

# Comprehensive measurements on base station modules via the CPRI™ interface

New options for the R&S®EX-IQ-Box digital interface module make it possible to perform comprehensive measurements on base station RF and baseband modules via the CPRI™ interface.

## Digital interfaces becoming increasingly popular

As in many other areas, digital interfaces are also being used increasingly in wireless communications. Instead of using analog I/Q signals, the baseband and RF modules of base stations communicate by means of digital baseband signals. Wireless communications network operators, in particular, are demanding the possibility of combining base station modules from different manufacturers to avoid being completely dependent on one supplier. The interfaces must therefore be standardized.

The common public radio interface (CPRI) standard is an attempt at creating a standardized platform for digital communications between baseband and RF. It defines the interface between the baseband unit of a base station (the REC, radio equipment control) and the RF unit (the RE, radio equipment). The trend toward digital interfaces also creates new requirements regarding measurement methods and measuring equipment for base stations. The RE and REC are now to be tested independently of one another, since an RE must function with every REC, and vice versa. The measuring equipment that is used must therefore be capable of sending or receiving suitable test signals to and from the device under test via the CPRI™ interface.

## R&S®EX-IQ-Box – the universal I/Q interface

The R&S®EX-IQ-Box\* provides versatile digital baseband inputs and outputs for Rohde&Schwarz measuring instruments, e.g. for the R&S®SMU200A and R&S®SMBV100A vector signal generators as well as for the R&S®FSQ and R&S®FSV signal and spectrum analyzers. New options allow the box – together with these measuring instruments or even independently – to perform tests on the base station modules via the CPRI™ interface. The R&S®EXBOX-B85 option provides the necessary hardware as a CPRI™-compliant breakout board. The R&S®EXBOX-K10 and -K11 options include the functionality needed for testing REs and RECs. The R&S®EX-IQ-Box currently supports version 4.0 of the CPRI™ standard with line bit rates of up to 3072 Mbit/s. Ready-to-use interface settings are available for the 3GPP FDD / HSPA / HSPA+, 3GPP LTE and WiMAX™ standards primarily supported by CPRI™. However, the box also enables user-defined configurations, providing users with maximum flexibility.

\* Bidirectional digital I/Q interface with flexible user configuration. NEWS (2008), No. 196, pp. 28–30.

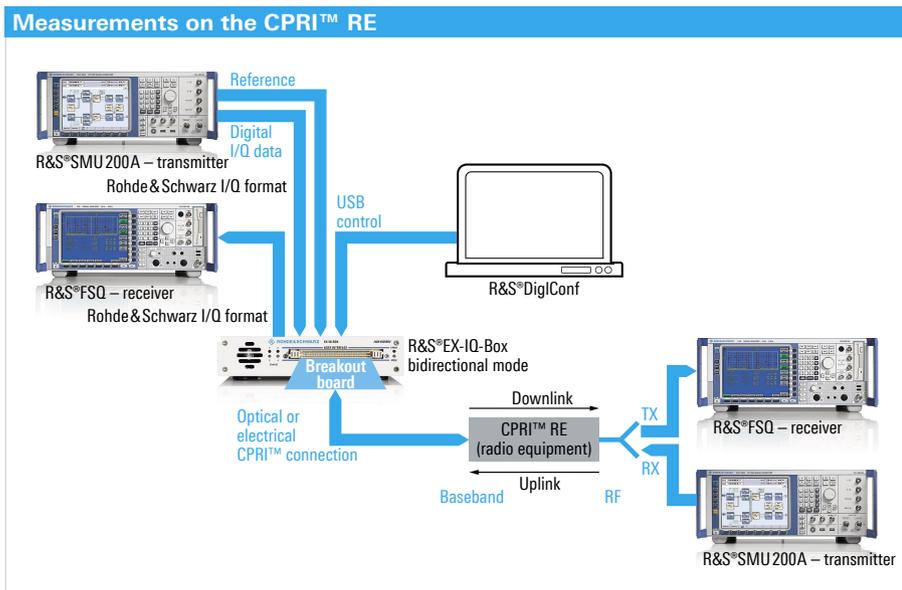


FIG 1 Test setup for tests on CPRI™ radio equipment: Fully duplex-capable, the uplink and downlink can be tested simultaneously or consecutively.

### Tests on the RE

FIG 1 shows the test setup for comprehensive tests on the RE, comprising an R&S®EX-IQ-Box with corresponding options for CPRI™ as well as vector signal generators (R&S®SMU200A) and signal analyzers (R&S®FSQ) with options for generating and analyzing baseband or RF signals. Transmitter tests on the RE (downlink direction), for example, can be carried out in the same way as on a complete base station. The baseband section of the generator generates the required digital I/Q signals, and therefore plays the role of an “ideal” REC. The R&S®EX-IQ-Box acts as the CPRI™ interface of the REC and sends the I/Q data, embedded in the CPRI™ protocol and together with the necessary CPRI™ control data, from the generator to the RE.

