Spectrum in a new light – wideband options for the R&S®ESMD

The R&S®ESMD wideband monitoring receiver is attracting significant attention with its wide range of new features: 80 MHz realtime bandwidth, very high scan speed, digital handoff receivers, innovative spectrum display and 10 Gbit Ethernet interface for signal output. Even the most challenging monitoring tasks can be handled faster and at less expense with this wideband monitoring receiver.

Always open for progress

The modular architecture of the R&S®ESMD wideband monitoring receiver was conceived from the very start with expandability in mind, allowing existing instruments to be retrofitted with the latest technology. Simply install the new multifunction board to increase the efficiency of the R&S®ESMD including its new wideband options:

- 80 MHz realtime bandwidth
- Reliable detection of extremely brief signals based on gapless monitoring and calculation of the spectrum
- 75 GHz/s scan speed with small resolution bandwidth
- Polychrome IF panorama for displaying the timing characteristics of signals starting in the spectrum
- Four digital downconverters (DDCs) within the realtime bandwidth
- 10 Gbit Ethernet interface for outputting wideband data

80 MHz realtime bandwidth

Short interfering signals that occur at irregular intervals are difficult to detect, since their exact frequency and the exact time of their occurrence are generally unknown. This is why scanning for pulsed signals of this kind is one of the most time-consuming radiomonitoring tasks, using typically scarce resources for above-average amounts of time.

The new wideband options for the R&S®ESMD can help, since they drastically increase the probability of intercepting pulsed signals of this kind. An A/D converter on the new multifunction board samples the IF signal at 400 MHz and increases the realtime bandwidth of the R&S®ESMD to 80 MHz. Large frequency ranges and even entire radio bands can be monitored all at once (FIG 1). A powerful FPGA calculates the spectrum (FFT), which ensures that there are no gaps or blind times and even the briefest of emissions can be reliably detected.

The 80 MHz realtime bandwidth also enables faster scanning of large frequency ranges in the panorama scan mode (PSCAN)*. The scan speed in any frequency range is boosted from the previous value of 20 GHz/s to 75 GHz/s. Careful attention was paid to the details especially for demanding applications. Using elaborate resampling, the channel spacings for the most common radio services can be directly selected as resolution bandwidths in the spectrum both for the IF panorama and for the panorama scan. As a result, cumbersome post-processing of measurement results due to an improper frequency resolution is avoided.

"Fast detection of signals, highly accurate measurements and demodulation, and versatility": The R&S®ESMD wideband monitoring receiver was presented with these outstanding features*.

Now the instrument is back in the limelight. The new wideband options make it one of the most powerful radiomonitoring receivers that is currently available on the market.

* News from Rohde&Schwarz (2009) No. 195, pp. 62–67.

Polychrome IF panorama (PIFPAN)

Depending on the selected resolution bandwidth, the new multifunction board computes up to two million spectra per second. To make them visible to the human eye, the spectra are summarized in realtime using the customary MaxHold, MinHold, Average and ClearWrite weighting filters. MaxHold is ideal for detecting pulse-type emissions, while the Average filter is beneficial for investigating continuous signals.

However, what should be done when short-duration signals are superimposed on the continuous signals so that none of the methods listed above are optimal? Even in this situation, the R&S®ESMD has a suitable method. An innovative type of spectrum display for radiomonitoring combines the benefits of the familiar weighting filters. The polychrome IF panorama (PIFPAN) can distinguish short-duration signals from continuous signals and shows the timing characteristic of the signals

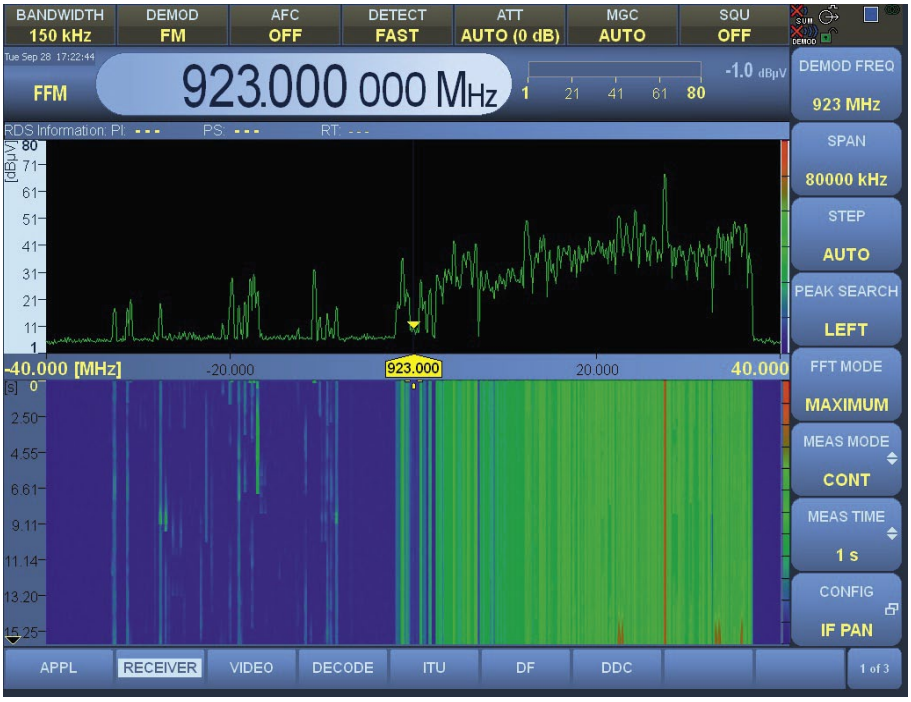

FIG 1 The GSM900 band in the IF panorama provided by the R&S®ESMD with an 80 MHz bandwidth. The left half of the spectrum shows the uplink (mobile phones) while the right half shows the downlink (base stations) with significantly higher signal strength.

