Photo 43 238/16

Universal Radio Communication Tester R&S CMU 200

Measuring EDGE signals

The mobile radio future means even greater speed on the data highway. The HSCSD[1] and GPRS[2] technologies recently introduced by network operators are just the beginning; the potential for more speed in 2.5G networks is far from exhausted.

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 CMU 200 [1 to 5] is already able to perform all measurements required of future EDGE technology. Thus the R&S CMU 200 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 3π/8 in phase, and the frequency spectrum is then matched to that of GMSK (FIG 1).

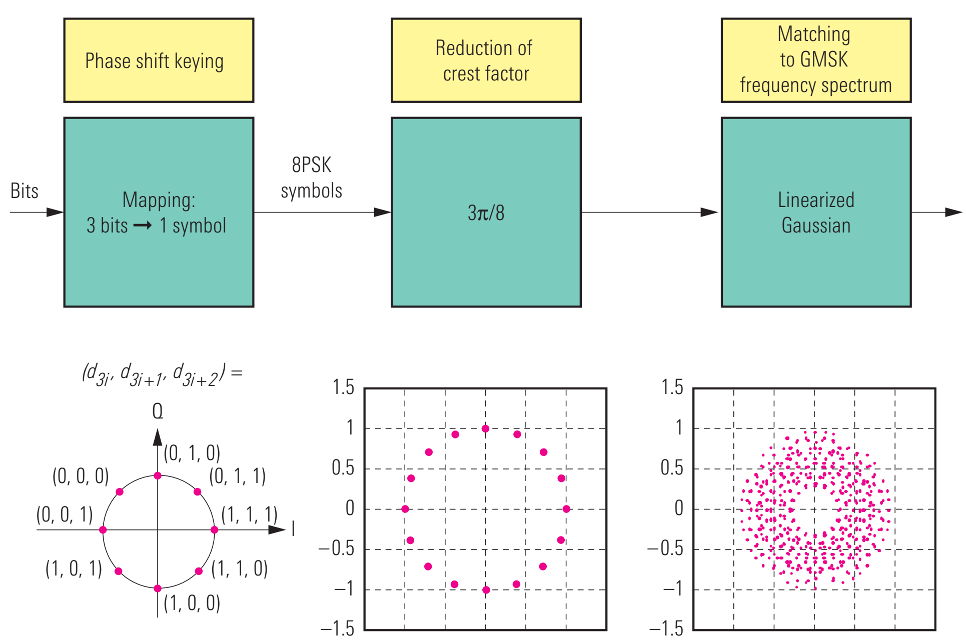
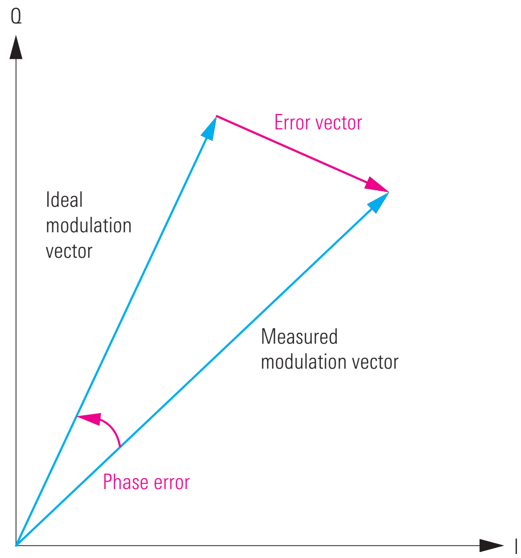


FIG 1 EDGE 8PSK modulation consists of mapping, rotation and filtering

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



Error vector magnitude = |error vector|
Magnitude error = |ideal modulation vector| – |measured modulation vector|

FIG 2 Error vector magnitude is an important variable in quality assessment. It indicates the absolute length of the error vector between ideal and measured symbol time.

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

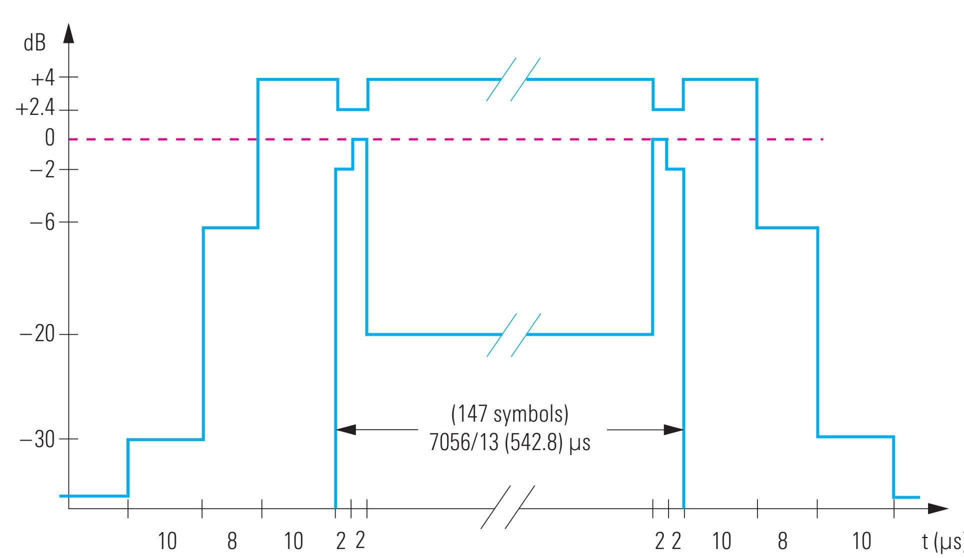


FIG 3 Power time template for EDGE signals

that is synonymous with long measurement time – which is naturally not welcomed in production. The R&S CMU 200 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