All of the box parameters are conveniently configured using the R&S®DigiConf PC software (FIG 2). The software can be remote-controlled via LAN in the same way as the measuring instruments so that the complete system can be embedded in existing test environments. The quality of the RF signals output by the RE can then be measured in the same way as with a complete base station using a suitable signal and spectrum analyzer such as the R&S®FSQ.

For tests in the uplink, the R&S®SMU200A generator sends RF test signals to the RX port of the RE. The resulting digital I/Q signals are sent from the RE to the R&S®EX-IQ-Box via the CPRI™ interface. The signal and spectrum analyzer is connected to the box via its optional digital baseband interface and analyzes the I/Q signals. The performance of the RE can be determined via measurands such as noise figure or EVM.

The major advantage of this concept is that the same measuring instruments – and for the most part, the same measurement methods – can be used as are also employed for testing the complete base station. This makes expensive new

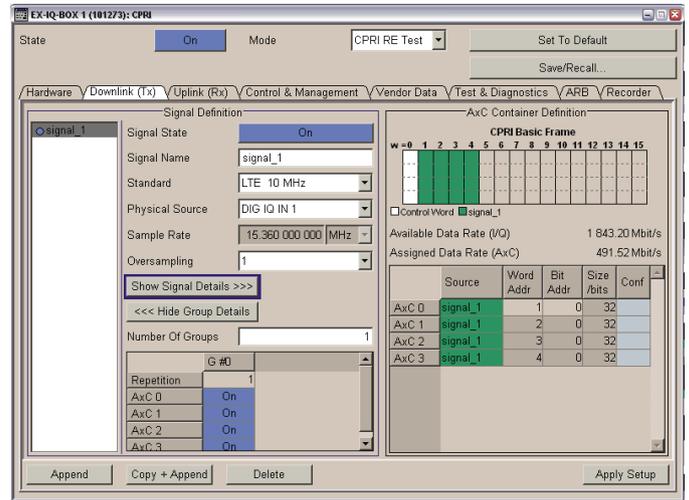


FIG 2 CPRI™ menu of the R&S®DigiConf software allows easy configuration of all R&S®EX-IQ-Box parameters.

investments superfluous in many cases. Plus, measurements on the modules and on the complete base station are easier to compare – which can significantly speed up DUT optimization and troubleshooting.

In addition, users are able to tailor the test setup precisely to their requirements by simply selecting the suitable instruments from Rohde&Schwarz. The test setup shown is fully duplex-capable, i.e. uplink and downlink can be tested simultaneously. If only one direction is required or the uplink and downlink are tested consecutively, one generator/analyzer pair is sufficient. If the performance of the R&S®FSQ and R&S®SMU200A high-end instruments is not actually required, they can be replaced by the less expensive R&S®FSV, R&S®SMJ100A or R&S®SMBV100A.

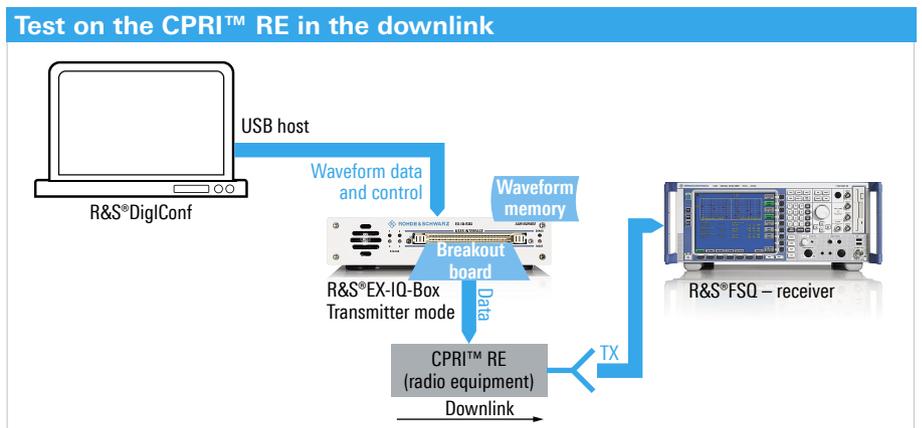


FIG 3 Reduced test setup for tests on CPRI™ radio equipment in the downlink. The R&S®EX-IQ-Box provides the necessary I/Q signals with the aid of its integrated ARB generator.

