



**ROHDE & SCHWARZ**

Test and Measurement  
Division

## **Software Manual**

# **1xEV-DO Base Station Test**

## **Application Firmware R&S FS-K84**

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## Contents of the Software Manual for Application Firmware R&S FS-K84

This software manual contains information on operation of the R&S FSU and R&S FSP spectrum analyzers and the R&S FSQ signal analyzer configured with Application Firmware R&S FS-K84. It includes a description of the menus and the remote-control commands for the 1xEV-DO base station test application firmware.

All other aspects of analyzer operation can be taken from the operating manual of the analyzer.

The software description of the application firmware consists of the data sheet and the following chapters:

The <b>data sheet</b>	informs on the typical specifications and the firmware characteristics
<b>Chapter 1</b>	describes how you enable the application firmware.
<b>Chapter 2</b>	describes typical examples of measurements by means of tests.
<b>Chapter 3</b>	describes the test setup for base station tests.
<b>Chapter 4</b>	describes the predefined channel tunnels
<b>Chapter 5</b>	gives a schematic view of the control menus.
<b>Chapter 6</b>	contains a detailed description of all functions for base station tests as a reference for manual operation. The chapter also lists the corresponding IEC bus command for each chapter.
<b>Chapter 7</b>	describes all the remote-control commands that have been defined for the application firmware. A table containing the IEC bus commands assigned to the softkeys are given at the end of the chapter.
<b>Chapter 8</b>	describes the performance test
<b>Chapter 9</b>	contains tables that illustrate the relationship between the MAC index and the Walsh code for the MAC and PREAMBLE channel types
<b>Chapter 10</b>	provides definitions and abbreviations relating to the 1xEV-DO standard that are also used in this software description
<b>Chapter 11</b>	contains the index of this software manual.





# 1xEV-DO Base Station Test Application Firmware

## R&S FS-K84

When configured with Application Firmware R&S FS-K84, the analyzer performs code domain power measurements on forward link signals (base station) on the basis of the 3GPP2 Standard (Third Generation Partnership Project 2) 3GPP2 Standard (Third Generation Partnership Project 2) High Rate Packet Data. This Standard, which was defined for packet-oriented data communications, is generally referred to as 1xEV-DO (First EVolution Data Only). This name is also used in Application Firmware R&S FS-K84.

In this Standard, the expressions "access network" (AN) and "access terminal" (AT) are used for the base station and the mobile terminal, respectively. To retain the similarity with the CDMA2000 BTS application firmware, the expression "base station" is also used in connection with the 1xEV-DO FS-K84 application firmware.

The 1xEV-DO BTS application firmware is based on the "**CDMA2000 High Rate Packet Data Air Interface Specification**" of version C.S0024 v.3.0 dated December 2001 and the "**Recommended Minimum Performance Standards for CDMA2000 High Rate Packet Data Access Network**" of version C.S0032-0 v.1.0 dated December 2001.

These standard documents are published as TIA 856 (IS-856) and TIA 864 (IS-864), respectively. The application firmware supports code domain measurements on 1xEV-DO signals. This code domain power analyzer provides the following analyses, among others: Code Domain Power, Channel Occupancy Table, EVM, Frequency Error and RHO Factor. All four channel types (PILOT, MAC, PREAMBLE and DATA) are supported and the modulation types in the DATA channel type are detected automatically. The signals needing to be measured may contain different modulation types or preamble lengths in each slot, thus making it possible to perform measurements on base stations while operation is in progress.

In addition to the code domain measurements described in the 1xEV-DO Standard, the application features measurements in the spectral range such as channel power, adjacent channel power, occupied bandwidth and spectrum emission mask with predefined settings.

The 1xEV-DO Standard has been developed from the CDMA2000 Standard, which in its turn was an extension of cdmaOne (IS 95). All these standards are based on the same RF parameters, this being the reason why the RF measurements of CDMA2000 and 1xEV-DO are identical. In the code domain, however, CDMA2000 and 1xEV-DO are not compatible, since the chips for 1xEV-DO are assigned chronologically one after the other to the different channel types, and in the DATA channel type 8-PSK and 16-QAM modulation methods are used in addition to QPSK. With CDMA2000, there are only BPSK and QPSK modulation methods. Furthermore, a slot is always assigned to precisely one node with 1xEV-DO, whereas with CDMA2000 several nodes communicate with the base station simultaneously. For further details refer to the chapter entitled "Code Domain Measurements on 1xEV-DO Signals", starting on page 57.

# 1 Installing and Enabling the Application Firmware

## Installation

If Application Firmware R&S FS-K84 has not been installed on the device, a firmware update will have to be performed. This will have been done already if the application software was installed at the factory.

Before the application firmware can be installed, a corresponding basic firmware of the basic device has to be installed on the analyzer. Refer to the release notes of the current Application Firmware R&S FS-K84 for the latest versions.

If the basic firmware has to be updated, start the firmware update from the current floppy disks of the basic firmware by successively pressing *SETUP* → *NEXT* → *FIRMWARE UPDATE*.

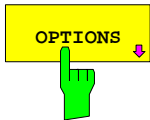
If the correct basic firmware is installed, the firmware update for the firmware application is started from the floppy disks of the Firmware Application R&S FS-K84 using the same key sequence - *SETUP* → *NEXT* → *FIRMWARE UPDATE*.

Following installation, the application firmware has to be enabled as described below.

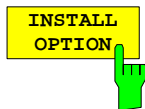
## Enabling

Application Firmware R&S FS-K84 is enabled on the *SETUP* → *GENERAL SETUP* menu by entering a keyword. The keyword is supplied with the application firmware. When the application software is installed before the device leaves the factory, the application firmware will already have been enabled.

*GENERAL SETUP* menu:



The *OPTIONS* softkey opens a submenu in which the keywords can be entered for the application firmware. The available applications are displayed in a table, which is opened when you enter the submenu.



The *INSTALL OPTION* softkey activates input of the keyword for an application firmware.

One or several keywords can be entered in the input field. If the keyword is valid, the message *OPTION KEY OK* is displayed and the application firmware is entered in the *FIRMWARE OPTIONS* table.

If a keyword is invalid, the message *OPTION KEY INVALID* is displayed.

If the version of the application firmware and the version of the basic firmware are not compatible, an appropriate message is issued. In this instance, follow the instructions contained in the above chapter, "Installation".

## 2 Getting Started

The following chapter explains basic 1xEV-DO base station tests using a test setup with the Signal Generator R&S SMIQ as the device under test. It describes how operating and measuring errors can be avoided by means of correct default settings.

The measurement screen is presented in Chapter 6 for the different measurements.

Attention is drawn to important settings exemplifying how to avoid measurement errors during measurements. The correct setting is followed by the effect of an incorrect setting. The following measurements are performed:

- Measurement 1: Measuring the signal spectrum
- Measurement 2: Measuring the spectrum emission mask
- Measurement 3: Measuring the relative code domain power and the frequency error
  - Setting: Center frequency
- Measurement 4: Triggered measurement of relative code domain power
  - Setting: Trigger offset
  - Setting: PN offset of base station
- Measurement 5: Measurement of composite EVM
- Measurement 6: Measurement of peak code domain error
- Measurement 7: Measurement of RHO factor

The 1xEV-DO raw data are created with the R&S WinIQSIM software and loaded into the arbitrary waveform generator of the SMIQ.

The measurements are performed with the following instruments and aids:

- Spectrum Analyzers R&S FSU, R&S FSP or Signal Analyzer R&S FSQ with Application Firmware R&S FS-K84 (base station test for 1xEV-DO).
- Vector Signal Generator SMIQ with hardware options data generator B11 / modulation coder B20 and arbitrary waveform generator B60 together with firmware version 5.70 or higher with enabled option K17 1xEV-DO and SMIQ-Z5 PARADATA BNC ADAPTER for external trigger signal.
- PC that is either connected by means of a serial cable to the SMIQ, or has an IEC bus card and connected by means of an IEC bus cable to the SMIQ. R&S WinIQSIM Software 3.91 or higher is installed on that PC. The software can be downloaded from the Rohde & Schwarz web site on the Internet at <http://www.rohde-schwarz.com>.
- 1 coaxial cable, 50  $\Omega$ , approximately 1 m, N connector
- 2 coaxial cables, 50  $\Omega$ , approximately 1 m, BNC connector

## Generating a 1xEV-DO forward link signal with WinIQSIM

The WinIQSIM software can be downloaded at <http://www.rohde-schwarz.com> and is installed on a PC. The WinIQSIM software can be used to generate 1xEV-DO forward link signals, which are transferred on an SMIQ or AMIQ. An explanation is given below of how the test signal described in the 1xEV-DO Standard is generated. WinIQSIM version 3.91 or higher is assumed.

Selecting Start and Standard:

Start **WinIQSIM.exe**.

On the **File** menu, select the **New** option and select **1xEV-DO** from the list that follows. The 1xEV-DO dialog box appears.

Select **BS1** in the dialog box to configure base station 1 and the following dialog box is opened:

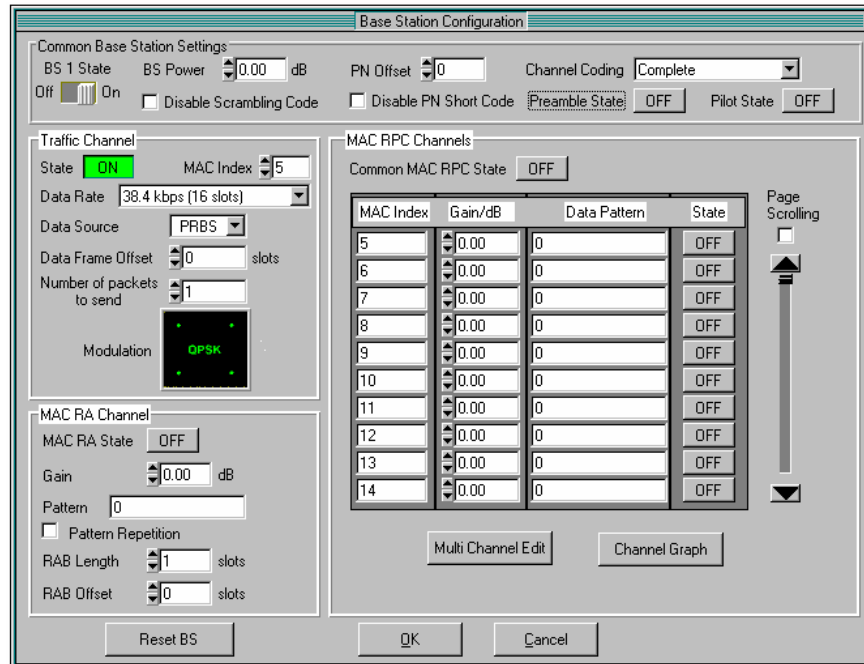


Fig. 2-1 WinIQSIM base station configuration prior to settings

Activate channel types:

In this **base station configuration**, the following settings are performed so that a full-slot signal of the maximum data rate is generated at 14 assigned MAC indices. This model is specified as a test standard for some tests in the 1xEV-DO Standard.

Set **Preamble State** to **ON** so that a preamble is contained in the signal and set **Pilot State** to **ON** so that the pilot is sent.

At **Traffic Channel**, select **Data Rate '2457.6 kbps (1 slot)'**; this is a 16-QAM modulated data signal for a preamble length of 64 chips.

At **MAC RA Channel**, the **MAC RA State** must be set to **ON** and the **RAB Length** set to **16 Slots**.

In the **MAC RPC Channels** section, set the **Common MAC RPC State** to **ON**. Use the **Multi Channel Edit** key to open the following dialog box, which allows a rapid MAC Index entry:

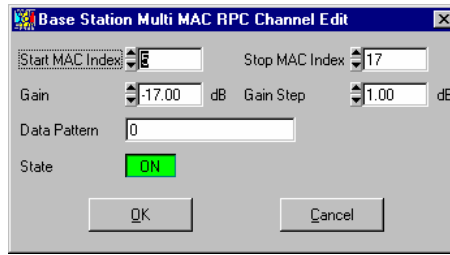


Fig. 2-2 WinIQSIM – Multi MAC RPC Channel Edit

To activate 13 more MAC codes for the test model, enter a **5** at **Start MAC Index**, and **17** at **Stop MAC Index**, and then set the **State** to **ON**. So that the RPC channels differ in terms of power, enter -17 dB at Gain and 1 dB at Gain Step. After you click **OK**, the **base station configuration** will look as follows:

The model is configured:

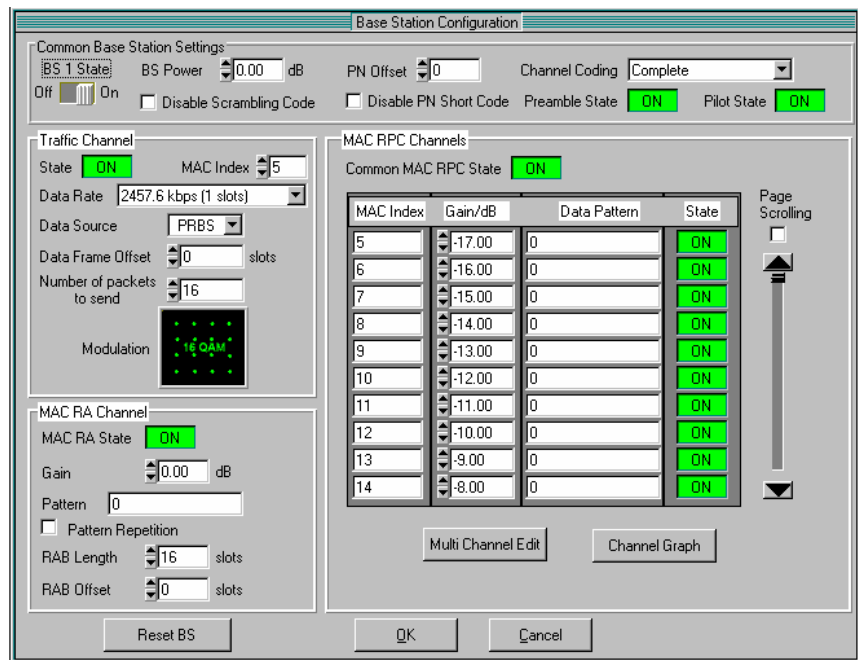


Fig. 2-3 WinIQSIM base station configuration of the finished model

Define trigger settings:

Then, set the trigger settings on the **SMIQ** menu by choosing the option **Trigger Output Settings**. For the **Current Mode: Mode 1** the **Restart Clock (SEQUENCE)** is defined. This means that the trigger at the slot limit is available every 80 ms at TRIG1 of the SMIQ Z5 BNC adapters.

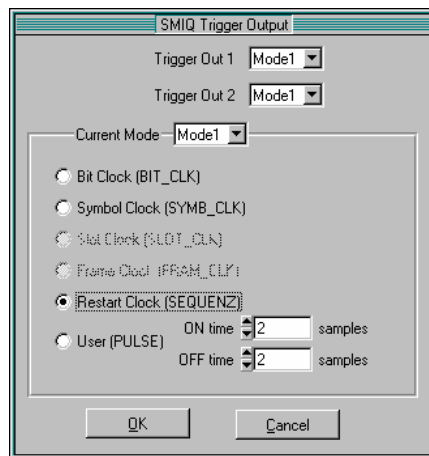


Fig. 2-4 WinIQSIM base station configuration of the finished model

Save and download to SMIQ:

Save this 1xEV-DO configuration by choosing **File|Save** as file 'DO\_FFULL.IQS' (1xEV-DO Forward Link FULL Slot).

Connect the SMIQ either serially or by means of an IEC bus card and IEC bus cable to the SMIQ and, on the **SMIQ|TRANSMISSION** menu, load the generated signal under the name 'DO\_FFULL' onto the SMIQ.

## Default settings in 1xEV-DO BTS operating mode

At the default setting after PRESET, the analyzer is in SPECTRUM mode. The following basic settings of the code domain measurement are not activated until the 1xEV-DO BTS operating mode is selected by operating hot key **1xEVDO BS**.

Table 2-1 Default setting of code domain measurement after preset

Parameter	Setting
Digital standard	CDMA 2000 MC1 (where MC1 stands for Multi Carrier 1 and thus describes CDMA2000 1X, that is a carrier and consequently also applicable to 1xEV-DO, since the RF parameters such as occupied bandwidth and channel spacings are compatible with CDMA2000)
Band class	Band class 0 (800 MHz band)
Sweep	CONTINUOUS
CDP mode	CODE CHAN AUTOSEARCH
CDP average	OFF (the CDP measurement is performed slot by slot and is not averaged for all slots)
Trigger setting	FREE RUN
Trigger offset	0 s
PN offset	0 chips
Threshold value	-40 dB
Channel type	PILOT
Mapping	AUTO (consequently, for channel type PILOT the I or Q branch is evaluated, depending on SELECT I/Q)
SELECT I/Q	I (the I branch is evaluated)
Code number	0
Slot number	0
Capture length	3 slots (where one slot contains 2048 chips and lasts 1.666 ms)
Evaluation	Screen A: CODE PWR RELATIVE Screen B: GENERAL RESULTS

The following conventions apply for displaying settings on the analyzer:

- [<Key>] Press a key on the front panel such as **[SPAN]**
- [<SOFTKEY>] Press a softkey such as **[MARKER -> PEAK]**
- [<nn unit>] Enter a value and terminate by entering the unit such as **[12 kHz]**

The following conventions apply for displaying settings on the SMIQ:

- [<Key>] Press a key on the front panel such as **[FREQ]**
- <MENU> Choose a menu, parameter or a setting such as **DIGITAL STD**. The menu level is identified by indenting.
- <nn unit> Enter a value and terminate by entering the unit such as **12 kHz**

## Measurement 1: Measuring the signal power

Measurement of the spectrum provides an overview of the 1xEV-DO signal and the carrier-oriented spurious emissions.

Test setup ➤ Connect the RF output of the SMIQ to the RF input of the analyzer (coaxial cable with N connectors).

Settings on SMIQ:

```
[PRESET]
[LEVEL:           0 dBm]
[FREQ:           878.49 MHz]
ARB MOD
  SET SMIQ ACCORDING TO WAVEFORM ...
    SET SMIQ ACCORDING TO WAVEFORM      ON
    IQ SWAP (VECTOR MODE)               ON
    TRIGGER OUT MODE                    ON
```

*(These three settings are only required once after generator preset and are used to apply, in VECTOR MODE, the IQ SWAP and, in ARB MOD, the trigger setting automatically from the waveform file generated by WinIQSIM. This is particularly present when a switch is made between different waveforms.)*

```
SELECT WAVEFORM... select name 'DO_FFULL'
STATE:      ON
```

Setting on analyzer:

```
[PRESET]
[FREQUENCY:      878.49 MHz]
[AMPT:           0 dBm]
[1xEVDO BS]
[MEAS:           POWER]
```

Measurement on analyzer: The following are displayed:

- The spectrum of the 1xEV-DO signal
- The channel power of the signal within the 1.2288 MHz channel bandwidth



## Measurement 2: Measuring the spectrum emission mask

The 1xEV-DO specification calls for a measurement which monitors compliance with a spectral mask in a range of at least  $\pm 4.0$  MHz around the 1xEV-DO carrier. To assess the power emissions within the specified range, signal power is measured with a 30 kHz filter. The ensuing trace is compared with the limit line defined in the 1xEV-DO specification depending on the selected band class.

Test setup ➤ Connect the RF output of the SMIQ to the RF input of the analyzer (coaxial cable with N connectors).

Settings on SMIQ: *SMIQ settings as for measurement 1*

Setting on analyzer:	<b>[PRESET]</b>	<i>Band class 0 is thus selected</i>
	<b>[FREQUENCY:</b>	<i>878.49 MHz]</i>
	<b>[AMPT:</b>	<i>0 dBm]</i>
	<i>[1xEVDO BS]</i>	
	<b>[MEAS:</b>	<i>SPECTRUM EM MASK]</i>

Measurement on analyzer: The following are displayed:

- The spectrum of the 1xEV-DO signal
- The channel power
- The limit line defined in the standard
- Information on limit line violations (passed/failed)

### Measurement 3: Measuring the relative code domain power and the frequency error

A measurement of the code domain power is shown in the following. In this case the basic parameters of the CDP measurements, which allow analysis of the signal, reset successively from values adjusted to the test signal to those that have not been adjusted in order to demonstrate the resulting effects.

Settings on SMIQ:

- Connect the RF output of the SMIQ to the RF Input of the analyzer.
- Connect the reference input (EXT REF IN/OUT) on the rear panel of the analyzer to the reference output (REF) on the SMIQ (coaxial cable with BNC connectors)

Settings on SMIQ: *SMIQ settings as for measurement 1*

Setting on analyzer:

**[PRESET]**  
**[FREQUENCY:**                    *878.49 MHz]*  
**[AMPT:**                            *10 dBm]*  
**[1xEVDO BS]**

Measurement on analyzer: The following are displayed:

Screen A:     Code domain power of signal

Screen B:     Numeric results of CDP measurement including the frequency error

## Setting: Synchronizing the reference frequencies

Synchronization of the transmitter and receiver to the same reference frequency reduces the frequency error.

- Test setup                                   ➤ Connect the reference input (EXT REF IN/OUT) on the rear panel of the analyzer to the reference output (REF) on the SMIQ (coaxial cable with BNC connectors)
- Settings on SMIQ:                         *SMIQ settings as for measurement 1*
- Setting on analyzer:                     *As for measurement 3, plus*  
**[SETUP:   REFERENCE EXT]**
- Measurement on analyzer:   Screen B:       Frequency error: The displayed frequency error should be < 10 Hz.

**The reference frequencies of the analyzer and the device under test should be synchronized.**

## Setting: Behaviour with deviating center frequency setting

In the following setting, the behaviour of the DUT and analyzer on a deviating center frequency setting is shown.

- Settings on SMIQ:                         ➤ Tune the center frequency of the signal generator in 1 kHz steps and watch the analyzer screen:
- Measurement on analyzer:             • Up to about 8.0 kHz frequency error, a CDP measurement is still possible on the analyzer. A difference in the measurement accuracy of the CDP measurement is not discernible up to this frequency error.
- Above a frequency error of 8.0 kHz, the probability of an impaired synchronization increases. The 'SYNC FAILED' message appears.
- Above a frequency error of 10 kHz, a CDP measurement becomes impossible. The 'SYNC FAILED' message appears.
- Settings on SMIQ:                         ➤ Set the signal generator center frequency again to 878.49 MHz:  
**[FREQ:   878.49 MHz]**

**The center frequency of the analyzer must agree with the frequency of the device under test to within a 8.0 kHz offset.**

## Measurement 4: Triggered measurement of relative code domain power

If the code domain power measurement is performed without external triggering, an extract is recorded from the test signal at a random point in time and attempts to detect the start of a slot in it. To detect this start, all possibilities of the PN sequence location have to be tested in Free Run mode. This requires computing time. This computing time can be reduced by creating an external (frame) trigger and entering the correct PN offset. The search range for the start of the slot and the PN offset are known and fewer options have to be tested.

Test setup

- Connect the RF output of the SMIQ to the RF input of the analyzer
- Connect the reference frequencies (refer to measurement 2)
- Connect external triggering of the analyzer (EXT TRIG GATE) to the SMIQ trigger (TRIGOUT1 at PAR DATA).

Settings on SMIQ: *SMIQ settings as for measurement 1*

Setting on analyzer: As for measurement 3, plus  
**[TRIG: EXTERN]**

Measurement on analyzer: The following are displayed:

Screen A: Code domain power of signal  
Screen B: Numeric results of CDP measurement

Trg to Frame: Timing offset between trigger event and start of the slot

The repetition rate of the measurement increases compared with measurement without an external trigger.

### Setting: Trigger offset

Any delay of the trigger event compared to the start of the slot can be compensated by changing the trigger offset.

Setting on analyzer: As for measurement 3, plus  
**[TRIG:]**  
*[TRIG OFFSET 100 μs]*

Measurement on analyzer: The parameter "Trg to Frame" in the numeric results table (screen B) changes:  
*Trg to Frame -100 μs*

**A trigger offset compensates analog delays of the trigger event.**

**Setting: Behaviour with wrong PN offset**

A valid CDP measurement can only be performed with an external trigger if the PN offset set on the analyzer agrees with that of the transmit signal.

Settings on SMIQ: *SMIQ settings as for measurement 1*

Setting on analyzer: Set PN offset to the new value:

*[SETTINGS: PN-OFFSET 200]*

Measurement on analyzer: The 'SYNC FAILED' message appears.

Setting on analyzer: Set PN offset to the new value:

*[SETTINGS: PN-OFFSET 0]*

Measurement on analyzer: The CDP display shows the test model again.

**The setting of the PN offset on the analyzer must agree with the PN offset of the signal to be measured. The TRG TO FRAME value of the general results analysis is correct only if the PN offset agrees.**

## Measurement 5: Measuring the composite EVM

Composite EVM is the measurement of the mean square error of the total signal of a channel type. An ideal reference signal is generated from the demodulated data. The test signal and the reference signal are compared with each other; the squared deviation produces the Composite EVM measurement.

- Test setup
- Connect the RF output of the SMIQ to the RF input of the analyzer (coaxial cable with N connectors)
  - Connect the reference input (EXT REF IN/OUT) on the rear panel of the analyzer to the reference output (REF) on the SMIQ (coaxial cable with BNC connectors)
  - Connect external triggering of the analyzer (EXT TRIG GATE) to the SMIQ trigger (TRIGOUT1 at PAR DATA).

Settings on SMIQ: *SMIQ settings as for measurement 1*

Setting on analyzer:

<b>[PRESET]</b>	
<b>[FREQUENCY:</b>	<i>878.49 MHz]</i>
<b>[AMPT:</b>	<i>10 dBm]</i>
<i>[1xEVDO BS]</i>	
<b>[TRIG</b>	<i>EXTERNAL]</i>
<b>[RESULTS</b>	<i>COMPOSITE EVM]</i>

Measurement on analyzer: The following are displayed:

Screen A:	Code domain power of signal
Screen B:	Composite EVM (EVM for total signal)

## Measurement 6: Measuring the peak code domain error

With the peak code domain error measurement, an ideal reference signal is generated from the demodulated data. The test signal and the reference signal of a channel type are compared with each other. The difference between the two signals is projected to the class of the channel-type spreading factor. The peak code domain error measurement is obtained by summing the symbols of each difference signal slot and searching for the maximum error code.

- Test setup
- Connect the RF output of the SMIQ to the RF input of the analyzer (coaxial cable with N connectors)
  - Connect the reference input (EXT REF IN/OUT) on the rear panel of the analyzer to the reference output (REF) on the SMIQ (coaxial cable with BNC connectors)
  - Connect external triggering of the analyzer (EXT TRIG GATE) to the SMIQ trigger (TRIGOUT1 at PAR DATA).

Settings on SMIQ: *SMIQ settings as for measurement 1*

Setting on analyzer:

<b>[PRESET]</b>	
<b>[FREQUENCY:</b>	<i>878.49 MHz]</i>
<b>[AMPT:</b>	<i>0 dBm]</i>
<i>[1xEVDO BS]</i>	
<b>[TRIG</b>	<i>EXTERN]</i>
<b>[RESULTS</b>	<i>PEAK CODE DOMAIN ERR]</i>

Measurement on analyzer: The following are displayed:

Screen A:	Code domain power of signal
Screen B:	Peak code domain error

## Measurement 7: Measurement of the RHO factors

A measurement of the RHO factors is shown in the following. The Standard specifies measurement of 3 RHO factors: RHO Pilot (only in the Pilot channel type), RHO<sub>overall-1</sub> (RHO over all slots with start of averaging at the half slot boundary) and RHO<sub>overall-2</sub> (RHO over all slots with start of averaging at the half slot boundary).

- Settings on SMIQ:
- Connect the RF output of the SMIQ to the RF Input of the analyzer.
  - Connect the reference input (EXT REF IN/OUT) on the rear panel of the analyzer to the reference output (REF) on the SMIQ (coaxial cable with BNC connectors)

Settings on SMIQ: *SMIQ settings as for measurement 1*

Setting on analyzer:

**[PRESET]**  
**[FREQUENCY: 878.49 MHz]**  
**[AMPT: 10 dBm]**  
**[1xEVDO BS]**

Measurement on analyzer: The following are displayed:

Screen A: Code domain power of signal

Screen B: Numeric results of CDP measurement including the RHO factors



### 3 Test Setup for Base Station Tests



**Note:**

Before taking the device into operation, make sure that

- The housing covers are in place and their screws have been tightened
- The ventilation slits are free
- No signal voltage levels above the permissible limits are applied to the inputs
- The outputs of the device are not overloaded or wrongly connected

**Failure to comply with the above points may result in damage to the device.**

This chapter describes the default settings of the analyzer for operation as a 1xEV-DO base station tester. A condition that has to be met before measurements can start is that the analyzer is correctly configured and supplied with power, as described in Chapter 1 of the operating manual for the basic device. Furthermore, Application Firmware R&S FS-K84 must be enabled. Installation and enabling of the application firmware are explained in Chapter 1 of this software manual.

#### Standard Test Setup

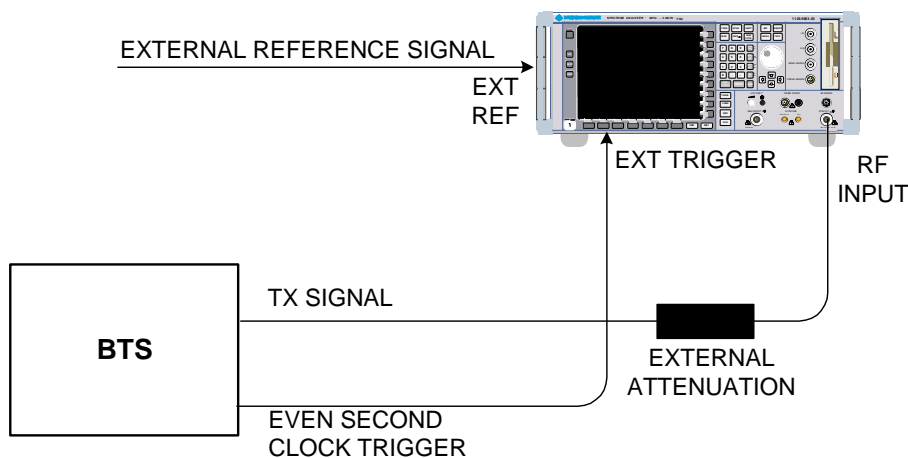


Fig. 3-1 BTS test setup

- Connect the antenna output (or TX output) of the base station by means of a power attenuator exhibiting suitable attenuation to the RF input of the analyzer.  
The following level values for external attenuation are recommended to ensure that the RF input of the analyzer is protected and the sensitivity of the device is not impaired too much:

Maximum power	Recommended external attenuation
≥ 55 to 60 dBm	35 to 40 dB
≥ 50 to 55 dBm	30 to 35 dB
≥ 45 to 50 dBm	25 to 30 dB
≥ 40 to 45 dBm	20 to 25 dB
≥ 35 to 40 dBm	15 to 20 dB
≥ 30 to 35 dBm	10 to 15 dB
≥ 25 to 30 dBm	5 to 10 dB
≥ 20 to 25 dBm	0 to 5 dB
20 dBm	0 dB

- For signal measurements at the output of two-port networks, connect the reference frequency of the signal source to the rear reference input of the analyzer (*EXT REF IN/OUT*).
- To maintain the error limits called for in the 1xEV-DO specification during frequency measurement on base stations, the analyzer has to be operated on an external reference. The reference source might be a rubidium frequency standard, for example.
- If the base station has a trigger output, connect the trigger output of the base station to the rear trigger input of the analyzer (*EXT TRIG GATE*).

**Default settings**

- Enter the external attenuation. **[AMPT] [NEXT] [REF LVL OFFSET].**
- Enter the reference level. **[AMPT]**
- Enter the center frequency. **[FREQUENCY]**
- Set the trigger. **[TRIG]**
- During use, switch on external reference. **[SETUP] [REF: EXT]**
- Select the standard and the desired measurement. **[1xEVDO BS] [RESULTS]**
- Set the PN offset. **[SETTINGS] [PN OFFSET]**

## 4 Predefined Channel Tables

By default, the application firmware works in automatic Channel Search mode (softkey *CODE CHAN AUTOSEARCH*). However, there is also the option of using predefined channel tables and taking the code domain analysis as a basis. To do this, select the channel table and enable the predefined search mode (softkey *CODE CHAN PREDEFINED*). As an example or basis for customer-specific channel tables, some tables have been defined already. They are listed below. With redefined channel tables, it is assumed that the signals needing to be investigated have the same configuration in each slot (known as 1 slot signals). Should channels other than those that appear in the predefined channel tables of the firmware application be used, the original tables should be copied and the channels adapted in the copy. (Refer to the hot key *CHAN CONF* on page 79.)

Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type QPSK in channel type DATA and the following listed active codes in channel types.  
(File name DOQPSK.)

Table 4-1 Base station channel table DOQPSK with QPSK modulation in DATA area

Channel type	Number of channels	Code channel (Walsh Code.SF)	Modulation/mapping
PILOT	1	0.32	BPSK-I
MAC	5	2.64 (RA) 3.64 4.64 34.64 35.64	BPSK-I BPSK-I BPSK-I BPSK-Q BPSK-Q
PREAMBLE 64 chips long	1	3.32	BPSK-I
DATA	16	0.16 1.16 2.16 ... 13.16 14.16 15.16	QPSK QPSK QPSK ... QPSK QPSK QPSK

Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type 8-PSK in channel type DATA and the following listed active codes in channel types.  
(File name DO8PSK.)

Table 4-2 Base station channel table DO8PSK with 8-PSK modulation in DATA area

Channel type	Number of channels	Code channel (Walsh Code.SF)	Modulation/mapping
PILOT	1	0.32	BPSK-I
MAC	5	2.64 (RA) 3.64 4.64 34.64 35.64	BPSK-I BPSK-I BPSK-I BPSK-Q BPSK-Q
PREAMBLE 64 chips long	1	3.32	BPSK-I
DATA	16	0.16 1.16 2.16 ... 13.16 14.16 15.16	8-PSK 8-PSK 8-PSK ... 8-PSK 8-PSK 8-PSK

Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type 16-QAM in channel type DATA and the following listed active codes in channel types.  
(File name DO16QAM.)

Table 4-3 Base station channel table with 16-QAM modulation in DATA area

Channel type	Number of channels	Code channel (Walsh Code.SF)	Modulation/mapping
PILOT	1	0.32	BPSK-I
MAC	5	2.64 (RA) 3.64 4.64 34.64 35.64	BPSK-I BPSK-I BPSK-I BPSK-Q BPSK-Q
PREAMBLE 64 chips long	1	3.32	BPSK-I
DATA	16	0.16 1.16 2.16 ... 13.16 14.16 15.16	16-QAM 16-QAM 16-QAM ... 16-QAM 16-QAM 16-QAM

Channel table with channel types PILOT/MAC – known as IDLE slot, since it does not contain any active channels in the DATA channel type.  
(File name DO\_IDLE.)

Table 4-4 Base station test model DO\_IDLE for idle slot configuration

Channel type	Number of channels	Code channel (Walsh Code.SF)	Modulation/mapping
PILOT	1	0.32	BPSK-I
MAC	1	2.64 (RA)	BPSK-I

For further information on the channel table defaults refer to HOT KEY *CHAN CONF*.

The channel abbreviations are defined in Chapter 10, "Glossary".

## 5 Menu Overview

Application Firmware R&S FS-K84 (1xEV-DO base station tests) adds RF measurements and code domain power measurements for the 1xEV-DO Forward Link mobile radio standard to the analyzer.

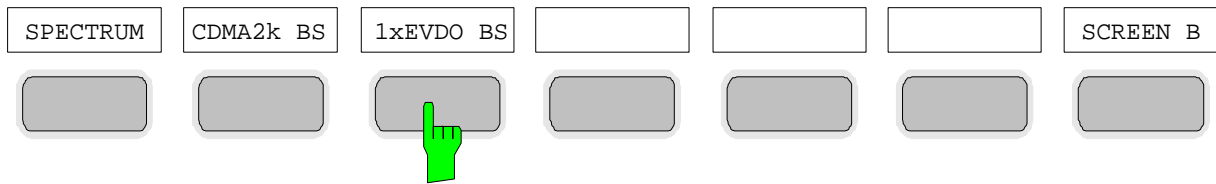


Fig. 5-1 Hot key bar with enabled Application Firmware R&S FS-K82 and R&S FS-K84

After the application firmware has been called by operating hot key **1xEVDO BS** a new hot key bar is displayed at the bottom edge of the screen and the code domain analyzer is selected and started.

