Universal Radio Communication Tester CMU 200

Multislot measurements on HSCSD and GPRS mobile phones

There is an increasing trend in mobile radio towards fast data transmission. Mobile Internet access, in particular, opens up new applications for network operators. Here, too, the CMU 200 offers full test functionality for HSCSD and GPRS mobiles in development and production.

Photo 43238/16N

Testing HSCSD and GPRS links in mobile phone production

In voice communication tests it is obvious: the microphone, loudspeaker and the RF are the mobile's interfaces, and these are tested in production. This is different in the case of data links like HSCSD and GPRS (see box on page 17). The voice communication standards are not appropriate for carrying out production tests on data-transmitting mobiles, so the standardization bodies have defined special test modes. Because in data transmission, the mobile is just a link in a long chain (PC – mobile – Internet – server).

Analogously to the loops known from bit-error-rate measurements, multislot loops were defined for HSCSD. Via these loops, the mobile is informed of the downlink timeslots in which data should be received, and of the uplink timeslots in which data should be returned. This allows bit-error-rate measurements to be performed in configurations with more downlinks than uplinks.

The situation is somewhat more complicated with GPRS. Unlike HSCSD with constant data transmission during which transmitter and receiver measurements can be performed, transmission in GPRS is activated only if there is actually something to transmit. To enable GPRS measurements, the standardization bodies have specified two link modes, i.e. GPRS test mode A and GPRS test mode B.
In test mode A, the mobile constantly transmits a temporary block flow (TBF) that carries user data in the form of pseudo-random bit sequences. In test mode B, the TBF received in the downlink is returned in the uplink. In test mode B, too, the uplink slots can be defined in which downlink data should be returned. The two test modes allow transmitter and receiver measurements to be carried out, since the mobile is continuously transmitting and receiving, same as in circuit-switched links.

BLER measurements – problematic in production

The BLER (block error rate) measurement is the relevant receiver measurement in conformance tests on GPRS mobiles. With GPRS, retransmission is requested for such data blocks (RLC blocks) that are not received error-free by the mobile. The BLER is the ratio of received errored blocks (for which retransmission is requested) to the total number of data blocks transmitted. In production, BLER measurements have two major disadvantages, however. Firstly, they do not furnish information that is statistically conclusive. There is only the result OK or not OK for each data block, but no information on the number of errored bits in a data block. It is precisely this parameter, however, that provides information on the physical quality of a receiver.

See page 18 ff for audio measurements on mobile phones with the CMU 200.

This can be demonstrated by a numerical example. With coding scheme CS-4, 400 information bits are transmitted in a data block. To yield the same conclusive statistical information as a BER measurement, the BLER measurement would have to be at least 400 times as long as the BER measurement.

The second disadvantage of BLER measurements in production is that they may stagnate for procedure-inherent reasons, so prolonging measurement time indefinitely. It is even possible that a measurement stops completely.

Notwithstanding this, BLER measurements offer advantages too. For example, data blocks are transmitted distributed over all downlink timeslots, and the mobile can deliver an OK/NOT OK statement simultaneously for all timeslots even if it supports only one uplink timeslot. However, taking into account the poor statistical information obtained with the BLER method, it is obvious that performing several single BER measurements in test mode B will lead to satisfactory results considerably faster. To sum up, it can be said that BLER measurements are unsuitable for production with its requirement for extremely short measurement times.

HSCSD and GPRS measurements with the CMU200

The CMU200 allows any desired slot configurations to be set for HSCSD and GPRS. The active uplink and downlink timeslots can be defined conveniently in a selection box (FIG 1). Whether the selected slot configuration will actually be activated depends on the multislot class of the mobile under test. It is advantageous that the CMU200 transmit level can be set separately for each timeslot. Worst-case scenarios for the mobile's receiver can thus be created very easily. The mobile transmit level too can be defined separately for each active uplink timeslot.

