



Products: CMU200, SMIQ

CMU200 Bluetooth™ Transmitter Measurements without Connection Setup

Application Note

This application note shows how to perform Bluetooth transmitter measurements with the CMU200 in a reduced signaling mode, in which the protocol handshake between the Bluetooth Equipment Under Test, the EUT, and CMU200 is skipped. This additional CMU200 feature allows both more flexible and faster RF testing of Bluetooth modules.

A step-by-step example with SMIQ demonstrates the principles and serves as a reference for integrating this method in user-specific test strategies.



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1 Overview

The CMU200 in signaling mode can carry out the most important transmitter and receiver tests on Bluetooth devices in production, quality management, and development. Signaling mode requires a connection setup to synchronize the CMU with the Equipment Under Test (EUT). However in unsynchronized mode, the CMU200 can also carry out a number of transmitter measurements. This additional CMU200 feature allows both more flexible and faster RF testing of Bluetooth modules. Unsynchronized mode without connection setup is presented in this application note.

The transmitter measurements possible in unsynchronized mode are:

- POWER: nominal and leakage, as well as the graphical display of the power versus bit curve
- MODULATION: frequency accuracy, frequency drift, maximum drift rate, and frequency deviation (average, minimum, maximum, and graphical result as a function of the bit)

These CMU200 measurements are performed in unsynchronized mode through either manual operation or remote control. There are no MASTER-SLAVE roles in unsynchronized mode and both the EUT and the tester must be configured locally prior to the measurement.

Examples using an SMIQ signal generator simulating the Bluetooth EUT both help demonstrate the principles and serve as the reference for integrating this method in user-specific test strategies. The SMIQ has to be equipped with options SMIQB11, and SMIQB10 or SMIQB20. Winbatch sequences demonstrate the application through the IEC/IEEE-bus remote control.

2 Abbreviations

| | |
|------------|--------------------------|
| BD_Address | Bluetooth Device Address |
| EUT | Equipment Under Test |

3 Principle of Operation

CMU200 Bluetooth transmitter measurements without a connection setup are based on the CMU200 signaling mode with:

- source trigger configured as RF or IF Power
- local pre-configuration of the Bluetooth signal on both the EUT and the CMU200 as required for each of the transmitter measurements.

This mode is defined as REDUCED SIGNALING MODE for simplicity's sake and common terminology across the supported CMU200 standards (e.g. GPRS). The difference from signaling mode is explained below.

In signaling mode (see fig. 1) the CMU first transmits an inquiry signal to detect connectable Bluetooth devices within its domain. From the list of devices, a target device is selected. The CMU transmits a signal to synchronize and attempt a connection to the target device. After the connection is established, the EUT is put into its internal test mode where transmitter and receiver tests can be performed provided that the test mode has been locally enabled. When switching between the various measurements, signalling control commands are transmitted by CMU200 to re-configure the EUT for the next measurement to be performed; this procedure is skipped when performing measurements in reduced signaling mode.

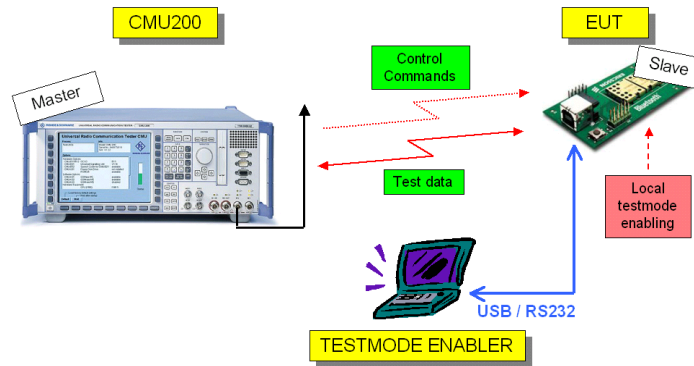


Fig. 1: Test setup in signaling mode

In reduced signaling mode, both the EUT and the CMU200 must be configured by the operator or via remote control prior to each measurement. Therefore CMU200 does not act as “Master” and the EUT is not “Slave”.

