R&S®SMM-K80
Bit Error Rate Tester
User Manual

ROHDE&SCHWARZ

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This document describes the following software options:

- R&S®SMM-K80 Bit Error Rate Tester (1441.2066.xx)

This manual describes firmware version FW 5.20.043.xx and later of the R&S®SMM100A.

Contents

1 Welcome to the Bit Error Rate Tester option

The R&S SMM-K80 is a firmware application that adds a BER (Bit Error Rate) tester to evaluate the bit error rate of a signal demodulated and decoded by a DUT. The R&S SMM-K80 option also includes a BLER (Block Error Rate) measurement, used to verify CRC checksums, where the ratio of erroneous blocks to total blocks yields the block error rate.

The R&S SMM-K80 features:

● Adjustable measurement for bit and block error measurements
● Switching between test modes
● Configurable connectors

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S SMM100A user manual. The latest version is available at:

www.rohde-schwarz.com/manual/SMM100A

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMM100A service manual.

1.1 Accessing the Bit Error Rate Tester dialog

To open the dialog with Bit Error Rate Tester settings

► In the block diagram of the R&S SMM100A, select "System Config > Setup > Bit/ Block Error Rate".

A dialog box opens that displays the provided general settings.

The signal generation is not started immediately. To start signal generation with the default settings, select "State > On".

1.2 What's new

This manual describes firmware version FW 5.20.043.xx and later of the R&S®SMM100A.

Compared to the previous version there are editorial changes only.

1.3　Documentation overview

This section provides an overview of the R&S SMM100A user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/smm100a

1.3.1　Getting started manual

Introduces the R&S SMM100A and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.3.2　User manuals and help

Separate manuals for the base unit and the software options are provided for download:

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Software option manual
  Contains the description of the specific functions of an option. Basic information on operating the R&S SMM100A is not included.

The contents of the user manuals are available as help in the R&S SMM100A. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

All user manuals are also available for download or for immediate display on the Internet.

1.3.3　Service manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

1.3.4　Instrument security procedures

Deals with security issues when working with the R&S SMM100A in secure areas. It is available for download on the internet.

1.3.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.3.6 Data sheets and brochures

The data sheet contains the technical specifications of the R&S SMM100A. It also lists the options and their order numbers and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/smm100a

1.3.7 Release notes and open source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/smm100a

1.3.8 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/smm100a

1.3.9 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

On the menu bar, search for your product to find related videos.

Figure 1-1: Product search on YouTube

1.4 Scope

Tasks (in manual or remote operation) that are also performed in the base unit in the same way are not described here.

In particular, it includes:

- Managing settings and data lists, like saving and loading settings, creating and accessing data lists, or accessing files in a particular directory.
- Information on regular trigger, marker and clock signals and filter settings, if appropriate.
- General instrument configuration, such as checking the system configuration, configuring networks and remote operation
- Using the common status registers

For a description of such tasks, see the R&S SMM100A user manual.

1.5 Notes on screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 About the Bit Error Rate Tester option

2.1 Required options

The equipment layout for bit and block error rate measurements includes:

- Option Baseband Generator(R&S SMM-B9)
- Option Bit Error Rate Tester (R&S SMM-K80)

2.2 About bit and block error rate measurements

The BER (Bit Error Rate) tester evaluates the bit error rate of a signal. The DUT decodes a known PRBS-modulated data sequence and returns clock and data signals to the R&S SMM100A. The BER tester synchronizes to the PRBS sequence and counts the bit errors. The bit error rate is defined by the ratio of the number of error bits to the total number of bits.

The BLER calculates the checksum from the feedback data and compares it with the checksum of the data signal that is fed to the DUT. If the two checksums differ, a block error is counted. The quotient obtained by dividing the number of faulty blocks by the total number of blocks is the block error rate.

2.2.1 PRBS data

The PRBS (Pseudo Random Binary Sequence) sequences are used for computing the data. To detect faulty bits using the BER measurement, it is required to know the data generation polynomial. Depending on the selected polynomial, these quasi-random bit sequences are repeated periodically. A randomly selected initial status yields exactly one subsequent status, therefore both occur only once in the whole sequence.

An advantage of the PRBS data is that the bit error detector must know only the polynomial but not the entire sequence. At measurement start, the feedback shift register is filled once with the applied data sequence (which corresponds to the synchronization time) and is then switched from "Fill" to "Feedback". This function creates a defined initial status and generates the same data that the applied data stream has. Faulty bits can thus be identified and counted by comparing the received data with the results obtained from the shift register.

Creating a defined initial status makes it possible to start the analysis anywhere in the bitstream, i.e. the bitstream source and the analyzer need not be synchronized. Delays of the DUT and transmission over long air paths, where the transmitter and the receiver are located at separate sites, are therefore not a problem.

For details, see R&S SMM100A User Manual.

CRC polynomial

At the beginning of the data, the shift register is initialized with 0. All user data bits are then shifted through the shift register. The checksum (CRC) component is then read into a second register and compared bit by bit with the result of the calculation. The supported CRC polynomial is as follows:

CCITT CRC 16 : $G(x) = x^{16} + x^{12} + x^5 + 1$

The user data is marked by a signal that comes from the DUT and is fed to the "Data Enable" input of the BERT interface, see Figure 2-5.

Clock signal

Usually the DUT provides the clock signal. If not, consider the following alternatives:

- Use a custom digitally modulated signal and extract the bit clock from the clock output connector.
- Generate a digitally modulated signal according to one of the supported digital standards or play a waveform with the ARB and use one of the marker signals as clock.

As the DUT causes a delay, we recommend that you measure the ratio of clock-to-data transmission times with an oscilloscope. In the R&S SMM100A, observe the status indication for the clock and data lines, and for the synchronization in the "Bit/Block Error Rate" dialog.

2.2.2 External restart

The "External Restart" function allows BER measurements with short signals or with signals that are not continuously generated. Such signals usually do not contain any whole-number multiples of PRBS sequences. An external signal input holds the measurement, integrates BER results of relevant (sub-) sequences and restarts the measurement when the data sequence begins.

Example:

Figure 2-1 illustrates the principle of external restart in case of short sequenced.

The length of the signal is too short for a complete PRBS sequence. The restart signal restarts PRBS generation when the signal begins anew.
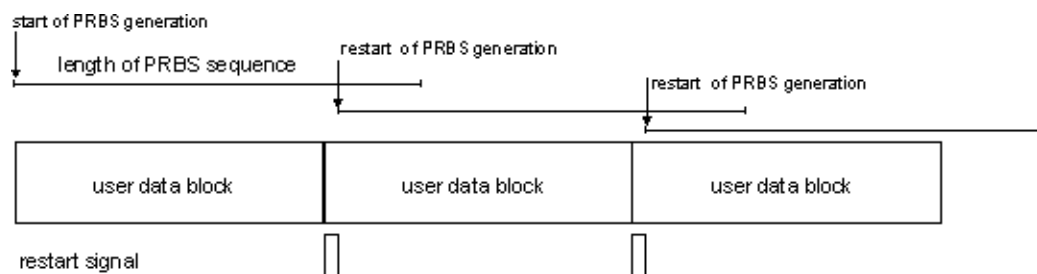
Figure 2-1: External restart

R&S SMM100A or the R&S WinIQSIM2 software generates frames, that contain PRBS data continuously written to the user data fields. A restart is necessary, if the R&S SMM100A is the data source and the total length of the signal does not contain a whole-number multiple of a PRBS sequence.
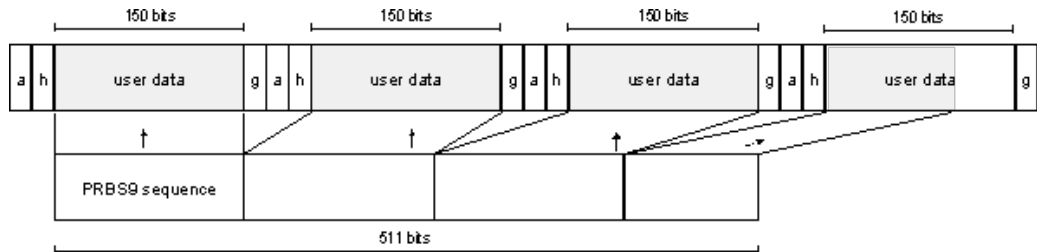
Example:

The R&S SMM100A generates a TDMA signal with user data that contains the PRBS data sequence; it writes the PRBS sequence continuously to the user data fields.

2.2.3 Data enable

Usually the data of bit error rate measurement signals contain more than PRBS data (e.g. sync and preambles), which would result in bit errors. The "Data Enable" signal interrupts the BER measurement for this data.