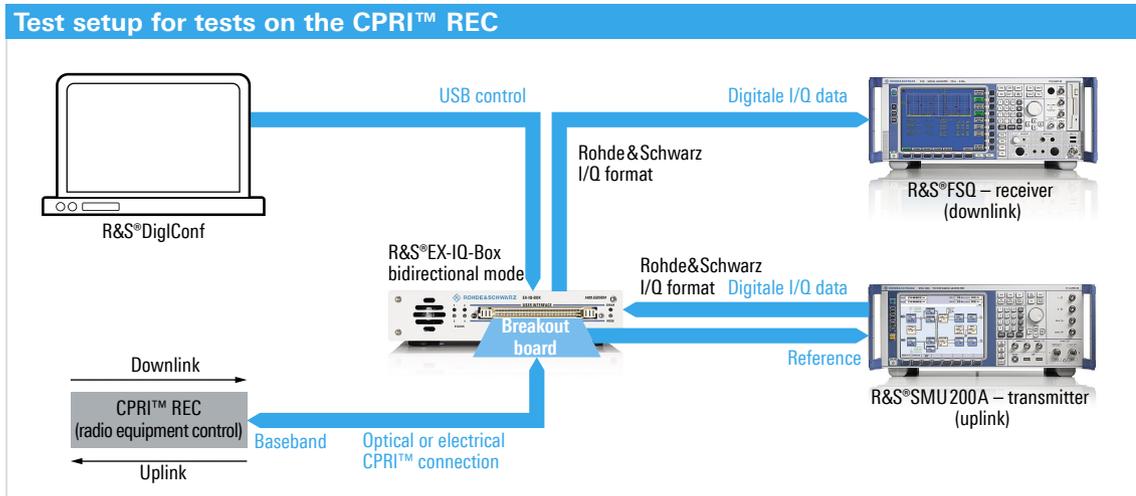


FIG 4 Test setup for tests on the CPRI™ radio equipment control.

### Optional ARB generator

If testing is only required in the downlink, it is even possible to dispense with a signal generator completely, since the R&S®EXBOX-K90 arbitrary (ARB) waveform generator option for the R&S®EX-IQ-Box generates digital I/Q signals itself. It is also supported by the R&S®WinIQSIM2™ simulation software. Combined with the R&S®EXBOX-K240 to -K259 options, digital I/Q signals can be quickly and conveniently generated for all important wireless communications standards (FIG 3).

The ARB waveform generator of the R&S®EX-IQ-Box can also be used for complex signal scenarios. The multiwaveform playback option (R&S®EXBOX-K91) outputs up to four waveforms at the same time. This means, for example, that up to four TX signals for testing REs with transmit diversity, i.e. multiple transmit antennas, can be generated and transferred to the RE via the CPRI™ interface. Another application is the testing of state-of-the-art multistandard base stations where signals of different standards are transferred simultaneously via one CPRI™ interface. The R&S®EXBOX-K94 recorder option enables users to also record I/Q signals coming in from the DUT and transfer them to the control PC so that the signals are available for their own analyses.

### Tests on the REC

The Rohde&Schwarz concept also clearly demonstrates its advantages in tests on the REC. FIG 4 shows a corresponding test setup. The R&S®SMU200A signal generator, which has proven its effectiveness in many base station tests, provides the signals for testing the REC receiver, in this case not as RF signals but as digital I/Q signals. The R&S®EX-IQ-Box acts as the CPRI™ interface of an RE and sends the signals from the generator to the REC receiver. The R&S®SMU200A not only provides options for all important digital communications

standards such as 3GPP FDD / HSPA / HSPA+, 3GPP LTE FDD and TDD, WiMAX™, TD-SCDMA and CDMA2000®, but also exceptional signal processing and realtime capabilities such as fading, MIMO or HARQ feedback. All of these functions are also beneficial when used for REC tests. For tests in the downlink, the R&S®EX-IQ-Box can record the REC transmission signals with the recorder option, or send them to the baseband input of an R&S®FSQ or R&S®FSV and use their extensive capabilities for signal analysis.

### Conclusion

The new options for the R&S®EX-IQ-Box digital interface module make it possible to perform versatile tests on baseband and RF modules via the CPRI™ interface. The box can be used both independently as well as in combination with Rohde&Schwarz vector signal generators and signal and spectrum analyzers, and allows comprehensive characterization of REs and RECs.

Dr. René Desquiotz

#### R&S®EX-IQ-Box options for CPRI™

R&S®EXBOX-B85	CPRI breakout board
R&S®EXBOX-K10	CPRI RE test
R&S®EXBOX-K11	CPRI REC test
R&S®EXBOX-K90	Waveform memory
R&S®EXBOX-K91	Multiwaveform playback
R&S®EXBOX-K94	Recording memory
R&S®EXBOX-K240 to -K259	Digital standards such as 3GPP FDD / HSPA / HSPA+, 3GPP LTE, CDMA2000® etc.