R&S®IQR
I/Q Data Recorder
User Manual

1175.6326.02 — 12

ROHDE & SCHWARZ

This manual describes the I/Q Data Recorder models R&S®IQR20, order no. 1513.4600K02 and R&S®IQR100, order no. 1513.4600K10, including the following options:

- R&S®IQR-B010, "HDD Module 1 TB, 80 MByte/s", order number 1513.4700.10
- R&S®IQR-B020, "HDD Module 2 TB, 80 MByte/s", order number 1513.4700.20
- R&S®IQR-B110, "SSD Module 1 TB, 300 MByte/s", order number 1513.4717.10
- R&S®IQR-B109F, "SSD Module 0.9 TB, 400 MByte/s", order number 1513.4723.09
- R&S®IQR-B119F, "SSD Module 1.9 TB, 400 MByte/s", order number 1513.4723.19
- R&S®IQR-B138F, "SSD Module 3.8 TB, 400 MByte/s", order number 1513.4723.38
- R&S®IQR-K1, "TSMW Control", order number 1513.4730.02
- R&S®IQR-K101, "Import/Export of Waveform Files and Meta Data Files", order number 1517.5001.02
- R&S®IQR-K102, "GPS Data Recording", order number 1517.5018.02
- R&S®IQR-K103, "GPS Map", order number 1517.5024.02
- R&S®IQR-K104, "Ref. level controlled recording and replay of RF signals for AGC", order number 1517.5182.02
- R&S®IQR-K105, "Multiplexing I/Q Data", order number 1517.5047.02
- R&S®IQR-K107, "2nd Dig IQ Out", order number 1517.5060.02
- R&S®IQR-K108, "Network Attached Streaming", order number 1517.5076.02
- R&S®IQR-K2, "Generator Control", order number 1513.4752.02

The following abbreviations are used throughout this guide: R&S® is abbreviated as R&S. R&S IQR denotes both the R&S®IQR20 and the R&S®IQR100.

Contents

1 Preparing the I/Q Data Recorder for Use

The R&S IQR is a fast recording and replay device for digital I/Q data which is transferred over the R&S Digital I/Q Interface. The R&S Digital I/Q Interface is supported by many Rohde & Schwarz instruments. A typical application scenario is a drive test where an R&S TSMW "Universal Radio Network Analyzer" is used as a network scanner, providing an I/Q baseband data stream which is recorded by the R&S IQR. The subsequent analysis (e.g. using an R&S FSV spectrum analyzer) is based on the raw I/Q data with no loss of information. You can also feed the recorded I/Q data stream to an appropriate signal generator (e.g. an R&S SMU200A) in order to re-generate the modulated RF signal.

Rohde & Schwarz provides two different I/Q Data Recorder models which essentially differ in the recording and data transmission speed.

- The R&S IQR20 supports data rates up to 20 megasamples per second (MSa/s), corresponding to 80 MByte/s.
- The R&S IQR100 supports data rates up to approx. 99.5 MSa/s (with R&S IQR-B110 up to 75 MSa/s), corresponding to 400 MByte/s.

Both instruments can be combined with the following memory pack options:

- R&S IQR-B010, "HDD Module 1 TB, 80 MByte/s"
- R&S IQR-B020, "HDD Module 2 TB, 80 MByte/s"
- R&S IQR-B110, "SSD Module 1 TB, 300 MByte/s"
- R&S IQR-B109F, "SSD Module 0.9 TB, 400 MByte/s"
- R&S IQR-B119F, "SSD Module 1.9 TB, 400 MByte/s"
- R&S IQR-B138F, "SSD Module 3.8 TB, 400 MByte/s"

To use the full data rate of the R&S IQR100, one of the SSD options R&S IQR-B109F, R&S IQR-B119F or R&S IQR-B138F is required.

The present chapter gives all information that is necessary to put the instrument into operation and presents an overview of the front panel controls and connectors of the R&S IQR.

Chapter 2, Basic R&S IQR Operation outlines typical application examples for the I/Q Data Recorder. The following chapters provide reference and background information about the use of the Graphical User Interface (GUI) and about remote control.

1.1 Putting the I/Q Data Recorder into Operation

This section describes the basic steps to be taken when setting up the I/Q Data Recorder for the first time.

⚠ WARNING

Risk of injury and instrument damage

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury, or damage.

- Do not use an isolating transformer to connect the instrument to the AC power supply.
- Do not open the instrument casing.
- Read and observe the "Basic Safety Instructions" at the beginning of this manual, in addition to the safety instructions in the following sections. Notice that the data sheet may specify additional operating conditions.

NOTICE

Risk of instrument damage during operation

An unsuitable operating site or test setup can damage the instrument and connected devices. Ensure the following operating conditions before you switch on the instrument:

- All fan openings are unobstructed and the airflow perforations are unimpeded. The minimum distance from the wall is 10 cm.
- The instrument is dry and shows no sign of condensation.
- The instrument is positioned as described in the following sections.
- The ambient temperature does not exceed the range specified in the data sheet.
- Signal levels at the input connectors are all within the specified ranges.
- Signal outputs are correctly connected and are not overloaded.

1.1.1 Unpacking and Checking the I/Q Data Recorder

Check the equipment for completeness using the delivery note and the accessory lists for the various items. Should you notice any damage, immediately contact the carrier who delivered the instrument.

Packing material

Retain the original packing material. If the instrument needs to be transported or shipped at a later date, you can use the material to protect the control elements and connectors.

NOTICE

Risk of instrument damage during transportation and shipment

Insufficient protection against mechanical and electrostatic effects during transportation and shipment can damage the instrument.

- Always make sure that sufficient mechanical and electrostatic protection is provided.
- When shipping an instrument, use the original packaging. If it is not available, allow for sufficient padding to prevent the instrument from moving around inside the box. Pack the instrument in antistatic wrap to protect it from electrostatic charging.
- Secure the instrument to prevent any movement and other mechanical effects during transportation.

The **carrying handles** at the front are designed to lift or carry the instrument. Do not apply an excessive external force to the handles.

1.1.2 Positioning the Instrument

The I/Q Data Recorder is designed for use under laboratory conditions, preferably on a bench top. For test drives, it is also possible to use the instrument in a vehicle. Notice the general ambient conditions at the operating site described under "Risk of instrument damage during operation" on page 10.

1.1.3 Bench Top Operation

If the I/Q Data Recorder is operated on a bench top, the surface should be flat. The instrument can be used in horizontal or vertical position, standing on its feet, or with the support feet on the bottom expanded.
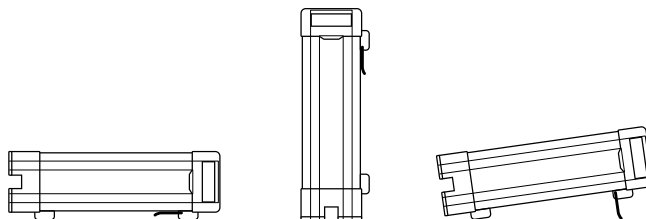
⚠ **CAUTION**

Risk of injury if feet are folded out

The feet may fold in if they are not folded out completely or if the instrument is shifted. This may cause damage or injury.

●   Fold the feet completely in or completely out to ensure stability of the instrument. Never shift the instrument when the feet are folded out.

●   When the feet are folded out, do not work under the instrument or place anything underneath.

●   The feet can break if they are overloaded. The overall load on the folded-out feet must not exceed 500 N.

F < 500 N
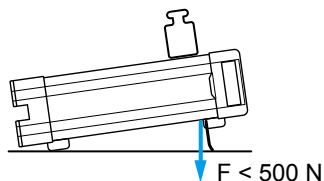
1.1.4   EMI Suppression

To suppress generated Electromagnetic Interference (EMI), operate the instrument only while it is closed, with all shielding covers fitted. Note the EMC classification in the data sheet.

Use appropriate shielded cables to ensure successful control of electromagnetic radiation during operation, especially for the following connector types:

●   Output connectors for reference signals (rear panel, REF IN / OUT): Use double-shielded RF cables and terminate open cable ends with 50 Ω.

●   USB: Use double-shielded USB cables and ensure that external USB devices comply with EMC regulations.

●   LAN: Use CAT6 or CAT7 cables.

Observe the additional connector, cable, and cable length requirements in Chapter 1.2, "Front Panel Tour", on page 13 and Chapter 1.3, "Rear Panel Tour", on page 16.

1.1.5   Connecting the R&S IQR to the AC Supply

The I/Q Data Recorder is automatically adapted to the AC supply voltage. The supply voltage must be in the range 100 V to 240 V; 50 Hz to 60 Hz. The mains connector and power switch are located at the rear panel.

