Testing the capabilities of the Bit Error Rate Tester SMIQB21 without having a DUT

In order to test the capabilities of the Bit Error Rate Tester SMIQB21 normally a DUT that demodulates the signal and outputs the data bits would be required. But some principle tests to understand the functionality can also be done without a DUT.

This paper describes how to use SMIQB21's functionality by using the DLISTs and the Data / Clock Outputs of SMIQ.

1

DATA

BIT CLOCK

- Connect the SUB-D connector of the BERT cable (1110.3551.00, delivered with SMIQB21) to the BER socket on the rear side of the SMIQ
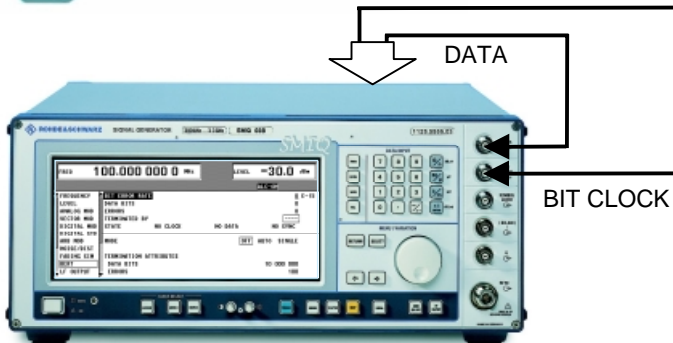
- Connect the BNC plug marked with "DATA" of the cable with the DATA socket on the SMIQ front panel
- Connect the BNC plug marked with "CLOCK" of the cable with the BIT CLOCK socket on the SMIQ front panel

- The other two lines of the cable (RES and MASK) are not needed in this setup

2
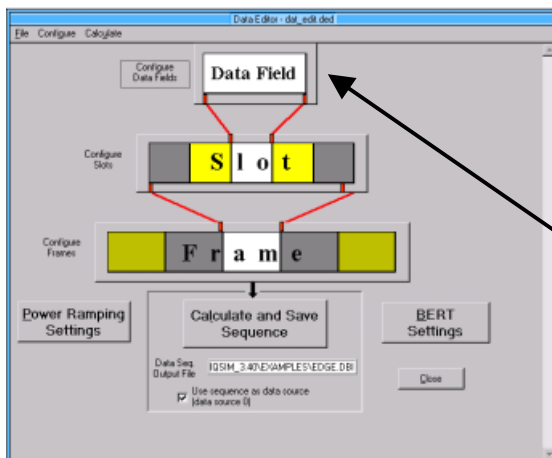
Connect the SMIQ with your computer via GPIB for the DLIST transmission.

A DLIST (e.g. with PN9 data + "errors") for the SMIQ has to be generated.