Example: Understanding the data enable signal for BER and BLER measurements
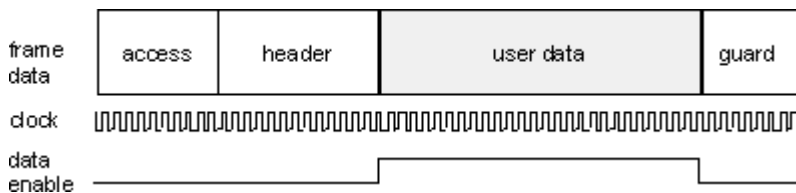
Figure 2-2: Data enable signal for BER measurement

Figure 2-2 shows an example of a TDMA signal with user data that contains the PRBS data sequence, various check fields and the associated clock and data enable signals. The data enable signal is low during the check fields so that these fields are ignored for BER measurement.

In the case of the block error rate measurement, the "Data Enable" signal masks the user data and thus not evaluate the user data.
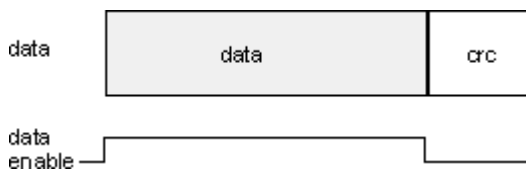
Figure 2-3: Data enable signal with BLER measurement

2.2.4 Pattern ignore

When faulty frames (e.g. an incorrect checksum) are detected, some mobile radio standards generate bit sequences of at least 32 bits with only "1" or "0" instead of frame data. The "Pattern Ignore" function excludes those sequences from the measurement.

Example:

Lets assume that the DUT sets 50 bits to "0". These 50 bits plus the preceding "0" are ignored in the bit error rate measurement.

Figure 2-4: Pattern ignore

2.2.5 Terminating BER/BLER measurement

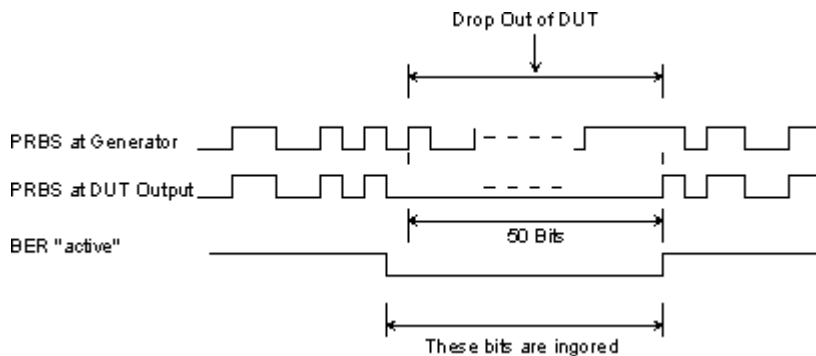The measurement results usually are in the range of 10^{-2} to 10^{-9} for the bit error rate, and in the range of 10^{-2} to 10^{-4} for the block error rate. Hence, many bits or blocks must be tested before a faulty bit or block occurs, which leads to longer measurement times. Since 32-bit-wide counters are used for the total number of bits/blocks and the number of error bits, the maximum measurement time is 4.29×10^9 bits.

To keep the measurement times short, consider the following:

- Terminate the measurement manually.
- Use one of the predefined termination criteria:
  - Reaching a user-defined number of checked data bits/blocks.
  - A maximum number of detected errors.

The measurement stops when at least one criteria is met. The display shows which of the two criteria caused the measurement to stop.

The BER/BLER measures statistical bit/block errors, i.e. errors which occur at random. A single measurement determines the exact number of errors in the measured interval, but it is only statistically reliable when a sufficient number of errors occur in the measured interval. A sufficient number of errors makes sure that the single BER/BLER measurement result approaches the true error rate with high probability.

Bit error rates of approximately 50 % indicate a faulty measurement.

In the case of continuously generated signals that contain whole-number multiples of the PRBS sequence, the measurement occurs without interruption. The measurement only uses the data and clock lines of the BERT interface. The length of the random sequence is calculated as follows:

PRBS length = $2^{\text{power of the degree of the polynomial}}$ - 1

For example, the length of the PRBS9 sequence is 511 = 2^9 - 1.

2.3 BER/BLER test setup

Figure 2-5 shows an example of the bit/block error rate measurement test setup.

BERT/BLER testing requires test signal (PRBS data sequence) that is fed to the DUT, and a set of different control signals, like the clock, data and restart signals. You can generate the test signal in the fowlloing ways:

- Internally - with one of the digital standards or as custom digital modulated signal
- Externally - for example with the R&S WinIQSIM2 software and play this signal with the ARB.

The test signal is output at the RF connector; the control signal at the User x connectors. The latter is connectors with definable signal. Assign the dedicated BERT/BLER signals according to the current cabling.
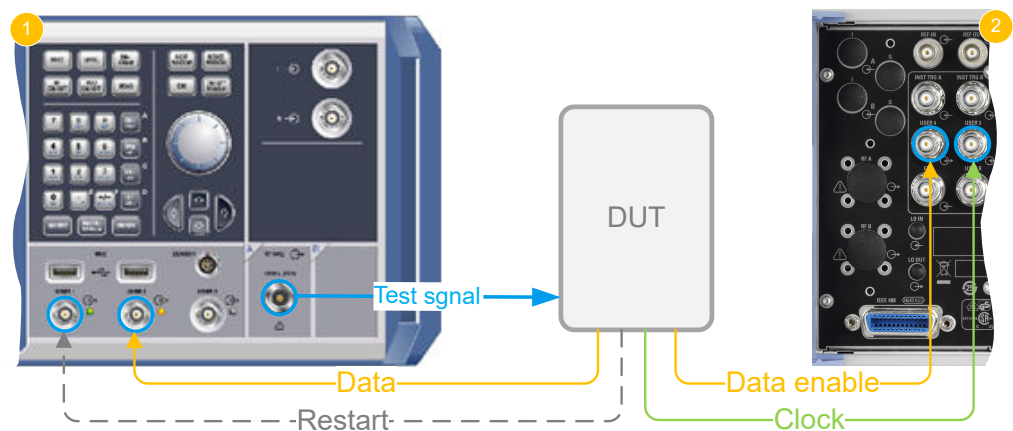
Figure 2-5: Example of a test setup for bit or block error rate measurement

1	= R&S SMM100A front panel (part view)
2	= R&S SMM100A rear panel (part view)
DUT	= Device under test
Test signal	= PRBS data sequence (RF connector), see Chapter 2.2.1, "PRBS data", on page 9
Restart	= Input signal for BER measurements (User 1 connector), see Chapter 2.2.2, "External restart", on page 10.
Data	= Input signal (User 2 connector), see Chapter 2.2.1, "PRBS data", on page 9
Data enable	= Input signal (User 4 connector), see Chapter 2.2.3, "Data enable", on page 11
Clock	= Input signal (User 5 connector), see "Clock signal" on page 10

2.4 BER/BLER self-test setup

The BER/BLER self-test validates the BER and BLER measurements.

You can perform self-tests for different signals, which mainly differ in the routing of the signals. You can assign the BER/BLER signals at the global User x connectors. These connectors serve as input or output interface and, depending on the selected direction, also as an interface for different signals.

When you specify a connector for input signals, the R&S SMM100A routes the assigned BER signal internally. For external tests, you can set one connector as output and a second connector as input. Connect the connectors with a cable, define the direction and assign the signals according to the particular test case.

As the R&S SMM100A has fewer connectors than BER signals, you can execute the self-test for more signals using these routing possibilities.

Despite the naming of the "BER", the signals apply to both, the BER and BLER measurements.

Self-test with output and input signals

To perform a self-test, assign at least one input / output signal pair and connect the corresponding User x connectors with a BNC cable. Table 2-1 shows the possible loop back types.

You can configure 3 loops at most simultaneously, because every loop requires an input *and* output signal.

Table 2-1: Possible loops and the required input and output signals

Loop back type	Signal input	Signal output
Data signal	BER Data	BER TestGen Data
Data enable signal	BER Data Enable	BER TestGen Data Enable
Restart signal	BER Restart	BER TestGen Restart
Clock signal	BER Clock	BER TestGen Clock

Example: "BER Clock" and "BER Data" signal loops; "BER Data Enable" signal routed internally

Figure 2-6 shows an example setup with a clock and data signal loop.

