NADC MS-Test

Software Option   897 073

Operating Instructions

01_nadms   Doc. Version: 9611-160-A

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

Appendix

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

Introduction

The NADC MS-TEST program supports you in signaling tests as well as RX and TX tests on NADC mobiles. 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 burst and modulation spectrum of a mobile.

What is tested	
Call from mobile	RF power
Call from base station	Frequency offset
Handoff procedures	ΔP/symbol
Hookflash	Origin offset
Speech loop	RMS vector error (graphic)
Bit error rate (BER)	Phase error (graphic)
Mobile-assisted handoff (MAHO)	Min./max. magnitude (graphic)
Modulation spectrum (graphic)	Time alignment
Burst power (graphic)	Standard analog measurements

NADC = D-AMPS = TDMA

North   **D**ual Mode   **T**ime
American   **A**merican   **D**ivision
Digital   **M**obile   **M**ultiple
Cellular   **P**hone   **A**ccess
                     System

                     Synonym for   Technique used in
                     NADC   NADC

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General preparations

Check that STABILOCK is fitted with NADC-compatible hardware. In order to test NADC mobiles, the D-AMPS unit (236 044), the D-AMPS duplex unit (229 063) and the DATA module (236 034) have to be installed.

Check procedure
- ❍ Call up the STATUS mask: $\boxed{\text{AUX}}$+$\boxed{\text{DEF.PAR}}$+$\boxed{\text{STATUS}}$
- ❍ 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 options Duplex + I/Q and Data Module (**Fig. 10.1**).
- ❍ Call up the HW-REVISIONS mask. This must show the marked entries illustrated in **Fig. 10.2**.

Fig. 10.1: The OPTIONS mask gives you the information whether the D-AMPS duplex unit and the DATA module are installed.

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

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 measurement results.
Select pre-attenuation	❍ Enter the compensation value in the `Pre-attenuation` field of the GENERAL PARAMETERs mask. 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).
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 MS-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 test mask appears onscreen (**Fig. 10.3**).
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: Basic NADC test mask immediately after calling up system program.

```
                    ─ >>> NADC <<< ─
 00001  HOMESYSTEM      RESULTS
 1111110111    MIN      MIN:
 0333 FOCC CHANNEL      SN :

 To digital TC          No.:
                        SCM:
 0595   FVC CHANNEL     ERR:    ───────
 6030 Hz  SAT FREQ      DEV:    ───────
 0      POWER LEVEL
                        PWR:    ───────
 0600  DTC CHANNEL
 005 DVCC   1 SLOT      ERR:
 0      POWER LEVEL     PWR:
 00 TIME ALIGNMENT      DCC:
 Full
                        RF Level:  - 60.0 dBm
```

```
-ETC-   EXECUTE   RELEASE   MOBILE   CELL.   RETURN
```

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Test Setup

Levels of < –110 dBm appear when testing (eg bit error rate BER), 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 test setup and the mobile.
- Terminate the RF DIRECT socket of the test setup with 50 Ω.
- Make sure that all plug-ins of the test setup (back panel) are screwed in tight.
- Close vacant plug-in slots on the test setup (back panel) with dummy panels.
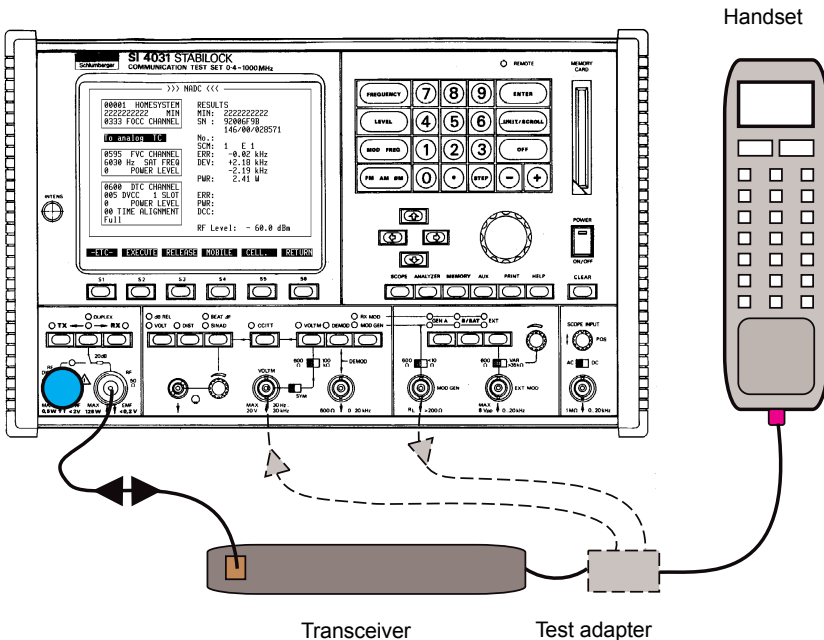
Fig. 10.4: Test setup with NADC carphone (handset + transceiver). The test adapter is not necessary for the described signaling tests. The test adapter couples out the microphone signal and the loudspeaker signal so that the usual analog tests can also be performed on NADC mobiles (eg modulation frequency response, SINAD).

☞ 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). Without this connection no call can be set up to the mobile.

General Test Preparations

The following entries in the basic NADC mask are necessary for correct setup of a call between the mobile and the test setup. These entries are thus a general requirement for performing all tests. Here they will be looked at separately, but in the individual test procedures they are simply mentioned.

❶   **Home system number** of the mobile. Any number can be entered (if the home system number differs from that stored in the mobile, the ROAM display on the mobile will flash).

❷   **Mobile identification number** MIN. If the number is not known, perform "Call from mobile" as the first test. The correct identification number (transmitted by the mobile) will then be entered automatically in the MIN field (the originally wrong MIN triggers the message `Wrong Ident`). Then repeat the call setup.

❸   **Forward control channel** FOCC. This must be a channel number actually used by the mobile (eg system A: 0333, system B: 0334), otherwise there will be no call setup.

❹   With this scroll field you choose the **type of traffic channel**, ie whether call setup is to lead to an analog or digital traffic channel (scroll variables: `To analog TC` and `To digital TC`). Set `To analog TC` to test an (E)AMPS mobile, otherwise there will be no call setup.

The following fields ❺ to ❼ (**Fig. 10.5**) are only of importance if the scroll variable `To analog TC` directs call setup to an analog traffic channel.

❺   **Forward voice channel** FVC. The permissible figures depend on the system (A/B) (see appendix, "Technical Data").

❻   With this scroll field you choose one of the suggested **SAT frequencies** (scroll variables: `5970 Hz, 6000 Hz, 6030 Hz`). Do not choose `NO SAT`, otherwise the call breaks off after approx. 5 s.

❼   With this scroll field you choose the **power level** 0 to begin with (scroll variables: `0` to `7`).
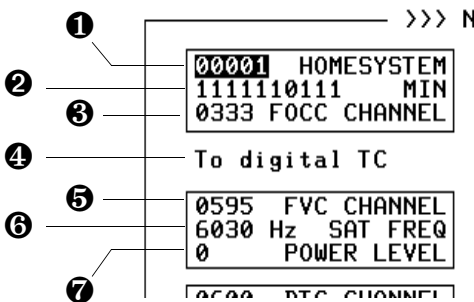

Fig. 10.5: Upper entry sector of basic NADC mask comprises system-related entry fields (❶ to ❸). Middle entry sector (❺ to ❼) is only of importance if call setup is directed to analog traffic channel with scroll variable ❹. All entry and scroll fields can be accessed with cursor keys.

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The following fields ❶ to ❻ (**Fig. 10.6**) are only of importance if the scroll variable `To digital TC` directs call setup to a digital traffic channel.

❶ **Digital traffic channel** DTC. The permissible figures are identical to the FVC numbers and likewise depend on the system (A/B) (see appendix, "Technical Data").

❷ **Digital verification color code** DVCC (any figure between 1 and 255 is permissible).

