Universal Radio Communication Tester R&S CMU200

Measuring EDGE signals

What EDGE is all about

EDGE\(^3\) is the magic formula for more speed. The idea behind it is really very simple: a modified form of modulation transmits every three data bits simultaneously, and so makes transmission three times faster.

But new kinds of modulation also make new demands on test and measurement technology. The Universal Radio Communication Tester R&S CMU200 [1 to 5] is already able to perform all measurements required of future EDGE technology. Thus the R&S CMU200 again consolidates its leading role in mobile radio measurement.

The speed in GSM networks is 271 kbit/s; transmitting one bit takes approx. 3.7 µs. To increase the transmission rate of existing GSM networks, you must under no circumstances expand the bandwidth, since this would interfere with the networks currently operated. The idea of combining three bits into a symbol and transmitting them simultaneously does not work with the GMSK modulation (Gaussian minimum shift keying) used in GSM networks. 8PSK (8 phase shift keying) is instead used to modulate EDGE signals. To reduce the crest factor, the transition between two symbols is shifted by \(3\pi/8\) in phase, and the frequency spectrum is then matched to that of GMSK (FIG 1).

1) HSCSD: high-speed circuit switched data
2) GPRS: general packet radio service
3) EDGE: enhanced data rate for GSM evolution

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**FIG 1** EDGE 8PSK modulation consists of mapping, rotation and filtering
New measurement requirements through EDGE

Frequency error, peak phase error and RMS phase error are measured to judge the quality of a GMSK-modulated signal. These variables are also important when assessing 8PSK-modulated signals. EVM (error vector magnitude) is particularly significant as a measure of the deviation of the ideal symbol pointer from the symbol pointer detected (FIG 2).

An 8PSK signal cannot match the familiar power time template of a GSM burst because its crest factor is much higher. The GSM standardization committee consequently defined a new power time template for EDGE signals (FIG 3) and relaxed the limits of the spectrum due to modulation and switching somewhat.

EDGE measurements in practice

The R&S CMU 200 already meets the demands of future EDGE T&M technology; its measurement range even far exceeds the requirements. In modulation measurements (FIG 4) for instance, its clear menu shows magnitude error (peak and RMS) and origin offset in addition to the obligatory parameters frequency error, phase error (peak and RMS) and EVM (peak and RMS). All results appear not only for the currently measured burst but also as a mean and min./max. value across a set number of bursts.

Another special feature of the R&S CMU 200 is the determination of the 95:th percentile. For this purpose, it measures in a burst the phase error, EVM and magnitude error of each symbol (3 to 144) transmitted in the useful part. From these figures it determines the value below which 95% of all symbols measured are at the respective quantity. In addition, all the symbol values measured can be graphically displayed.

For power measurement, the set provides the power time template for measuring EDGE signals. As usual, this template is user-editable.

The R&S CMU 200 really demonstrates its unrivalled performance in the measurement of multislot power ramping (FIG 5). It analyzes the received signal and positions the correct power time template on up to four timeslots. Separately for each timeslot, it automatically determines the template type (GMSK or 8PSK), the template position on the time axis using the decoded midamble in the burst, and the template position on the power axis using the average burst power in the useful part of the burst. In line with the standard, it then joins the part templates of the individual bursts in the transition areas—a more convenient way is hardly conceivable.

What is not so nice about 8PSK signals is that, due to the high crest factor, they only yield stable measurement results for a very high averaging depth. But
that is synonymous with long measurement time – which is naturally not welcomed in production. The R&S CMU200 shows you how to get round this. For average burst power it provides not only single burst assessment (with strongly varying results) and averaged measurement (stable results but a long time to measure them) but also data-compensated measurement. Here the tester calculates the nominal power ramp from the symbols received, taking into account only the difference between the nominal and the measured power ramp. The results are stable even at a low averaging depth and match those with high averaging depth.

In spectrum measurements, the tester of course automatically adapts the permissible limits to the modulation mode.

EGPRS

EGPRS is the logical combination of GPRS technology and EDGE modulation. Standardization committees have defined nine channel coders for EGPRS (MCS-1 to MCS-9). MCS-1 to MCS-4 are GMSK-modulated, the other five are 8PSK-modulated. The R&S CMU200 supports all nine coders and is thus optimally suited in the reduced signalling mode for the development of EGPRS modules for example.

Conclusion

Opting for the R&S CMU200 makes you state of the art and up to the minute, and keeps you there. Even before the first mobile with EDGE technology is ready to go into production, this tester provides the required T&M technology in the GSM software packets.

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