The signal to connector mapping in the "System Config > Setup > Bit/Block Error Rate > Signal Configuration > Global Connectors" dialog is as follows:

- "User 1 > Direction = Output" and "User 1 > Signal = BER TestGen Clock"
- "User 2 > Direction = Input" and "User 2 > Signal = BER Clock"
- "User 4 > Direction = Output" and "User 4 > Signal = BER TestGen Data"
- "User 5 > Direction = Input" and "User 5 > Signal = BER Data"
- "User 3 > Direction = Input" and "User 3 > Signal = BER Data Enable"

Figure 2-6: Looping back of the clock and data signals (the BER Data Enable signal is routed internally)

1 = R&S SMM100A front panel
2 = R&S SMM100A rear panel

Self-test with coherent signal direction

Select either all input *or* output signals for the self-test. The error rate tester tests the outgoing signal. The R&S SMM100A routes the signal internally, cable connections are not required.

Example:

The signal to connector mapping in the "System Config > Setup > Bit/Block Error Rate > Signal Configuration > Global Connectors" dialog is as follows:

- "User 1 > Direction = Input" and "User 1 > Signal = BER Data"
- "User 2 > Direction = Input" and "User 2 > Signal = BER Clock"
- "User 4 > Direction = Input" and "User 4 > Signal = BER Data Enable"
- "User 5 > Direction = Input" and "User 5 > Signal = BER Restart"
- "User 3 > Signal = Not Used"

3 Bit and block error rate settings

Access:

► Select "System Config > Setup > Bit/Block Error Rate > General".
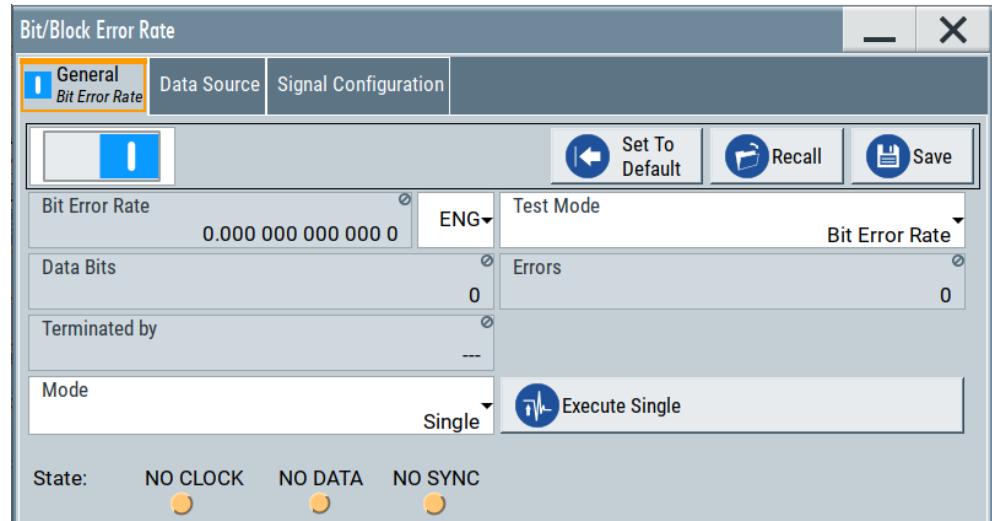
The "General" dialog contains file settings relevant for both test modes and allows the start of the measurement.

3.1 Common settings

Access:

► Select "Bit/Block Error Rate > General".

State

Activates the bit error rate measurement.

Remote command:
:BERT:STATe on page 46
:BLER:STATe on page 46

Set To Default

Calls the default settings.

Remote command:

:BERT|BLER:PRESet on page 40

Save/Recall

Accesses the "Save/Recall" dialog, that is the standard instrument function for saving and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The settings are saved in a file with predefined extension. You can define the filename and the directory, in that you want to save the file.

See also, chapter "File and Data Management" in the R&S SMM100A user manual.

Remote command:

:BERT|BLER:LOAD on page 39

:BERT|BLER:STORe on page 39

Test Mode

Select the error rate test mode.

Remote command:

:TEST:BB:DATA:TYPE on page 40

3.2 Bit error rate settings

Access:

1. Select "Bit/Block Error Rate > General".

2. Select "Test Mode = Bit Error Rate".

The "Bit Error Rate" dialog contains all the parameters to configure, activate and evaluate the measurement.
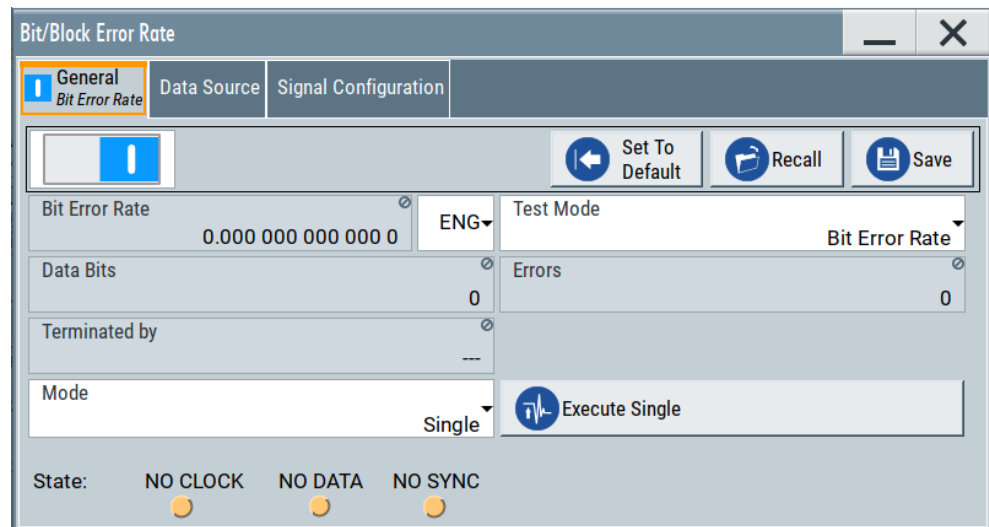
The remote commands required to define these settings are described in Chapter 6, "Remote-control commands", on page 36.

3.2.1 General settings

Access:

1. Select "Bit/Block Error Rate > General".

2. Select "Test Mode = Bit Error Rate".

Bit Error Rate

Displays the measured bit error rate in exponential notation with the exponent $^{-3}$ or $^{-6}$.

The bit error rate is the ratio of occurred errors to transmitted data bits.

"ENG"   Bit error rate output in exponential notation with the exponent $^{-3}$ or $^{-6}$.

"%"   Bit error rate output in percent.

"PPM"   Bit error rate output in parts per million.

Remote command:
:BERT:RESult? on page 40

Data Bits

Displays the current number of checked data bits.

Remote command:
:BERT:RESult? on page 40

Errors

Displays the current number of occurred errors.

Remote command:
:BERT:RESult? on page 40

Terminated By

Displays the termination criterion for the measurement.

Termination criteria shorten the duration of the measurement for low and high bit error rates. The last measurement result is displayed after the measurement has been terminated.

"User"   The measurement was manually stopped with State"State > Off" or :
                BERT:STOP.

"Number of Data Bits"
                The measurement stopped after the specified number of data bits
                was reached.

"Number of Errors"

> The measurement stopped after the specified number of errors was reached.

Remote command:

n. a.

Mode

Selects the type of measurement.

"Auto"
> Continuous measurement.
> If at least one termination criteria is met, terminates the measurement in progress and immediately starts a new one. During the first measurement, intermediate results are displayed. For the following measurements, only the final results are shown. Continuously updates the parameters "Data Bits/Received Blocks" and "Errors".

"Single"
> Single measurement. Start the measurement with "Execute Single". If a measurement is in progress, cyclically displays the current values for "Bit Error Rate/Block Error Rate", "Errors" and "Data Bits/Received Blocks". If at least one termination criterion is met, terminates the measurement in progress.

Remote command:

:BERT:TRIGger:MODE on page 42

:BLER:TRIGger:MODE on page 42

Execute Single

If "Mode = Single", initiates a single BER/BLER measurement manually.

Remote command:

:BERT:TRIGger[:IMMediate] on page 46

:BLER:TRIGger[:IMMediate] on page 46

State

Displays the status of the measurement.

- Green indicates a correct status
- Yellow refers to a missing/undetected signal
- Red denotes a faulty status

The function displays the status of the data and clock lines, and of the synchronization. If the status is faulty, check the BER signals at the connectors with an oscilloscope.

"Clock"
> The applied clock signal is detected.

"No Clock"
> The applied clock signal is not detected. Possible causes are:
> - The clock recovery is not available (e.g. with tests of RF components). See"Clock signal" on page 10.
> - The wrong impedance for the applied clock rate is selected.
> - The wrong threshold for the applied clock signal is selected.

"Data"
> The applied data signal was detected.

