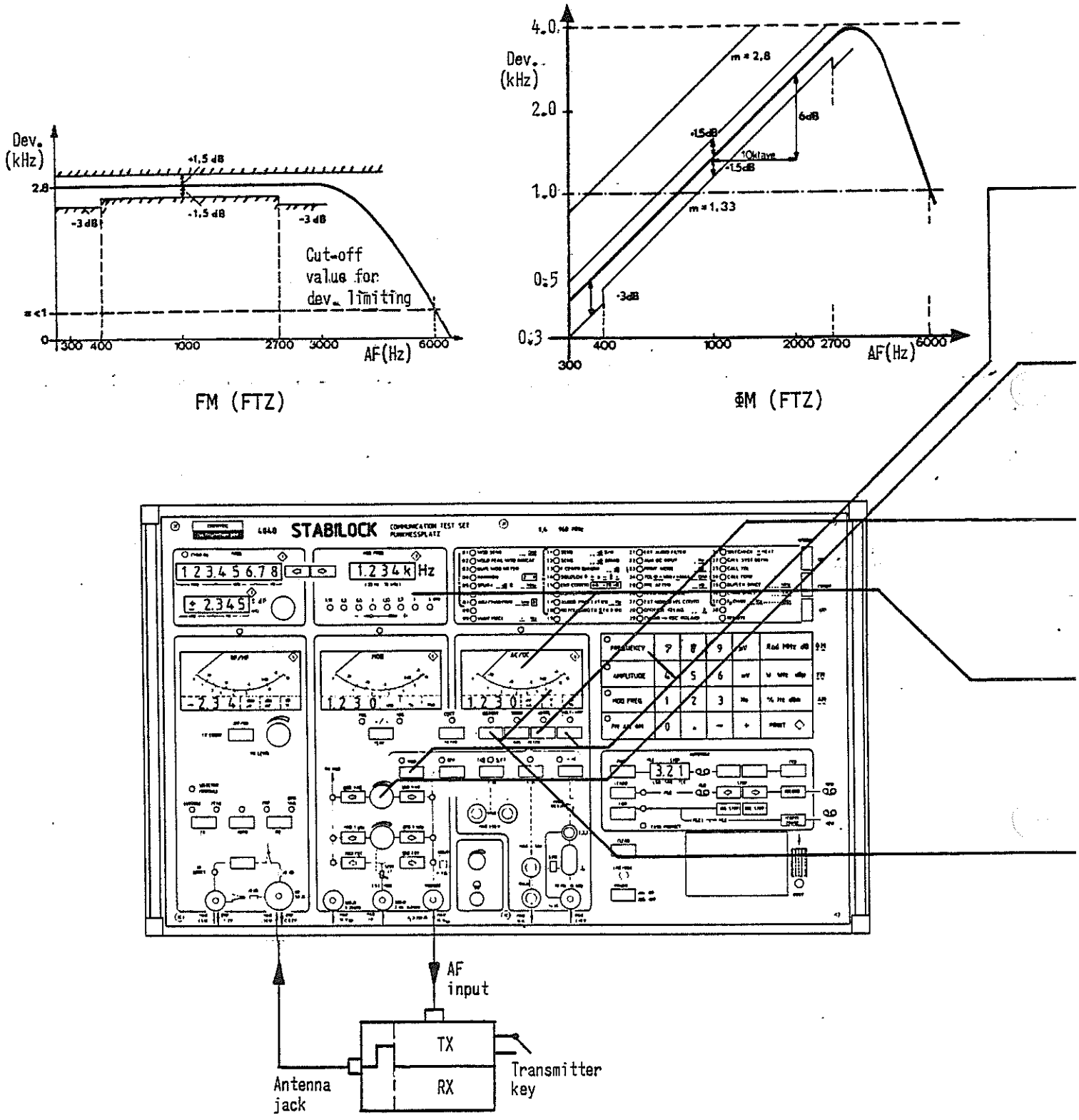


Fig. 2.:
Test Configuration for Transmitter Measurements

"Step for Step" Test Sequence	Explanations
Connection as shown in Fig. 2: Mode TX or AUTO	Ensure short RF/AF connections. In the AUTO mode the 4040 automatically switches to transmitter measurement at outputs >50 mW.
Set transmitter frequency. Voltmeter to: VOLT/AMP MOD	Set the frequency of the transmitter on STABILOCK 4040; switch the voltmeter to the output of the 4040 modulation meter (DEMOD).
Modulate transmitter with f 1 kHz and specified modulation intensity.	Modulate the transmitter with the specified test modulation e.g. fMOD 1 kHz, deviation 20 % of peak deviation - test modulation is indicated by modulation meter ⑤ .
Voltmeter to: dB REL Display: 0 dB	Switch the voltmeter to dB REL - the modulation frequency response is thus related to the test modulation.
Alter modulation frequency as specified, read off frequency response on voltmeter in dB.	Vary the modulation frequency as stated in your specifications (fixed frequencies or variable frequency modulation generator).
Voltmeter to: DISTORT Read off distortion factor on voltmeter.	Voltmeter ⑥ shows you the transmitter distortion factor at the specified test modulation when the DISTORT button is pressed.

Frequency response

Distortion factor

The signal/noise ratio is the ratio of the standard modulation level to the noise level without modulation. It is expressed in dB, e.g. -40 dB i.e. the noise level is 40 dB below the standard modulation level. The signal/noise ratio is measured weighted (CCITTP53).