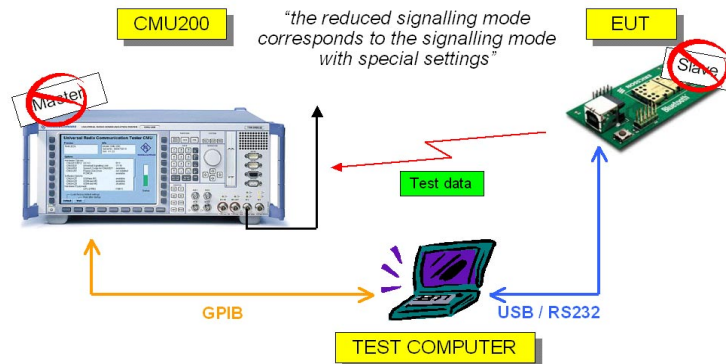


Fig. 2: Test setup in reduced signaling mode

4 Configuration

Equipment Under Test (EUT)

Parameters required for both the CMU200 and the EUT configuration:

- Frequency
- Transmit power
- Packet type
- Access code (sync word must correspond to the CMU200 BD_Address)
- Payload length
- Payload data pattern

CMU200

Step by step configuration:

- GROUP CONFIGURATION:
 - Input level / max. manual level 5.0dB higher than EUT expected power considering the coupling losses
 - Source trigger as "RF Power" or "IF Power"
- CONNECTION CONTROL, tab SIGNALLING:
 - Automatic connection control pop up "OFF"
- CONNECTION CONTROL, tab NETWORK, section MASTER SIGNALING:
 - CMU200 BD_Address as coded in the synch word of the EUT's transmitted signal
- CONNECTION CONTROL, tab NETWORK, section TEST MODE:
 - Test scenario as transmitted by the EUT
 - Test mode hop scheme as "Hopping Rx/Tx Single"
 - Tx packet type as transmitted by the EUT
 - Tx packet length as transmitted by the EUT
- CONNECTION CONTROL, tab RF:
 - Coupling losses (RF Input 2 / Ext. Att. Input 2)
- Measurement menus POWER and MODULATION, soft-key CHANNEL:
 - Measurement mode as "Single"
 - Display channel/frequency as transmitted by the EUT

5 Transmitter Tests

Hardware Test Setup for Reduced Signaling Mode

The EUT is in general connected by wire for calibration measurements and by a coupling device in a shielded chamber for the final test. Either way the **coupling loss** between the RF connector of the EUT and the CMU200 must be known exactly.

The EUT and the CMU200 must be locally configured to each test.

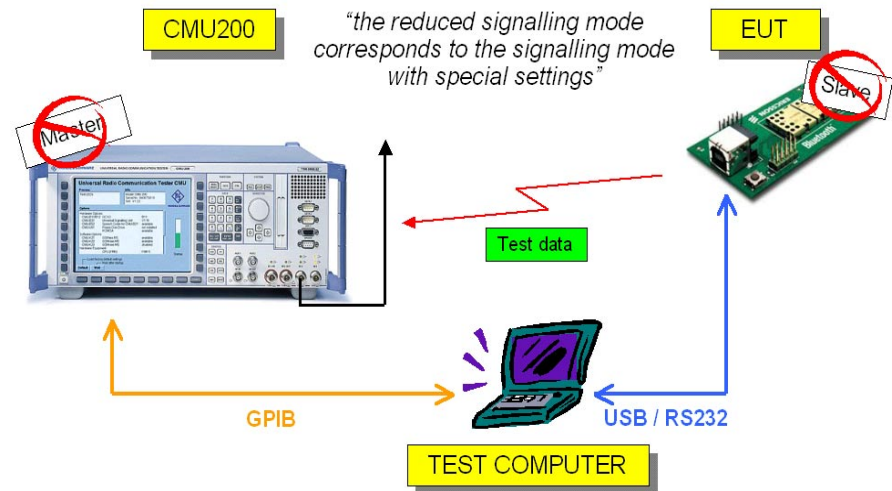


Fig. 3: Hardware test setup for Tx measurements in reduced signaling mode

The example below uses SMIQ vector signal generator to simulate the transmitter signal of an EUT. SMIQ is set up via IEEE-bus or RS232 by the application software SMIQ-K5 running on an external PC.

SMIQ-K5 V1.0 is attached to this application note. For a short description, see chapter 6 *Working with SMIQ-K5*.

For a more detailed description, download the application note 1GP48

Generating Bluetooth TM Signals with SMIQ and the Application Software SMIQ-K5*

(and the latest version of this software) from

<http://www.rohde-schwarz.com/> --> products --> Application Notes --> 1GP48.