"No Data"   The applied data signal is not detected.
Only clocked-in signals are detected. If the clock signal is missing, data changes are also not detected.

If the data is not detected, although the clock signal is detected, it can be caused by:
- The signal from the DUT is missing.
- The wrong impedance for the applied clock rate was selected.
- The wrong threshold for the applied data signal was selected.

"Sync"   The measurement is synchronized.

"No Sync"   The measurement is not synchronized.

Generally, a measurement cannot be synchronized until a clock and a data signal have been detected. If synchronization still does not occur, it can be caused by:
- The selected PRBS is not correct. For the bit error rate measurement, the PRBS sequence on which the data is based must be set on the bit error rate tester. If the PRBS is not correct, the BER measurement cannot synchronize to the data (due to the incorrect polynomial).
- A wrong clock slope is used, which violates setup or hold times.
- The travel times of clock and data are unfavorable (e.g. clock slope at data change). Check the relationship of clock to data using an oscilloscope and optimize the travel times (e.g. clock slope when the data signal applied is stable).
- Reflections on the clock line occur, clocking the data signal into the BER measurement twice, e.g. on lines without termination. The R&S SMM100A input is not terminated.
- Incorrect polarity of data signal (or "Data Enable" signal). In this case, the PRBS cannot synchronize. Note that an inversion of the output signal specified for some cases by the PRBS standard is performed automatically upon PRBS selection. Manual inversion of the data signal is therefore not required.

No sync status and an error rate of approx. 50%:
- A bit error occurs during synchronization (e.g. nine data bits with PRBS9). The BER measurement is set up incorrectly. This fault is internally detected and automatically corrected.
- If data that is not cyclically continued (i.e. when a break in the sequence occurs at the memory wraparound), the measurement does not start at the right time. The signal on the "Restart" line enables the measurement to be started optimally at the beginning of the sequence.
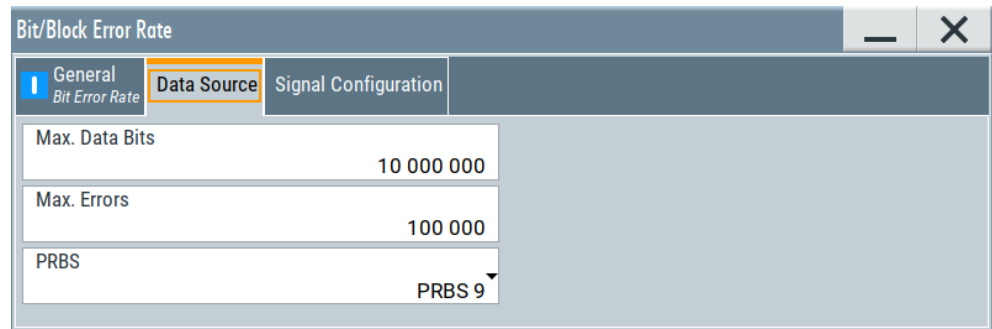
Remote command:
:BERT:RESult? on page 40

3.2.2 Data source

Access:

► Select "Bit/Block Error Rate > Data Source".

Settings in the "Data Source" dialog affect the PRBS sequence and termination criteria.

Max Data Bits

Sets the number of transmitted data bits to be checked before the measurement is terminated, even if few or no errors have been detected.

With a low number of bit errors, the measurement result is statistically unreliable.

If the measurement is terminated due to the set number of max data bits was checked, "Number of Data Bits" appears to the right of "Terminated By".

Does not count data excluded from the measurement by "Data Enable" or "Pattern Ignore".

Remote command:
:BERT:SETup:MCOunt on page 44

Max Errors

Sets the number of bit/block errors to occur before the measurement is terminated.

This criterion terminates the measurement relatively quickly if the error rate is high. The measurement result is statistically reliable, since many errors were already counted.

If the measurement is terminated because the set number of bit/block errors was reached, "Number of Errors" appears to the right of "Terminated By".

Remote command:
:BERT:SETup:MERRor on page 44
:BLER:SETup:MERRor on page 44

PRBS

Selects the PRBS (Pseudo random binary sequence). The data generated by the PRBS generator is used as a reference for the measurement.

Note: Standard-compliant data inversion for PRBS15 and PRBS23 is performed automatically when the PRBS is selected. "Data Polarity" remains unaffected.
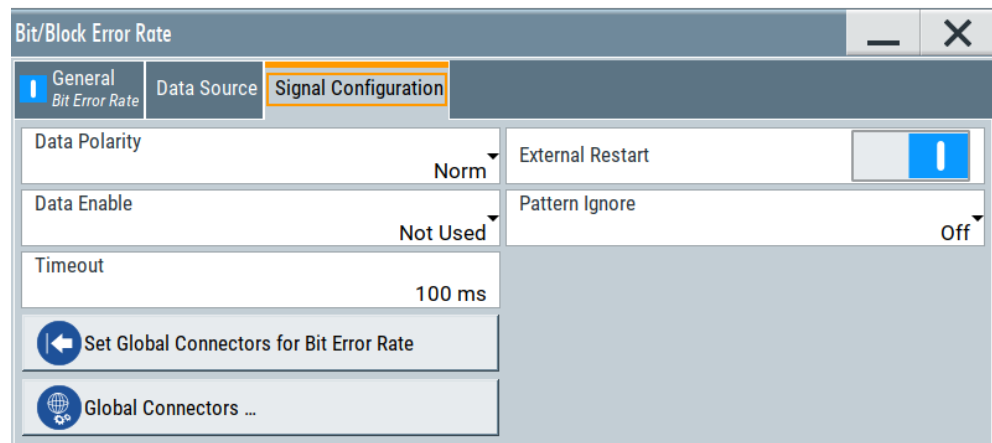
Remote command:
`:BERT:SETup:TYPE` on page 45

3.2.3 Signal configuration settings

The "General" dialog contains file settings relevant for both test modes and allows the start of the measurement.

Access:

► Select "Bit/Block Error Rate > Signal Configuration".

The "Signal Configuration" section is used to select the type of measurement. If the data is not cyclically continued, the measurement can be selectively interrupted and restarted. Certain data areas and frames that have been marked as faulty can be excluded from the measurement.

Data Polarity

Sets the polarity of the feedback data bits/blocks.

Note: For BER: Standard-compliant data inversion for PRBS15 and PRBS23 is performed automatically when the PRBS is selected. "Data Polarity" remains unaffected.

"Norm"   High level stands for logic 1, low level for logic 0.

"Inv"   Low level stands for logic 1, high level for logic 0.

Remote command:
`:BERT:SETup:DATA[:POLarity]` on page 42
`:BLER:SETup:DATA[:POLarity]` on page 42

External Restart
Activates an external restart of the BER measurement, see Chapter 2.2.2, "External restart", on page 10.

"On"   The reset signal for the BER measurement is fed via the "Restart" input of the BERT interface.
                   If the PRBS cannot continue uninterruptedly, the BER measurement must be stopped at the end of the data sequence and restarted at the beginning of the new data sequence. The 0-1-0 slope of the restart signal starts and stops the measurement. A transition from logic 0 to 1 generates a partial result and stops the measurement. A transition from 1 to 0 starts the measurement for the next subinterval. This measurement is synchronized anew.
                   If the R&S SMM100A is used as a data source, a signal with a single 1 at the end of the data sequence can be used as a restart signal at the R&S SMM100A marker output. This signal causes the BER measurement to stop briefly at the end of the data sequence and start again.
                   Partial results (number of data and error bits) are added up until the predefined total number of data or error bits is reached or exceeded. "Pattern Ignore" or "Data Enable" resets the measurement, regardless of its status.

"Off"   Generates the reset signal for the BER measurement internally.
                   This setting is suitable for PRBS sequences that run continuously and thus ensure uninterrupted repetition.

Remote command:
`:BERT:SETup:RESTart[:STATe]` on page 44

Data Enable
Activates the use of the "Data Enable" signal and sets the polarity of this signal if it is used. The data enable signal determines the data evaluated by the BER measurement (see Chapter 2.2.3, "Data enable", on page 11).

Usually the DUT generates this signal, which is fed in at the "Data Enable" input of the BERT interface.

Note: If the data is not enabled, the BER measurement is stopped completely. The identification circuit for "Pattern Ignore" and the PRBS generator of the BER measurement wait as long as data is not enabled. If the data is enabled, the measurement continues.

"Not Used"   Any signal at the "Data Enable" input is ignored; all data at the BER data input is used for the measurement.

"High"   The "Data Enable" signal is active. The BER tester measures all incoming data during the high level of the "Data Enable" signal. During the low level, the measurement is interrupted.

