Compact system for measuring radiated spurious emissions on LTE devices

The European R&TTE Directive and standardization bodies such as the ITU specify radiated spurious emission (RSE) measurements for wireless communications devices. The conventional approach to measuring RSE uses notch filters to suppress strong wireless carrier signals. However, this approach is impractical for Long Term Evolution (LTE) which uses 258 combinations of frequency bandwidths. Rohde&Schwarz now presents a new test concept that significantly reduces costs and effort.

Strict requirements: high sensitivity …

Regulatory authorities do not make any compromises when it comes to specifications for RSE measurement. And for good reason: If wireless devices radiate outside the specified frequency ranges, they will interfere with other instruments, radio systems or services. Manufacturers, test houses and regulatory authorities use standard-specific RSE tests to check whether wireless devices fulfill these conditions.

For the LTE wireless standard, these measurements are not easy to implement. Test systems must have a high dynamic range. The relevant RSE tests have a defined measurement range from 30 MHz to 12.75 GHz, with an equivalent transmit power of –30 dBm. The inherent noise of test systems must be as low as possible to have a sufficient measurement safety margin at the stipulated limit of –30 dBm. This can only be realized with a built-in low noise amplifier (LNA), especially because of the relatively high and frequency-dependent free-space path loss at a measurement distance of three meters. Cable attenuation has an impact, too, even if it is partially compensated by the antenna gain.

… combined with high signal levels

High signal levels represent a further difficulty for RSE measurements. A transmitting wireless device radiates the LTE carrier signal. In the worst case it has a low frequency of 800 MHz in power class 3, i.e. at the maximum output power of 23 dBm plus/minus tolerances. These strong signals must not interfere with the measurement.

For conventional wireless standards such as GSM and WCDMA, wireless devices are tested using notch filters in front of the LNA to suppress these signals. The passband of these filters features very steep slopes to permit accurate measurements at carrier offsets of ±2 channels. However, this conventional measurement approach has several disadvantages:

- Each frequency band and bandwidth requires a separate filter
- Only one carrier frequency measurement per filter can be performed without time-consuming retuning
- Steep-sloped filters are bulky and need a lot of space
- The many signal paths and RF relays reduce the mean time between failures (MTBF)
- Calibration is time-consuming and costly

For GSM, this measurement approach typically requires four notch filters. The WCDMA standard with its overlapping frequency bands requires nine filters – and a corresponding amount of space.

This measurement method is impractical for LTE which has 43 defined frequency bands, each with six bandwidths. 258 notch filters would be needed to cover all frequency bandwidth combinations, a space-consuming and costly solution.

Fig. 1 Extremely compact: Equipped with the new R&S®OSP-B155 plug-in filter module, the 2 HU R&S®OSP130 open switch and control platform covers all LTE bands.

The compact solution from Rohde&Schwarz

That is why Rohde&Schwarz has developed a new test concept for radiated spurious emission measurements on LTE devices. First, it takes advantage of the fact that LTE operates at a lower output power than GSM and WCDMA. Second, Rohde&Schwarz has the right receiver for this application: the R&S®ESU EMI test receiver which offers an exceptionally high sensitivity of typically –155 dBm/Hz and a high dynamic range of 80 dB in the relevant frequency range.

