STABILOCK 4031 4032

NADC BS-Test

Software Option 897 072

Operating Instructions

02_nadbs Doc. Version: 9512-130-A

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Supplement to operating manual; file under chapter 10

10

Contents

☞ **For differences from former software versions:** see the Lifeline at the end of this supplement.

Introduction

The NADC BS-Test program supports you in RX and TX quality tests on NADC base stations. Precise, numeric measured figures are read out of course. What is new, and indispensable for a fast visual check of performance, is the graphic presentation of the quality parameters of the modulator in the "constellation display". Here you can recognize phase and magnitude errors of the modulator at a glance. And what is also useful for a fast visual check is the graphic display of the modulation spectrum of a base station.

What is tested			
Bit error rate (Ericsson base stations only)		ΔP/symbol	
		Origin offset	
Modulation spectrum	(graphic)	RMS vector error	(graphic/numeric)
Adjacent-channel power measurement		Max. vector error	(numeric)
RF power		Phase error	(graphic/numeric)
Frequency offset		Min./max. magnitude	(graphic/numeric)

NADC = D-AMPS = TDMA

North
American
Digital
Cellular

Dual Mode
American
Mobile
Phone
System

Synonym for NADC

Time
Division
Multiple
Access

Technique used in NADC

10

General preparations

Check that STABILOCK is fitted with NADC-compatible hardware. The D-AMPS unit (236 044) and the D-AMPS duplex unit (229 063) have to be installed in order to test NADC base stations.

Check procedure

- ❍ Call up the STATUS mask: (AUX)+(DEF.PAR)+(STATUS)
- ❍ Check the status of the related firmware versions (SOFTWARE-VERSIONS:)

STABILOCK 4031		STABILOCK 4032	
HOST-MCU	≥ 3j58	HOST-MCU	≥ 5.00
CRT-MCU	≥ 2.58	CRT-MCU	≥ 5.00
RF/AF-MCU	≥ 2.5S	RF/AF-MCU	≥ 5.00

- ❍ If the STATUS mask shows DIG-MCU, the D-AMPS unit is installed.
  (4031: If HOST-MCU ≤ 3.82, STATUS mask shows OPT-MCU instead of DIG-MCU.)
  (4032: If HOST-MCU ≤ 5.02, STATUS mask shows OPT-MCU instead of DIG-MCU.)
- ❍ Call up the OPTIONS mask. This must show the entry installed after the option Duplex + I/Q (**Fig. 10.1**).
- ❍ Call up the HW-REVISIONS mask. This must show the marked entries illustrated in **Fig. 10.2**.

Select power unit

- ❍ Call up the GENERAL PARAMETERS mask: (AUX)+(DEF.PAR).
- ❍ Select the power unit (WATT|dBm) with the scroll field RF-Power. The selected unit will appear in all RF power results.

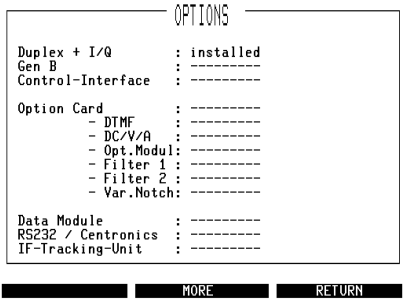


Fig. 10.1: The OPTIONS mask tells you whether the D-AMPS duplex unit is installed.

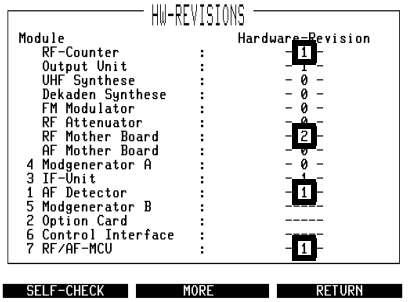


Fig. 10.2: If the mask shows smaller entries for the marked fields, you will have to update the corresponding stage.

Preparation for working with channel numbers

❍ Enter the following values in the GENERAL PARAMETERS mask (**Fig. 10.3**):

```
Channel space       =     30.0 kHz
Duplex space        =     45.0 MHz
Channel             =     1 No.
Corresp. frequ.     =     825.030 MHz
Channel no. ↑       =     Freq. ↑
```

Select EMF/50Ω

❍ Call up the Duplex or RX mask.

❍ Use the softkey to select RF output level = EMF or measured into 50Ω (standard).

Loading system program

Depending on the capacity of the available memory cards, the NADC BS Test system program is supplied on one or more (n) cards.

1) Insert the first memory card (1 of n) in the slot on STABILOCK.
2) Press (AUX)+(DATA) to start the loading procedure.
3) When the message `INSERT NEXT CARD` appears in the status line onscreen, insert the next card.
4) When the system program is fully loaded, the basic NADC mask appears onscreen (**Fig. 10.4**).
5) Now insert the first memory card again or leave the single one in place. In this way STABILOCK can store entered test parameters on the card so that you do have not to enter them again the next time you call up the system program (deactivate write protection if it is set on the memory card).

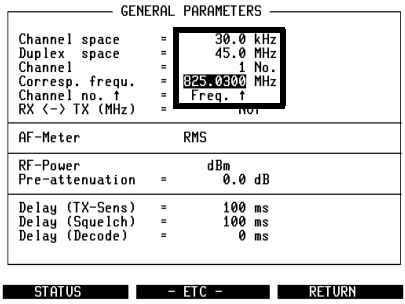


Fig. 10.3: If you want to work with channel numbers, you have to enter the marked values in the GENERAL PARAMETERS mask.