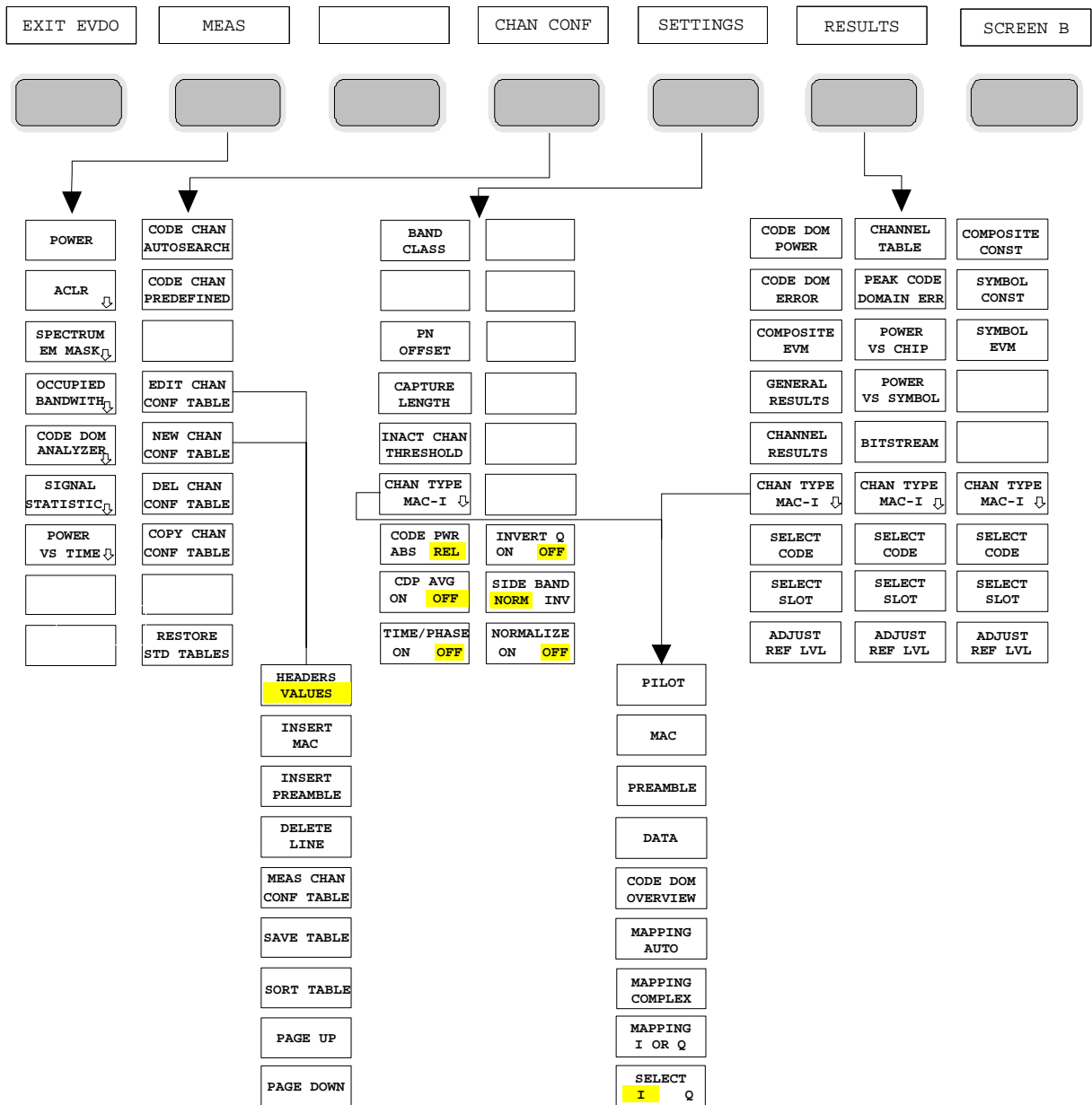


Fig. 5-2 Overview of the menus in Application Firmware R&S FS-K84

There are different analyses for the code domain analyzer. They can be selected by means of the *RESULTS* hot key. The *SETTINGS* hot key allows the application firmware to be parameterized. The PN offset of the base station or the band class can be set on this menu, for example. The *CHAN CONF* hot key is used to set Channel Search mode for the code domain analyzer. Furthermore, the customer can also define his own channel tables.

The MEAS hot key is identical to the MEAS key (on the right of the front panel) and is used to select the different RF measurements or the code domain analyzer.

Selection of the *CHAN CONF* or *RESULTS* hot key automatically results in switching to the code domain analyzer.

Pressing the **EXIT EVDO** hot key once exits R&S FS-K84. The hot key bar of the basic device is displayed again and the analyzer goes to SPECTRUM, the default mode.

#### Transition from the SPECTRUM operating mode to the application firmware:

The following user-specific settings are not modified so that the adaptation to the device under test is retained:

- Reference Level + Rev Level Offset
- Center Frequency + Frequency Offset
- Input Attenuation + Mixer Level

The following user-specific settings are transferred as follows:

- External trigger sources are retained, while all other trigger sources result in Free Run mode.
- Additional trigger settings are retained.

#### Transition from the application firmware to the SPECTRUM operating mode:

The following user-specific settings are not modified so that the adaptation to the device under test is retained:

- Reference Level + Rev Level Offset
- Center Frequency + Frequency Offset
- Input Attenuation + Mixer Level

The following user-specific settings are transferred as follows:

- The trigger source is switched to FREE RUN and an analyzer frequency sweep is set with the SPAN equal to the double center frequency, or the maximum possible span, so that the center frequency remains unchanged at any event.

The measurements available in R&S FS-K84 can be selected by means of the *MEAS* hot key or the *MEAS* key:

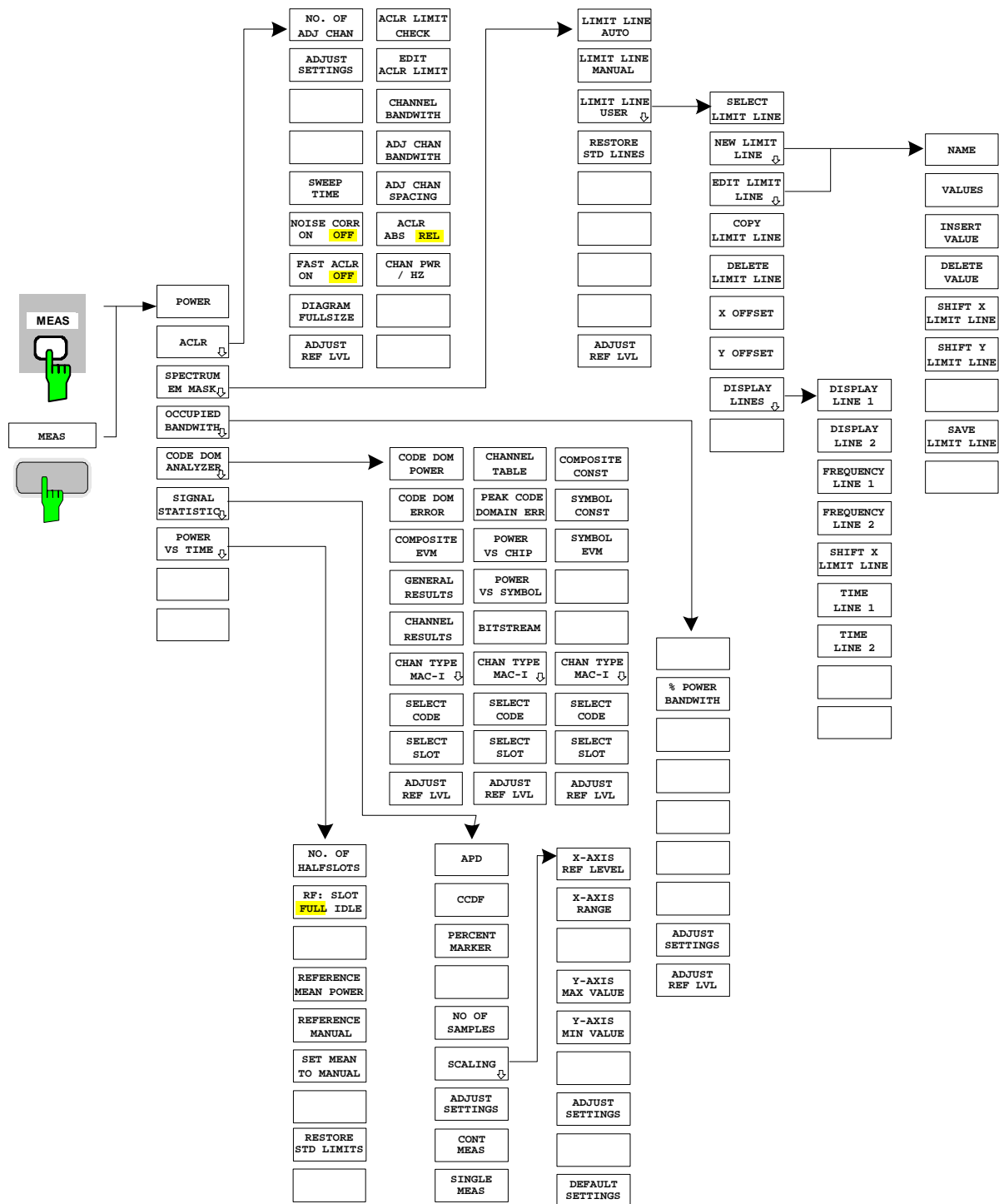


Fig. 5-3 Overview of menus

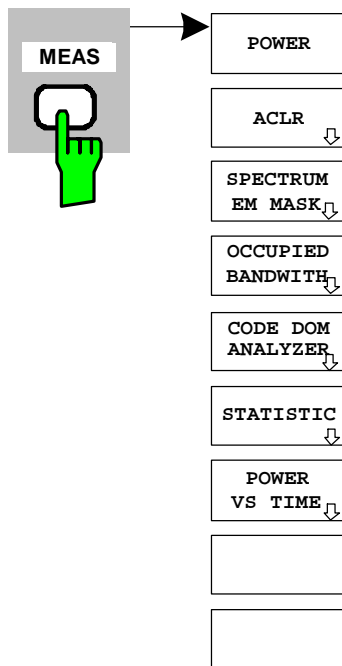
## 6 Configuration of 1xEV-DO Measurements

The most important measurements of the 1xEV-DO specification for base stations can be selected by means of the *MEAS* hot key and *MEAS* key. They will be explained below on the basis of the softkey functions.

The *CODE DOM ANALYZER* softkey activates the code domain analyzer and guides the user to the submenus for selection of the analysis. Changing the assignment of the hot key bar during transition to the application ensures that the most important parameters of the code domain analyzer can be directly accessed on the hot key bar.

The *POWER*, *ACLR*, *SPECTRUM EM MASK*, *OCCUPIED BANDWIDTH*, and *STATISTICS* softkeys activate base station measurements with predefined settings, which are performed in *SPECTRUM* mode of the basic device. The measurements are performed with the parameters contained in the 1xEV-DO specification. The settings can be modified later.

*MEAS* key or *MEAS* hot keys



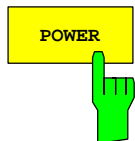
The *MEAS* hot key or the *MEAS* key opens a submenu for selecting the measurements:

- *POWER* enables the channel power measurement with defined default values in *SPECTRUM* mode.
- *ACLR* enables the adjacent channel power measurement with defined default values in *SPECTRUM* mode.
- *SPECTRUM EM MASK* compares the signal power in different offset ranges of the carrier with the maximum values laid down in the 1xEV-DO specification.
- *OCCUPIED BANDWIDTH* enables measurement of the bandwidth assigned to the signal.
- *CODE DOM ANALYZER* enables the code domain analyzer and opens another menu for choosing the analysis type. All other menus of the analyzer are adapted to the functions of the code domain analyzer mode. The code domain analyzer is described in a separate chapter starting on page 57.
- *STATISTICS* analyzes the signal with regard to its statistical characteristics (distribution function of the signal amplitudes).
- *POWER VS TIME* activates the measurement of power versus time for *FULL* or *IDLE* slot signals.



### Measuring channel power

MEAS key or MEAS hot key



The *POWER* softkey enables measurement of the channel power of the 1xEV-DO signal.

The analyzer measures the RF signal power in the 1.2288 MHz bandwidth. The power is calculated by summation of the values at the trace points. The bandwidth and the associated channel power are displayed beneath the measurement screen.

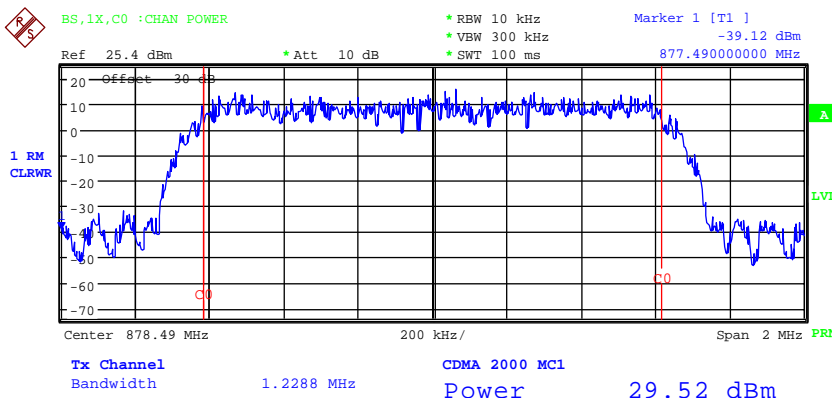


Fig. 6-1 Power measurement in the 1.2288 MHz transmission channel

The softkey enables SPECTRUM mode with defined settings:

The following user-specific settings are not modified on the first access following presetting: Level parameters Center Frequency + Frequency Offset All trigger settings	
ADJACENT CHAN POWER	ON
ACP STANDARD	CDMA2000 MC1 (MC1 simply stands for multi carrier, i.e. a carrier)
NO OF ADJ CHANNELS	0 (main channel only)
FREQUENCY SPAN	2 MHz

Departing from these settings, the analyzer can be operated in many functions featured in SPECTRUM mode, i.e. measurement parameters can be adapted to the requirements of the specific measurement.

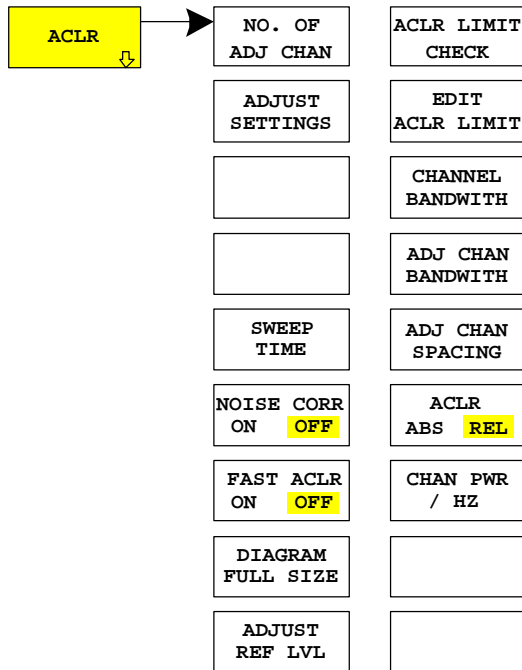
To restore adapted measurement parameters, the following parameters are saved on exiting and are set again on <u>re-entering</u> this measurement: Level parameters RBW, VBW Sweep time Trigger settings	
--	--

IEC bus command: :CONFigure:CDPower:MEASurement Power

Query of results: :CALCulate:MARKer:FUNction:Power:RESult? CPower

### Measuring adjacent channel power - ACLR

MEAS key or MEAS hot key



The ACLR (Adjacent Channel Leakage Power Ratio) softkey enables measurement of the adjacent channel power. The settings and limit values are taken from the spurious measurement defined in the 1xEV-DO specification.

The analyzer measures the power of the useful channel and of the adjacent channels on the left and right sides. At the default setting, only two adjacent channels are taken into account. Measurement results are displayed beneath the measurement screen.

The limits depend on the band class setting (*BAND CLASS* softkey).

The ACLR limit check can be enabled or disabled by means of the *ACLR LIMIT CHECK* softkey.

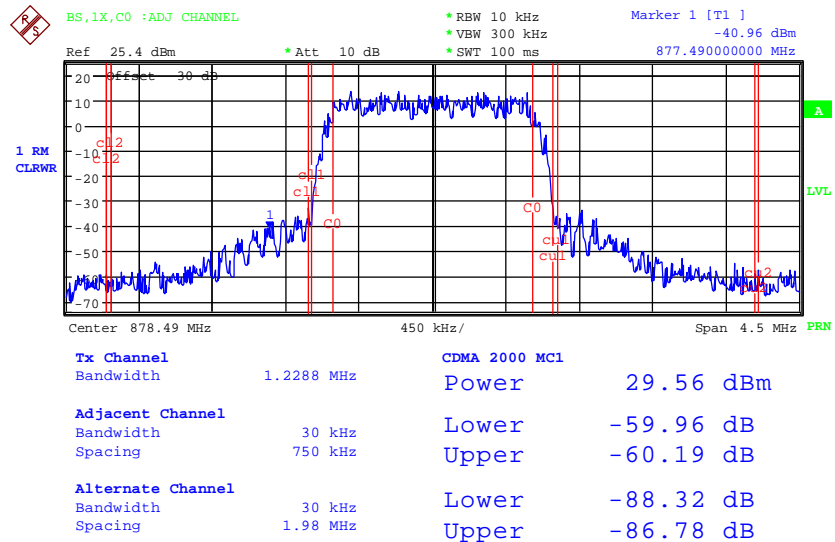


Fig. 6-2 Measuring adjacent channel power

The softkey enables SPECTRUM mode with defined settings:

The following user-specific settings are not modified on the first access following presetting: Level parameters Center Frequency + Frequency Offset All trigger settings	
ADJACENT CHAN POWER	ON
ACP STANDARD	CDMA2000 MC1
NO OF ADJ. CHANNELS	2

Table 6-1 ACLR settings for band classes 0, 2, 3, 5, 9, 10, 11, 12

Adjacent channel type	Spacing	RBW	Rel. Limit	Abs. Limit
Adjacent	750 kHz	30 kHz	-45 dBc	none
Alternate	1.98 MHz	30 kHz	-60 dBc	-27 dBm
Alternate2	4.00 MHz	30 kHz	-60 dBc	-27 dBm

Table 6-2 ACLR settings for band class 7

Adjacent channel type	Spacing	RBW	Rel. Limit	Abs. Limit
Adjacent	750 kHz	30 kHz	-45 dBc	none
Alternate	1.98 MHz	30 kHz	-60 dBc	-27 dBm
Alternate2	4.00 MHz	30 kHz	none	-39.2 dBm

Table 6-3 ACLR settings for band classes 1, 4 and 8

Adjacent channel type	Spacing	RBW	Rel. Limit	Abs. Limit
Adjacent	885 kHz	30 kHz	-45 dBc	none
Alternate	1.25 MHz	30 kHz	-45 dBc	-9 dBm
Alternate2	1.98 MHz	30 kHz	-55 dBc	-22 dBm

Table 6-4 ACLR settings for band class 6

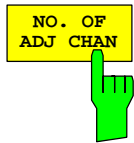
Adjacent channel type	Spacing	RBW	Rel. Limit	Abs. Limit
Adjacent	885 kHz	30 kHz	-45 dBc	none
Alternate	1.25 MHz	30 kHz	none	-13 dBm
Alternate2	1.45 MHz	30 kHz	none	-13 dBm

Departing from these settings, the analyzer can be operated in many functions featured in SPECTRUM mode, i.e. measurement parameters can be adapted to the requirements of the specific measurement.

To restore adapted measurement parameters, the following parameters are saved on exiting and are set again on <u>re-entering</u> this measurement: Level parameters RBW, VBW Sweep time SPAN NO OF ADJ. CHANNELS FAST ACLR MODUS Trigger settings
--

IEC bus command: :CONFigure:CDPower:MEASurement ACLR

Query of results: :CALCulate:MARKer:FUNCTion:POWer:RESult? ACPower



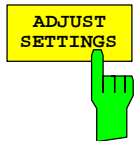
The *NO. OF ADJ CHAN* softkey enables input of the number  $\pm n$  of adjacent channels which are taken into account for the adjacent channel power measurement.

0 to 3 can be entered.

The following measurements are performed depending on the number of channels.

- 0 Only the channel power is measured.
- 1 The channel power and the power of the upper and lower adjacent channel are measured.
- 2 The channel power, the power of the upper and lower adjacent channel and of the next upper and lower channel (alternate channel 1) are measured.
- 3 The channel power, the power of the upper and lower adjacent channel, the next higher and lower channel (alternate channel 1) and the next but one higher and lower channel (alternate channel 2) are measured.

IEC bus command: `:SENS:POW:ACH:ACP 2`



The *ADJUST SETTINGS* softkey automatically optimizes the settings of the analyzer for the selected power measurement.

All the analyzer settings relevant to power measurement within a specific frequency range (channel bandwidth) are then optimally set as a function of the channel configuration (channel bandwidth, channel spacing):

- Frequency span:  
The frequency span must include all the channels to be analyzed as a minimum.  
The double channel bandwidth is set as the span for measuring the channel power.  
The span setting depends for adjacent channel power measurement on the channel spacing and the channel bandwidth of the adjacent channel ADJ, ALT1 or ALT2 farthest away from the transmission channel.
- Resolution bandwidth  $RBW \leq 1/40$  of channel bandwidth
- Video bandwidth  $VBW \geq 3 \times RBW$
- Detector RMS detector

The trace mathematics and the trace averaging are disabled.  
The reference level is not affected by *ADJUST SETTINGS*. It has to be set separately by means of *ADJUST REF LVL*.

Adjustment is performed once; if necessary, the device settings can be changed again later.

IEC bus command: `:SENS:POW:ACH:PRES ACP|CPOW|OBW`

With manual setting of the measurement parameters deviating from that performed with *ADJUST SETTINGS*, the following must be borne in mind for the different parameters:

**Frequency span**                      The frequency span must include at least all the channels needing to be measured.  
This is the channel bandwidth when channel power is measured.  
If the frequency span is large compared with the analyzed frequency section (or frequency sections), only a few pixels on the trace are available for the measurement.

**Resolution bandwidth (RBW)**      To ensure an acceptable measurement speed and also the necessary selection (for inhibiting spectral components outside the channel you want to measure, especially the adjacent channels), the resolution bandwidth must be selected so that it is neither too small nor too large. As a rule of thumb, the resolution bandwidth has to be set to values between 1% and 4% of the channel bandwidth. A larger resolution bandwidth can be set when the spectrum within and around the channel to be measured has an even characteristic.

**Video bandwidth (VBW)**            For a correct power measurement, the video signal must not be limited in terms of bandwidth. A band limitation of the logarithmic video signal would result in averaging and thus in a display of the power that would be too low (-2,51 dB at very small video bandwidth). The video bandwidth must therefore be at least three times higher than the resolution bandwidth.

The *ADJUST SETTINGS* softkey sets the video bandwidth (VBW) as a function of the channel bandwidth as follows:

$$VBW \geq 3 \times RBW.$$

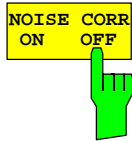
**Detector**                                The *ADJUST SETTINGS* softkey selects the RMS detector.  
The RMS detector is selected because it always indicates the power correctly, irrespective of the characteristics of the signal you want to measure. Generally speaking, the sample detector would also be possible. However, it results in unstable results by virtue of the limited number of trace pixels for calculation of the power in the channel. An averaging, which is often performed to stabilize the measurement results, produces a level display that is too low and must therefore be avoided. The lower level display depends on the number of averagings and the signal characteristic in the channel needing to be measured.



The *SWEEP TIME* softkey enables entry of the sweep time. A longer sweep time results in more stable measurement results with the RMS detector.

This setting is identical to the *SWEEP TIME MANUAL* on the *BW* menu.

IEC bus command:     :SWE:TIME <value>



The NOISE CORR ON/OFF softkey enables correction of the measurement results by the background noise of the device, thus raising the dynamic range.

When the function is enabled, a reference measurement of the background noise on the device is performed first. The measured noise power is then subtracted from the power in the channel being analyzed. The background noise of the device depends on the selected center frequency, resolution bandwidth and level setting. The correction is therefore switched every time these settings are changed, and a corresponding message is displayed on the monitor.

To switch the background noise correction with the modified setting back on, the softkey must be pressed again. The reference measurement is then performed again.

IEC bus command:       :SENS:POW:NCOR ON



The FAST ACLR softkey toggles between measurement by the IBW method (FAST ACLR OFF) and the time domain method (FAST ACLR ON).

With *FAST ACLR ON*, the power measurement is performed in the different channels in the time domain. The analyzer adjusts its center frequency in succession to the different channel center frequencies and measures the power with the set measuring time (i.e. sweep time/number of measured channels). The suitable RBW filters for the selected standard and frequency offset are used automatically.

The RMS detector is used for correct power measurement. This means that software correction factors are not necessary.

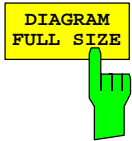
Measure values are displayed in a table, the power in the useful channel being output in dBm and the power in the adjacent channels in dBm (*ACLR ABS*) or dB (*ACLR REL*).

Selection of the sweep time (= measurement time) depends on the required reproducibility of the measurement results. The longer the selected sweep time, the more reproducible the measurement results will be, since the power measurement is then performed over a longer time.

As a rule of thumb, it can be assumed for a reproducibility of 0.5 dB (99% of the measurements are within 0.5 dB of the true measured value) that approximately 500 uncorrelated measured values are necessary (applies to white noise). The measured values are assumed to be uncorrelated when their spacing in time corresponds to the reciprocal value of the measurement bandwidth (= 1/BW).

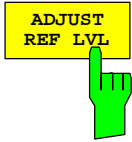
With 1xEV-DO the measurement bandwidth is 10 kHz, i.e. measured values at an interval of 10  $\mu$ s are assumed to be uncorrelated. Thus a measurement time (sweep time) of 50 ms per channel is required for 500 measured values. This is the default sweep time which the analyzer sets in coupled mode. Approximately 5000 measured values (i.e. the measurement time has to be extended to 500 ms) are required for a reproducibility of 0.1 dB (99% of all measurements are within 0.1 dB of the true measured values).

IEC bus command:       :SENS:POW:HSP ON



The *DIAGRAM FULL SIZE* softkey switches the diagram to full screen size.

IEC bus command: -



The *ADJUST REF LVL* softkey adjusts the reference level of the analyzer to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without the analyzer being overloaded or the dynamic response being limited by too low a signal-to-noise ratio. Since the measurement bandwidth is distinctly narrower for power channel measurements than the signal bandwidth, the signal branch can be overloaded, even though the trace is still well below the reference level.

IEC bus command: :SENS:POW:ACH:PRES:RLEV



The *ACLR LIMIT CHECK* softkey enables and disables the limit check for the ACLR measurement .

IEC bus command: :CALC:LIM:ACP ON  
:CALC:LIM:ACP:ACH:RES?  
:CALC:LIM:ACP:ALT:RES?



The default settings of limits are defined at the start of the adjacent channel power measurement as a function of the selected band class (refer to the *BAND CLASS* softkey), as in the tables on page 33. Similarly, the values in these tables are restored on a change of band class. After the band class has been selected, a table can be opened in the ACLR measurement, however, by means of the *EDIT ACLR LIMITS* softkey and the limits for the ACLR measurement can be modified in the table..

ACP LIMITS				
CHAN	RELATIVE LIMIT CHECK		ABSOLUTE LIMIT CHECK	
	VALUE	ON	VALUE	ON
ADJ	-45 dBc	*	0 dBm	
ALT1	-60 dBc	*	-27 dBm	
ALT2	-60 dBc	*	-27 dBm	*

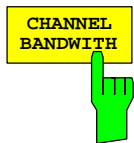
The following rules apply to limits:

- A separate limit can be defined for each of the adjacent channels. The limit applies simultaneously to the lower and upper adjacent channels.
- A relative limit and/or an absolute limit can be defined. Checks of both limits can be enabled independently of each other.
- Compliance with the active limits is checked independently of whether the limits are absolute or relative and whether the measurement itself is performed at absolute levels or at relative signal intervals. If both checks are active and if the higher of the two limits has been exceeded, the measured value concerned is identified.

**Note:** *Measured values which violate the limit are preceded by an asterisk and identified in red.*

IEC bus command:

```
:CALC:LIM:ACP ON
:CALC:LIM:ACP:ACH 0dB,0dB
:CALC:LIM:ACP:ACH:STAT ON
:CALC:LIM:ACP:ACH:ABS -10dBm,-10dBm
:CALC:LIM:ACP:ACH:ABS:STAT ON
:CALC:LIM:ACP:ALT1 0dB,0dB
:CALC:LIM:ACP:ALT1:STAT ON
:CALC:LIM:ACP:ALT1:ABS -10dBm,-10dBm
:CALC:LIM:ACP:ALT1:ABS:STAT ON
:CALC:LIM:ACP:ALT2 0dB,0dB
:CALC:LIM:ACP:ALT2:STAT ON
:CALC:LIM:ACP:ALT2:ABS -10dBm,-10dBm
:CALC:LIM:ACP:ALT2:ABS:STAT ON
```



The CHANNEL BANDWIDTH softkey enables entry of the channel bandwidth for the transmission channel.

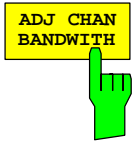
The useful channel bandwidth is normally determined by the transmission procedure. With 1xEV-DO measurements are performed at the default setting with a channel bandwidth of 1.2288 MHz.

When measuring by the IBW method (*FAST ACLR OFF*), the channel bandwidth is represented on the screen by two vertical lines to the left and right of the center of the screen. This allows visual inspection of whether the whole power of the signal being measured is within the selected channel bandwidth.

With the time domain method (*FAST ACLR ON*), the measurement is performed in zero span and the channel limits are not identified in this instance. The analyzer provides all available channel filters for selection of the channel bandwidth entry. Channel bandwidths that deviate from this cannot be set. Should deviating channel bandwidths be necessary, perform the measurement by the IBW method.

IEC bus command:     :SENS:POW:ACH:BWID 1.2288MHz





The ADJ CHAN BANDWIDTH softkey opens a table for defining the channel bandwidths for the adjacent channels.

ACP CHANNEL BW	
CHAN	BANDWIDTH
ADJ	30 kHz
ALT1	30 kHz
ALT2	30 kHz

When measuring by the IBW method (FAST ACLR OFF), the bandwidths of the different adjacent channels have to be entered numerically. Since it is common for all adjacent channels to have the same bandwidth, the other channels Alt1 and Alt2 are set to the bandwidth of the adjacent channel when the adjacent channel bandwidth (ADJ) is entered. Thus only one value needs to be entered in the case of equal adjacent channel bandwidths. The procedure is the same for the Alt2 channels (Alternate Channels 2) when the bandwidth of the Alt1 channel (Alternate Channel 1) is entered.

**Note:** The bandwidths can be set independently of each other by overwriting the table from top to bottom.

With the time domain method (FAST ACLR ON), the adjacent channel bandwidths are selected from the list of available channel filters. Use the IBW method for adjacent channel bandwidths that deviate from this.

```
IEC bus command:  :SENS:POW:ACH:BWID:ACH 30kHz
                  :SENS:POW:ACH:BWID:ALT1 30kHz
                  :SENS:POW:ACH:BWID:ALT2 30kHz
```

The ADJ CHAN SPACING softkey opens a table for defining the channel spacings.

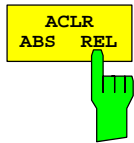


CHANNEL SPACING	
CHAN	SPACING
ADJ	750 kHz
ALT1	1.98 MHz
ALT2	4.00 MHz

Since the adjacent channels frequently have the same spacing from each other, channel ALT1 and channel ALT2 are set to twice and three times the channel spacing of the adjacent channel, respectively, when the adjacent channel spacing (ADJ) is entered. Thus only one value needs to be entered in the case of identical channel spacings. The procedure for Alt2 channels is similar when the bandwidth of the Alt1 channel is entered.

**Note:** The channel spacings can be set independently of each other by overwriting the table from top to bottom.

```
IEC bus command:  :SENS:POW:ACH:SPAC:ACH 750kHz
                  :SENS:POW:ACH:SPAC:ALT1 1.98MHz
                  :SENS:POW:ACH:SPAC:ALT2 4MHz
```



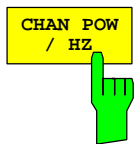
The ACLR ABS/REL softkey (channel power absolute/relative) toggles between absolute and relative measurement of the power in the channel.

**ACLR ABS** The absolute value of the power in the transmission channel and the adjacent channels is displayed in the unit of the Y axis such as dBm or dBμV.

**ACLR REL** In the case of adjacent channel power measurement (*NO. OF ADJ CHAN* > 0), the level of the adjacent channels is displayed relative to the level of the transmission channel in dBc.

With linear scaling of the Y axis, the relative power ( $CP/CP_{ref}$ ) of the new channel to the reference channel is displayed. With dB scaling, the logarithmic ratio  $10 \cdot \lg(CP/CP_{ref})$  is displayed. This means that the relative channel power measurement can also be used for universal adjacent channel power. In this instance each channel is measured separately.

IEC bus command: :SENS:POW:ACH:MODE ABS



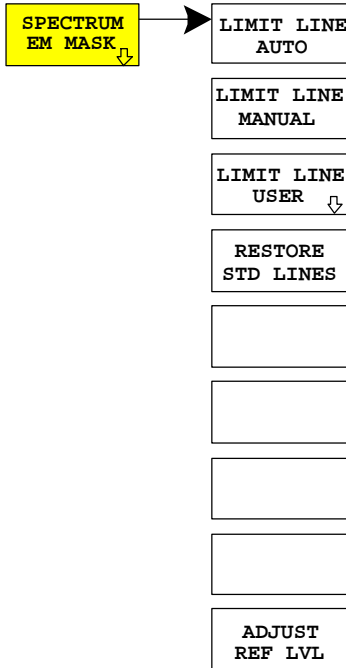
The *CHAN POW / HZ* softkey toggles between measurement of the total power in the channel and measurement of the power in the channel referred to 1 Hz of bandwidth .

The conversion factor is  $10 \cdot \lg \frac{1}{\text{Channel} \cdot \text{Bandwidth}}$  .

IEC bus command: :CALC:MARK:FUNC:POW:RES:PHZ ON | OFF

Signal power check – SPECTRUM EM MASK

MEAS key or MEAS hot key



The *SPECTRUM EM MASK* (Spectrum Emission Mask) softkey starts determination of the 1xEV-DO signal power at defined offsets from the carrier and compares the power values with that of the spurious emission mask called for in the 1xEV-DO specification, in the carrier-oriented range between -4 MHz and 4 MHz.

The limits depend on the band class setting (*BAND CLASS* softkey).

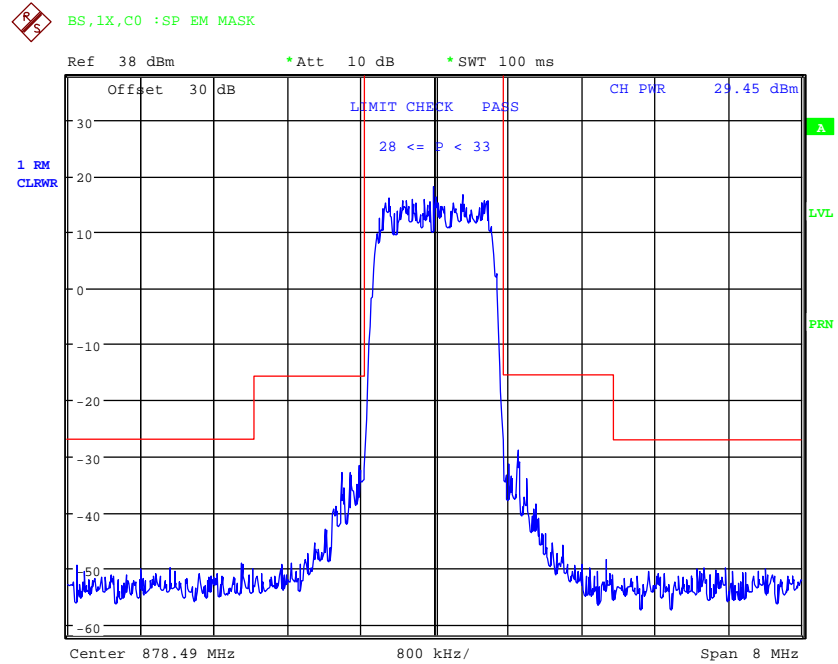


Fig. 6-3 Measuring the spectrum emission mask

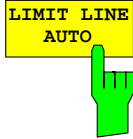
The softkey enables SPECTRUM mode with defined settings:

The following user-specific settings are not modified on the first access following presetting: Level parameters Center Frequency + Frequency Offset All trigger settings	
ADJACENT CHAN POWER	ON
ACP STANDARD	CDMA2000 MC1
NO OF ADJ. CHANNELS	0
FREQUENCY SPAN	8 MHz
SWEEP TIME	100 ms
DETECTOR	RMS

Departing from these settings, the analyzer can be operated in many functions featured in SPECTRUM mode. Changes to the RBW and VBW are limited, because they are specified by definition of the limits.

