Baseband tests reduce time to market

Tests at module level boost efficiency

Developers of mobile radiocommunications products are facing the challenge of having to launch their products in ever shorter times. Plus, solutions have to be found to cope with the growing cost pressure. A suitable way to solve these problems is to modularize device architectures. Dividing a communications device into independent, standardized functional units allows each unit to be developed — and also produced — separately, maximizing efficiency with respect to both cost and time. When taking this approach, it is vital to bear two factors in mind: First, each module must perform in a defined manner at the interfaces. This is particularly important where interoperability between products from different manufacturers is required. Second, to save cost and time in the overall design process, it is necessary to test the individual functional units of a system completely and under real conditions prior to integrating them into the system.

In mobile radiocommunications, the trend toward modularization is primarily indicated by the separate development of baseband and RF modules. With base stations as well as with mobile terminals, there is a growing need to develop — and also to test — these two types of modules separately. The new R&S®AMU 200 A baseband signal generator and fading simulator has been designed for precisely this application.

Scalable for any requirement

The R&S®AMU 200 A includes two baseband generators and a dual-channel fading simulator in a 19" box occupying four height units. In addition, it features with its analog and digital inputs and outputs, which makes the R&S®AMU 200 A a highly versatile generator that performs all types of baseband tests. Whether you need a single-channel baseband generator, a pure baseband fader, or a dual-channel generator that offers fading capabilities and internal signal generation: The modular concept of the R&S®AMU 200 A allows the instrument to be tailored to your specific requirements. This scalability also means that you can easily upgrade the instrument to handle future measurement tasks.

Integrated dual-channel baseband signal generator

The R&S®AMU 200 A can be equipped with two internal baseband generators. The generators independently deliver signals in line with the following digital standards: GSM/EDGE, 3GPP FDD (including HSPA), CDMA2000®, TD-SCDMA, WLAN (IEEE 802.11a/b/g/n), WiMAX (IEEE 802.16-2005), DVB-H, GPS, and 3GPP Long Term Evolution (LTE), which is the next generation of the UMTS standard. The signals are in part even generated with channel coding and in realtime. Moreover, you can easily generate multicarrier signals, which may be made up of individual CW carriers or of signals modulated in line with various standards. Moreover, each generator has an arbitrary waveform memory of 16, 64, or 128 Msamples via which waveforms can be output that...

For a description of MIMO receiver tests with the R&S®AMU 200 A or the R&S®SMU 200 A, refer to the article on page 9.
are calculated by means of simulation programs such as R&S®WinIQSIM2™ or MATLAB®. Using the optional R&S®AMU-K6 pulse sequencer, you can generate pulse trains (e.g. for radar, DFS, or RFID), thus opening up further applications. The above functionalities combine to make the R&S®AMU200A a platform suitable for generating proprietary signals and also for simulating signals in accordance with new digital standards that are still at an early stage of development.

Dual-channel fading and AWGN simulation

The trend toward ever higher data rates is leading to increasingly complex digital mobile radio standards. Analyzing the performance of products under realistic transmission conditions is therefore becoming more and more important. The R&S®AMU200A is a cost-effective solution, as it can be equipped with up to two baseband fading simulators. In the single-channel mode, up to 40 fading paths are available at a bandwidth of 80 MHz and a path delay resolution of 10 ns. Current — and future — mobile radio standards normally use bandwidths narrower than 40 MHz. For bandwidths of maximally 50 MHz (30 MHz) and a maximum of 16 (24) paths, resolution as high as 0.01 ns is achieved. With dual-channel fading, the R&S®AMU200A can simulate up to 20 different propagation paths of a signal for each channel. The R&S®AMU200A offers predefined static and dynamic fading scenarios (e.g. for 3GPP FDD, WiMAX, GSM/EDGE, and CDMA2000®) for standard-conforming channel simulations. All fading parameters can also be configured manually (including fading statistics, delay, and correlations). The current configuration can be seen at a glance on the straightforward graphical user interface (FIG 2).

Versatile test capabilities

The R&S®AMU200A is a powerful signal source for performing tests at the baseband level including channel simulation. This allows baseband and RF modules commonly used in transmission to be developed separately from each other (FIG 5a).

Featuring excellent signal quality, the R&S®AMU200A is an ideal baseband signal source, e.g. for designing I/Q modulators or complete RF frontends.
Typical frequency response of the analog I/Q outputs of the R&S®AMU 200 A. (FIG 4).

FIG 5. The R&S®AMU 200 A allows complex systems to be tested at module level. The integrated fading simulator provides realistic transmission conditions. Due to the instrument’s dual-channel concept, TX and RX diversity as well as 2 × 2 MIMO scenarios can be simulated.

Channel simulation at the baseband makes it possible to perform tests under realistic transmission conditions even at an early stage of development, often before the RF design is completed. It is thus easy to verify the performance of hardware prototypes, and to optimize baseband algorithms from the outset. All this helps to reduce time to market for new technologies.

The R&S®AMU 200 A can also be used as a pure baseband fader. For instance, signals from a radiocommunications tester can be fed to the R&S®AMU 200 A via its baseband inputs. The R&S®AMU 200 A fades the signals, superimposes AWGN, and outputs them again as baseband signals. The signals are either directly applied to the DUT, or upconverted to the RF by the radiocommunications tester.
RX/TX diversity and MIMO

In addition to general tests on RF and baseband modules, the R&S®AMU200A is also ideal for diversity tests due to its dual-channel concept. Diversity tests usually require two antenna signals, which are both provided by the R&S®AMU200A. The instrument’s baseband architecture allows the versatile generation of signal scenarios by the internal addition of signals including frequency and level offsets. Signals for TX and RX diversity tests can thus be generated solely by means of the R&S®AMU200A’s internal signal generators (FIGs 6 and 7).

Using the R&S®AMU-K74 option, the R&S®AMU200A also simulates $2 \times 2$ MIMO scenarios. The option adds two more fading channels to the R&S®AMU200A to give a total of four, which allows the simulation of the four transmission paths between the two transmit and the two receive antennas of a $2 \times 2$ MIMO configuration. For more information, refer to page 9. By using the R&S®AMU200A in conjunction with the R&S®SMATE 200A dual-channel vector signal generator, you can perform receiver tests covering two receive antennas (up to $2 \times 6$ GHz) even at the RF level.

**Summary**

The R&S®AMU200A is a universal baseband source that combines the functionalities of a realtime I/Q source, an arbitrary waveform generator, and a channel simulator in a single box. The optional two-path functionality makes it easy to generate even complex signal scenarios. You can simulate interference, noise, multipath propagation, antenna diversity, as well as $2 \times 2$ MIMO scenarios, and determine their effect on a DUT reproducibly, with minimum effort, and with only one instrument.

These capabilities make the R&S®AMU200A an ideal tool for performing complex tests already at the baseband. The R&S®AMU200A makes it possible to detect and eliminate design errors at module level even at an early stage of development. This does away with costly and time-consuming redesign work at later stages in product development. The R&S®AMU200A can thus play a major role in getting your products to the market faster and at lower cost.

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More information and data sheet at www.rohde-schwarz.com (search term: AMU200A)