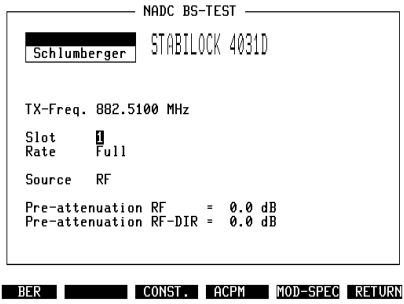


Fig. 10.4: The basic NADC mask defines elementary test conditions. This mask appears onscreen after calling up the program.

General Test Preparations

The following entries in the basic NADC mask are general preparations for the different RX and TX tests (receiver/transmitter). Here they will be looked at separately, but in the individual test procedures they are simply mentioned. The (relevant) values entered in the basic NADC mask will be adopted in the different test masks and vice versa.

Set TX frequency

- Place the cursor on entry field `TX-Freq`. Enter the current transmit frequency of base station. This is true for all TX tests (**Fig. 10.5**). For RX tests use the corresponding entry field in the RX BER test mask.

Set channel number

- If you want to work with TX channel numbers, place the cursor on entry field `TX-Freq`. and select with UNIT/SCROLL the scroll variable `NoU` (STABILOCK receives in upper band, see **Fig. 10.6**). After this enter the desired channel number (see also "General preparations"). For RX tests use the corresponding entry field in the RX BER test mask.

Select slot

- Place the cursor on scroll field `Slot` and select the current time slot (permissible figure: 1 to 3). This value is only relevant for the RX test and must correspond to the time slot set on the base station.

Select rate

- `Full` rate cannot be altered in the current version of the system program (later versions will also offer `Half` rate).

Select signal input

- Place the cursor on scroll field `Source` and select the desired signal input:
  - `RF` Signal input via RF socket of test set.
  - `Ext. I/Q` Signal input via socket Bu 106 on the rear of the D-AMPS unit (see Appendix). If the base station supports the I/Q output, select this input for more accuracy in modulation measurements).

Set pre-attenuation

- To avoid RF level errors produced by the attenuation of the RF cables, you can compensate them separately for both RF sockets by the entries in the corresponding `Pre-attenuation` entry fields.
  If any other value than 0 is entered, the pointer `ATT` appears in all relevant masks to draw your attention to the correction of the measured and the transmitted RF level (for more information, see details of GENERAL PARAMETERS mask).
  In the event of compensation by entries in the basic NADC mask, compensation defined in the GENERAL PARAMETERS mask is set to 0 automatically.

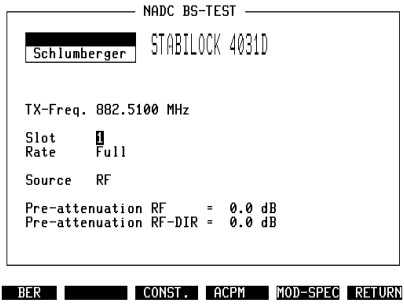


Fig. 10.5: Basic NADC mask with entered frequency for TX tests.

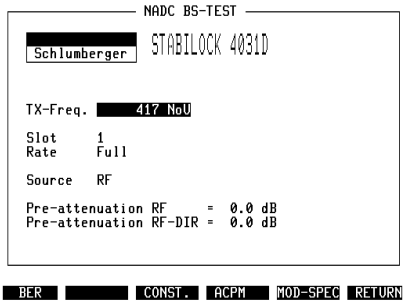


Fig. 10.6: Basic NADC mask with entered channel number for TX tests.

How to Read the "Test Results" Table

IEEE command for sampling results by controller or AUTORUN

Test Results		
RESULtx	**MIN**	Explanation of result
RESULty	**SN**	Explanation of result
RESULtz	**No**	Explanation of result
MPOWER	**PWR**	Explanation of result
RESULtu	**ERR**	Explanation of result

Name of result field in test mask

NADC TX Tests

TX Test Setup

Levels of < –110 dBm appear when testing, so the entire setup must be proof against EMI pickup and not radiate any either. The following measures are recommended for this purpose:

- Use a doubly shielded RF cable between the Communication Test Set and the base station.
- Terminate the RF DIRECT socket of the Communication Test Set with 50 Ω.
- Make sure that all plug-ins of the Communication Test Set (back panel) are screwed in tight.
- Close vacant plug-in slots on the Communication Test Set (back panel) with dummy panels.

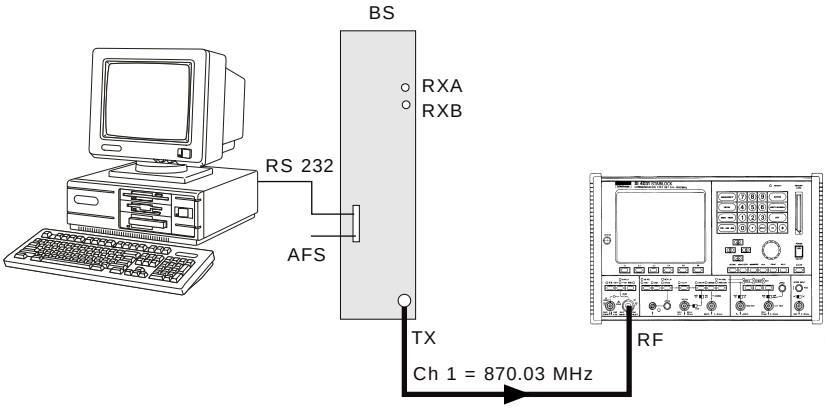


Fig. 10.7: Setup for transmitter testing on base stations. Connect the RF output (TX) of the base station to the RF input of STABILOCK. No other connections to the Communication Test Set are necessary.