To restore adapted measurement parameters, the following parameters are saved on exiting and are set again on <u>re-entering</u> this measurement: Level parameters Sweep time SPAN Trigger settings	
--	--

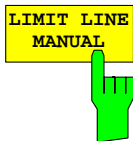
IEC bus command: :CONFigure:CKPower:MEASurement ESpectrum  
 Query of results: :CALCulate:LIMit:FAIL? and visual evaluation



The LIMIT LINE AUTO softkey automatically selects the limit line for checking after the power in the useful channel has been determined. If the measurement is performed in *CONTINUOUS SWEEP* and if the channel power varies from sweep to sweep, it can result in continuous replotting of the limit line.

The softkey is activated on entering the spectrum emission mask measurement.

IEC bus command: :CALC:LIM:ESP:MODE AUTO



The LIMIT LINE MANUAL softkey gives you an opportunity to select the limit line manually. If this softkey is selected, the channel power measurement is not used for selecting the limit line but for determining its relative components. The power for the different frequency offsets is compared with the limit line specified by the user.

The softkey opens a table containing all predefined limit lines on the device:

Name of limit line
P >= 33 dBm
28 dBm <= P < 33 dBm
P < 28 dBm

The name of the limit line specifies the range for the expected power, for which the limit line was defined.

IEC bus command: :CALC:LIM:ESP:MODE MANuAl  
 :CALC:LIM:ESP:VALue 28  
 'selects line 28 dBm <= P < 33 dBm

The definition of the limit line names is described at the *LIMIT LINE USER* softkey.

Table 6-5 Band classes 0, 2, 3, 5, 9, 10, 11, 12 for carrier power  $P < 28$  dBm

Offset frequency	Limit	Type/name DOB0CR	RBW
-4.00 MHz	-55 dBc	relative to carrier power	30 kHz
-1.98 MHz	-55 dBc	relative to carrier power	30 kHz
-1.98 MHz	-45 dBc	relative to carrier power	30 kHz
-750 kHz	-45 dBc	relative to carrier power	30 kHz
+750 kHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-55 dBc	relative to carrier power	30 kHz
+4.00 MHz	-55 dBc	relative to carrier power	30 kHz

Table 6-6 Band classes 0, 2, 3, 5, 9, 10, 11, 12 for carrier power  $28$  dBm  $\leq P < 33$  dBm

Offset frequency	Limit	Type/name DOB0BA and DOB0BR	RBW
-4.00 MHz	-27 dBm	absolute	30 kHz
-1.98 MHz	-27 dBm	absolute	30 kHz
-1.98 MHz	-45 dBc	relative to carrier power	30 kHz
-750 kHz	-45 dBc	relative to carrier power	30 kHz
+750 kHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-27 dBm	absolute	30 kHz
+4.00 MHz	-27 dBm	absolute	30 kHz

Table 6-7 Band classes 0, 2, 3, 5, 9, 10, 11, 12 for carrier power  $P \geq 33$  dBm

Offset frequency	Limit	Type/name DOB0AR	RBW
-4.00 MHz	-60 dBc	relative to carrier power	30 kHz
-1.98 MHz	-60 dBc	relative to carrier power	30 kHz
-1.98 MHz	-45 dBc	relative to carrier power	30 kHz
-750 kHz	-45 dBc	relative to carrier power	30 kHz
+750 kHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-60 dBc	relative to carrier power	30 kHz
+4.00 MHz	-60 dBc	relative to carrier power	30 kHz

The limits for band class 7 are derived from band class 0, but a -46 dBm/6.25 kHz limit is defined additionally between 3.25 MHz and 4 MHz. This limit is raised by 6.8 dB so that 30 kHz filters can be measured with the resolution filter. More power is "seen" in it,  $10 \log 30 \text{ kHz} - 10 \log 6.25 \text{ kHz} = 6.8 \text{ dB}$ . Accordingly the limit is  $-46 \text{ dBm} + 6.8 \text{ dB} = -39.2 \text{ dBm}$ .

Table 6-8 Band classes 7 for carrier power  $P < 28 \text{ dBm}$

Offset frequency	Limit	Type/name DOB7CA and DOB7R	RBW
-4.00 MHz	-39.2 dBm	absolute	30 kHz
-3.25 MHz	-39.2 dBm	absolute	30 kHz
-3.25 MHz	-55 dBc	relative to carrier power	30 kHz
-1.98 MHz	-55 dBc	relative to carrier power	30 kHz
-1.98 MHz	-45 dBc	relative to carrier power	30 kHz
-750 kHz	-45 dBc	relative to carrier power	30 kHz
+750 kHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-55 dBc	relative to carrier power	30 kHz
+3.25 MHz	-55 dBc	relative to carrier power	30 kHz
+3.25 MHz	-39.2 dBm	absolute	30 kHz
+4.00 MHz	-39.2 dBm	absolute	30 kHz

Table 6-9 Band classes 7 for carrier power  $28 \text{ dBm} \leq P < 33 \text{ dBm}$

Offset frequency	Limit	Type/name DOB7BA and DOB7BR	RBW
-4.00 MHz	-39.2 dBm	absolute	30 kHz
-3.25 MHz	-39.2 dBm	absolute	30 kHz
-3.25 MHz	-27 dBm	absolute	30 kHz
-1.98 MHz	-27 dBm	absolute	30 kHz
-1.98 MHz	-45 dBc	relative to carrier power	30 kHz
-750 kHz	-45 dBc	relative to carrier power	30 kHz
+750 kHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-27 dBm	absolute	30 kHz
+3.25 MHz	-27 dBm	absolute	30 kHz
+3.25 MHz	-39.2 dBm	absolute	30 kHz
+4.00 MHz	-39.2 dBm	absolute	30 kHz

Table 6-10 Band classes 7 for carrier power  $P \geq 33 \text{ dBm}$

Offset frequency	Limit	Type/name DOB7AA and DOB7AR	RBW
-4.00 MHz	-39.2 dBm	absolute	30 kHz
-3.25 MHz	-39.2 dBm	absolute	30 kHz
-3.25 MHz	-60 dBc	relative to carrier power	30 kHz
-1.98 MHz	-60 dBc	relative to carrier power	30 kHz
-1.98 MHz	-45 dBc	relative to carrier power	30 kHz
-750 kHz	-45 dBc	relative to carrier power	30 kHz
+750 kHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-45 dBc	relative to carrier power	30 kHz
+1.98 MHz	-60 dBc	relative to carrier power	30 kHz
+3.25 MHz	-60 dBc	relative to carrier power	30 kHz
+3.25 MHz	-39.2 dBm	absolute	30 kHz
+4.00 MHz	-39.2 dBm	absolute	30 kHz

The limits for band classes 1, 4 and 8 are defined by separate limits. RBW switching is necessary in this instance. The 1 MHz channel filter is used for the 1 MHz segments. The frequency range is divided into three sub-segments. The user's sweep time is distributed over the segments as follows (k = filter sweep rate factor):

Segment1: -4.00 ... -2.25 MHz RBW = 1 MHz k = 850 SWT1 = SWT \* 1/10  
 Segment2: -2.25 ... +2.25 MHz RBW = 30 kHz k = 2.5 SWT2 = SWT \* 8/10  
 Segment3: +2.25 ... 4.00 MHz RBW = 1 MHz k = 850 SWT3 = SWT \* 1/10

For larger spans, the sweep time is adjusted so that the three areas are swept at a constant filter sweep rate factor k.

For entering the limit "Stricter from" a check determines whether  $P - 45 \text{ dBc} > -9 \text{ dBm}$ . If this is the case, the measured value is compared with  $P - 45 \text{ dBc}$ , in all other cases with  $-9 \text{ dBm}$ .

Table 6-11 Band classes 1, 4 and 8 for carrier power  $P < 28 \text{ dBm}$

Offset frequency	Limit	Type/name DOB1CA and DOB1CR	RBW
-4.00 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-50 dBc	relative to carrier power	30 kHz
-1.98 MHz	-50 dBc	relative to carrier power	30 kHz
-1.98 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
-1.25 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
-1.25 MHz	-45 dBc	relative to carrier power	30 kHz
-885 kHz	-45 dBc	relative to carrier power	30 kHz
+885 kHz	-45 dBc	relative to carrier power	30 kHz
+1.25 MHz	-45 dBc	relative to carrier power	30 kHz
+1.25 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
+1.98 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
+1.98 MHz	-50 dBc	relative to carrier power	30 kHz
+2.25 MHz	-50 dBc	relative to carrier power	30 kHz
+2.25 MHz	-13 dBm	absolute	1 MHz
+4.00 MHz	-13 dBm	absolute	1 MHz

Table 6-12 Band classes 1, 4 and 8 for carrier power 28 dBm <= P < 33 dBm

Offset frequency	Limit	Type/name DOB1BA and DOB1BR	RBW
-4.00 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-22 dBm	absolute	30 kHz
-1.98 MHz	-22 dBm	absolute	30 kHz
-1.98 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
-1.25 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
-1.25 MHz	-45 dBc	relative to carrier power	30 kHz
-885 kHz	-45 dBc	relative to carrier power	30 kHz
+885 kHz	-45 dBc	relative to carrier power	30 kHz
+1.25 MHz	-45 dBc	relative to carrier power	30 kHz
+1.25 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
+1.98 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
+1.98 MHz	-22 dBm	absolute	30 kHz
+2.25 MHz	-22 dBm	absolute	30 kHz
+2.25 MHz	-13 dBm	absolute	1 MHz
+4.00 MHz	-13 dBm	absolute	1 MHz

Table 6-13 Band classes 1, 4 and 8 for carrier power P >= 33 dBm

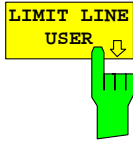
Offset frequency	Limit	Type/name DOB1AA and DOB1AR	RBW
-4.00 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-55 dBc	relative to carrier power	30 kHz
-1.98 MHz	-55 dBc	relative to carrier power	30 kHz
-1.98 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
-1.25 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
-1.25 MHz	-45 dBc	relative to carrier power	30 kHz
-885 kHz	-45 dBc	relative to carrier power	30 kHz
+885 kHz	-45 dBc	relative to carrier power	30 kHz
+1.25 MHz	-45 dBc	relative to carrier power	30 kHz
+1.25 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
+1.98 MHz	Stricter of: -45 dBc / -9 dBm	relative to carrier power/absolute	30 kHz
+1.98 MHz	-55 dBc	relative to carrier power	30 kHz
+2.25 MHz	-55 dBc	relative to carrier power	30 kHz
+2.25 MHz	-13 dBm	absolute	1 MHz
+4.00 MHz	-13 dBm	absolute	1 MHz



The limits for band class 6 are derived from the limits of band classes 1, 4 and 8. The difference is that there is no dependence on carrier power and there is a gradient between 1.45 and 2.25 MHz.

Table 6-14 Band class 6 for all carrier power values

Offset frequency	Limit	Type/name DOB6_A and DOB6_R	RBW
-4.00 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-13 dBm	absolute	1 MHz
-2.25 MHz	-26.6 dBm	absolute	30 kHz
-1.45 MHz	-13 dBm	absolute	30 kHz
-1.25 MHz	-13 dBm	absolute	30 kHz
-1.25 MHz	-45 dBc	relative to carrier power	30 kHz
-885 kHz	-45 dBc	relative to carrier power	30 kHz
+885 kHz	-45 dBc	relative to carrier power	30 kHz
-1.25 MHz	-45 dBc	relative to carrier power	30 kHz
-1.25 MHz	-13 dBm	absolute	30 kHz
-1.45 MHz	-13 dBm	absolute	30 kHz
-2.25 MHz	-26.6 dBm	absolute	30 kHz
-2.25 MHz	-13 dBm	absolute	1 MHz
-4.00 MHz	-13 dBm	absolute	1 MHz



The LIMIT LINE USER softkey enables input of user-defined limit lines. The softkey opens the menus of the limit line editor, which are known from the basic device. The limit lines created by the user are included in the table for *LIMIT LINE MANUAL*.

The following limit line settings are sensible for base station tests: Trace 1, Domain Frequency, X-Scaling Relative, Y-Scaling Absolute, Spacing linear, Unit dBm.

Unlike the default limit lines on the device when the analyzer is supplied from the factory that conform to the standard specifications, the user-specified limit line can be specified for the whole frequency range ( $\pm 4.0$  MHz from the carrier) only either relatively (referred to the reference level) or absolutely.

The supplied limit lines of AUTO and MANUAL modes can also be selected. The names are specified next to the type in the tables above and are defined as follows:

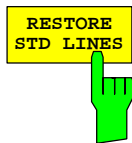
- 1) Standard in 2 characters
- 2) Link direction B for base station
- 3) Band class, the lowest digit being used in the case of more than one band class
- 4) Power classes A, B, C, where A is the highest power class and is not used for any power class dependency.
- 5) Type differentiation: A for absolute and R for relative

Example of 1xEV-DO band class 0, 2, 3, 5, 9, 10-12 for P<28 dBm:

```
DO      : 1xEV-DO
  B     : base station
    0   : lowest of band classes 0,2,3,5,9,10-12
    C   : lowest of the three power classes
    R   : relative line
=====
DOB0CR
```

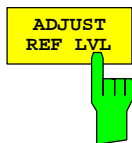
The limit line names are given in the above tables next to the type/name.

IEC bus command: refer to Table of Softkeys with Assignment of IEC Bus Commands



The RESTORE STD LINES softkey restores the limit lines defined in the standard to the state they were in when the device was supplied. In this way unintended overwriting of the standard lines can be undone.

IEC bus command: :CALC:LIM:ESP:RESTore



The ADJUST REF LVL softkey adjusts the reference level of the analyzer to the measured total signal power.

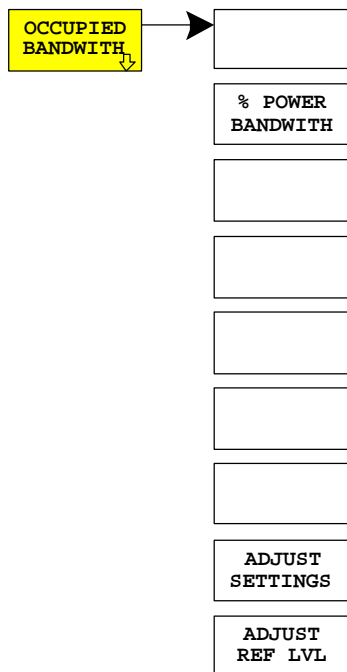
The softkey becomes active after the first sweep ends with measurement of the occupied bandwidth and thus the total power of the signal becomes known.

Adaptation of the reference level ensures that the signal path of the analyzer is not overloaded and the dynamic response is not restricted by a reference level that is too low.

IEC bus command: :SENS:POW:ACH:PRES:RLEV

### Measuring bandwidth occupied by the signal - OCCUPIED BANDWIDTH

MEAS key or MEAS hot key



The OCCUPIED BANDWIDTH softkey enables measurement of the bandwidth occupied by the signal.

This measurement determines the bandwidth in which - in the initial state - 99% of the signal power are to be found. The percentage of the signal power that has to be included in the bandwidth measurement can be modified. The bandwidth and the frequency markers for the measurement are displayed in the Marker Info field at the top right corner of the display.

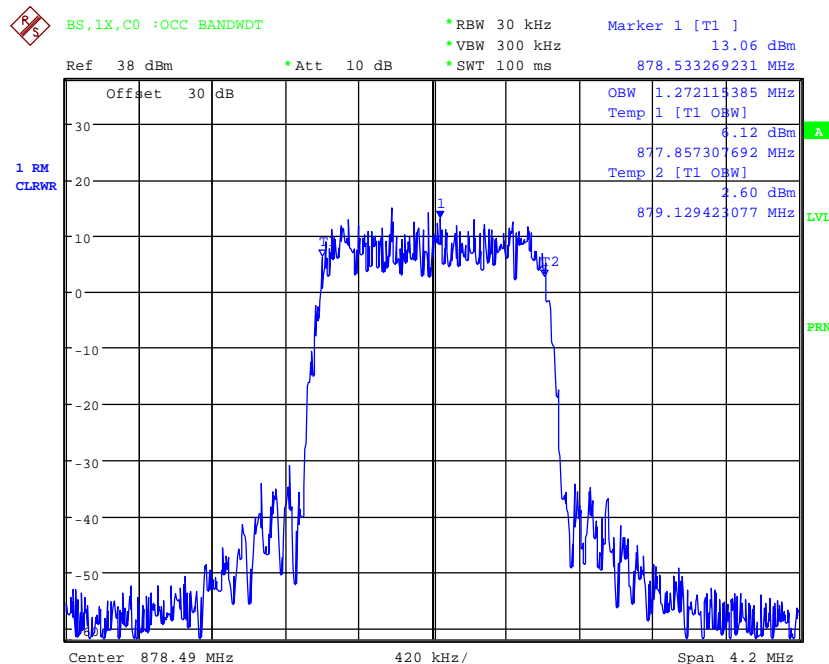


Fig. 6-4 Measuring occupied bandwidth

The softkey enables SPECTRUM mode with defined settings:

The following user-specific settings are not modified on the first access following presetting:

- Level parameters
- Center Frequency + Frequency Offset
- All trigger settings

OCCUPIED BANDWIDTH	ON
FREQUENCY SPAN	4.2 MHz
SWEEP TIME	100 ms
RBW	30 kHz
VBW	300 kHz
DETECTOR	RMS

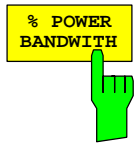
Departing from these settings, the analyzer can be operated in many functions featured in SPECTRUM mode, i.e. measurement parameters can be adapted to the requirements of the specific measurement.

To restore adapted measurement parameters, the following parameters are saved on exiting and are set again on re-entering this measurement:

- Level parameters
- RBW, VBW
- Sweep time
- SPAN
- Trigger settings

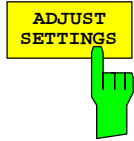
IEC bus command: :CONFIGure:CDPower:MEASurement OBANdwidth

Query of results: :CALCulate:MARKer:FUNctioN:POWer:RESult? OBANdwidth



The % POWER BANDWIDTH softkey opens a field for entering the percentage power referred to the total power in the displayed frequency range, by means of which the occupied bandwidth is defined (percentage of total power).  
The permissible range is 10% to 99.9%.

IEC bus command: `:SENS:POW:BWID 99PCT`



The ADJUST SETTINGS softkey adjusts the settings of the analyzer to the specified channel bandwidth for measurement of the occupied bandwidth.

All analyzer settings relevant for power measurement within a certain frequency range (channel bandwidth) such as:

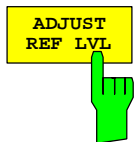
- Frequency span 3 x channel width
- Resolution bandwidth  $RBW \leq 1/40$  of channel bandwidth.
- Video bandwidth  $VBW \geq 3 \times RBW$ .
- Detector RMS

are optimized.

The reference level is not affected by *ADJUST SETTINGS*. It must be set for optimum dynamics so that the maximum signal is close to the reference level.

Adjustment is performed once only but, if necessary, the device settings can again be changed afterwards.

IEC bus command: `:SENS:POW:PRES OBW`



The ADJUST REF LVL softkey adjusts the reference level of the analyzer to the measured total signal power.

The softkey becomes active after the first sweep ends with measurement of the occupied bandwidth and thus the total power of the signal becomes known.

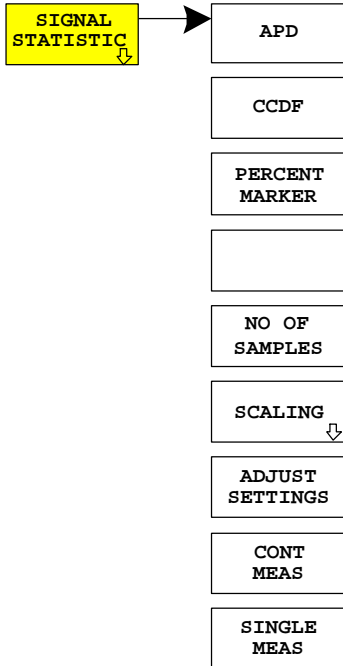
Adjustment of the reference level ensures that the signal path of the analyzer is not overloaded and the dynamic response is not restricted by a reference level that is too low.

Since the measurement bandwidth is distinctly narrower for power channel measurements than the signal bandwidth, the signal branch can be overloaded, even though the trace is still well below the reference level. When the measured channel power is identical to the reference level, the signal path is not overloaded.

IEC bus command: `:SENS:POW:ACH:PRES:RLEV`

Signal statistics

MEAS key or MEAS hot key



The STATISTICS softkey launches measurement of the distribution function of signal amplitudes (complementary cumulative distribution function). The measurement can be switched, using the menu softkey, to amplitude power distribution (APD).

For this measurement, a signal section of settable length is recorded continuously in the zero span and the distribution of the signal amplitudes is evaluated. The record length and the display range of the CCDF can be set using the softkeys of the menu. The amplitude distribution is plotted logarithmically as a percentage of the amount by which a certain level is exceeded, starting with the average value of the signal amplitudes.

In addition, the crest factor, i.e. the difference between the maximum value and the mean power, is output in dB.

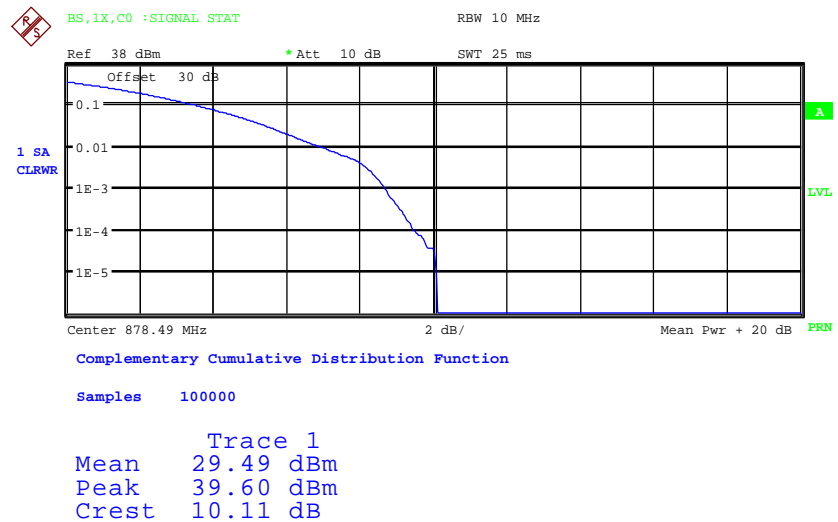


Fig. 6-5 CCDF of 1xEV-DO signal.

The softkey enables SPECTRUM mode with predefined settings:

The following user-specific settings are not modified so that the adaptation to the device under test is retained: Level parameters Center Frequency + Frequency Offset All trigger settings	
CCDF	ON
RBW	10 MHz
DETECTOR	SAMPLE

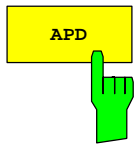
To restore adapted measurement parameters, the following parameters are saved on exiting and are set again on <u>re-entering</u> this measurement: Level parameters RBW NO OF SAMPLES Trigger settings	
--	--

Departing from these settings, the analyzer can be operated in many functions featured in SPECTRUM mode, i.e. measurement parameters can be adapted to the requirements of the specific measurement.

IEC bus command: :CONFigure:CDPower:MEASurement CCDF  
 or  
 :CALCulate:STATistics:CCDF ON

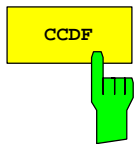
Query of results:

```
:CALCulate:MARKer:X?
:CALCulate:STATistics:RESults? MEAN |
                                PEAK |CFactor | ALL
MEAN  mean (RMS) measured power in dBm
      in the period of observation
PEAK  measured peak power in dBm
      in the period of observation
CFACtor determined CREST factor (i.e. ratio of
      peak power to mean power) in dB
ALL   Results of all three named
      measurements, separated by a comma:
      <mean pow>, <peak pow>, <crest factor>
```



The APD softkey enables the amplitude probability distribution function.

IEC bus command: :CALC:STAT:APD ON



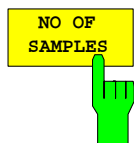
The CCDF softkey switches the complementary distribution function (complementary cumulative distribution function).

IEC bus command: :CALC:STAT:CCDF ON



When the CCDF function is enabled, the PERCENT MARKER softkey *supports* positioning of marker 1 by entering a sought probability. This means that the power that will be exceeded with a given degree of probability can be determined in a simple manner. If marker 1 is disabled, it is automatically enabled.

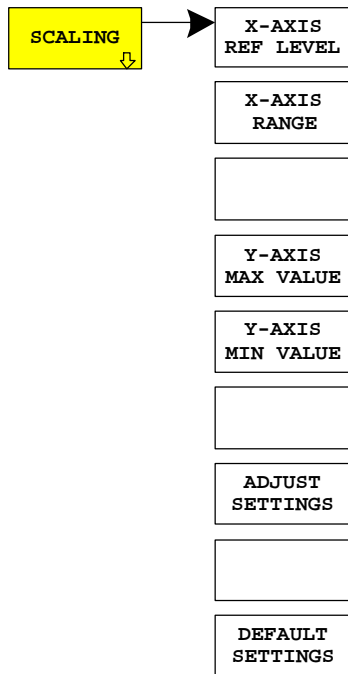
IEC bus command: :CALC:MARK:Y:PERC 0...100%



The NO OF SAMPLES softkey sets the number of power measurement values that have to be taken into account for the distribution measurement function.

**Note:** *The overall measurement time is influenced by the selected number of samples as well as by the resolution bandwidth selected for the measurement, since the resolution bandwidth directly affects the sampling rate.*

IEC bus command: :CALC:STAT:NSAM <value>



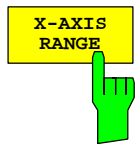
The SCALING softkey opens a menu on which the scaling parameters for the X axis and the Y axis can be modified.



The *X-AXIS REF LEVEL* softkey changes the level settings of the device and sets the maximum measurable power. The function is identical to that of the *REF LEVEL* softkey on the *AMPT* menu.

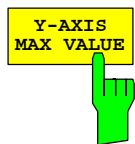
This value is mapped to the right diagram border for the *APD* function. For the *CCDF* function, this value is not directly represented in the diagram because the X axis is scaled relative to the measured *MEAN POWER*.

IEC bus command: `:CALC:STAT:SCAL:X:RLEV <value>`



The *X-AXIS RANGE* softkey changes the level range that has to be covered by the distribution sampling function. The function is identical to that of the *RANGE LOG MANUAL* softkey on the *AMPT* menu.

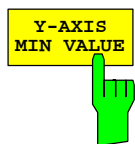
IEC bus command: `:CALC:STAT:SCAL:X:RANG <value>`



The *Y-AXIS MAX VALUE* softkey sets the upper limit of the displayed probability range .

The values on the Y axis are normalized, i.e. the maximum value is 1.0. Since the Y axis is logarithmically scaled, the gap between the maximum and minimum values must be at least one decade.

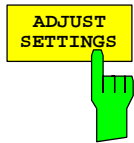
IEC bus command: `:CALC:STAT:SCAL:Y:UPP <value>`



The *Y-AXIS MIN VALUE* softkey sets the lower limit of the displayed probability range.

Since the Y axis is logarithmically scaled, the gap between the maximum and minimum values must be at least one decade. Permissible range of values  $0 < \text{value} < 1$ .

IEC bus command: `:CALC:STAT:SCAL:Y:LOW <value>`

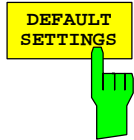


The ADJUST SETTINGS softkey optimizes the analyzer level settings according to the measured peak power in order to gain maximum sensitivity of the device.

The level area is set for the APD measurement according to the measured difference between the peak value and the minimum value of the power and, for the CCDF measurement, between the peak value and the mean value of the power in order to achieve maximum power resolution.

In addition, the probability scale of the selected number of measured values is adjusted.

IEC bus command: :CALC:STAT:SCAL:AUTO ONCE



The DEFAULT SETTINGS softkey resets the scaling on the X axis and the Y axis to the default (PRESET) settings.

X-axis reference level: -20 dBm

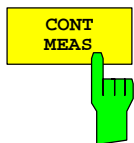
X-axis range for APD: 100 dB

X-axis range for CCDF: 20 dB

Y axis for upper limit: 1.0

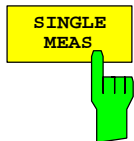
Y axis for lower limit: 1E-6

IEC bus command: :CALC:STAT:PRES



The CONT MEAS softkey starts the collection of new sequences of sample data and the calculation of the APD or CCDF trace, depending on the selected measurement. The next measurement is started automatically as soon as the indicated number of samples has been reached ("CONTinuous MEASurement").

IEC bus command::INIT:CONT ON;  
:INIT:IMM



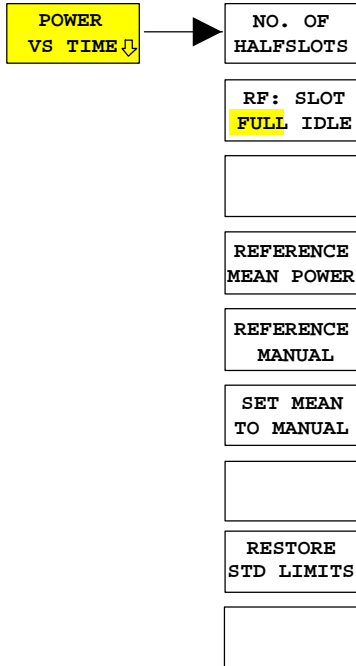
The SINGLE MEAS softkey starts the collection of one new sequence of sample data and the calculation of the APD or CCDF trace, depending on the selected measurement. The measurement finishes after the displayed number of measured values has been reached.

IEC bus command: :INIT:CONT OFF;  
:INIT:IMM



Power versus Time

MEAS key or MEAS hot key



The **POWER VS TIME** Softkey enables the power versus time measurement as requested by the "emission envelope mask" measurement of the 1xEV-DO Standard.

Up to 36 halfslots are captured and postprocessed with trace averaging simultaneously. For a standard measurement of 100 halfslots only 3 data captures are necessary. An external trigger should be used in order to trigger on the slot boundary.

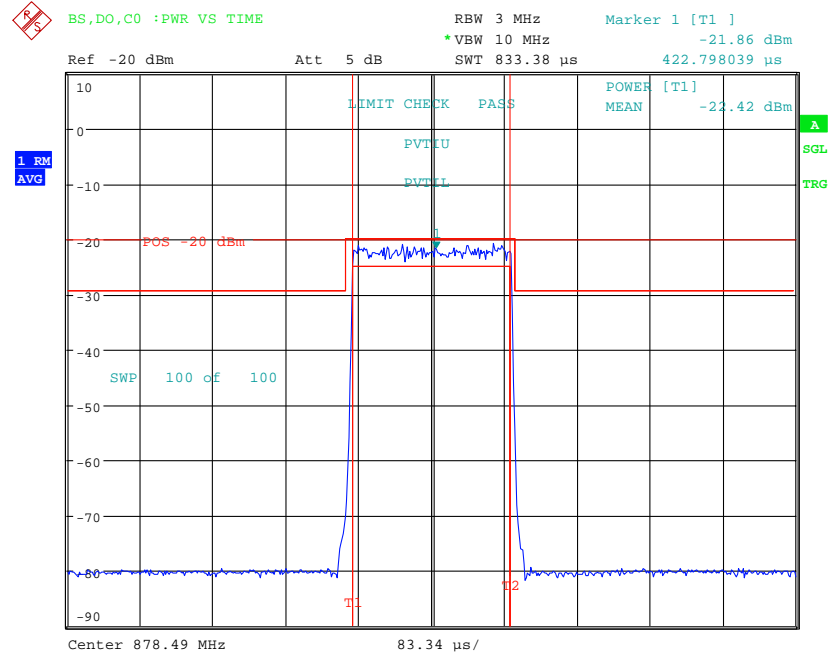


Fig. 6-6 PVT of a 1xEV-DO IDLE slot signal.

The softkey enables SPECTRUM mode with predefined settings:

The following user-specific settings are not modified so that the adaptation to the device under test is retained:

- Level parameters
- Center Frequency + Frequency Offset
- All trigger settings

FREQUENCY SPAN	Zero Span 0 Hz
SWEEP TIME	833.38 μs
RBW	3 MHz
VBW	10 MHz
DETECTOR	RMS
TRACE MODE	AVERAGE

To restore adapted measurement parameters, the following parameters are saved on exiting and are set again on re-entering this measurement:

- Level parameters
- RBW/VBW
- Trigger settings

Departing from these settings, the analyzer can be operated in many functions featured in SPECTRUM mode, i.e. measurement parameters can be adapted to the requirements of the specific measurement.

IEC bus command: :CONFigure:CDPower:MEASurement PVTime

Query of results::

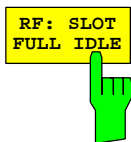
```
:CALC:MARK:FUNC:SUMM:MEAN:RES?      'read the mean power
:TRACe:DATA? TRACE1                  '512 points are returned
                                        'upon trace request
:CALCulate1:LIMit1:FAIL?             'upper line failed
:CALCulate1:LIMit2:FAIL?             'lower line failed
```



With the softkey *NO. OF HALFSLOTS* the number of halfslots for the averaging can be changed. Default value is 100.

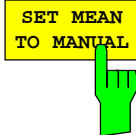
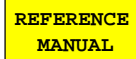
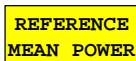
IEC/IEEE bus command:

```
:SENS:SWE:COUNT <numeric_value>
```



The softkey *RF: SLOT FULL/IDLE* defines the expected signal: FULL slot or IDLE slot. Accordingly the limit lines and the borders for calculating the mean power are set. The lower and upper limit line are called *DOPVTFL/DOPVTFU* for FULL and *DOPVTIL/DOPVTIU* for IDLE mode. It is possible to change these lines with the standard limit line editor.

IEC bus command: :CONF:CDP:RFSlot FULL | IDLE



The standard asks for the sequence to first measure the FULL slot with the limit line relative to the mean power of the averaged time response. Therefore the softkey *REFERENCE MEAN POWER* in a FULL slot measurement should be selected. In this mode the mean power is calculated and the limit lines are relative to that mean power value. This value should be used also as the reference for the IDLE slot measurement. With the softkey *SET MEAN TO MANUAL* the current mean power value of the averaged time response is used to set as the fixed reference value for the limit lines. The mode is switched from *REFERENCE MEAN POWER* to *REFERENCE MANUAL*. Now the IDLE slot can be selected and the measurement sequence can be finished.

The manual mode can also be selected via the *REFERENCE MANUAL* softkey. Then a user defined value can be entered as the reference value for the limits.

IEC bus command: :CALC:LIM:PVT:REF AUTO|MANUAL|ONCE  
:CALC:LIM:PVT:RVAL <value> in dBm



The *RESTORE STD LINES* softkey restores the limit lines defined in the standard to the state they were in when the device was supplied. In this way unintended overwriting of the standard lines can be undone.

IEC bus command: :CALC:LIM:PVT:RESTore

### Code Domain Measurements on 1xEV-DO Signals

Application Firmware R&S FS-K84 makes a code domain analyzer available. With its help, the measurements called for in the 1xEV-DO specification in respect of the power of the different codes can be performed. In addition, the modulation quality (EVM and RHO factors), frequency error and trigger-to-frame time, and also peak code domain error are determined. Constellation analyses and bit stream analyses are similarly available. The calculation of the timing and phase offsets of the channels for the first active channel can be enabled (refer to the *TIME/PHASE* softkey). The observation period can be adjusted in multiples of the slot by means of the *CAPTURE LENGTH* softkey.