❸ Enter the number of the **time slot** in which data are to be exchanged on the digital traffic channel. The permissible figure depends on whether the mobile is fitted with a full-rate or a half-rate speech codec (full rate: 1, 2, 3; half rate: 1, 2, 3, 4, 5, 6).

❹ With this scroll field you choose the **power level** 0 to begin with (scroll variables: `0` to `A`).

❺ Enter a **time alignment** value (any figure between 00 and 31 is permissible; see "Burst Power & Time Alignment"). For measurements in the Constellation display and the Numeric display the value has to be < 26.

❻ With this scroll field you choose the **speech-codec type** of the mobile (scroll variables: `Full`, `Half`). This setting affects the permissible figures for the time slot. There will be no call setup if the setting is wrong.

❼ Enter an **RF output level** for the test setup that is high enough to ensure (to begin with) a reliable connection between the mobile and the setup (recommended figure: –60 dBm). The units for the level can be selected as usual with [UNIT/SCROLL] (dBm, dBµ, mV/µV).

Note: Setting the RF level in the basic NADC test mask is only possible on the keyboard (spinweel disabled). In the MAHO and RX-BER masks the level can be altered continuously with the spinwheel.
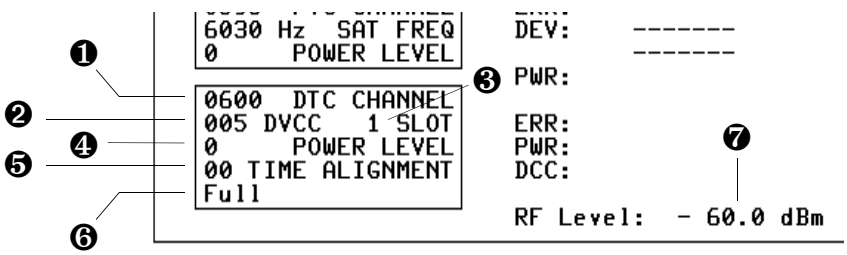
Fig. 10.6: Lower entry sector of basic NADC mask is only of importance if call setup is directed to digital traffic channel.

Test Callup

More than five tests can be called up from the basic NADC test mask, so the softkeys have three levels with different functions assigned to them. Use (ETC) to reach the required level:

| -ETC- | EXECUTE | RELEASE | MOBILE | CELL. | RETURN |

| -ETC- | AUTO | SP-LOOP | HOOKFLSH | REGISTER | RETURN |

| -ETC- | BER | MAHO | CONST. | MOD-SPEC | BURSTS |
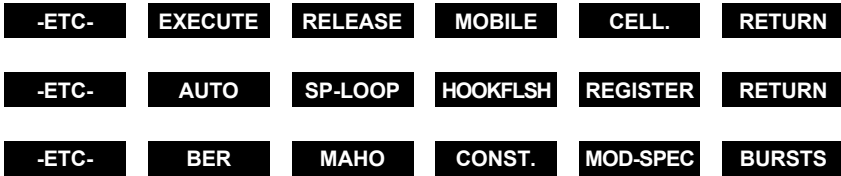
The basic NADC mask shows all test results in the righthand half of the screen (**Fig. 10.7**). The entry sectors (analog/digital) are assigned the appropriate display sectors. Depending on what type of traffic channel the connection was directed to (analog/digital), only the corresponding display sector will show test results. The other sector remains blank.

☞ To set the number of measurements in the AUTORUN or remote-control mode, use the IEEE command described in the appendix.
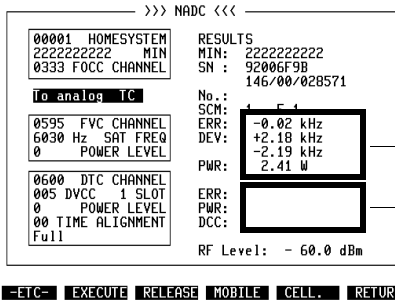
Fig. 10.7: Basic NADC test mask after call setup in analog TC

| -ETC- | EXECUTE | RELEASE | MOBILE | CELL. | RETURN |

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How to Read the "Test Results" Table

Results depend on selected traffic channel (analog or digital)

Results **only** for analog traffic channel

Results **only** for digital traffic channel

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

IEEE command for sampling results by controller or AUTORUN

Name of result field in test mask

The NADC MS-TEST system program is also suitable for testing AMPS and E-AMPS mobiles. So the letters also indicate what tests are permissible on these mobiles:

A+D   Test also permissible on AMPS/E-AMPS mobiles.
A   Test also permissible on AMPS/E-AMPS mobiles.
D   Test not permissible on AMPS/E-AMPS mobiles.

NADC Signaling Tests

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Registration Call

WHY?   ○ Test whether the mobile sets up a registration answer to the calling base station.

Requirement   ○ The mobile is not in an analog or digital traffic channel. In any other case drop the call with (RELEASE).
                  ○ The mobile is not in test mode.

HOW?   ○ Make the general test preparations.
                  ○ Press (REGISTER) in the basic test mask. The Communication Test Set sends a registration call to the mobile and waits for the answer.
                  ○ If the mobile fails to respond to the registration call, halt the test with (STOP), enter a new, valid home system number and start the test again.

Test Results			
RESULt1	**MIN**	Received mobile identification number.	
RESULt2	**SN**	1st line:	Serial number of mobile (hexadecimal code).
RESULt3		2nd line:	Serial number of mobile (decimal code).
A + D	RESULt5	**SCM**	Station class mark
			1st character: power class (1 = high, 2 = medium, 3 = low, 4 = very low)
			2nd character: transmit mode (blank = continuous, D = discontinuous)
			3rd character: RF bandwidth (blank = 20 MHz; E = extended = 25 MHz)
			4th character: mobile type (0 = analog mobile; 1 = NADC mobile)

Fig. 10.8: Results of a registration call.

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Call from Mobile

WHY?
- ❍ Test whether the mobile sets up a call to the base station.
- ❍ Prober call setup is a requirement for further tests.

Requirement
- ❍ The mobile is not in an analog or digital traffic channel. In any other case drop the call with (RELEASE).
- ❍ The mobile is not in test mode.

HOW?
- ❍ Make the general test preparations.
- ❍ Press (MOBILE) in the basic test mask.
- ❍ Dial a number on the mobile and press the [SEND] key. The mobile sends the dialed number and then it is handed off to the selected analog or digital traffic channel. Now the display will show the test results.

Test Results			
A + D	RESULt1	**MIN**	Received mobile identification number.
	RESULt2 RESULt3	**SN**	1st line: Serial number of mobile (hexadecimal code). 2nd line: Serial number of mobile (decimal code).
	RESULt4	**No**	Number dialed on mobile.

	RESULt5	**SCM**	Station class mark
			1st character: power class
			    (1 = high, 2 = medium, 3 = low, 4 = very low)
			2nd character: transmit mode
			    (blank = continuous, D = discontinuous)
			3rd character: RF bandwidth
			    (blank = 20 MHz; E = extended = 25 MHz)
			4th character: mobile type
			    (0 = analog mobile; 1 = NADC mobile)

A	MTXOFFset	**ERR**	Frequency error of mobile transmitter in actual analog TC.
	MDEMOD	**DEV**	Mobile frequency deviation in actual analog TC.
	MPOWER	**PWR**	Mobile output power in actual analog TC (average value). Power must correspond to entered power level (see appendix).
D	RESULt6	**ERR**	Frequency error of mobile transmitter in actual digital TC.
	RESULt7	**PWR**	Mobile output power in actual digital TC (average value). Power must correspond to entered power level (see appendix).
	RESULt8	**DCC**	Digital color code. Value must be same as entered DVCC.

```
┌──────────── >>> NADC <<< ────────────┐
│ ┌─────────────────┐  RESULTS          │
│ │00001  HOMESYSTEM│  MIN:  2222222222 │
│ │2222222222    MIN│  SN :  92006F9B   │
│ │0333 FOCC CHANNEL│        146/00/028571│
│ ├─────────────────┤  No.:  123456     │
│ │To analog  TC    │  SCM:  1   E 1    │
│ ├─────────────────┤  ERR:  -0.03 kHz  │
│ │0595  FVC CHANNEL│  DEV:  +0.25 kHz  │
│ │6030 Hz  SAT FREQ│        -0.28 kHz  │
│ │0     POWER LEVEL│  PWR:   2.27 W    │
│ ├─────────────────┤                   │
│ │0600  DTC CHANNEL│                   │
│ │005 DVCC   1 SLOT│  ERR:             │
│ │0     POWER LEVEL│  PWR:             │
│ │00 TIME ALIGNMENT│  DCC:             │
│ │Full             │                   │
│ └─────────────────┘  RF Level:  - 60.0 dBm │
└──────────────────────────────────────┘
```

