ACP measurements for W-CDMA using Signal Generator SMIQ and Low ACP option

The new mobile-radio generation based on W-CDMA (wideband code-division multiple access) is aiming at high transmission quality together with high availability and economy. This is to be guaranteed by specifications like the one relating to adjacent-channel power (ACP), which will ensure unimpaired communication in adjacent frequency channels. In the special case of W-CDMA this specification makes very high demands on the measurement technology. Rohde & Schwarz's response to this was to develop Low ACP option SMIQB46 for Signal Generator SMIQ [1] .

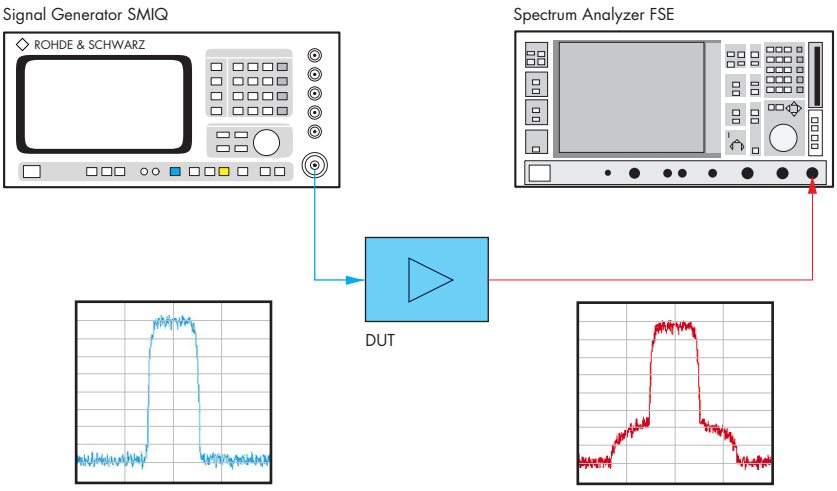

FIG 1 Setup for ACPR measurement on modules, eg amplifiers

FIG 1 shows a typical **setup for measurement of ACPR** (adjacent-channel power ratio) on a W-CDMA amplifier. Signal Generator SMIQ is the signal source feeding the amplifier. The in-channel/adjacent-channel power ratio is measured at the amplifier output by Spectrum Analyzer FSE. At 4.096 Mchip/s, the demands of the current W-CDMA standard for mobile and base stations are very high: a ratio of 40 dB at 5 MHz offset for the mobile station and 55 dB for the base station, and at 10 MHz offset a ratio of 60 dB and 70 dB respectively. To be able to measure the specified ACPR, the instruments must have a better specification, a reserve of about 10 dB is normally sufficient.

The contributions of the measuring instruments to adjacent-channel power stem from intermodulation and broadband noise. Intermodulation produces the major share of ACP at 5 MHz offset, while at 10 MHz offset only broadband noise plays a role. **Signal Generator SMIQ** features excellent values in this respect: ACPR of typically 64 dB at 5 MHz offset and 66 dB at 10 MHz offset. The **Low ACP option SMIQB46** improves these figures to 68 dB at 5 MHz and 73 dB at 10 MHz offset. The values apply to simulation of one code channel, no matter whether the baseband signal is generated internally or externally. FIG 2 shows the spectrum obtained with the Low ACP option.

W-CDMA is **multichannel,** allowing several channels to be transmitted on one carrier. This increases the peak value of modulation, which in turn has a negative effect on adjacent-channel power, since the margin from broadband noise becomes less due to the lower rms power. ACPR at 10 MHz offset, determined solely by broadband noise, degrades precisely by how much the crest factor of the modulation signal increases. Since ACPR at 5 MHz offset is mostly caused by intermodulation, it is not affected to the same extent. With 127 code

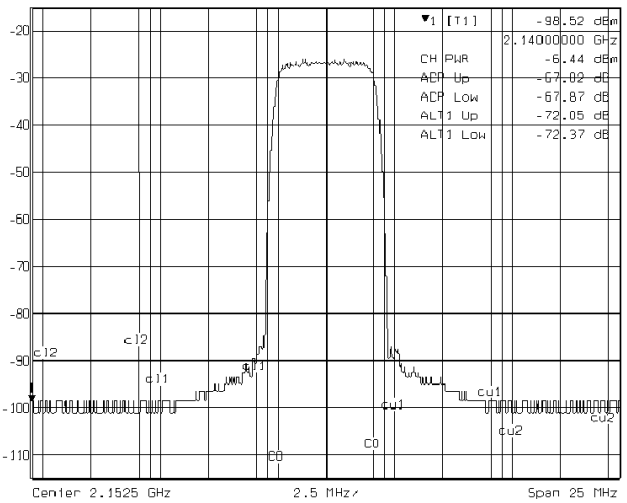

FIG 2 W-CDMA spectrum of SMIQ with option SMIQB46. ACP readings also contain components from Spectrum Analyzer FSE. Corrected values for SMIQ are –68 dB for ACP and –73 dB for ALT1.