- Open WinIQSIM™ (ver. 3.40 or higher) and activate the Data Editor (WinIQSIM™ can be downloaded free of charge under www.rohde-schwarz.com)
- Click the field "Data Field"
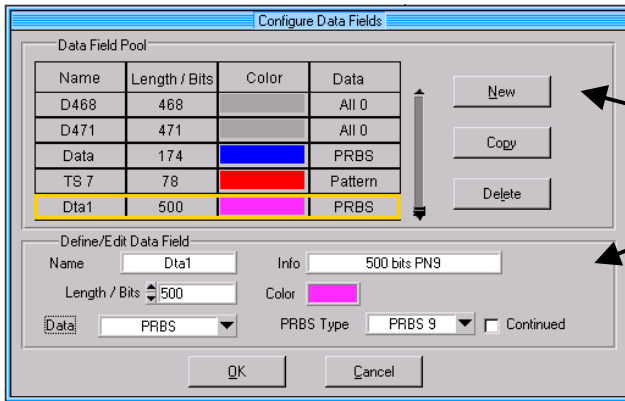
Configure a new data field (500 bits with PN9 data) in the window "Configure Data Fields:
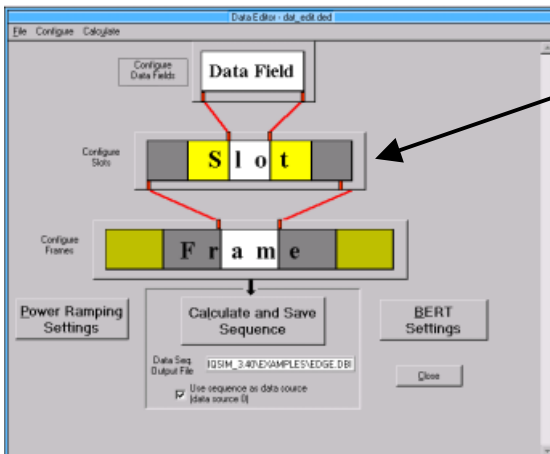- Select "New"
- Enter the data displayed left in the "Define/Edit Data Field"
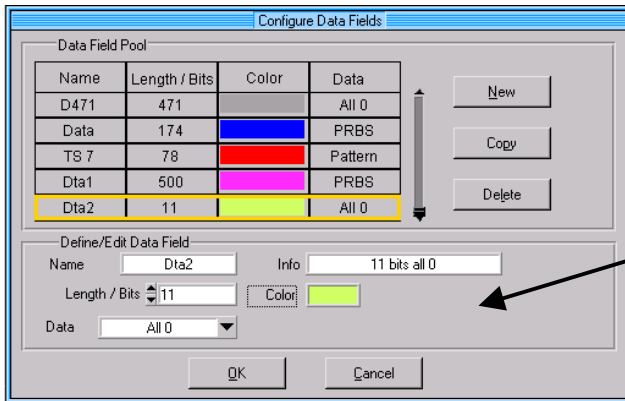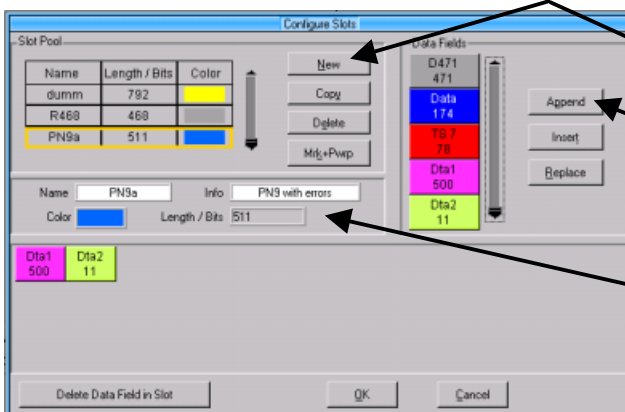

Configure a second data field (11 bits, all bits "0") in the window "Configure Data Fields:
- Select "New"
- Enter the data displayed left in the "Define/Edit Data Field
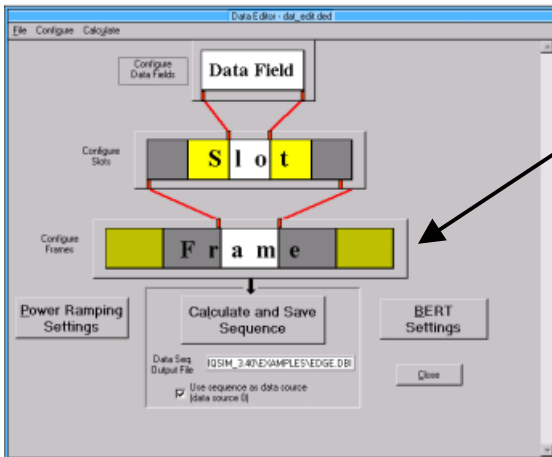- Close the window by clicking "OK"

4
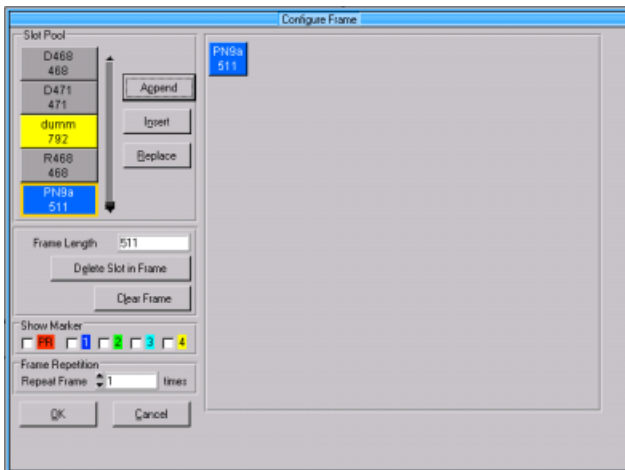

- Click onto the field "Slot"

Configure the slot in the window that is popping up:

- Select "New" in the section "Slot Pool"
- Append the Data Fields Dta1 and Dta 2 from the Data List section to the new slot by selecting the data fields first and then clicking "Append"
- Enter "Name" and "Info" for the slot if necessary
- Close the window by clicking "OK"

5

Click onto the field "Frame"

Configure the frame in the window that is popping up:

- If there are older slots in the frame delete them by clicking "Clear Frame"
- Select the slot "PN9a" from the section "Slot Pool" and add it to the new frame by clicking "Append"
- Close the window by clicking "OK"

6
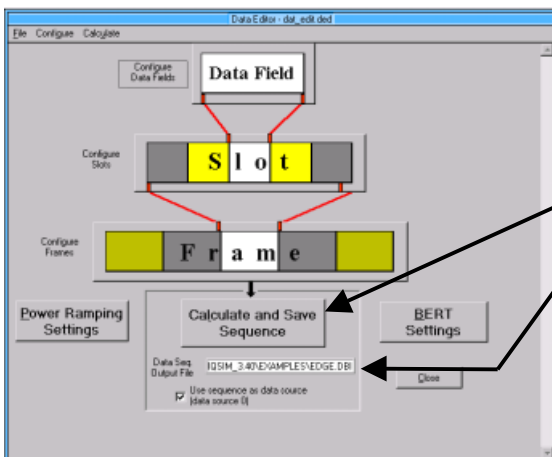
- Enter the file name of the data sequence in the line "Data Seq. Output File"
- Click the field "Calculate and Save Sequence"
- Close the Data Editor by clicking "Close"
- Save the Data Editor settings as a .ded – file (so modifications can be done later easily, the whole procedure has not to be done a second time)

7
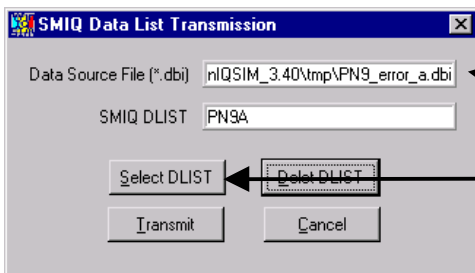
- Select "SMIQ (ARB) in WinIQSIM's top menu bar
- Select „DLIST Transmission..."
- Select the Data Source File (*.dbi)
- Click on "Select DLIST"
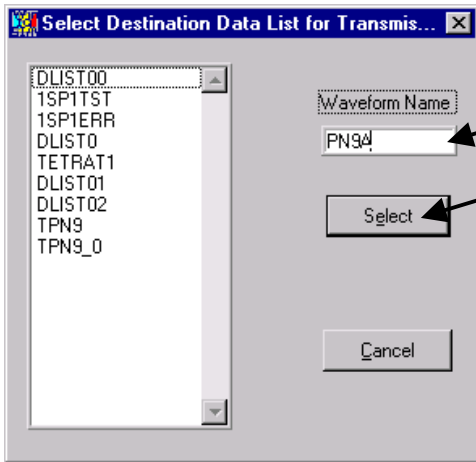
- Enter the Waveform Name (max. 7 characters long)
- Close window by clicking "Select"
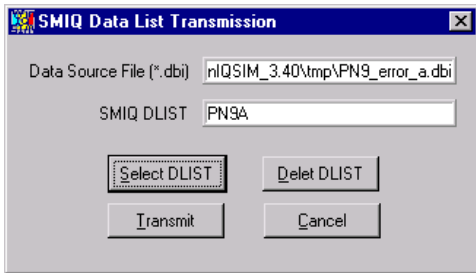
- Transmit the DLIST to the SMIQ by clicking "Transmit"