-ETC- EXECUTE RELEASE MOBILE CELL. RETURN

Fig. 10.9: Call from mobile (analog channel).

```
┌──────────── >>> NADC <<< ────────────┐
│ ┌─────────────────┐  RESULTS          │
│ │00001  HOMESYSTEM│  MIN:  2222222222 │
│ │2222222222    MIN│  SN :  92006F9B   │
│ │0333 FOCC CHANNEL│        146/00/028571│
│ ├─────────────────┤  No.:  654321     │
│ │To digital TC    │  SCM:  1   E 1    │
│ ├─────────────────┤  ERR:             │
│ │0595  FVC CHANNEL│  DEV:             │
│ │6030 Hz  SAT FREQ│                   │
│ │0     POWER LEVEL│  PWR:             │
│ ├─────────────────┤                   │
│ │0600  DTC CHANNEL│                   │
│ │005 DVCC   1 SLOT│  ERR:  -519  Hz   │
│ │0     POWER LEVEL│  PWR:   2.24 W    │
│ │00 TIME ALIGNMENT│  DCC:    005      │
│ │Full             │                   │
│ └─────────────────┘  RF Level:  - 60.0 dBm │
└──────────────────────────────────────┘
```

-ETC- EXECUTE RELEASE MOBILE CELL. RETURN

Fig. 10.10: Call from mobile (digital channel).

10

Call from Base Station

WHY?
- ❍ Test whether the base station sets up a call to the mobile.
- ❍ Proper call setup is a requirement for further tests.

Requirement
- ❍ The mobile is not in an analog or digital traffic channel. In any other case drop the call with (RELEASE).
- ❍ The mobile is not in test mode.

HOW?
- ❍ Make the general test preparations.
- ❍ Press (CELL.) in the basic test mask.
- ❍ Lift the handset when the mobile rings or the "Call Received" indicator symbol lights up. Then the mobile is handed off to the selected analog or digital traffic channel. Now the display will show the test results.

Test Results			
A + D	RESULt1	**MIN**	Received mobile identification number.
	RESULt2 RESULt3	**SN**	1st line: Serial number of mobile (hexadecimal code). 2nd line: Serial number of mobile (decimal code).

	RESULt5	**SCM**	Station class mark
			1st character: power class
			                         (1 = high, 2 = medium, 3 = low, 4 = very low)
			2nd character: transmit mode
			                         (blank = continuous, D = discontinuous)
			3rd character: RF bandwidth
			                         (blank = 20 MHz, E = extended = 25 MHz)
			4th character: mobile type
			                         (0 = analog mobile; 1 = NADC mobile)

A	MTXOFFset	**ERR**	Frequency error of mobile transmitter in actual analog TC.
	MDEMOD	**DEV**	Mobile frequency deviation in actual analog TC.
	MPOWER	**PWR**	Mobile output power in actual analog TC (average value). Power must correspond to entered power level (see appendix).
D	RESULt6	**ERR**	Frequency error of mobile transmitter in actual digital TC.
	RESULt7	**PWR**	Mobile output power in actual digital TC (average value). Power must correspond to entered power level (see appendix).
	RESULt8	**DCC**	Digital color code. Value must be same as entered DVCC.

```
┌──────────── >>> NADC <<< ────────────┐
│ ┌─────────────────┐  RESULTS                    │
│ │00001  HOMESYSTEM│  MIN:  2222222222           │
│ │2222222222   MIN │  SN :  92006F9B             │
│ │0333 FOCC CHANNEL│         146/00/028571       │
│ └─────────────────┘                             │
│ ┌─────────────────┐  No.:                       │
│ │To analog  TC    │  SCM:  1   E 1              │
│ └─────────────────┘  ERR:   -0.02 kHz           │
│ ┌─────────────────┐  DEV:   +2.18 kHz           │
│ │0595  FVC CHANNEL│          -2.19 kHz          │
│ │6030 Hz  SAT FREQ│  PWR:    2.41 W             │
│ │0     POWER LEVEL│                             │
│ └─────────────────┘                             │
│ ┌─────────────────┐                             │
│ │0600  DTC CHANNEL│                             │
│ │005 DVCC   1 SLOT│  ERR:                       │
│ │0     POWER LEVEL│  PWR:                       │
│ │00 TIME ALIGNMENT│  DCC:                       │
│ │Full             │                             │
│ └─────────────────┘  RF Level:  - 60.0 dBm      │
└──────────────────────────────────────┘
```

-ETC- EXECUTE RELEASE MOBILE CELL. RETURN

Fig. 10.11: Call from base (analog channel).

```
┌──────────── >>> NADC <<< ────────────┐
│ ┌─────────────────┐  RESULTS                    │
│ │00001  HOMESYSTEM│  MIN:  2222222222           │
│ │2222222222   MIN │  SN :  92006F9B             │
│ │0333 FOCC CHANNEL│         146/00/028571       │
│ └─────────────────┘                             │
│ ┌─────────────────┐  No.:                       │
│ │To digital TC    │  SCM:  1   E 1              │
│ └─────────────────┘  ERR:                       │
│ ┌─────────────────┐  DEV:                       │
│ │0595  FVC CHANNEL│                             │
│ │6030 Hz  SAT FREQ│  PWR:                       │
│ │0     POWER LEVEL│                             │
│ └─────────────────┘                             │
│ ┌─────────────────┐                             │
│ │0600  DTC CHANNEL│                             │
│ │005 DVCC   1 SLOT│  ERR:   -250  Hz            │
│ │0     POWER LEVEL│  PWR:    2.04 W             │
│ │00 TIME ALIGNMENT│  DCC:    005                │
│ │Full             │                             │
│ └─────────────────┘  RF Level:  - 60.0 dBm      │
└──────────────────────────────────────┘
```

-ETC- EXECUTE RELEASE MOBILE CELL. RETURN

Fig. 10.12: Call from base (digital channel).

10

Handoff Procedures

You use the handoff procedures to test whether the mobile – during a call – correctly adopts changes in transmission parameters (channel, SAT, power level, time slot, etc) as instructed by the base station (ie the test setup).

☞ Do not forget to confirm every change in an entry field of the basic mask with [ENTER].

Change analog/digital traffic channel

WHY?
- ❍ Test whether the mobile correctly changes to another analog/digital TC. All variants are permissible, eg also changing from an analog to a digital TC.
- ❍ Test whether the frequency error and transmitting power of the mobile in the target channel meets requirements.

Requirement
- ❍ The mobile is not in test mode.
- ❍ Make the general test preparations.
- ❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in an analog or digital traffic channel).

Manual change of channel

HOW?

○ To change the type of traffic channel, change from scroll variable `To analog TC` to `To digital TC` or vice versa (the TC number does not have to be changed).

○ If you have not changed the type of traffic channel, enter the new TC number in the appropriate analog field `FVC CHANNEL` or digital field `DTC CHANNEL`.

○ Press (EXECUTE) in the basic test mask. In this way signaling adopts the new type of channel or the new channel number.

Test Results			
A + D		**Mobile could change to new TC:** basic test mask shows figures measured for frequency error and transmitting power of mobile (ERR and PWR). **Mobile could not change to new TC:** connection breaks off.	
A	MTXOFFset	**ERR**	Frequency error of mobile transmitter in new analog TC.
	MDEMOD	**DEV**	Mobile frequency deviation in new analog TC.
	MPOWER	**PWR**	Mobile output power in new analog TC (see appendix).
D	RESULt6	**ERR**	Frequency error of mobile transmitter in new digital TC.
	RESULt7	**PWR**	Mobile output power in new digital TC (see appendix).
	RESULt8	**DCC**	Digital color code. Value must be same as entered DVCC.