Basically, there are the following results classes for the analyses:

- Results that take the total signal into account over the whole period of observation
- Results that take the total signal into account over a slot
- Results that take a channel type (such as MAC) into account over the whole period of observation
- Results that take a channel type (such as MAC) into account over a slot
- Results that take a code in a channel type (such as MAC) into account over the whole period of observation
- Results that take a code in a channel type (such as MAC) into account over a slot

A slot with 1xEV-DO is a basic time unit of 1.666 ms duration and corresponds to the expression power control group (PCG) with CDMA2000. Every slot consists of two half-slots that are identically structured. Each half-slot contains 1024 chips, which are distributed as shown below according to the different channel types:

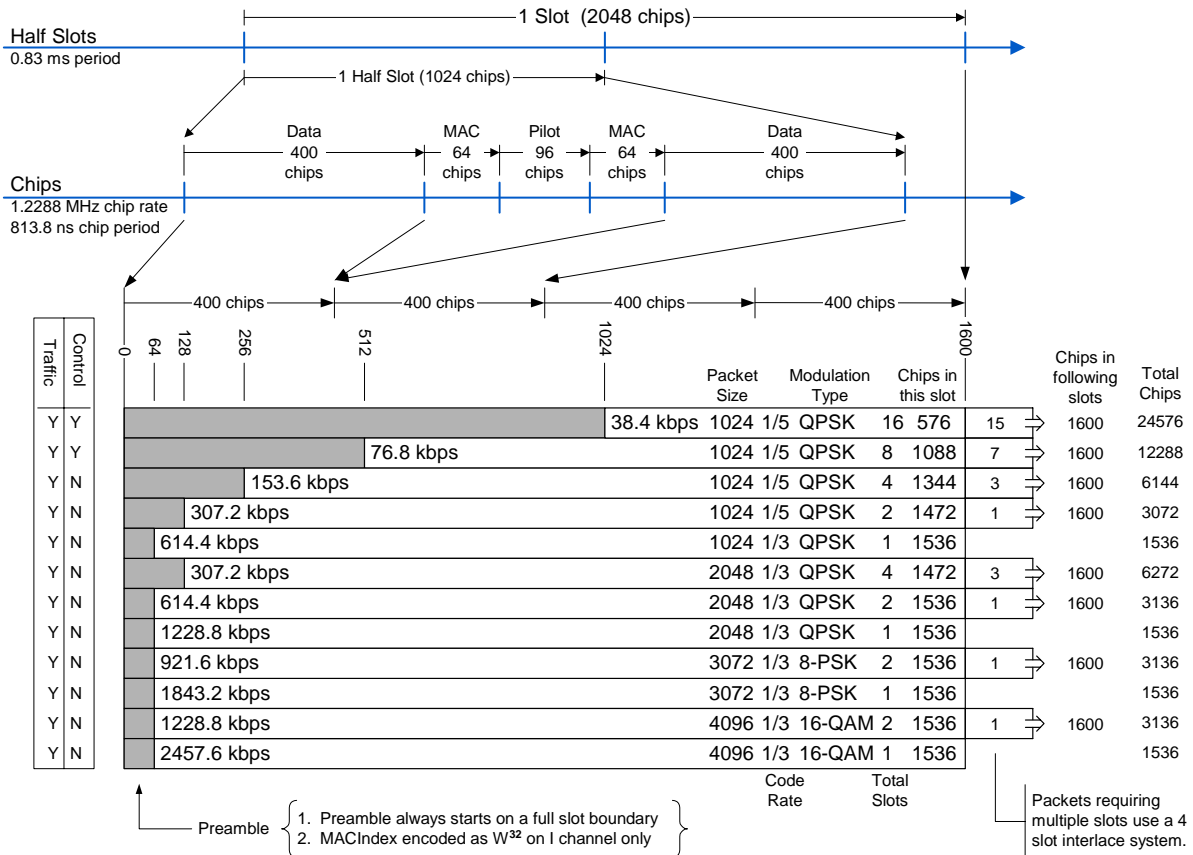


Fig. 6-7 Slot structure, chip distribution and preamble lengths.

From the slot structure it can be seen that with the 1xEV-DO forward link there are 4 channel types which are sent at exclusive times in the diagram shown above:

- **PILOT:** The PILOT channel type comprises 96 chips and is located in the center of each half-slot. It must be present in the signal for the base station signal to be detected. In the PILOT channel type, only the 0.32 channel on the I branch is active.<sup>1</sup> With spreading factor 32, the BPSK-I and, hypothetically, BPSK-Q modulation are used. Hypothetically because no signal should be present on the Q branch.
- **MAC:** The Medium Access Control channel type is 64 chips in front of and behind the PILOT. The MAC channel type contains the reverse activity (RA) channel and the MAC reverse power control (RPC) channels with which the power of the active terminals is controlled. The MAC indices described in the Standard MAC can be simply transformed into Walsh codes. For further details refer to the chapter entitled "Relationship between Mac Index and Walsh Codes", starting on page 139. The analysis for the MAC channel type takes place with spreading factor 64. There is BPSK-I and BPSK-Q modulation.
- **DATA:** The DATA channel type is located with a length of up to 400 chips at the beginning and end of each half slot. The useful data proper are transmitted in it. As shown in the figure, there are packets that transmit their data distributed over 1, 2, 4, 8 or 16 slots, depending on the transmission rate. Initially, a PREAMBLE range is transmitted, being between 64 and 1024 chips long – followed by the data. If more than one slot is required for transmission, the other data of this data packet follow at intervals of four slots, then without another preamble. In the DATA channel type, QPSK, 8-PSK and 16-QAM modulation types are used. Analysis takes place with a spreading factor of 16.
- **PREAMBLE:** As can be seen from the figure, the first 64 to 1024 chips of the DATA channel type are replaced at the beginning of a data packet by the PREAMBLE channel type. Depending on the transmission speeds being used and whether the start of data of the packet is missed, there are therefore preambles of different length in the signal. The application firmware detects the preambles automatically. If the PREAMBLE channel type is examined and there is no preamble in the signal, this is indicated by means of 'PREAMBLE MISSING'. Spreading factor 32 applies similarly to the PREAMBLE channel type as for the PILOT channel type. Again, only a BPSK-I modulated channel should occur, but with variable code number.

Depending on the result class, the customer sets the channel type, the slot number and the code number in order to obtain the results for the analyses he requires. In addition, mapping can be set. In this case it is necessary to specify whether just the I branch or just the Q branch or the complex signal consisting of I and Q should be analyzed. The Standard generally expects a separate Code Domain Power analysis for I and Q. The 'Mappings' column in the table below indicates which analyses in the application firmware work with the different mapping modes. For the analyses in which this is possible, there is the option of setting mapping itself and thus analyzing separately for I or Q, or of analyzing the signals as in Complex mode. For the Code Domain Power analysis, there are also the results across all slots demanded by the Standard, in addition to the slot-by-slot method of calculation.

---

<sup>1</sup> The notation 0.32 means code number 0 at spreading factor 32 (code class 5, because  $2^5=32$ )

The analyses of the code domain analyzer are performed on a split screen. The screen is divided into two halves for this.

The upper screen (screen A) displays analyses which vary by means of the codes. The lower screen (screen B) displays all other analyses.

Table 6-15 Overview of the analyses

Code dimension			Time dimension		Mappings	
Analyses on screen A	Total signal	One channel type		All slots	One slot	I or Q/ complex/ overview
		All codes	One code			
Code domain power		✓		✓ AVG ON	✓ AVG OFF	I or Q/ complex/ overview
Code domain error power		✓			✓	I or Q/ complex/ overview
Channel table	✓				✓	Not used
Analyses on screen B	Total signal	One channel type		All slots	One slot	I or Q/ complex/ overview
		All codes	One code			
GENERAL RESULTS	✓			✓	✓	Not used
Channel Results		✓	✓		✓	I or Q/ complex
Power versus Chip	✓				✓	Not used
Power versus symbol			✓		✓	I or Q/ complex
Composite EVM (modulation accuracy)	✓			✓		Not used
Composite constellation		✓			✓	Not used
Peak code domain error		✓		✓		I or Q/ complex
Symbol constellation			✓		✓	<b>DATA:</b> complex <b>Others:</b> I or Q/ complex
Symbol EVM			✓		✓	<b>DATA:</b> complex <b>Others:</b> I or Q/ complex
Bit stream			✓		✓	<b>DATA:</b> Complex <b>Others:</b> I or Q, complex

The number of results for the analyses depends with the Code Domain Power analysis, for example, on the spreading factor and with the Bit Stream analysis on the number of bits. At a chip rate of 1.2288 MHz, the symbol rate results as 1.2288MHz/spreading factor. The bit rate depends on how many bits describe a symbol in the modulation type being used. Due to the different PREAMBLE lengths, the DATA area is shortened depending on the PREAMBLE. All relationships can be seen in the table below:

Table 6-16 Relationship between symbol rate, spreading factor, number of symbols, number of bits, number of chips and channel type

Channel type	Spreading factor	Symbol rate	Modulation type	Chips per slot	Symbols per slot and code	Bits per slot and code			
PILOT	32	38.4 ksps	BPSK-I or BPSK-Q	96*2 = 192	6	Mapping I or Q	6	Mapping complex	12
MAC	64	19.2 ksps	BPSK-I or BPSK-Q	64*4 = 256	4	4	4	8	
PRE-AMBLE	32	38.4 ksps	BPSK-I or BPSK-Q	Preamble length 64: 128: 256: 512: 1024:	2 4 8 16 32	2 4 8 16 32		4 8 16 32 64	
DATA	16	76.8 ksps	QPSK, 8-PSK, 16-QAM	400*4- PreambleChips= DataNettoChips	Mapping always complex Modulation type:				
					QPSK	8-PSK	16-QAM		
				1600-0 = 1600	100	200	300	400	
				1600-64 = 1536	96	192	288	384	
				1600-128 = 1472	92	184	276	368	
				1600-256 = 1344	84	168	252	336	
				1600-512 = 1088	68	136	204	272	
1600-1024 = 576	36	72	104	144					

The channel type for which a result has to be displayed is selected with the help of the *CHAN TYPE* softkey and the code number and the slot for which a result has to be displayed are selected *SELECT CODE* and *SELECT SLOT*. Let us assume that the MAC channel type, code 2.64 (Walsh code number 2 for spreading factor 64) and slot 1 have been selected. On screen A, the Code Domain Power analysis is relative and on screen B the symbol EVM analysis is active. Screen A will thus display the Code Domain Power analysis of slot 1 (with MAC the default setting of the Code Domain Power analysis is that the I branch is displayed). In this instance code 2.64 is shown selected in red. In the lower half of the screen, the EVM symbol for analysis of code 2.64 in slot 1 with, aptly, four values, one for each symbol, can be seen. Incidentally, the MAC reverse activity (RA) channel was examined in this example. In the 1xEV-DO system, it has MAC index 4 as a general rule, which is transmitted as described in the section on the "Relationship between Mac Index and Walsh Codes" (page 139) on the code 2.64 I branch.

The code domain analyzer can be operated in two modes. In CODE CHAN AUTOSEARCH mode it performs an automatic search for active channels in the whole code domain. In the other mode, CODE CHAN PREDEFINED, the user has the option of determining the active channels in the signal by means of selectable and editable tables of his own accord. The automatic channel search is then replaced by this user input.

**Messages:**

The code domain analyzer expects the presence of pilot channel 0.32 in the PILOT channel type. If it is not detected because the center frequency or the signal level has not been set properly, or because the PN OFFSET or Q-INVERT or SIDE BAND INVERT do not match the signal, or because no valid signal has been applied, the 'SYNC FAILED' message is issued.

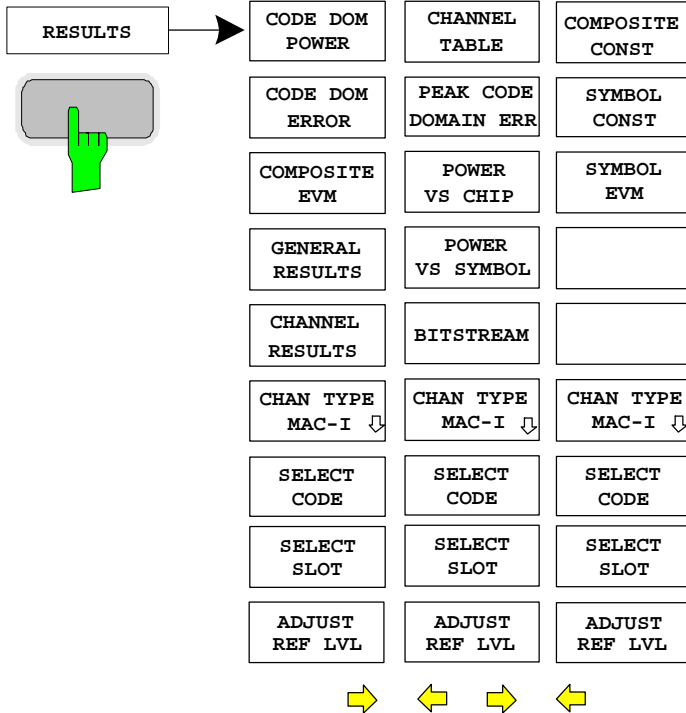
If the PREAMBLE channel type (*CHAN TYPE* softkey) is examined, signals may still be applied that do not exhibit a PREAMBLE channel type in every slot or the slot currently being examined. The reason for this is that the PREAMBLE is only ever transmitted in the first slot of a data packet. When signals are transmitted that are not identical in each slot but are repeated with reference to a trigger event, a repetitive measurement is possible by means of external triggering. Otherwise, each sweep produces a new result, which reflects the changing slot assignments.

For it to be possible to detect that, when the PREAMBLE channel type is selected, it is not present in the slot or, in the case of analyses working over all slots, it is not available in at least one of the slots, the 'PREAMBLE MISSING' message is issued.

For remote control, registers are available for these messages and can be interrogated in the status reporting system.

## Presentation of analyses - RESULTS

The *RESULTS* hot key or the *MEAS* hot key and then the *CODE DOM ANALYZER*.



The *RESULTS* hot key opens the submenu for choosing the analysis. On the main menu, the most important analyses are offered for rapid access, and advanced analyses are available on the side menus.

**Note:** To go to the far side menu, press the *NEXT* hard key twice.

You can choose from the following analyses:

- CODE DOM POWER Code domain power analysis, depending on the CODE PWR ABS/REL softkey, in relative or absolute scaling
- CODE DOM ERROR Code domain error power analysis
- COMPOSITE EVM Square difference between the test signal and ideal reference signal
- GENERAL RESULTS Tabulated general results
- CHANNEL RESULTS Tabulated results that do not refer to the channel type or the selected channel
- CHANNEL TABLE Channel occupancy table
- PEAK CODE DOMAIN ERR  
Projection of the error between the test signal and the ideal reference signal to the spreading factor of the channel type and subsequent summation over the symbols of each slot of the differential signal
- POWER VS CHIP Power of the total signal of a slot at chip level
- POWER VS SYMBOL Power of the selected channel and the selected slot over all symbols
- BITSTREAM Display of decided bits
- COMPOSITE CONST Composite constellation analysis
- SYMBOL CONST Symbol constellation analysis
- SYMBOL EVM Error vector magnitude analysis

The *CHAN TYPE* softkey opens a submenu for setting the channel type, mapping and the I/Q selection.



By entering a code number (*SELECT CODE* softkey), a channel can be selected for the SYMBOL CONST, SYMBOL EVM, BITSTREAM and POWER VS SYMBOL analyses.

Using the *SELECT SLOT* softkey, a slot can be selected for the CODE DOM POWER, CODE ERROR, CHANNEL TABLE, SYMB CONST, SYMBOL EVM, BITSTREAM, COMPOSITE CONST and POWER VS SYMBOL analyses.

You can use *ADJUST REF LVL* to obtain optimum matching of the device reference level to the signal level.

The following user-specific settings are not modified on the first access following presetting:  
 Level parameters  
 Center Frequency + Frequency Offset  
 Input Attenuation + Mixer Level

The following user-specific settings are transferred as follows:  
 External trigger sources are retained, while all other trigger sources result in Free Run mode.  
 Additional trigger settings are retained.

To restore adjusted level parameters, they are saved on exiting the code domain analyzer and reset on re-entering the code domain analyzer.

The most important measurement settings, which are based on the displays, are grouped above the diagram:

BS,DO,C1	: CODE POWER	TYPE:	MAC-I
		Code	2.64
DB	CF 1.93125 GHz	Slot	1

Fig. 6-8 Function fields of diagrams

The meanings are as follows:

1st column: Mobile radio system (base station 1xEV-DO)      BS,DO  
 Band class (class 0-12) abbreviated      such as      C1 for 1900 MHz band  
 Name of selected analysis:      such as      CODE POWER  
 (blank line)  
 Unit of y axis      such as      dB for relative power

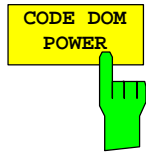
2nd column: (blank line)  
 (blank line)  
 Center frequency of the signal.      such as      CF 1.93125 GHz

3rd column: channel type and mapping :      such as      TYPE:      MAC-I

**CHANNEL TYPE**      the channel type is specified as follows:  
 ALL      for analysis POWER VS CHIP/GENERAL RESULTS/COMP. EVM  
 PILOT      for channel type PILOT  
 MAC      for channel type MAC  
 PREAMB      for channel type PREAMB  
 DATA      for channel type DATA

**MAPPING**      the mapping is specified as follows:  
 (No text)      for analysis entered as "not used" in Table 6-15 at mapping  
 -IQ      for analyses that only allow IQ mapping in Table 6-15 for channel type DATA, or Complex mapping  
 -I      for I or Q mapping and I selection, or overview screen A  
 -Q      for I or Q mapping and Q selection, or overview screen B

Walsh code and spreading factor of selected code:      for example      code      2.64  
 Selected slot number      slot      1



The CODE DOM POWER softkey selects the Code Domain Power (CDP) analysis with relative scaling.

With the Code Domain Power analysis, allowance is made for one channel type over precisely one slot. The power values of the different codes are determined and plotted in a diagram. In this diagram, the x axis is the code number and the y axis is a logarithmic level axis. The number of codes on the x axis depends on the channel type. It can be set by means of the *CHAN TYPE* softkey. The slot needing to be analyzed can be set by means of the *SELECT SLOT* softkey.

If the *CDP AVG* softkey is set to ON, an averaged analysis is performed over all included slots, not just over a single slot. The averaged analysis is called for by the Standard, but assumes with channel types DATA and PREAMBLE that preambles of different length do not occur in the slots.

The power of the channels is referred in the default setting to the total power in the selected channel type (such as MAC).

Apart from this relative display, there is also the option of specifying the absolute power. It can be enabled by means of the CODE PWR ABS/REL softkey. The unit of the y axis is dBm, accordingly, for absolute analysis and dB for relative analysis.

The power values of the active and unassigned codes are displayed in different colors:

- Yellow active channel
- Cyan inactive code

A channel in *CODE CHAN AUTOSEARCH mode* (Automatic Channel Search mode) is termed active when the minimum power entered by the user (refer to the *INACT CHAN THRESHOLD* softkey) is exceeded. In *CODE CHAN PREDEFINED* mode, each code channel contained in the user-defined channel table is identified as active.

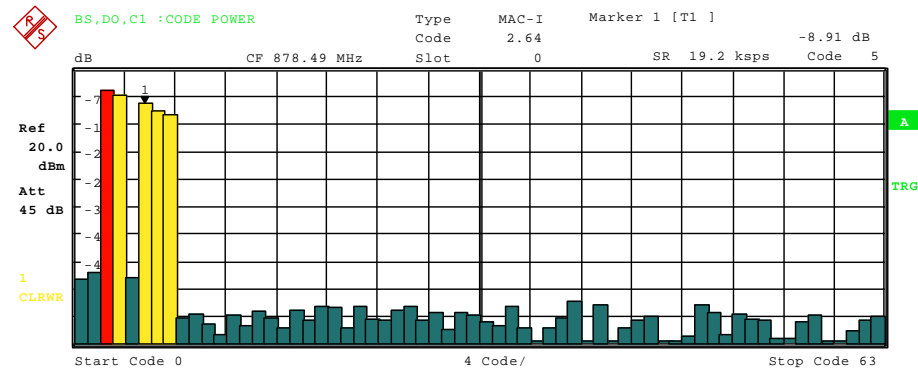


Fig. 6-9 CDP diagram for MAC-I

Mapping can also be set on the *CHAN TYPE* menu. An AUTO MODE is featured; it causes complex mapping to be analyzed separately for the DATA channel type and mapping for the I or Q branch to be analyzed separately for the other channel types. In the latter case the I/Q selection can be set by means of the *SELECT I/Q* softkey. For an overview of two code domain power measurement for separate analysis of the I and Q branches, there is similarly the *CODE DOM OVERVIEW* softkey on the *CHAN TYPE* menu, which can be used to switch to Overview mode. In Overview mode, the I branch is analyzed on screen A and the Q branch on screen B.

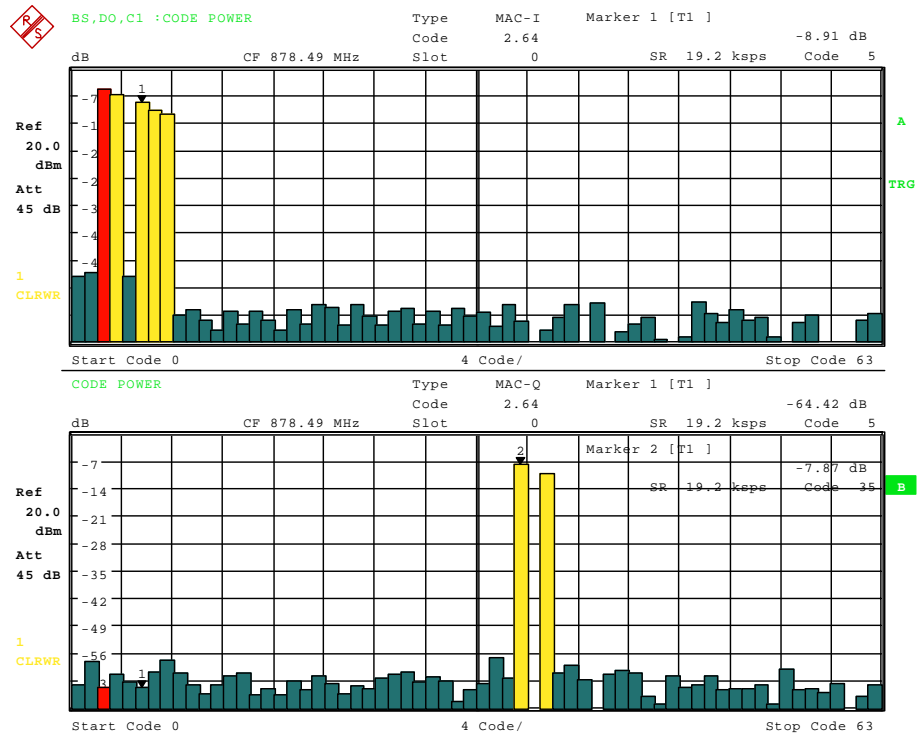


Fig. 6-10 CDP diagram in Overview mode for MAC

Another option for obtaining an overview of the CDP is to enable *MAPPING COMPLEX*, since the code domain power is then constantly displayed as a complex analysis on screen A for the selected channel type.

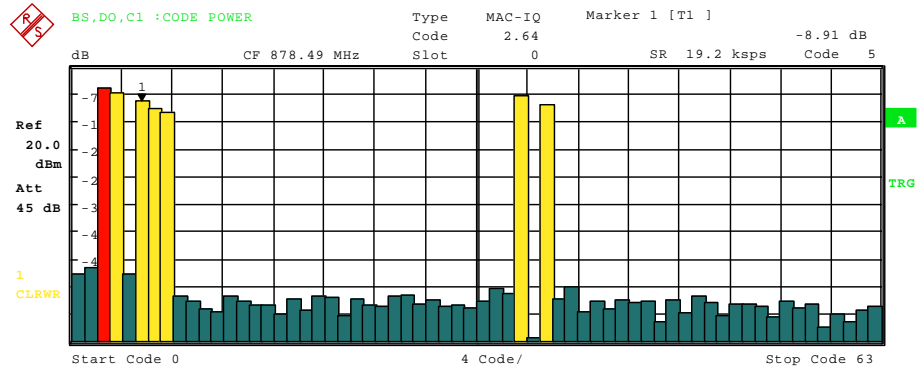
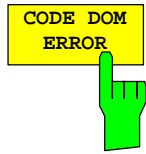


Fig. 6-11 CDP complex analysis diagram for MAC-IQ

If the DATA channel type is examined (not shown in these figures), it will be seen that the complex analysis is approximately 3 dB higher than the separate I or Q analysis. This is absolutely correct, for 50% of the power values are distributed to I and Q, respectively, for the complex modulation types of the DATA channel type.

By entering a code number (refer to the *SELECT CODE* softkey), a code can be highlighted for more detailed displays. The code is displayed in red. The selection of more detailed analyses (such as *SYMBOL CONSTELLATION*) for unassigned codes is possible but not meaningful, since the results are not valid.

IEC bus command: :CALCulate<1>:FEED "XPOW:CDP:RAT" (relative)  
 :CALCulate<1>:FEED "XPOW:CDP" (absolute)  
 :CDPower:OVERview ON | OFF



The CODE DOM ERROR softkey selects the analysis of the code domain error power (CDEP).

The code domain error-power measurement outputs the power value difference between the measured and ideally generated reference signal for each code of a channel type in dB. Since it is an error power, active and inactive channels can be assessed jointly at a glance with this analysis.

With the code domain error-power analysis, allowance is made for one channel type over precisely one slot and the error powers are determined for the different codes and plotted in a diagram. In this diagram, the x axis is the code number and the y axis is a logarithmic level axis, dB being the unit. The number of codes on the x axis depends on the channel type. It can be set by means of the *CHAN TYPE* softkey. The slot needing to be analyzed can be set by means of the *SELECT SLOT* softkey. Averaging over all slots, as with the Code Domain Power analysis, cannot be enabled.

The power values of the active and unassigned codes are displayed in different colors:

- Yellow active channel
- Cyan inactive code

A channel in *CODE CHAN AUTOSEARCH mode* (Automatic Channel Search mode) is termed active when the minimum power entered by the user (refer to the *INACT CHAN THRESHOLD* softkey) is exceeded. In *CODE CHAN PREDEFINED* mode, each code channel contained in the user-defined channel table is identified as active.

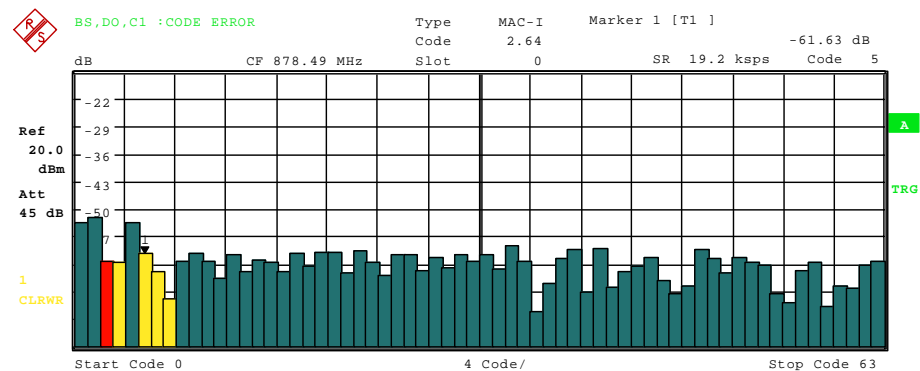


Fig. 6-12 CDEP diagram for MAC-I

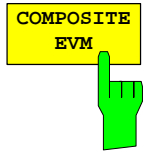
Mapping can also be set on the *CHAN TYPE* menu. An *AUTO MODE* is featured; it causes complex mapping to be analyzed separately for the DATA channel type and mapping for the I or Q branch to be analyzed separately for the other channel types. In the latter case the I/Q selection can be set by means of the *SELECT I/Q* softkey. For an overview of two code domain error-power measurements for separate analysis of the I or Q branches, there is similarly the *CODE DOM OVERVIEW* softkey on the *CHAN TYPE* menu, which can be used to switch to Overview mode. In Overview mode, the I branch is analyzed on screen A and the Q branch on screen B.

Another option for obtaining an overview of the CDEP is to enable *MAPPING COMPLEX*, since the code domain error power is then constantly displayed as a complex analysis on screen A for the selected channel type.

By entering a code number (refer to the *SELECT CODE* softkey), a code can be highlighted for more detailed displays. The code is displayed in red.

The selection of more detailed analyses (such as *SYMBOL CONSTELLATION*) for unassigned codes is possible but not meaningful, since the results are not valid.

IEC bus command: `:CALCulate<1>:FEED "XPOW:CDEP"`  
`:CDPower:OVERview ON | OFF`



The COMPOSITE EVM softkey selects the analysis of the error vector magnitude (EVM) over the total signal (modulation accuracy).

In the Composite EVM measurement, the square root is determined from the square of the error between the real and imaginary components of the test signal and of an ideally generated reference signal.

The measurement result consists of one composite EVM measurement value per slot. The number of slots can be set by means of the *CAPTURE LENGTH* softkey. Accordingly, the COMPOSITE EVM analysis takes into account the whole signal over the whole period of observation.

Only the channels detected as being active for this channel type are used to generate the ideal reference signal. In the case of a channel which is not detected as being active on account of, say, low power, the difference between the test signal and the reference signal and the composite EVM is therefore very large (refer to the figure).

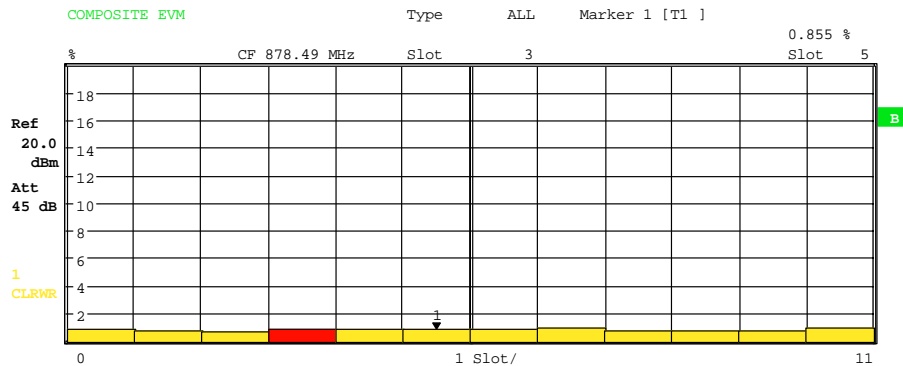


Fig. 6-13 Display of Composite EVM when all channels contained in the signal were detected as active

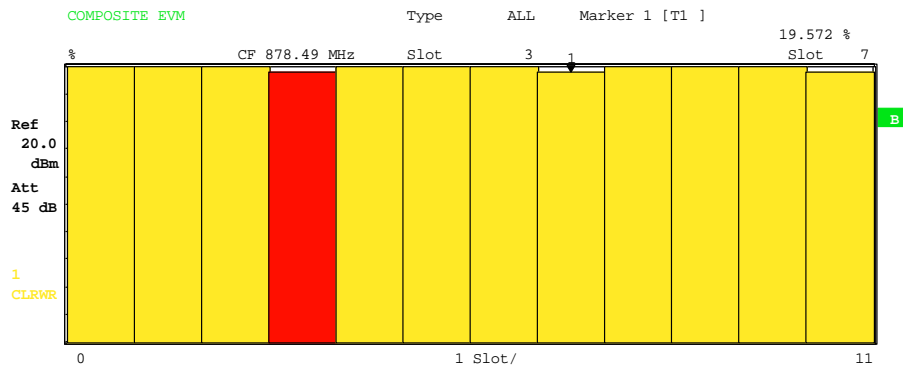
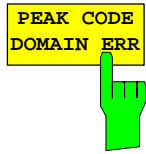


Fig. 6-14 Display of Composite EVM when one code channel was not detected as active

As with the selection of a code in the CDP or CDEP diagram, there is the option in the Composite EVM diagram of selecting a slot. Selection is performed by entering the slot number (refer to the *SELECT SLOT* softkey). The selected slot is displayed as a red bar.

IEC bus command: :CALCulate2:FEED "XTIM:CDP:MACCuracy"



The PEAK CODE DOMAIN ERR softkey selects the analysis of the peak code domain error.

With the peak code domain-error measurement, there is a projection of the error between the test signal and the ideally generated reference signal to the spreading factor. The value of the spreading factor is automatically determined by the channel type (refer to Table 6-16). The unit on the y axis is dB.

The measurement result consists of a numerical value per slot for the peak code domain error. The number of slots can be set by means of the CAPTURE LENGTH softkey. Accordingly, the peak code domain-error analysis allows for a channel type over the whole period of observation.

Only the channels detected as being active are used to generate the ideal reference signal for the peak code domain error. If an assigned code is not detected as being active on account of low power, the difference between the test signal and the reference signal is very large. The R&S FS-K84 therefore displays a peak code domain error that is too high (refer to figure).

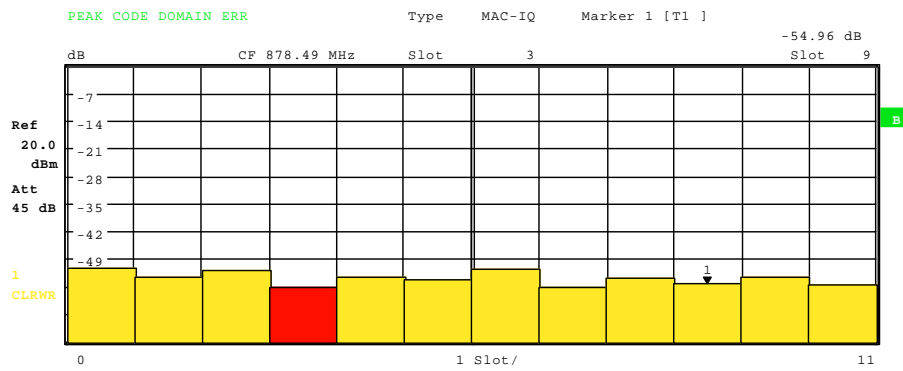


Fig. 6-15 Peak code domain error in the event of all channels contained in the signal being detected as active

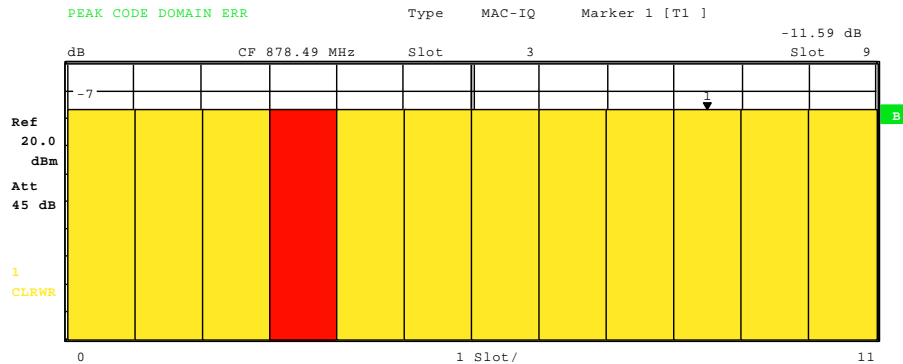
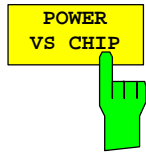


Fig. 6-16 Peak code domain error in the event of one channel not being detected as active

As with the selection of a code channel in the CDP or CDEP diagram, there is the option of selecting a slot in the peak code domain-error diagram. Selection is performed by entering the slot number (refer to the SELECT SLOT softkey). The selected slot is displayed as a red bar.

IEC bus command: :CALCulate2:FEED "XTIM:CDP:ERR:PCDomain"



The *POWER VS CHIP* softkey enables the power versus chip analysis.

The absolute power is displayed in dBm per chip time for the selected slot. There are thus 2048 power values as a trace. This analysis accordingly makes allowance for the total signal for the duration of one slot.

With the help of the Power versus Chip analysis, it is simple to identify which channel types in the slot have power on account of the symmetrical structure of the 1xEV-DO forward link signal (refer to the section "Code Domain Measurements on 1xEV-DO Signals" on page 57).

The slot to be examined can be selected by means of the *SELECT SLOT* softkey.