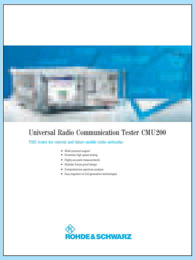
EGPRS is the logical combination of GPRS technology and EDGE modulation. Standardization committees have defined nine channel coders for EGPRS (MCS-1 to MCS-9). MCS-1 to MCS-4 are GMSK-modulated, the other five are 8PSK-modulated. The R&S CMU 200 supports all nine coders and is thus optimally suited in the reduced signalling mode for the development of EGPRS modules for example.

Conclusion

Opting for the R&S CMU 200 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.

Rudolf Schindlmeier

More information and data sheet at www.rohde-schwarz.com (search term: CMU 200)



REFERENCES
[1] CMU 200 – GSM power measurement – versatile, fast and accurate. News from Rohde & Schwarz (2000) No. 167, pp 24–25
[2] CMU 200 – Speeded-up test of GSM mobiles without signalling. News from Rohde & Schwarz (2000) No. 168, pp 16–17
[3] CMU 200 – Measuring bit error rate on GSM mobiles. News from Rohde & Schwarz (2000) No. 169, pp 11–13
[4] CMU 200 – Multislot measurements on HSCSD and GPRS mobile phones. News from Rohde & Schwarz (2001) No. 172, pp 15–17
[5] CMU 200 – Audio measurements on mobile phones. News from Rohde & Schwarz (2001) No. 172, pp 18–19

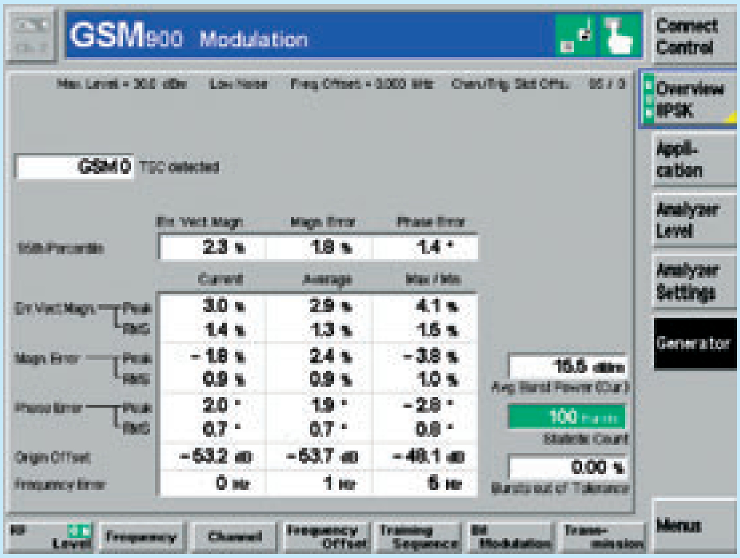


FIG 4 The R&S CMU 200 displays all important EDGE modulation variables in a clear menu. The values measured for origin offset are particularly useful for conveniently adjusting or checking a mobile's I/Q modulator. In addition, the tester determines the 95:th percentile for phase error, error vector magnitude and magnitude error.

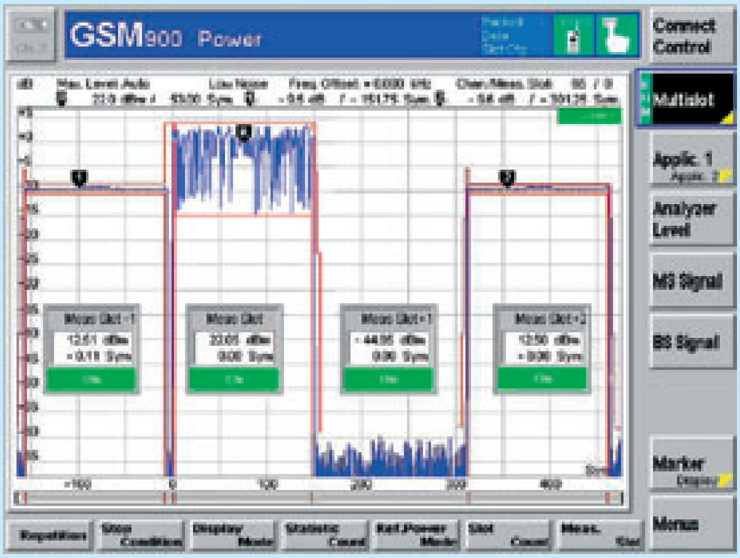


FIG 5 The measurement of multislot power ramping displays up to four timeslots, with the power time template automatically matched to the received signal. The user no longer needs to bother selecting the correct template.