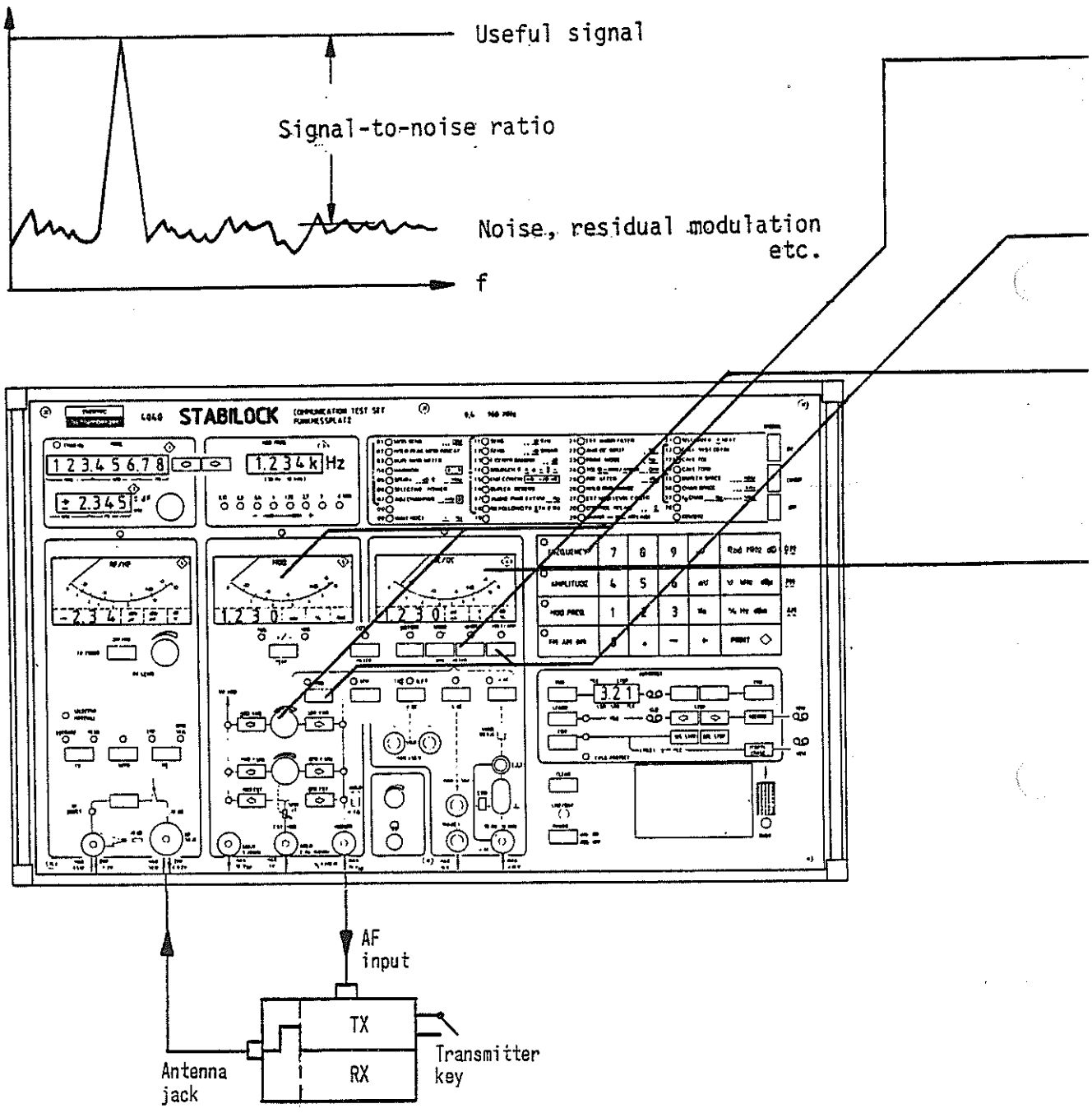


Fig. 2.:
Test Configuration for Transmitter Measurements

"Step for Step" Test Sequence	Explanations
Connection as shown in Fig. 2. Mode TX or AUTO	Ensure short RF/AF connections. In the AUTO mode the 4040 automatically switches to transmitter measurement at outputs >50 mW.
Set transmitter frequency. Modulate transmitter with standard modulation.	Set the transmitter frequency on STABILOCK 4040, modulate the transmitter with the specified standard modulation e.g. fMOD 1 kHz, dev. 2.8 kHz - display ⑤ .
Voltmeter to: VOLT/AMP MOD	The voltmeter is switched to the demodulation output.
Voltmeter to: dB REL Display: 0 dB	The voltmeter operates as a relative level meter - the standard modulation is the reference value for the signal/noise ratio.
Switch off modulation. Read off S/N ratio on voltmeter ⑥ , e.g. -42.2 dB	