Connect the I/Q Data Recorder to the AC power source using the AC power cable delivered with the unit. The maximum and typical power consumption of the I/Q Data Recorder is listed in the data sheet.

1.1.6 Power on and off

The mains connector and power switch are located at the rear panel.

To turn the power on or off, press the AC power switch to position I (On) or 0 (Off). After power-on, the I/Q Data Recorder is in standby or ready state, depending on the state of the standby key at the front panel.

1.1.7 Standby and Ready State

The standby key connects/disconnects all internal modules of the I/Q Data Recorder to/from the DC supply voltage generated by its internal power supply. In standby state (orange PWR LED) the power consumption of the I/Q Data Recorder is very small, however, the internal power supply is still connected to the AC mains power as long as the mains power switch at the rear panel is on.

In ready state (green PWR LED) all modules are power-supplied and the I/Q Data Recorder can be used as described in Chapter 2, "Basic R&S IQR Operation", on page 24.

It is recommendable to switch the I/Q Data Recorder to standby state or switch it off by the rear panel AC power switch if it is not used for some time. Observe the instructions for startup and shutdown in Chapter 1.4, "Starting and Shutting Down the Instrument", on page 18.

1.2 Front Panel Tour

The front panel of the I/Q Data Recorder provides the touchscreen display, the standby key with a power status LED (PWR), two type A USB connectors, and the removable memory pack, to be locked by a key.
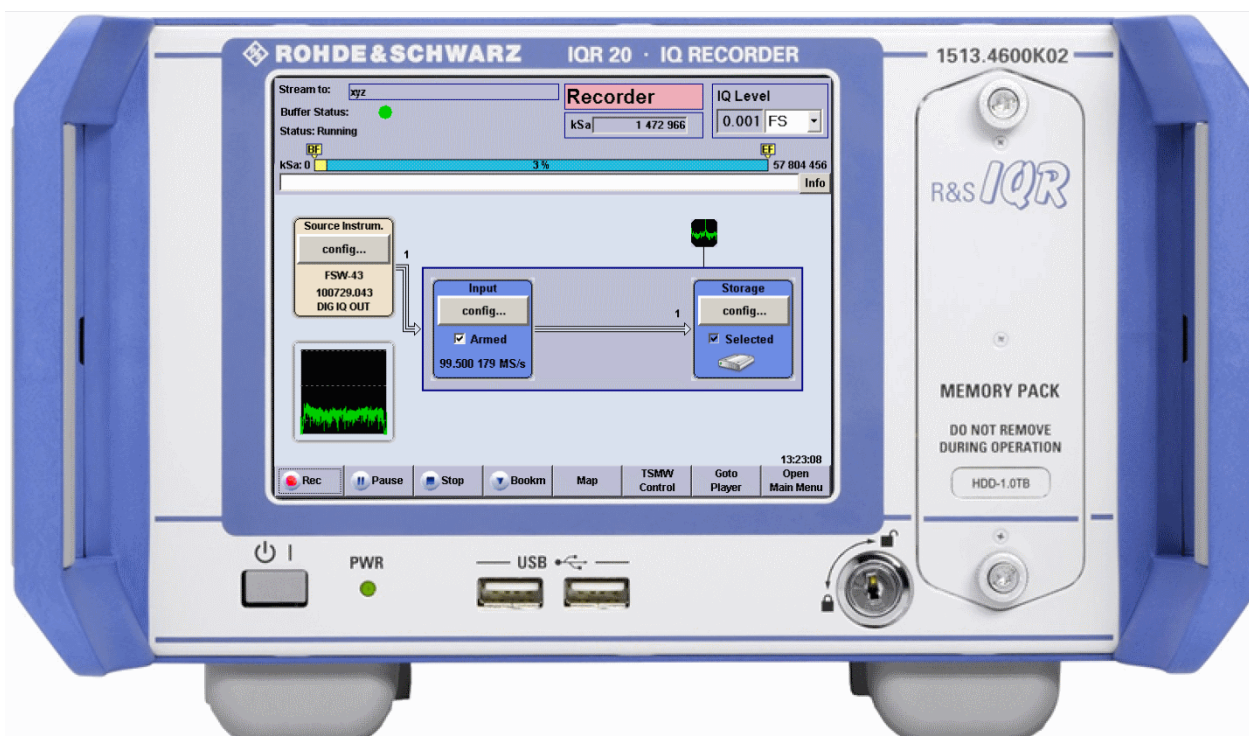
In the following sections the front panel elements are described from top left to bottom right.

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument. For example, cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances.

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

1.2.1 Display

The I/Q Data Recorder is equipped with a touchscreen display. It is also possible to control the instrument via mouse and/or keyboard. Both can be connected to the USB connectors on the front panel.

The GUI elements are described in Chapter 5, "General and Administrative Tasks", on page 79.

1.2.2 Standby Key

The standby key connects/disconnects all internal modules of the I/Q Data Recorder to/from the DC supply voltages generated by its internal power supply.

See Chapter 1.1.7, "Standby and Ready State", on page 13.

The PWR LED indicates whether the I/Q Data Recorder is ready to operate (LED green) or in standby state (LED is orange).

The LED does not light when the AC power switch on the rear panel is in position 0 (Off).

1.2.3 USB Connectors
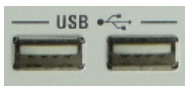
The USB connectors of type A (master USB) may be used to connect e.g. a keyboard, mouse or other pointing devices or an external storage device (USB stick, CD-ROM drive etc.).

Additional USB connectors are located on the rear panel of the I/Q Data Recorder.

The length of the connecting USB cables should not exceed 1 m. The maximum current per USB port is 500 mA. See also Chapter 1.1.4, "EMI Suppression", on page 12.

To avoid disturbances, do not connect or disconnect USB devices while data is being recorded or replayed.

1.2.4 Memory Pack

The removable memory pack contains two hard disk drives or two solid state drives. Additional memory packs are available as options R&S IQR-B020, "HDD Module 2 TB, 80 MByte/s", R&S IQR-B109F, "SSD Module 0.9 TB, 400 MByte/s", R&S IQR-B119F, "SSD Module 1.9 TB, 400 MByte/s" and R&S IQR-B138F, "SSD Module 3.8 TB, 400 MByte/s".

The data rates and maximum recording times of the memory packs depend on the operating mode of the source instrument; refer to the data sheet for details.

 The memory pack is secured by a key. You can replace the pack while the key is in its vertical (unlocked) position: Turn the two screws on the top and bottom counterclockwise off the threads, then pull out the memory pack in horizontal direction. Insert the new memory pack in reverse order.

NOTICE

Risk of data loss

The memory pack must not be removed while the R&S IQR is in ready state, or while data is recorded or replayed. Always switch the instrument to standby (or turn the power off) before you remove the memory pack. See Chapter 1.2.2, "Standby Key", on page 15.

NOTICE

Backups of recorded data

The hard disk and solid state drives in the memory packs have a limited useful life, depending on the number of recording cycles and their repetition rate. For details refer to the R&S IQR data sheet. To prevent loss of valuable data, perform regular backups using the archiving function; see Chapter 5.5, "Tools", on page 84.