1. Connect the RF output of the SMIQ to the RF input of the CMU200, as well as the remote control cables between both instruments and the test computer.
2. Set up SMIQ as EUT.
3. Set up CMU200.
4. Start measurement and check the results.

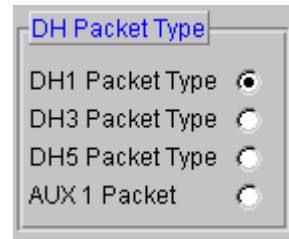
Settings for SMIQ as EUT

Start the SMIQ-K5 program on your test computer to transfer suitable data/control lists to SMIQ. At the top menu

1. Click 'Configure Packet'



2. Select Packet Type



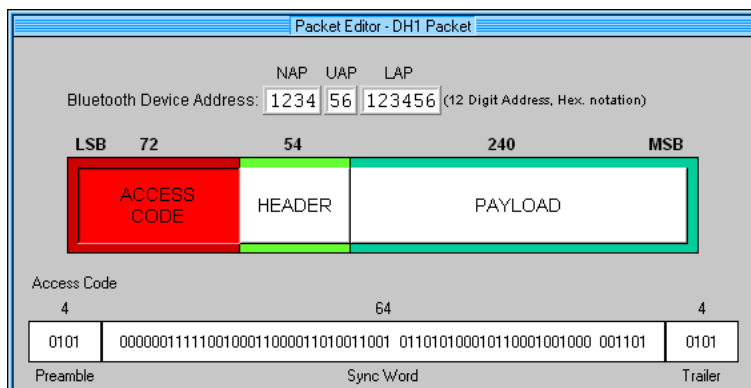
3. Set Data Source to Standard



4. Click 'Packet Editor'



5. Enter the CMU200 Bluetooth Device Address for the Access Code of the EUT (SMIQ)



(The CMU200 default BD_Address is 1234 56 123456)

Configure SMIQ manually to transmit the Bluetooth uplink signal:

11. Set FREQUENCY (e.g. 2.473GHz)
SMIQ: SOUR:FREQ 2.473 GHZ
12. Set LEVEL (e.g. 0dBm)
SMIQ: SOUR:POW 0.0 DBM

Settings for CMU200

1. Select the function group BLUETOOTH, SIGNALLING
2. Configure GROUP CONFIGURATION:
 - Set Input Level, Max. Level, Manual Level: 5dBm (5dB higher than expected)
CMUBT: LEV:MAX 5
 - Set Trigger, Source (e.g. IF Power)
CMUBT: TRIG:SOUR IFPower
3. Configure CONNECTION CONTROL by setting:
 - I. Signaling, automatic pop-up OFF
GPIB command not applicable
 - II. Network, Master Signaling, CMU BD_Address (default 1234 56 123456)
CMUBT: CONF:NETW:PAG:TARG '123456123456'
 - III. Network, Test Mode, Test Scenario (e.g. Tx Test – 1010 Pattern)
CMUBT: CONF:NETW:TMOD:SCEN P10;
 - IV. Network, Test Mode, Test Mode Hop Scheme: Hopping Rx/Tx on single
CMUBT: CONF:NETW:TMOD:HSCH RXTX
 - V. Network, Test Mode, Transmitter Test, Packet Type (e.g. DH1)
CMUBT: CONF:NETW:TMOD:TXT:PTYP DH1
 - VI. Network, Test Mode, Transmitter Test, Packet Length (e.g. 27bytes)
CMUBT: CONF:NETW:TMOD:TXT:LOTS 27
 - VII. RF, Ext. Att. Input (e.g. cable loss 1.0dB)
CMUBT: INP RF2; :CORR:LOSS:INP2 1.0

4. Configure MEASUREMENTS:

ESCAPE gets you from CONNECTION CONTROL to the last selected MEASUREMENT window

I. Select the POWER measurement window

Configure POWER by pressing Power/Time twice:

- Control, Power/Time, Measure Mode: Single
CMUBT: CONF:POW:TIME:MMODE SING
- Control, Power/Time, Display Channel/Frequency (e.g. channel 71)
CMUBT: CONF:POW:TIME:MFR:UNIT CH
CMUBT: CONF:POW:TIME:MFR 71

II. Select the MODULATION measurement window

Configure MODULATION by pressing Deviation/Time twice:

- Control, Modulation, Measure Mode: Single
CMUBT: CONF:MOD:DEV:MMODE SING
- Control, Modulation, Display Channel/Frequency (e.g. channel 71)
CMUBT: CONF:MOD:DEV:MFR:UNIT CH
CMUBT: CONF:MOD:DEV:MFR 71

Measurement Results of Transmitter Tests

Test Object Power:

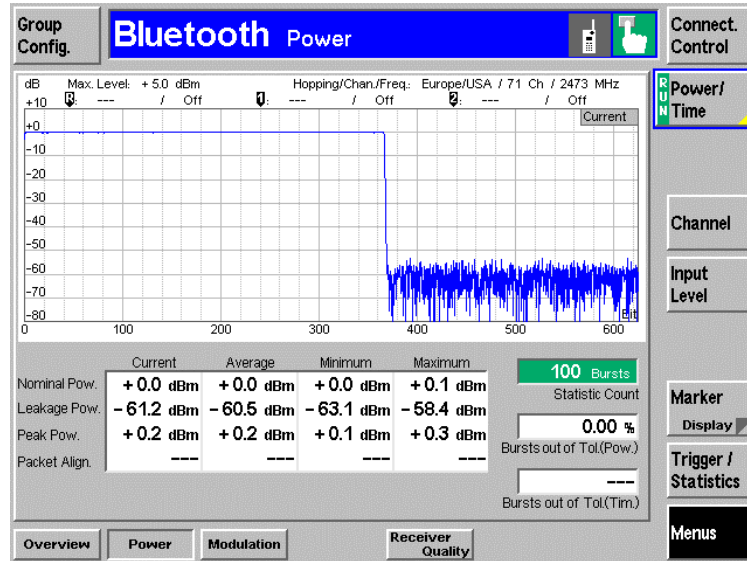


Fig. 4: Nominal-, Leakage-Power and Power versus Time
CMUBT: READ:POW:TIME?

Test Object Modulation:

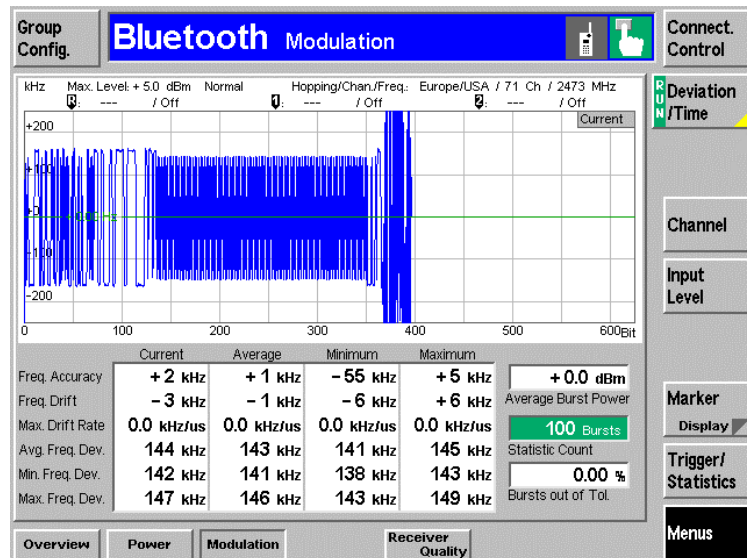


Fig. 5: Frequency-Accuracy, -Drift, -Deviation, Maximum Drift Rate and Deviation versus Time

CMUBT: READ:MOD:DEV?

6 Working with SMIQ-K5

The SMIQ-K5 software can define a Bluetooth signal setup and transmit it to a SMIQ as a set of Data and Control Lists. The SMIQ can be configured to use the content of this Data List as data source and the data sequence is then modulated using Bluetooth modulation. The modulation parameters can be changed, as well as parameters like power ramping, etc. These parameters either influence the calculation of the Data and Control Lists, or they are transferred to the SMIQ directly by remote control commands.

The SMIQ-K5 helps to create Bluetooth compatible standard packets. **DH1, DH3, DH5 and AUX1 packet types** are supported. With the integrated packet editor it is possible to edit every single information element of the packet, whilst the software calculates defined elements like CRCs or Sync Words by itself.