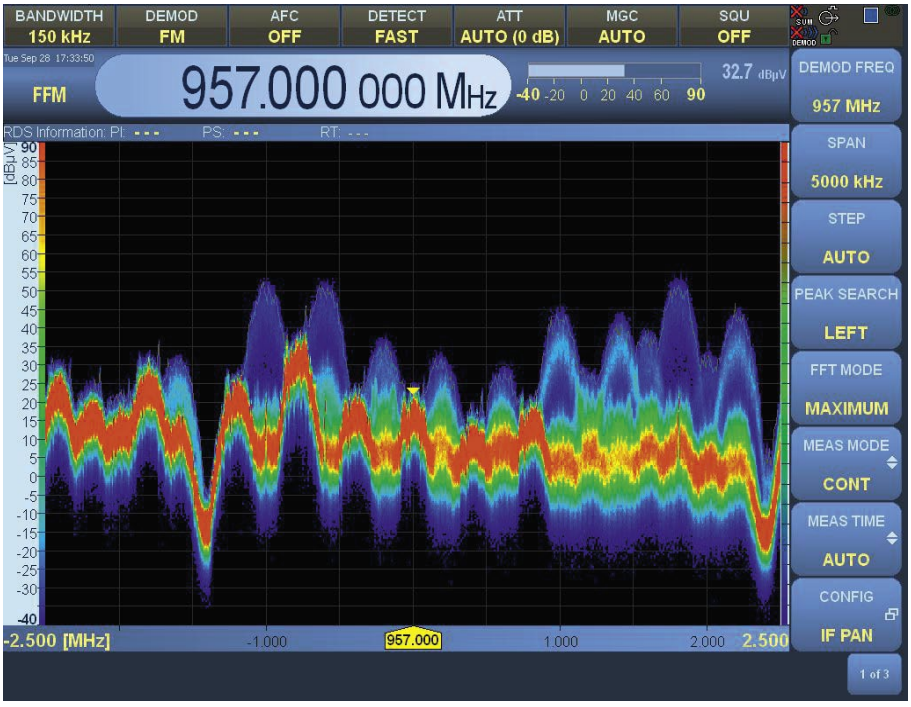

FIG 2 A section of the GSM900 downlink shown using the polychrome IF panorama display. Signal components shown in blue exhibit pulse-like behavior while red indicates signals that are permanently present. The color coding indicates how the timeslots in the individual GSM channels are occupied.

FIG 3 The four digital downconverters provided by the R&S®ESMD in use. Each of the orange-colored bars in the IF panorama indicates the current position and bandwidth of a DDC. Their configuration can be read off from the four status fields above.

already in the spectrum (FIG 2). The spectrum is divided into a grid of frequencies and level values. The individual spectra that occur within an adjustable time interval are depicted on this grid. The display uses colors to indicate the frequency whith which each point in the grid has been captured: This ranges from blue for seldom through green and yellow to red for permanent. In this manner, the polychrome IF panorama helps to highlight signal scenarios at a glance which before would not have been detected at all.

Digital downconverters (DDCs)

If multiple signals need to be simultaneously detected and demodulated, many systems use a wideband search receiver along with multiple dedicated handoff receivers. The new wideband options of the R&S®ESMD will greatly simplify such systems in the future, since the receiver offers four DDCs in addition to the wideband demodulation path. These DDCs function entirely in parallel within the realtime bandwidth up to 80 MHz and can be parameterized independently of one another. Each of the individual DDCs supports AM, FM, PULSE, I/Q, LSB, USB and CW demodulation modes as well as a comprehensive set of 25 IF bandwidths from 100 Hz to 1 MHz, automatic gain control (AGC) and a squelch function. Moreover, each DDC provides the complex baseband (I/Q), the associated signal level and an audio signal (FIG 3).

10 Gbit Ethernet interface

Detailed analysis of unknown or complex signal scenarios is costly and very difficult to manage in realtime. This is why the R&S®ESMD outputs the IF signal up to the full realtime bandwidth of 80 MHz as a complex baseband signal on a standardized 10 Gbit Ethernet interface. This signal can be recorded on hard disks and evaluated at a later point in time, for example. Copper or fiber-optic cables can be used as the transmission medium.

Summary

The new wideband options have turned the R&S®ESMD into one of the most powerful radiomonitoring receivers currently available on the market. Owing to its modular instrument architecture, future advances in the field of radiomonitoring can also be incorporated and retrofitted accordingly. Additional options are currently being developed.

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