1.3 Rear Panel Tour

The rear panel contains the mains connector with the AC power switch and several connectors for instrument control and digital I/Q data transfer.
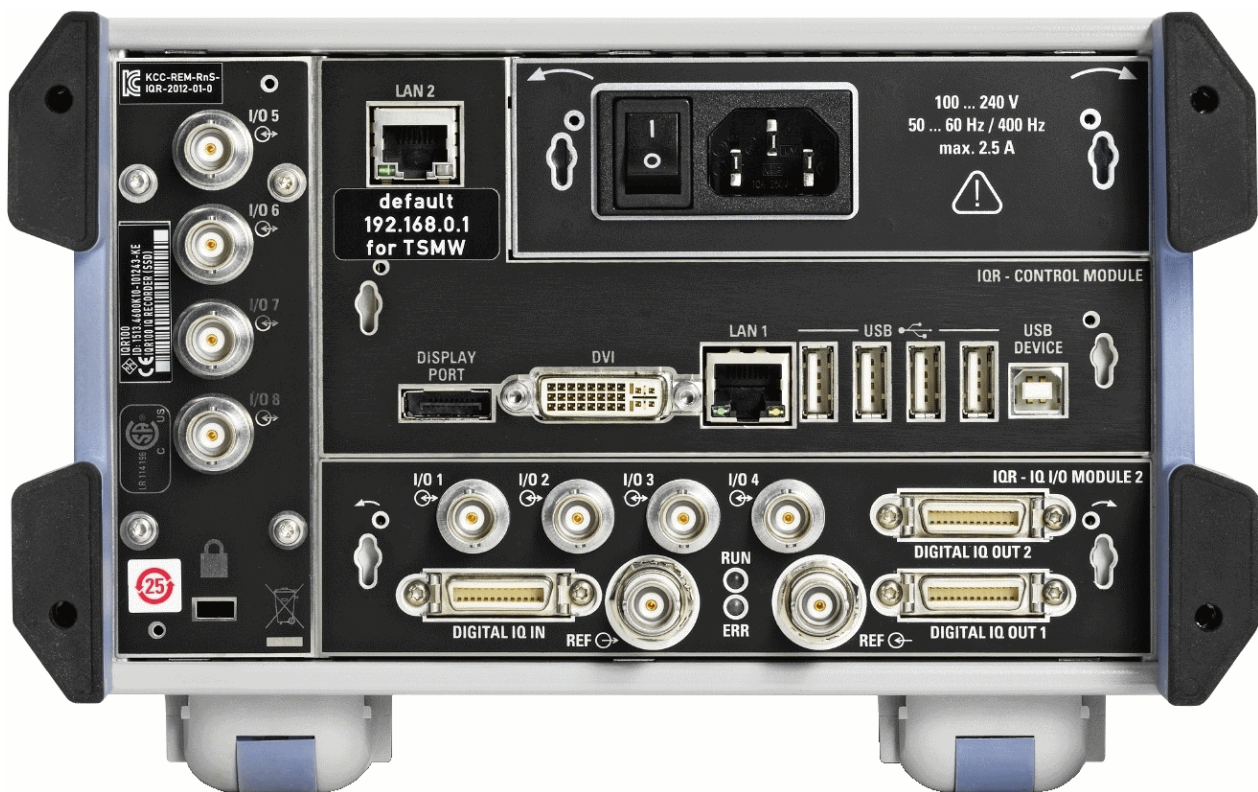
From top to bottom, the different connectors serve the following purpose.

LAN 1 / LAN 2
Two 8-pin RJ-45 connectors to integrate the I/Q Data Recorder into a Local Area Network (LAN), e.g. for remote control (LAN 1) or for control of an R&S TSMW or an Rohde & Schwarz Signal Generator using option R&S IQR-K1 or R&S IQR-K2 (LAN 2). The pin assignment of the RF-45 connectors supports category 6 / 7 UTP/STP (Unshielded/Shielded Twisted Pair) cables. See also Chapter 1.1.4, "EMI Suppression", on page 12 and Chapter 1.6.4, "Connecting a LAN Cable", on page 22.

Mains connector and switch

The mains connector and power switch is located in the upper part of the rear panel; see also Chapter 1.1.6, "Power on and off", on page 13.

I/O 1 to I/O 8 connectors
Configurable BNC connectors for the following input or output control signals.
● External sampling clock input signal (fixed input I/O 1, player mode; see Chapter 4.2.4.1, "Clock", on page 72)
● External trigger input signals (I/O 1 to I/O 8, player or recorder mode; see "Control Line Setup" on page 71)

DVI

External monitor connector; see Chapter 1.6.3, "Connecting a Monitor", on page 21.

Master USB Connectors

Four type A USB connectors (master USB), equivalent to the master USB connectors on the front panel; see Chapter 1.2.3, "USB Connectors", on page 15.

DIGITAL IQ IN / DIGITAL IQ OUT 1/2

Input and output connectors for digital signals. Use DIGITAL IQ IN for data recording, DIGITAL IQ OUT 1/2 for replay. An appropriate cable is supplied with the R&S IQR.

Note: It is not possible to use the two I/Q connectors simultaneously except for running the "DIG I/Q Interface" selftest.

REF IN / REF OUT

Two BNC connectors for external/internal 10 MHz reference frequency signals; see Chapter 4.2.4.1, "Clock", on page 72.
● Use REF IN to synchronize the R&S IQR to another device.
● Use REF OUT to synchronize another device to the R&S IQR.

Additional Connectors

The type B USB connector (slave USB) labeled USB DEVICE and the DISPLAY PORT connector are intended for future extensions.

1.4 Starting and Shutting Down the Instrument

To start the R&S IQR, proceed as follows:

1. Make sure that the I/Q Data Recorder is connected to the AC power supply and the power switch on the rear panel is in position I (On).

2. If necessary, press the standby toggle switch on the front panel to switch the instrument to ready state (the PWR LED is green).
   See also Chapter 1.1.7, "Standby and Ready State", on page 13

In ready state, the R&S IQR automatically performs a system check, boots the Windows® XP Embedded operating system ("Booting Windows®, please wait...") and then starts the R&S IQR application, showing its startup screen.

Figure 1-1: R&S IQR startup screen

If the previous session was terminated regularly, the R&S IQR application uses the last instrument configuration.

Once the startup procedure has been terminated, the "Player" main dialog is displayed. See Chapter 2.4, "Replaying Data", on page 36.

To shut down the R&S IQR, proceed as follows:

1. Press the standby toggle switch to save the current instrument configuration, close the R&S IQR application, shut down the Windows® XP Embedded operating system and set the instrument to standby state. You can also perform this procedure step by step like in any Windows® session.

2. If desired, set the AC power switch to position 0 (Off).

NOTICE

Standby state

It is strongly recommended to switch the R&S IQR to standby state before disconnecting it from the AC supply. If you set the power switch to 0 while the R&S IQR application is still running, you will lose the current settings. Moreover, loss of program data cannot be excluded if the application is terminated improperly.

1.5 Instrument Control

The R&S IQR can be controlled in the following ways:

- Using the touchscreen display. The functions of the Graphical User Interface (GUI) are described in Chapter 5, "General and Administrative Tasks", on page 79.
- With a remote desktop connection through a Local Area Network, see Chapter 10.2, "Remote Operation in a LAN", on page 177
- With an external monitor in combination with a mouse and/or keyboard, see Chapter 1.6.3, "Connecting a Monitor", on page 21.

1.6 Connecting External Accessories

The equivalent USB ports on the front and rear panel of the R&S IQR can be used to connect a variety of accessories:

- A mouse simplifies operation of the instrument using the controls and dialogs of the Graphical User Interface (GUI).
- A keyboard simplifies the entry of data.

In addition the R&S IQR provides interfaces for monitor connection and network integration:

- An external monitor shows the magnified Graphical User Interface (GUI) with all diagram areas and controls.
- A LAN connection can be established in order to access the hard disk or control the tester from an external PC.

1.6.1 Connecting a Mouse

A USB mouse can be connected to one of the Universal Serial Bus (USB) connectors on the front panel or on the rear panel.

The mouse is detected automatically when it is connected. It is safe to connect or disconnect the mouse while the R&S IQR is in ready state.

NOTICE

Risk of data loss

Do not connect or disconnect the mouse while data is being recorded or replayed.

Mouse configuration

Use the "Start - Control Panel - Mouse" menu of Windows® XP Embedded to configure the mouse properties. To access Windows® XP Embedded, use the on-screen keyboard or connect an external keyboard to your R&S IQR and press the Windows key + D.

Operating an R&S IQR does not require a mouse. You can access all essential functions using the keys on the front panel.

1.6.2 Connecting a Keyboard

A keyboard can be connected to one of the Universal Serial Bus (USB) connectors on the front panel or on the rear panel.

The keyboard is detected automatically when it is connected. The default input language is English - US. It is safe to connect or disconnect the external keyboard while the R&S IQR is in ready state.

NOTICE

Risk of data loss

Do not connect or disconnect the keyboard while data is being recorded or replayed.

Keyboard configuration

Use the "Start - Control Panel - Keyboard" or "Regional and Language Options" menu of Windows® XP Embedded to configure the keyboard properties. To access Windows® XP Embedded, use the on-screen keyboard or connect an external keyboard to your R&S IQR and press the Windows key + D.

Operating the R&S IQR does not require a keyboard. You can access all functions using the touchscreen display.

1.6.3 Connecting a Monitor

A standard monitor can be connected to the DVI-D connector of the R&S IQR.

NOTICE

Monitor connection

The monitor must be connected while the instrument is switched off (in standby mode). Otherwise correct operation cannot be guaranteed.

The monitor displays the magnified Graphical User Interface (GUI) with all dialogs and control elements. No extra configuration is required.

Instrument control from the monitor

With an additional mouse or keyboard connected to the tester, you can control the measurement from the external monitor.

You may also connect a VGA monitor using an appropriate adapter.