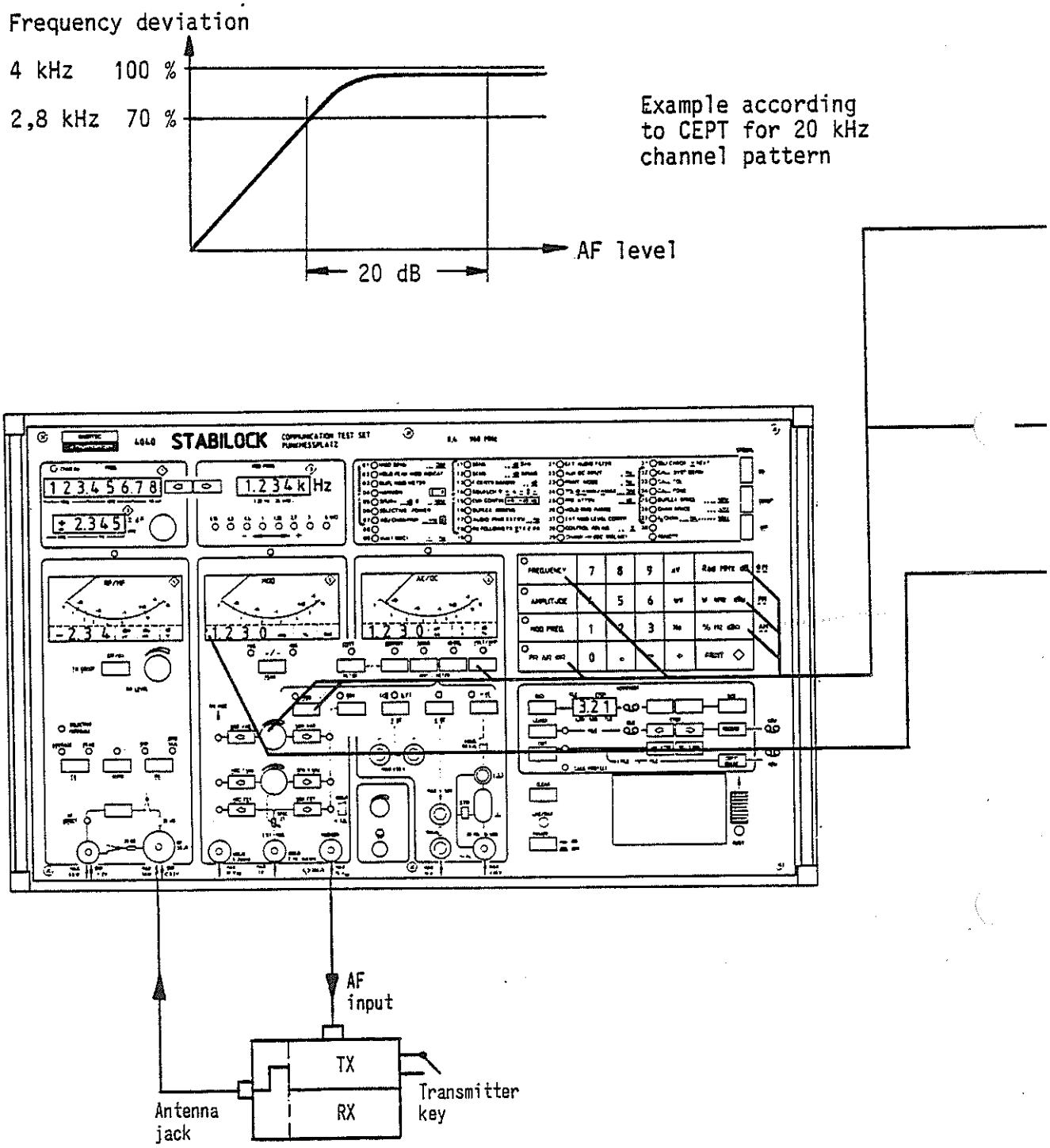
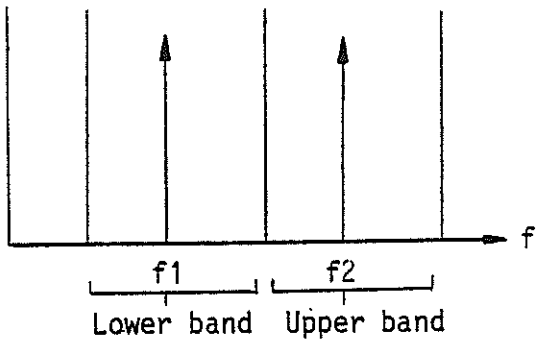
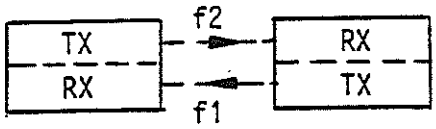


Fig. 2.:
Test Configuration for Transmitter Measurements

"Step for Step" Test Sequence	Explanations
Connection as shown in Fig. 2. Mode TX or AUTO	Ensure short RF/AF connections. In the AUTO mode the 4040 automatically switches to transmitter measurement at outputs >50 mW.
Set transmitter frequency. Voltmeter to: VOLT/AMP, MOD Modulate transmitter with test modulation.	The transmitter modulation is displayed on the modulation meter ⑤. Test modulation for 20 kHz channel spacing e.g. fMOD 1 kHz, frequency dev. 2.8 kHz (≙ 70 % of permissible maximum deviation).
Increase level of modulation generator by +20 dB.	Output level of modulation generator is increased by +20 dB so that the modulation limiter of the transmitter is now operating.
Read off modulation intensity on modulation meter ⑤.	The modulation intensity must not exceed the permissible maximum value, e.g. frequency dev. 4 kHz at 20 kHz channel spacing.





The DUPLEX meter option enhances test convenience since the DUPLEX meter is automatically tuned to the transmitter. The STABILOCK 4040 can thus remain set on the receiver frequency when the measuring mode is switched over from RX to TX.