Automatic change of channel

HOW?

○ Press (AUTO) in the basic test mask to call up the AUTO HANDOFF mask (**Fig. 10.13**).

○ Select the desired scroll variable `To analog TC` or `To digital TC`.

○ Select `Channels` or `Auto Incr.` and change to the corresponding entry fields for defining the traffic channels in which the mobile is to be automatically tested:

`Channels`: entry of up to five channel numbers.
`Auto Incr.`: entry of first and last channel number plus stepping increment.

☞ In case of automatic change of channel the mobile output power level has to be > approx. 17 dBm. This is only necessary to get measurement results for the mobile output power in the AUTO HANDOFF mask.

10

>>>

❍ Select the other test conditions shown in **Fig. 10.13**.
❍ Press (SINGLE STEP) or (AUTO-HANDOFF) to start the test.
(SINGLE STEP): the test is stopped when the result of the current channel is available. Pressing the softkey will move you to the next predefined channel and display the test results.
(AUTO-HANDOFF): the test runs through to the end without interrupting for each channel.
❍ (RETURN) takes you back to the basic test mask.

Test Results			
A + D		**Mobile could change to predefined TCs:** AUTO HANDOFF mask shows current channel number plus values measured for frequency error and transmitting power of mobile in current channel (ERR and PWR). **Mobile could not change to predefined TCs:** connection breaks off (softkey (STOP) changes to (RETURN) before end of test).	
A	MTXOFFset*	**ERR**	Frequency error of mobile transmitter in current analog TC. If measurement exceeds limits in any channel.
	MPOWER*	**PWR**	Mobile output power in current analog TC (see appendix).
D	RESULt6*	**ERR**	Frequency error of mobile transmitter in current digital TC. If measurement exceeds limits in any channel.
	RESULt7*	**PWR**	Mobile output power in current digital TC (see appendix).
* Querying with these IEEE commands is only possible in single-step mode after each step. In auto-handoff mode IEEE querying by evaluation of PRINT data.			

Scroll fields   Entry fields

Select type of target channel

Cross to test on up to five random channels

Cross to test on sequence of channels

Cross if test results to be printed out

Cross to continuously repeat test (end with (STOP))

```
                    >>> NADC <<<
     Conditions for AUTO-HANDOFF
     To digital TC
     X Channels    0230 0120 0450 0560 0600
     Auto Incr.    0100 First Channel
                   0600 Last Channel
                   0010 Increment
     Print                            Results
     Continuous
     Curr.Channel 0230  ERR :      -81  Hz
                        PWR :     2.46  W
```

```
 SINGLE STEP     AUTO-HANDOFF     RETURN
```
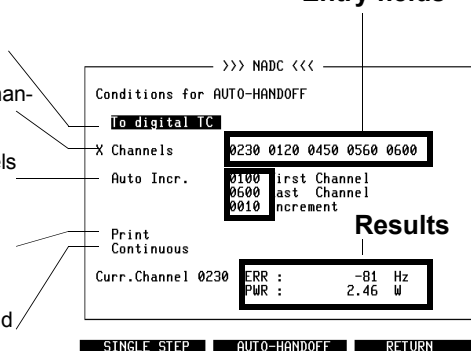
Fig. 10.13: AUTO-HANDOFF mask. To get measurement results for the output power PWR the mobile has to work at a power level > +17 dBm.

Change SAT

WHY?
- ❍ Test whether the mobile switches to a different SAT (supervisory audio tone), sends this back correctly to the base station and thus maintains connection.

Requirement
- ❍ The mobile is not in test mode.
- ❍ Make the general test preparations. The channel type must be `To analog TC`.
- ❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in an analog traffic channel).

HOW?
- ❍ Change the scroll variable for SAT frequency.
- ❍ Press (EXECUTE) in the basic test mask. In this way signaling adopts the new SAT frequency.

Test Results

A

Mobile could send back new SAT correctly: connection does not break off, basic test mask continues to show results in analog sector. Exception: if `NO SAT` is selected, connection must break off after approx. 5 s.

Frequency of SAT can be read from AF frequency meter in DUPLEX mask (return to basic test mask with (AUX)+(DATA)).

Mobile could not send back new SAT correctly: connection usually breaks off.

Fig. 10.14: SAT has two major functions in AMPS radio networks:

a) SAT frequency serves mobile and base station for mutual recognition.

b) Phase drift results when mobile is moving. From this base station is able to detect whether mobile is moving away fast, for example, and power level should be increased.

```
                    >>> NADC <<<
00001 HOMESYSTEM    RESULTS
2222222222    MIN   MIN:  2222222222
0333 FOCC CHANNEL   SN :  92006F9B
                          146/00/028571
To analog TC        No.:
                    SCM:  1   E 1
0595   EVC CHANNEL  ERR:   -0.02 kHz
5030 Hz  SAT FREQ   DEV:   +2.18 kHz
0      POWER LEVEL         -2.19 kHz
                    PWR:    2.41 W
0600  DTC CHANNEL
005 DVCC  1 SLOT    ERR:
0     POWER LEVEL   PWR:
00 TIME ALIGNMENT   DCC:
Full
                    RF Level:  - 60.0 dBm

-ETC-  EXECUTE  RELEASE  MOBILE  CELL.  RETURN
```

10

Change analog/digital power level

WHY?   ❍ Test whether the mobile correctly switches to a different power level.

Requirement   ❍ The mobile is not in test mode.
                      ❍ Make the general test preparations.
                      ❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in an analog or digital traffic channel).

HOW?   ❍ Change the POWER LEVEL for the selected channel type in the appropriate (analog or digital) field.
                      ❍ Press (EXECUTE) in the basic test mask. In this way signaling adopts the new power level.

<table>
<tr><td colspan="4" style="text-align:center">Test Results</td></tr>
<tr><td>A</td><td>MPOWER</td><td>PWR</td><td>Mobile output power in current analog TC (see appendix).
Note: maximum possible power level depends on mobile type reported in SCM message.</td></tr>
<tr><td>D</td><td>RESULt7</td><td>PWR</td><td>Mobile output power in current digital TC (see appendix).
Note: maximum possible power level depends on mobile type reported in SCM message.</td></tr>
</table>

Fig. 10.15: Power-level handoff (analog channel).

Fig. 10.16: Power-level handoff (digital channel).

No PWR figure?

If the PWR figure is missing after a handoff at low power level, it means that the transmitting power of the mobile could not be measured precisely. This happens, for example, when a switch is made from an analog to a digital TC and a low POWER LEVEL < 4 is requested.

Remedy: Hand off first with a high POWER LEVEL > 4. This always produces an exact PWR figure that is used internally to calibrate the power meter. Proceeding from this, a further handoff at any power level will also produce a correct PWR figure.

Change DVCC

WHY?
❍ Test whether the mobile switches to a different DVCC, sends this back correctly to the base station and thus maintains connection.

Requirement
❍ The mobile is not in test mode.
❍ Make the general test preparations. The channel type must be `To digital TC`.
❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).

HOW?
❍ Enter a new figure in the DVCC field. Confirm it with (ENTER).
❍ Press (EXECUTE) in the basic test mask. In this way signaling adopts the new DVCC.

Test Results	
D	RESULt8 **DCC** New digital color code. Value must be same as entered DVCC.