☞ Use the supplied BNC/BNC cable (382 678) to connect socket Bu 103 of the IF unit (back panel) to socket Bu 103 of the D-AMPS unit (see Appendix). Testing is not possible without this connection.

Modulation Quality

WHY?

- Test the modulation characteristics of the base station. For this the Communication Test Set offers fast visual judgement of modulation quality with the constellation display (graphic presentation of modulation parameters) plus comprehensive indication of the measured figures on the numeric display (with peak-hold function).

Requirement

- Make the general test preparations.

Constellation display

HOW?

- Press (CONST) in the basic NADC mask.
- Select DISPLAY MODE in the scroll field (**Fig. 10.8**): D = dots, L = lines, S = statistics (see box on page 10-17).
- Press (RUN). The display shows the test results. If there are no test results, the base station's power level is too small (see box below).
- End the test with (STOP). After this (NUMERIC) takes you to the numeric display or (RETURN) back to the basic NADC mask.

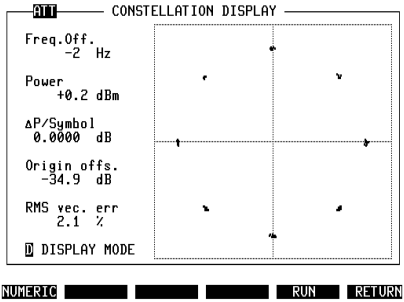


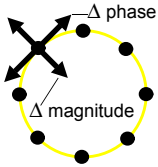
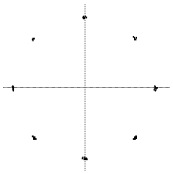
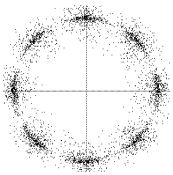
Fig. 10.8: Constellation display after starting test with (RUN). ATT in mask header tells you that cable attenuation of Communication Test Set is compensated (see "General Test Preparations"). This only affects absolute Power figure, not other (relative) power figures like ΔP/Symbol.

No PWR figure?

If the PWR figure is missing after setting a low power level on the base station, it means that the transmitting power of the base station could not be measured precisely.

Remedy: first set a high power level on the base station (eg > +17 dBm on RF input of Communication Test Set). This always produces an exact PWR figure that is used internally to calibrate the power meter of STABILOCK. Proceeding from this, decreasing at any power level will also produce a correct PWR figure.

Test Results

RESULt1	**Freq.Off**.	Deviation of base-station transmit frequency from its rating (receive frequency of Communication Test Set).
RESULt2	**Power**	Average RF power of base station. (Missing measurement value? See box "No PWR figure?" on page 10-14.)
RESULt3	**ΔP/Symbol**	Measure of continuous alteration of power, measured for duration of slot and normalized to symbol. Ideal figure = 0; positive value for increasing power and negative value for decreasing power.
RESULt4	**Origin offs.**	Measure of erroneous DC offset of RMS vector. Ideal figure is –∞; a value of –20 dB would correspond to 10 % DC offset refered to average magnitude.
RESULt5	**RMS vec. err**	Average residual vector error, measured on 162 symbols (one burst). **Residual** means after arithmetic elimination of frequency offset, power alteration and origin offset plus normalization of power. Residual error includes both magnitude and phase error at maximum effect points. Average residual error of base-station transmit signal must not be greater than 12.5 %.
		In (theoretical) ideal case constellation display shows eight points arranged on 360° circle and 45° apart (RMS vector on points of maximum effect). The greater the phase and magnitude error of the RMS vector is, the further the points are from these ideal positions.
		Constellation display of well aligned modulator. Points are closely grouped about eight ideal positions (high modulation quality). The longer the measurement lasts (for statistical presentation), the tighter the populations of points become around the ideal positions.
		Constellation display of poorly aligned modulator. Points are far from ideal positions because of substantial phase and magnitude fluctuations of RMS vector.

Numeric display

HOW?

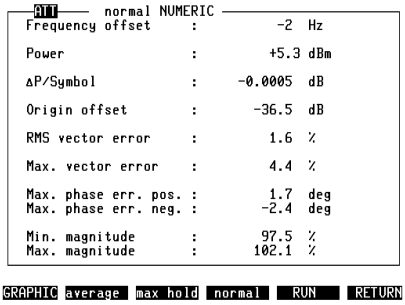
- ❍ Press (NUMERIC) in the constellation display.
- ❍ Select the result mode (see examples):
  - (average) = Results shown are averaged from nine bursts.
  - (max hold) = Results shown are maximum figures during measuring time (peak-hold function). Inapplicable for `Power` result.
  - (normal) = Results shown are measured from one burst.

  The actual display mode is shown in the mask header. You can only change the mode when testing is not in progress.
- ❍ Press (RUN). The display shows the test results.
  Note: For accurate test results, changing the base station's power level during a test is only permissible in the `normal` result mode.
- ❍ End the test with (STOP). After this (GRAPHIC) takes you back to the constellation display or (RETURN) to the basic NADC mask.