Requirements to run SMIQ-K5:

- Windows 95/98, Windows NT or Windows 2000
- At least Intel x486 CPU with 32 MB RAM. Pentium or higher recommended.
- GPIB-bus card PS-B4 from Rohde & Schwarz or an equivalent card from National Instruments with installed Windows drivers is required. A RS232 connection can also be used if no GPIB interface is present.
- SMIQxB equipped with options B20 and B11. B12 is recommended if a non-truncated PRBS 15 is being used with DH1 packets.
- SMIQ-Z5 (extension Board) needed if any trigger output signals shall be used.

Installing SMIQ-K5 Software

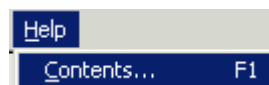
SMIQ-K5 V1.0 is attached to this application note as a windows self-expanding file (smiq_k5.exe). Download the latest version of the software from "<http://www.rohde-schwarz.com/>" --> products --> Application Notes --> 1GP48.

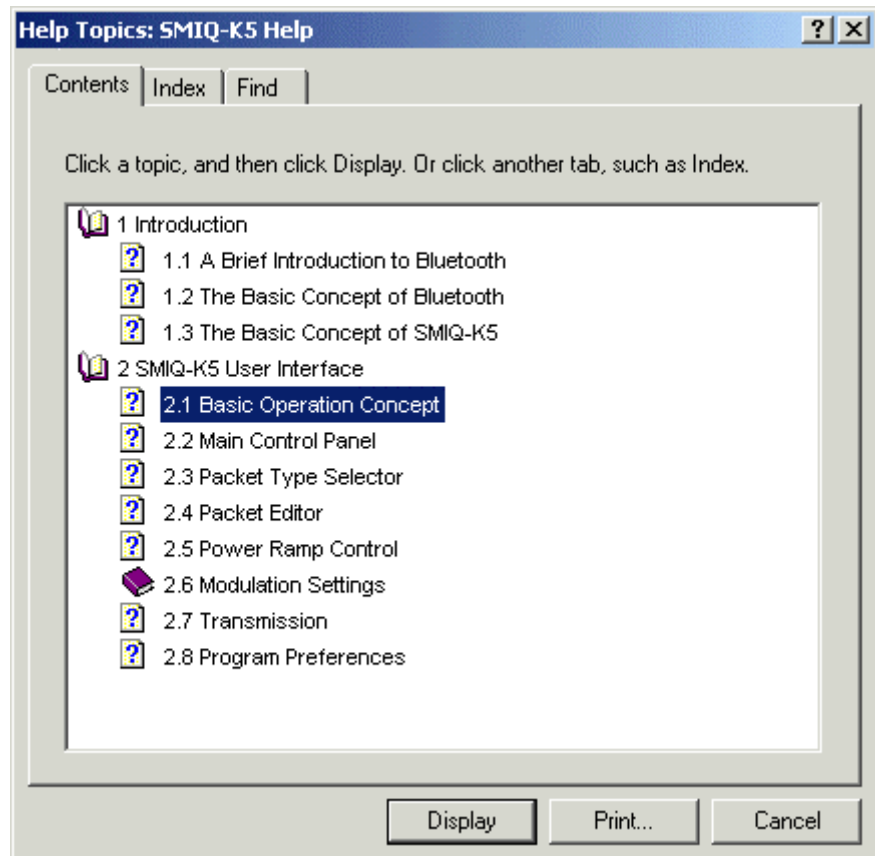
. Install the software as follows:

1. Start **smiq_k5.exe** copying the setup files into a directory of your choice.
The installation kit consists of 5 files: readme.txt, setup.exe, smiq-k5.001, smiq-k5.002 and smiq-k5.003
2. Start **setup.exe** and proceed in accordance with the dialog.

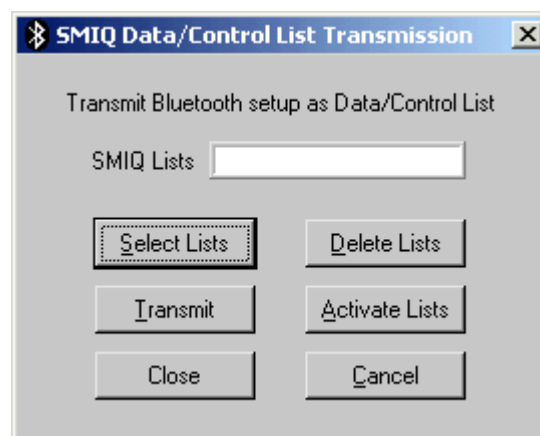
User Interface of SMIQ-K5 Software

After starting SMIQ-K5, the software is ready to create the Bluetooth compatible packets. A detailed help function is available.