8
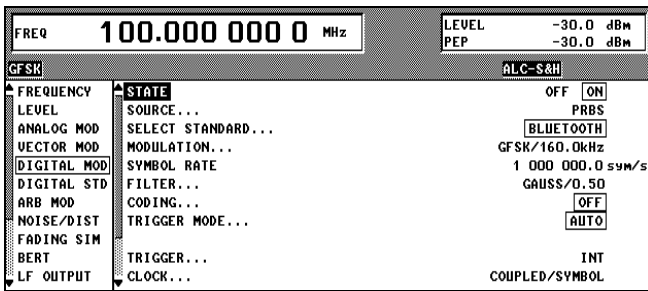
- Go into the SMIQ menu "DIGITAL MOD"
- Set the *STATE* to "ON"
- Select a Standard or enter *MODULATION* and *SYMBOL RATE*
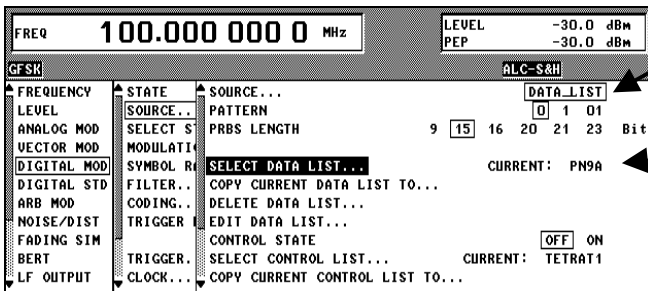
- Go into the submenu *SOURCE...* and switch from *PRBS* to *DATA_LIST*
- Check if the current data list is that one which was transmitted from WinIQSIM. If not select it from the DLIST pool.

9
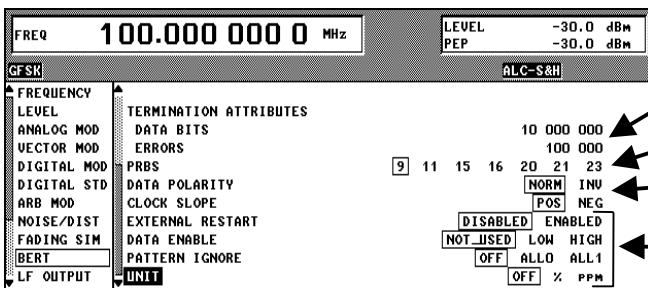
Go into SMIQ'S BERT menu and

- set the *TERMINATION ATTRIBUTES*
- set the appropriate PRBS length (PN9 in this example)
- set *DATA POLARITY* and *CLOCK SLOPE* correctly
- leave the rest of the parameters as displayed on the left side

- Start the BER measurement by switching the *STATE* from "OFF" to "AUTO"

The *STATE* indicators should

FREQ   100.000 000 0 MHz   LEVEL   -30.0 dBm
                               PEP   -30.0 dBm

GFSK BERT   ALC-SH

FREQUENCY   BIT ERROR RATE   5.870 7 E-03
LEVEL   DATA BITS   5 770 097
ANALOG MOD   ERRORS   33 876
VECTOR MOD   TERMINATED BY   ----
DIGITAL MOD   STATE   CLOCK DETECTED   DATA DETECTED   SYNCHRONIZED
DIGITAL STD
ARB MOD   MODE   OFF AUTO SINGLE
NOISE/DIST
FADING SIM   TERMINATION ATTRIBUTES
BERT   DATA BITS   10 000 000
LF OUTPUT   ERRORS   100 000

change from NO CLOCK / NO DATA / NO SYNC to CLOCK DETECTED / DATA DETECTED / SYNCHRONIZES

The bit error rate in this example is $5.87 \cdot 10^{-3}$. That means 3 bits (= 511 bits $\cdot \, 5.87 \cdot 10^{-3}$) of the DLIST are different to the standard PN9 data sequence.

10
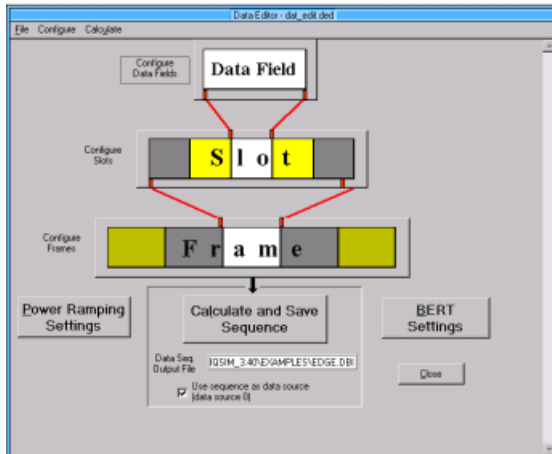
- Open the Data Editor in WinIQSIM again
- Load the .ded file that was created before (File → Open Settings...)
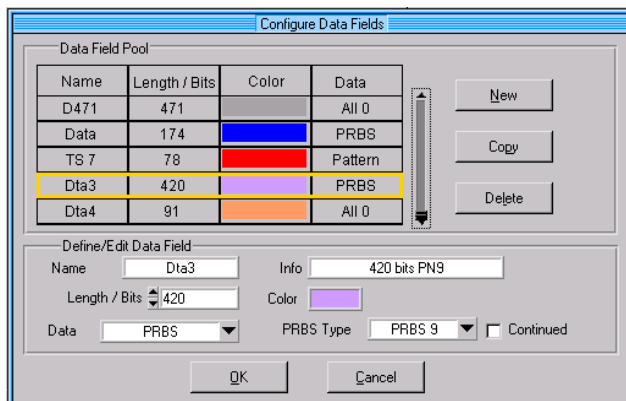
Modify the data fields Dta1 and Dta2 as follows:
- Dta3: 420 bits, PRBS9
- Dta4: 91 bits, All 0

