

Bluetooth® enhanced data rate (EDR) – signals for development and production

Two new options for Rohde&Schwarz vector signal generators generate test signals for all EDR packet types.

Two modulations in one data packet

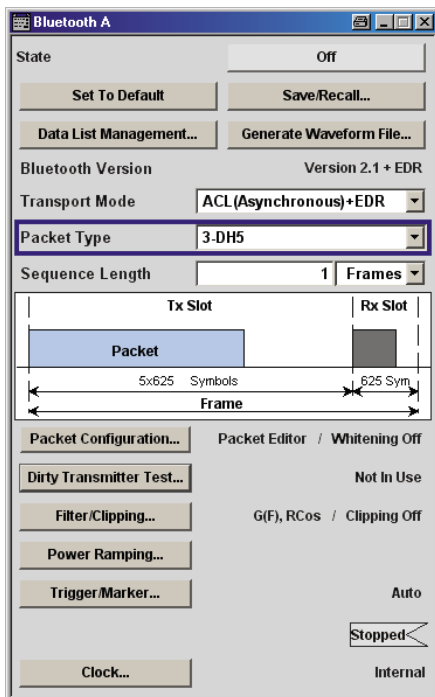
Bluetooth® technology, which is commonly found in mobile phones, offers easy-to-use wireless connections to nearby telephones or laptops. The Bluetooth® specification 2.0 has increased the achievable gross data rate from previously 1 Mbit/s up to 3 Mbit/s. Although these data rates may seem low when compared to forthcoming standards such as LTE, very high data rates are not the decisive factor for most Bluetooth® applications, where low energy consumption is crucial.

In order to ensure downward compatibility to the original standard (version 1.0), Bluetooth® EDR employs two completely different modulations in one data packet: GFSK in the packet header and $\pi/4$ -DQPSK or 8DPSK in the data sections. Intensive testing is the only way to ensure that the receivers are capable of reliably mastering this sophisticated switching task when receiving data.

Software options for all applications

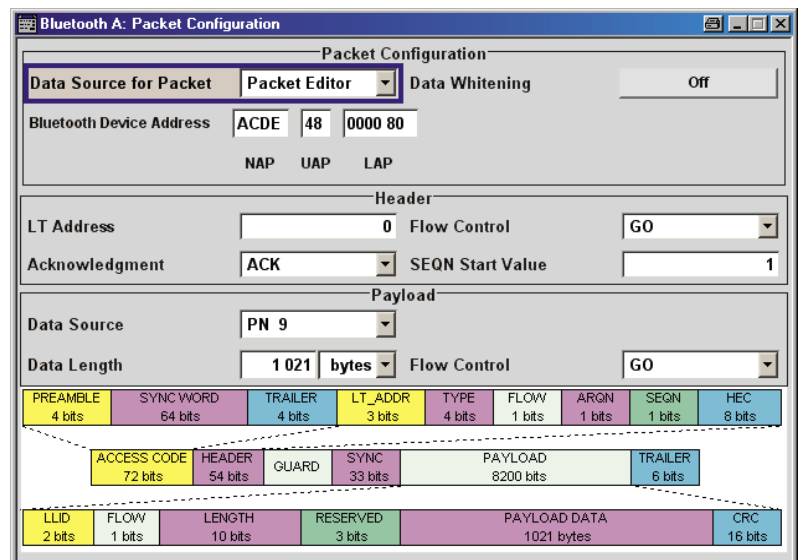
The new R&S®SMx-K60 and R&S®SMx-K260 software options for vector signal generators from Rohde&Schwarz generate test signals for all EDR packet types: 2-DHx with a data rate of 2 Mbit/s and $\pi/4$ -DQPSK modulation as well as 3-DHx with 3 Mbit/s and 8DPSK modulation (FIG 1). A convenient packet editor with a graphical display provides comfortable access to all of the packet's relevant data content (FIG 2). The software automatically calculates the access code from the Bluetooth® Device Address. In addition to standard PN sequences, user-defined data is also adjustable for the packet's payload section. However, there are also options that support all previous packet types of the Bluetooth® 1.0 standard such as DM, DH, HV, EV, and FHS.

FIG 1 The generator only transmits in TX timeslots, seen here as a graphic representation in the R&S®SMx-K60 option's main menu.



* Options are available for the R&S®SMU200A, R&S®SMJ100A, R&S®SMATE200A, R&S®SMBV100A, R&S®AMU200A, R&S®AFQ100A, and R&S®AFQ100B signal generators.

FIG 2 Clear configuration: all packet data fields at a glance.



