STABILOCK 4031/4032

# SSB package

**Hardware Option 248 154**

**Operating Instructions**

Doc. Version: 9401-100-A

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Supplement to operating manual; file under Chapter 9

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# Contents

# Requirements for SSB testing

Your STABILOCK must be fitted as follows:

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

The firmware version of your STABILOCK appears in the status mask. The status mask is brought onscreen with [AUX] + (DEF.PAR.) + (STATUS).

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# Technical data

## TX tests

| | |
|---|---|
| Frequency range: | 2 to 999.999 MHz |
| RF power: | 1 mW to 125 W |
| Measuring error: | see data sheet |
| Preselectable intermodulation for power measurement: | 0 to 45 dB |
| Test tones/frequency: | 2/freely selectable |
| Frequency offset: | ±1 kHz |
| AF bandwidth: | 10 Hz to 30 kHz |
| Carrier suppression: | 0 to 60 dB at f = 1 kHz |
| Opposite sideband suppression: | 0 to 60 dB at f = 1 kHz |
| Measuring error: | 0 to 40 dB ±1 dB<br>0 to 60 dB ±2 dB |
| AGC delay time: | 0 to 9999 ms |

## RX tests

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

## Cabling

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

## Test setup

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

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

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

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

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# TX SSB tests

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

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

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

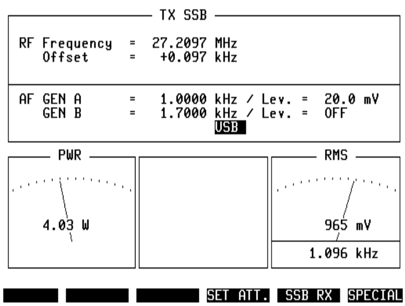
## Basic TX SSB setting

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

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

With SSB RX you can change to the RX SSB mask. RX or TX terminates SSB testing and takes you to the RX or TX mask.

**Fig. 9.1:** TX mask: the instrument is set for 28 MHz channel frequency, the upper sideband is selected and the modulation level of generator GEN A is 1 mV for a modulation frequency of $f_{mod}$ = 1 kHz.



# Frequency offset

## Measurement ---> Frequency offset

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

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

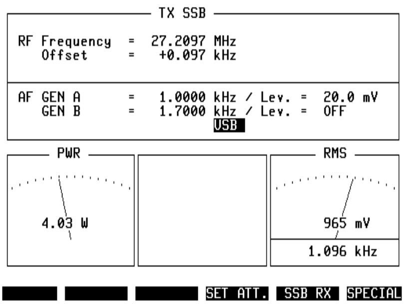



**Fig. 9.2:** Frequency offset: in the Offset field you can read the difference between the measured RF frequency and the figure entered in the RF Frequency field.

## RF power (average power)

### Measurement ---> RF power

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

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

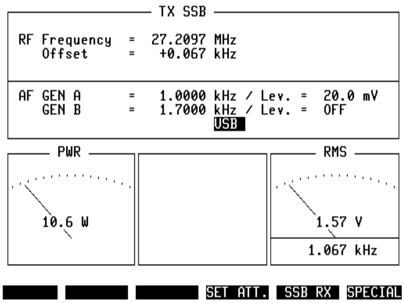



**Fig. 9.3:** RF power: the PWR meter shows the average carrier power of the radio set. Measurement is broadband, so the channel frequency (`RF Frequency` field) is unimportant.

# Distortion factor

## Boundary conditions

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

## Measurement ---> Distortion factor

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

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

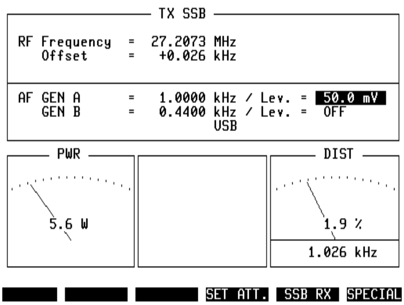



**Fig. 9.4:** Distortion factor: the distortion factor of the test item can be read on the DIST meter.

# Noise voltage - spurious modulation

## Boundary conditions

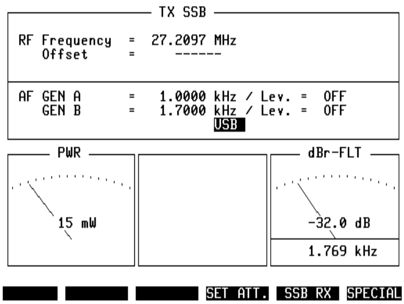
- Disconnect filters 1 and 2 (enter blanks in scroll fields `Filter 1` and `Filter 2` of OPTION CARD mask)

## Measurement ---> Spurious modulation

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

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

**Fig. 9.5:** Spurious modulation: on the dBr meter you can read the noise voltage with CCITT weighting.



# Suppression of carrier and opposite sideband

## Boundary conditions

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

## Measurement ---> Suppression of carrier and opposite sideband

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

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

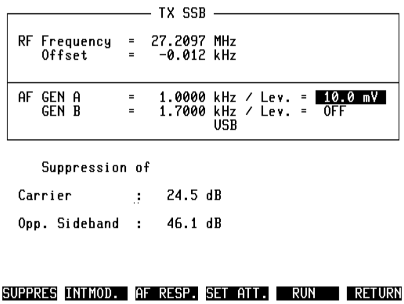



**Fig. 9.6:** Suppression of carrier and opposite sideband: the suppression of the carrier is 34.1 dB, that of the opposite sideband 58.4 dB.