Append Dta3 and Dta4 to a new slot

Configure the frame with Slot PN9b.

Save and calculate the data sequence and transmit it to the SMIQ (as described above).

11

| FREQ | 100.000 000 0 MHz | LEVEL | -30.0 dBm |
| | | PEP | -30.0 dBm |

GFSK BERT   ALC-S&H

```
ANALOG MOD    BIT ERROR RATE                                84.151 E-03
VECTOR MOD    DATA BITS                                      2 802 547
DIGITAL MOD   ERRORS                                           235 812
DIGITAL STD   TERMINATED BY                                       ----
ARB MOD       STATE      CLOCK DETECTED    DATA DETECTED   SYNCHRONIZED
NOISE/DIST
FADING SIM    MODE                             OFF  AUTO  SINGLE
BERT
LF OUTPUT     TERMINATION ATTRIBUTES
SWEEP           DATA BITS                                    10 000 000
LIST            ERRORS                                        1 000 000
```
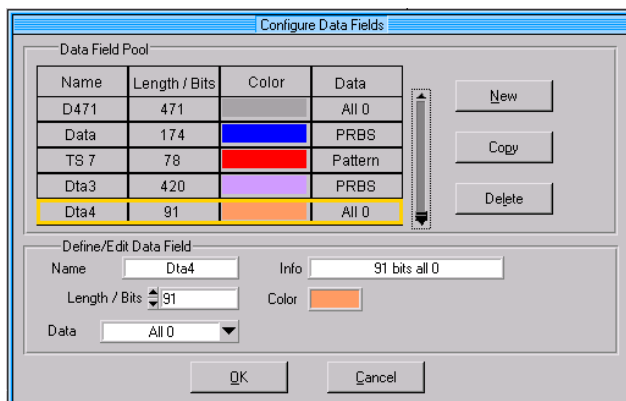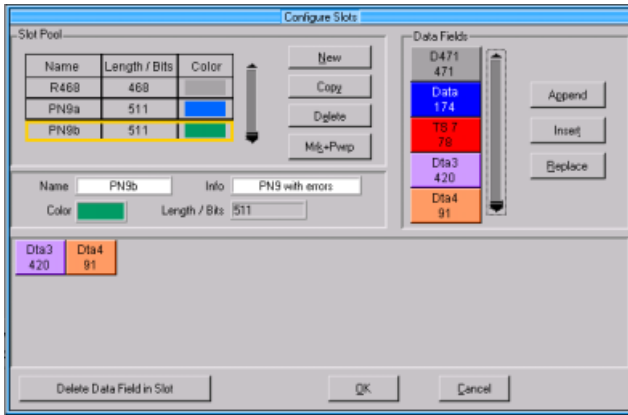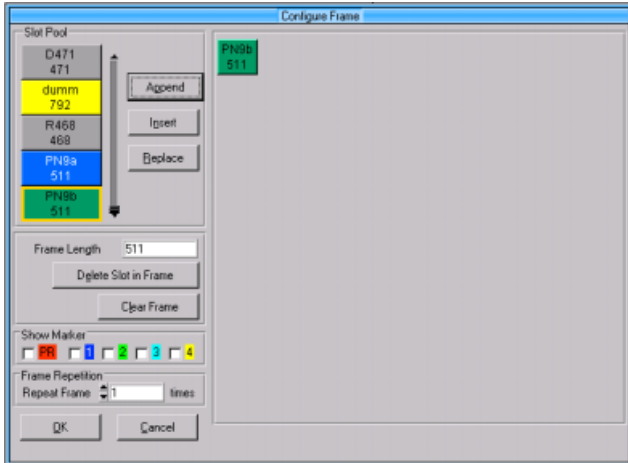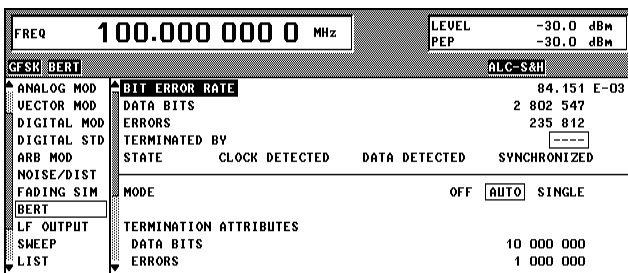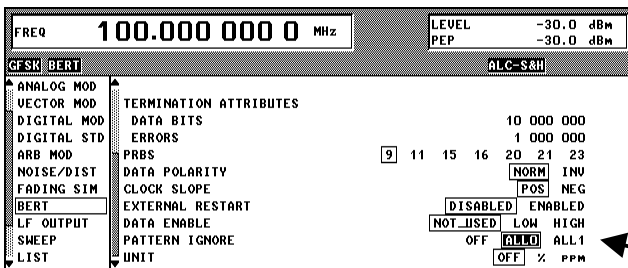
- Switch the Digital Modulation *STATE* to "ON" again
- Make sure that the new DLIST PN9B is loaded into the
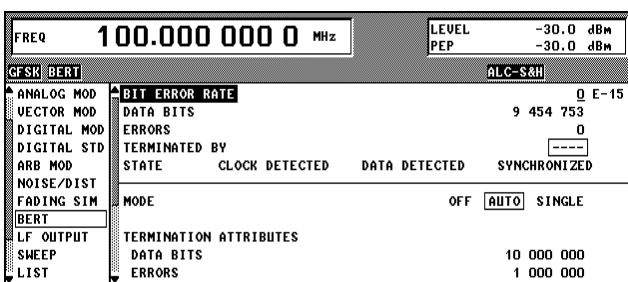- Switch the BERT MODE from "OFF" to "AUTO"