"Low"   The "Data Enable" signal is active. The BER tester measures all incoming data during the low level of the "Data Enable" signal. During the high level, the measurement is interrupted.

Remote command:

:BERT:SETup:DENable on page 43

Pattern Ignore

Activates ignoring of pure at least 32 bits long "0" or "1" bit sequences. Activating "Pattern Ignore" excludes faulty frames from the measurement, see Chapter 2.2.4, "Pattern ignore", on page 12.

Note: While ignoring the bits, the PRBS generator for the BER measurement keeps running. Following the "0" or "1" sequence, the BER measurement continues as if the ignored sequence had contained PRBS data.

If "Pattern Ignore" is switched on, synchronization time is 32 bits longer.

If "Pattern Ignore" and "External Restart" are active at the same time, the measurement terminates immediately when the restart signal is applied. None of the 32 bits within the "Pattern Ignore" detector is evaluated.

If "Data Enable" and "Pattern Ignore" are active at the same time, "Data Enable" has priority, i.e. disabled bits are not examined for "0" or "1" sequences.

"Off"   Pattern ignore is not active.

"All 1"   Bit sequences consisting of 32 or more consecutive "1" data are not used for the BER measurement.

"All 0"   Bit sequences consisting of 32 or more consecutive "0" data are not used for the BER measurement.

Remote command:

:BERT:SETup:IGNore on page 43

Timeout

Sets a time limit for the BER/BLER process.

Remote command:

:BERT:SETup:TIMeout on page 45

:BLER:SETup:TIMeout on page 45

Set Global Connectors for BER/BLER

Sets the direction and the signal assigned to the global connectors to their default values for BER/BLER testing.

Table 3-1: Default signal assignment at the global connectors

Connector	Direction	Signal
User 1	Output	Baseband Marker 1
User 2	Input	BER Data Enable
User 3	Input	Global Trigger 1

Connector	Direction	Signal
User 4	Input	BER Data
User 5	Input	BER Clock
User 6	Input	BER Restart

Remote command:
n.a.

Global Connectors
Accesses the dialog for mapping the signals to the connectors.

For more information, refer to the description R&S SMM100A user manual, section "Local and global connectors settings".

3.3 Block error rate settings

Access:

1. Select "Bit/Block Error Rate > General".

2. Select "Test Mode = Block Error Rate".

   The "Block Error Rate" dialog contains all the parameters to configure, activate and evaluate the measurement.

The remote commands required to define these settings are described in Chapter 6, "Remote-control commands", on page 36.

3.3.1 General settings

Access:

1. Select "Bit/Block Error Rate > General".

2. Select "Test Mode = Block Error Rate".
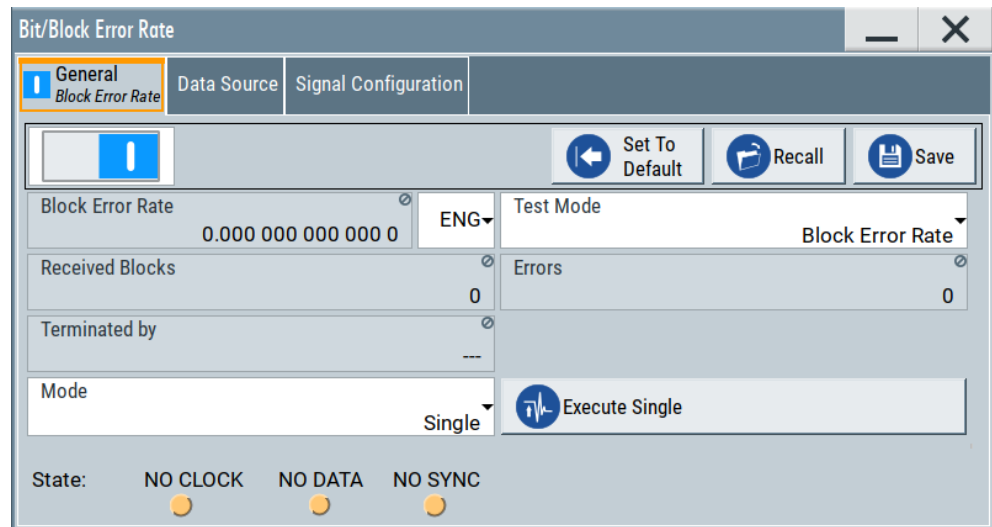
Block Error Rate

Displays the measured block error rate in exponential notation with the exponent $^{-3}$ or $^{-6}$.

The block error rate is the ratio of faulty blocks to total blocks.

"ENG"   BLER output in exponential notation with the exponent $^{-3}$ or $^{-6}$.

"%"   BLER output in percent.

"PPM"   BLER output in parts per million.

Remote command:
:BLER:RESult? on page 40

Received Blocks

Displays the current number of checked data blocks.

Remote command:
:BLER:RESult? on page 40

Errors

Displays the current number of occurred errors.

Remote command:
:BLER:RESult? on page 40

Terminated By

Displays the termination criterion for the measurement.

Termination criteria shorten the duration of the measurement for low and high block error rates. The last measurement result is displayed after the measurement has been terminated.

"User"   The measurement was manually stopped with "State > "Off" or `:BLER:STOP`.

"Number of Data Blocks"

The measurement stopped after the specified number of data blocks was reached.

"Number of Errors"

The measurement stopped after the specified number of errors was reached.

Remote command:
n. a.

Mode

Selects the type of measurement.

"Auto"   Continuous measurement.
If at least one termination criteria is met, terminates the measurement in progress and immediately starts a new one. During the first measurement, intermediate results are displayed. For the following measurements, only the final results are shown. Continuously updates the parameters "Data Bits/Received Blocks" and "Errors".

"Single"   Single measurement. Start the measurement with "Execute Single". If a measurement is in progress, cyclically displays the current values for "Bit Error Rate/Block Error Rate", "Errors" and "Data Bits/Received Blocks". If at least one termination criterion is met, terminates the measurement in progress.

Remote command:
`:BERT:TRIGger:MODE` on page 42
`:BLER:TRIGger:MODE` on page 42

Execute Single

If "Mode = Single", initiates a single BER/BLER measurement manually.

Remote command:
`:BERT:TRIGger[:IMMediate]` on page 46
`:BLER:TRIGger[:IMMediate]` on page 46

State

Displays the status of the measurement.

A green LED indicates a correct status, yellow refers to a missing/undetected signal and red denotes a faulty status.

The function displays the status of the data and clock lines, and of the synchronization. If the status is faulty, check the BLER signals at the connectors with an oscilloscope.

"Clock"   The applied clock signal was detected.

"No Clock"   The applied clock signal was not detected.

Possible causes are:
- Clock recovery is not available (e.g. with tests of RF components).
  If the signal is generated using the instrument family, the bit clock can be extracted from the clock output connector (only with "Custom Dig Mod" signals in real time). If signals complying with other digital standards are generated or if ARB waveforms are used, a marker signal can be used as a clock. As the DUT causes a delay, the ratio of clock-to-data travel times must always be considered and checked with an oscilloscope if necessary.
- The wrong impedance for the applied clock rate was selected.
- The wrong threshold for the applied clock signal was selected.

"Data"   The applied data signal was detected.

"No Data"   The applied data signal was not detected.

Possible causes are:
- The signal from the DUT is missing.
- The wrong impedance for the applied clock rate was selected (see "Impedance" parameter).
- The wrong threshold for the applied data signal was selected.

"Sync"   The measurement is synchronized.

"No Sync"   The measurement is not synchronized.
Generally, a measurement cannot be synchronized until a clock and a data signal have been detected. If synchronization still does not occur, can be caused by:

- A wrong clock slope is set, which violates setup or hold times.
- Reflections on the clock line occur and clock the data signal into the BER measurement twice, e.g. on lines without termination. The R&S SMM100A input is **not** terminated.
- The travel times of clock and data are unfavorable (e.g. clock slope with data change).
  Check the relationship of clock to data using an oscilloscope and optimize the travel times (e.g. clock slope when the data signal applied is stable).
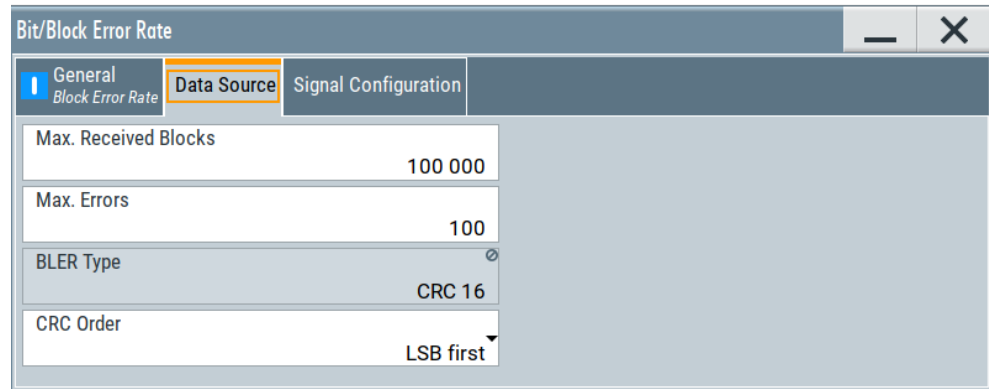
Remote command:
`:BLER:RESult?` on page 40

3.3.2 Data source

Access:

► Select "Bit/Block Error Rate > Data Source".

