Easy BER measurements for long PRBS

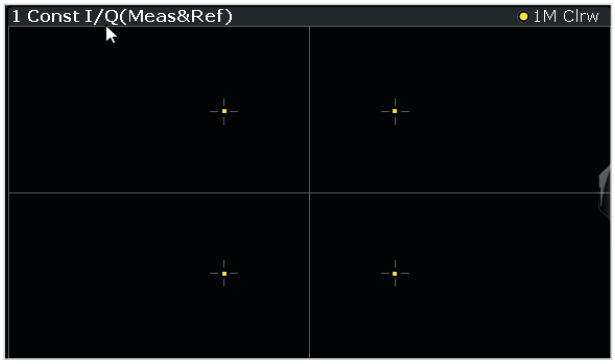
The R&S®FSW signal and spectrum analyzer is a high-performance instrument capable of measuring many key system and component parameters. Using the bit error rate (BER) functionality of the R&S®FSW-K70P option, the raw data error performance of a component or system can be accurately determined.

Your task

Developers of components and communications systems are interested in the modulation signal quality provided by their device. This has a direct relationship to the quality of the data that is being sent. Bad quality can result in poor voice call quality and low data throughput due to data being transmitted incorrectly.

Each bit in a communications system is transmitted in a data symbol. Modulation accuracy measures the deviation of each received symbol from its ideal symbol position in its constellation diagram. This measurement is called error vector magnitude (EVM).

Although this measurement is useful, it says nothing about the impact on data errors in the system since it is possible to have a bad EVM in a system with zero bit errors.

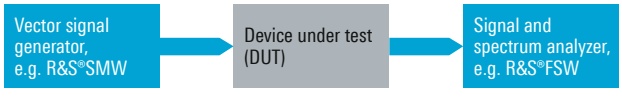


Signal with excellent EVM (i.e. high modulation accuracy)

The same signal with strong distortion. It has poor modulation quality, but it is clear that no symbols would fall in an adjacent quadrant.

Bit errors occur when a data symbol appears in the wrong area (quadrant for QPSK) of the constellation diagram. This is called a symbol decision error. They occur because the data symbol was distorted during transmission by amplitude, phase, timing or additive noise. When this happens, bit errors occur because our wanted data has been corrupted and received incorrectly.

Test setup



Rohde&Schwarz solution

Bit errors can be measured using both one-port and two-port test setups.

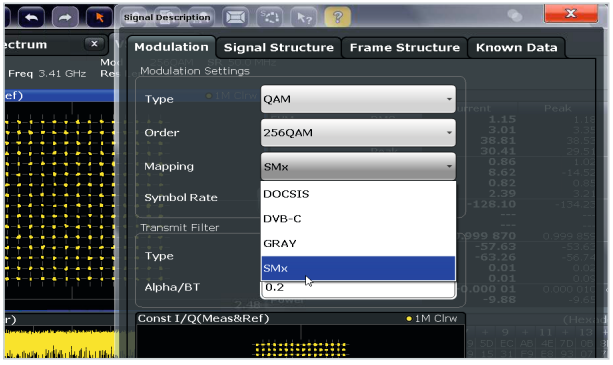
Typical one-port and two-port test setups

In a one-port test setup, the DUT itself produces both the data patterns and the modulation format to be measured. A transmitter chipset or a modem are examples for this setup.

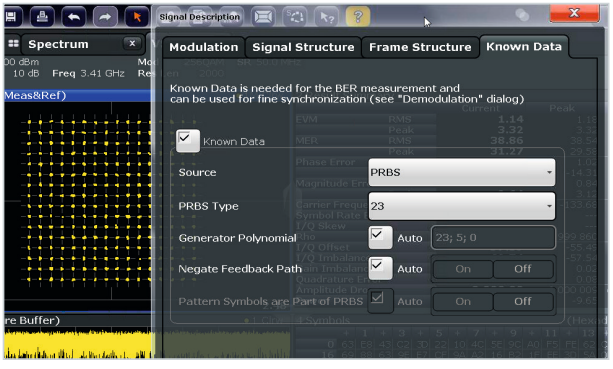
In the past, measuring BER was time-consuming and complex. Now, the process has been made simple and almost instantaneous, even for very long and complex data patterns such as PRBS23 which has more than 8 million possible combinations that have to be calculated in advance.

Configuring the R&S®FSW-K70P

- First, the R&S®FSW must know the type of modulation it is expecting, e.g. QAM or QPSK. Then, the R&S®FSW must know how the data is mapped to each constellation point. Whenever an R&S®SMx vector signal generator is used, the mapping can simply be set to "SMx", which will always match the default mapping of the generator regardless of the modulation.



- Next, we need to tell the R&S®FSW that it will use "Known Data" for its demodulation process and select the data source and type.



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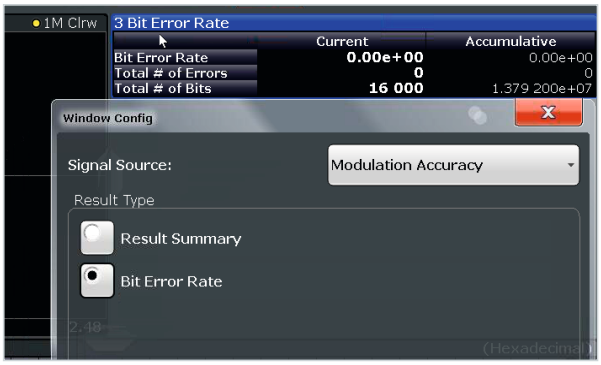
It is also possible to manually change the polynomial or negate the feedback path in this step.

- Finally, the bit error rate results need to be displayed. This can be done under "Window Config" for the "Modulation Accuracy" measurement.



Summary

With basic knowledge of the PRBS polynomial and data mapping, BER can be easily measured in the R&S®FSW for any PRBS sequence, no matter how long.

As an additional benefit, the known data approach delivers highly accurate EVM results, even for low SNR environments.

See also

- www.rohde-schwarz.com/product/fsw
- www.rohde-schwarz.com/product/fswk70
- https://www.rohde-schwarz.com/us/manual/r-s-fsw-k70-measuring-unknown-signals-application-sheet-manuals-gb1_78701-286988.html

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R&S®FSW: Easy BER measurements for long PRBS
Data without tolerance limits is not binding | Subject to change

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