The bit error rate is now higher ($84.151 \cdot 10^{-3}$) as more bits (511 bits $\cdot\ 84.151 \cdot 10^{-3} = 43$ bits) are false.

12

| FREQ | 100.000 000 0 MHz | LEVEL | -30.0 dBm |
| | | PEP | -30.0 dBm |

GFSK BERT   ALC-S&H

```
ANALOG MOD
VECTOR MOD    TERMINATION ATTRIBUTES
DIGITAL MOD     DATA BITS                                    10 000 000
DIGITAL STD     ERRORS                                        1 000 000
ARB MOD         PRBS                        9  11  15  16  20  21  23
NOISE/DIST    DATA POLARITY                                 NORM  INV
FADING SIM    CLOCK SLOPE                                   POS  NEG
BERT          EXTERNAL RESTART                        DISABLED  ENABLED
LF OUTPUT     DATA ENABLE                           NOT_USED  LOW  HIGH
SWEEP         PATTERN IGNORE                           OFF  ALL0  ALL1
LIST          UNIT                                      OFF  %  PPM
```

Some mobile standards return in the case of a so called frame error only a complete "0" or "1" frame instead of the really detected frame data. This should indicate the BERT that this frame should not be considered for the BER measurement.

- Switch PATTERN IGNORE to "ALL0"

| FREQ | 100.000 000 0 MHz | LEVEL | -30.0 dBm |
| | | PEP | -30.0 dBm |

GFSK BERT   ALC-S&H

```
ANALOG MOD    BIT ERROR RATE                                     0 E-15
VECTOR MOD    DATA BITS                                      9 454 753
DIGITAL MOD   ERRORS                                                 0
DIGITAL STD   TERMINATED BY                                       ----
ARB MOD       STATE      CLOCK DETECTED    DATA DETECTED   SYNCHRONIZED
NOISE/DIST
FADING SIM    MODE                             OFF  AUTO  SINGLE
BERT
LF OUTPUT     TERMINATION ATTRIBUTES
SWEEP           DATA BITS                                    10 000 000
LIST            ERRORS                                        1 000 000
```

The "All 0" bits are ignored. The bit error rate is now 0.