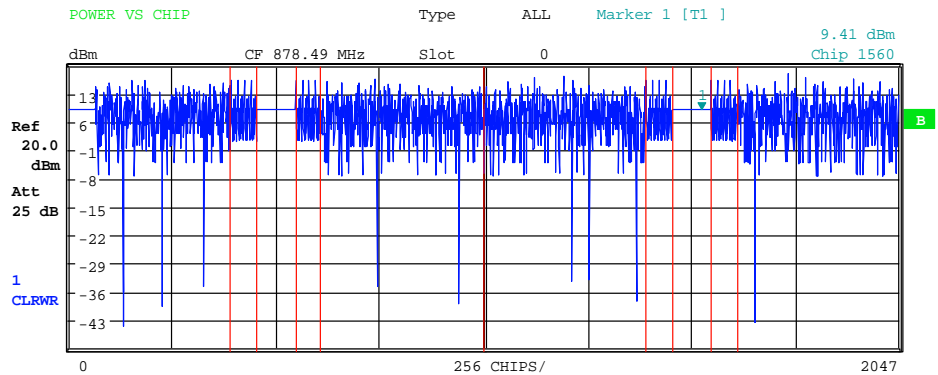


Fig. 6-17 Power versus Chip for all channel types active

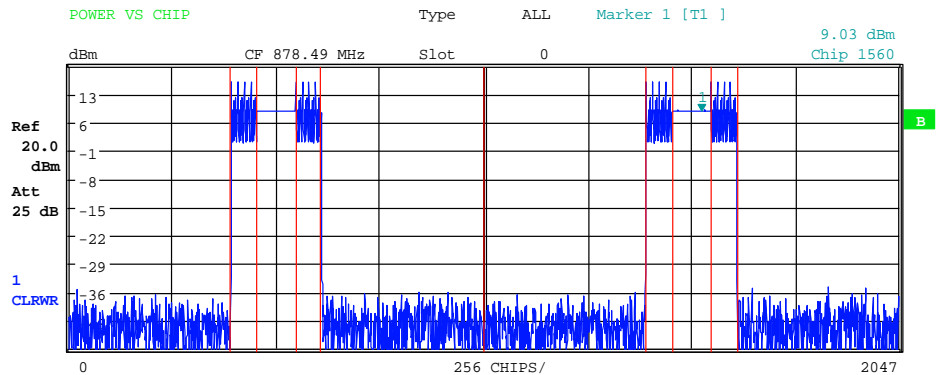
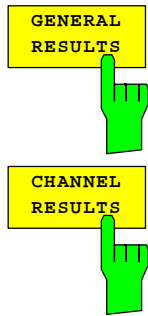


Fig. 6-18 Power versus Chip for IDLE slot (only PILOT and MAC active)

IEC bus command: :CALCulate2:FEED "XTIM:CDP:PVChip"



The *GENERAL RESULTS* and *CHANNEL RESULTS* softkeys feature the numerical analysis of the measurement results on two pages. The two pages are broken down as follows:

GENERAL RESULTS		Type	ALL
CF 878.49 MHz			
Global Results			
Ref	Carr Freq Error	-306.12 Hz	RHO Pilot 0.99995
20.0	Carr Freq Error	-0.35 ppm	RHO overall-1 0.99993
dBm	Chip Rate Error	-0.14 ppm	RHO overall-2 0.99993
Att	Trg to Frame	715.58 ns	
45 dB	Results for Slot: 1		
	Power PILOT	9.24 dBm	Data Modulation Type 16-QAM
	Power MAC	9.22 dBm	Act. MAC Channels 7
	Power DATA	9.26 dBm	Act. DATA Channels 16
	Power PREAMBLE	9.24 dBm	Preamble Length 64 Chips
	Composite EVM	0.82 %	RHO 0.99993
CHANNEL RESULTS		Type	MAC-I
		Code	2.64
		Slot	1
CF 878.49 MHz			
Results for Channel Type: MAC / Slot: 1			
Ref	Power	9.22 dBm	IQ Imbalance 0.06 %
20.0	Pk CDE (SF 64/I)	-54.24 dB	IQ Offset 0.25 %
dBm			
Att	Channel Results for Channel Type: MAC-I / Slot: 1		
45 dB	Symbol Rate	19.2 ksps	Timing Offset 0.00 ns
	Channel.SF	2.64	Phase Offset 0.00 mrad
	Channel Power Rel	-5.89 dB	Channel Power Abs 3.33 dBm
	Symbol EVM	0.16 % rms	Symbol EVM 0.23 % Pk
	Modulation Type	BPSK-I	

Fig. 6-19 General results and channel results

The top part of GENERAL RESULTS presents global results that display the total signal over the whole period of observation (all slots):

**Carrier Freq Error:**

Specifies the frequency error referred to the set center frequency of the analyzer. The absolute frequency error is the sum of the frequency error of the analyzer and that of the device under test.

Differences of more than 8.0 kHz between transmitter and receiver frequency impair the synchronization of the CDP measurement. If at all possible, the transmitter and the receiver should be synchronized (refer to the Getting Started chapter). The frequency error is available in Hz as the unit, on the one hand, and in ppm referred to the carrier frequency, on the other.

**Chip Rate Error:**

Specifies the chip rate error (1.2288 Mcps) in ppm. A large chip rate error results in symbol errors and, consequently, possibly in the CDP measurement not being able to perform synchronization. This measurement result is also valid if the analyzer was not able to synchronize onto the 1xEV-DO signal.

**Trigger to Frame:**

This measurement result reproduces the timing offset from the beginning of the acquired signal section until the start of the first slot. In the case of triggered data acquisition, this corresponds to the timing offset frame-trigger (+ trigger-offset) - start of the first slot. If the analyzer was not able to synchronize onto the 1xEV-DO signal, the value of Trg to Frame is not meaningful. If the *FREE RUN* trigger is selected, dashes (---) are displayed.



- RHO Pilot: Specifies the RHO quality parameter for the area of the pilot channel calculated over all slots, as called for in the Standard.
- RHO overall-1: Specifies the RHO quality parameter calculated for over all chips and over all slots, where the averaging limit is on the half-slot limit, as called for in the Standard.
- RHO overall-2: Specifies the RHO quality parameter calculated for over all chips and over all slots, where the averaging limit is on the quarter-slot limit, as called for in the Standard.

The bottom part of General Results shows results applicable to the selected slot (*SELECT SLOT*):

- Power PILOT: Absolute power measurements in dBm in the PILOT channel type.
- Power MAC: Absolute power measurements in dBm in the MAC channel type.
- Power DATA: Absolute power measurements in dBm in the DATA channel type.
- Power PREAMBLE: Absolute power measurements in dBm in the PREAMBLE channel type.
- Composite EVM: The composite EVM value is the difference between the test signal and ideal reference signal (refer to the *COMPOSITE EVM* softkey).
- Data Modulation Type: Modulation type of the DATA channel type.
- Act. MAC Channels: Number of active MAC channels.
- Act. DATA Channels: Number of active DATA channels.
- Preamble Length: Length of the preamble in chips, 0 if no preamble is present in this slot. .
- RHO: Specifies the RHO quality parameter calculated over a slot. (As in CDMA2000 BTS R&S FS-K82).

The CHANNEL RESULTS analysis is subdivided into two halves. The top part displays results that depend on the selected channel type (*CHAN TYPE* softkey) and the selected slot:

- Power: The total power of the channel type. This result is identical to one from the bottom half of General Results and is listed again, because the Channel Power Rel relative to this value is displayed from this point on.
- Pk CDE: The *PEAK CODE DOMAIN ERR* measurement specifies a projection of the difference between test signal and ideal reference signal to the spreading factor that belongs to the channel type. This spreading factor is output in brackets.
- IQ Imbalance: IQ imbalance of the signal in %
- IQ Offset: DC offset of the signal in %

The lower part of CHANNEL RESULTS displays the results of measurements

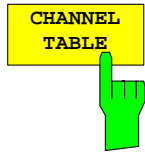
on the selected channel in the specified channel type and of the selected slot.

- Symbol Rate: Symbol rate with which the channel is transmitted
- Code.SF: Number of the code and its associated spreading factor
- Timing Offset: Timing offset between the selected channel and the first active channel in the channel type. This measurement can be enabled by means of the *TIME/PHASE* softkey.
- Phase Offset: Phase offset between the selected channel and the first active channel in the channel type. This measurement can be enabled by means of the *TIME/PHASE* softkey.
- Chan Pow rel. / abs.: Channel power relative (referred to the total power of the channel type) and absolute channel power.
- Symbol EVM Pk / RMS: Peak or mean value of the results of the error vector magnitude measurement (refer to the *SYMBOL EVM* softkey). The measurement provides information about the EVM of the selected channel for the selected slot at symbol level.

If the *MAX/MIN HOLD* or *AVERAGE* trace statistics are enabled using the *TRACE* hardkey, the values are interlinked accordingly from one analysis to the next. The Active MAC or DATA Channels, Data Modulation Type, Symbol Rate, Channel.SF and Mapping values are not statistically interlinked. In the case of the values which have an expectation value of 0 (Carr Freq Error, Trg to Frame, IQ Imbal/Offset, Timing and Phase Offset), the maximum value is formed in such a way that the maximum is sought among the absolute values and then output with sign. In this way it is possible to determine the largest deviation including the direction of the deviation. The minimum value is formed in the same way.

IECbus command:

```
:CALCulate2:FEED "XTIM:CDP:ERR:SUMM"
:CALCulate<1|2>:MARKer<1>:FUNction:CDPower[:BTS]:RESult?
RHO | MACCuracy | PCDerror FERRor | FERppm |
CERRor | TFRame I IQOFFset | IQIMbalance |
SRATE | CHANnel | SFACTOR | TOFFset | POFFset |
CDPabsolute | CDPRelative | EVMRms | EVMPeak |
RHOPilot | RHO1 | RHO2 | PPILot | PMAC | PDATA|
PPReamble | MACTive | DACTive | PLENGth | MTYPE
| DMType
```



The CHANNEL TABLE softkey selects the Channel Occupancy Table analysis, in which all active channels are displayed.

The channel assignment table can theoretically contain 146 entries. One in the PILOT and one in the PREAMBLE channel type, 16 in the DATA channel type and theoretically 64 on the I and 64 on the Q branch of the MAC channel type. In reality, not more than 64 MAC codes should be assigned, since the Standard only provides for 64 MAC indices. The Channel Occupancy Table analysis makes allowance for the total signal over precisely one slot. The slot needing to be analyzed can be set by means of the SELECT SLOT softkey.

The channels are listed in the following channel type order: PILOT, MAC, PREAMBLE, DATA. Within the channel types, the channels are sorted in ascending code number order.

BS,DO,C0 :CHANNEL TAB

CF 878.49 MHz

Type	Chan.SF	Symb Rate ksps	Modulation	Pwr Abs dBm	Pwr Rel dB	T Offs ns	Ph Offs mrad
Ref	PILOT	0.32	38.4	BPSK-I	-0.76	-0.00	0.00
10.0	MAC	2.64	19.2	BPSK-I	-6.71	-5.91	0.00
dBm	MAC	3.64	19.2	BPSK-I	-7.70	-6.91	-0.84
Att	MAC	5.64	19.2	BPSK-I	-9.71	-8.91	1.57
40 dB	MAC	6.64	19.2	BPSK-I	-11.72	-10.92	0.86
	MAC	7.64	19.2	BPSK-I	-12.72	-11.92	-0.78
	MAC	35.64	19.2	BPSK-Q	-8.67	-7.87	0.88
	MAC	37.64	19.2	BPSK-Q	-10.68	-9.88	0.65
1	PRE64	7.32	38.4	BPSK-I	-0.79	-0.00	0.00
CLRWR	DATA	0.16	76.8	8-PSK	-12.83	-12.04	0.00
	DATA	1.16	76.8	8-PSK	-12.83	-12.05	0.16
	DATA	2.16	76.8	8-PSK	-12.82	-12.03	0.49

Fig. 6-20 Channel table

The following parameters are determined for the channels:

**Channel type:** Specifies the channel type of the active channel. Possible values are PILOT, MAC and DATA. For the PREAMBLE channel, the length in chips is similarly specified, thus resulting in the following options for the PREAMBLE channel type: PRE64, PRE128, PRE256, PRE512 or PRE1024.

**CHAN.SF:** The number of the Walsh code of the active channel including spreading factor. The spreading factor depends on the channel type.

**Symb. Rate:** Symbol rate with which the channel is transmitted

**Modulation/mapping**

The DATA channel type can contain QPSK, 8-PSK or 16-QAM modulated channels; there is BPSK-I or BPSK-Q modulation for the other channel types.

**Pwr Abs / Pwr Rel:**

Specification of the absolute and relative power (referred to the total power in the channel type) of the channel.

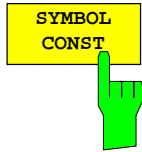
**T Offs:** Timing offset. Timing offset between this channel and the first active channel can be enabled by means of the TIME/MEAS softkey.

**Ph Offs:** Phase offset. Phase offset between this channel and the first active channel can be enabled by means of the TIME/MEAS softkey.

A data channel is referred to as active in CODE CHAN AUTOSEARCH mode when it exhibits the minimum power (refer to the INACT CHAN THRESHOLD softkey). In CODE CHAN PREDEFINED mode, all code channels contained in the channel table are marked as active.

If the TIME/PHASE softkey is set to ON, the maximum value of the TIMING and PHASE OFFSET is displayed together with the associated channel type and channel on the right-hand side above the channel table. Since the TIMING and PHASE values of each active channel can be either negative or positive, the absolute values are compared and the maximum is then displayed with the original sign.

IEC bus command: :CALCulate<1>:FEED "XTIM:CDP:ERR:CTABLE"



The *SYMBOL CONST* softkey selects the analysis of the constellation diagram at symbol level.

Analysis of the symbols is performed for the selected code (*SELECT CODE* softkey) in the set channel type (*CHAN TYPE* softkey) and the selected slot (*SELECT SLOT* softkey). This means that this analysis makes allowance for results of a code in the selected channel type for one slot. The number of symbols on the x axis is between 2 and 100 (refer to Table 6-16).

Evaluation of the constellation diagram is possible for unassigned codes, but the results are meaningless since unassigned code channels do not contain data.

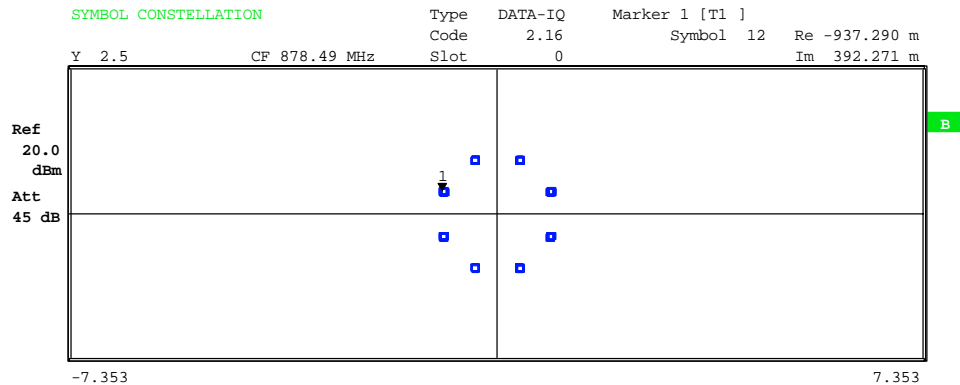
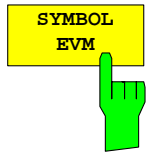


Fig. 6-21 Symbol constellation diagram

IEC bus command: :CALCulate2:FEED "XTIM:CDP:SYMB:CONS"



The *SYMBOL EVM* softkey selects the analysis for the symbol error vector magnitude. Analysis of the EVM is performed for the selected code (*SELECT CODE* softkey) in the set channel type (*CHAN TYPE* softkey) and the selected slot (*SELECT SLOT* softkey). This means that this analysis makes allowance for results of a code in the selected channel type for one slot. The number of symbols on the x axis is between 2 and 100 (refer to Table 6-16).

Evaluation of the symbol error vector magnitude for unassigned codes is possible, but the results are not valid.

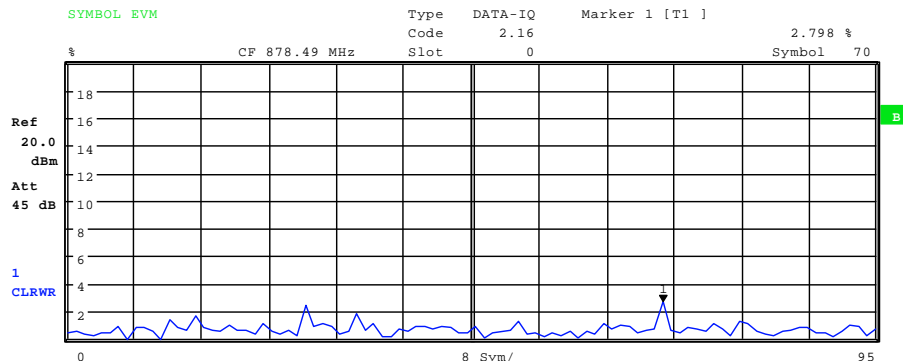


Fig. 6-22 Error vector magnitude for one slot of a channel

IEC bus command: :CALCulate2:FEED "XTIM:CDP:SYMB:EVM"



The *BITSTREAM* softkey selects the "Bit Stream" analysis".

Analysis of the different bits is performed for the selected code (*SELECT CODE* softkey) in the set channel type (*CHAN TYPE* softkey) and the selected slot (*SELECT SLOT* softkey). This means that this analysis makes allowance for results of a code in the selected channel type for one slot .

Depending on the symbol rate of the channel type and on the number of chips of the channel type, and also on the modulation type, a minimum of 4 and a maximum of 400 bits can be contained in a slot; refer to Table 6-16 on page 60. With QPSK modulated channels, one symbol always consists of two bits; with 8-PSK the number is three bits 3 and with 16-QAM it is four bits. With BPSK modulated channels, a symbol consists of one bit (either the I component or the Q component is assigned; for complex analysis a 2BPSK is displayed with I and Q components).

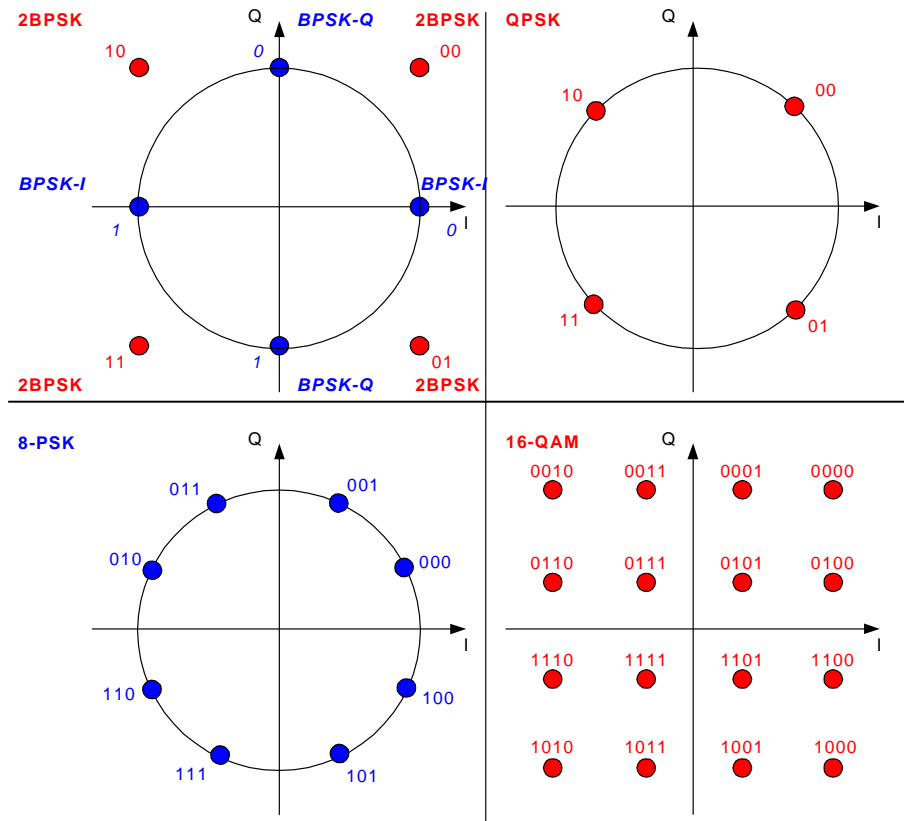


Fig. 6-23 Constellation diagrams for BPSK, QPSK, 8-PSK and 16-QAM including bit values

Depending on the channel type, there are the following modulated channels in the 1xEV-DO system:

Table 6-17 Relationship between channel type and modulation type

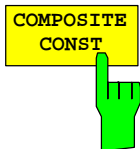
Kanaltyp	Modulation
PILOT	BPSK-I
MAC	BPSK-I / BPSK-Q
PREAMBE	BPSK-I
DATA	QPSK / 8-PSK / 16-QAM

An analysis of the bit stream for unassigned codes is indeed possible, but since

the results are not meaningful on account of the missing data, all bits are identified as invalid in this case by '-'.  
The marker can be used to scroll in the bit stream.

BITSTREAM		Type	DATA-IQ
CF 878.49 MHz		Code	2.16
		Slot	0
0	101 010 110 111	001 010 000 010	101 000
30	010 100 010 000	010 000 010 111	100 000
60	111 011 000 010	000 001 101 000	001 010
90	111 010 110 011	011 001 010 110	101 001
120	111 000 010 011	110 011 110 001	100 101
150	011 011 000 100	100 001 110 011	001 100
180	110 011 011 100	100 110 001 000	011 001
210	010 101 000 001	001 110 001 101	100 001
240	110 100 011 101	010 101 000 101	101 111
270	010 011 000 011	110 101	

Fig. 6-24 Demodulated bits for a slot of a channel in the channel type IEC bus command: :CALCulate2:FEED "XTIM:CDP:BSTream"



The *COMPOSITE CONST* softkey selects the analysis of the constellation diagram at chip level. With the *COMPOSITE CONST*, the total signal is taken into account by means of the selected channel type over the selected slot (*SELECT SLOT* softkey). A constellation point is plotted for each chip in the diagram. The number of chips depends on the selected channel type and, in the case of *PREAMBLE* and *DATA*, on the length of the preamble and can vary between 64 and 1600 chips.

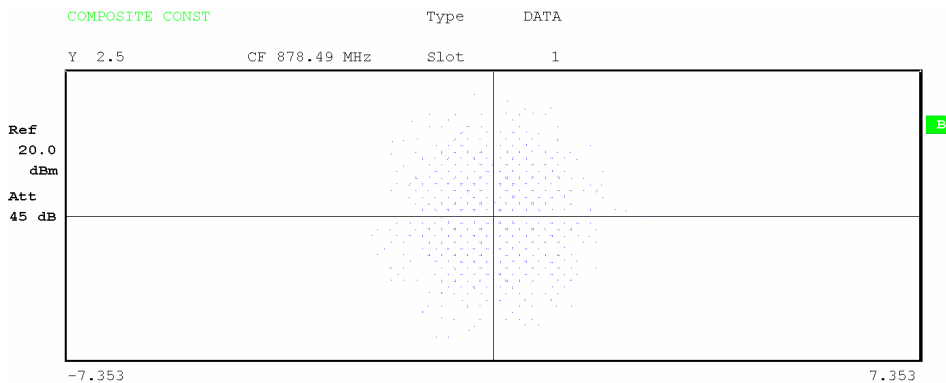
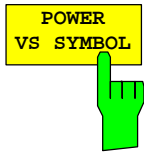


Fig. 6-25 Composite constellation diagram

IEC bus command: :CALCulate2:FEED "XTIM:CDP:COMP:CONS"



The *POWER VS SYMBOL* softkey selects the Power versus Symbol analysis. The analysis outputs the absolute power in dBm at each symbol time for the selected code (*SELECT CODE* softkey) in the set channel type (*CHAN TYPE* softkey) and the selected slot (*SELECT SLOT* softkey). This means that this analysis makes allowance for results of a code in the selected channel type for one slot. The number of symbols on the x axis is between 2 and 100 (refer to Table 6-16).

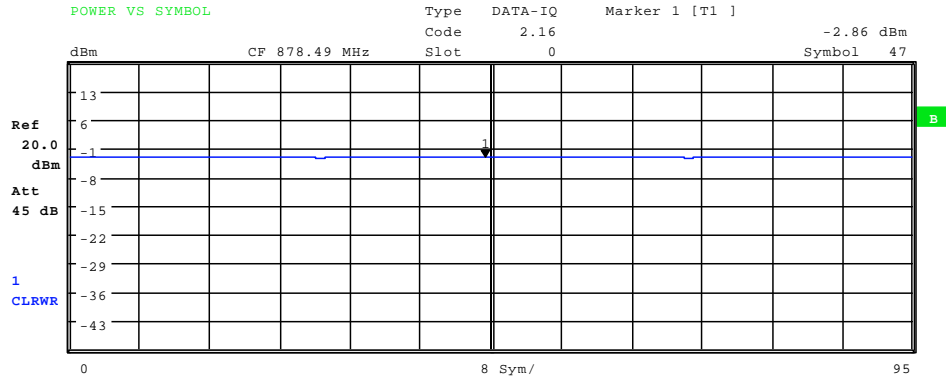
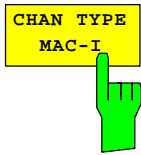


Fig. 6-26 Power versus Symbol for one slot of a channel in the channel type

IEC bus command: :CALCulate2:FEED "XTIM:CDP:PVSY"

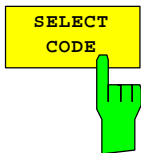


By operating the *CHAN TYPE* softkey, you go to a submenu on which you can set the following parameters:

- Channel type: *PILOT*, *MAC*, *PREAMBLE* or *DATA*
- Code Domain Overview mode can be enabled/disabled
- Mapping mode: *AUTO*, *COMPLEX* or *I OR Q* (whether I or Q branch is analyzed)
- *SELECT I/Q*: With separate *I OR Q* analysis, this determines which branch will be displayed.

On the second line of the *CHAN TYPE* softkey, the setting performed in the submenu is shown in its short form. Precise details of this softkey are provided on page 89.

IEC bus command: :[SENSe:]CDPower:CTYPe PILOt | MAC |  
PREAmble | DATA



You can use the *SELECT CODE* softkey to select a code. All analyses that take the results for a code into account specify the results for the newly selected channel: *POWER VS SYMBOL*, *CHANNEL RESULTS*, *BITSTREAM*, *SYMBOL CONSTELLATION* and *SYMBOL EVM*.

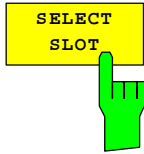
In the analyses *CODE DOMAIN POWER*, *CODE DOMAIN ERROR POWER* and *CHANNEL TABLE* (all on screen A), the selected code is identified in red to distinguish it.

Codes are entered in decimal format.

The rotating wheel behaviour depends on the analysis on screen A and is geared to the graphic display. With *CODE DOMAIN POWER* and *CODE DOMAIN ERROR POWER*, it is always the adjacent channel that is selected. With the channel table, the rotating wheel is used to scroll through the list. In this instance, the channel type and the selection of I or Q are reset automatically if this is required by the new channel that has to be selected.

The maximum settable value depends on the spreading factor of the channel type. *PILOT*, *PREAMBLE*: 0..31, *MAC*: 0..63 and *DATA* 0.63.

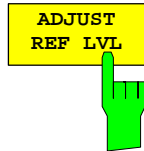
IEC bus command: :[SENSe:]CDPower:CODE 0...31 | 63 | 15,  
depending on the channel type



The *SELECT SLOT* softkey is used to select a slot. Slots are entered in decimal format. In this instance the range of values is from 0 to (Capture-Length-1); refer to the *CAPTURE LENGTH* softkey. All analyses that take the results for a slot into account specify the results for the newly selected slot: (CODE DOMAIN POWER, CODE DOMAIN ERROR POWER, CHANNEL TABLE, POWER vs CHIP, POWER vs SYMBOL, COMPOSITE CONSTELLATION, GENERAL RESULTS, CHANNEL RESULTS, BITSTREAM, SYMBOL CONSTELLATION and SYMBOL EVM)

In the analyses COMPOSITE EVM and PEAK CODE DOMAIN ERROR, the selected slot is highlighted in red.

IEC bus command: :[SENSe:]CDPower:SLOT 0 ...  
(CAPTURE\_LENGTH-1)



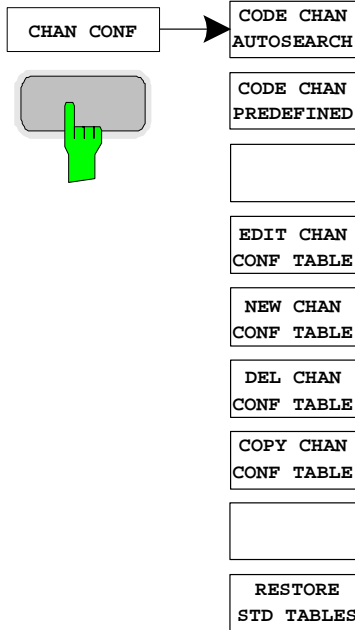
The *ADJUST REF LVL* softkey adjusts the reference level of the analyzer to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without the analyzer being overloaded or the dynamic response being limited by a too low signal-to-noise ratio.

IEC bus command: SENS:POW:ACH:PRES:RLEV



Measurement configuration

CHAN CONF hot key



The CHAN CONF hot key opens a submenu with the configuration options for the channel search. On this submenu, predefined channel tables can be selected and are then taken as a basis for measurements of the code domain analyzer.

When the hot key is selected, a table containing the channel tables stored on the hard disk of the measuring instrument is opened. The table is used merely to obtain an overview; one of the tables can be selected for the measurement only after the *CODE CHAN PREDEFINED* softkey has been operated. The *RECENT* entry is the channel table of the last Code Domain Power analysis to be performed.

IEC bus command:

```
:CONFigure:CDPower[:BTS]:CTable:CATalog?
```

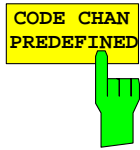


The *CODE CHAN AUTOSEARCH* softkey supports measurements of the code domain power analyzer in Autosearch mode. In this mode, all channel types are searched according to their spreading factors for active channels. A channel is active when the minimum power, referred to the total power, entered by the user is exceeded (refer to the *INACT CHAN THRESHOLD* softkey).

*CODE CHAN AUTOSEARCH* mode is the default search mode with which the CDP analysis starts. It is primarily used to provide the user with an overview of the channels contained in the signal. If the signal contains channels which are not detected as being active in Autosearch mode, the CDP analysis can be performed with predefined channel configurations by changing to *CODE CHAN PREDEFINED* mode.

IEC bus command:

```
:CONFigure:CDPower[:BTS]:CTable[:STATe] OFF
```



The *CODE CHAN PREDEFINED* softkey switches the CDP analysis to the measuring mode with the help of predefined channel tables. In this mode, there is no search for active channels, but the channels of a channel table defined before the measurement are assumed to be active.

When the softkey is selected, a table containing all the channel tables stored on the measuring instrument is opened. The CDP analysis is switched to "Predefined Channel Table" mode. In this instance, the last table of the automatic search mode is taken as a basis for the measurement. This table is available at the *RECENT* entry .

Switching to one of the predefined channel tables is done by selecting the corresponding table entry and operating one of the unit keys or by pressing Enter; the selected channel table is taken as a basis for the analysis as from the next measurement. A tick marks the selected channel table.

When the R&S FS-K84 leaves the factory, the following channel tables are stored on the measuring instrument:

Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type QPSK in channel type DATA. (File name: DOQPSK).

Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type 8-PSK in channel type DATA (File name DO8PSK).

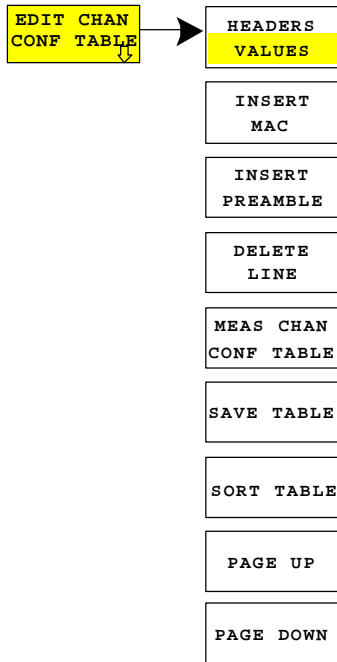
Channel table with channel types PILOT/MAC/PREAMBLE/DATA with modulation type 16-QAM in channel type DATA. (File name DO16QAM).

Channel table with channel types PILOT/MAC – known as IDLE slot, since it does not contain any active channels in the DATA channel type. (File name DO\_IDLE).

For a precise definition of the channel tables refer to Chapter 4.

IEC bus command:

```
:CONFigure:CDPower[:BTS]:CTABLE[:STATe] ON
:CONFigure:CDPower[:BTS]:CTABLE:SElect "DOQPSK"
```



The *EDIT CHAN CONF TABLE* softkey opens the selected channel table in which the channel configuration can be modified. In addition, a submenu is opened with the softkeys required for editing the channel table.

EDIT CHANNEL TABLE					
NAME:	DO16QAM				
COMMENT:	Base Station Main 2457.6 kbps (1 Slot) 16-QAM				
TYPE	CHAN.SF	SYMBOL RATE [ksps]	MODULATION/MAPPING	CDP REL [dB]	STATUS
PILOT	0.32	38.4	BPSK-I	0.0	ACTIVE
MAC	2.64	19.2	BPSK-I	0.0	ACTIVE
MAC	3.64	19.2	BPSK-I	0.0	ACTIVE
MAC	4.64	19.2	BPSK-I	0.0	ACTIVE
MAC	34.64	19.2	BPSK-Q	0.0	ACTIVE
MAC	35.64	19.2	BPSK-Q	0.0	ACTIVE
PRE64	2.32	38.4	BPSK-I	0.0	ACTIVE
DATA	0.16	76.8	16-QAM	0.0	ACTIVE
DATA	1.16	76.8	16-QAM	0.0	ACTIVE
DATA	2.16	76.8	16-QAM	0.0	ACTIVE
DATA	3.16	76.8	16-QAM	0.0	ACTIVE
DATA	4.16	76.8	16-QAM	0.0	ACTIVE
DATA	5.16	76.8	16-QAM	0.0	ACTIVE
DATA	6.16	76.8	16-QAM	0.0	ACTIVE
DATA	7.16	76.8	16-QAM	0.0	ACTIVE
DATA	8.16	76.8	16-QAM	0.0	ACTIVE
DATA	9.16	76.8	16-QAM	0.0	ACTIVE
DATA	10.16	76.8	16-QAM	0.0	ACTIVE
DATA	11.16	76.8	16-QAM	0.0	ACTIVE
DATA	12.16	76.8	16-QAM	0.0	ACTIVE
DATA	13.16	76.8	16-QAM	0.0	ACTIVE
DATA	14.16	76.8	16-QAM	0.0	ACTIVE
DATA	15.16	76.8	16-QAM	0.0	ACTIVE

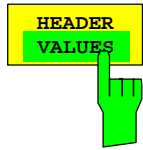
Fig. 6-27 Table for editing a channel configuration

As a general rule, each of the channel tables stored on the measuring instrument can be modified at will. The edited table is not stored automatically on the hard disk of the measuring instrument but only by selecting the *SAVE TABLE* softkey. This prevents a table from being accidentally overwritten (such as one of the channel models).

If a table is edited that is currently the basis for the Code Domain Power analysis, the edited table is used for the next measurement immediately after being saved. The effects of the changes in the table are therefore immediately visible. Here again, the edited table is not saved on the hard disk of the measuring instrument until the *SAVE TABLE* softkey has been selected.

If a table is edited that is stored on the hard disk of the measuring instrument but is not currently enabled, the changes will not be visible until it has been saved (*SAVE TABLE* softkey) and then enabled.

If the CHAN parameter of a channel is modified, a check of the code domain conflicts is performed after pressing the input (units keys). If a code domain conflict is detected, the associated channels are identified by an asterisk. You are given the opportunity of eliminating the code domain conflicts. When a table with code domain conflicts is used for a CDP analysis, the results are invalid.



The HEADER/VALUES softkey sets the focus of the edit option either to the entries in the table or to the table header.

Editing the table header (*HEADER*):

Overwriting of saved tables can be avoided by changing the name of a table. A table name must not consist of more than 8 characters.

IEC bus command:

```
:CONFigure:CDPower[:BTS]:CTable:NAME "NEW_TAB"
```

Editing table entries (*VALUES*):

The actual data of the channel table are edited here. The following entries are available for each of the channels contained in the table (confirm an input with the help of the units keys):

**TYPE:** Defines the channel type, either PILOT, MAC, PRE64, PRE128, PRE256, PRE512, PRE1024 or DATA. With the PREAMBLE channel type, the length of the preamble is entered simultaneously in chips. The entry cannot be edited, because the PILOT channel and the 16 DATA channels are always available, and MAC and PREAMBLE can be inserted by means of the *INSERT* softkeys.

**CHAN.SF:** The channel number is entered for the channel in this column. The spreading factor is inserted automatically depending on the channel type (refer to Table 6-16 on page 60). Invalid entries are rejected.

**SYMBOL RATE:** Symbol rate with which the channel is transmitted. It depends directly on the spreading factor of the channel type (refer to Table 6-16) and cannot therefore be edited.

**MODULATION:** The modulation type is entered here. With channel types PILOT, MAC and PREAMBLE, mapping is specified too - that is, whether a channel will transmit on the I or Q branch. The following settings are possible:

- PILOT : BPSK-I (permanent, edit not possible)
- MAC : BPSK-I / BPSK-Q
- PREAMBLE : BPSK-I / BPSK-Q
- DATA : QPSK / 8-PSK / 16-QAM

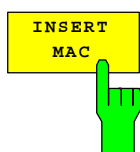
**CDP REL.:** Informative entry of the relative channel power (referred to the total power in the channel type). The entry cannot be edited and only exists for the *RECENT* table; it is used to detect channels with low power.

**STATUS:** Status of the channel (active/inactive). When a change of channel status occurs, a channel that has been entered in the table can be hidden in the Code Domain Power analysis without having to remove the corresponding entry from the table. Only channels having an "active" channel status are used for the CDP analysis.

**IEC bus commands**

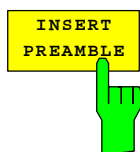
```
:CONF:CDP:CTAB:DATA 0,5,0,0,0,0,1,0.0,
                    1,6,35,1,0,0,1,0.0"
'Selects PILOT 0.32 BPSK-I and
'MAC 35.64 BPSK-Q..

:CONFigure:CDPower[:BTS]:CTABLE:COMMENT "Comment
for new table"
```



The *INSERT MAC* softkey adds a new entry to the table. Entries can be made in any order.

IEC bus command: -- (integrated in the :CONFigure:CDPower[:BTS]:CTABLE:DATA command)

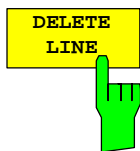


The *INSERT PREAMBLE* softkey makes it possible to add the Preamble channel to the channel table.