Test Results		
RESULt1	**Freq.Off.**	Same result as in constellation display
RESULt2	**Power**	Same result as in constellation display
RESULt3	**ΔP/Symbol**	Same result as in constellation display
RESULt4	**Origin offs.**	Same result as in constellation display
RESULt5	**RMS vector error**	Same result as in constellation display
RESULt6	**Max. vector error**	Largest residual vector error
RESULt7	**Max. phase err. pos.**	Largest phase error in direction of rotation (counterclockwise)
RESULt8	**Max. phase err. neg.**	Largest phase error opposite to direction of rotation (clockwise)
RESULt9	**Min. magnitude**	Smallest magnitude
RESULtA	**Max. magnitude**	Largest magnitude

Examples of result modes	
normal	Result field `RMS vector error` shows the average residual vector error measured on 162 symbols (one burst). With `Max. vector error` you see the largest residual vector error measured on 162 symbols.
average	Result field `RMS vector error` shows the average residual vector error measured on 9 ×162 symbols (nine bursts). With `Max. vector error` you see the average of the largest residual vector errors measured on nine bursts.

Fig. 10.9: In two result modes (normal) and (average), measured figures are updated so fast that exact visual evaluation is barely possible. Result mode (max.hold) solves this problem (display of maximum readings). ATT draws your attention to compensation of cable attenuation of Communication Test Set (see "General Test Preparations").

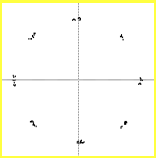


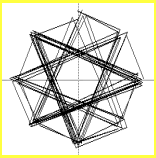
Available display modes

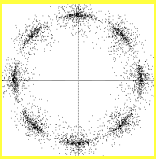
D = dots, the 162 points of maximum effect (POMEs) are shown singly. This display, for a well adjusted base station, shows eight tightly limited accumulations of dots, offset by 45°. After the 162th value the screen is extinguished and the next 162 dots are displayed.

L = lines, consecutive points of maximum effect are connected. From this display it is possible to deduce the symbol contents (data stream). Additionally you can detect phase errors very clearly. A PRBS (pseudo-random bit sequence) generates a closed figure. But, in practical terms, this display is just a pretty show.

S = statistics, corresponds to the display as dots but without their being extinguished after the 162th value. This makes it possible to trace seldom occuring outliers (phase and magnitude). In contrast to the dots display, the dimension of each dot is reduced to 50% due to better resolution in the statistics display.







Modulation spectrum

WHY?

- Test whether the modulation spectrum of the base station maintains the permissible levels within the 30-kHz channel spacing (otherwise there is adjacent-channel interference).

Requirement

- Make the general test preparations.

HOW?

- Press (MOD-SPEC) in the basic NADC mask.
- Select in the scroll field whether the modulation spectrum is to be shown `unfiltered` (you see the signal on the input of the test set) or `filtered` like from a mobile.
- Start the test with (CONTIN) (continuous measurement, halted by (STOP)) or with (1-SHOT) (one measurement frozen on display).
  Note: Because of the autoranging at the beginning of the measurement, it is not possible to change the base station's output power during a measurement.
- (RETURN) takes you back to the basic NADC mask.

Test Results

	When filtered, modulation spectrum of correctly aligned base station must be approximately as shown in **Fig. 10.10**. These are relative power figures refered to average power of burst.
RESULt1	Relative power at –30 kHz
RESULt2	Relative power at –15 kHz
RESULt3	Relative power at 0 kHz
RESULt4	Relative power at +15 kHz
RESULt5	Relative power at +30 kHz

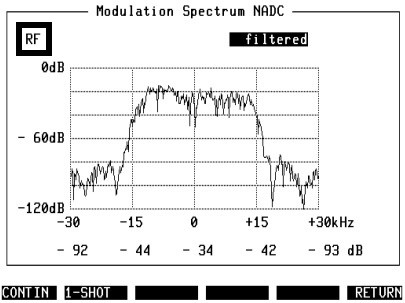


Fig. 10.10: Modulation spectrum of correctly aligned base station shown here barely trespasses on upper and lower adjacent channel. The marked field in the upper left corner shows you the selected signal input.

Adjacent-Channel Power Measurement ACPM

WHY?

- Adjacent-channel power is that part of base-station power which is emitted as noise in each of the six adjacent channels.

Requirement

- Make the general test preparations.

HOW?

- Press (ACPM) in the basic NADC mask.
- Enter the number of the channel (no frequency value) on which the base station currently sends (**Fig. 10.11**). See the following channel number/frequency calculation:

$$869.010 \le \mathbf{f} \le \mathbf{870.000} \quad \mathbf{N} = \frac{f - 870.000}{0.03} + 1023$$

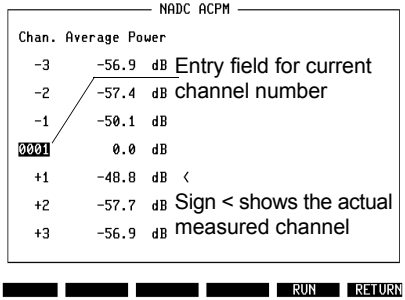
$$\mathbf{870.030} \le \mathbf{f} \le \mathbf{893.970} \quad \mathbf{N} = \frac{f - 870.000}{0.03}$$

- Start the test with (RUN). The display shows the test results. Do not change power level of the base station during the test is in process (failed test results).
- End the test with (STOP). (RETURN) takes you back to the basic NADC mask.