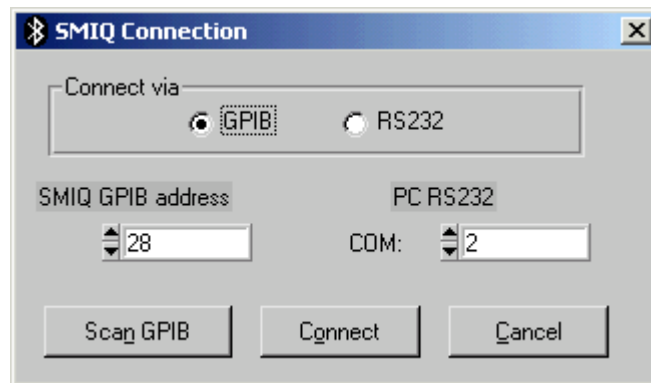


The GPIB device address can be defined later when a connection to the SMIQ is needed, e.g. for transferring a set of data and control lists to the SMIQ.

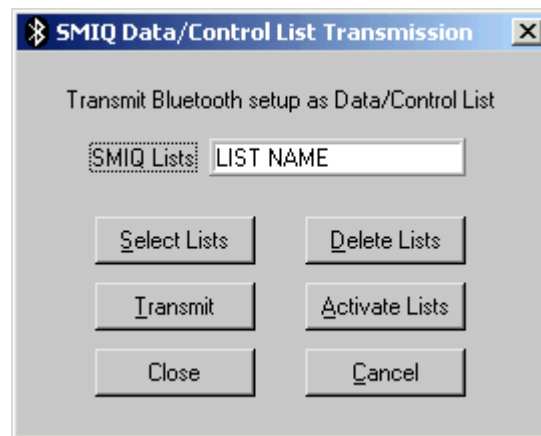


CMU200 Bluetooth(TM) Transmitter Measurements without connection setup

The GPIB/RS232 configuration window is available only after an attempt to connect to an SMIQ.



A tentative to transmit data without selecting or defining a **LIST NAME** will result in a 'LIST Transmission Error'. A tentative to 'Activate Lists' without selecting or defining a **LIST NAME** will result in a 'Data/Control List Error'.



The data transferred to SMIQ are data (**DLIST**) and control lists (**CLIST**).

The DLIST is **organized in bits**. The index counts the bit positions.

The CLIST is **organized in symbols** (the index counts symbol positions).

The CLIST contains status **changes**.

7 Ordering Information

Universal Radio Communication Tester CMU200:

| | | |
|--------|-----------|--------------|
| CMU200 | Base unit | 1100.0008.02 |
|--------|-----------|--------------|

Options:

| | | |
|-------------------------------------|-------------------------|---------------------------------|
| CMU-B11 or CMU-B12 | Reference Oscillator | 1100.5000.02 or 1100.5100.02 |
| CMU-B21 | Signalling unit | 1100.5200.02 |
| CMU-B53 (factory installation only) | Bluetooth extension | 1100.5700.02 |
| CMU-K53 (factory installation only) | Bluetooth test software | 1115.5000.02 |
| CMU-U53 (B53/K53 upgrade) | Bluetooth upgrade kit | 1100.7302.02 |

Vector Signal Generator SMIQ:

| | | |
|---------|--------------------|--------------|
| SMIQ02B | 300 kHz to 2.2 GHz | 1125.5555.02 |
| SMIQ03B | 300 kHz to 3.3 GHz | 1125.5555.03 |
| SMIQ03B | 300 kHz to 3.3 GHz | 1125.5555.03 |
| SMIQ04B | 300 kHz to 4.4 GHz | 1125.5555.04 |
| SMIQ06B | 300 kHz to 6.4 GHz | 1125.5555.06 |

Options:

| | | |
|---------|------------------|--------------|
| SMIQB11 | Data Generator | 1085.4502.04 |
| SMIQB12 | Memory Extension | 1085.2800.04 |
| SMIQB20 | Modulation Coder | 1125.5190.02 |

IEC/IEEE-Bus Card

| | | |
|-------|--------------------------|--------------|
| PS-B4 | IEEE 488.2-Bus Interface | 1006.6207.04 |
|-------|--------------------------|--------------|



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