Settings in the "Data Source" dialog affect termination criteria.

Max Received Blocks
Sets the number of transmitted data blocks to be checked before the measurement is terminated, even if few or no errors have been detected.

With a low number of block errors, the measurement result is statistically unreliable.

If the measurement is terminated due to checking the set number of max data blocks, "Number of Data Blocks" appears to the right of "Terminated By".

Remote command:
:BLER:SETup:MCOunt on page 44

Max Errors
Sets the number of bit/block errors to occur before the measurement is terminated.

This criterion terminates the measurement relatively quickly if the error rate is high. The measurement result is statistically reliable, since many errors were already counted.

If the measurement is terminated because the set number of bit/block errors was reached, "Number of Errors" appears to the right of "Terminated By".

Remote command:
:BERT:SETup:MERRor on page 44
:BLER:SETup:MERRor on page 44

BLER Type
Displays the CRC polynomial used.

CCITT CRC 16 : $G(x) = x^{16} + x^{12} + x^5 + x^1$ is the supported CRC polynomial.

Remote command:
:BLER:SETup:TYPE on page 45

CRC Order

Selects the byte order of the checksum (CRC).

"LSB"   The checksum starts with the least significant byte.

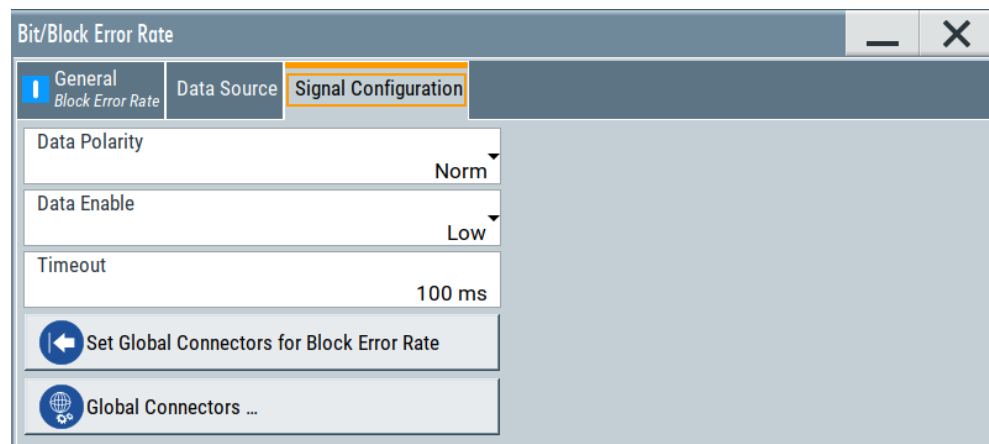"MSB"   The checksum starts with the most significant byte.

Remote command:
:BLER:SETup:CORDer on page 42

3.3.3 Signal configuration settings

Access:

► Select "Bit/Block Error Rate > Signal Configuration".

The "Configuration" section is used to select the type of measurement and the termination criteria and to set the polarity of the input signals.

Data Polarity

Sets the polarity of the feedback data bits/blocks.

Note: For BER: Standard-compliant data inversion for PRBS15 and PRBS23 is performed automatically when the PRBS is selected. "Data Polarity" remains unaffected.

"Norm"   High level stands for logic 1, low level for logic 0.

"Inv"   Low level stands for logic 1, high level for logic 0.

Remote command:
`:BERT:SETup:DATA[:POLarity]` on page 42
`:BLER:SETup:DATA[:POLarity]` on page 42

Data Enable

Sets the polarity of the "Data Enable" signal. This signal determines the user data evaluated by the BLER measurement (see Chapter 2.2.3, "Data enable", on page 11).

Usually the DUT generates this signal, which is fed in at the "Data Enable" input of the BERT interface.

"High"   If the "Data Enable" signal is at a high level, the incoming data bits are interpreted as user data. During the low level, the data is interpreted as checksum bits.

"Low"   If the "Data Enable" signal is at a low level, the incoming data bits are interpreted as user data. During the high level, the data is interpreted as checksum bits.

Remote command:
`:BLER:SETup:DENable` on page 43

Timeout

Sets a time limit for the BER/BLER process.

Remote command:
`:BERT:SETup:TIMeout` on page 45
`:BLER:SETup:TIMeout` on page 45

Set Global Connectors for BER/BLER

Sets the direction and the signal assigned to the global connectors to their default values for BER/BLER testing.

Table 3-2: Default signal assignment at the global connectors

Connector	Direction	Signal
User 1	Output	Baseband Marker 1
User 2	Input	BER Data Enable
User 3	Input	Global Trigger 1
User 4	Input	BER Data
User 5	Input	BER Clock
User 6	Input	BER Restart

Remote command:
n.a.

Global Connectors

Accesses the dialog for mapping the signals to the connectors.

For more information, refer to the description R&S SMM100A user manual, section "Local and global connectors settings".

4 Test generator settings

The BERT/BLER test generator enables you to test and validate the bit and block error rate function, see Chapter 2.4, "BER/BLER self-test setup", on page 14.

Access:

1. This function is password-protected. Unlock the protection level 1 to access it. Select "System Config > Setup > Protection > Protection Level 1 > Password = 123456".

2. Select "Bit/Block Error Rate > General > Test Mode = Block Error Rate".

3. Select "Bit/Block Error Rate > Selftest".

4. Select "Bit/Block Error Rate > General > Test Mode = Bit Error Rate".

5. Select "Bit/Block Error Rate > Selftest".
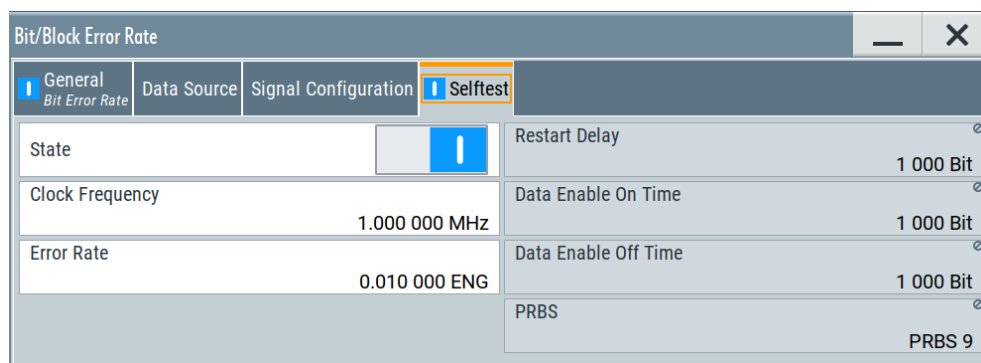
The availability of the parameters in the "Selftest" dialog varies, depending on the test mode. In the "Block Error Rate" (BLER) test mode, the SMM100A calculates the CRC based on the test sequence "PRBS", and sets the value by default. In contrast to the "Bit Error Rate" (BER) test mode, you cannot adjust it.

The remote commands required to define these settings are described in Chapter 6, "Remote-control commands", on page 36.

State
Activates the BER/BLER selftest.

Remote command:
:TEST:BB:DATA:STATe on page 47

Clock Frequency
Selects the clock frequency for the BER/BLER selftest.

Remote command:
:TEST:BB:DATA:FREQuency on page 47

Error Rate

Sets the error bit pattern.

This parameter allows you to specify defined error bits to check whether the BER/ BLER function detects the error properly. Use either exponential, percent or parts per million values for input.

Remote command:
:TEST:BB:DATA:ERRor:RATE on page 47

Restart Delay

For active External Restart, determines the time delay to the start of the user data sequence. The time value is defined in bits.

Remote command:
:TEST:BB:DATA:RDELay on page 48

Data Enable On Time, Data Enable Off Time

Determines the time interval of the "Data Enable" signal for data acquisition. The time values are defined in bits.

For BER measurements, "Data Enable > High/Low" is prerequisite.