1.6.4 Connecting a LAN Cable

A LAN cable can be connected to any of the LAN connectorsof the R&S IQR. Refer to Chapter 10.2, "Remote Operation in a LAN", on page 177 and learn how to avoid connection errors before you establish a LAN connection.

Connect a CAT6 or CAT7 RJ-45 (LAN, Ethernet) cable to one of the LAN ports LAN 1 or LAN 2 on the rear panel of the R&S IQR. See also Chapter 1.1.4, "EMI Suppression", on page 12.

Direct Ethernet connection

The LAN ports of the R&S IQR are auto-crossover Ethernet ports. You can connect them to a network that is equipped with Ethernet hardware (hub, switch, router), but you can also set up a direct connection to a computer or another test instrument. For both connection types, you can use either crossover or standard straight-through Ethernet cables.

The LAN connectors LAN 1 and LAN 2 are configured independently. See also Chapter 10.2.1, "Assigning IP Addresses", on page 178.

1.6.5 Test Setups with Two LAN Connections

Two LAN connectors LAN 1 and LAN 2 are located on the rear panel of the R&S IQR. With one LAN connector used to establish a connection to a home/company network, the other one can be used to connect an additional instrument, e.g. an R&S TSMW "Universal Radio Network Analyzer".

With two LAN connections, it is possible to use the R&S IQR in two alternative ways:

- As a client participating in two independent networks, one comprising the company network including the tester, the second consisting of the additional test instrument plus the tester. The default IP address settings of the R&S IQR are optimized for this kind of network topology; LAN 1 is the preferred connector for the company LAN.

- As a data router between the additional test instrument and the company network. This configuration means that the tester and the additional test instrument are integrated into a single network.
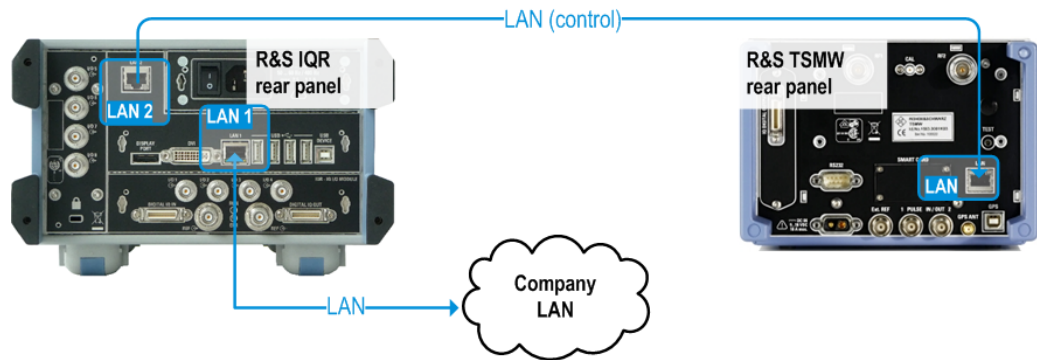
The network topology is defined in Windows® XP's "Control Panel - Network Connections - Local Area Connection Status - Local Area Connection Properties - Internet Protocol (TCP/IP) Properties - Advanced TCP/IP Settings" dialog. Both LAN interfaces must have independent IP addresses; see Chapter 10.2.1, "Assigning IP Addresses", on page 178. Contact your LAN administrator for details.

NOTICE

Avoid parallel connections

Never use both LAN connectors to connect the R&S IQR in parallel to the same network as this will result in connection errors.

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2 Basic R&S IQR Operation

This chapter describes the use of an R&S IQR I/Q Data Recorder for data recording and replay. For a detailed description of the complete functionality of the instrument refer to the subsequent chapters.

NOTICE

Instrument setup and safety instructions

Please notice the instructions in chapter "Preparing the I/Q Data Recorder for Use" before working with your I/Q Data Recorder.

To avoid disturbances, do not run other applications, connect or disconnect USB devices, or configure the Windows® operating system while data is being recorded or replayed.

2.1 Required Equipment

The measurement examples in this chapter require a R&S IQR20 or R&S IQR100 I/Q Data Recorder. Control of both instruments is analogous.

In principle, any Rohde & Schwarz instrument which is equipped with an R&S Digital I/Q Interface can serve as a source instrument for recording and/or a destination instrument for data replay. In the examples below, an R&S AMU200A Digital Baseband Generator and Fading Simulator is used. The R&S AMU200A serves as a I/Q data source for recording. In a replay session, data can be transferred to the R&S AMU200A; a typical task is fading of the replayed baseband data.

Touchscreen operation

The functionality of the R&S IQR is accessible by tapping on the touchscreen elements. No mouse or external keyboard is required to perform any of the tasks described in this chapter.

2.2 Recording Data

Data recording requires a connection to a suitable I/Q data "Source Instrument": Recording will start only if the source instrument transmits data to the DIGITAL IQ IN connector at the rear panel of the R&S IQR.

To establish the test setup and prepare the instruments,

1. Connect the R&S IQR to the source instrument (here: the R&S AMU200A) as shown below. Use the I/Q data cable which you received with your R&S IQR to establish the digital I/Q data connection. No additional cabling is needed; the R&S

Digital I/Q Interface ensures all the necessary communication between the two instruments.
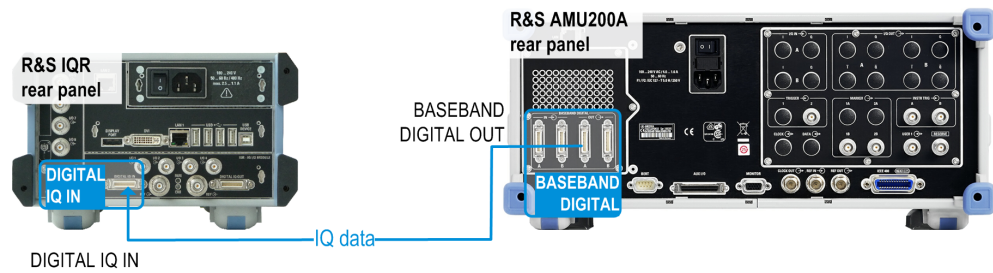
Figure 2-1: Basic test setup for data recording

2. Switch on both instruments and make sure the R&S AMU200A is configured to transmit data at BASEBAND DIGITAL OUT. Refer to the R&S AMU200A operating manual for details.
   See also Chapter 1.4, "Starting and Shutting Down the Instrument", on page 18.

Checking the connection

After the R&S IQR has completed its startup procedure, the "Source Instrum." control block of the "Recorder" window shows the connected instrument with its serial number and digital output connector.

2.2.1 Basic Operating Sequence

In the following example, the I/Q data stream from the R&S AMU200A is stored to a data file `2june16`. The maximum file size is restricted to 100 megasamples; manual trigger mode is used.

After startup, the R&S IQR shows its main window in "Recorder" mode.