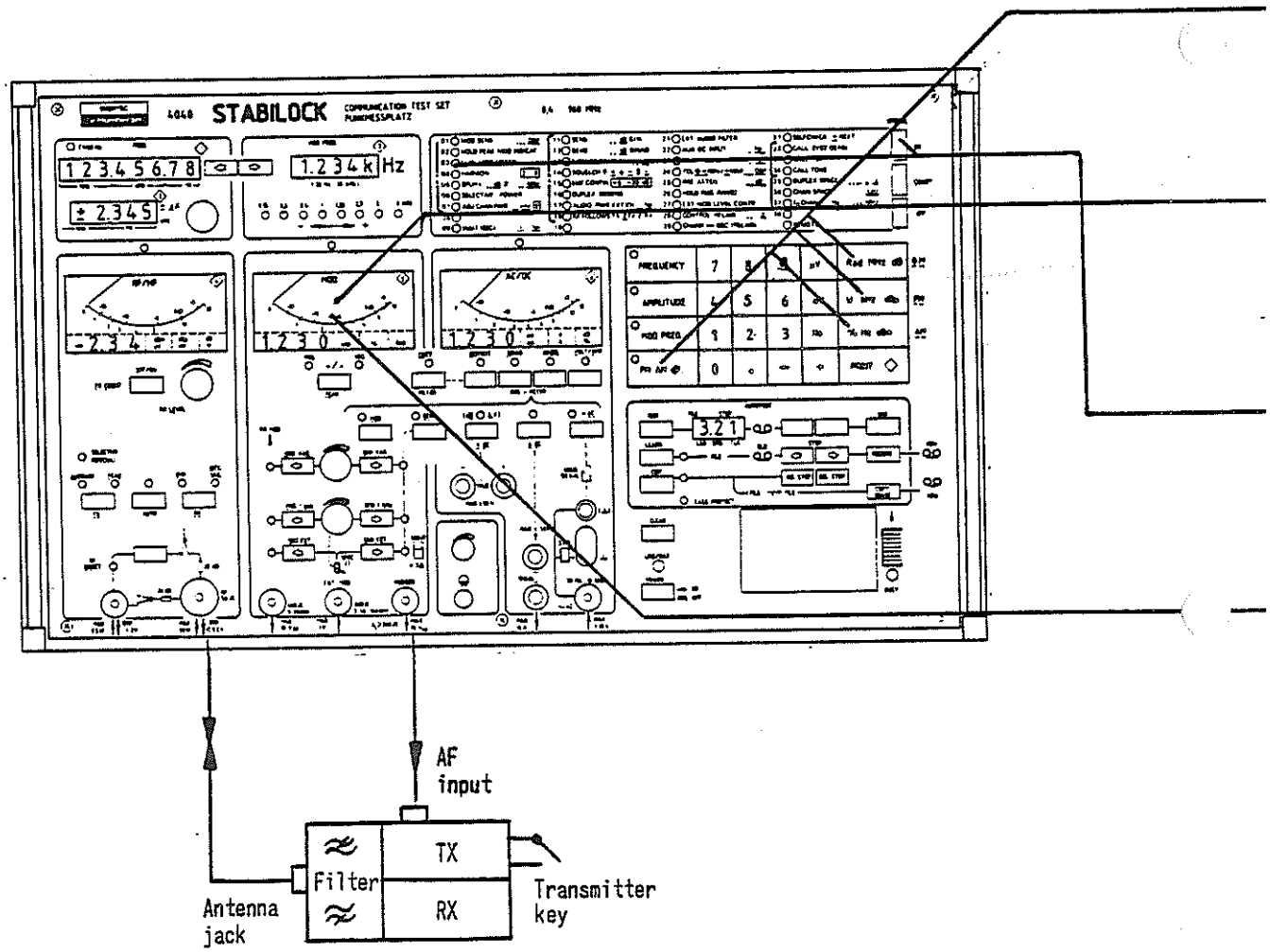
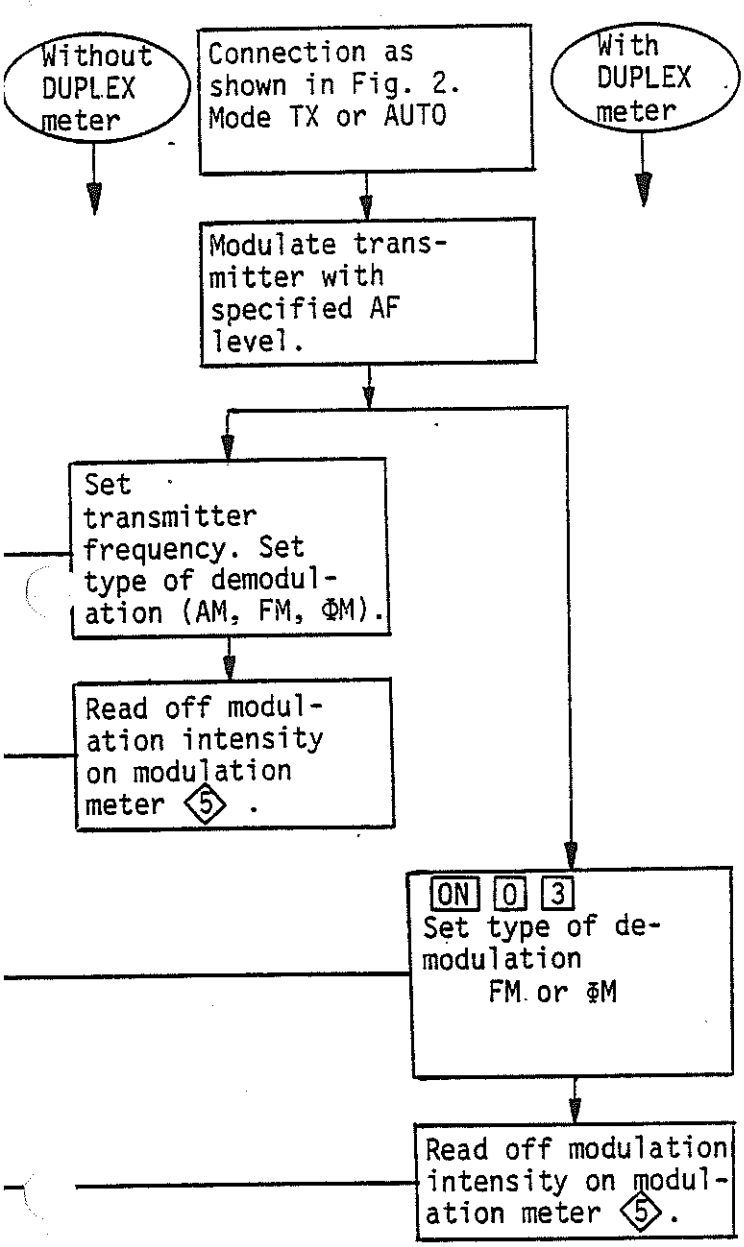