Remote command:
:TEST:BB:DATA:ONTime on page 48
:TEST:BB:DATA:OFFTime on page 48

5 How to perform a self-test of the BER/BLER

The self-test verifies the basic functionality of the bit and block error rate tester. The R&S SMM100A continuously evaluates the incoming signal compared to the outgoing signal, and displays the results in the "Bit Error Rate" and "Block Error Rate" dialogs. In addition, you can manually affect the self-test, e.g. to check the functionality of the LEDs, or the synchronization.

This description shows how to perform the provided self-tests by the example of the bit error rate tester. Proceed in the same way for the block error rate test.

To route the signals to the corresponding connectors

1. Connect the required cables, for example see Figure 2-6.

    Note: Long cables impair the measurements.
    Always use short cables of the same length and type.

2. Select "System Config > Setup > Bit/Block Error Rate > Signal Configuration > Global Connectors".

3. Assign the input and output signals according to the test setup.

To enable self-test

1. This function is password-protected. Unlock the protection level 1 to access it.
    Select "System Config > Setup > Protection > Protection Level 1 > Password = 123456".

2. Select "System Config > Setup > Bit/Block Error Rate > General".

3. Select "Test Mode = Block Error Rate".

4. Select "Bit/Block Error Rate > Selftest".

To test the bit error rate functionality continuously

1. In the "Bit Error Rate" dialogs, configure the outgoing signal.

2. Select "Selftest".

3. Configure the settings as required.

4. Select "Selftest > State > On".

5. Select "General > State > On".

    The test runs continuously.

6. Observe the state indications in the "General" dialog

    The bit error rate tester works correctly, if no error occurs, and all LEDs are green.

To check the clock signal

1. Remove the clock out connection.
    See Figure 2-6.

2. Observe the state indications in the "General" dialog.

   The "No Clock" LED is expected to turn red.

To check the data transmission

1. Remove the data connection.
   See Figure 2-6.

2. Observe the state indications in the "General" dialog.

   The "No Data" LED is expected to turn red.

To check the synchronization

1. In the "Selftest" dialog, arbitrarily increase the "Error Rate".

2. Observe the state indications in the "General" dialog.

   At a specific value, the synchronization is no longer possible. A red "No Sync" LED is the indicator that the synchronization is lost.

6 Remote-control commands

The following commands are required to generate signals with the Bit Error Rate Tester option in a remote environment. We assume that the R&S SMM100A has already been set up for remote operation in a network as described in the R&S SMM100A documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

ⓘ **Conventions used in SCPI command descriptions**

For a description of the conventions used in the remote command descriptions, see section "Remote-Control Commands" in the R&S SMM100A user manual.

The following commands specific to the Bit Error Rate Tester option are described here:

6.1 Programming examples

The corresponding sections of the same title provide simple programming examples for the R&S SMM100A. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the examples as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (for example comments) start with two // characters.

At the beginning of the most remote control program, an instrument (p)reset is recommended to set the R&S SMM100A to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

Example: Performing BERT and BLER measurements

The following example shows a command sequence to perform a BERT test.

```
// Reset the parameters of the BERT test generator
BERT:PRES

// Select the test mode bit error rate
TEST1:BB:DATA:TYPE BER

// Adjust settings related to the data source:
// Set the maximum data bits to 12000, the number of maximum errors to 50
```

```
// and a PRBS of size 15
BERT:SET:MCO 12000
BERT:SET:MERR 50
BERT:SET:TYPE PRBS15

// Adjust the signal configuration:
// Set inversion of the data signal, activate external restart of the measurement,
// activate interruption during low level of the data enable input,
// ignore at least 32 bits long bit sequences of "1" data and set a timeout of 0.12 s.
BERT:SET:DATA:POL INV
BERT:SET:REST:STAT ON
BERT:SET:DEN HIGH
BERT:SET:IGN ONE
BERT:SET:TIM 0.12

// Activate the bit error rate measurement
BERT:STATe 1
// Alternatively use BERT:STAR and BERT:STOP

//To activate a single measurement, use the trigger settings:
BERT:TRIG:MODE SING
BERT:TRIG:SOURce INT
BERT:TRIG
// Alternatively use an external triger source

// Query the results of the bit error rate measurement
BERT:RES?
// "1000,5,5E-4,1,1,1,1"
// The measurement has been terminated, and synchronization
// has been performed. Out of 1000 data bits, 5 error bits were
// measured, yielding an error rate of 0.005
```

The following example shows a command sequence to perform a BLER test.

```
// Reset the parameters of the BERT test generator
BLER:PRES

// Select the test mode block error rate
TEST1:BB:DATA:TYPE BLER

// Adjust settings related to the data source:
// Set the maximum received blocks to 80000, the number of maximum errors to 150
// and the checksum starts with the most significant byte
BLER:SET:MCO 80000
BLER:SET:MERR 150
BLER:SET:CORD MSB

// Adjust the signal configuration:
// Set inversion of the data signal, activate interruption during low level
// of the data enable input and set a timeout of 0.12 s.
BLER:SET:DATA:POL INV
```

```
BLER:SET:DEN HIGH
BLER:SET:TIM 0.12

// Activate the bit error rate measurement
BLER:STATe 1
// Alternatively use BLER:STAR and BLER:STOP

//To activate a single measurement, use the trigger settings:
BLER:TRIG:MODE SING
BLER:TRIG:SOURce INT
BLER:TRIG
// Alternatively use an external triger source

// Query the results of the block error rate measurement
BLER:RES?
// "1000,5,5E-4,1,1,1,1"
// The measurement has been terminated, and synchronization
// has been performed. Out of 1000 data blocks, 5 error bits were
// measured, yielding an error rate of 0.005.

// Query the measurement type of BLER
BLER:SET:TYPE
// "CRC16"
```

Example: Saving the recalling configurations

```
BERT:STORe "/var/user/bert.ber_bler"
BERT:PRESt
BERT:LOAD "/var/user/bert.ber_bler"
```

6.2 BERT and BLER subsystems

These subsystems contain the commands for the bit and block error rate measurement. Commands of these two subsystems are often identical, so they are grouped whenever possible.

:BERT|BLER:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.ber_bler`

Setting parameters:

<Filename>	string
	Filename or complete file path; file extension can be omitted
Example:	See Example"Saving the recalling configurations" on page 38.
Usage:	Setting only
Manual operation:	See "Save/Recall" on page 17

:BERT|BLER:STORe <Filename>

Saves the current settings into the selected file; the file extension (`*.ber_bler`) is assigned automatically.

Setting parameters:

<Filename>	"<filename>"
	Filename or complete file path.
Example:	See Example"Saving the recalling configurations" on page 38.
Usage:	Setting only
Manual operation:	See "Save/Recall" on page 17

:BERT|BLER:PRESet

Sets the parameters of the BERT/BLER test generator to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command .`:BERT:STATe`/`:BLER:STATe`.

Example:	See Chapter 6.1, "Programming examples", on page 36.
Usage:	Event
Manual operation:	See "Set To Default" on page 17

:TEST:BB:DATA:TYPE <Type>

Selects the type of error measurement.

Parameters:

<Type>	BER | BLER
	*RST: BER
Example:	See Chapter 6.1, "Programming examples", on page 36.
Manual operation:	See "Test Mode" on page 17

:BERT:RESult?
:BLER:RESult?

Queries the result of the last BLER measurement and responds with seven results, separated by commas. The first measurement following the start also queries intermediate results for the number of data bits, error bits and error rate.

For `:BLER:TRIGger:MODE`AUTO, only the final results of each single measurement are queried in the following measurements.

Note: The restart of a new measurement is delayed until the first measurement result has been queried. The resulting brief measurement interruption is irrelevant because the subsequent measurement is synchronized within 24 data bits.

Return values:

<NumBlock>	integer
	Number of checked data bits.
<NumErrors>	integer
	Number of error bits.

<ErrorRate>	float
	If no termination criterion has been reached since the beginning of the measurement, display the current quotient of `<NumErrors>` (number of error bits) and `<NumBlock>` (number of data bits).
	When at least one final result has been reached in continuous measurement, display the most recent final result.
<MeasFinished>	integer
	Status of measurement.
	1
	Measurement has been terminated, i.e. stopped or the defined number of data bits or error bits has been reached.
	0
	Measurement has not been terminated.
<ClockDetected>	integer
	Status of clock line.
	1
	Clock line active.
	0
	Clock line not active.
<DataDetected>	integer
	Status of data line.
	1
	Data line active.
	Only clocked data is detected. If the clock signal is missing, a data change is also not detected.
	0
	Data line is not active.
<Synchronized>	integer
	1
	The measurement is synchronized and the ratio is assumed realistic.
	That is, the clock and data lines are active and the following apples:
	`<NumErrors>`/`<NumBlock>`> 0.1.
	0
	The measurement is not synchronized.
Example:	See Chapter 6.1, "Programming examples", on page 36.
Usage:	Query only
Manual operation:	See "Block Error Rate" on page 26
	See "Received Blocks" on page 26
	See "Errors" on page 26
	See "State" on page 27

:BERT:TRIGger:MODE <Polarity>
:BLER:TRIGger:MODE <Polarity>

Selects the type of measurement.