Test Results

		Display shows adjacent-channel power related to reference level measured in channel on which base station currently sends. Results must not exceed specified values. Max. measurement error: ±0.5 dB for test results until –46 dB (results below –46 dB may have a larger error).
RESULt1	**–3**	Relative power in 3rd lower adjacent channel
RESULt2	**–2**	Relative power in 2nd lower adjacent channel
RESULt3	**–1**	Relative power in 1st lower adjacent channel
RESULt4	**xxxx**	Reference level in current transmitter channel
RESULt5	**+1**	Relative power in 1st upper adjacent channel
RESULt6	**+2**	Relative power in 2nd upper adjacent channel
RESULt7	**+3**	Relative power in 3rd upper adjacent channel

Fig. 10.11: NADC-ACPM test mask.



10

NADC RX Tests

RX Test Setup

Standard setup

- Use the standard setup shown in **Fig. 10.12** if you need a relatively strong RF level for the base-station antenna inputs. This level is available on the RF DIRECT socket of the Communication Test Set.
- The transmitter of the base station must be terminated with 50 Ω. For this defined termination use the connection shown between the TX output of the base station and the RF socket of the Communication Test Set.
- For time-slot synchronization between the base station and the Communication Test Set, apply the AFS signal from the base station to the SYNC IN socket Bu 107 on the rear of the D-AMPS unit.

Special setup

If you need a relatively weak RF level, use the special setup. The differences from the standard setup are described below:

- Connect the power splitter to the RF socket of the Communication Test Set.
- Terminate the transmitter of the base station with a 50- Ω power attenuator.
- Terminate the RF DIRECT socket of the Communication Test Set with 50 Ω.

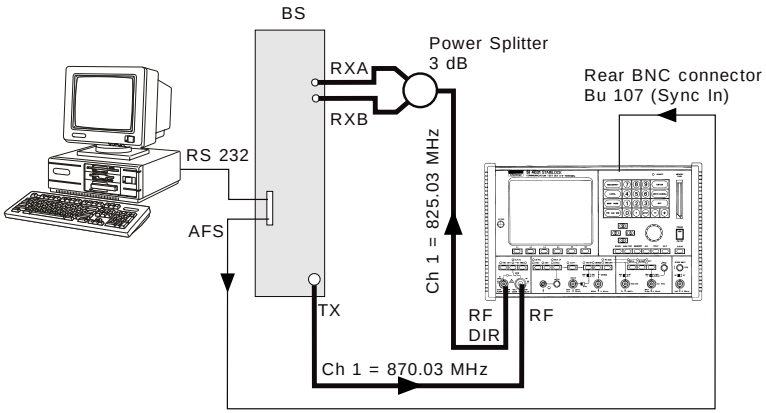


Fig. 10.12: Standard setup for receiver testing on Ericsson base stations (wiring instructions for sync/control cable: see Appendix). For the general setup preparations see "TX Test Setup".

☞ In each setup use the supplied BNC/BNC cable (382 678) to connect socket Bu 103 of the IF unit (back panel) to socket Bu 103 of the D-AMPS unit (see Appendix). Testing is not possible without this connection.

Bit Error Rate (BER)

WHY?

- Bit error rate is a measure of the RF sensitivity of the base station in a digital channel. BER corresponds to an "analog" sensitivity figure refered to a defined signal/noise ratio.

Requirement

- Make the general test preparations.
- The BER measurement is a special application only for PC- controlled Ericsson base stations. This means you have to operate with the corresponding PC control program. If you have questions about this software, please contact Ericsson.
- Select PSEUDO in the PC control program for the modulation and 20-dB power attenuation.

Preparations for BER measurement

Call up RX BER test mask

- Press (BER) in the basic NADC mask. This calls up the RX BER test mask, the entries from the basic NADC mask being transfered into the entry and scroll fields of the RX BER mask.

Select operating level

- With a scroll field in the RX BER mask you can select two different operating levels for tests (**Fig. 10.13/14**):

  Max Select this level for deep BER tests. All entry fields and softkeys are available.

  Min Select this level for quick tests. You see only the most important fields and softkeys.

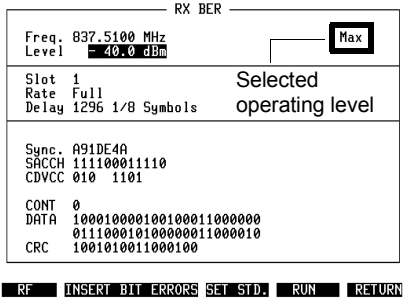


Fig. 10.13: RX BER test mask with maximum operating level.

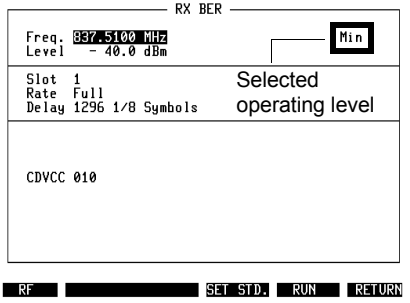


Fig. 10.14: RX BER test mask with minimum operating level.

Select RF socket

❍ Use the appropriate softkey to select the RF output socket of the test set (see also "RX Test Setup"). The default setting after each callup of the RX BER test mask is `RF DIR` (this means you see softkey (RF)).

Set RX frequency

❍ Enter the current receive frequency of the base station in the `Freq.` field.

❍ If you want to work with RX channel numbers, place the cursor on entry field `Freq.` and select with (UNIT/SCROLL) the scroll variable `NoL` (STABILOCK sends in lower band). After this enter the desired channel number (see also "General preparations").