Fig. 10.17: Digital verification color code is identification code for base station used, similar to SAT in analog channel. If base station further away receives same mobile, it is distinguished by DVCC.

```
                    — >>> NADC <<< —
  ┌─────────────────┐  RESULTS
  │00001  HOMESYSTEM│  MIN:  2222222222
  │2222222222    MIN│  SN :  92006F9B
  │0333 FOCC CHANNEL│         146/00/028571
  │                 │  No.:
  │ To digital TC   │  SCM:  1  E 1
  │                 │  ERR:
  │0595  FVC CHANNEL│  DEV:
  │6030 Hz  SAT FREQ│
  │0    POWER LEVEL │  PWR:
  │                 │
  │0600  DTC CHANNEL│  ERR:   -250  Hz
  │005 DVCC   1 SLOT│  PWR:   2.04 W
  │0    POWER LEVEL │  DCC:     005
  │00 TIME ALIGNMENT│
  │Full             │
  └─────────────────┘  RF Level:  - 60.0 dBm

  -ETC-   EXECUTE   RELEASE   MOBILE   CELL.    RETURN
```

10

Change time slot

WHY?

❍ Test whether the mobile switches correctly to a different time slot and the connection is maintained.

Requirement

❍ The mobile is not in test mode.
❍ Make the general test preparations. The channel type must be `To digital TC`.
❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).

HOW?

❍ Change the number in the SLOT field. Confirm your entry with (ENTER).
Note: the permissible slot number depends on the type of speech codec in the mobile (see "General Test Preparations").
❍ Press (EXECUTE) in the basic test mask. In this way signaling adopts the new time slot.

Test Results

D	**Mobile could switch to new slot:** connection does not break off, basic test mask continues to show results in digital sector.
	Mobile could not switch to new slot: connection breaks off.

Fig. 10.18: One digital traffic channel (DTC) is divided into six time slots. In full-rate data transmission time slots are used as pairs (1st and 4th, 2nd and 5th, 3rd and 6th), with each time slot carrying half of speech data. Full rate means three users share one frequency (DTC).

Change time alignment

WHY?   ❍ A change of time alignment can be made in complex handoff procedures but shows no effect in the basic test mask. It is not possible to see whether the mobile actually executes the time-alignment instruction from the base station correctly until the BURST mask has been called up.

Requirement   ❍ The mobile is not in test mode.
                          ❍ Make the general test preparations. The channel type must be `To digital TC`.
                          ❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).

HOW?   ❍ Enter a new figure in the `TIME ALIGNMENT` field. Confirm your entry with [ENTER].
                          ❍ Press (EXECUTE) in the basic test mask. In this way signaling adopts the new time alignment.

Test Results

D   No test result in basic test mask. Call up BURST mask with (BURSTS).

Fig. 10.19: Time alignment can only be changed in basic test mask. For explanation of terms, see "Burst Power & Time Alignment".

10

Change transfer rate

WHY?	❍ Test whether a half-rate mobile also works correctly in full-rate mode.

Requirement

❍ The mobile is not in test mode.
❍ Make the general test preparations. The channel type must be `To digital TC`.
❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).

HOW?

❍ Change the transfer rate. Note: a mobile with a full-rate speech codec cannot handle half rate.
❍ Press (EXECUTE) in the basic test mask. In this way signaling adopts the new transfer rate.

<table>
<tr><td colspan="2" align="center">Test Results</td></tr>
<tr><td rowspan="2">D</td><td>Mobile could switch to new rate: connection does not break off, basic test mask continues to show results in digital sector.</td></tr>
<tr><td>Mobile could not switch to new rate: connection breaks off.</td></tr>
</table>

Fig. 10.20: Full-rate mobile can only handle three time slots per DTC, but half-rate mobile can work with six time slots.

Combined changes

These parameters can be combined in any way for handoff procedures	
Analog TC	**Digital TC**
FVC	DTC
SAT FREQ	DVCC
POWER LEVEL	SLOT
	POWER LEVEL
	TIME ALIGNMENT
	Rate

Besides simple handoff procedures (changing a single parameter), complex handoff procedures are also permissible (changing several parameters at the same time). In earlier versions of (E)AMPS test programs there were impermissible parameter combinations. There is no such restriction in the NADC MS-TEST program: all parameters allowed in handoff procedures can be changed in any combination.

Examples:

1) The mobile is in a digital TC. Change DTC, DVCC, SLOT, POWER LEVEL, TIME ALIGNMENT and Rate; this is the most complex handoff in the digital mode of a mobile.
2) The mobile is in an analog TC. Change FVC, SAT FREQ and POWER LEVEL; this is the most complex handoff in the analog mode of a mobile.
3) Of course it is possible to change from an analog TC to a digital one and vice versa.

10

Hookflash

WHY?

- ❍ Test whether the mobile – during a call – correctly sends the call request for a third subscriber (conference circuit).

Requirement

- ❍ The mobile is able to handle hookflash.
- ❍ The mobile is not in test mode.
- ❍ Make the general test preparations.
- ❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in an analog or digital traffic channel).

HOW?

- ❍ Press (HOOKFLSH) in the basic test mask. This produces the prompt Dial number, then Send in the status line. The test setup is now waiting for the telegram that contains the call number for the third party.
- ❍ Enter the call number on the mobile and send it to the test setup by pressing the (SEND) key.

Test Results		
A + D	RESULt4 **F-No** Indicated call number must be same as dialed on mobile.	

Fig. 10.21: Call number dialed on mobile appears in No display field as in "Call from mobile" test. To distinguish both tests, F is prefixed to display field for hookflash.

Speech Loopback

WHY?

○ Acoustic check of the entire speech-signal transmission in the mobile (transmit and receive).

Requirement

○ The mobile is not in test mode.
○ Make the general test preparations. The channel type must be `To digital TC.`
○ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).

HOW?

○ Press (SP-LOOP) in the basic test mask.
○ Speak into the microphone of the handset. The test set sends the digital speech signal transmitted by the mobile (with a delay of about 1 s) back to the mobile unaltered.

Test Results

D	Loudspeaker of handset must reproduce words spoken into microphone with brief delay and as little distortion as possible: a unique opportunity of telling yourself a lot of nice things.

10

NADC TX Tests

10

Modulation Quality

WHY?

❍ Test the modulation characteristics of the mobile. For this the 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. The channel type must be `To digital TC`. Set time alignment to a value smaller than 26 (in other case no measurement results).

❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).

❍ This is also possible in test mode of the mobile.

Constellation display

HOW?

❍ Press (CONST) in the basic test mask.

❍ Select `DISPLAY MODE` in the scroll field (**Fig. 10.22**): `D` = dots, `L` = lines, `S` = statistics (see box on page 10-37).

❍ Press (RUN). The display shows the test results.

❍ Press (STOP).

❍ Change the output power of the mobile in the `POWER LEVEL` scroll field. Confirm this by pressing (POW CHG).

❍ Press (RUN). The display shows the new test results.

❍ End the test with (STOP). After this (NUMERIC) takes you to the numeric display or (RETURN) back to the basic test mask.

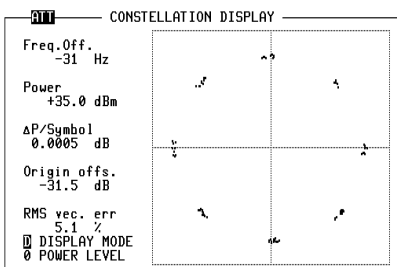**Fig. 10.22:** Constellation display after starting test with (RUN). ATT in mask header tells you that cable attenuation of test setup is compensated (see "General Preparations"). This only affects absolute `Power` figure, not other (relative) power figures like ΔP/Symbol.

Test Results

RESULt6	**Freq.Off**.	Deviation of mobile transmit frequency from its rating (receive frequency of Communication Test Set).
RESULt7	**Power**	Average RF power of mobile(missing measurement value? See box "No PWR figure?" on page 10-24).
RESULt8	**∆P/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.
RESULt9	**Origin offs.**	Measure of erroneous DC offset of RMS vector. Ideal figure = $-\infty$; in IS-55 recommended minimum performance: < –20 dB.
RESULtA	**RMS vec. err**	Average residual vector error, measured on 156 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 mobile transmit signal must not be greater than 12.5 %.