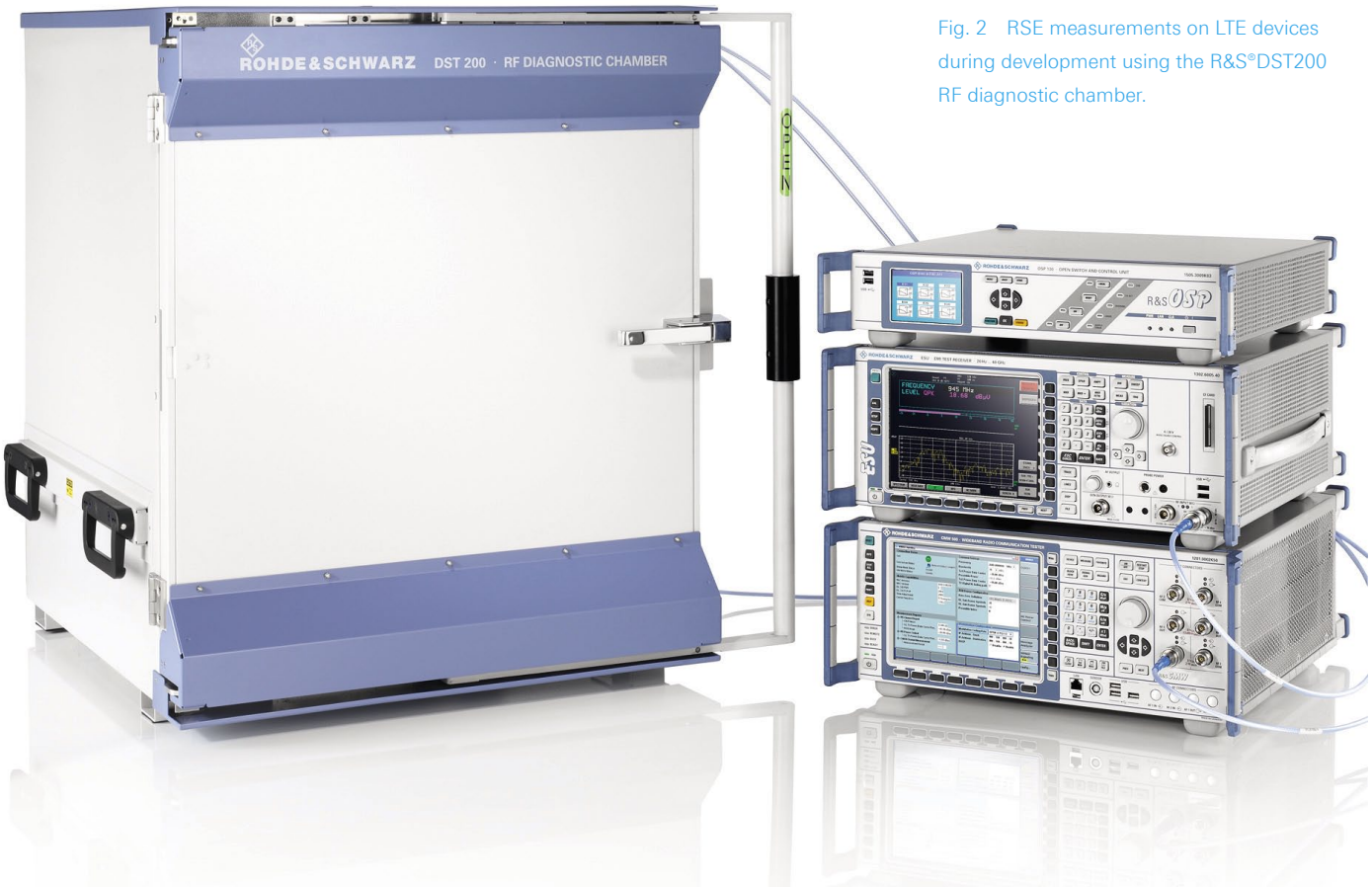

Fig. 2 RSE measurements on LTE devices during development using the R&S®DST200 RF diagnostic chamber.

Another component is the new filter module for the R&S®OSP130 open switch and control platform (Fig. 1). The R&S®OSP-B155 filter module shifts the received signal spectrum into the optimum power range to allow full use of the dynamic range of the connected R&S®ESU EMI test receiver. RSE measurements can be performed with sufficient sensitivity without any notch filters.

The R&S®OSP-B155 has a built-in LNA to amplify small signals and can simultaneously receive high-level signals. The result is higher sensitivity and lower noise floor. A highpass filter prevents the harmonics of the built-in LNA from distorting measurement results. The module takes up two of the three slots on the R&S®OSP130. To expand an existing filter matrix to cover LTE signaling, the module can simply be connected to a free filter path. The rest of the matrix is set to through. The R&S®OSP-B155 option features an additional signal path which can be used to expand the filter matrix. The R&S®OSP130 open switch and control platform processes the signals.

The R&S®EMC32 EMC measurement software adjusts the level during measurement to prevent overloading. In combination with the R&S®CMW500 wideband radio communication tester, it also controls LTE signaling.

The R&S®OSP-B155 filter module is also included in the R&S®TS8996 RSE test system. This system uses the filter module in conjunction with its GSM and WCDMA filter modules to test wireless devices for compliance with the GSM, WCDMA and LTE standards. Plus, the R&S®OSP-B155 can be used for measuring RSE on LTE devices during development, using a test setup with the R&S®DST200 compact RF diagnostic chamber (Fig. 2).

Summary

The R&S®OSP-B155 filter module option for the R&S®OSP130 open switch and control platform is designed to be used in combination with the R&S®EMC32 EMC measurement software and the R&S®ESU EMI test receiver from Rohde&Schwarz. All RSE measurements specified for LTE devices can be performed using this compact and cost-efficient test setup which seamlessly integrates into existing RSE filter matrices. In combination with the R&S®CMW500 wideband radio communication tester, which provides LTE signaling, the setup can be integrated into an LTE test system as an independent RSE measurement system.

Per Isacsson

The article starting on page 16 shows OTA and RSE measurements using the R&S®DST200 RF diagnostic chamber. The article starting on page 21 presents other new modules for the R&S®OSP120 open switch and control platform.