Set RF level

❍ Enter the required RF output level of STABILOCK in the `RF Level` field. After the test is started, this level can be changed. A level of at least –90 dBm is sufficient for transmission free of bit errors.

Select slot

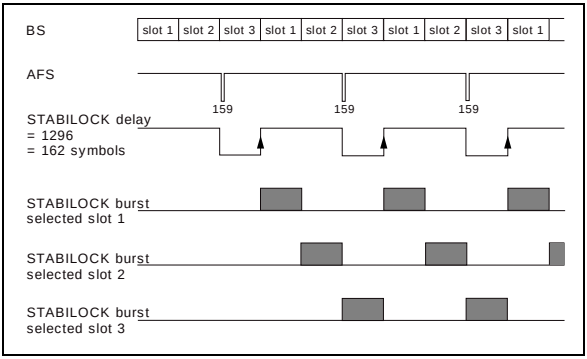
❍ See "General Test Preparations".

Select rate

❍ See "General Test Preparations".

Set delay

❍ Enter a figure of 1296 in the `Delay` field. This value is necessary for correct synchronization between the base station and the test set (1296 × 1/8 symbols = 162 symbols).



Change synchronization

❍ By selection of the slot number the correct synchronization word is entered automatically in the `Sync` field. If necessary, you can change this (hexadecimal) value before starting the BER test (see also "Set standard").

Set SACCH

❍ Any bit sequence is permissible for the slow associated control channel (recommended binary bit sequence: 100010001101).

Set CDVCC

❍ For the coded digital verification color code enter the same value (decimal) as the one the base station works with (recommended value: 010).

Set CONT

- Any binary value is permissible for the continuous bit (recommended value: 1).

Enter DATA

- The data will be transmitted in the traffic channel. You can enter any bit sequence in the DATA field. But, for practical simulation of the real data stream, it is not advisable to enter any regularly repeated passages (this condition is valid for the default entry).

Change CRC

- The checksum will be entered automatically. If an alteration is made in the CDVCC, CONT or DATA field, the correct checksum is formed after confirmation of alteration with [ENTER]. After this you can change the CRC manually before starting the test (see also "Set standard").

Set standard

- After manual alterations in the Sync and CRC fields, you can reset these entries to their correct values by pressing softkey (SET STD.).

Insert bit errors

- For special applications you can insert bit errors in the transmitted data stream. To do this, call up the RX-BER DATA mask by pressing softkey (INSERT BIT ERRORS). This mask shows the complete bit sequence transmitted by the test set (**Fig. 10.15**). The meaning and position of the bit patterns is described in the interim standard specification IS 54.
- Now you can change each bit by opening the corresponding field with [ENTER], selecting the bit with the cursor and changing the binary value (entry 0 or 1). Do not forget to confirm the entry by pressing [ENTER].
- With softkey (INSERT PATTERN) you can replace the actual bit sequence by a special 324-bit CCITT bit pattern. This is unnecessary for normal BER tests.
- Each alteration in the RX-BER DATA mask will be adopted in the corresponding fields of the RX BER test mask.
- (RETURN) takes you back to the BX BER test mask.

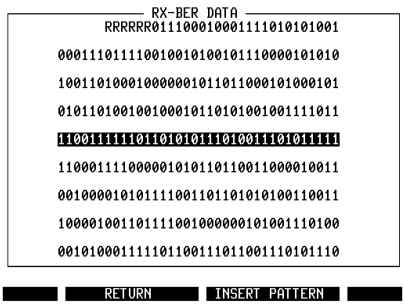


Fig. 10.15: The BER data field shows the complete bit sequence output by the Communication Test Set.

HOW?

- ❍ Enter the test parameters as described. Make sure the relevant RF socket of the Communication Test Set is coupled to the power splitter of the test setup.
- ❍ Start output of the bit sequence with (RUN).
- ❍ Start the BER test program on the PC controller and look for the test result. During the test you can alter the RF output level of STABILOCK with the spinwheel or by direct numeric entry (range of interest: approx. –105 to –120 dBm). The effect on the bit error rate can be observed on the PC.
- ❍ End the test with (STOP) and repeat it if necessary with different transmission parameters.
- ❍ (RETURN) takes you back to the basic NADC mask.

Test Result	
Result shown by PC	To measure BER, test set simulates mobile. To do this, it sends burst output signal of adjustable RF level true to base-station specifications. PC connected to base station evaluates signal received and calculates bit error rate. Bit error rate is ratio of number of errored bits received to total number of bits received during period of observation.

Appendix

Technical Data

System	Bandwidth (MHz)	Number of channels	Boundary channels	Transmitter frequencies	
				Mobile (MHz)	Base (MHz)
Not used		1	990	824.010	869.010
A''	1	33	991 1023	824.040 825.000	869.040 870.000
A	10	333	1 333	825.030 834.990	870.030 879.990
B	10	333	334 666	835.020 844.980	880.020 889.980
A'	1.5	50	667 716	845.010 846.480	890.010 891.480
B'	2.5	83	717 799	846.510 848.970	891.510 893.970
Control channels FOCC		System A System B	333 to 313 334 to 354		
Frequency calculation (transmitter)		Mobile Base	1≤N≤799 f = 0.03×N+825.000 990≤N≤1023 f = 0.03×(N–1023)+825.000 1≤N≤799 f = 0.03×N+870.000 990≤N≤1023 f = 0.03×(N–1023)+870.000		
Channel spacing Duplex offset Signaling rate Deviation		30 kHz 45 MHz 10 kbit/s Signaling ±8 kHz, speech ±2.9 kHz			