Parameters:

<Polarity>   AUTO | SINGle

      AUTO
      Continuous measurement.
      Terminates the measurement in progress if one or both termina-
      tion criteria are met. Delays the restart of a new measurement
      until the first measurement result has been queried. The result-
      ing brief measurement interruption is irrelevant because the sub-
      sequent measurement is synchronized within 24 data bits.

      SINGle
      Single measurement, started with `:BERT:TRIGger[:`
      `IMMediate]` | `:BLER:TRIGger[:IMMediate]`.

      *RST: AUTO

Manual operation: See "Mode" on page 19

See Chapter 6.1, "Programming examples", on page 36.

:BLER:SETup:CORDer <COrder>

Sets the byte order of the checksum (CRC).

Parameters:

<COrder>   LSB | MSB

      LSB
      The checksum starts with the least significant byte.

      MSB
      The checksum starts with the most significant byte.

      *RST: LSB

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "CRC Order" on page 30

:BERT:SETup:DATA[:POLarity] <Polarity>
:BLER:SETup:DATA[:POLarity] <Polarity>

Sets the polarity of the feedback data bits.

Parameters:

<Polarity>   NORMal | INVerted

      NORMal
      High level represents a logic 1, low level a logic 0.

      INVerted
      Low level represents a logic 1, high level a logic 0.

*RST:	NORMal

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Data Polarity" on page 22

:BERT:SETup:DENable <DEnable>
:BLER:SETup:DENable <DEnable>

Activates the Data Enable signal and, if activated, sets its polarity.

The signal marks the data that is evaluated by the BERT/BLER measurement. Does not evaluate data supplied by the DUT, that is additional to the PRBS sequence (e.g. sync, preambles, other channels, etc.).

Parameters:

<DEnable>   HIGH | LOW

OFF
Ignore any signal at the data enable input; use all data at the BERT/BLER data input for the measurement.

HIGH
Use the data enable signal.
Only measures the data at the BERT/BLER data input during a high level of the data enable signal. Interrupts the measurement during a low level.

LOW
Use the data enable signal.
Only measures the data at the BERT/BLER data input during a low level of the data enable signal. Interrupts the measurement during a high level.

*RST: LOW

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Data Enable" on page 31

:BERT:SETup:IGNore <Ignore>

Activates ignoring of pure "0" or "1" bit sequences of at least 32 bits, so that faulty frames are excluded from the measurement.

Some mobile radio standards indicate faulty frames with pure "0" or "1" bit sequences when errors (e.g. an incorrect checksum) are detected.

Parameters:

<Ignore>   OFF | ZERO | ONE

OFF
Pattern ignore is not active.

ZERO
Ignore bit sequences of 32 or more consecutive "0" for the BERT measurement.

ONE

Ignore bit sequences of 32 or more consecutive "1" for the BERT measurement.

*RST: OFF

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Pattern Ignore" on page 24

:BERT:SETup:MCOunt <MCount>
:BLER:SETup:MCOunt <MCount>

Enters the number of transmitted data bits/data blocks to be checked before the measurement is terminated.

A BERT/BLER measurement does not count data suppressed by `:BERT:SETup:DENable`|`:BLER:SETup:DENable`.

This termination criteria always terminates the measurement after the specified number of data bits/data blocks. Starting from this point, outputs the fourth value with 1 (= terminate measurement) if the result is queried. For the continuous measurement mode, the measurement restarts once the results have been queried.

Parameters:

<MCount>   integer

       Range: 0 to 4294967295
       *RST: 1E5

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Max Received Blocks" on page 29

:BERT:SETup:MERRor <Merror>
:BLER:SETup:MERRor <MError>

Enters the number of errors to occur before the measurement is terminated.

This termination criterion always terminates the measurement after the specified number of errors. Starting from this point, outputs the fourth value with 1 (= terminate measurement) if the measurement result is queried.

Parameters:

<MError>   integer

       Range: 0 to 4294967295
       *RST: 100

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Max Errors" on page 21

:BERT:SETup:RESTart[:STATe] <State>

Activates/deactivates an external restart of the BERT measurement.

Parameters:

<State>   0 | OFF | 1 | ON

                           *RST: 0

Manual operation: See "External Restart" on page 23

:BERT:SETup:TYPE <Type>

Selects the PRBS sequence.

The data generated by the PRBS generator is used as a reference for the measurement.

Parameters:

<Type>   PRBS9 | PRBS11 | PRBS15 | PRBS16 | PRBS20 | PRBS21 |
                           PRBS23

                           *RST: PRBS9

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "PRBS" on page 22

:BLER:SETup:TYPE <Type>

Queries the used CRC polynomial.

Parameters:

<Type>   CRC16

                           CCITT CRC 16 : $G(x) = x^{16} + x^{12} + x^5 + x^1$

                           *RST: CRC16

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "BLER Type" on page 29

:BERT:SETup:TIMeout <Timeout>
:BLER:SETup:TIMeout <Timeout>

Sets the timeout.

Parameters:

<Timeout>   float

                           Range: 0.1 to 1
                           Increment: 0.001
                           *RST: 0.1

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Timeout" on page 24

:BERT:TRIGger:SOURce <Polarity>
:BLER:TRIGger:SOURce <Polarity>

For `:BLER:TRIGger:MODE`SINGle, selects the source of the trigger signal.

Parameters:
<Polarity>   INTernal | EGT1

                            *RST: INTernal

:BERT:STATe <State>
:BLER:STATe <State>

Activates/deactivates the measurement.

Parameters:
<State>   1 | ON | 0 | OFF

                            *RST: 0

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "State" on page 16

:BERT:STARt
:BLER:STARt

Starts a continuous measurement.

Example: See Chapter 6.1, "Programming examples", on page 36.

Usage: Event

:BERT:STOP
:BLER:STOP

Stops an ongoing measurement.

Example: See Chapter 6.1, "Programming examples", on page 36.

Usage: Event

:BERT:TRIGger[:IMMediate]
:BLER:TRIGger[:IMMediate]

For `:BERT:TRIGger:MODE`|`:BLER:TRIGger:MODE` SING, triggers a single bit error rate or block error rate measurement.

Usage: Event

Manual operation: See "Execute Single" on page 19

See Chapter 6.1, "Programming examples", on page 36.

6.3 Test subsystem

:TEST:BB:DATA:STATe <State>

Activates the test generator for the bit or block error rate measurement.

Parameters:

<State>	1	ON	0	OFF
	*RST: 0

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "State" on page 32

:TEST:BB:DATA:FREQuency <Clock>

Sets the clock frequency for the BER/BLER test generator.

Parameters:

<Clock>	integer
	Range: 100 to 1E8
	*RST: 1E6

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Clock Frequency" on page 32

:TEST:BB:DATA:ERRor:RATE <ErrorRate>

Sets the error bit pattern of the BER/BLER test generator.

Parameters:

<ErrorRate>	float
	Range: 1E-6 to 1
	Increment: 1E-6
	*RST: 0.01

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Error Rate" on page 33

:TEST:BB:DATA:TRIGger[:MODE] <TriggerMode>

Selects the trigger input mode for the BER test generator.

Parameters:

<TriggerMode>	DENable	RESTart
	*RST: DENable

Example: See Chapter 6.1, "Programming examples", on page 36.

:TEST:BB:DATA:RDELay <RestartDelay>

For "`External Restart = On`, sets the delay time for the restart signal of the BER/ BLER test generator.

Parameters:

<RestartDelay>   integer

                         Range: 0 to 4294967295
                         *RST: 1000

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Restart Delay" on page 33

:TEST:BB:DATA:ONTime <OnTime>
:TEST:BB:DATA:OFFTime <OffTime>

Sets the on/off time of the data enable time interval of the BER/BLER test generator.

Parameters:

<OffTime>   integer

                         Range: 0 to 4294967295
                         *RST: 1000
                         Default unit: Bit

Example: See Chapter 6.1, "Programming examples", on page 36.

Manual operation: See "Data Enable On Time, Data Enable Off Time" on page 33

List of commands

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