D
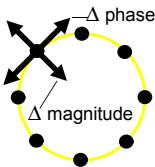
In (theoretical) ideal case constellation display shows eight points arranged on 360° circle and 45° apart (RMS vector on points of maximum effect). The greater the phase and magnitude error of the RMS vector is, the further the points are from these ideal positions.
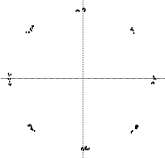
Constellation display of well aligned modulator. Points are closely grouped about eight ideal positions (high modulation quality). The longer the measurement lasts (for statistical presentation), the tighter the populations of points become around the ideal positions.
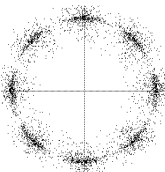
Constellation display of poorly aligned modulator. Points are far from ideal positions because of substantial phase and magnitude fluctuations of RMS vector.

10

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 results `Power` and `Err. 1st 10 Symbols`.

(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.

❍ End the test with (STOP). After this (GRAPHIC) takes you back to the constellation display or (RETURN) to the basic test mask.

Test Results

RESULt5	**Freq.Off.**	Same result as in constellation display.
RESULt6	**Power**	Same result as in constellation display.
RESULt7	**∆P/Symbol**	Same result as in constellation display.
RESULt8	**Origin offs.**	Same result as in constellation display.
RESULt9	**RMS vector error**	Same result as in constellation display.
RESULtA	**Err. 1st 10 Symbols**	Average residual vector error.
RESULtB	**Max. vector error**	Largest residual vector error.
RESULtC	**Max. phase err. pos.**	Largest phase error in direction of rotation (counterclockwise).
RESULtD	**Max. phase err. neg.**	Largest phase error opposite to direction of rotation (clockwise).
RESULtE	**Min. magnitude**	Smallest magnitude.
RESULtF	**Max. magnitude**	Largest magnitude.

D (marker on left of table)

Examples of result modes

normal Result field `RMS vector error` shows the average residual vector error measured on 156 symbols (one burst). With `Max. vector error` you see the largest residual vector error measured on 156 symbols.

average Result field `RMS vector error` shows the average residual vector error measured on 9×156 symbols (nine bursts). With `Max. vector error` you see the average of the largest residual vector errors measured on nine bursts.

Fig. 10.23: 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 test setup (see "General Preparations").

```
ATT ─── average NUMERIC ───
Frequency offset     :        -35  Hz

Power                :      +35.0  dBm

ΔP/Symbol            :     0.0002  dB

Origin offset        :      -32.0  dB

RMS vector error     :        5.3  %
Err. 1st 10 Symbols  :        7.3  %
Max. vector error    :       12.2  %

Max. phase err. pos. :        6.2  deg
Max. phase err. neg. :       -6.0  deg

Min. magnitude       :       91.4  %
Max. magnitude       :      105.6  %
```

GRAPHIC average max hold normal RUN RETURN

Available display modes

D = dots, the 156 points of maximum effect (POMEs) are shown singly. This display, for a well adjusted mobile, shows eight tightly limited accumulations of dots, offset by 45°. After the 156th value the screen is extinguished and the next 156 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 156th 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.

10

Modulation spectrum

WHY?   ❍ Test whether the modulation spectrum of the mobile main-
tains the permissible levels within the 30-kHz channel
spacing (otherwise there is adjacent-channel interference).

Requirement   ❍ Make the general test preparations. The channel type
must be `To digital TC`.
❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be
in a digital traffic channel).
❍ This is also possible in test mode of the mobile.

HOW?   ❍ Press (MOD-SPEC) in the basic test 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 base station
(see IS-54 section 2.1.3.3).
❍ Start the test with (CONTIN) (continuous measurement,
halted by (STOP)) or with (1-SHOT) (one measurement
frozen on display).
Note: Due to a single autoranging at the beginning of the
measurement it isn't permissible to change the mobile
output power during the measurement.
❍ (RETURN) takes you back to the basic test mask.

	Test Results	
		When filtered, modulation spectrum of correctly aligned mobile must be approximately as shown in **Fig. 10.24**. These are relative power figures refered to average power of burst.
D	RESULt6	Relative power at –30 kHz
	RESULt7	Relative power at –15 kHz
	RESULt8	Relative power at 0 kHz
	RESULt9	Relative power at +15 kHz
	RESULtA	Relative power at +30 kHz

Fig. 10.24: Modulation spectrum of correctly aligned mobile shown here barely tres-passes on upper and lower adjacent chan-nel.

Burst Power & Time Alignment

WHY?
- ❍ Visual assessment of the burst and ramping time.
- ❍ Measurement of transmitting power during the burst.
- ❍ Test whether the mobile correctly executes a time alignment from the base station.

Requirement
- ❍ Make the general test preparations. The channel type must be `To digital TC`.
- ❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).
- ❍ This is also possible in test mode of the mobile.

HOW?
- ❍ Press (BURSTS) in the basic test mask.
- ❍ Select in the scroll field whether the burst is to be shown `unfiltered` (you see the signal on the input of the test set) or `filtered` like from a base station (see IS-54 section 2.1.3.3).
- ❍ Start the test with (CONTIN) (continuous measurement, halted by (STOP)) or with (1-SHOT) (one measurement frozen on display).
- ❍ (RETURN) takes you back to the basic test mask.

Test Results

D			Burst from intact mobile should be similar to **Fig. 10.25**.
	RESULt6	**Averag. Power**	Average RF output power of mobile during burst shown (missing measurement value? See box "No PWR figure?" on page 10-24).
	RESULt7	**Time Alignment**	Time alignment assigned by test set (ideal value) should be as close as possible to what is actually measured. Display shows by how many units (1 unit = 1 bit) mobile sends its bursts earlier (refered to time alignment 0 = mobile is right near base station).

Why time alignment?

Without time alignment the bursts of mobiles at different distances from the base station would overlap. So, when requested by the base station, mobiles send "shorten" bursts that cannot cause any interference because they are too short. The base station computes the time alignment from the propagation delay of such bursts. The time alignment is the amount of time by which a distant mobile must transmit earlier than a close one so that the normal bursts of both mobiles fall precisely within the assigned
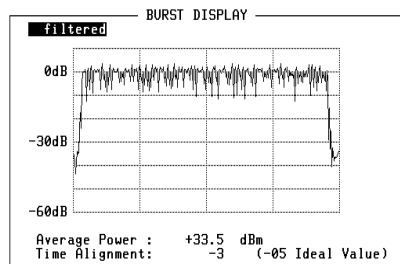
Fig. 10.25: Burst display showing ramping times and measured figures for power and time alignment.

10

Adjacent-Channel Power Measurement ACPM

WHY?   ❍ Adjacent-channel power is that part of mobile-station power which is emitted as noise in each of the two adjacent channels. To avoid adjacent-channel inter-ference, the noise must not exceed a defined value.

Requirement   ❍ Make the general test preparations.

HOW?   ❍ Press (ACPM) in the burst display mask.
❍ Enter the number of the channel on which the mobile station currently sends (**Fig. 10.26**). Entry of a frequency value is not possible.

Channel-number calculation

$$824.010 \leq f \leq 825.000 \qquad N = \frac{f - 825.000}{0.03} + 1023$$

$$825.030 \leq f \leq 848.970 \qquad N = \frac{f - 825.000}{0.03}$$

❍ Start the test with (RUN). The display shows the test results.
❍ End the test with (STOP). (RETURN) takes you back to the burst display mask.

	Test Results		
A + D	Display shows adjacent-channel power related to reference level measured in channel on which base station currently sends. Values must not exceed specified values.		
	RESULt6	**−1**	Relative power in lower adjacent channel
	RESULt7	**xxxx**	Reference level in current transmitter channel
	RESULt8	**+1**	Relative power in upper adjacent channel

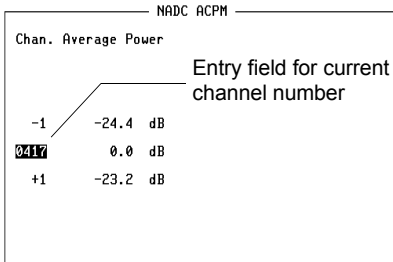Entry field for current channel number

Fig. 10.26: NADC-ACPM test mask.

