Recording and playing digital I/Q data in realtime

The R&S®IQR I/Q data recorder can record and play I/Q data in realtime in combination with numerous Rohde&Schwarz instruments that have the company's proprietary digital I/Q interface. This opens up new applications for users of these instruments, e.g. for drive tests (i.e. mobile data acquisition) as well as in research and development.

The I/Q data recorder is versatile

The real and imaginary parts of digital I/Q data make it possible to completely describe RF signals. Many Rohde&Schwarz T&M instruments have an interface for these I/Q signals for analyzing and generating RF signals or for outputting measurement and analysis results. The R&S®IQR I/Q data recorder (FIG 1) is designed for rapid recording and playing of digitized RF data via this Rohde&Schwarz specific I/Q interface. It can provide interference or test signals, store data during drive tests, archive data from RF signals in realtime and play recorded I/Q signals. The instrument can be used for research and development applications, for drive tests when measuring wireless communications and broadcast signals, and for military applications, for example.

Compact and rugged

The compact recorder is extremely rugged; its system disk and RAM featuring solid-state technology make it ideal for mobile deployment. It is easy to operate via the color touchscreen and the flat menu structure. The normal mode or expert mode is selected, depending on the application. Softkeys simulate the buttons of a recorder for manual control of recording and playing. Of course, the I/Q recorder can also be remote-controlled via LAN or external trigger events.

The I/Q input/output module in the R&S®IQR converts the I/Q data streams, synchronizes the data and controls recording and playing in accordance with the trigger conditions. The FPGA-based design of the digital I/Q interface and the internal data processing is open for enhancements with regard to data rate and data width.

FIG 1 In combination with Rohde&Schwarz instruments that have the company's proprietary digital I/Q interface, the R&S®IQR digital I/Q data recorder opens up new applications in the area of RF data storage, evaluation and provision.

The removable I/Q data memory pack on the front panel, which is equipped with hard disk or solid-state disks depending on the model, makes it easy to handle large quantities of data – no time-consuming copying is required. This is particularly beneficial for drive tests and subsequent evaluation at a central location.

Touchscreen operation and sophisticated triggering possibilities

The operating concept distinguishes between the main menu for configuration and self-testing, and the recording and playing menu. The different color schemes of the menus

The R&S®IQR in combination with other Rohde&Schwarz instruments

Stimulation of DUTs and error analysis using digital I/Q data

Via the R&S®EX-IQ-Box interface module – which converts the digital I/Q data into the Rohde&Schwarz specific I/Q data format and vice versa – the R&S®IQR can record and play parallel or serial digital I/Q data in realtime (FIG 2). This also makes it possible to exchange customer-specific I/Q data. A DUT's I/Q data stored in the recorder can be used for subsequent error analysis. Conversely, data streams played by the recorder can be used to stimulate a DUT via the R&S®EX-IQ-Box.

Recording and playing of RF broadband spectra for tests on broadcast receiver modules

Tests under realistic conditions are essential for developing broadcast receivers. For example, such tests allow Asian manufacturers to test their devices under "European locational conditions" using broadband spectra that have been recorded in Europe. For this purpose, the relevant broadcast signals must be recorded on-site. FIG 3 shows, as an example, an FM spectrum recorded in Munich. These recordings can be made from a stationary position over an extended period of time, or during a drive test.

The R&S®TSMW universal radio network analyzer is the ideal RF frontend for mobile applications up to a bandwidth of 2 × 20 MHz, also because of its compact dimensions and the 12 V power supply. The R&S®IQR, connected via the digital I/Q interface, stores the data received from the R&S®TSMW in realtime (FIG 4). The recorder can subsequently play the recorded data, which can then be used to parameterize or test broadcast modules – modulated by the R&S®SFE broadcast tester, for example.

Recording/playing of digital I/Q data

FIG 2 Recording (red) and playing (green) of digital I/Q data. The R&S®EX-IQ-Box converts the I/Q data into the Rohde&Schwarz specific format.

FM frequency spectrum

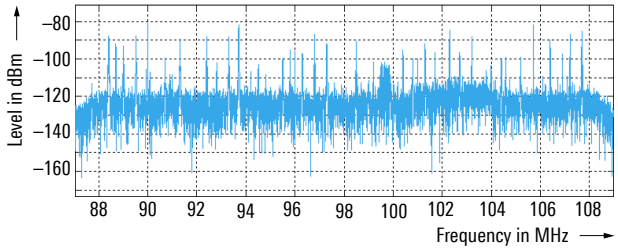

FIG 3 Recorded FM broadband frequency spectrum for testing broadcast receiver modules.

