Quality testing of mobile phones using multitone audio analysis of Digital Radiocommunication Tester CMD

FIG 1 To handle more stringent quality requirements for GSM and DECT mobile stations, Digital Radiocommunication Tester CMD from Rohde & Schwarz was upgraded with powerful AF measurement functions. Photo 40 944/1

Europe is not the only place where digital GSM and DECT networks have flourished. Variations of these networks are taking hold all over the world, but the market is by no means saturated. Manufacturers of mobile phones still have to woo the customer to win orders. All manufacturers are able to supply the basic functions required for mobile operation and so customers now tend to go for features that can be assessed directly rather than the provision of basic features. Design and quality are features that can clinch a purchase.

Using the right measurement technology has a positive effect on quality. From the outset, Rohde & Schwarz has designed its GSM and DECT production testers to guarantee quality at the RF interface [1; 2]. In the meantime, this has come to be thought of as a standard basic function. The situation is different as far as the AF interface of the mobile is concerned. Within the acceptable quality range, quality differences in the audio signal can be clearly discerned by the user and this may influence his decision to buy.

For this reason, Rohde & Schwarz has considerably upgraded the AF measurement capabilities of its GSM/DCS 1800/DCS 1900 and DECT radiocommunication testers. Multitone audio analysis has been added to functions such as AF generator, AF meter with rms and peak value meter, distortion meter and frequency counter. In the new measurement mode, CMD (FIG 1) generates up to 14 user-selectable frequencies in the range 50 Hz to 8 kHz with individually adjustable levels (can also be switched off). After the multifrequency signal has passed through the DUT, CMD performs narrowband voltage measurements at these frequencies.

Measurements

Fast frequency response measurement (FIG 2): the user selects 14 points on the frequency response curve and sets each frequency to the same level. Measuring the output levels of the DUT at these points gives the frequency response of the DUT. If there are frequencies which have passed through the DUT and are far below the possible measurement limits, the measurement range for these particular frequencies can be extended by increasing the level on the generator side. Since all frequencies are measured simultaneously, the frequency response measurement is fast in spite of the narrow measurement bandwidth (approx. 2 s at 1 Hz). This measurement is a good choice for noisy production environments as most of the external noise is excluded thanks to the narrow measurement bandwidth.

True harmonic distortion measurement: the distortion measurement performed up to now was in fact a SINAD measurement, ie the total signal is referenced to a signal from which the fundamental has been removed. With multitone audio analysis individual harmonics can be singled out. The fundamental frequency at a certain level is set on the signal generator. Then up to 13 harmonics are chosen with the signal generator switched off. On the output side, narrowband measurements on all the frequencies provide information about the whole harmonic spectrum.

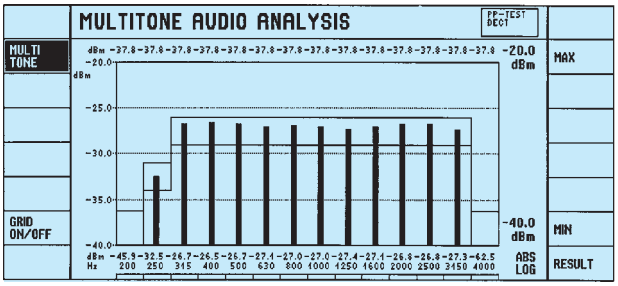

FIG 2 AF frequency response. Results from multitone audio analysis are always displayed as bargraphs. Bars represent points selected on DUT's AF frequency response.

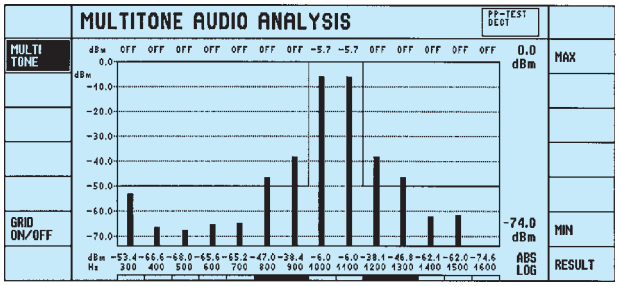

FIG 3 AF intermodulation measurement. Two larger bars represent test tones, smaller ones at right and left unwanted intermodulation products measured by CMD at high speed over wide dynamic range.

Intermodulation measurement (FIG 3): like distortion measurement, this measurement too is used to check the linearity of the DUT. Two test tones instead of one are used in this case, however. The intermodulation products occur at precisely predictable frequencies which are a function of the two test tones. Consequently, a level is assigned to two of the frequencies and the others are set to the expected intermodulation frequencies with no generator signal present.

Aliasing products: prior to transmitting analog voice signals in a range from 300 Hz to 3.3 kHz on the digital network, the signals are sampled at a rate of 8 kHz. Frequency components above 4 kHz must not reach the sampler as otherwise unwanted aliasing products would be produced. Knowing the test frequency and the sampling frequency, the aliasing frequency can be determined precisely. The level is then measured at these points.

Control and operation

Signal paths (FIG 4): CMD's AF interface with its new multitone analysis facilities and the "old" AF test functions with generator and analyzer can be connected to the front-panel connectors or to CMD's ADPCM interface for DECT applications. If CMD is equipped with a Speech Encoder/Decoder CMD-B5 for GSM, the AF interface may be internally switched to this option.

Operating modes: in the single-shot mode, the generator can be started before the analyzer to allow the DUT to settle completely before the measurement is started. Normally the continuous measurement mode is chosen for manual operation, results being updated every second. If the operator suspects that there is an out-of-tolerance condition, continuous measurement can be stopped to examine the outlier more closely.

Analysis using tolerances: as with any other CMD result, tolerances may be set for the results obtained from multitone audio analysis on a go/nogo basis. With the aid of this function, a single go/nogo outcome can be obtained from every group of 14 results – in other words, a single, accurate conclusive result can be obtained from a complex measurement.

Result display: the great variety of display and scaling modes – tailored to specific measurement tasks – makes reading of results easy and simplifies their interpretation. Any signal generator level may be used as a reference for the measurements or an independent reference value can be defined. As appropriate, log or linear scales may be chosen on CMD.

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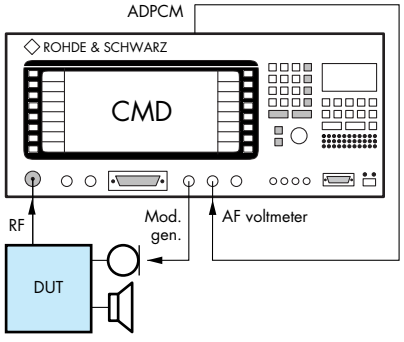

FIG 4 Setup for measuring frequency response, distortion, intermodulation and aliasing in microphone path of DUT (here DECT portable part). Similar setup is used for measurements in loudspeaker path.

REFERENCES

[1] Maucksch, T.: Digital Radiocommunication Tester CMD60 – A favourably priced compact test set for series production of DECT mobiles. News from Rohde & Schwarz (1995) No. 149, pp 13–15

[2] Vohrer, M.: Multimode Radiocommunication Tester CMD for GSM, PCN, PCS and DECT mobiles. News from Rohde & Schwarz (1996) No. 150, pp 53–54

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