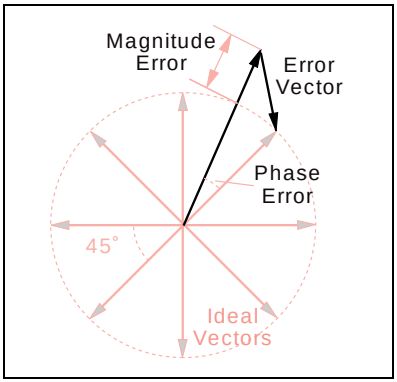
Input sockets on D-AMPS unit (for more technical data: see data sheet)				
Socket	Signal	R_i	V_{max}	Application
Bu 103	IF	270 Ω	±14 V	Ext. loop to IF unit
Bu 104	AF	approx. 3 kΩ	±5 V	Reserved
Bu 106, pin 1	Analog IN I	approx. 3 kΩ	±5 V	Input for external I/Q signal
Bu 106, pin 2	Analog IN Q	approx. 3 kΩ	±5 V	
Bu 106, pin 15	EXTQ	approx. 5 kΩ	2.5 V ± 2.5 V_p	Input for fading generator
Bu 106, pin 16	EXTI	approx. 5 kΩ	2.5 V ± 2.5 V_p	
Bu 107	SYNC	TTL	TTL	Sync with base station, neg. pulse > 125 ns

A Little NADC Background Information

All NADC mobiles are dual mode, meaning that a mobile can use the analog and the digital network. To maintain compatibility with the analog (E)AMPS network, channel spacing is 30 kHz. This results in the requirement to limit the bandwidth of a carrier to ±15 kHz in the modulation spectrum.

A digital traffic channel (DTC) is divided into six time slots. In full-rate data transmission these time slots are used as pairs (1st and 4th, 2nd and 5th, 3rd and 6th) with each time slot carrying half the speech data. Full rate means that three users share one frequency (DTC).

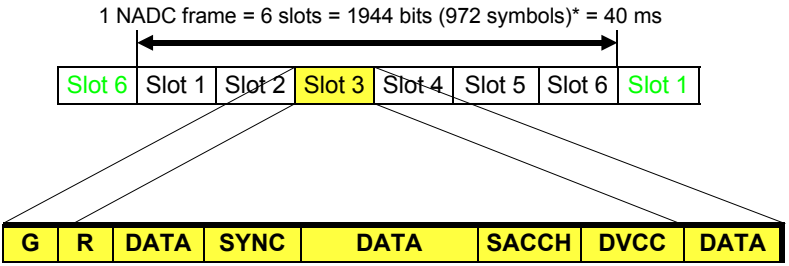
With the introduction of half-rate data transmission it is possible to use each time slot independently. That means a doubling of capacity in digital networks because six users share one frequency. This technique is also refered to as time-division multiple access (TDMA), because several mobiles/users share one frequency at the same time.



The digital modulation used for NADC is π/4 DQPSK (digital quadrature phase-shift keying). This modulation process shifts phase in steps of ±π/4 depending on bit-pattern changes. With each phase step you can transmit two bits (special NADC terms: 2 bits = 1 symbol; 1 bit = 1 unit). In a vector diagram of the modulation signal the ideal end positions of the eight possible vectors describe a circle. The error vector is the line drawn between the ideal signal vector and the real signal vector. Modulation accuracy is measured by determining the RMS difference (root mean square) between the real signal and the ideal signal. For this the individual vector error on each symbol in a slot is measured and computed to the sum-square vector error. Finally the RMS vector error is computed as the square root of the sum-square vector error divided by the number of symbols in the slot (162 for transmission from base station to mobile).

DQPSK modulation is error-tolerant. This means, for example, that if the vector error of the base-station transmitter becomes too high, the mobile receiver will still be able to reconstruct the correct bit stream with an intelligent bit-error-correction mechanism. But if this correction function is operating at its limits, speech quality could suddenly turn from good to bad. Therefore, well adjusted modulators are necessary nevertheless. In each time slot the mobile or base station has to ramp its power up and down at the beginning and end of the time slot within specified limits. The resulting signal is called a burst. The duration of a burst is 6.66 ms. This is exactly the duration of a time slot.

NADC frame and slot structure (mobile to base station)



G	During the guard time (three symbols) no information is transmitted in a slot.
R	The ramp time (three symbols) allows ramping up and down of power.
DATA	These fields contain the actual user data (speech).
SYNC	This field contains a fixed bit sequence which is needed to demodulate and decode the burst exactly. In a TDMA system multipath propagation disturbs the reception of signals as they arrive at different power levels and different times at the receiver. To allocate the bit stream exactly, a known bit sequence (SYNC) is used.
SACCH	The slow associated control channel is used during a call for signaling message exchange between the base station and the mobile.
DVCC	The digital verification color code is an identification code for the base station used. If a more distant base station also receives the same mobile, it is distinguished by the DVCC.

* Including six symbols without information (guard time and ramp time)

Six time slots are refered to as an NADC frame, with a duration of 40 ms. Each NADC frame carries the information of 1944 bits (972 symbols). This means that each time slot can carry the information of 324 bits or 162 symbols (mobiles use only 156 symbols due to guard and power ramp times).

