Universal Radio Communication Tester R&S®CMU 200

UE measurement reports: checking mobile phone measurement accuracy

Mobile phones have to measure characteristics such as the pilot channel power of the base station and then send the results to the radio network. Such measurements strongly affect the distribution of resources at the radio interface. The R&S®CMU 200 triggers the mobile phone to carry out these measurements and presents the results in a clear-cut manner. The R&S®CMU 200 can also set the mobile phone to compressed mode, in which the phone performs measurements on neighbour frequencies.

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UE measurement reports

Mobile phones perform measurements for determining link quality in a radio network and then send the results to the network as UE measurement reports. These reports provide vital information for dynamic network planning and the distribution of resources at the radio interface (radio resource management). The measurements and the mode of signalling are defined in the 3GPP specifications [1, 2]. Mobile phones have to be tested to verify this functionality and the stipulated measurement accuracy [3].

A mobile phone measures important characteristics such as the power on the frequency currently in use (intra-frequency measurements), on UMTS neighbour frequencies (inter-frequency measurements) and on GSM frequencies (inter-RAT measurements; RAT: radio access technology). These measurements are used to determine which neighbour cell offers the best radio link quality; a link is then set up to this cell (FIG 1).

During signalling, it is also possible to query the current transmit power of the mobile phone, the timing of its transmit and receive signals, and the block error ratio (BLER) of a data channel. To prepare for handover between UMTS cells, the mobile phone can determine the frame timing of its current link and of its target cell.

Additional articles on the R&S®CMU 200 can be found on pages 11 and 14 of this issue.

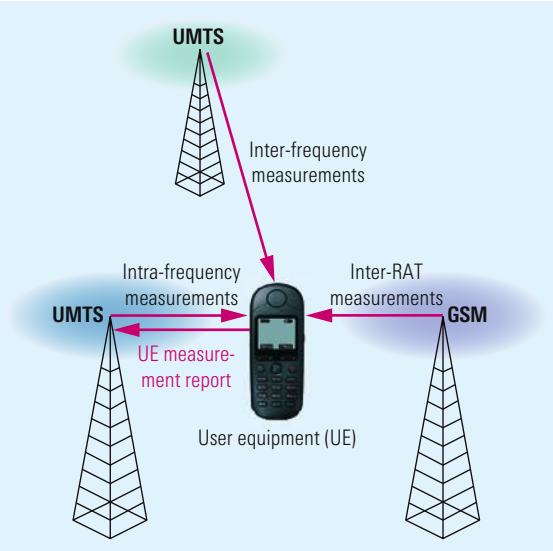


FIG 1 A mobile phone can carry out power measurements on the frequency currently in use, on UMTS neighbour frequencies and on GSM frequencies. It sends the results to the network on the current link. A new link is established to the neighbour cell that offers the best radio link quality.

The base station requests the measurements and the UE measurement reports from the mobile phone by sending a measurement control message. The R&S®CMU 200 can activate the various measurements independently of each other (FIG 2). Depending on the selected measurements, the R&S®CMU 200 automatically sends the required measurement control message(s) and displays the returned results on a clear-cut screen (FIG 3).

Compressed mode

In contrast to TDMA signals, WCDMA signals are continuous (see box). This means that the mobile phone transmits and receives signals without interrup-

tion. How, then, can the mobile phone carry out measurements on other frequencies? One solution would be to equip the mobile phone with a second receiver, although this would be complicated and expensive. Moreover, the effect of the mobile phone's own transmit signal would have to be taken into account, an effect that becomes increasingly problematic the closer the frequency to be measured is to the transmit frequency.

To solve this problem, the 3GPP standard provides for a specific operating mode referred to as compressed mode. In this mode, gaps are inserted into the mobile phone's transmit and/or receive signal without impairing the useful data rate (see box).

The compressed mode is activated in the mobile phone by way of signalling during call setup or while a measurement is being configured. The settings for this mode are made in a compressed mode pattern sequence that comprises more than 20 parameters.