1.
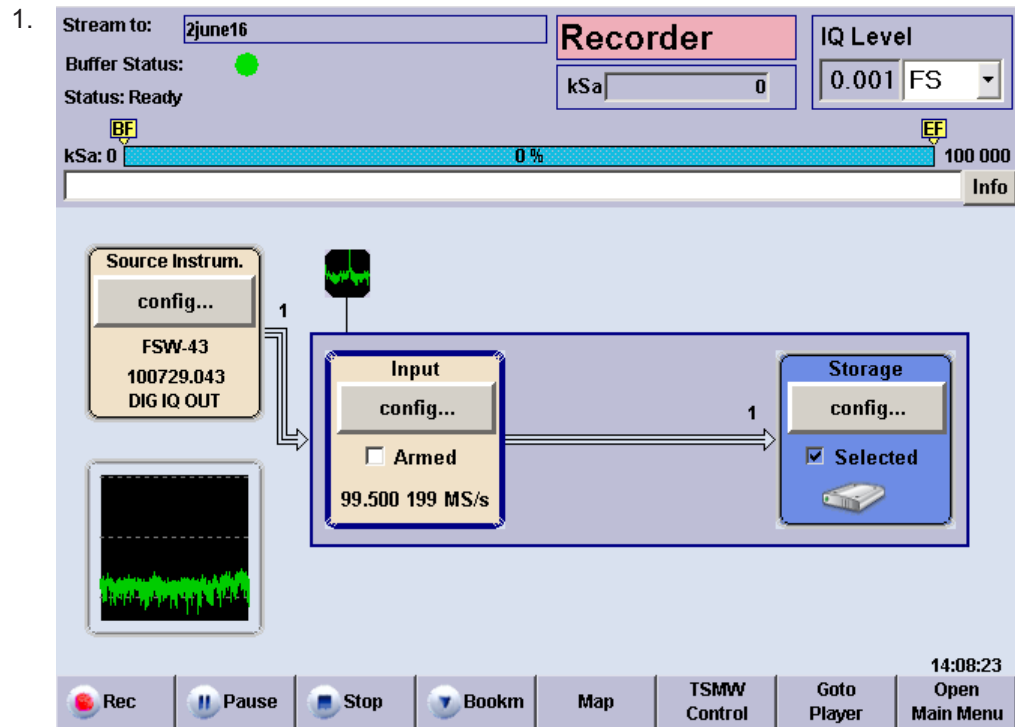
2. Tap "Open Main Menu" and "Configuration File > Set to default..." to preset your R&S IQR. This ensures that the behavior of the instrument is as described in this section.
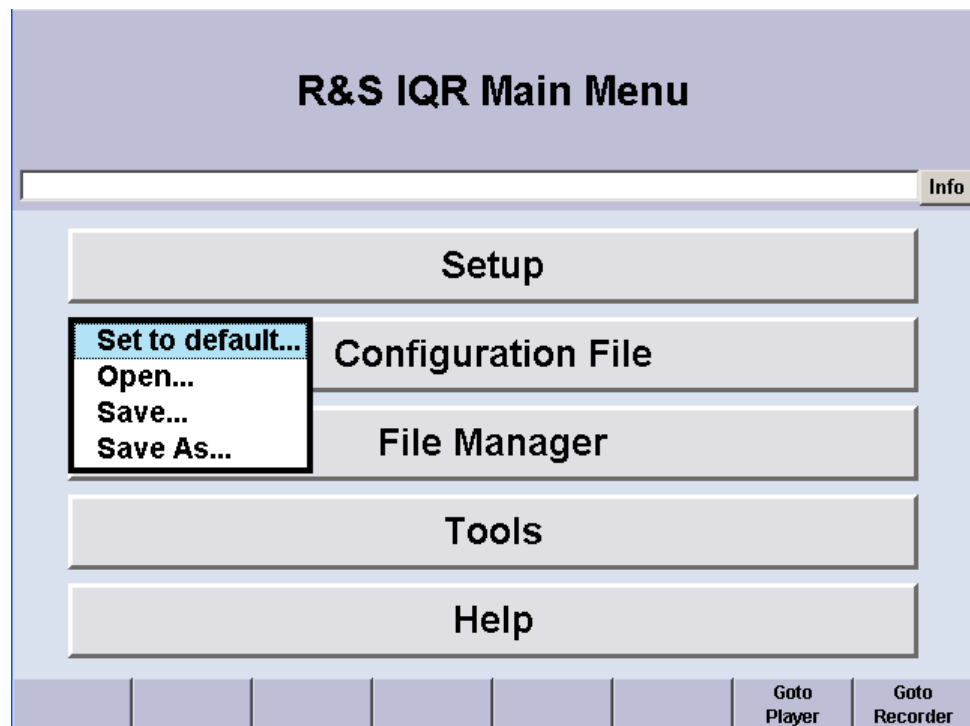
3. Tap "Goto Recorder" to return to the GUI for I/Q data recording.

4. Tap "Storage > config..." and use the on-screen keyboard to define a "Maximum File Size" of 100 MSa (megasamples). See also Chapter 10.1, "On-Screen Keyboard", on page 177.

    The R&S IQR will stop recording when the recorded file has reached the size of approx. 100 MSa. For more information refer to "Terminate Condition" on page 55.
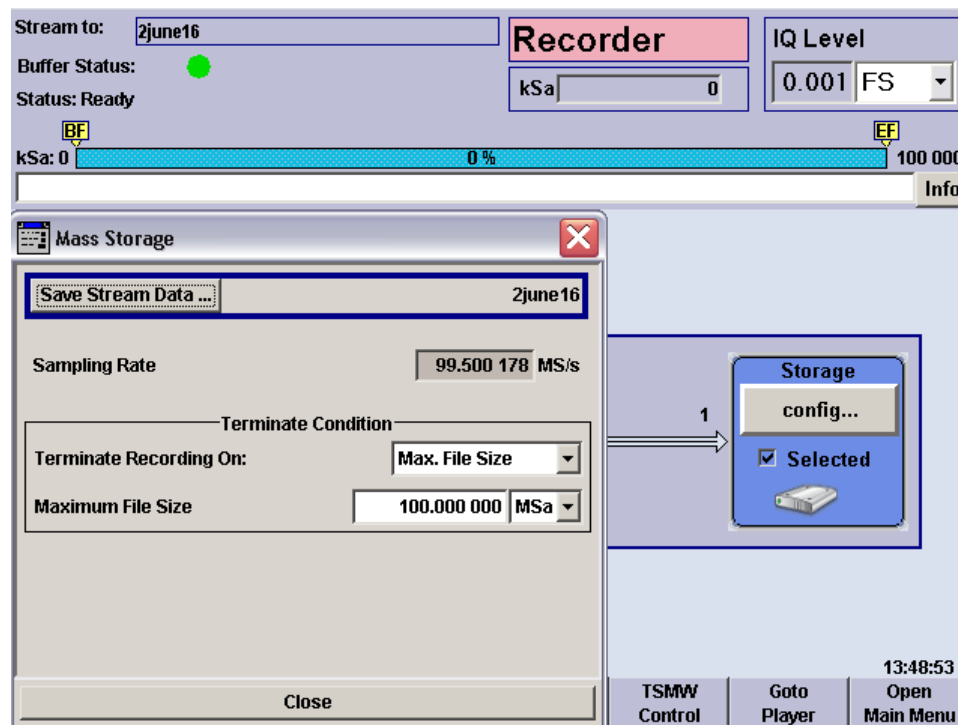
5. Tap "Save Stream Data..." and use the on-screen keyboard to enter the file name, e.g. 2june16, in the "Save Stream Data" dialog. Tap the "Ok" button below the entry field.

    The I/Q data file 2june16.ws1 will be written to partition e:\ of the removable memory pack; a second file 2june16.ws2 will be stored in partition f:\. See also Chapter 4.1, "General Description", on page 59.
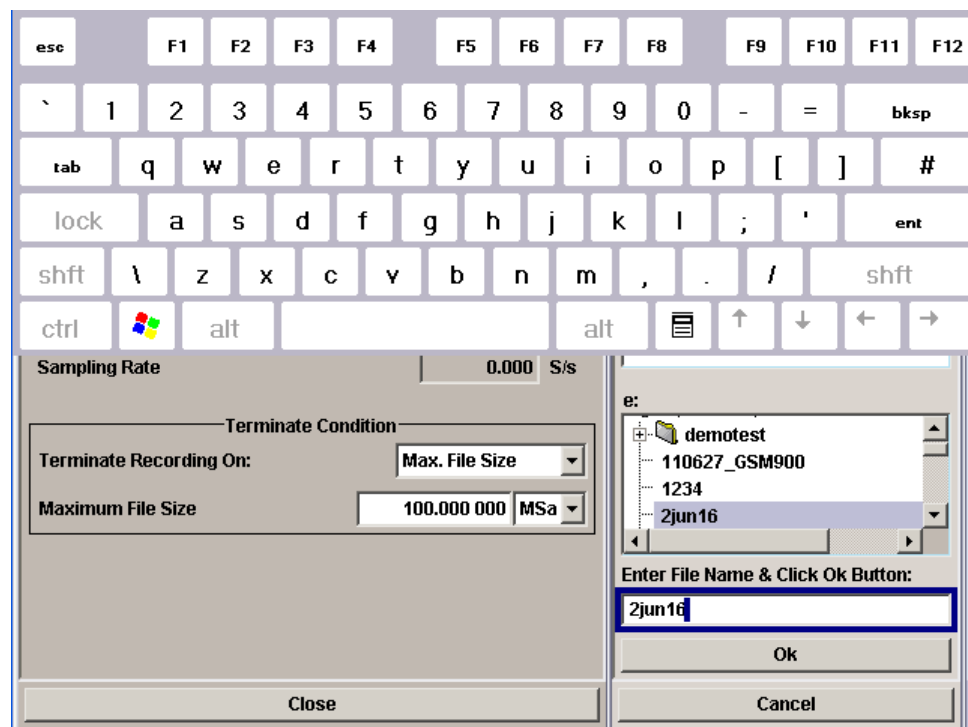
6. Close the mass storage dialogs and the on-screen keyboard.