Fig. 2.:
Test Configuration for Transmitter Measurements


"Step for Step" Test Sequence
Explanations
Without DUPLEX meter
Connection as shown in Fig. 2. Mode TX or AUTO
With DUPLEX meter
Ensure short RF/AF connections. In the AUTO mode the 4040 automatically switches to transmitter measurement at outputs >50 mW.
Modulate transmitter with specified AF level.
Modulate transmitter with the specified AF level e.g. 4 mV at fMOD 1 kHz.
Set transmitter frequency. Set type of demodulation (AM, FM, ΦM).
Set the transmitter frequency on STABILOCK 4040, note the DUPLEX offset - upper band/lower band position.
Read off modulation intensity on modulation meter ⑤ .
Read off modulation intensity on modulation meter, compare with your specifications, e.g. frequency deviation 2.8 kHz.
ON 0 3
Set type of demodulation FM or ΦM
The DUPLEX meter automatically tunes to the transmitter; the 4040 can thus remain on the RX frequency. You do not need to pay attention to the DUPLEX offset and to the upper band/lower band position.
Read off modulation intensity on modulation meter ⑤.
The DUPLEX meter shows you the modulation intensity of the transmitter.

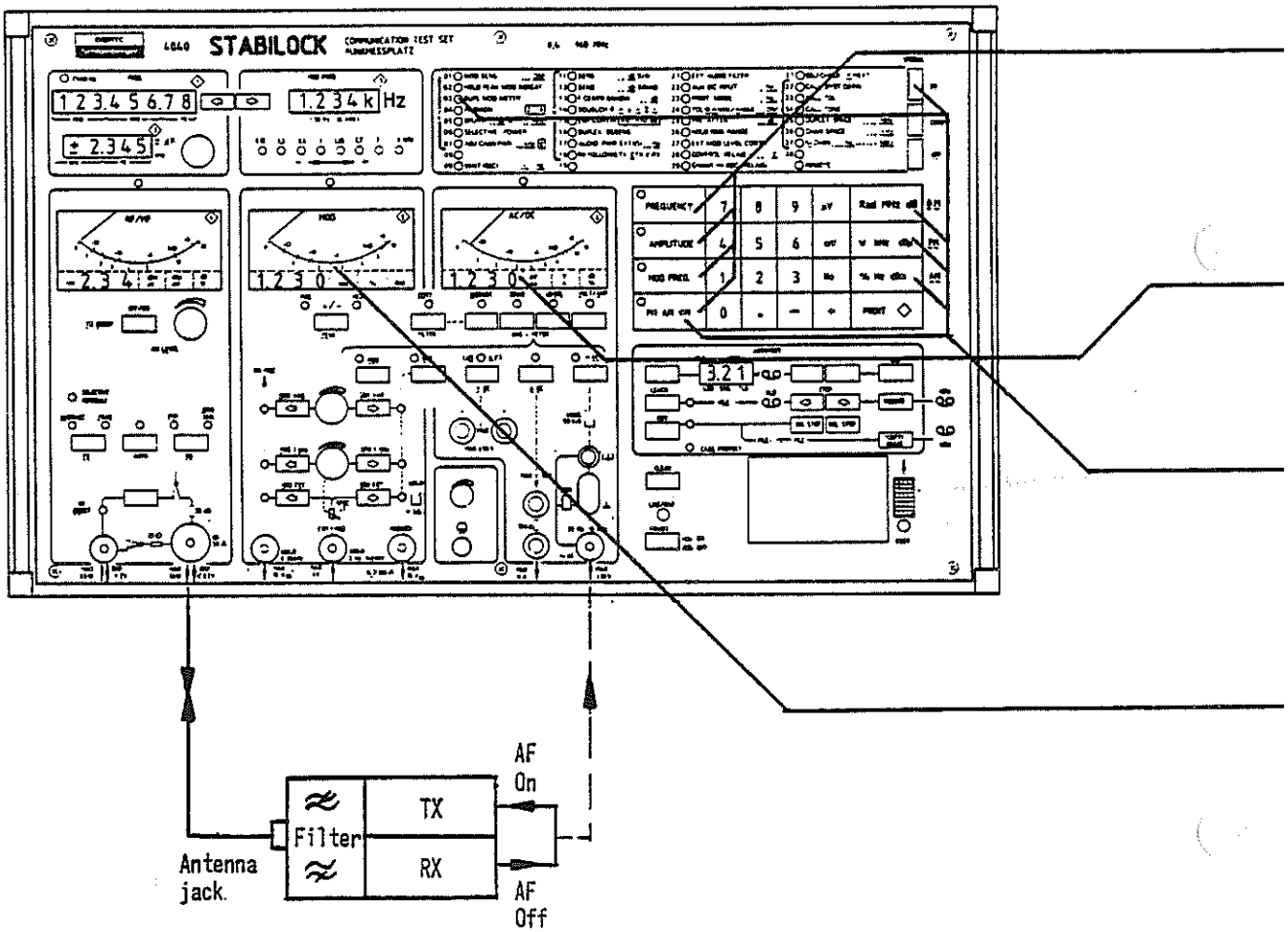
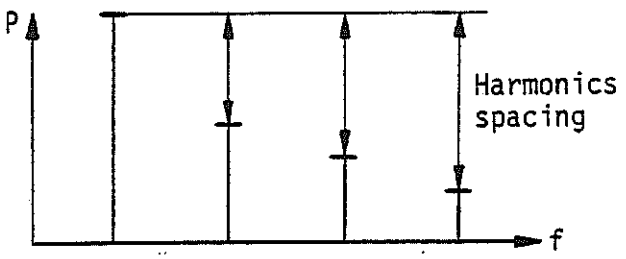
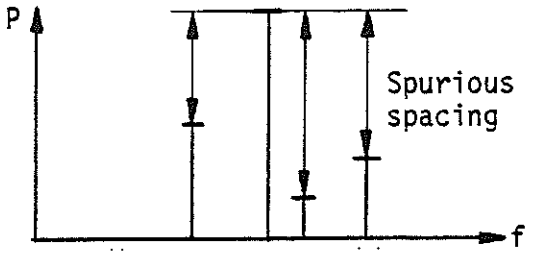