INSERT PREAMBLE	
PRE64	PREAMBLE 64 CHIPS
PRE128	PREAMBLE 128 CHIPS
PRE256	PREAMBLE 256 CHIPS
PRE512	PREAMBLE 512 CHIPS
PRE1024	PREAMBLE 1024 CHIPS

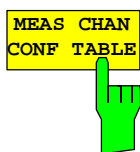
Fig. 6-28 Table of Preamble selection

IEC bus command: -- (integrated in the :CONFigure:CDPower[:BTS]:CTABLE:DATA command)



The *DELETE LINE* softkey deletes the selected line from the table.

IEC bus command: --



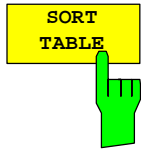
The *MEAS CHAN CONF TABLE* softkey initiates a measurement in *CODE CHAN AUTOSEARCH* mode. The measurement results are applied to the open channel table. The softkey is only available in *CODE CHAN AUTOSEARCH* mode.

IEC bus command: --



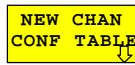
The *SAVE TABLE* softkey saves the table with its specified name.  
 Note: Editing of the channel models and saving with the original name results in the models being overwritten.

IEC bus command: -- (automatic with remote control)



The *SORT TABLE* softkey sorts the table according to channel types (PILOT, MAC, PREAMBLE, and DATA) and in channel number order within the channel types.

IEC bus command: --



- HEADERS VALUES
- INSERT MAC
- INSERT PREAMBLE
- DELETE LINE
- MEAS CHAN CONF TABLE
- SAVE TABLE
- SORT TABLE
- PAGE UP
- PAGE DOWN

The *NEW CHAN CONF TABLE* softkey opens a submenu that is identical with that described for the *EDIT CHAN CONF TABLE* softkey. Unlike *EDIT CHAN CONF TABLE*, a new channel table with the PILOT channel type and channel 0.32 and the 16 DATA channel types for *NEW CHAN CONF TABLE*. The name of the table has still not been fixed at present:

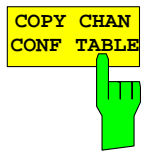
EDIT CHANNEL TABLE					
NAME:					
COMMENT:					
TYPE	CHAN.SF	SYMBOL RATE [kpsps]	MODULATION/MAPPING	CDP REL [dB]	STATUS
PILOT	0.32	38.4	BPSK-I	0.0	ACTIVE
DATA	0.16	76.8	16-QAM	0.0	ACTIVE
DATA	1.16	76.8	16-QAM	0.0	ACTIVE
DATA	2.16	76.8	16-QAM	0.0	ACTIVE
DATA	3.16	76.8	16-QAM	0.0	ACTIVE
DATA	4.16	76.8	16-QAM	0.0	ACTIVE
DATA	5.16	76.8	16-QAM	0.0	ACTIVE
DATA	6.16	76.8	16-QAM	0.0	ACTIVE
DATA	7.16	76.8	16-QAM	0.0	ACTIVE
DATA	8.16	76.8	16-QAM	0.0	ACTIVE
DATA	9.16	76.8	16-QAM	0.0	ACTIVE
DATA	10.16	76.8	16-QAM	0.0	ACTIVE
DATA	11.16	76.8	16-QAM	0.0	ACTIVE
DATA	12.16	76.8	16-QAM	0.0	ACTIVE
DATA	13.16	76.8	16-QAM	0.0	ACTIVE
DATA	14.16	76.8	16-QAM	0.0	ACTIVE
DATA	15.16	76.8	16-QAM	0.0	ACTIVE

Fig. 6-29 Creating a new channel configuration



The *DEL CHAN CONF TABLE* softkey deletes the selected table. The current table in *CODE CHAN PREDEFINED* mode cannot be deleted.

IEC bus command:  
 :CONFigure:CDPower[:BTS]:CTable:DELeTe



The *COPY CHAN CONF TABLE* softkey copies the selected table. The system asks the name under which you want to save the copy.

IEC bus command:  
 :CONFigure:CDPower[:BTS]:CTable:COpy "CTAB2"



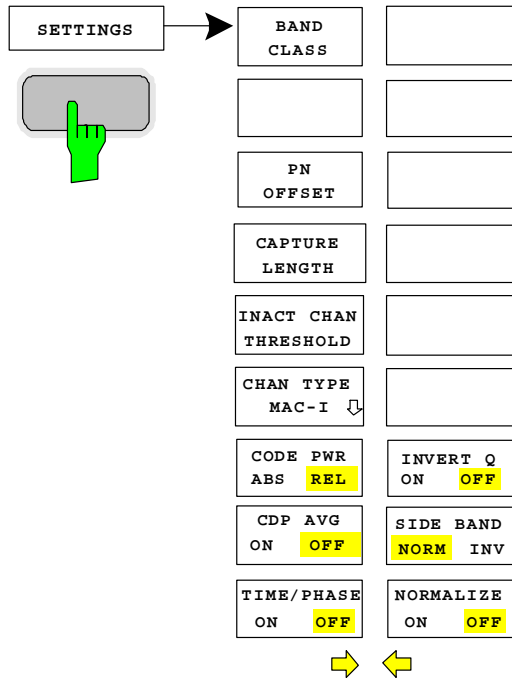
The *RESTORE STD TABLES* softkey restores the channel tables defined in Chapter 4, "Predefined Channel Tables", to the state in which they were in when the device left the factory. In this way unintentional overwriting of the channel table can be undone.

IEC bus command:

```
:CONFigure:CDPower[:BTS]:CTABLE:RESTore
```

### Configuring the firmware application – SETTINGS

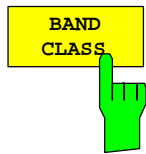
SETTINGS hot key



The *SETTINGS* hot key opens a submenu for setting the measurement parameters of the firmware application.

The *BAND CLASS* softkey is a setting parameter for the RF measurements "adjacent channel power" and "spectrum emission mask".

All other softkeys configure the measurements in the code domain analyzer.



The *BAND CLASS* softkey allows input of the used frequency band for the RF measurements, adjacent channel measurement and spectrum emission mask. The selection is made from a table in which the name of the band class is displayed.

Entry of the center frequency is not restricted by the band class selection.

BAND CLASS SELECTION	
Band Class 0	(800 MHz Band)
✓ Band Class 1	(1900 MHz Band)
Band Class 2	(TACS Band)
Band Class 3	(JTACS Band)
<b>Band Class 4</b>	<b>(Korean PCS Band)</b>
Band Class 5	(450 MHz Band)
Band Class 6	(2 GHz Band)
Band Class 7	(700 MHz Band)
Band Class 8	(1800 MHz Band)
Band Class 9	(900 MHz Band)
Band Class 10	(Secondary 800 MHz Band)
Band Class 11	(400 MHz European PAMR Band)
Band Class 12	(800 MHz PAMR Band)

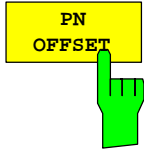
Fig. 6-30 Band class selection

You can scroll in the table, and the entry currently being used is checked, while a bar displays the selected entry; click ENTER to apply the value.

The numerical value is specified over the IEC bus.

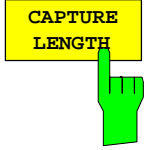
IEC bus command: :CONFigure:CCDPower:BClass 1 '1900 MHz





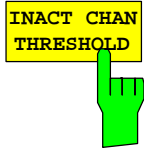
The PN OFFSET softkey allows entry of the base station PN offset, which is used to distinguish between the base stations with 1xEV-DO. The PN offset determines the offset in the circulating PN sequence in multiples of 64 chips with reference to the event second clock trigger.

IEC bus command: `: [SENSe:]CDPower:PNOffset 0...511`



The CAPTURE LENGTH softkey allows entry of the number of slots to be acquired. The input is always made as a multiple of the slot. The range is between 2 and 36 for the Analyzers R&S FSU/R&S FSQ and from 2 to 12 for the Analyzer R&S FSP. For all analyses that exhibit a value per slot on the x axis the maximum value on the x axis is the set CAPTURE LENGTH -1.

IEC bus command: `: [SENSe:]CDPower:IQLength 2..36 (2..12)`



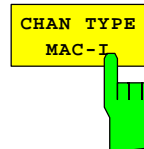
The INACT CHAN THRESHOLD softkey allows entry of the minimum power that an individual channel must have in the MAC or DATA channel type, compared with the total signal of the channel type, to be regarded as the active channel. Channels below the specified threshold are regarded as "inactive".

With the PILOT channel type, the code 0.32 is normally expected on the I branch, synchronization will not otherwise take place and the 'SYNC FAILED' message failed appears. In the PREAMBLE channel type, only one code is normally assigned and thus the optimum detection threshold is permanently -4.5 dB below the total power of the PREAMBLE channel type.

The two measurements COMPOSITE EVM and PEAK CODE DOMAIN ERR, which are specified as measurements on the total signal, are performed using the list of active channels. Distortions of these two measurements always occur when active channels are not detected as being active and unassigned codes are wrongly given the status of "occupied channel". INACT CHAN THRESHOLD can therefore be used to influence the results of the two measurements.

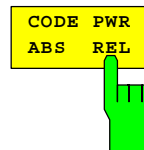
The default value is -40 dB. If not all channels contained in the signal are detected automatically, INACT CHAN THRESHOLD must be decremented.

IEC bus command:  
`: [SENSe:]CDPower:ICTReshold -100 dB ... 0 dB`



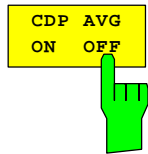
The CHAN TYPE softkey branches to a separate submenu. This will be explained after the Settings menu.

IEC bus command:  
`: [SENSe:]CDPower:CTYPE PILOt | MAC | PREAMble | DATA`



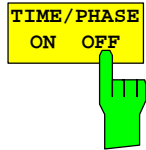
The CODE PWR ABS/REL softkey selects for the CODE DOMAIN POWER analysis whether the y-values should be displayed as absolute (dBm) or relative (dB). In Relative mode the reference is the total power of the channel type.

IEC bus command:  
`:CALCulate<1>:FEED "XPOW:CDP:RAT" (relative)`  
`:CALCulate<1>:FEED "XPOW:CDP" (absolute)`



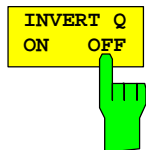
The CDP AVG softkey is available for the code domain analysis. If it is ON, the code domain analysis is averaged over all slots. This analysis is required by the 1xEV-DO Standard. It presumes, however, with the DATA and PREAMBLE channel types that preambles of different length do not occur in the slots. This averaging is not permitted otherwise. If averaging is active, then it will be necessary, in the function field above the CDP display *SLOT*:, to read *ALL*. To be able to measure signals of any configuration, the default value is OFF.

IEC bus command: `:[SENSe:]CDPower:AVERage ON | OFF`



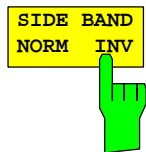
The TIME/PHASE ON/OFF softkey supports specific enabling and disabling of the Timing and Phase Offset analysis of the channels for the pilot. If the value of the softkey is OFF (default setting) or there are more than 50 active channels in the signal, dashes ('---') are entered in the channel occupancy and in the Channel Results analysis for timing and phase offset. If the softkey is ON, the analysis will take place and the values will be displayed.

IEC bus command: `: [SENSe: ]CDPower:TPMeas ON | OFF`



The *INVERT Q* softkey inverts the sign of the Q component of the signal. The default setting is OFF.

IEC bus command: `: [SENSe:]CDP:QINVert OFF`



The *SIDE BAND NORM / INV* softkey chooses between measurement of the signal in normal (NORM) and inverted spectral position (INV).

**NORM** The normal position allows measurement of base station RF signals.

**INV** The inverted position is practical for measurements on IF modules or components in the case of spectral inversion.

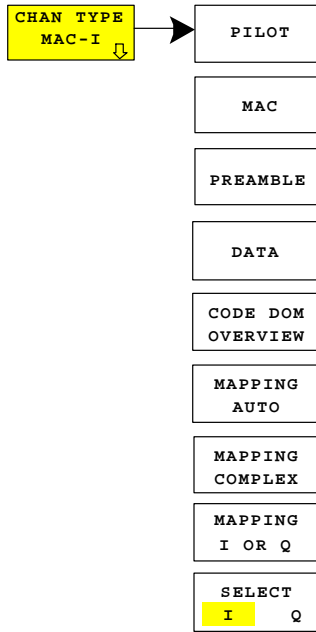
The default setting is NORM.

IEC bus command: `: [SENSe: ]CDPower:SBANd NORMal | INVers`



The *NORMALIZE ON / OFF* softkey eliminates the DC offset from the signal. The default setting of the parameter is OFF.

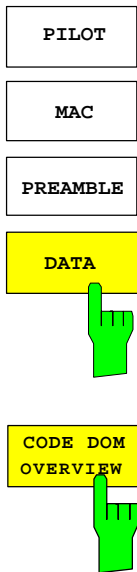
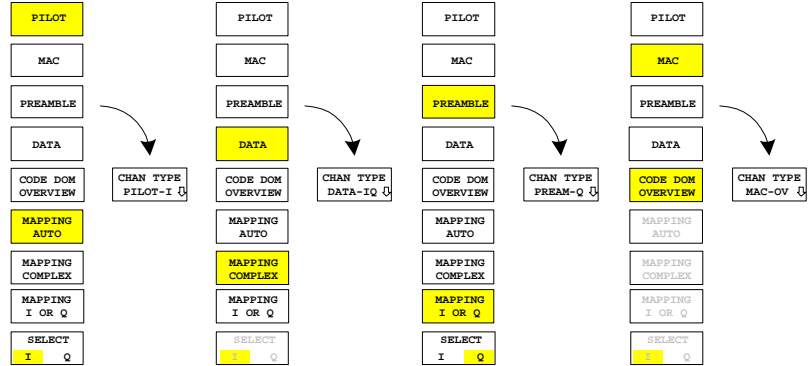
IEC bus command: `: [SENSe:]CDP:NORMAlize OFF`



The menu shown on the left is opened with the *CHAN TYPE* softkey. This softkey is present on both the *SETTINGS* and the *RESULTS* menus.

On the *CHAN TYPE* menu, the channel type and mapping mode can be set. Furthermore, it is possible to select I/Q on it, and the Code Domain Overview mode can be enabled and disabled.

Depending on the menu settings, the second line of the *CHAN TYPE* softkey is labeled in the following examples:

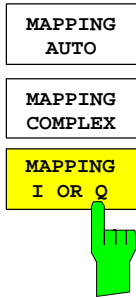


The *PILOT*, *MAC*, *PREAMBLE* and *DATA* softkeys are a 1-out-of-4 selection and define the corresponding channel type. Since the four channel types subdivide 1xEV-DO slot with regard to time, the majority of the analyses of the code domain analyzers are available for each channel type. Refer to Table 6-15. The default value is *PILOT*.

```
IEC bus command: :[SENSe:]CDPower:CTYPE PILOt | MAC |
PREAmble | DATA
```

The *CODE DOM OVERVIEW* softkey is available for the code domain power and code domain error-power and can be enabled. If Overview mode is activated, screen A will display the I branch and screen B the Q branch of the CDP and CDEP analysis as a general rule. The *MAPPING AUTO*, *MAPPING COMPLEX*, *MAPPING I OR Q* and *SELECT I/Q* softkeys are not available when Code Domain Overview mode is active. The default setting is OFF.

```
IEC bus command: :[SENSe:]CDPower:OVERview ON | OFF
```

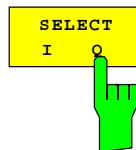


The *MAPPING AUTO*, *MAPPING COMPLEX* and *MAPPING I OR Q* softkeys are a 1-out-of-3 selection. Mapping mode determines whether the I or Q branch or the complex signal is analyzed. Mapping is selected automatically with the *MAPPING AUTO* softkey, depending on the channel type:

Channel type	Mapping
PILOT	I OR Q
MAC	I OR Q
PREAMBLE	I OR Q
DATA	COMPLEX

In order to obtain the option of examining every channel type individually as either complex, or the I and Q branch on their own, mapping can be permanently set by means of the *MAPPING COMPLEX* and *MAPPING I OR Q* softkeys. It is then valid for all channel types. The default value is *MAPPING AUTO*.

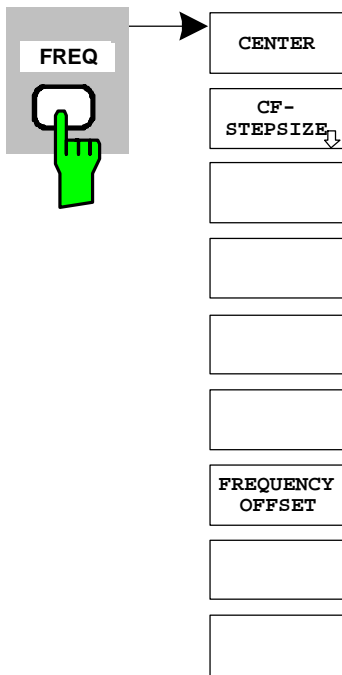
IEC bus command: :[SENSe:]CDPower:MMODE AUTO | IOQ | COMPLEX



The I or Q branch to be analyzed is selected with the *SELECT I/Q* softkey. The softkey is not available for *MAPPING COMPLEX*. The I branch is selected after a Preset.

IEC bus command: :[SENSe:]CDPower:MAPPING I | Q

**Frequency settings – FREQ key**



The *FREQ* key opens a submenu for changing the measurement frequency.

The *CENTER* softkey opens the input window for manually entering the center frequency.

The permissible input range of the center frequency is 
$$\text{Minspan}/2 \leq f_{\text{center}} \leq f_{\text{max}} - \text{Minspan}/2$$

- $f_{\text{center}}$  center frequency
- Minspan smallest selectable span >0 Hz (10 Hz)
- $f_{\text{max}}$  maximum frequency

IEC bus command: :FREQ:CENT 100MHz

*CF-STEPSIZE* opens a submenu for setting the step size of the center frequency change. There is an option of entering the step size manually (*MANUAL* softkey) or using the current measurement frequency (*CENTER* softkey). The softkeys are described in the manual for the basic device.

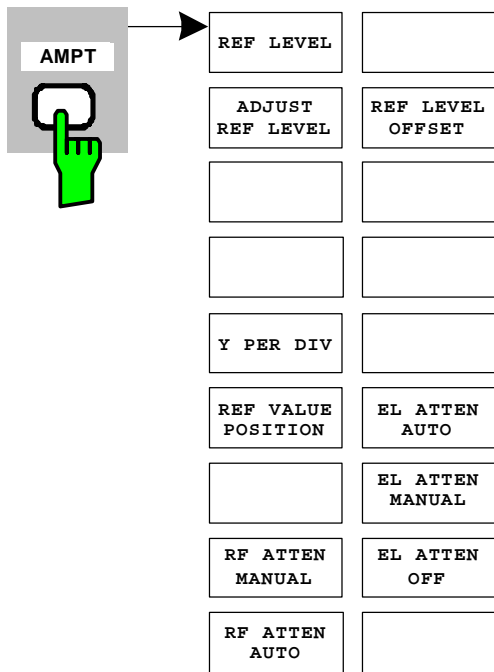
The *FREQUENCY OFFSET* softkey enables entry of an arithmetic frequency offset which is added to the frequency axis labelling. The range for the offset is -100 GHz to 100 GHz. The default setting is 0 Hz.

IEC bus command: :FREQ:OFFS 10 MHz

**Span settings – SPAN key**

The *SPAN* key is disabled for measurements in the code domain analyzer. For all other measurements (refer to the *MEAS* key), the permissible span settings are explained for the measurement concerned. The associated menu corresponds to that of the measurement in the basic device and is described in the manual for the basic device.

Level settings – AMPT key



The *AMPT* key opens a submenu for setting the reference level.

The *REF LEVEL* softkey enables entry of the reference level. The entry is performed in dBm.

```
IEC bus command: :DISP:WIND:TRAC:Y:RLEV -60dBm
```

*ADJUST REF LEVEL* executes a routine for optimum adaptation of the reference level to the signal.

```
IEC bus command: :[SENSe<1|2>:]CDPower:LeVel:ADJust
```

The *REF LEVEL OFFSET* softkey enables entry of an arithmetic level offset. This is added to the measured level irrespective of the selected unit. The Y axis scaling is changed accordingly.

The setting range is  $\pm 200$  dB in steps of 0.1 dB.

```
IEC bus command: :DISP:WIND:TRAC:Y:RLEV:OFFS -10dB
```

*Y PER DIV* sets the grid spacing on the y axis for all diagrams in which this is possible.

```
IEC bus command: :DISPlay[:WINDow<1|2>]:TRACe<1..3>:Y[:SCALE]:RPOSITION
```

*REF VALUE POSITION* supports entry of the position of the y-axis reference value on the axis (0 to 100%).

```
IEC bus command: :DISPlay[:WINDow<1|2>]:TRACe<1..3>:Y[:SCALE]:PDIVision
```

The *RF ATTEN MANUAL* softkey enables entry of the attenuation, irrespective of the reference level.

If the required reference level can no longer be set for the given RF attenuation, it will be adjusted and the message "Limit reached" will be issued.

```
IEC bus command: INP:ATT 40 DB
```

The *RF ATTEN AUTO* softkey sets the RF attenuation automatically irrespective of the set reference level.

This ensures that the optimum attenuation desired by the user is always used.

*RF ATTEN AUTO* is the default setting.

```
IEC bus command: INP:ATT:AUTO ON
```

The *EL ATTEN MANUAL* softkey enables the electronic step attenuator enables entry of the attenuation, which is set on the electronic step attenuator.

The attenuation can be modified in steps of 5 dB between 0 and 30 dB. Other entries will be rounded down to the next lower integer value.

```
IEC bus command: INP:EATT:AUTO OFF;  
                  INP:EATT 10 DB
```

The softkey is only available with the *ELECTRONIC ATTENUATOR FSP-B25, FSU-B25 and FSQ-B25* option.

The *EL ATTEN AUTO* softkey enables the electronic step attenuator and sets its attenuation to 0 dB.

The permissible range of the reference level extends from the current reference level on enabling the electronic step attenuator to 30 dB beyond that value. If a reference level outside the permissible 30 dB range is set, the setting is performed with the mechanical step attenuator. Starting from this new reference level up to 30 dB above it, the setting is again performed with this electronic step attenuator.

```
IEC bus command:      INP:EATT:AUTO ON
```

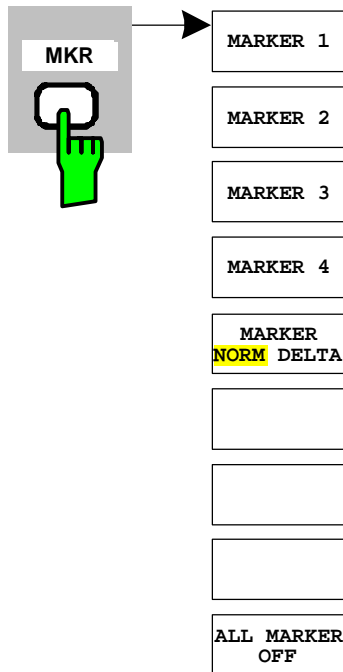
The softkey is only available with the *ELECTRONIC ATTENUATOR FSP-B25, FSU-B25 and FSQ-B25* option.

The *EL ATTEN OFF*

```
IEC bus command:      INP:EATT:STAT OFF
```

The softkey is only available with the *ELECTRONIC ATTENUATOR FSP-B25, FSU-B25 and FSQ-B25* option.

Marker settings - MKR key



The *MARKER* key opens a submenu for the marker settings.

Markers are not available for the *GENERAL RESULTS*, *CHANNEL RESULTS* and *CHANNEL TABLE* analyses. Up to four markers can be enabled in all other analyses and defined as marker or delta marker with the help of the *MARKER NORM/DELTA* softkey.

The *MARKER 1/2/3/4* softkeys select the marker concerned and enable it simultaneously.

Marker 1 is always the normal marker after it has been enabled, while markers 2 to 4 are delta referring to marker 1 after they have been enabled. The *MARKER NORM DELTA* softkey can be used to transform these markers into markers with absolute measure value display. If marker 1 is the active marker, *MARKER NORM DELTA* is enabled as an additional delta marker.

Pressing the *MARKER 1* to *MARKER 4* softkeys disables the selected marker.

IEC bus command:       :CALC:MARK ON;  
                           :CALC:MARK:X <value>;  
                           :CALC:MARK:Y?  
                           :CALC:DELT ON;  
                           :CALC:DELT:MODE ABS|REL  
                           :CALC:DELT:X <value>;  
                           :CALC:DELT:X:REL?  
                           :CALC:DELT:Y?

The *ALL MARKER OFF* softkey disables all markers (reference and delta markers). It also disables the functions and displays associated with the markers and delta markers.

IEC bus command:       :CALC:MARK:AOFF

The parameters relating to an enabled marker are read out above the diagrams:

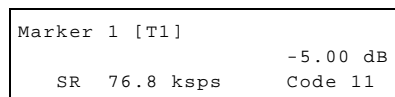


Fig. 6-31 Diagram marker field

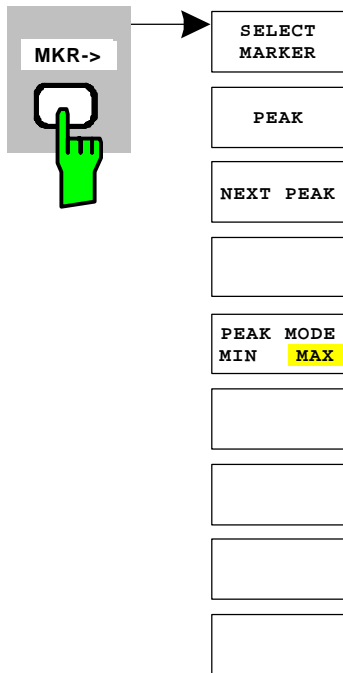
Apart from the channel power, which is displayed relative to the total power in the channel type, the parameters of the channel are specified. The meanings are as follows (for the channel assigned to the marker):

SR 76.8 ksp/s:   Symbol rate of the channel  
 Code 11:       Walsh code number of the channel

For all other measurements not belonging to the code domain analyzer the marker functions of the basic device apply.



## Changing instrument settings – MKR→ key



The *MKR→* key opens a submenu for marker functions:

The *SELECT MARKER* softkey selects the desired marker in a data input field. If the marker is disabled, it is enabled and can then be moved. You enter a number. Delta marker 1 is selected by entering '0'.

IEC bus command:       :CALC:MARK1 ON;  
                           :CALC:MARK1:X <value>;  
                           :CALC:MARK1:Y?

The *PEAK* softkey sets the active marker or delta marker to the maximum/minimum of the associated trace.

If no marker had been active before the *MKR->* menu was opened, marker 1 is automatically enabled and the Peak function is executed.

IEC bus command:       :CALC:MARK:MAX  
                           :CALC:DELT:MAX  
                           :CALC:MARK:MIN  
                           :CALC:DELT:MAX

The *NEXT PEAK* softkey sets the active marker or delta marker to the next lower maximum/minimum value of the associated trace. The search direction is specified by the setting in the *NEXT MODE LEFT/RIGHT* submenu.

IEC bus command:       :CALC:MARK:MAX:NEXT  
                           :CALC:DELT:MAX:NEXT  
                           :CALC:MARK:MIN:NEXT  
                           :CALC:DELT:MIN:NEXT

The *PEAK MODE MIN/MAX* softkey sets whether the peak search should determine the maximum or minimum value of the trace. The parameter affects the behavior of the *PEAK* and *NEXT PEAK* softkeys.

IEC bus command:       --

IEC bus commands:  
                           :CALCulate<1|2>:MARKer<1>:Y?

## Marker functions – MKR FCTN key

The MKR FCTN key is disabled for all measurements of the code domain analyzer. For all other measurements of the R&S FS-K84, the softkeys are described in the manual for the basic device.

## Bandwidth setting – BW key

The BW keys disabled for all measurements of the code domain analyzer. For all other measurements of the R&S FS-K84, the softkeys associated with the menu are described in the manual for the basic device.

**Measurement control – SWEEP key**

The menu of the SWEEP key contains options for switching between single measurement and continuous measurement, and also control of single measurements. For measurements in the spectral range, the measurement time for a sweep and the number of sweep points can also be set. All the softkeys associated with the menu are described in the manual for the basic device.

**Measurement selection – MEAS key**

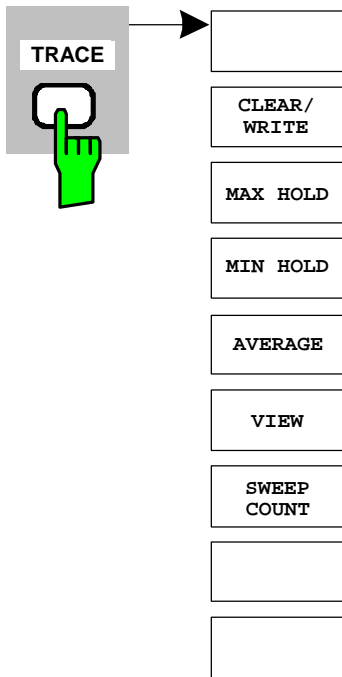
The menu of the MEAS key contains all the measurements that can be selected on the R&S FS-K84 by pressing a key. The menu and its submenus are described in Chapter 6.

### Trigger settings – TRIG key

The selectable trigger options depend on the measurement selected. For the code domain power analyzer, a free-run mode and a mode with the external even second clock trigger called for by the 1xEV-DO Standard are possible. The trigger options for all other measurements are identical to those of the corresponding measurement in the basic device. The associated softkeys are described in the manual for the basic device.

The GATED TRIGGER can be used with POWER, ADJACENT CHANNEL LEAKAGE RATION, SPECTRUM EMISSION MASK and OCCUPIED BANDWIDTH measurements to measure idle slots as well (only PILOT and MAC channel types active). To do this, set the power range with GATE DELAY and GATE LENGTH after selecting a trigger source in the GATED TRIGGER SETTINGS and then connect the GATED TRIGGER on the Trigger menu.

### Trace settings – TRACE key



The TRACE key opens the following submenu:

The CLEAR/WRITE softkey enables Overwrite mode for the acquired measured values, i.e. the trace is rewritten for each sweep. After the CLEAR/WRITE softkey has been operated, the device deletes the selected trace memory and restarts the measurement.

IEC bus command: `:DISP:WIND:TRAC:MODE WRIT`

The MAX HOLD softkey activates the peak value detector. The analyzer only accepts the new measured value into the saved trace data if it is larger than the previous one. Pressing the MAX HOLD softkey a second time deletes the trace memory and starts peak value detection from the beginning again.

IEC bus command: `:DISP:WIND:TRAC:MODE MAXH`

The MIN HOLD softkey activates the minimum value detector. The analyzer only accepts the new measured value into the saved trace data if it is smaller than the previous one. Pressing the MIN HOLD softkey a second time deletes the trace memory and starts minimum peak detection from the beginning again.

IEC bus command: `:DISP:WIND:TRAC:MODE MINH`

The AVERAGE softkey enables the trace averaging function. The average is formed from several sweeps. Averaging is performed irrespective of the AVG MODE LOG / LIN setting on the logarithmic level values or on the measured power/voltage values. Averaging is restarted every time the AVERAGE softkey is pressed. The trace memory is always cleared.

IEC bus command: `:DISP:WIND:TRAC:MODE AVER`

For the measurements in the code domain analyzer, an AVERAGE/ MAX HOLD or MIN HOLD is possible. With the Channel Occupancy Table analysis, the channel configuration measured on the first sweep is retained for the trace statistics. If the signal is reconfigured, the SINGLE SWEEP softkey (and CONTINUOUS SWEEP if necessary) must be pressed. The GENERAL RESULT, CHANNEL RESULT, BITSTREAM analyses and the CONSTELLATION diagrams support only CLEAR WRITE

mode as a general rule.

The *SWEEP COUNT* softkey sets the number of sweeps over which the average value is formed. The permissible range is 0 to 30000, though the following should be noted:

Sweep Count = 0 means running averaging with averaging length of 10

Sweep Count = 1 means no averaging

Sweep Count > 1 averaging over the specified number of sweeps; in continuous sweep mode averaging changes over to running averaging once this number has been reached.

The default setting is running averaging (Sweep Count = 0). The number of sweeps used for averaging is always equal to the averaging length of 10 for all active traces in the selected diagram.

IEC bus command:       :SWE:COUN 64

### Display lines – *LINES* key

The *LINES* key is disabled for all measurements of the code domain analyzer. The menu setting options for all other measurements are equivalent to those of the corresponding measurement in the basic device. The respective softkeys are described in the manual for the basic device.

### Measurement screen settings – *DISP* key

The menu of the *DISP* key contains softkeys for configuring the measurement screen. The menus and the softkey properties are described in the manual for the basic device.

### Storing and loading of device data – *FILE* key

The *FILE* menu is the same as that of the basic device. All softkeys are described in the manual for the basic device.

**Preset of device – PRESET key**

The *PRESET* key presets the device. The behaviour is the same as of the basic unit and is described in the manual for the basic unit.

**Calibration of device – CAL key**

The menu *CAL* is the same as that of the basic unit. All softkeys are described in the manual for the basic unit.

**Setup of device – SETUP key**

The menu *SETUP* is the same as that of the basic unit. All softkeys are described in the manual for the basic unit. The usage of transducer factors is possible in the Code-Domain as well as in the RF measurements.

**Printing – HCOPY key**

The menu *HCOPY* is the same as that of the basic unit. All softkeys are described in the manual for the basic unit.

All keys on the front panel of the unit that are not specifically mentioned are identical to those of the basic unit. The functions of the keys and the softkeys are described in the manual of the basic unit.

## 7 Remote Control Commands

This chapter describes the remote control commands for the application firmware. An alphabetical list following the description provides a quick overview of the commands.

The commands, which also apply to the basic device in SPECTRUM mode, and the system settings are described in the operating manual for the analyzer.

### CALCulate:FEED subsystem

The type of analysis can be selected with the CALCulate:FEED subsystem. This corresponds to the result display selection in manual operation.

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate<1 2>: :FEED	<string>		No query

#### :CALCulate<1|2>:FEED <string>

This command selects the measured data that will be displayed.

**Parameters:**      <string>::= 'XPOW:CDP' |  
                                       'XPOW:CDP:RAT' |  
                                       'XPOW:CDEP' |  
                                       'XTIM:CDP:MACCuracy' |  
                                       'XTIM:CDP:PVCHip' |  
                                       'XTIM:CDP:PVSYmbol' |  
                                       'XTIM:CDP:BSTReam' |  
                                       'XTIM:CDP:ERR:SUMM' |  
                                       'XTIM:CDP:ERR:CTABLE' |  
                                       'XTIM:CDP:ERR:PCDomain' |  
                                       'XTIM:CDP:SYMB:CONStellation' |  
                                       'XTIM:CDP:SYMB:EVM' |  
                                       'XTIM:CDP:COMP:CONStellation'

The meanings of the string parameters are as follows:

'XPOW:CDP'	Result display of the code domain power absolute in the bar chart (CALCulate<1>)
'XPOW:CDP:RAT'	Result display of the code domain power ratio (relative) in the bar chart (CALCulate<1>)
'XPOW:CDEP'	Result display of the code domain error power in the bar chart (CALCulate<1>)
'XTIM:CDP:ERR:SUMM'	Tabular analysis of results (CALCulate2)
'XTIM:CDP:ERR:CTABLE'	Display of the channel occupancy table (CALCulate<1>)
'XTIM:CDP:ERR:PCDomain'	Result display of the peak code domain error (CALCulate2)
'XTIM:CDP:MACCuracy'	Result display of the COMPOSITE EVM (CALCulate2)
'XTIM:CDP:PVCHip'	Result display of power versus chip (CALCulate2)
'XTIM:CDP:PVSYmbol'	Result display of power versus symbol (CALCulate2)
'XTIM:CDP:BSTReam'	Result display of bit stream (CALCulate2)
'XTIM:CDP:SYMB:CONStellation'	Result display of symbol constellation (CALCulate2)
'XTIM:CDP:SYMB:EVM'	Result display of error vector magnitude (CALCulate2)
'XTIM:CDP:COMP:CONStellation'	Result display of composite constellation (CALCulate2)

<b>Example:</b>	"INST:SEL BDO"	'Activate 1xEV-DO BTS
	"INIT:CONT OFF"	'Select single sweep
	"CALC2:FEED `XTIM:CDP:MACC`"	'Select COMP EVM analysis
	"INIT;*WAI"	'Start measurement with sync
	"TRAC? TRACE2"	'Query COMP EVM data

<b>Features:</b>	*RST value:	'XPOW:CDP:RAT' (CALCulate<1>)
		'XTIM:CDP:ERR:SUMM' (CALCulate<2>)
	SCPI:	Conforms

**Note:** *The code domain power measurements are always shown in split screen mode and the allocation of the analysis to the measurement window is fixed. Therefore, specify for every analysis in brackets the numerical suffix that is necessary or allowed at CALCulate.*

*To activate the Overview mode for Code Domain Power and Code Domain Error-Power, you must use the CDP:OVER ON command. If you then switch to an analysis different from these two, (such as the Channel Occupancy table), you leave Overview mode and the analysis you used last on the other screen is restored.*

### CALCulate:LIMit:SPECtrum subsystem

The CALCulate:LIMit:SPECtrum subsystem defines the limit check for spectral measurements.