7. Tap "Input > config..." to open the "Trigger" dialog. Ensure that "Manual" trigger source is selected.
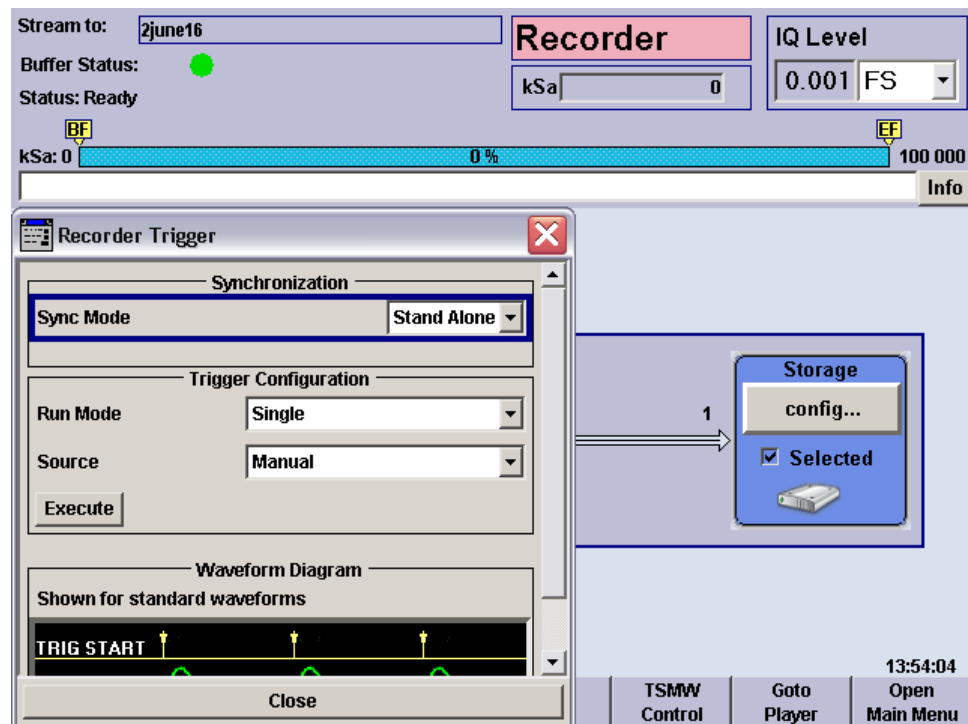
8. Tap "Execute" to configure the R&S IQR and the memory according to your settings.

    Configuration is finished when the box with the progress bar is closed and the status message "Please wait..." has disappeared.

9. Close the "Recorder Trigger" dialog.

    Both the "Input" and "Storage" configuration blocks must be blue. The used sample rate is shown in the "Input" box.
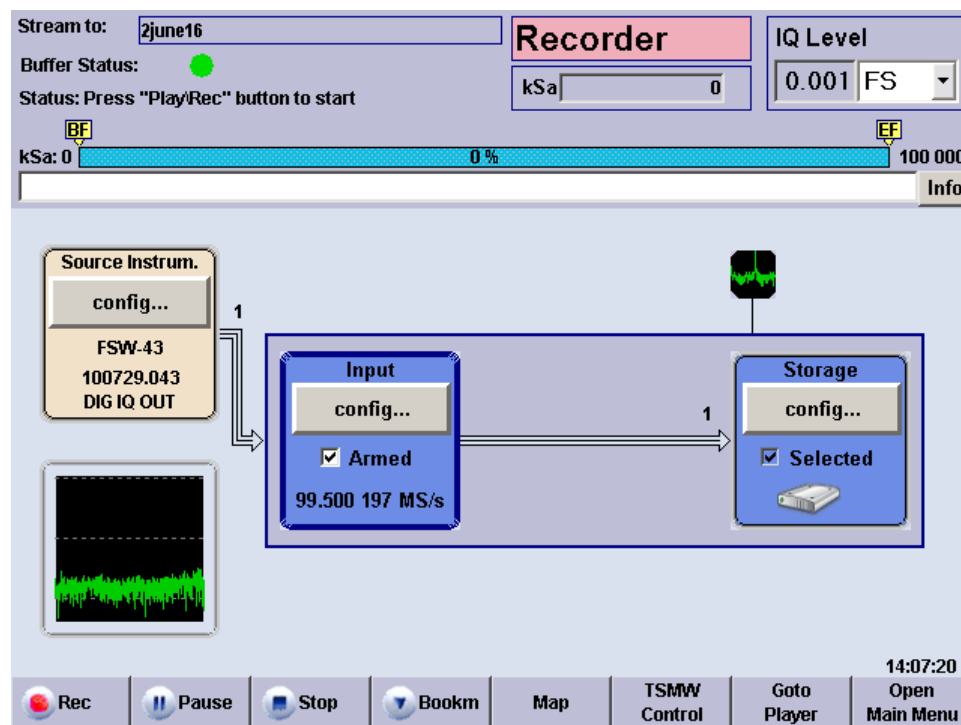
10. Tap the "Rec" control button in the lower left corner of the dialog to start recording. Tap "Stop" or "Pause" if you wish to stop or interrupt recording.

    The progress bar and the "kSa:" output field in the upper part of the main window show the progress of data recording. Recording is terminated, and a message is displayed, when the maximum file size has been reached.
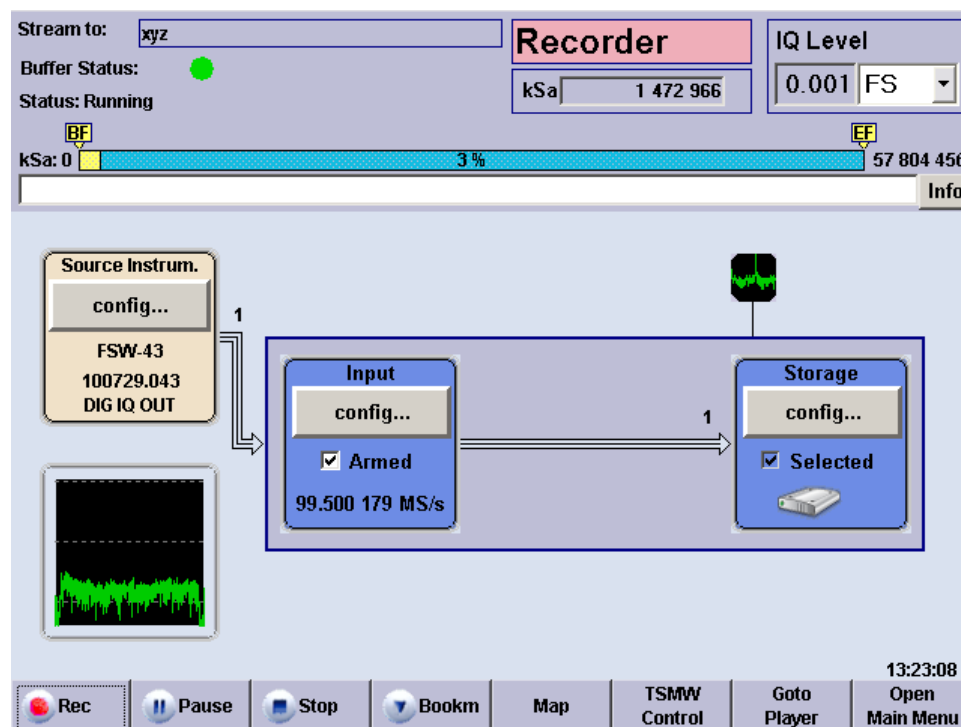
11. If you wish to repeat data recording using the same data file, you can simply tap "Rec" again.

A message box prompts you to confirm that the stored data can be overwritten.

Recorded data is stored in blocks with a 10 MByte block size. When recording is stopped, the currently recorded data block is discarded; only complete 10 MByte blocks are stored. See also "Terminate Condition" on page 55.

2.2.2 Possible Extensions

You can modify the trigger settings to refine the amount of recorded data; see Chapter 3.1.1, "Trigger System", on page 40. Moreover, you can include bookmarks in the recorded file. For an example refer to Chapter 2.3, "Recording Data Using TSMW Control", on page 30.

2.3 Recording Data Using TSMW Control

An R&S TSMW "Universal Radio Network Analyzer" with a digital I/Q interface can be used for data recording as outlined in the previous example (see Chapter 2.2, "Recording Data", on page 24). If the R&S IQR is equipped with option R&S IQR-K1, "TSMW Control", you can configure the R&S TSMW from the R&S IQR, control measurements, and record the measured I/Q data. No additional control device is required.