Fig. 3.:
Test Configuration

"Step for Step" Test Sequence	Explanations
Connections as shown in Fig. 3. RX mode	
STABILOCK 4040 to RX frequency with standard modulation and standard EMF.	Set the STABILOCK 4040 to the receiver frequency: With standard modulation e.g. fMOD 1 kHz, frequency deviation 2.8 kHz, with standard EMF e.g. 10 µV ◇5◇ indicates incoming deviation.
If necessary, check the AF level of the RX with voltmeter ◇6◇ .	Check the AF transfer level to the transmitter and set the correction value on the radiotelephony set, if necessary.
Transmitter on [ON] [0] [3] Select type of demodulation.	Switch on the transmitter, switch on the DUPLEX meter and select the right type of demodulation: FM or ΦM.
Modulation meter ◇5◇ shows outgoing deviation.	Is the outgoing deviation correct? If not correct on radiotelephony set. [OFF] [03] → ◇5◇ = incoming FM [ON] [03] → ◇5◇ = Outgoing FM



Harmonics (remote from carrier)



Nonharmonic spurious (close to carrier)

The STABILOCK 4040 operates as a spectrum analyser; this requires the adjacent channel power meter option. The test bandwidth is approx. 2 kHz.

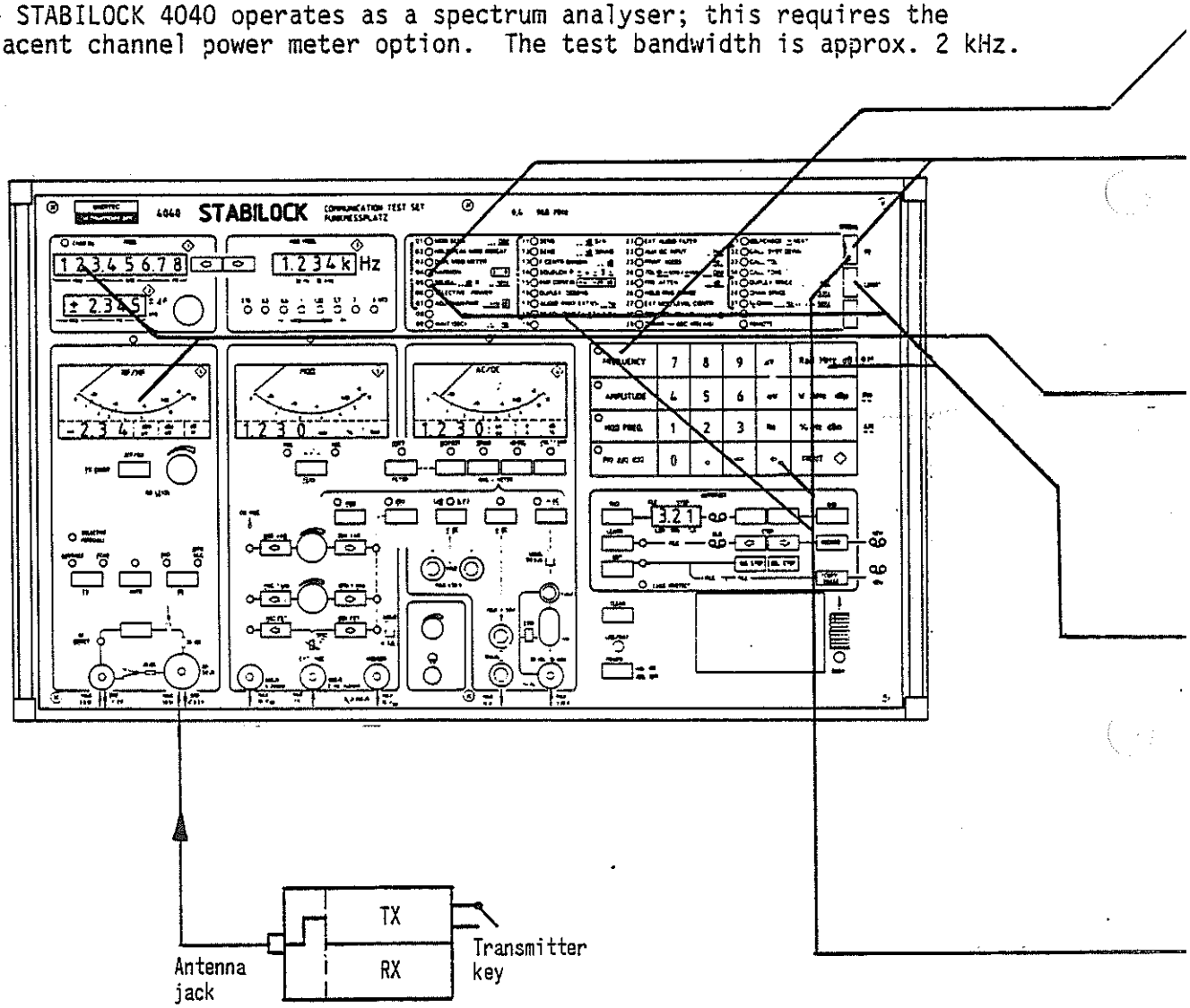
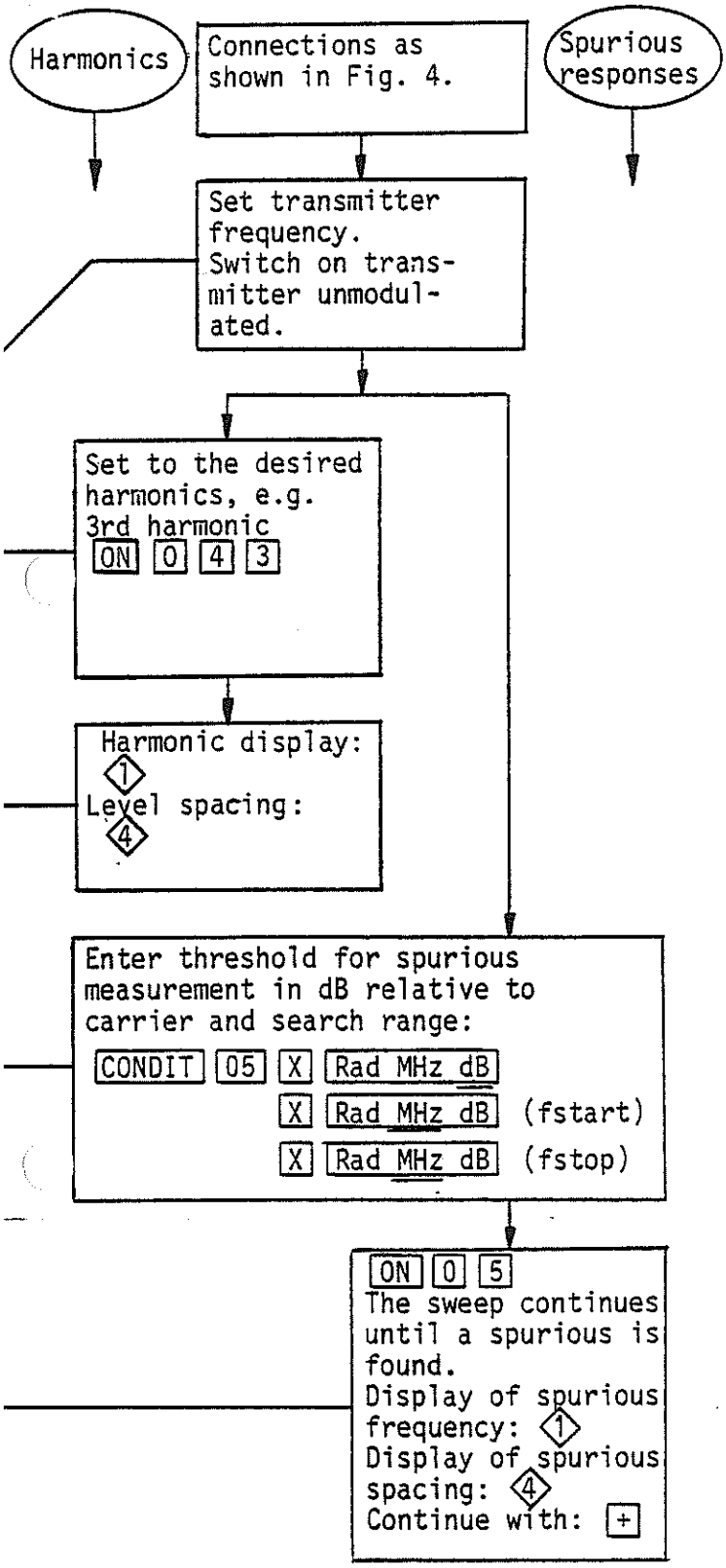


Fig. 4.:
Test Configuration

"Step for Step" Test Sequence

Explanations



Ensure short RF connections, switch STABILOCK 4040 to TX mode (transmitter measurement).

The rule here is: The first harmonic (fundamental) is the carrier frequency of the transmitter.
Special 04 is the routine for automatically measuring harmonics spacing.