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate<1 2> :LIMit<1...8> :ESPectrum :MODE :VALue :RESTore	AUTO   MANual   USER <numeric_value>	DBM	No query

#### :CALCulate:LIMit:ESPectrum:MODE AUTO | MANual | USER

This command automatically enables and disables automatic selection of the limit line in the spectrum emission mask measurement.

The limit lines normally depend on the selected band class.  
(Command CONF:CDP:BCL)

**Parameters:**

- AUTO The limit line depends on the measured channel power
- MANUAL One of the three default limit lines is set. The selection is made with the command CALC:LIM:ESP:VAL
- USER Query only, user-defined limit lines are enabled (refer to the description of limit lines in the manual for the device)

**Example:**

```
"INST:SEL BDO"           'Activate 1xEV-DO BTS
"INIT:CONT OFF"          'Select single sweep
"CONF:CDP:BCL 1"         'Select band class 1, 1900 MHz
"CONF:CDP:MEAS ESP"      'Measure spectrum emission mask
"CALC:LIM:ESP:MODE AUTO" 'Activates automatic selection of
                           'limit line
"INIT;*WAI"              'Start measurement with sync
"CALC:LIM:FAIL?"         'Query result of the limit check
```

**Features:**

- \*RST value: AUTO
- SCPI: device-specific



**:CALCulate:LIMit:ESPectrum:VALue** <numeric\_value>

This command switches to manual limit line selection. The limit line is selected by specifying the expected power as a value. One of the four possible limit lines is selected depending on the value entered:

Specified value in dBm	Selected limit line	Value when queried
Value $\geq$ 33	"P $\geq$ 33"	33
$28 \leq$ value < 33	"28 $\leq$ P < 33"	28
Value < 28	"P < 28"	0

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS
"INIT:CONT OFF"	'Select single sweep
"CONF:CDP:BCL 1"	'Select band class 1, 1900 MHz
"CONF:CDP:MEAS ESP"	'Measure spectrum emission mask
"CALC:LIM:ESP:VALue 33"	'Activates manual selection of the limit line and selects the <b>one</b> for $P \geq 33$
"INIT;*WAI"	'Start measurement with sync
"CALC:LIM:FAIL?"	'Query result of the limit check

**Features:**

*RST value:	0
SCPI:	device-specific

**:CALCulate:LIMit:ESPectrum:REStore**

This command restores the standard limit lines for the spectrum emission mask measurement. All changes made to the standard limit lines are lost and the state of these limit lines as they left the factory is restored .

**Example:**

"INST BDO"	'Activate 1xEV-DO BTS
"CALC:LIM:ESP:REST"	'Resets the spectrum emission mask limit lines to their default setting

**Features:**

*RST value:	--
SCPI:	device-specific

This command is an event and therefore has neither a query function nor a \*RST value.

### CALCulate:LIMit:PVTime Subsystem

The CALCulate:LIMit:PVTime subsystem defines the limit check for Power vs. Measurement

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate<1 2> :LIMit<1...8> :PVTime :REFerence :RVALue :RESTore	AUTO   MANual   ONCE <numeric_value>	-- DBM --	No query

#### :CALCulate:LIMit:PVTime:REFerence AUTO | MANual | ONCE

The standard asks for the sequence to first measure the FULL slot with the limit line relative to the mean power of the averaged time response. Therefore the parameter AUTO in a FULL slot measurement should be selected. In this mode the mean power is calculated and the limit lines are relative to that mean power value. This value should be used also as the reference for the IDLE slot measurement. With the parameter ONCE the current mean power value of the averaged time response is used to set as the fixedreference value for the limit lines. The mode is switched from AUTO to MANUAL. Now the IDLE slot can be selected and the measurement sequence can be finished.

The manual mode can also be selected via the parameter MANUAL. Then a user defined value can be entered via the command :CALC:LIM:PVT:RVAL <value> in dBm as the reference value for the limits.

```

Example:
"INST:SEL BDO"           'Activate 1xEV-DO BTS
"INIT:CONT OFF"         'Select single sweep
"CONF:CDP:MEAS PVT"     'Measure Power vs Time
"SENS:SWE:COUN 50"      'Only 50 halfslots averaging
"CONF:CDP:RFSL FULL"    'Limit lines for FULL Slot,
                        'use FULL slot signal at input
"CALC:LIM:PVT:REF AUTO" 'Automatic reference value
                        'for limit lines
"INIT:IMM;*WAI"         'Start measurement with sync
"CALC:MARK:FUNC:SUMM:MEAN:RES?"
                        'Read out mean power
"CALCulate1:LIMit1:FAIL?" 'Upper line failed?
"CALCulate1:LIMit2:FAIL?" 'Lower line failed?
"CALC:LIM:PVT:REF ONCE" 'Use the FULL slot results as manual
                        'reference value for IDLE slot
                        'measurement
"CONF:CDP:RFSL IDLE"    'Limit lines for FULL Slot,
                        'use FULL slot signal at input
"INIT:IMM;*WAI"         'Start measurement with sync
"TRACe1? TRACe1"        'Read out 512 points
"CALCulate1:LIMit1:FAIL?" 'Upper line failed?
"CALCulate1:LIMit2:FAIL?" 'Lower line failed?
"TRACe1? TRACe1"        'Read out 512 points
"CALC:LIM:PVT:RVAL?"    'Read out reference value
                        '(in this example identical to
                        'the mean power)
"CALC:LIM:PVT:RVAL -33.5" 'Define a new reference value
    
```

**Features:** \*RST-value: AUTO  
SCPI: device-specific

**:CALCulate:LIMit:PVTTime:RVALue** <numeric\_value>

With this command the reference level in dBm for calculating the limit lines can be set. Precondition is that the automatic mode of power calculation is switched off via the commands `CALC:LIM:PVT:REF ONCE` or `CALC:LIM:PVT:REF:MAN`.

**Example:** See example of command `CALC:LIM:PVT:REF`

**Features:** \*RST-value: -20 dBm  
SCPI: device-specific

**:CALCulate:LIMit:PVTTime:RESTore**

This command restores the standard limit lines for the power versus time measurement. All changes made to the standard limit lines are lost and the state of these limit lines as they left the factory is restored .

**Example:** "INST BDO" 'Activate 1xEV-DO BTS  
"CALC:LIM:PVT:REST" 'Resets the PVT limit lines to their  
'default setting

**Features:** \*RST-value: --  
SCPI: device-specific

This command is an event and therefore has neither a query function nor a \*RST value.

## CALCulate:MARKer subsystem

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate<1 2> :MARKer<1...4> :FUNction :CDPower [:BTS] :RESult?	FERRor   RHO   FERPpm   CERRor   TFramE   IQOFFset   IQIMbalance   MACCuracy   PCDError   SRATe   TOFFset   CHANnel   POFFset   SFACtor   CDPabsolute   CDPRelative   EVMRms   EVMPeak   RHOPilot   RHO1   RHO2   PPILot   PMAC   PDATa   PPReamble   MACTive   DACTive   PLENGth   MTYPe   DMTYPe		Query only

**:CALCulate<1|2>:MARKer<1>:FUNction:CDPower[:BTS]:RESult?**

RHO | MACCuracy | PCDError | FERRor | FERPpm | CERRor | TFramE | IQOFFset |  
IQIMbalance | SRATe | CHANnel | SFACtor | TOFFset | POFFset | CDPabsolute | CDPRelative |  
EVMRms | EVMPeak | RHOPilot | RHO1 | RHO2 | PPILot | PMAC | PDATa | PPReamble |  
MACTive | DACTive | PLENGth | MTYPe | DMTYPe

This command queries the measured and calculated values of the Code Domain Power analysis. The channel type can be set by means of the `CDPower:CTYPe` command, the slot number by means of the `CDPower:SLOT` command and the code number by means of the `CDPower:CODE` command.

**Parameters:**

Global results for all slots:

FERRor	Frequency error in Hz
FERPpm	Frequency error in ppm
CERRor	Chip rate error in ppm
TFramE	Trigger to Frame
RHOPilot	RHO over all slots for the pilot area
RHO1	RHO <sub>overall-1</sub> over all slots over all chips with start of averaging at the half-slot limit
RHO2	RHO <sub>overall-2</sub> over all slots over all chips with start of averaging at the quarter-slot limit

Results for the selected slot:

PPILot	Absolute power in the PILOT channel type
PMAC	Absolute power in the MAC channel type
PDATa	Absolute power in the DATA channel type
PPReamble	Absolute power in the PREAMBLE channel type
MACCuracy	Composite EVM in %
DMTYPe	Modulation type of the DATA channel type: 2 = QPSK 3 = 8-PSK 4 = 16-QAM
MACTive	Number of active MAC channels
DACTive	Number of active DATA channels
PLENGth	Length of preamble in chips
RHO	RHO value for the selected channel type/slot

Results for the selected channel type in the selected slot:

PCDError	Peak code domain error in dB
IQIMbalance	IQ imbalance in %
IQOffset	IQ offset in %

Channel results:

SRATE	Symbol rate in ksps
CHANnel	Channel number
SFACTOR	Spreading factor of the channel
TOFFset	Timing offset in s
POFFset	Phase offset in rad
CDPRelative	Channel power, relative, in dB
CDPabsolute	Channel power, absolute, in dBm
EVMRms	Error vector magnitude RMS in %
EVMPeak	Error vector mag. peak in %
MTYPE	Modulation type:
	0 = BPSK-I
	1 = BPSK-Q
	2 = QPSK
	3 = 8-PSK
	4 = 16-QAM
	5 = 2BPSK (if complex analysis selected for PILOT, PREAMBLE or MAC)

**Note:**

The Trigger to Frame value (TFrame) supplies a '9' if the trigger is at *FREE RUN*.

The Timing/Phase Offset values (TOFFset/POFFset) supply a '9' if timing and phase measurement is disabled (refer to CDP:TPM) or the number of active channels is higher than 50.

<b>Example:</b>	"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are 'CDP relative on screen A and 'General results active on screen B
	"INIT:CONT OFF"	'Select single sweep
	"INIT;*WAI"	'Start measurement with sync
	"CALC:MARK:FUNC:CDP:RES? PPIL"	'Read out pilot power
	"CDP:SLOT 2"	'Selects slot 2
	"CDP:CODE 11"	'Select code number 11
	"CALC:MARK:FUNC:CDP:RES? EVMR"	'Read out EVM RMS of the code with 'number 11 in slot 2

<b>Features:</b>	*RST value:	-
	SCPI:	device-specific

**CALCulate:STATistics subsystem**

The CALCulate:STATistics subsystem controls the statistical measurement functions in the device. The measurement functions cannot be selected for these measurement functions. The numerical suffix is ignored accordingly with CALCulate.

COMMAND	PARAMETER	UNIT	COMMENT
CALCulate			
:STATistics			
:CCDF			
[:STATe]	<Boolean>		
:APD			
[:STATe]	<Boolean>		
:NSAMples	<numeric_value>		
:SCALe			
:Y			
:UPPer	<numeric_value>		
:LOWer	<numeric_value>		
:RESults?	MEAN   PEAK   CFACtor   ALL		Query only

**:CALCulate:STATistics:CCDF[:STATe] ON**

This command enables and disables measurement of the complementary cumulated distribution function (CCDF).

**Example:** "CALC:STAT:CCDF ON"

**Features:** \*RST value: OFF  
SCPI: device-specific

Hint:

The OFF state is reachable by selecting another measurement with the CONF:CDP:MEAS command.

**:CALCulate:STATistics:APD[:STATe] ON**

This command enables and disables measurement of the amplitude probability distribution (APD).

**Example:** "CALC:STAT:APD ON"

**Features:** \*RST value: OFF  
SCPI: device-specific

Hint:

The OFF state is reachable by selecting another measurement with the CONF:CDP:MEAS command.

**:CALCulate:STATistics:NSAMples 100 ... 1E9**

This command sets the number of measurement points for the statistical measurement functions.

**Example:** "CALC:STAT:NSAM 5000"

**Features:** \*RST value: 100000  
SCPI: device-specific

**:CALCulate:STATistics:SCALE:Y:UPPer** 1E-5 ...1.0

This command defines the upper limit for the y axis of the diagram in statistical measurements. Since probabilities are plotted on the y axis, the entered numerical values have no units.

**Example:** "CALC:STAT:SCALE:Y:UPP 0.01"

**Features:** \*RST value: 1.0  
SCPI: device-specific

**:CALCulate:STATistics:SCALE:Y:LOWer** 1E-6 ...0.1

This command defines the lower limit for the y axis of the diagram in statistical measurements. Since probabilities are plotted on the y axis, the entered numerical values have no units.

**Example:** "CALC:STAT:SCALE:Y:LOW 0.001"

**Features:** \*RST value: 1E-6  
SCPI: device-specific

**:CALCulate:STATistics:RESult?** MEAN | PEAK | CFACtor | ALL

This command reads out the results of statistical measurements from a recorded trace.

**Parameters:** The desired result is selected by means of the following parameters:

MEAN Mean (RMS) power measured in the period of analysis in dBm

PEAK Peak power in dBm measured in the period of analysis

CFACtor Determined CREST factor (i.e. ratio of peak power to mean power) in dB

ALL Results of all three named measurements, separated by a comma:

<mean power>,<peak power>,<crest factor>

**Example:** "CALC:STAT:RES? ALL" 'Reads out all three measurement results.  
Example of reply string:  
5.56,19.25,13.69  
i.e. Mean power: 5.56 dBm,  
Peak power 19.25 dBm,  
CREST factor 13.69 dB

**Features:** \*RST value: --  
SCPI: device-specific

**Operating mode:** A

### CONFigure:CDPower subsystem

This subsystem contains the commands for the selection and configuration of measurement in the 1xEV-DO BTS application firmware. The numerical suffix 1 is allowed with CONFigure. You will find more examples of the Code Domain Power analysis under the:[SENSe]:CDPower command.

Further settings for the spectrum emission mask measurement can be found under the CALCulate:LIMit:ESpectrum command.

COMMAND	PARAMETER	UNIT	COMMENT
CONFigure :CDPower [:BTS] :MEASurement  :CTABLE [:STATe] :SElect :NAME :DATA  :COMment :COPY :DElete :CATalog? :REStore  :BCLass :RFSLot	POWer   ACLR   ESpectrum   OBANdwidth   OBWidth   CDPower   CCDF   PVTime  <Boolean> <file_name> <file_name> <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value> ... <string> <file_name>		FS-K84 option

#### CONFigure<1>:CDPower[:BTS]:MEASurement Power | ACLR | ESpectrum | OBANdwidth | OBWidth | CDPower | CCDF

This command selects the measurement of Application FS-K84, 1xEV-DO base station tests. The predefined settings of the different measurements are described at length in Chapter 6.

**Parameters:**

POWER	Power channel measurement (Standard 1xEV-DO Forward) with predefined settings
ACLR	Adjacent channel power measurements (Standard 1xEV-DO forward) with predefined settings
ESpectrum	Check on signal power (Spectrum Emission Mask)
OBANdwidth   OBWidth	Measurement of occupied bandwidth
CDPower	Code domain analyzer measurement.
CCDF	Measurement of the Complementary Cumulative Distribution function (signal statistics measurement)
PVTime	Measurement or power versus time, here trace readout delivers 512 points

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS
"INIT:CONT OFF"	'Select single sweep
"CONF:CDP:MEAS POW"	'Select Channel Power measurement
"INIT;*WAI"	'Start measurement with sync

**Feature:**

*RST value:	CDPower
SCPI:	device-specific



**:CONFigure<1>:CDPower[:BTS]:CTABLE[:STATe] ON | OFF**

This command enables and disables the channel table. Enable results in the measured channel table being saved as "RECENT" and enabled. After the channel table called "RECENT" has been enabled, another channel table can be selected with the `CONF:CDP:CTABle:SElect` command

*Note: Always use the `CONF:CDP:CTAB:STAT` command to enable the "RECENT" channel table and then the `CONF:CDP:CTAB:SElect` command to select the required channel table.*

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are
	'CDP Relative active on screen A and
	'General Results on Screen B
"INIT:CONT OFF"	'Select single sweep
"INIT;*WAI"	'Start measurement with sync
	'so that channel table can be
	'enabled
"CONF:CDP:CTAB ON"	'Use predefined channel table
"CONF:CDP:CTAB:SEL 'CTAB_1'"	'Select channel table
"INIT;*WAI"	'Start measurement with sync

**Example:**

**Features:**

*RST value:	OFF
SCPI:	device-specific

**:CONFigure<1>:CDPower[:BTS]:CTABLE:SElect <string>**

This command selects a predefined channel table file. Before this command, you must first enable the "RECENT" channel table with the `CONF:CDP:CTAB ON` command.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are
	'CDP Relative active on screen A and
	'General Results on Screen B
"INIT:CONT OFF"	'Select single sweep
"INIT;*WAI"	'Start measurement with sync
	'so that channel table can be
	'enabled
"CONF:CDP:CTAB ON"	'Use predefined channel table
"CONF:CDP:CTAB:SEL 'CTAB_1'"	'Select channel table
"INIT;*WAI"	'Start measurement with sync

**Features:**

*RST value:	"RECENT"
SCPI:	device-specific

**:CONFigure:CDPower[:BTS]:CTABLE:NAME <file\_name>**

This command selects a channel table for editing or creating. It is not used for the analysis. In this respect refer to the commands `CONF:CDP:CTAB:STAT` and `CONF:CDP:CTAB:SEL`.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS
"CONF:CDP:CTAB:NAME 'NEW_TAB'"	'Select table for processing

**Features:**

*RST value:	""
SCPI:	device-specific

**:CONFigure:CDPower[:BTS]:CTABLE:DATA** 0..7, 4..6, 0..63, 0..4, 0, 0, 0 | 1, <numeric\_value>...

This command defines a channel table. The whole table is defined in one go. The inactive channels (INACTIVE) do not have to be defined. Eight values are specified for a line of table.

<Channel type>, <Code class>, <Code number>, <Modulation>, <Reserved1>, <Reserved2>, <Status>, <CDP Relative [dB]>, etc.

Channel type	The channel type is numerically coded as follows:
	0 = PILOT
	1 = MAC
	2 = PREAMBLE with 64 chip length
	3 = PREAMBLE with 128 chip length
	4 = PREAMBLE with 256 chip length
	5 = PREAMBLE with 512 chip length
	6 = PREAMBLE with 1024 chip length
	7 = DATA
Code class:	Depending on channel type, fixed: PILOT: 5, MAC: 6, PREAMBLE: 5 and DATA: 4 (spreading factor = 2^code class)
Code number:	0...spreading factor-1
Modulation:	Modulation type including mapping:
	0 = BPSK-I
	1 = BPSK-Q
	2 = QPSK
	3 = 8-PSK
	4 = 16-QAM
	Modulation types QPSK/8-PSK/16-QAM have complex values.
Reserved1:	Always 0 (reserved)
Reserved2:	Always 0 (reserved)
Status:	0: inactive, 1:active
	Can be used in a setting command to disable a channel temporarily
CDP relative:	Any with setting command, relative with CDP query

Before using this command, you must set the name of the channel table using the CONF:CDP:CTAB:NAME command.

**Example:**

```
"INST:SEL BDO" 'Activate 1xEV-DO BTS
"CONF:CDP:CTAB:NAME 'NEW_TAB'" 'Select table for processing
"CONF:CDP:CTAB:DATA 0,5,0,0,0,0,1,0.0,
1,6,35,1,0,0,1,0.0"
'Selects PILOT 0.32 BPSK-I and
'MAC 35.64 BPSK-Q..
```

**Features:**

*RST value:	-
SCPI:	device-specific

**:CONFigure:CDPower[:BTS]:CTABLE:COMMENT** <string>

This command defines a comment on the selected channel table.

Before using this command, you must set the name of the channel table using the CONF:CDP:CTAB:NAME command and enter a valid channel table by means of CONF:CDP:CTAB:DATA.

**Example:**

```
"INST:SEL BDO" 'Activate 1xEV-DO BTS
"CONF:CDP:CTAB:NAME 'NEW_TAB'" 'Select table for processing
"CONF:CDP:CTAB:COMM 'Comment for NEW_TAB'"
```

**Features:**

*RST value:	""
SCPI:	device-specific

**:CONFigure:CDPower[:BTS]:CTABLE:COpy <file\_name>**

This command copies one channel table to another. You select the channel table you want to copy by means of the `CONF:CDP:CTAB:NAME` command.

**Parameters:** <file\_name> ::= name of the new channel table

**Example:** "INST:SEL BDO" 'Activate 1xEV-DO BTS  
 "CONF:CDP:CTAB:NAME 'CTAB\_1'" 'Select table for processing  
 "CONF:CDP:CTAB:COpy 'CTAB\_2'" 'Copies CTAB\_1 to C\_TAB2

**Features:** \*RST value: --  
 SCPI: device-specific

The name of the channel table may contain up to 8 characters. This command is an "event" and therefore has neither a \*RST value nor a query function.

**:CONFigure:CDPower[:BTS]:CTABLE:DELeTe**

This command deletes the selected channel table. You select the channel table you want to delete by means of the `CONF:C2KP:CTAB:NAME` command.

**Example:** "INST:SEL BDO" 'Activate 1xEV-DO BTS  
 "CONF:CDP:CTAB:NAME 'CTAB\_2TAB'" 'Select table for processing  
 "CONF:CDP:CTAB:DEL" 'Deletes CTAB\_2

**Features:** \*RST value: --  
 SCPI: device-specific

This command is an "event" and therefore has neither a \*RST value nor a query function.

**:CONFigure:CDPower[:BTS]:CTABLE:CATalog?**

This command retrieves the names of all the channel tables for 1xEV-DO BTS stored on the hard disk.

The syntax of this output format is as follows:

<Sum of file sizes of all subsequent files>,<spare storage space on fixed disk>,  
 <1st file name>,<1st file size>,<2nd file name>,<2nd file size>,,...,<nth file name>,,  
 <nth file size>,,

**Example:** "INST:SEL BDO" 'Activate 1xEV-DO BTS  
 "CONF:CDP:CTAB:CAT?" 'Query catalog

**Features:** \*RST value: --  
 SCPI: device-specific

**:CONFigure:CDPower[:BTS]:CTABLE:REStore**

This command restores the supplied channel table. Any channel tables delivered with the instrument modified by the customer are thus returned to their initial state.

**Example:** "INST:SEL BDO" 'Activate 1xEV-DO BTS  
 "CONF:CDP:CTAB:RESt" 'Restore table

**Features:** \*RST value: --  
 SCPI: device-specific

This command is an "event" and therefore has neither a \*RST value nor a query function.

**:CONFigure:CDPower[:BTS]:BCLass 0...12**

This command selects the band class.

Band class	Name
0	800 MHz band
1	1900 MHz band
2	TACS band
3	JTACS band
4	Korean PCS band
5	450 MHz band
6	2 GHz band
7	700 MHz band
8	1800 MHz band
9	900 MHz band
10	Secondary 800 MHz band
11	400 MHz European PAMR band
12	800 MHz PAMR band

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS
"INIT:CONT OFF"	'Select single sweep
"CONF:CDP:BCL 1"	'Select Band Class 1, 1900 MHz

**Features:**

*RST value:	0
SCPI:	device-specific

**:CONFigure:CDPower[:BTS]:RFSLot FULL | IDLE**

This command defines the expected signal: FULL slot or IDLE slot. Accordingly the limit lines and the borders for calculating the mean power are set. The lower and upper limit line are called DOPVTFL/DOPVTFU for FULL and DOPVTIL/DOPVTIU for IDLE mode. It is possible to change these lines with the standard limit line editor.

### INSTrument subsystem

The INSTrument subsystem selects the operating mode of the device either by means of text parameters or by means of permanently assigned numbers.

COMMAND	PARAMETER	UNIT	COMMENT
INSTrument [:SElect] :NSElect	SANalyzer   BC2K   BDO <numeric_value>		

**:INSTrument[:SElect]** SANalyzer | BC2K | BDO

This command switches from one operating mode to another by means of text parameters.

Selecting 1xEV-DO BTS (BDO = base station 1xEV-DO) sets the device to a defined state. The preset values are described in Chapter 2, in the section entitled "Default settings in ".

**Example:** "INST BDO" 'Activate 1xEV-DO BTS  
**Features:** \*RST value: SANalyzer  
 SCPI: Conforms

Switching to BC2K presupposes the option CDMA2000 FWD (BTS) R&S FS-K82.  
 Switching to BDO presupposes the option 1xEV-DO FWD (BTS) R&S FS-K84.

**:INSTrument:NSElect** 1 | 10 | 14

This command switches from one operating mode to another by means of numbers.

Parameters: 1: Spectral analysis mode  
 10: CDMA2000 FWD (BTS) mode  
 14: 1xEV-DO FWD (BTS) mode

**Example:** "INST:NSEL 14" 'Activate 1xEV-DO BTS.  
**Features:** \*RST value: 1  
 SCPI: Conforms

Switching to 10 presupposes the option cdma2000 FWD (BTS) R&S FS-K82.  
 Switching to 14 presupposes the option 1xEV-DO FWD (BTS) R&S FS-K84.

### SENSe:CDPower subsystem

This subsystem sets the parameters for the code domain measurements mode. The numerical suffix for SENSE<1|2> is meaningless for this subsystem.

COMMAND	PARAMETER	UNIT	COMMENT
[SENSe<1 2>] :CDPower			
:ICTReshold	<numeric_value>	DB	
:SBANd	NORMal   INVerse		
:LEVel			
:ADJust			
:CODE	<numeric_value>	--	
:SLOT	<numeric_value>	--	
:MMODE	AUTO   IOQ   COMPLex	--	
:MAPPING	I   Q	--	
:NORMalize	<Boolean>	--	
:QINVert	<Boolean>	--	
:PNOffset	<numeric_value>	--	
:IQLength	<numeric_value>	--	
:TPMeas	<Boolean>	--	
:CTYPe	PILot   MAC   PREamble   DATA	--	
:OVERview	<Boolean>	--	
:AVERage	<Boolean>	--	

#### :[SENSe:]CDPower:ICTReshold -100 dB ...0 dB

This command sets the threshold value from which a channel is regarded as active. The level refers to the signal total power.

**Example:**

```
"INST:SEL BDO"
"INIT:CONT OFF"
"CDP:ICTR -10DB"
"INIT;*WAI"
```

'Activate 1xEV-DO BTS, implicit are  
'CDP Relative active on screen A and  
'General Results on screen B  
'Select single sweep

'Threshold value to -10dB  
'Start measurement with sync

**Features:**

\*RST value: -40 dB  
SCPI: device-specific

#### :[SENSe:]CDPower:SBANd NORMal | INVers

This command is used to swop the left and right sideband.

**Example:**

```
"INST:SEL BDO"
"INIT:CONT OFF"
"CDP:SBAN INV"
"INIT;*WAI"
```

'Activate 1xEV-DO BTS, implicit are  
'CDP Relative active on screen A and  
'General Results on screen B  
'Select single sweep  
'Swap sidebands  
'Start measurement with sync

**Features:**

\*RST value: NORM  
SCPI: device-specific

**:[SENSe:]CDPower:LEVel:ADJust**

This command initiates automatic setting of the RF attenuation and IF gain to the level of the applied signal. The device is placed in the *ATTEN MANUAL* mode to set RF attenuation and IF gain independently of each other to optimum values. This mode is retained even after the mode has changed from 1xEV-DO BTS to SPECTRUM.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are
	'CDP Relative active on screen A and
	'General Results on screen B
"INIT:CONT OFF"	'Select single sweep
"CDP:LEV:ADJ"	'Start automatic level setting
"INIT;*WAI"	'Start measurement with sync

**Features:**

*RST value:	-
SCPI:	device-specific

This command is an "event" and therefore has neither a \*RST value nor a query function.

**:[SENSe:]CDPower:CODE <numeric value>**

This command selects the code number. The maximum value depends on the spreading factor of the channel type. PILOT/PREAMBLE: 0..31, DATA: 0..15, MAC: 0..63.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are
	'CDP Relative active on screen A and
	'General Results on screen B
"INIT:CONT OFF"	'Select single sweep
"CDP:CODE 11"	'Select code number 11
"INIT;*WAI"	'Start measurement with sync

**Features:**

*RST value:	0
SCPI:	device-specific

**:[SENSe:]CDPower:SLOT 0 ...IQLength-1**

This command selects the slot.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are
	'CDP Relative active on screen A and
	'General Results on screen B
"INIT:CONT OFF"	'Select single sweep
"CDP:SLOT 2"	'Selects slot 2
"INIT;*WAI"	'Start measurement with sync

**Features:**

*RST value:	0
SCPI:	device-specific

**:[SENSe:]CDPower:MMODE** AUTO | IOQ | COMPlEx

This command defines the mapping mode. With AUTO, internal working takes place in "Complex" mapping mode for the DATA channel type and "I or Q" for the PILOT, MAC and PREAMBLE channel types. With this command, each mapping mode can be determined personally for all channel types, or it is possible to return to AUTO.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are 'The PILOT channel type and the I 'branch are 'selected
"INIT:CONT OFF"	'Select single sweep
"CDP:MMODE COMP"	'The pilot channel type is analyzed 'Complex
"INIT;*WAI"	'Start measurement with sync

**Features:**

*RST value:	AUTO
SCPI:	device-specific

**:[SENSe:]CDPower:MAPPING** I | Q

This command selects, when the mapping mode is not Complex, whether the I or Q branch should be analyzed.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are 'The PILOT channel type, mapping 'mode IORQ and the I branch are 'selected
"INIT:CONT OFF"	'Select single sweep
"CDP:MAPP Q"	'Selects the Q branch
"INIT;*WAI"	'Start measurement with sync

**Features:**

*RST value:	I
SCPI:	device-specific

**:[SENSe:]CDPower:NORMAlize** ON | OFF

This command enables and disables elimination of the IQ offset.

**Example:**

"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B
"INIT:CONT OFF"	'Select single sweep
"CDP:NORM OFF"	'Elimination of IQ Offset off
"INIT;*WAI"	'Start measurement with sync

**Features:**

*RST value:	OFF
SCPI:	device-specific



**:[SENSe:]CDPower:QINVert ON | OFF**

This command inserts the sign of the signal Q component.

<b>Example:</b>	"INST:SEL BDO"  "INIT:CONT OFF" "CDP:QINV ON" "INIT;*WAI"	'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B 'Select single sweep 'Enable Invert Q component 'Start measurement with sync
<b>Features:</b>	*RST value: OFF SCPI: device-specific	

**:[SENSe:]CDPower:PNOffset 0..511**

This command sets the PN offset of the base station in multiples of 64 chips.

<b>Example:</b>	"INST:SEL BDO"  "INIT:CONT OFF" "CDP:PNOF 45" "INIT;*WAI"	'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B 'Select single sweep 'Set PN Offset 'Start measurement with sync
<b>Features:</b>	*RST value: 0 SCPI: device-specific	

**:[SENSe:]CDPower:IQLength FSU/FSQ: 2..36, FSP: 2..12**

This command sets the capture length (IQ Capture Length) in multiples of the slot. The range is between 2 and 36 for the Analyzer R&S FSU/R&S FSQ and from 2 to 12 for the Analyzer R&S FSP.

<b>Example:</b>	"INST:SEL BDO"  "INIT:CONT OFF" "CDP:IQL 8" "INIT;*WAI"	'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B 'Select single sweep '8 slots capture length 'Start measurement with sync
<b>Features:</b>	*RST value: 3 SCPI: device-specific	

**:[SENSe:]CDPower:TPMeas ON | OFF**

This command supports the specific enabling and disabling of the timing and phase offset analysis of the channels for the first active channel in the channel type. If the value is OFF or if more than 50 channels are active, the command TRACe? TRACe1 and CALC:MARK:FUNC:CDP:RES? returns a value of '9' for the timing and phase offset as the result. If the value is ON, the timing and phase offsets are calculated and returned.

<b>Example:</b>	"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B
	"INIT:CONT OFF"	'Select single sweep
	"CDP:TPM ON"	'Enable Analyze Timing and Phase 'Offset
	"INIT;*WAI"	'Start measurement with sync
	"CDP:SLOT 2"	'Selects slot 2
	"CDP:CODE 11"	'Select code number 11
	"CALC:MARK:FUNC:CDP:RES? TOFF"	'Read out timing offset of the code with 'number 11 in slot 2
	"CALC:MARK:FUNC:CDP:RES? POFF"	'Read out phase offset of code with 'number 11 in slot 2

<b>Features:</b>	*RST value: OFF
	SCPI: device-specific

**:[SENSe:]CDPower:CTYPe PILOT | MAC | PREamble | DATA**

This command is used to select the channel type. The number of results then changes in most analyses, such as code domain power, symbol EVM, and bit stream, because either a different spreading factor or a different number of symbols is available for the analysis.

<b>Example:</b>	"INST:SEL BDO"	'Activate 1xEV-DO BTS, implicit are 'The PILOT channel type is selected
	"INIT:CONT OFF"	'Select single sweep
	"CDP:CTYP MAC"	'MAC channel type is selected
	"INIT;*WAI"	'Start measurement with sync

<b>Features:</b>	*RST value: PILOT
	SCPI: device-specific

**:[SENSe:]CDPower:OVERview ON | OFF**

This command can be precisely enabled by means of ON when either the Code Domain Power or the Code Domain Error Power analysis is active. (Refer to the command `CALC1:FEED`). In Overview mode, the I branch of the signal is normally displayed on screen A and the Q branch of the signal on screen B with the CDP/CDEP. The branches can be read out separately by means of `TRAC:DATA? TRACE1` and `TRAC:DATA? TRACE2`.

The previous analyses become active again when you exit Overview mode.

If an analysis other than Code Domain Power or Code Domain Error Power is selected when Overview mode is active, you exit Overview mode and the previous analysis is reset on the other screen.

<b>Example:</b>	<pre>"INST:SEL BDO" "INIT:CONT OFF" "INIT;*WAI" "CDP:OVER ON"  "TRAC? TRACE1" "TRAC? TRACE2" "CDP:OVER OFF"</pre>	<pre>'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B 'Select single sweep 'Start measurement with sync 'Activate Overview mode 'CDP Relative on screen A I branch 'CDP Relative on screen B Q branch 'Read out CDP Relative of I branch 'Read out CDP Relative of Q branch 'Disable Overview mode: 'CDP Relative active on screen A and 'General Results on screen B</pre>
-----------------	---	--

<b>Features:</b>	<pre>*RST value: OFF SCPI: device-specific</pre>
------------------	--

**:[SENSe:]CDPower:AVERage ON | OFF**

This command can be precisely enabled by means of ON when the Code Domain Power analysis is active. (Refer to the command `CALC1:FEED`). If averaging is active, the CDP is calculated over all slots and displayed as called for by the 1xEV-DO Standard.

<b>Example:</b>	<pre>"INST:SEL BDO" "INIT:CONT OFF" "INIT;*WAI" "CDP:AVER ON"</pre>	<pre>'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B 'Select single sweep 'Start measurement with sync 'Activate averaging 'CDP Relative over all slots 'active on screen A</pre>
-----------------	---	---

<b>Features:</b>	<pre>*RST value: OFF SCPI: device-specific</pre>
------------------	--

**TRACe subsystem**

**:TRACe[:DATA] TRACE1 | TRACE2**

The command transfers trace data from the controller to the device, and the query command reads trace data from the device

TRACE1, TRACE2 can be read out, depending on the display.

The trace data (TRACE1 | TRACE2) are formatted for the different displays as shown in the following. The number of values refers to the table below:

Channel type	Spreading factor	Symbol rate	Modulation type	Chips per slot	Symbols per slot and code	Bits per slot and code		
						Mapping I or Q	Mapping complex	
PILOT	32	38.4 ksps	BPSK-I or BPSK-Q	96*2 = <b>192</b>	6	6	12	
MAC	64	19.2 ksps	BPSK-I or BPSK-Q	64*4 = <b>256</b>	4	4	8	
PRE-AMBLE	32	38.4 ksps	BPSK-I or BPSK-Q	Preamble length				
				64:	2	2	4	
				128:	4	4	8	
				256:	8	8	16	
				512:	16	16	32	
1024:	32	32	64					
DATA	16	76.8 ksps	QPSK, 8-PSK, 16-QAM	400*4- PreambleChips= <b>DataNettoChips</b>		Mapping always complex Modulation type:		
						QPSK	8-PSK	16-QAM
				1600-0 = <b>1600</b>	100	200	300	400
				1600-64 = <b>1536</b>	96	192	288	384
				1600-128 = <b>1472</b>	92	184	276	368
				1600-256 = <b>1344</b>	84	168	252	336
				1600-512 = <b>1088</b>	68	136	204	272
				1600-1024 = <b>576</b>	36	72	104	144

CODE DOMAIN POWER ABSOLUT/CODE DOMAIN POWER RELATIVE (TRACE1/TRACE2):

The following is output for each channel of the selected channel type:

Code number            Code number of the channel, values between 0 to 31/15/63 depending on the channel type

Level                    - For CODE DOMAIN POWER ABSOLUTE in unit dBm  
                             - For CODE DOMAIN POWER RELATIVE in unit dB

Power ID                0 - inactive channel  
                             1 - active channel

Three values are thus transferred for all channels:  
<Code number>, <Level>, <Power ID>, etc.