Recording/playing of RF spectra

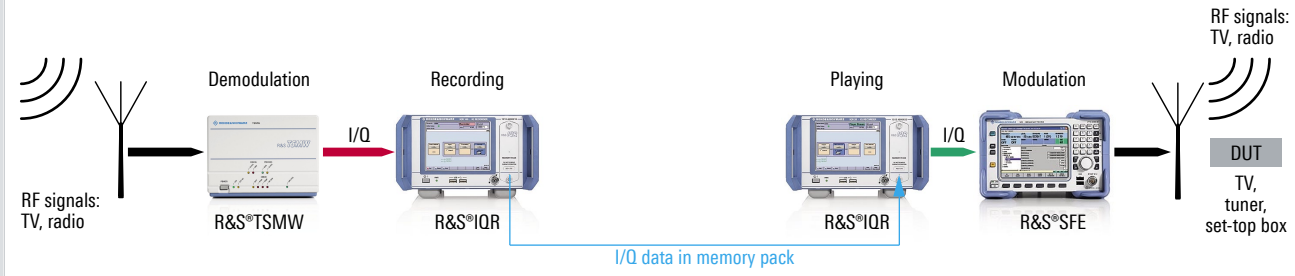

FIG 4 Separate recording and playing of broadcast signals.

for controlling recording and playing, which have an otherwise similar structure, make orientation easier. The information field displays parameters such as file name, sample counter and I/Q level. The trigger conditions and the file names, for example, are defined using the function blocks in the middle section of the touchscreen.

The extensive trigger menu provides numerous control options to start and stop recording and playing. Continuous, one-shot (single) and repeating (retrigger) modes are available, depending on the trigger source. The following trigger variants are available:

- Triggering on I/Q level, which prevents the recording of non-relevant data
- Triggering on external signals at the BNC sockets, e.g. in a test setup
- Temporal control for recording and playing without operating personnel
- Remote control via Ethernet for integration in systems
- Manual control for easy direct access via virtual control keys

Instrument models and memory packs

Appropriate instrument models and memory packs are available for the different requirements with regard to data rate and area of application (FIG 5):

- The R&S®IQR20 base unit provides sampling rates of up to 20 Msample/s and a maximum data rate of 80 Mbyte/s, and is suitable for stationary operation
- The R&S®IQR100 is prepared for sampling rates of up to 100 Msample/s. A rate of 66.6 Msample/s and data rates of 270 Mbyte/s can be achieved with the currently available R&S®IQR-B110 solid-state memory packs

The recorders can be cost-effectively configured with two alternative memory packs for the respective application:

- The lower-priced R&S®IQR-B010 hard disk memory packs are suitable for stationary use with slower data rates of up to 80 Mbyte/s, and are therefore ideal for use with the R&S®IQR20.
- The rugged R&S®IQR-B110 solid-state memory packs provide much faster data rates and are recommended for applications that require greater mechanical stability, as is the case with drive tests, for example.

Recording and playing times

Crucial factors for the practicality of a recording and playing system are the frontend bandwidth as well as the data rate and the usable recording time. The recording time is directly dependent on the sampling rate that is used. For example, with a 1 Tbyte memory pack, the entire FM frequency spectrum can be recorded at a bandwidth of 20 MHz for a period of up to three hours (FIG 6).

Rohde&Schwarz specific digital I/Q interface

Since there is no standardized I/Q interface, Rohde&Schwarz has defined a proprietary I/Q and information interface for rapid data exchange of RF signals between Rohde&Schwarz instruments. Enables, samples, triggers and markers are transmitted via this I/Q interface. The instruments communicate with each other via the information interface, which facilitates setting up the connected instruments. Parallel or serial I/Q signals can be converted into Rohde&Schwarz format by the R&S®EX-IQ-Box.

Model	Data memory	Achievable data rate
R&S®IQR20	R&S®IQR-B010, 1 Tbyte hard disk	max. 20 Msample/s, max. 80 Mbyte/s
R&S®IQR100	R&S®IQR-B110, 1 Tbyte solid-state disks	max. 66 Msample/s, max. 270 Mbyte/s

FIG 5 Models of the R&S®IQR and memory packs.

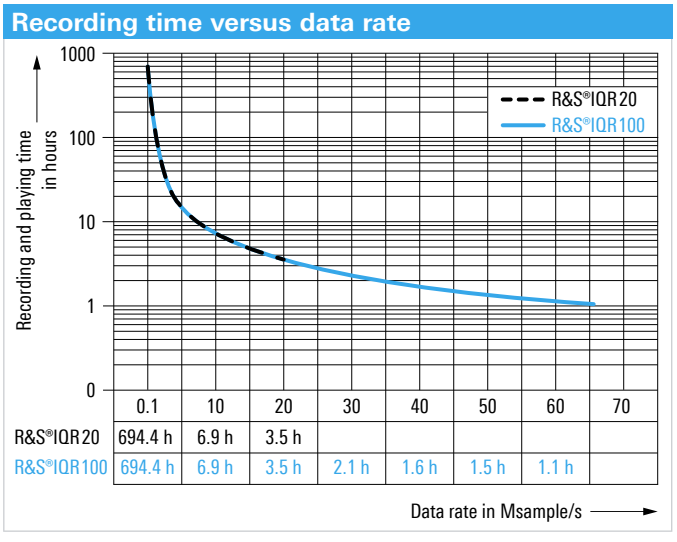

FIG 6 Recording time as a function of data rate (1 Tbyte memory pack, 32 bit I/Q data).

Summary

In combination with instruments that have the proprietary digital I/Q interface from Rohde&Schwarz, the R&S®IQR digital I/Q data recorder opens up new applications in the field of RF data storage, evaluation and provision.

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