NADC RX Tests

10

Bit Error Rate (BER)

WHY?
❍ Bit error rate is a measure of the RF sensitivity of the mobile 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 mobile must be in test mode.

HOW?
❍ Press (BER) in the basic test mask. This calls up the RX BER test mask, the entries from the basic test mask being transfered into the entry and scroll fields of the RX BER mask.
❍ Change the entries as necessary.
❍ Put the mobile into test mode and enter on it the same transmission parameters shown in the RX BER mask (channel number, slot number, rate, DVCC).
❍ Enter in the Number field how often the BER test is to be performed (number of bursts evaluated). The higher the figure, the more dependable is the test result.
❍ Start the test with (RUN) and look for the test result. You can change RF level during a test (range of interest: approx. –105 to –120 dBm).
❍ End the test with (STOP) and repeat it if necessary with different transmission parameters.
❍ (RETURN) takes you back to the basic test mask.

Test Results		
D		To measure BER, test set sends bit patterns. Mobile receives them and sends them back unaltered. Test set calculates BER by comparing transmitted bit patterns to those returned by mobile. Five test bit patterns are available, so these are repeated from sixth measurement.
	RESULt6 **BER**	Test result is BER averaged over number of bursts evaluated (Number field). According to IS-55 standard, BER must not exceed 3% at RF level of –110 dBm. Results display is suppressed for BER figures of >40%; it does not appear again until BER is <10% (hysteresis).

Fig. 10.27: RX BER test mask. Bit error rate is ratio of number of errored bits received to total number of bits received during period of observation. In this example mobile has BER of > 5% at -114 dBm receive level. ATT again draws your attention to compensation of cable attenuation in test setup (see "General Preparations").

```
┌─ATT─────────── RX BER ──────────────┐
│                                      │
│    Channel: 0230                     │
│    Slot   : 1                        │
│    Rate   : Full                     │
│    DVCC   : 005                      │
│ RF Power  : 0                        │
│    Number : 100                      │
│ RF Level  : -114.0 dBm   BER:  5.23 %│
│                                      │
└──────────────────────────────────────┘

        ▄▄▄▄  ▄▄▄▄▄  ▄▄▄▄▄  ▄▄▄▄▄  RUN   RETURN
```

10

Mobile-Assisted Handoff (MAHO)

WHY?
- ❍ MAHO checks the capability of the mobile to assist the base station in a handoff. For this purpose the mobile receives a command to measure signal strength in adjacent channels and to report the result back to the base station.

Requirement
- ❍ The mobile is able to handle MAHO.
- ❍ For correct measurement you need a second RF generator that is able to perform DQPSK modulation, eg a second STABILOCK 4031/4032.
- ❍ Make the general test preparations. The channel type must be `To digital TC`.
- ❍ Initiate a call with (MOBILE) or (CELL.) (the mobile must be in a digital traffic channel).

Test with 2nd RF generator

HOW?
- ❍ Press (MAHO) in the basic test mask. This calls up the MAHO test mask and adopts the current DTC number.
- ❍ Set the RF level in the MAHO test mask to –60 dBm (standard).
- ❍ Enter the number of an adjacent channel in the field `2nd DTC`.
- ❍ Couple the second RF generator in addition to the antenna terminal of the mobile and set the frequency of the selected adjacent channel.
- ❍ Set the RF level of the second unit to –118 dBm.
- ❍ Start the test with (CONTIN). (1-SHOT) is only useful for a remotely controlled measurement.
- ❍ Vary the RF level of the second unit to at least –51 dBm and look for the test results.
- ❍ End the test with (STOP).
- ❍ (RETURN) takes you back to the basic test mask.

Test Results			
D	RESULt6	**Current BER**	Bit error rate of mobile in current DTC. Because of strong –60 dBm signal, (coded) display must be 0 (corresponding to < 0.01% BER, see Table B).
	RESULt7	**Current RSSI**	RF signal level of mobile in current DTC (received-signal-strength indicator). Because of strong –60 dBm signal, (coded) display must be 27 (corresponding to –60 dBm, see Table A).
	RESULt8	**2nd RSSI**	RF signal level of mobile in defined adjacent channel. Depending on RF level of second generator, display will be 0 to 31 (see Table A).

Test without 2nd RF generator

HOW?
- ❏ Set the RF level in the MAHO test mask to –60 dBm.
- ❏ Enter the no. of an adjacent channel in the field `2nd DTC`.
- ❏ Start the test with (CONTIN). (1-SHOT) is only useful for a remotely controlled measurement.
- ❏ Decrease RF level in the MAHO test mask and look for the test results. Increase RF level to approx. –20 dBm and look for the test result `2nd RSSI`.
- ❏ End the test with (STOP).
- ❏ (RETURN) takes you back to the basic test mask.

Test Results

D	RESULt6	**Current BER**	Bit error rate of mobile in current DTC. Display may only show > 0 for very small RF levels < –110 dBm (see Table B).
	RESULt7	**Current RSSI**	RF signal level of mobile in current DTC. Display may show 0 to 31 (see Table A).
	RESULt8	**2nd RSSI**	At very high RF signal level, noise spectrum of test set provokes "measured figures" in adjacent channel.

Fig. 10.28: MAHO test mask showing field strength (RSSI) and bit error rate (BER) in traffic channel (`Current DTC`) as well as field strength in selected adjacent channel (`2nd DTC`). While testing it is possible to observe effect of change in level (by `RF Level` field) on measured figures.
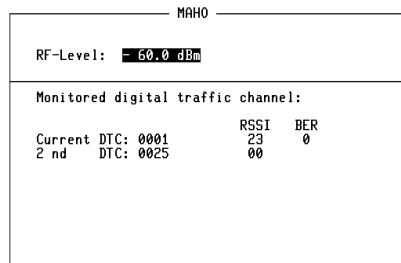
```
                        ┌──── MAHO ────┐

  RF-Level:  ▮ 60.0 dBm

  Monitored digital traffic channel:

                              RSSI   BER
  Current DTC: 0001            23     0
  2 nd   DTC: 0025             00

```

CONTIN 1-SHOT   RETURN

Table A	
Shown RSSI	**Real RSSI**
1	–113 dBm or less
2	–111 dBm
3	–109 dBm
4	–107 dBm
...	...
...	...
30	– 53 dBm
31	– 51 dBm or greater

Table B	
Shown BER	**Real BER (%)**
0	< 0.01
1	0.01 to less than 0.1
2	0.1 to less than 0.5
3	0.5 to less than 1.0
4	1.0 to less than 2.0
5	2.0 to less than 4.0
6	4.0 to less than 8.0
7	≥ 8.0

RSSI and BER according to specification IS-54-B (tolerances: RSSI ±3 to ±5 dB, BER ±25%)

10

Analog Tests

Background Signaling

As soon as a connection has been set up between the test set and a mobile, the DUPLEX or RX mask can be called up at any time. Here it is then possible to perform further typical mobile tests (eg the SAT loop test described at the beginning of Chapter 10). The signaling is continued that is necessary to keep the mobile connected. The fact that the signaling works in the background can be seen from the lighting of the green LED of modulation generator GEN B.

$\boxed{\text{AUX}}$+$\boxed{\text{DATA}}$ takes you back to the system program.

Striking the $\boxed{\text{B/SAT}}$ key or calling up the basic TX mask will terminate background signaling. You notice this from the fact that the LED extinguishes and the message DATA-MODUL-Generator stopped appears in he status line on-screen. The absence of signaling leads after a short time to termination of the connection between the test set and the mobile.

RS-232 interface

10

Application Notes

If STABILOCK is fitted with the D-AMPS module, the "RS-232/Centronics Interface" hardware option cannot be installed. But to allow data communication with other units or printout on conventional printers, the D-AMPS module has a fully functional RS-232 interface (socket Bu 105).