Characteristics of WCDMA signals

In WCDMA (UMTS-FDD), a continuous signal is transmitted and received on a dedicated link. The division of the signal into frames and slots is based on the signal concept and does not serve the purpose of multiplexing signals of different users, which is the case in GSM.

Compressed mode

The compressed mode inserts gaps into the mobile phone's transmit and receive signals. This can be done in various ways, e. g. by **reducing the spreading factor**. The spreading factor indicates the ratio of CDMA chips to data bits and is typical of CDMA systems. Reducing the spreading factor usually results in a higher data rate. When the spreading factor is reduced, the data rate is briefly increased immediately ahead of and after the signal gap. Another way of implementing the compressed mode is to **reduce the number of redundant bits** that the channel coder inserts into the data stream. This method, which is also known as puncturing, can be used only for signals transmitted to the mobile phone. The third way of generating gaps in the signal is by **higher layer scheduling**, which however is less relevant for measurement purposes and is therefore not implemented in the R&S®CMU 200.

The parameters for the compressed mode are communicated to the mobile phone in the "DPCH compressed mode info" signalling element [2]. These parameters determine factors such as where gaps should be inserted into the continuous WCDMA signal. A compressed mode pattern sequence may include two compressed mode patterns with up to two gaps each. Mobile phones are required to support up to six sequences for the various measurements.

FIG 2 The R&S®CMU 200 can request the mobile phone to send the measured powers of a UMTS and a GSM neighbour cell independently of each other. The compressed mode can be activated separately for each measurement.

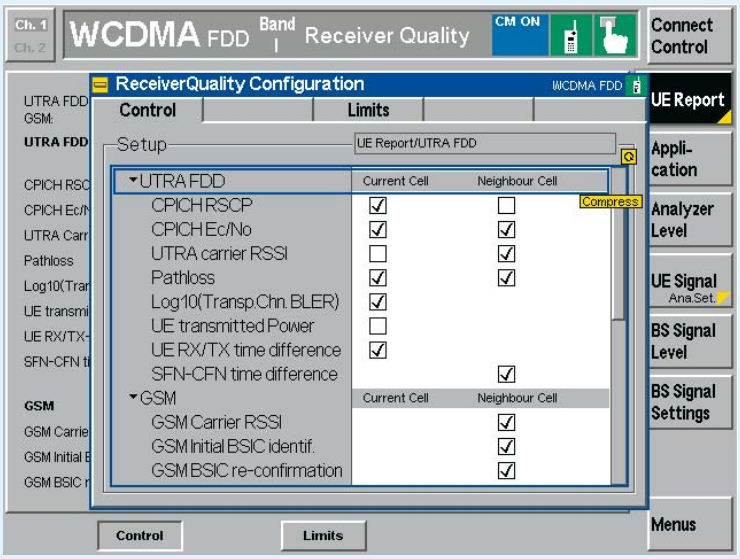
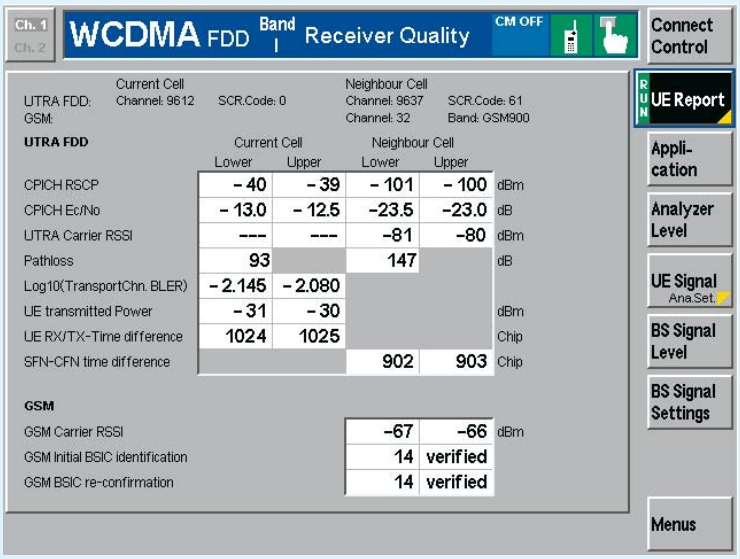


FIG 3 The R&S®CMU 200 displays the results received from the mobile phone on a clear-cut screen. The value ranges and intervals for measured values are defined in the 3GPP specification [3].