The number of output codes corresponds to the spreading factor, which depends on the channel type: PILOT/PREAMBLE: 32, DATA: 16, MAC: 64. (See table above.)

Depending on the mapping settings, the I or Q branch or the complex signal is returned. With Code Domain Overview, the I branch in TRACE1 and the Q branch in TRACE2 are always returned.

**Example:**

The example shows the results of the query for the PILOT channel type, in which only code 0.32 at BPSK-I with 0 dB power is active:

"INST:SEL BDO"		'Activate 1xEV-DO BTS, implicit are 'CDP Relative active on screen A and 'General Results on screen B 'and PILOT channel type, mapping 'mode 'IORQ and I branch selected
"INIT:CONT OFF"		'Select single sweep
"INIT;*WAI"		'Start measurement with sync
"TRAC? TRACE1"		'Read out CDP Relative of the I branch
0, 0.0,1,	1,-57.3,0,	
2,-54.6,0,	3,-55.3,0,	
....	31,-54.7,0	
"CDP:OVER ON"		'Activate Overview mode
"TRAC? TRACE1"		'Read out CDP Relative of the I branch
0, 0.0,1,	1,-57.3,0,	'Same values as above
2,-54.6,0,	3,-55.3,0,	
....	31,-54.7,0	
"TRAC? TRACE2"		'Read out CDP Relative of the 'Q branch
0,-53.1,0,	1,-54.2,0,	'Code 0 has no component at Q!
2,-53.3,0,	3,-56.0,0,	
....	31,-52.1,0	

CODE DOMAIN ERROR POWER (TRACE1/TRACE2):

The following is output for each channel of the selected channel type:

Code number            Code number of the channel, values between 0 to 31/15/63  
                          depending on the channel type

Error power            In unit dB

Power ID                0 - inactive channel  
                          1 - active channel

Three values are thus transferred for all channels: <Code number>, <Level>, <Power ID>, etc.

The number of output codes corresponds to the spreading factor, which depends on the channel type: PILOT/PREAMBLE: 32, DATA: 16, MAC: 64. (See table above.)

Depending on the mapping settings, the I or Q branch or the complex signal is returned. With Code Domain Overview, the I branch in TRACE1 and the Q branch in TRACE2 are always returned.

**Example:**

The example shows the results of the query for the PILOT channel type, in which only code 0.32 at BPSK-I with 0 dB power is active:

```
"INST:SEL BDO"                            'Activate 1xEV-DO BTS, implicit are
                                           'CDP Relative active on screen A and
                                           'General Results on screen B'and
                                           'PILOT channel type, mapping mode
                                           'IQRQ and I branch selected

"INIT:CONT OFF"                            'Select single sweep
"CALC1:FEED `XPOW:CDEP`"                'Code Domain Error Power analysis
"INIT;*WAI"                                'Start measurement with sync
"TRAC? TRACE1"                            'Read out CDEP Relative of the
                                           'I branch

0,-52.0,1,                                1,-51.5,0,
2,-56.2,0,                                3,-53.9,0,
....                                        31,-55.3,0

"CDP:OVER ON"                             'Activate Overview mode
"TRAC? TRACE1"                            'Read out CDEP Relative of the
                                           'I branch

0,-52.0,1,                                1,-51.5,0,
2,-56.2,0,                                3,-53.9,0,
....                                        31,-55.3,0

"TRAC? TRACE2"                            'Read out CDEP Relative of the
                                           'Q branch

0,-54.2,0,                                1,-51.8,0,
2,-51.4,0,                                3,-54.3,0,
....                                        31,-54.3,0
```

CHANNEL TABLE (TRACE1):

The following is output for each active channel:

Channel type	The channel type is numerically coded as follows:
	0 = PILOT
	1 = MAC
	2 = PREAMBLE with 64 chip length
	3 = PREAMBLE with 128 chip length
	4 = PREAMBLE with 256 chip length
	5 = PREAMBLE with 512 chip length
	6 = PREAMBLE with 1024 chip length
	7 = DATA
Code class	Fixed, depending on channel type: PILOT: 5, MAC: 6, PREAMBLE: 5 and DATA: 4 (spreading factor = 2^code class)
Code number	Code number of channel, values between 0 and spreading factor 1
Modulation:	Modulation type including mapping:
	0 = BPSK-I
	1 = BPSK-Q
	2 = QPSK
	3 = 8-PSK
	4 = 16-QAM
	Modulation types QPSK/8-PSK/16-QAM have complex values.
Absolute level	In unit dBm
Relative level	In unit dB, referred to the total power in the channel type
Timing offset	Referred to the first active channel in seconds
Phase offset	Referred to the first active channel in rad
	If the analysis of the timing and phase offsets is not active (refer to CDPower:TPMeas) or if there are more than 50 active channels in the signal, a value of 9 is returned
	A value of 9 is generally returned for inactive channels.

This means that 8 values are transmitted for all active channels:

<Channel type>, <Code class>, <Code number>, <Modulation>, <Absolute level>, <Relative level>, <Timing offset>, <Phase offset>, etc.

The channels are listed in the following channel type order: PILOT, MAC, PREAMBLE, DATA. Within the channel types, the channels are sorted in ascending code number order.

**Example:** The example shows the results of the query for the following configuration:

PILOT	0.32	(CC 5)	BPSK-I	0.0dB
MAC	2.64	(CC 6)	BPSK-I	- 7.0dB
MAC	3.64	(CC 6)	BPSK-I	- 6.9dB
MAC	4.64	(CC 6)	BPSK-I	- 7.1dB
MAC	34.64	(CC 6)	BPSK-Q	- 7.1dB
MAC	35.64	(CC 6)	BPSK-Q	- 7.0dB
PRE64	2.32	(CC 5)	BPSK-I	- 0.0dB
DATA	0.16	(CC 4)	16-QAM	-12.1dB
DATA	1.16	(CC 4)	16-QAM	-12.0dB
DATA	2.16	(CC 4)	16-QAM	-12.2dB
...	.....	.....	.....	.....
DATA	13.16	(CC 4)	16-QAM	-12.1dB
DATA	14.16	(CC 4)	16-QAM	-12.2dB
DATA	15.16	(CC 4)	16-QAM	-12.3dB

```
"INST:SEL BDO"           'Activate 1xEV-DO BTS, implicit are
                           'CDP Relative active on screen A and
                           'General Results on screen B
"INIT:CONT OFF"         'Select single sweep
"CALC1:FEED `XTIM:CDP:ERR:CTAB`" 'Analyze channel tables
```

```

"INIT;*WAI"           'Start measurement with sync
"TRAC? TRACE1"       'Read out channel table
0 , 5, 0, 0, 15.0, 0.0, 9, 9, 'PILOT
1 , 6, 2, 0, 8.0, -7.0, 9, 9, 'MAC
1 , 6, 3, 0, 8.1, -6.9, 9, 9,
1 , 6, 4, 0, 7.9, -7.1, 9, 9,
1 , 6, 34, 1, 7.9, -7.1, 9, 9,
1 , 6, 35, 1, 8.0, -7.0, 9, 9,
2 , 5, 0, 0, 14.9, 0.0, 9, 9, 'PREAMBLE
7 , 4, 0, 4, 2.8, -12.1, 9, 9, 'DATA
7 , 4, 1, 4, 2.9, -12.0, 9, 9,
7 , 4, 2, 4, 2.7, -12.2, 9, 9,
7 , 4, 3, 4, 2.8, -12.1, 9, 9,
.. .. .. .. ... ..
7 , 4, 13, 4, 2.8, -12.1, 9, 9,
7 , 4, 14, 4, 2.7, -12.2, 9, 9,
7 , 4, 15, 4, 2.6, -12.3, 9, 9

```

### CHANNEL TABLE (CTABLE):

In addition to the results of the channel table which are output using the TRACE1 command, active timing and phase offset measurement (refer to `CDPower:TPMeas`) also has the CTABLE query command which displays the maximum values of the TIMING and PHASE OFFSET together with the associated channel type and channel.

The following values are output:

<Max. time offset in s>, <Channel Type>, <Code number for max. time>, <Code class for max. time>,

<Max. phase offset in rad>, <Channel type>, <Code number for max. phase>, <Code class for max. phase>, <Reserved 1>, ..., <Reserved 4>

The channel type is 1 for MAC and 7 for DATA.

#### **Example:**

```

"INST:SEL BDO"       'Activate 1xEV-DO BTS, implicit are
                    'CDP relative on Screen A and
                    'Result Summary active on Screen B
"INIT:CONT OFF"     'Select single sweep
"CALC2:FEED `XTIM:CDP:ERR:CTAB`"
                    'Analyze channel tables
"CDP:TPM ON"        'Activate timing and phase offset measurement
"INIT;*WAI"         'Start measurement with synchronization
"TRAC? CTAB"        'Read out maximum timing and phase offsets
-1.55E-009,1,5,6,   'Max. time offset with channel type code number and
                    'code class of associated channel
3.37E-003,1,37,6,   'Max. phase offset with channel type code number
                    'and code class of associated channel
0,0,0,0            '4 reserved values

```

### GENERAL RESULTS/CHANNEL RESULTS (TRACE2):

The results included in GENERAL RESULTS and CHANNEL RESULTS are read out in the following order:

<FERRor>, <FERPpm>, <CERRor>, <TFRame>, <RHOPilot>, <RHO1>, <RHO2>, <PPIlot>, <PMAC>, <PDATa>, <PPReamble>, <MACCuracy>, <DMTYpe>, <MACTive>, <DACTive>, <PLENth>, <RHO>, <PCDerror>, <IQIMbalance>, <IQOFFset>, <SRATe>, <CHANnel>, <SFACtor>, <TOFFset>, <POFFset>, <CDPRelative>, <CDPabsolute>, <EVMRms>, <EVMPeak>, <MTYPe>



In this instance the results have the following meaning and units:

Global results for all slots:

FERRor	Frequency error in Hz
FERPpm	Frequency error in ppm
CERRor	Chip rate error in ppm
TFRame	Trigger to Frame
RHOPilot	RHO over all slots for the pilot area
RHO1	RHOoverall-1 over all slots over all chips with start of averaging at the half-slot limit
RHO2	RHOoverall-2 over all slots over all chips with start of averaging at the quarter-slot limit

Results for the selected slot:

PPILot	Absolute power in the PILOT channel type
PMAC	Absolute power in the MAC channel type
PDATa	Absolute power in the DATA channel type
PPReamble	Absolute power in the PREAMBLE channel type
MACCuracy	Composite EVM in %
DMTYpe	Modulation type in the DATA channel type: 2 = QPSK 3 = 8-PSK 4 = 16-QAM
MACTive	Number of active MAC channels
DACTive	Number of active DATA channels
PLENGth	Length of preamble in chips
RHO	RHO value for the selected channel type/slot

Results for the selected channel type in the selected slot:

PCDerror	Peak code domain error in dB
IQIMbalance	IQ imbalance in %
IQOOffset	IQ offset in %

Channel results:

SRATe	Symbol rate in ksps
CHANnel	Channel number
SFACTor	Spreading factor of the channel
TOFFset	Timing offset in s
POFFset	Phase offset in rad
CDPRelative	Channel power, relative, in dB
CDPabsolute	Channel power, absolute, in dBm
EVMRms	Error vector magnitude RMS in %
EVMPeak	Error vector mag. peak in %
MTYPE	Modulation type: 0 = BPSK-I 1 = BPSK-Q 2 = QPSK 3 = 8-PSK 4 = 16-QAM 5 = 2BPSK (if complex analysis selected for PILOT, PREAMBLE or MAC)

**Note:** The Trigger to Frame value (*TFRame*) supplies a '9' if the trigger is at FREE RUN. The Timing/Phase Offset values (*TOFFset*/*POFFset*) supply a '9' if timing and phase measurement is disabled (refer to *CDP:TPM*) or the number of active channels is higher than 50.

POWER VS CHIP

The number of returned values is 2048, since one level value is available per chip.

POWER VS CHIP: <Level value in dBm>, <Level value in dBm>, etc.;

PEAK CODE DOMAIN ERR and COMPOSITE EVM (TRACE2):

The number of returned value pairs corresponds to the IQ capture length.

(Refer to the command `CDPower : IQLength`).

PEAK CODE DOMAIN ERROR: <Slot number>, <Level value in dB>, .....

COMPOSITE EVM: <Slot number>, <Value in %>, .....

SYMBOL EVM (TRACE2):

The number of values depends on the number of symbols and is between 2 and 100. Refer in this respect to the table above in the column 'Number of symbols per slot and code'.

<Value in % symbol 0>, <Value in % symbol 1>,.....;

POWER VS SYMBOL (TRACE2):

The number of values depends on the number of symbols and is between 2 and 100. Refer in this respect to the table above in the column 'Number of symbols per slot and code'.

<Value in dBm symbol 0>, <Value in dBm symbol 1>,.....;

SYMBOL CONST (TRACE2):

The number of value pairs depends on the number of symbols and is between 2 and 100. Refer in this respect to the table above in the column 'Number of symbols per slot and code'.

Real and imaginary parts are transferred as value pairs.

<re 0>,<im 0>,<re 1>,<im 1>,.....<re n>, <im n>

COMPOSITE CONST (TRACe2):

The number of value pairs corresponds to the number of chips for the channel type. The value is between 64 and 1600 chips per slot. Refer in this respect to the table above in the column 'Chips per slot'.

<re Chip 0>, <in Chip 0>, <re Chip 1>, <in Chip 1>,.....;

BITSTREAM (TRACE2):

The bit stream of a slot is output. A value is read out for each bit (range 0,1), each symbol consists of 1 bit for BPSK-I/BPSK-Q, 2 bits for QPSK and 2BPSK (Complex BPSK-I/BPSK-Q analysis), 3 bits for 8-PSK and 4 bits for 16-QAM. The bit stream per slot is accordingly of different lengths. Refer in this respect to the table above in the column 'Bits per slot and code'. The number of bits is between 2 and 400.

Example of bit stream trace: 0, 0, 1, 0, 1, 1, 0 ....

## STATus-QUEStionable:SYNC-Register

This register contains information about the error situation in the Code Domain Power analysis of the FS-K84 option.

It can be queried with the commands "STATus:QUEStionable:SYNC:CONDition?" and "STATus:QUEStionable:SYNC[:EVENT]?" .

Table 7-1 Significance of bits in STATus:QUEStionable:SYNC-Register

Bit No.	Explanation
0	Not used in the FS-K84 application
1	<p><b>K84 Frame Sync failed</b></p> <p>This bit is set when synchronization is not possible within the application. Possible reasons for this are:</p> <ul style="list-style-type: none"> <li>Wrongly set frequency</li> <li>Wrongly set level</li> <li>Wrongly set PN OFFSET</li> <li>Wrongly set values for Q-INVERT or SIDE BAND INVERT</li> <li>Invalid signal at Input</li> </ul>
2 to 3	Not used in the FS-K84 application
4	<p><b>K84 Preamble Current Slot missing</b></p> <p>This bit is set when the Preamble channel type is being investigated within the FS-K84 application, and there is no preamble in the current slot. The measurement results that can be read out for the Preamble channel type are not valid!</p>
5	<p><b>K84 Preamble Overall missing</b></p> <p>This bit is set when the Preamble channel type is being investigated within the FS-K84 application, and there is no preamble in at least one of the slots being examined. The measurement results that can be read out for the Preamble channel type are not valid if the analysis takes all slots into account. (CDP with Average, Peak Code Domain Error, Composite EVM)</p>
6 to 14	Not used in the FS-K84 application
15	This bit is always 0.

## Table of Softkeys with Assignment of IEC Bus Commands

## MEAS key and MEAS hot key

CODE DOM POWER	:CALCulate<1>:FEED "XPOW:CDP:RAT" (relative) :CALCulate<1>:FEED "XPOW:CDP" (absolute)
CODE DOM ERROR	:CALCulate<1>:FEED "XPOW:CDEP"
COMPOSITE EVM	:CALCulate2:FEED "XTIM:CDP:MACCuracy"
PEAK CODE DOMAIN ERR	:CALCulate2:FEED "XTIM:CDP:ERR:PCDomain"
POWER VS PCG	:CALCulate2:FEED "XTIM:CDP:PVSLOT"
GENERAL RESULT	:CALCulate2:FEED "XTIM:CDP:ERR:SUMM" :CALCulate<1 2>:MARKer<1>:FUNCTION:CDPower[:BTS]:RESult?
CHANEL RESULTS	RHO   MACCuracy   PCDError FERRor   FERPPm   CERRor   TFRame I IQOFFset   IQIMbalance   SRATe   CHANnel   SFACtor   TOFFset   POFFset   CDPabsolute   CDPRelative   EVMRms   EVMPeak   RHOPilot   RHO1   RHO2   PPIlot   PMAC   PDATA   PPReamble   MACTive   DACTive   PLENgth   MTYPE   DMType
SYMBOL CONST	:CALCulate2:FEED "XTIM:CDP:SYMB:CONS"
SYMBOL EVM	:CALCulate2:FEED "XTIM:CDP:SYMB:EVM"
BITSTEAM	:CALCulate2:FEED "XTIM:CDP:BSTream"
COMPOSITE CONST	:CALCulate2:FEED "XTIM:CDP:COMP:CONS"
POWER VS SYMBOL	:CALCulate2:FEED "XTIM:CDP:PVSY"
SELECT CHANNEL	: [SENSe:]CDPower:CODE 0...(BASE SF-1)
SELECT PCG	: [SENSe:]CDPower:SLOT 0 ...(IQ_CAPTURE_LENGTH-1)
ADJUST REF LVL	:SENS:POW:ACH:PRES:RLEV

SPECTRUM EM MASK	:CONFigure:CKPower:MEASurement ESpectrum  Ergebnisabfrage: :CALCulate<1>:LIMit<1>:FAIL?
LIMIT LINE AUTO	:CALC:LIM:ESP:MODE AUTO
LIMIT LINE MANUAL	:CALC:LIM:ESP:MODE MANUal :CALCul:LIM:ESP:VAL <numeric_value>
LIMIT LINE USER	:CALC:LIMit<1>:NAME <string> :CALC:LIMit<1>:UNIT DBM :CALC:LIMit<1>:CONT[:DATA] <num_value>, <num_value>, ... :CALC:LIMit<1>:CONT:DOMain FREquency :CALC:LIMit<1>:CONT:TRACe 1 :CALC:LIMit<1>:CONT:OFFset <num_value> :CALC:LIMit<1>:CONT:MODE RELative  :CALC:LIM<1>:UPPer[:DATA] <num_value>, <num_value>.. :CALC:LIM<1>:UPPer:STATe ON   OFF :CALC:LIM<1>:UPPer:OFFset <num_value> :CALC:LIM<1>:UPPer:MARGin <num_value> :CALC:LIM<1>:UPPer:MODE ABSolute :CALC:LIM<1>:UPPer:SPACing LINear
	<b>Hinweise:</b> - Werden die y-Werte mit dem Befehl :CALCulate:LIMit<1>:LOWer[:DATA] eingegeben, dann ergibt der Limit-Check "failed", wenn die Grenzwertlinie unterschritten wird. - Wird eine benutzerdefinierte Grenzwertlinie eingeschaltet, dann hat diese Vorrang vor Grenzwertlinien, die mit AUTO und MANUAL ausgewählt wurden.
RESTORE STD LINES	:CALC:LIM:ESP:RESTore
ADJUST REF LVL	:SENS:POW:ACH:PRES:RLEV
OCCUPIED BANDWIDTH	:CONFigure<1>:CDPower:MEASurement OBANdwidth  Ergebnisabfrage: :CALCulate<1>:MARKer<1>:FUNCTion:POWER:RESult? OBANdwidth
% POWER BANDWIDTH	:SENS:POW:BWID 99PCT
ADJUST SETTINGS	:SENS:POW:PRES OBW
ADJUST REF LVL	:SENS:POW:ACH:PRES:RLEV
STATISTICS	:CONFigure:CDPower:MEASurement CCDF <b>oder</b> :CALCulate:STATistics[:BTS]:CCDF[:STATe] ON  Ergebnisabfrage: CALCulate:MARKer:X?
APD	:CALC:STAT:APD ON
CCDF	:CALC:STAT:CCDF ON
PERCENT MARKER	:CALC:MARKr:Y:PERC 0...100%
NO OF SAMPLES	CALC:STAT:NSAM <value>
SCALING	

X-AXIS REF LVL	:CALC:STAT:SCAL:X:RLEV <value>
X-AXIS RANGE	:CALC:STAT:SCAL:X:RANG <value>
X-AXIS MAX VALUE	:CALC:STAT:SCAL:Y:UPP <value>
X-AXIS MIN VALUE	:CALC:STAT:SCAL:Y:LOW <value>
ADJUST SETTINGS	:CALC:STAT:SCAL:AUTO ONCE
DEFAULT SETTINGSL	:CALC:STAT:PRES
ADJUST SETTINGS	:CALC:STAT:SCAL:AUTO ONCE
CONT MEAS	:INIT:CONT ON; :INIT:IMM
SINGLE MEAS	:INIT:CONT OFF; :INIT:IMM

## RESULTS hot key and CODE DOM ANALYZER softkey

CODE DOM POWER	:CALCulate<1>:FEED "XPOW:CDP:RAT" (relative) :CALCulate<1>:FEED "XPOW:CDP" (absolute)
CODE DOM ERROR	:CALCulate<1>:FEED "XPOW:CDEP"
COMPOSITE EVM	:CALCulate2:FEED "XTIM:CDP:MACCuracy"
PEAK CODE DOMAIN ERR	:CALCulate2:FEED "XTIM:CDP:ERR:PCDomain"
POWER VS PCG	:CALCulate2:FEED "XTIM:CDP:PVSLOT"
GENERAL RESULT	:CALCulate2:FEED "XTIM:CDP:ERR:SUMM" :CALCulate<1 2>:MARKer<1>:FUNCTION:CDPower[:BTS]:RESult?
CHANEL RESULTS	RHO   MACCuracy   PCDError FERRor   FERPPm   CERRor   TFRame I IQOFFset   IQIMbalance   SRATE   CHANnel   SFACTOR   TOFFset   POFFset   CDPabsolute   CDPRelative   EVMRms   EVMPeak   RHOPilot   RHO1   RHO2   PPIlot   PMAC   PDATA   PPReamble   MACTive   DACTive   PLENgth   MTYPE   DMType
SYMBOL CONST	:CALCulate2:FEED "XTIM:CDP:SYMB:CONS"
SYMBOL EVM	:CALCulate2:FEED "XTIM:CDP:SYMB:EVM"
BITSTEAM	:CALCulate2:FEED "XTIM:CDP:BSTream"
COMPOSITE CONST	:CALCulate2:FEED "XTIM:CDP:COMP:CONS"
POWER VS SYMBOL	:CALCulate2:FEED "XTIM:CDP:PVSY"
SELECT CHANNEL	:[SENSe:]CDPower:CODE 0...(BASE SF-1)
SELECT PCG	:[SENSe:]CDPower:SLOT 0 ...(IQ_CAPTURE_LENGTH-1)
ADJUST REF LVL	:SENS:POW:ACH:PRES:RLEV

## CHAN CONF hot key

CODE CHAN AUTOSEARCH	:CONFigure:CDPower[:BTS]:CTABLE[:STATE] OFF
CODE CHAN PREDEFINED	:CONFigure:CDPower[:BTS]:CTABLE[:STATE] ON :CONFigure:CDPower[:BTS]:CTABLE:SElect <channel table name>
EDIT CHAN CONF TABLE	---
NEW CHAN CONF TABLE	---
HEADER VALUES	:CONFigure:CDPower[:BTS]:CTABLE:NAME "NEW_TAB"
INSERT MAC	---
INSERT PREAMBLE	---
DELETE LINE	---
MEAS CHAN CONF TABLE	---
SAVE TABLE	--
SORT TABLE	---
PAGE UP	---
PAGE UP	---
DEL CHAN CONF TABLE	:CONFigure:CDPower[:BTS]:CTABLE:DElete
COPY CHAN CONF TABLE	:CONFigure:CDPower[:BTS]:CTABLE:COpy "CTAB2"
RESTORE STD TABLES	:CONFigure:CDPower[:BTS]:CTABLE:REStore



**SETTINGS hot key**

BAND CLASS	:CONFigure:CCDPower:BClass 1 '1900 MHz
PN OFFSET	:[SENSe:]CDPower:PNOffset 0...511
CAPTURE LENGTH	:[SENSe:]CDPower:IQLength 2..50
HEADER VALUES	---
PILOT	
MAC	:[SENSe:]CDPower:CTYPE PILOt   MAC   PREAmble   DATA
PREAMBLE	
DATA	
CODE DOM CONF TABLE	:[SENSe:]CDPower:OVERview ON   OFF
MAPPING AUTO	
MAPPING COMPLEX	:[SENSe:]CDPower:MMODE AUTO   IOQ   COMPLex
MAPPING I OR Q	
SELECT I Q	:[SENSe:]CDPower:MAPPING I   Q
INACT CHAN THRESHOLD	:[SENSe:]CDPower:ICTReshold -100 dB ... 0 dB
CODE PWR ABS REL	:CALCulate<1>:FEED "XPOW:CDP:RAT" (relative) :CALCulate<1>:FEED "XPOW:CDP" (absolute)
CDP AVG ON OFF	:[SENSe:]CDPower:AVERage ON   OFF
TIME PHASE ON OFF	:[SENSe:]CDPower:TPMeas ON   OFF
ANT DIV ON OFF	
ANT NO. 64 128	:[SENSe:]CDPower:ANTenna OFF   1   2
INVERT Q ON OFF	:[SENSe]:CDP:QINVert ON   OFF
SIDE BAND NORN INV	:[SENSe:]CDPower:SBAND NORMAl INVers
NORMALIZE ON OFF	:[SENSe:]CDPower:NORMAlize ON   OFF

## 8 Checking the Rated Specifications

- Switch off the analyzer before withdrawing or inserting modules.
- Check the position of the mains voltage selector (230 V) before switching on the device.
- Perform measurement of the set characteristics after the device has warmed up for at least 30 minutes and after self-calibration of the analyzer and the SMIQ have been completed. This is the only way to ensure that the guaranteed data are complied with.
- Unless specified to the contrary, all settings will be performed starting from the PRESET setting.
- The following conventions apply to settings on the analyzer during measurement:

- [<TASTE>] Press a key on the front panel such as [SPAN]
- [<SOFTKEY>] Press a softkey such as [MARKER -> PEAK]
- [<tbid unit>] Enter a value and terminate by entering the unit such as [12 kHz]
- {<nn>} Enter values specified in the table below.

Successive entries are separated by [:] such as [**SPAN**: 15 kHz]

- The values in the sections that follow are not guaranteed; only the specifications in the data sheet are binding.

### Measuring equipment and accessories

Item	Device type	Recommended characteristics	Recommended device	R&S order number	Application
1	Signal generator	Vector signal generator	SMIQ with options: SMIQB20 SMIQB11 SMIQB60 SMIQK17 SMIQ-Z5 PARADATA	1125.5555.xx 1125.5190.02 1085.4502.04 1136.4390.02 1154.7800.02 1104.8555.02	
2	Control computer for signal generation using WinIQSIM  PC that is either connected by means of a serial cable to the SMIQ, or has an IEC bus card and connected by means of an IEC bus cable to the SMIQ. R&S WinIQSIM Software 3.91 is installed on that PC. The software can be downloaded from the Rohde & Schwarz web site on the Internet at <a href="http://www.rohde-schwarz.com">http://www.rohde-schwarz.com</a> .				

**Test sequence**

The performance test refers solely to results of the code domain analyzer. There is no need to check the measured values of the POWER, ACLR and SPECTRUM measurements, since they are already covered by the performance test of the basic device.

If not done already, the WinIQSIM file with the 1xEV-DO BTS signal must be created first and transferred to the SMIQ as DO\_FFULL. This is described at length in the section "Generating a 1xEV-DO forward link signal with WinIQSIM" on page 10.

Default setting on SMIQ:

```

[PRESET]
[LEVEL:           0 dBm]
[FREQ:           878.49 MHz]
ARB MOD
    SET SMIQ ACCORDING TO WAVEFORM ...
        SET SMIQ ACCORDING TO WAVEFORM           ON
        IQ SWAP (VECTOR MODE)                   ON
        TRIGGER OUT MODE                         ON
    
```

*(These three settings are only required once after generator preset and are used to apply, in VECTOR MODE, the IQ SWAP and, in ARB MOD, the trigger setting automatically from the waveform file generated by WinIQSIM. This is particularly present when a switch is made between different waveforms.)*

```

SELECT WAVEFORM... select name 'DO_FFULL'
STATE:           ON
    
```

Default setting on analyzer:

```

[PRESET]
[CENTER:         878.49 MHz]
[AMPT:           10 dBm]
[1xEVDO BS]
[TRIG             EXTERN]
[SETTINGS        TIME/PHASE: ON]
    
```

```

[RESULTS          CHANNEL TABLE]
    
```

Test setup and other settings

- Connect the RF output of the SMIQ to the RF input of the analyzer
- Connect the external trigger input of the analyzer to the TRIG1 port on the Z5 PARADATA BNC ADAPTER
- Connect the external reference output of the analyzer to the SMIQ.

```

SMIQ UTILITIES
      REF OSC
      SOURCE: EXT
    
```

```

Analyzer [SETUP:           REFERENCE INT]
    
```

The measurement result displayed on the screen of the analyzer should look as follows:



BS,DO,C0 :CHANNEL TAB

Type PILOT-I

Code 0.32 Max T 0.76 ns @ DATA 13.16

CF 878.49 MHz Slot 0 Max Ph 1.71 mrad @ DATA 5.16

	Type	Chan.SF	Symb Rate ksps	Modulation	Pwr Abs dBm	Pwr Rel dB	T Offs ns	Ph Offs mrad	
Ref	PILOT	0.32	38.4	BPSK-I	0.29	-0.00	0.00	0.00	A
10.0	MAC	2.64	19.2	BPSK-I	0.28	-0.00	0.00	0.00	
dBm	PRE64	2.32	38.4	BPSK-I	0.29	-0.00	0.00	0.00	
Att	DATA	0.16	76.8	16-QAM	-11.75	-12.12	0.00	0.00	TRG
40 dB	DATA	1.16	76.8	16-QAM	-11.75	-12.12	-0.28	0.19	
	DATA	2.16	76.8	16-QAM	-11.77	-12.13	0.05	0.55	
	DATA	3.16	76.8	16-QAM	-11.77	-12.13	-0.03	0.21	
	DATA	4.16	76.8	16-QAM	-11.75	-12.12	0.26	1.24	
1	DATA	5.16	76.8	16-QAM	-11.75	-12.11	-0.18	1.71	
CLRWR	DATA	6.16	76.8	16-QAM	-11.75	-12.12	0.14	-0.64	
	DATA	7.16	76.8	16-QAM	-11.76	-12.12	-0.02	-1.54	
	DATA	8.16	76.8	16-QAM	-11.77	-12.13	0.19	0.63	

GENERAL RESULTS

Type ALL

CF 878.49 MHz

Global Results				
Ref	Carr Freq Error	2.08 mHz	RHO Pilot 0.99989	B
10.0	Carr Freq Error	0.00 ppm	RHO overall-1 0.99989	
dBm	Chip Rate Error	0.15 ppm	RHO overall-2 0.99989	
Att	Trg to Frame	167.017333 ns		
40 dB	Results for Slot: 0			
	Power PILOT	0.29 dBm	Data Modulation Type 16-QAM	
	Power MAC	0.28 dBm	Act. MAC Channels 1	
1	Power DATA	0.36 dBm	Act. DATA Channels 16	
CLRWR	Power PREAMBLE	0.29 dBm	Preamble Length 64 Chips	
	Composite EVM	1.02 %	RHO 0.99989	

## 9 Relationship between Mac Index and Walsh Codes

With 1xEV-DO there are "MAC indices" to characterize channels. They are also used in Software R&S WinIQSIM.

The MAC index  $i$  can be transformed for the MAC channel type into the corresponding Walsh code for a fixed spreading factor of 64 as follows:

$$\left(\frac{i}{2}\right).64 \quad \text{for } i = 0, 2, \dots, 62 \text{ on I - branch}$$

$$\left(\frac{i-1}{2} + 32\right).64 \quad \text{for } i = 1, 3, \dots, 63 \text{ on Q - branch}$$

The PREAMBLE channel type also uses the MAC index as a criterion for channel calculation. The spreading factor in this instance is 32. Since a constant null sequence is sent for the PREAMBLE channel type in the same way as for the PILOT, it is possible to achieve for the PREAMBLE channel type, by means of bit-by-bit complements of the Walsh code for the odd indices, that the sent symbols are inverted. Instead of the null sequence, ones are received for the odd indices, there being 64 different possibilities.

$$\left(\frac{i}{2}\right).32 \quad \text{for } i = 0, 2, \dots, 62$$

$$\left(\frac{i-1}{2}\right).32 \quad \text{for } i = 1, 3, \dots, 63$$

Not all indices can be used in the 1xEV-DO system. Indices 0 and 1 are not used. Index 2 is not used with MAC and is reserved for the 76.8 kbps control channel with PREAMBLE. Index 3 is not used with MAC and is reserved for the 38.4 kbps control channel with PREAMBLE. Index 4 is the RA channel with MAC (Forward MAC Reverse Activity Channel) and is not used with Preamble. The indices are flexible from index 5 onward.

The relationships have been calculated as a look-up table in the table below:

Table 9-1 Relationship between an **even** MAC index and Walsh code for MAC and PREAMBLE

	MAC CHANNEL TYPE	PREAMBLE CHANNEL TYPE
Mac index	Walsh code on I branch	Walsh code on I branch
0	0	0
2	1	1
4	2 <i>(RA CHANNEL)</i>	2
6	3	3
8	4	4
10	5	5
12	6	6
14	7	7
16	8	8
18	9	9
20	10	10
22	11	11
24	12	12
26	13	13
28	14	14
30	15	15
32	16	16
34	17	17
36	18	18
38	19	19
40	20	20
42	21	21
44	22	22
46	23	23
48	24	24
50	25	25
52	26	26
54	27	27
56	28	28
58	29	29
60	30	30
62	31	31

Table 9-2 Relationship between an odd MAC index and Walsh code for MAC and PREAMBLE

	MAC CHANNEL TYPE	PREAMBLE CHANNEL TYPE
Mac index	Walsh code on Q branch	Walsh Code (bit-by-bit complements)
1	32	0
3	33	1
5	34	2
7	35	3
9	36	4
11	37	5
13	38	6
15	39	7
17	40	8
19	41	9
21	42	10
23	43	11
25	44	12
27	45	13
29	46	14
31	47	15
33	48	16
35	49	17
37	50	18
39	51	19
41	52	20
43	53	21
45	54	22
47	55	23
49	56	24
51	57	25
53	58	26
55	59	27
57	60	28
59	61	29
61	62	30
63	63	31

## 10 Glossary

1xEV-DO	First evolution data only. Packet-oriented standard for data services as a development of the CDMA2000 mobile radio system
CDEP	Code domain error power
CDP	Code domain power
Composite EVM	The composite EVM measurement determines the squared error between the real and imaginary components of the test signal and of an ideally generated reference signal (EVM referred to the total signal).
Crest factor	Ratio of peak to mean value of a signal
Inactive channel threshold	Minimum power that a single channel must have compared to the total signal in order to be detected as the active channel
DATA	The DATA channel type is located with a length of up to 400 chips at the beginning and end of each half slot. The useful data proper are transmitted in it.
Channel type	With regard to time, the slot is divided into 4 channel types containing independent cdma signals.
MAC	The Medium Access Control channel type is 64 chips in front of and behind the PILOT. The MAC channel type contains the reverse activity (RA) channel and the MAC reverse power control (RPC) channels with which the power of the active terminals is controlled.
MC1	Multicarrier1 (a carrier system 1X)
PILOT	The PILOT channel type comprises 96 chips and is located in the center of each half-slot. It must be present in the signal for the base station signal to be detected.
PREAMBLE	The first 64 to 1024 chips of the DATA channel type are replaced at the beginning of a data packet by the PREAMBLE channel type. Depending on the transmission speeds being used and whether the start of data of the packet is missed, there are therefore preambles of different length in the slot.



---

RA	Reverse activity channel. Indicates whether at least one terminal is transmitting to the base station.
RPC	Reverse power control. Power regulation of the data terminal equipment by the base station
SLOT	Term in the 1xEV-DO system for 2048 chips or a period of 1.6625 ms
x.y	Walsh code x.y, where: x is the code number and y the spreading factor of the channel.

---

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