Requirements for operation

The RS-232 interface of the D-AMPS module will only work if your Communication Test Set satisfies the following requirements:

STABILOCK 4031	HOST-MCU $\geq$ 3.83
STABILOCK 4032	HOST-MCU $\geq$ 5.03
STABILOCK 4032 MS	HOST-MCU $\geq$ 4.03
RS-232 driver software	DIG-MCU $\geq$ 1.20

If the STATUS mask (called up with $\boxed{\text{AUX}}$+$\boxed{\text{DEF.PAR}}$+$\boxed{\text{STATUS}}$) shows an older status, a software update will be necessary.

☞ **Do not start the NADC MS Test system program:** the RS-232 interface of the D-AMPS module will *not* work properly if the NADC MS Test (or NADC BS Test) system program is called up at the same time.

Control commands and transmission protocol

The RS-232 interface of the D-AMPS module offers exactly the same functions as the RS-232 interface of the hardware option "RS-232/Centronics Interface". All control commands for the interface are explained in Chapter 8 under the IEEE section "Special commands". Setting the transmission protocol (baud rate, number of data bits, parity, handshake, etc) is explained in Chapter 4, section "General Parameters".

Special features   Special operating parameters for the RS-232 interface are normally assigned with the commands WRITE[3000...] or SLAVE3000... (see Chapter 8). Replace control sequence 3000 by control sequence **2010** if you want to assign the RS-232 interface of the D-AMPS module special operating parameters.
Example: not WRITE[300012...] but WRITE[201012...].

Pinning of RS-232 interface
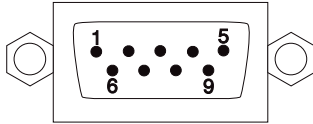
Bu 105			
Pin 1 = DCD		Pin 5 = GND	
Pin 2 = RXD		Pin 6 = nc	
Pin 3 = TXD		Pin 7 = RTS	
Pin 4 = DTR		Pin 8 = CTS	
		Pin 9 = nc	

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Appendix

Technical Data

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

| POWER LEVEL	Class 1	Class 2	Class 3	Class 4 only allowed in digital mode
0	+36 dBm	+32 dBm	+28 dBm	+28 dBm
1	+32 dBm	+32 dBm	+28 dBm	+28 dBm
2	+28 dBm	+28 dBm	+28 dBm	+28 dBm
3	+24 dBm	+24 dBm	+24 dBm	+24 dBm
4	+20 dBm	+20 dBm	+20 dBm	+20 dBm
5	+16 dBm	+16 dBm	+16 dBm	+16 dBm
6	+12 dBm	+12 dBm	+12 dBm	+12 dBm
7	+8 dBm	+8 dBm	+8 dBm	+8 dBm
8	+8 dBm	+8 dBm	+8 dBm	+4 dBm ±3 dB
9	+8 dBm	+8 dBm	+8 dBm	0 dBm ±6 dB
A	+8 dBm	+8 dBm	+8 dBm	–4 dBm ±9 dB
Unless stated otherwise, tolerance limits +2 dB and –4 dB				

Output power levels (ERP) of mobiles refered to mobile class and power level controlled by base station

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.
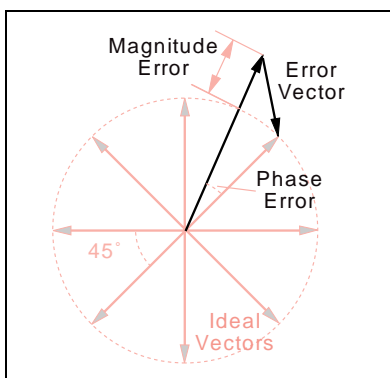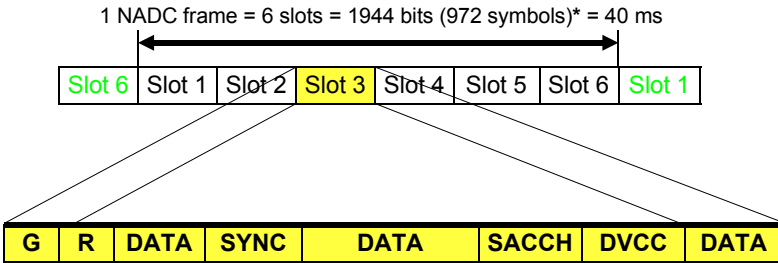

The digital modulation used for NADC is π/4 DQPSK (digital quadrature phase-shift keying). This modulation process shifts phase in steps of ±π/4 depending on bit-pattern changes. With each phase step you can transmit two bits (special NADC terms: 2 bits = 1 symbol; 1 bit = 1 unit). In a vector diagram 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 (156 for transmission from mobile to base station).

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.

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NADC frame and slot structure (mobile to base station)

1 NADC frame = 6 slots = 1944 bits (972 symbols)* = 40 ms

Slot 6	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 1

G	R	DATA	SYNC	DATA	SACCH	DVCC	DATA

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).
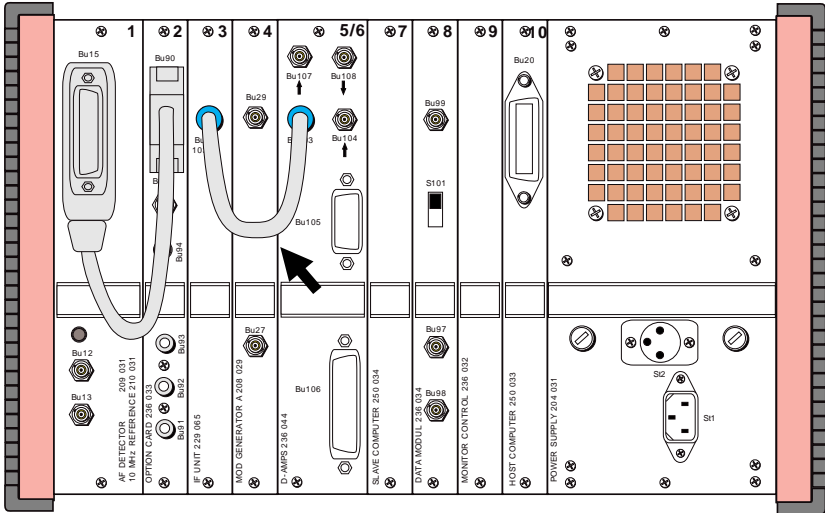
Back Panel

Fig. 10.29: If sockets Bu 103 are not connected as marked here, no call setup is possible between mobile and test set. All other sockets of D-AMPS unit are irrelevant for testing NADC mobiles.

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**
9	MONITOR CONTROL
10	HOST COMPUTER
Internal	**D-AMPS DUPLEX UNIT**

Equipment configuration required for testing NADC mobiles. Slot 2 can hold any of the options mentioned.

The following may not be included at the same time:
ACPM option
SSB option
GSM module
RS232/Centronics interface

10

Set Number of Measurements

To set the number of measurements in the AUTORUN or remote-control mode, use the following IEEE command only if the screen shows the NADC basic mask, the constellation display or the numeric display:

SPECIR[value]   [value] = Number of measurements (any figure be-
                             tween 01 and FF is permissible,
                             eg SPECIR0A for 10 measurements).

                             After loading the system program or after a reset the default
                             value is 1.

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	9311-100-A	none	-	First edition.
1.10	9312-110-A	10-16	NF	Display of mobile type in SCM message (analog/DAMPS).
		10-21	IN	Automatic change of channel: MS power must be > +17 dBm.
		10-38	IN	No power changing during mod. spectrum measurement.
		10-38	C	Insertion of missing text in the box "Test Results".
	9401-110-B	10-55	C	Insertion of missing text in the box.
		10-6	C	RF/AF-MCU (revision ≥ 1) necessary for testing.
1.20	9407-120-A	10-38	NF	Adjacent-Channel Power Measurement ACPM.
		10-14	NF	Registration call.
		10-58	NF	Special remote command to set number of measurements.
	9410-120-B	10-50	NF	Description of RS-232 interface.
	9503-120-C	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.
1.30	9504-130-A	none	C	Bug fixes.
1.40	9505-140-A	none	C	Bug fixes.
1.50	9609-150-A	none	C	Bug fixes.
1.60	9611-160-A	none	C	Internal optimation (power measurement).

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