The R&S®CMU 200 offers a largely user-definable sequence as well as a number of predefined sequences that comply with the stipulated 3GPP measurements (FIG 4). This provides the user with an optimal combination of flexibility and ease of operation. There are sequences for measuring UMTS cells on neighbour frequencies as well as sequences for measuring GSM cells. It is also possible to activate several compressed mode sequences simultaneously.

Measurements on GSM frequencies are of particular importance since most WCDMA mobile phones can also handle the GSM standard. Especially in the startup phase of UMTS, smooth handover of a call from a WCDMA cell to a GSM cell is of vital importance. Based on the measurements carried out by the mobile phone, handover is optimally prepared, i.e. the mobile phone is not handed over to the GSM cell "blindly". The R&S®CMU 200 is also capable of testing the handover function. With an UMTS call established, the R&S®CMU 200 generates a GSM signal using an optional second transmitter; the GSM signal is then measured by the mobile phone. The call can subsequently be handed over to the GSM cell [4].

Summary

The Universal Radio Communication Tester R&S®CMU 200 offers numerous functions for testing the measurement accuracy of mobile phones. Its elaborate test sequences in compressed mode enable you to check the mobile phone's measurements on neighbour UMTS and GSM cells.

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More information and data sheet at www.rohde-schwarz.com (search term: CMU200)

REFERENCES
[1] 3GPP Specification TS 25.215 "Physical Layer Measurements (FDD)"
[2] 3GPP Specification TS 25.331 "Radio Resource Control (RRC)"
[3] 3GPP Specification TS 25.133 "Requirements for Support of Radio Resource Management (FDD)"
[4] Handover scenarios in GSM systems. News from Rohde & Schwarz (2003) No. 180, pp 12–13

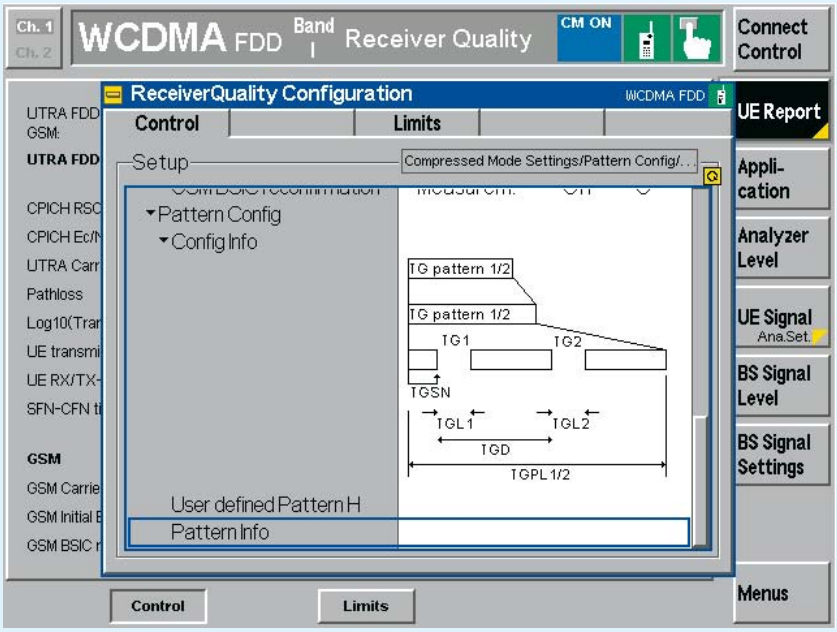

FIG 4
The compressed mode can conveniently be configured using predefined sequences. Sequences in compliance with the 3GPP specification are available for the various types of measurements. Moreover, you can parameterize a compressed mode sequence to fit your needs and activate it on the R&S®CMU 200. By providing access to the main parameters of the compressed mode, the R&S®CMU 200 offers maximum flexibility. The graphical representation of the compressed mode sequence makes configuration easier.