When setting up a HSCSD call, the CMU200 closes the multislot loop on the mobile, so enabling all transmitter and receiver measurements to be carried out.

With GPRS, the CMU200 automatically performs the attach, routing area update and detach, and displays the status in each case. The mobile under test can then be switched to GPRS test mode A or B at a keystroke. In test mode A, all transmitter measurements can be performed, and in test mode B all receiver measurements (BER/DBLER). The CMU200 supports all GPRS coding schemes (CS-1 to CS-4).

Apart from switching to a GPRS test mode, the CMU200 can perform measurements also without signalling. This is enabled simply by sending a TBF. The mobile can synchronize in time via the BCCH channel and then change immediately to the TBF. Mobile manufacturers supporting this mode benefit from the shorter production test time which is reduced by the signalling period.

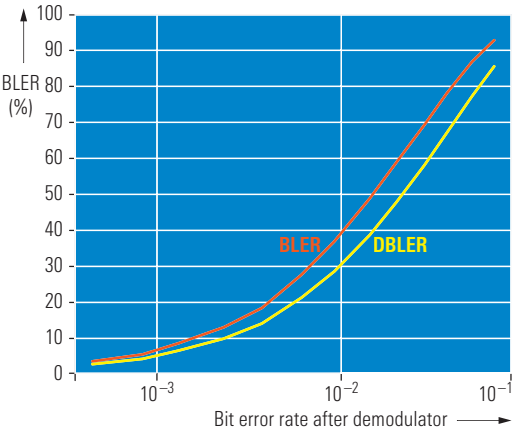
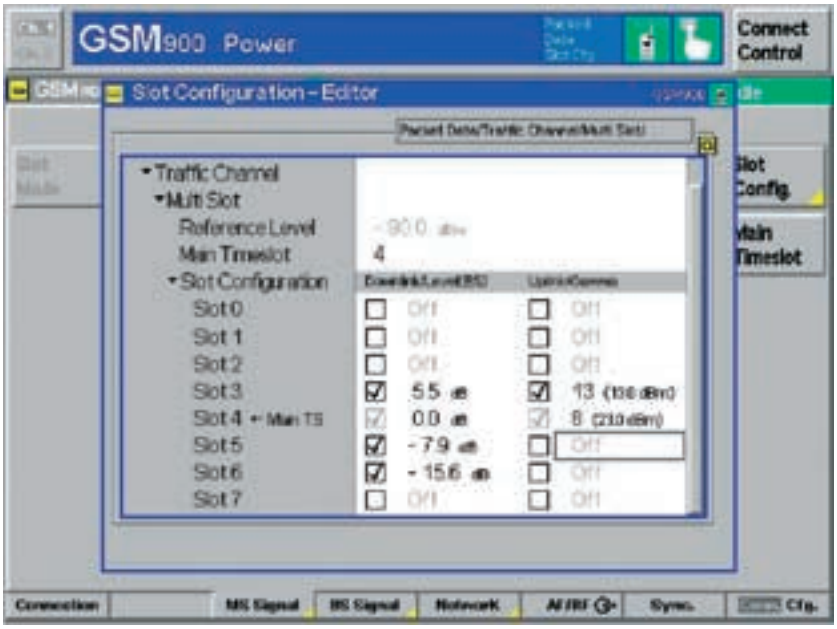


FIG 2 Relationship between BLER and DBLER measurement with coding scheme CS-1. In the case of CS-2, CS-3 and CS-4, the difference is even considerably smaller.

FIG 1 The CMU200 makes it very easy to define an uplink and downlink configuration. The downlink level (transmit level of the CMU200) and the uplink level (transmit level of the mobile) can be selected separately for each timeslot.



BER/DBLER measurements

In GPRS test mode B, the CMU 200 also performs BER measurements, and in addition determines the DBLER (data BLER). With DBLER, only the data bits proper are analyzed, whereas with BLER the block headers and the USF flag are analyzed as well. The two measurements do not differ appreciably (FIG 2), even though DBLER does not consider all bits that may lead to a block error. The advantage of DBLER over BLER is that it does not come to a halt.