Typical display:
2. 1 Number of harmonic
-75.2 dB 4 Harmonics spacing to carrier frequency

SPECIAL 05 is the routine for automatically measuring nonharmonic spurious. The search range and measuring threshold are set with CONDIT 0 5. They remain stored until they are overwritten, i.e. the CONDIT 0 5 step is not performed until the test conditions are altered.

Typical display:
150.612.05 1 = spurious frequency
-45.3 dB 4 = spurious spacing
If no spurious is found, the displays read as follows:
----- 1
--- 4

This measurement is only possible with the adjacent channel power meter option.

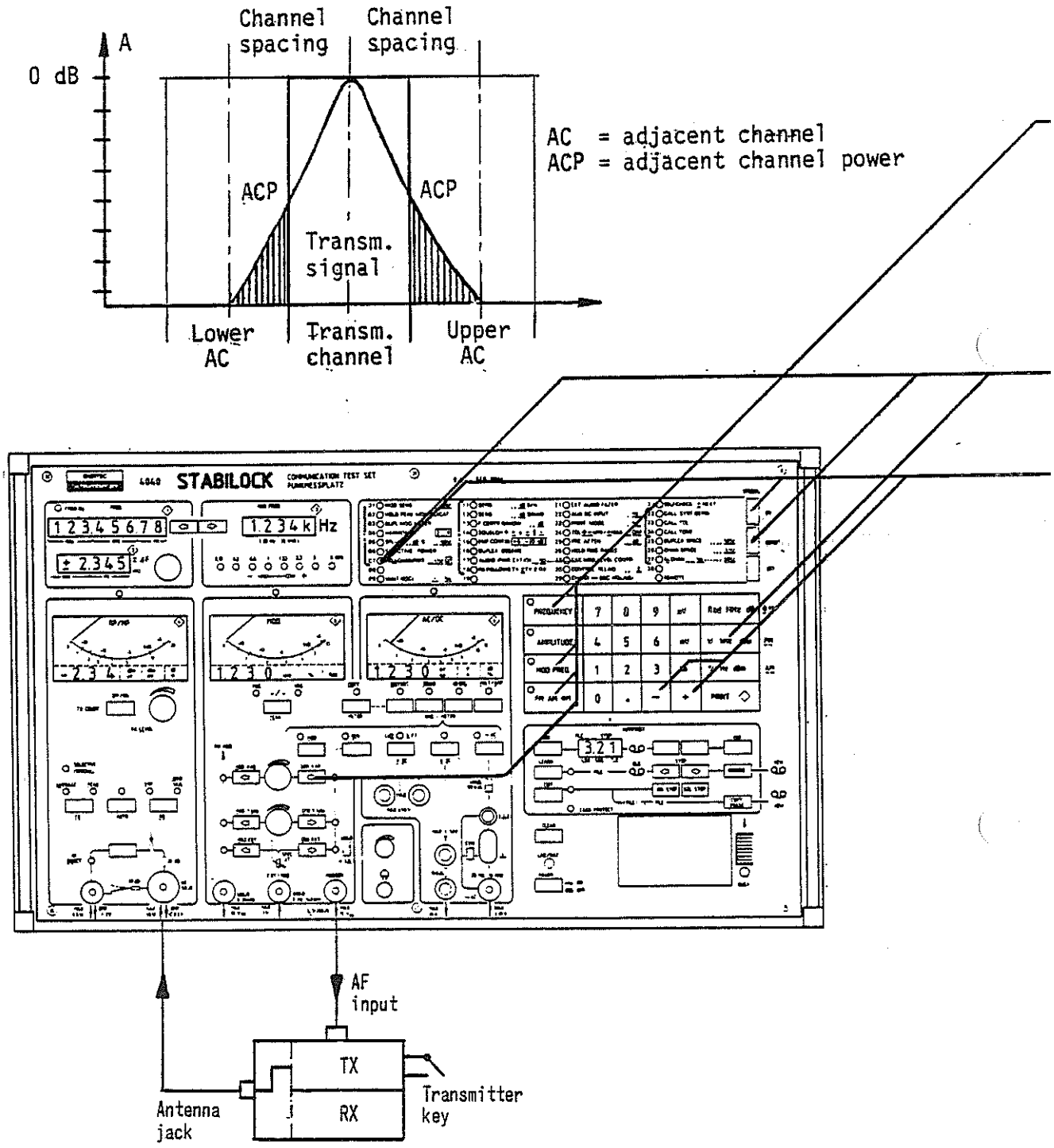


Fig. 2.:
Test Configuration for Transmitter Measurements

"Step for Step" Test Sequence	Explanations
Connections as shown in Fig. 2. TX mode	Ensure short RF/AF connections. In the AUTO mode the 4040 switches automatically to transmitter measurement at outputs >50 mW.
Set nominal frequency of transmitter. Modulate the transmitter as specified.	Set the STABILOCK 4040 to the nominal frequency of the transmitter. Modulate the transmitter as specified, e.g. fMOD 1250 Hz, AF level +20 dB above level with standard modulation.
CONDIT 0 7 Input of channel spacing e.g. 20 kHz 2 0 W kHz dBµ	SPECIAL 07 is the routine for automatically measuring adjacent channel output. The desired channel spacing is entered with CONDIT 0 7 . The spacing remains stored until it is over-written.
Upper adjacent channel: ON 0 7 + Read off test result in dB ◇4	
Lower adjacent channel: ON 0 7 - Read off test result in dB ◇4	