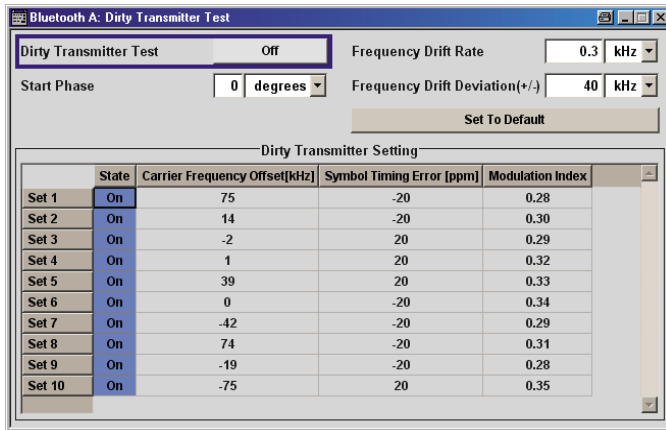


FIG 3 The dirty transmitter test: specific degradation of the signal quality.

Dirty transmitter tests – receiver quality put to the test

The R&S®SMx-K60 and R&S®SMx-K260 options also allow dirty transmitter tests to be performed. Here, the transmit signal is specifically impaired, as required for receiver sensitivity tests in line with the official test specification (RFTS.2.1) (FIG 3). Receivers must not exceed the prescribed bit error rate of 0.1 % under these complicated conditions.

Impairments include

- Frequency offset of the RF carrier (carrier frequency offset)
- Frequency offset of the symbol timing (symbol timing error)
- Drift in the GFSK frequency deviation (modulation index)
- Sinusoidal drift of the carrier frequency, for which frequency (frequency drift rate) and deviation (frequency drift deviation) can be entered (FIG 4)

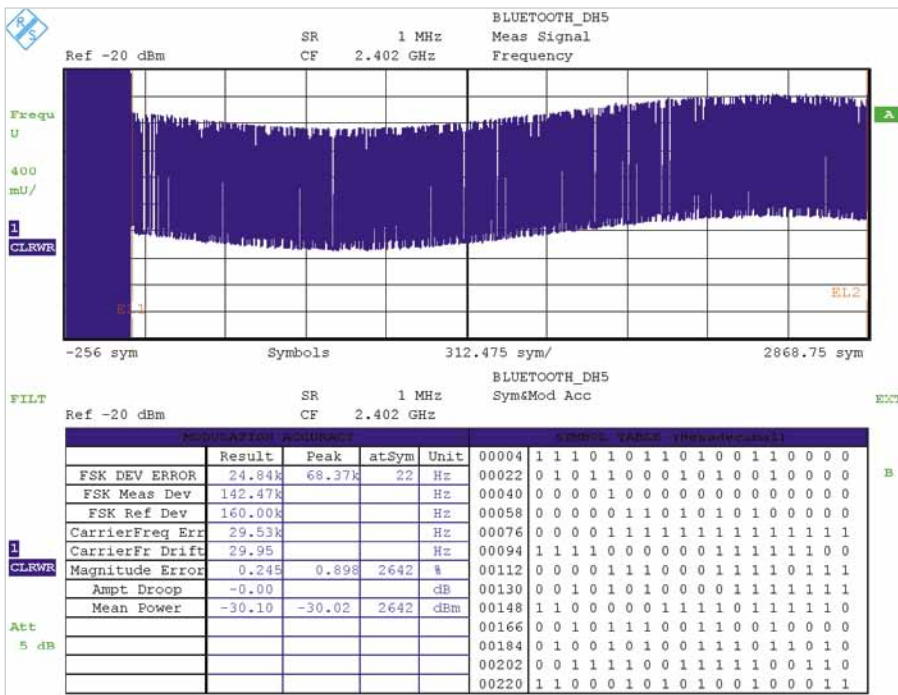
In addition, the parameters of these signal distortions are only valid for 20 ms; a new set of parameters is used for each additional 20 ms. Up to 10 such parameter sets are entered in a table.

Summary

Equipped with the new R&S®SMx-K60 and R&S®SMx-K260 options, Rohde&Schwarz signal generators are fit for all current Bluetooth® test requirements. The specification committee announced new expansions of the Bluetooth® standard such as ultra low power (ULP). As always, Rohde&Schwarz will be quick to offer an appropriate solution.

Gernot Bauer

FIG 4 Frequency demodulation using the R&S®FSQ signal and spectrum analyzer clearly shows the sinusoidal drift of the RF carrier caused by the dirty transmitter test.



Abbreviations

- 8DPSK 8-phase differential phase shift keying
- $\pi/4$ -DQPSK $\pi/4$ -rotated differential quaternary phase shift keying
- BER Bit error rate
- DH Data – high-rate data packet type
- DM Data – medium-rate data packet type
- EDR Enhanced data rate
- EV Enhanced voice packet
- FHS Frequency hop synchronization
- GFSK Gaussian frequency shift keying
- HV High-quality voice, e.g. HV1 packet
- PN Pseudo-random noise
- RX Receive
- TX Transmit
- ULP Ultra low power