To establish the test setup and prepare the instruments,

1. Connect the R&S IQR to the R&S TSMW as shown below. Use the I/Q data cable which you received with your R&S IQR to establish the digital I/Q data connection. Use a LAN cable to enable control of the R&S TSMW by R&S IQR-K1. If you wish to record additional GPS meta data using the built-in GPS receiver of the R&S TSMW, connect a USB cable between the "GPS" USB type B connector of the R&S TSMW and any of the master USB connectors of the R&S IQR.
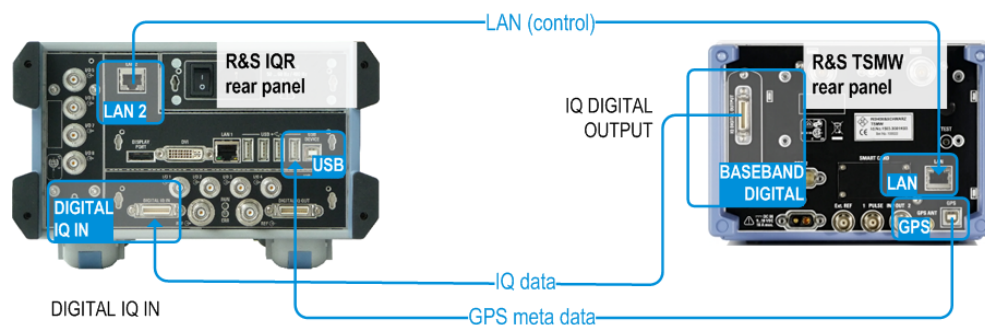
Figure 2-2: Basic test setup for TSMW control

2. Switch on both instruments.

LAN connection

In the factory configuration, the LAN 2 interface of the R&S IQR and the R&S TSMW have fixed IP addresses; the IP address of R&S IQR-K1 matches the R&S TSMW address. It is recommended to use LAN 2 for the connection to the R&S TSMW and to leave all IP address settings unchanged. For more information refer to Chapter 10.2, "Remote Operation in a LAN", on page 177.

2.3.1 Basic Operating Sequence

The following example simulates a test drive with an R&S TSMW. R&S IQR-K1 is used to record a WCDMA downlink signal at 2120 MHz. During the test drive, bookmarks are used to label the beginning and the end of a tunnel.

If option R&S IQR-K1 is unlocked and enabled, the "Recorder" window of the R&S IQR contains a "TSMW Control" button.
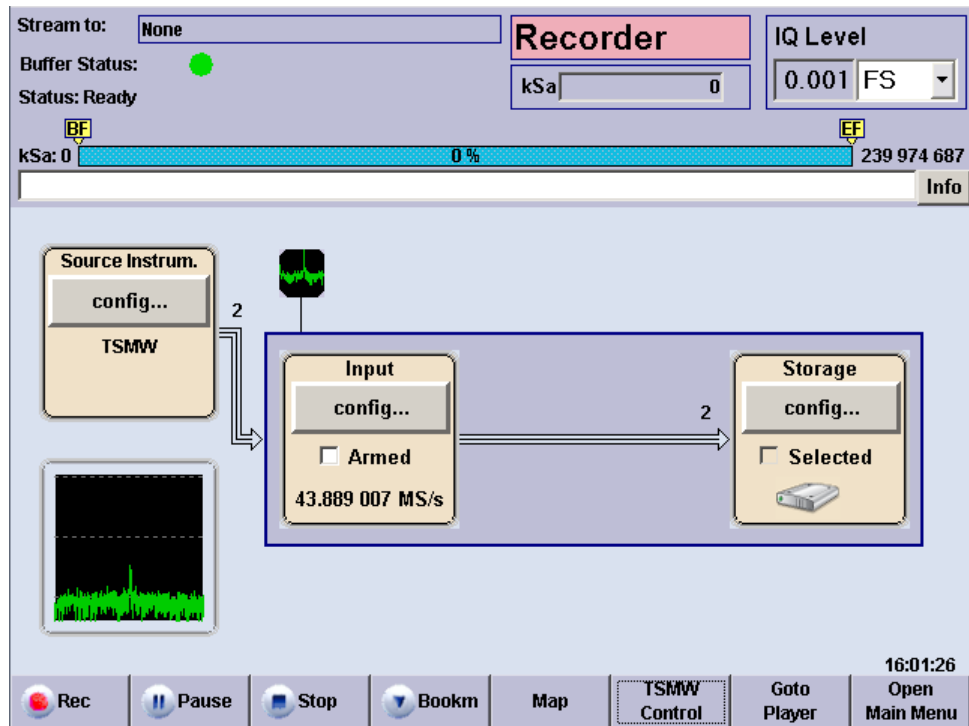
1. Preset your R&S IQR as described in Chapter 2.2.1, "Basic Operating Sequence", on page 25. This ensures that the behavior of the instrument is as described in this and in the following sections.

2. Proceed as described in Chapter 2.2.1, "Basic Operating Sequence", on page 25 to define the maximum file size of the recorded data file (e.g. 10 GSa) and select a file name (e.g. `2june16`).

3. Tap "TSMW Control" to load the control interface.

   After a startup screen, the R&S IQR displays the "Workspace" tab of the control interface.
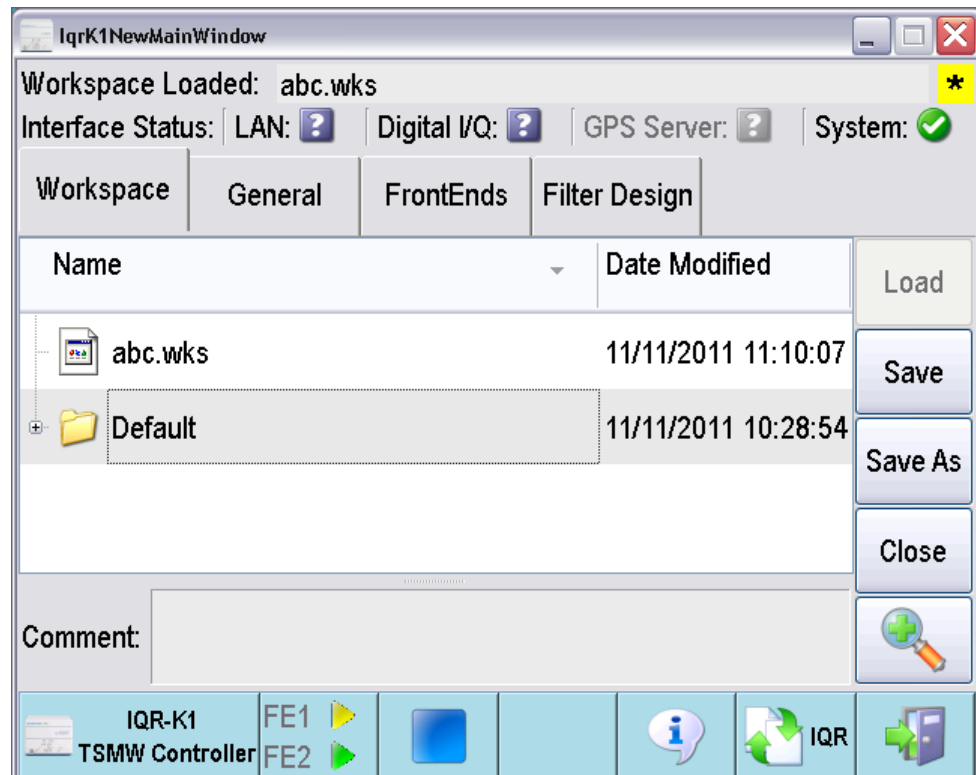
4. Tap "Filter Design" to open the associated tab. Select an appropriate bandwidth and tap "*1.25" to obtain the recommended sample rate. Tap "Generate" to terminate your settings.
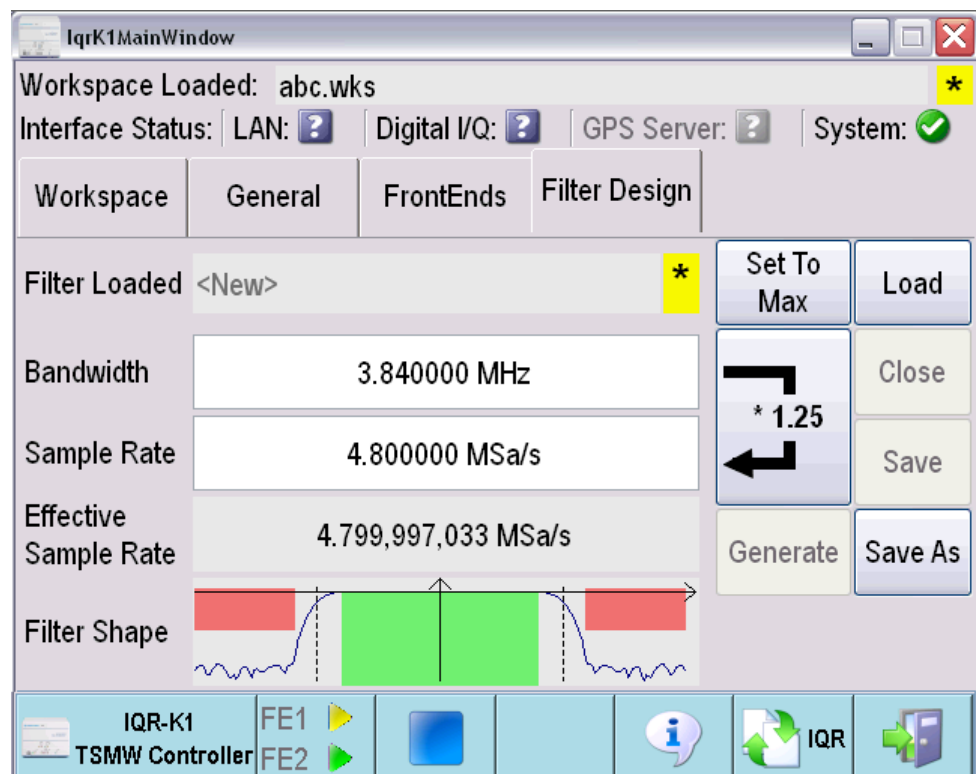
5. Tap "Save As" and store your filter configuration to a file, e.g. "WCDMA.flt".