Back Panel

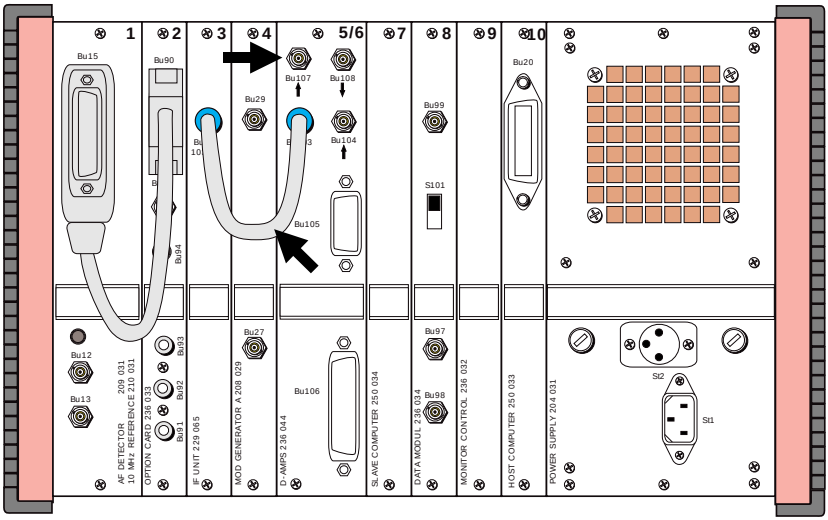
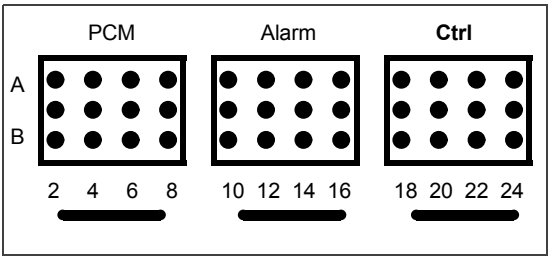


Fig. 10.16: Rear panel of the Communication Test Set. You have to connect sockets Bu 103 (IF unit and D-AMPS unit) with the supplied BNC/BNC cable. For BER testing it is also necessary to feed the AFS signal from the base station into socket Bu 107.

Wiring Instructions for Sync/Control Cable

Fig. 10.17: Ericsson base station connector P1. Only the Ctrl part of the connector is relevant for the control and frame synchronization cable.



Pin	Signal	Meaning	RS-232-C interface (9-way submin D)
		Bu 107 STABILOCK	
B18	AFS	GND	
A22 or C22	GND		Pin 5 GND (shield)
A20	LCTXD	Local control transmitted data	Pin 2 Receive data
A24	LCRXD	Local control received data	Pin 3 Transmit data

Pinning of Sockets on D-AMPS Unit

Bu 105		Bu 106				Bu 103	Bu 104	Bu 107	Bu 108
Pin 1	DCD	Pin 1	Analog IN I	Pin 14	IOUTM	IF IN	AF IN	SYNC IN	SYNCOUT
Pin 2	RXD	Pin 2	Analog IN Q	Pin 15	EXTQ				
Pin 3	TXD	Pin 3	GND	Pin 16	EXTI				
Pin 4	DTR	Pin 4	GND	Pin 17	GND				
Pin 5	GND	Pin 5	GND	Pin 18	QRX				
Pin 6	free	Pin 6	GND	Pin 19	IRX				
Pin 7	RTS	Pin 7	ITXOUT	Pin 20	GND				
Pin 8	CTS	Pin 8	QTXOUT	Pin 21	Vcc				
Pin 9	NC	Pin 9	GND	Pin 22	GND				
		Pin 10	GND	Pin 23	–15 V				
		Pin 11	GND	Pin 24	GND				
		Pin 12	GND	Pin 25	+15 V				
		Pin 13	QOUTM						

Compatibility with Other Options

Slot	Unit
1	AF DETECTOR
2	MOD GENERATOR B **or** OPTION CARD **or** CONTROL INTERFACE (A/B/C/D)
3	IF UNIT with/without **Tracking**
4	MOD GENERATOR A
5/6	**D-AMPS UNIT**
7	SLAVE COMPUTER
8	DATA MODULE **or** RS-232-C Interface
9	MONITOR CONTROL
10	HOST COMPUTER

Equipment configuration required for testing NADC base stations. Slot 2 and slot 8 can hold any of the options mentioned.

The following may not be included at the same time:
ACPM option
SSB option
GSM module

Lifeline

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

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

SW	Doc. Version	Δ pages		Changes
1.00	9306-100-A	none	-	First edition.
1.10	9401-110-A	all	NF	Change to small paper format.
		10-15	NF	Power measurement now with autorange.
		10-18	NF	Measurement of modulation spectrum.
		10-19	NF	Measurement of ACPM.
		10-16	NF	Different result modes selectable in numeric mask.
		10-25	NF	RF output socket selectable in RX BER test mask.
		10-24	NF	Two operating levels in RX BER mask.
		10-25	NF	Slot change automatically updates Sync and CRC fields.
		10-26	NF	CDVCC change automatically updates CRC field.
	9503-110-B	10-6	C	4031 FW > 3.82 STATUS mask: new code for D-AMPS unit.
		10-6	C	4032 FW > 5.02 STATUS mask: new code for D-AMPS unit.
1.20	9505-120-A	no	C	Bug fixes.
1.30	9512-130-A	10-19	NF	ACPM now noise reduced in 6 adjacent channels.