Multislot power ramp measurements

Measurements to HSCSD or GPRS standards are characterized by transmission and reception taking place in several timeslots simultaneously. This is of interest in power ramp measurements. The specified power time template varies depending on whether the preceding or following timeslot is active or not. In the transition region between two active timeslots, the power may be max. 3 dB higher than in the useful part of the timeslot with the higher power. The time position of the templates, too, may vary from timeslot to timeslot depending on the GSM method used by the mobile. The user need not bother about any of this since it is all handled by the CMU 200. The instrument represents four timeslots in a single display, and automatically determines the correct position of the templates along the X and the Y axis for each timeslot (FIG 3). The CMU 200 further determines the correct template in the transition region between two active timeslots. Plus, the instrument detects the modulation mode used (GMSK or 8PSK) and automatically selects the right power time template.

Summary

The CMU 200 shows its strengths also with HSCSD and GPRS data communication. The user benefits from convenient measurements and can create test scenarios of his own. This makes the CMU 200 the prime choice for these standards not only in production but also in RF development.

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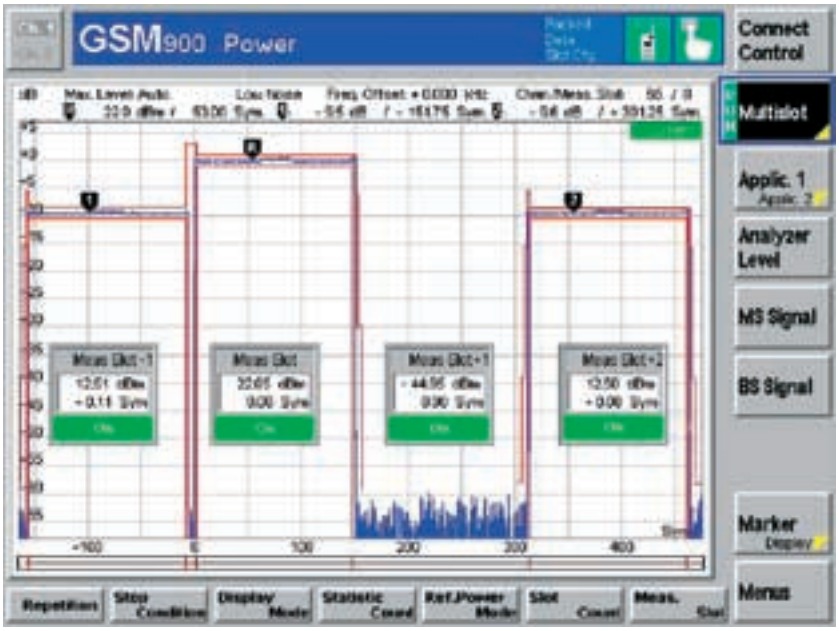
FIG 3 In multislot power ramp measurements, up to four timeslots can be displayed simultaneously. The number of timeslots shown is selectable, and the user can zoom in as desired in the X or Y direction. The power time templates are automatically adapted to the signal received, so that the user need not bother about selecting the right templates.



HSCSD and GPRS

HSCSD (high-speed circuit-switched data) relies on the same technique as normal GSM voice transmission. Instead of voice information, data contents are transmitted. Data is sent in several timeslots, which means that several parallel data links exist for each mobile. HSCSD offers the advantage of constant data rate thanks to the fixed assignment of timeslots. Assigned transmission resources have to be paid for however, whether data is transmitted or not.

GPRS (general packet radio service) uses the same technique as the Internet. Data is transmitted in the form of packets on variable channels, i.e. the transmission rate decreases as available transmission resources become scarcer. With GPRS, too, several timeslots are used simultaneously for communication between the mobile and the base station. The advantage with GPRS is that transmission resources are assigned only if data is to be sent, so that a subscriber pays only for the data volume actually transmitted.