# 3rd-order intermodulation product

## Boundary conditions

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

  upper intermodulation frequency = 2A + B

  lower intermodulation frequency = 2A - B

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

## Measurement ---> Intermodulation product

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

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

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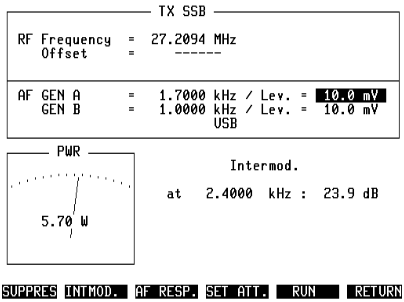


**Fig. 9.7:** Intermodulation: in the `INTERMOD.` field you can read the 3rd-order intermodulation product.

# Modulation frequency response

## Boundary conditions

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

## Measurement ---> Modulation frequency response

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

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

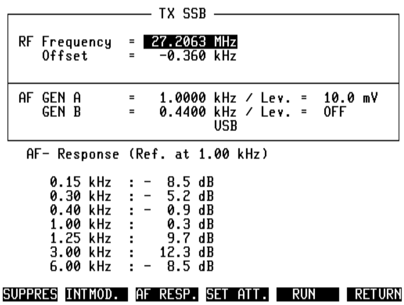


**Fig. 9.8:** Modulation frequency response: for the modulation frequency response of the test item there are seven reference values. The 0dB reference frequency is 1 kHz.

# RX SSB tests

## Basic RX SSB setting

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

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

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

## Boundary conditions

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

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

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

# Distortion factor

## Boundary conditions

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

## Measurement ---> Distortion factor

| | | |
|---|---|---|
| 1. | Make basic RX SSB setting. | |
| 2. | [DIST] | Call up DIST meter. |
| 3. | Read distortion factor on DIST meter. | |

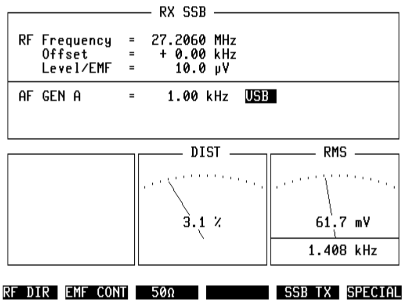


**Fig. 9.9:** Distortion factor: the distortion factor of the test item can be read on the DIST meter.

# Receiver sensitivity (SINAD)

## Boundary conditions

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

## Measurement ---> Sensitivity

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

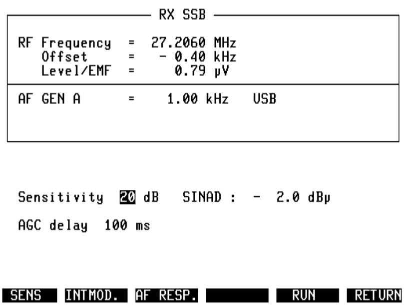


**Fig. 9.10:** Sensitivity: the sensitivity is read out in the `SINAD` field.

# Intermodulation

## Boundary conditions

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

## Measurement ---> Intermodulation

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

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

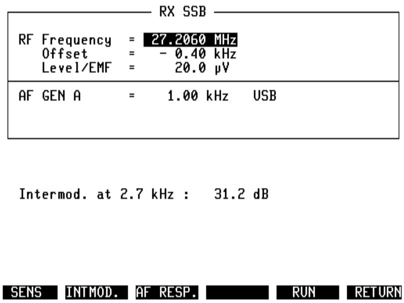


**Fig. 9.11:** Intermodulation: the `Intermod.` field shows the intermodulation product at 2.3 kHz or 2.7 kHz.

# AF frequency response

## Boundary conditions

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

## Measurement ---> AF frequency response

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

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

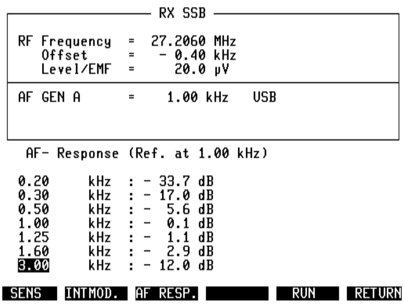


**Fig. 9.12:** Frequency response: the AF frequency response of the test item is shown in the form of seven reference values. The 0dB reference frequency is 1 kHz.