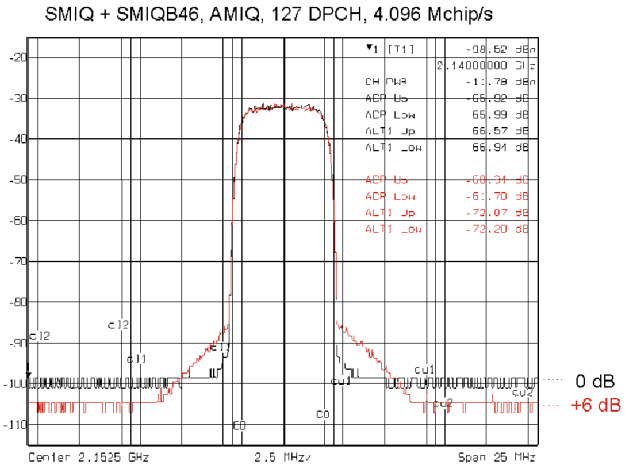

FIG 3
Comparison between normal drive (black) and +6 dB overdrive (red) for SMIQ with W-CDMA, 4.096 Mchip/s and 127 code channels. ACP readings also contain FSE components (for corrected SMIQ values see blue box).

The SMIQ/AMIQ team together with the overdrive method yields ACPR values at 10 MHz offset that have not been matched anywhere in the world to date. This method now also supports users who need to check compliance with the stringent ACPR requirements at 10 MHz offset.

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channels in use, ACPR values of 66 dB are obtained at 5 MHz offset and 67 dB at 10 MHz offset.

Multiple code channel mode with 127 channels is possible with I/Q Modulation Generator AMIQ plus Software WinIQSIM [2; 3] and SMIQ. Generating baseband signals with AMIQ has another decisive advantage. To obtain better ACPR at 10 MHz offset, SMIQ can be overdriven externally up to 6 dB due to the high linearity of its I/Q modulator. Intermodulation increases but only occurs at 5 MHz offset. The real benefit is the bigger margin from broadband noise. This means that the ACPR value at 10 MHz offset is also improved by exactly 6 dB. So 6 dB overdrive produces ACPR of 79 dB at 10 MHz offset for W-CDMA with one code channel and 4.096 Mchip/s. Refer to the blue BOX for the results of different configurations.

Normal drive or overdrive is selected depending on whether the measurement is to be carried out at **5 MHz or 10 MHz offset.** Normal drive is ideal for 5 MHz offset measurement and overdrive for 10 MHz. Overdrive is obtained by increasing the AMIQ output voltage from 0.5 V to 1 V. At the same time the output level on SMIQ, increased by 6 dB due to higher modulation, has to be reduced. This is done quite simply by entering a level offset of 6 dB.

The figures in bold in the table indicate the best combinations for 5 MHz or 10 MHz offset measurement. FIG 3 provides a comparison between the spectra with normal drive (0 dB) and overdrive with 6 dB for a signal with 127 code channels. The higher intermodulation can be clearly seen in the range up to a carrier offset of 5 MHz. The noise level is 6 dB lower at 10 MHz offset however.

Configuration	Modulation	ACPR 5 MHz offset	ACPR 10 MHz offset
Internal, 1 code channel	0 dB	**68 dB**	73 dB
External, 1 code channel	0 dB	**68 dB**	73 dB
External, 1 code channel	+6 dB	58 dB	**79 dB**
External, 127 code channels	0 dB	**66 dB**	67 dB
External, 127 code channels	+6 dB	61 dB	**73 dB**

Typical ACPR values of Signal Generator SMIQ with Low ACP option and different configurations

REFERENCES

[1] Klier, J.: Signal Generator SMIQ – High-quality digital modulation up to 3.3 GHz. News from Rohde & Schwarz (1997) No. 154, pp 4–6

[2] Kernchen, W.; Tiepermann, K.-D.: I/Q Modulation Generator AMIQ – Convenient generation of complex I/Q signals. News from Rohde & Schwarz (1998) No. 159, pp 10–12

[3] Pauly, A.; Holzhammer, J.: I/Q Simulation Software WinIQSIM – New approaches in calculating complex I/Q signals. News from Rohde & Schwarz (1998) No. 159, pp 13–15