6. Open the "Front Ends" tab, select the created filter file and enter a "Center Frequency" of 2120 MHz.
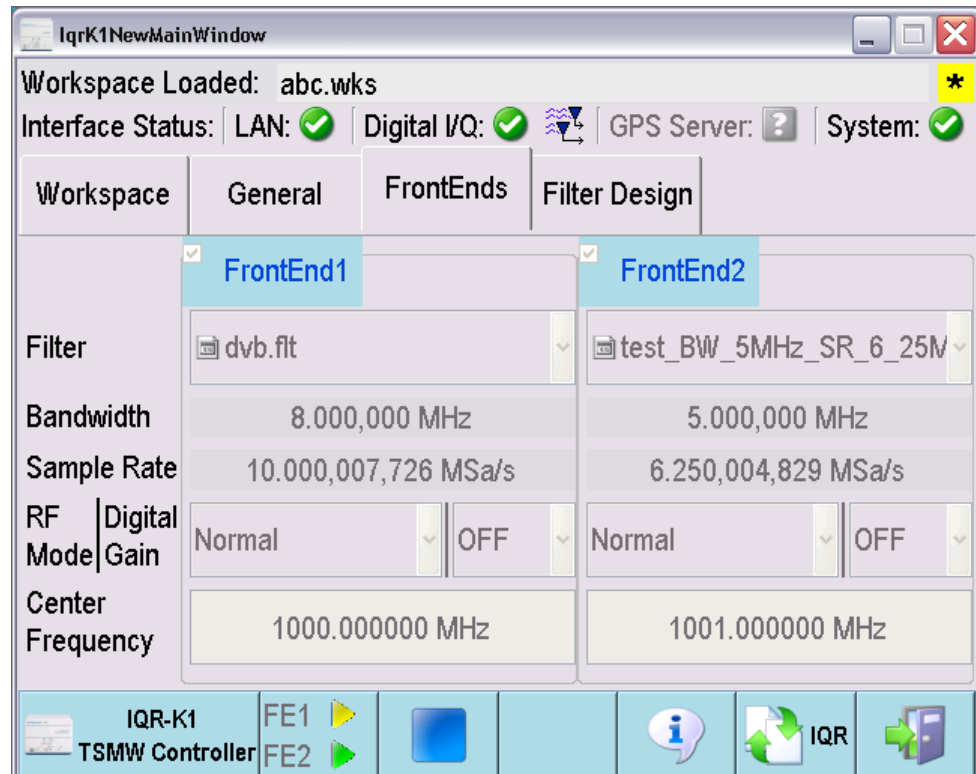
7. Tap the start button ▶ in the control bar at the bottom of the R&S IQR-K1 interface to start recording. For two frontends two arrows are blinking.

   As recording starts, the control interface indicates that the LAN and Digital I/Q connections are established ✓.

8. Tap the "IQR" button to return to the "Recorder" window.

9. At the beginning of the tunnel, press "Bookm". Enter an appropriate "Comment" as shown below.
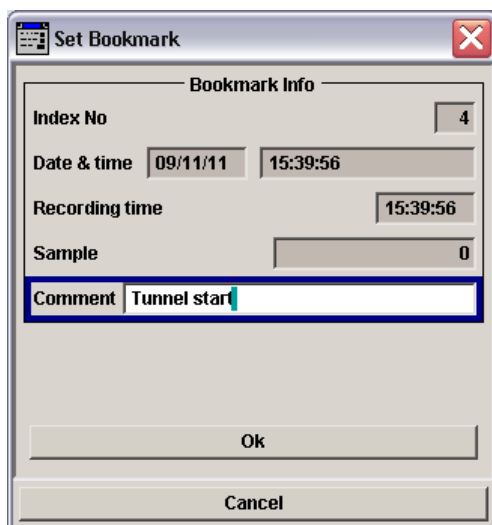
10. Click "Ok" to close the dialog. At the end of the tunnel, set a second bookmark.

    The toolbar shows the percentage of recorded data, relative to the selected maximum file size, and the positions of the bookmarks.
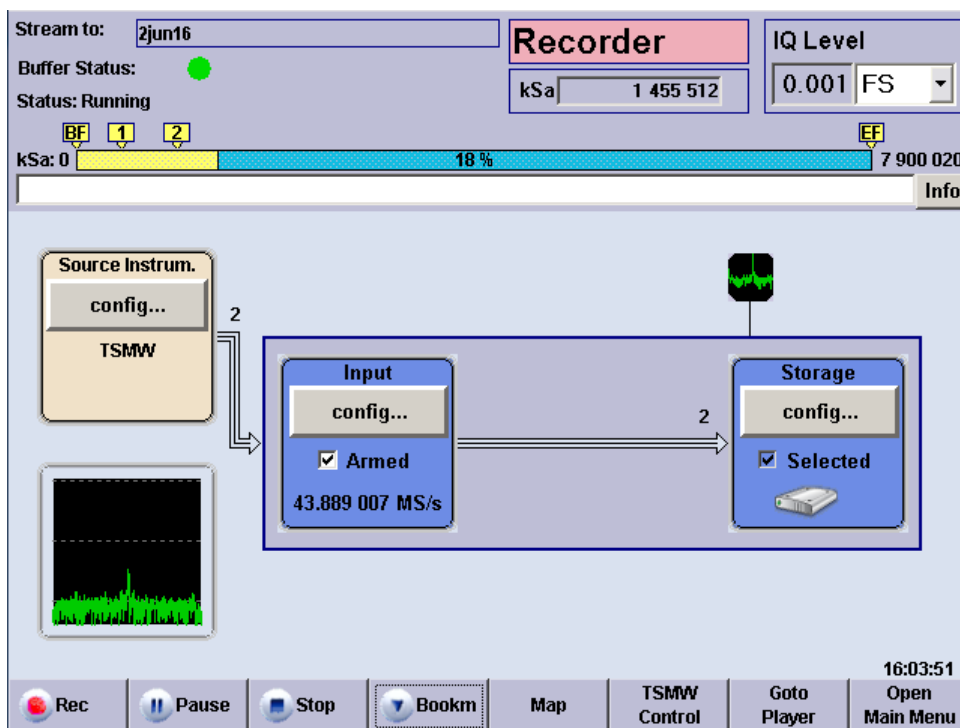
11. Use the control buttons "Recorder" window if you wish to pause or stop recording.

Recorded data is stored in blocks with a 10 MByte block size. When recording is stopped, the currently recorded data block is discarded; only complete 10 MByte blocks are stored. See also "Terminate Condition" on page 55.

2.4 Replaying Data

In a replay session, the recorded I/Q data is transferred to a destination instrument with an R&S Digital I/Q Interface where it can be analyzed or further processed. For the following example we assume that a I/Q data file `2june16` has been stored on the removable memory pack of the R&S IQR following the procedure in Chapter 2.2, "Recording Data", on page 24.

To adjust the previous test setup for data replay,

1. Change the I/Q data connection as shown below: Connect the DIGITAL IQ OUT connector of the R&S IQR to the BASEBAND DIGITAL IN connector of the R&S AMU200A. For accurate sampling rates of the replayed data, use one of the four delivered BNC cables for a reference frequency connection. No additional cabling is needed; the R&S Digital I/Q Interface ensures all the necessary communication between the two instruments.
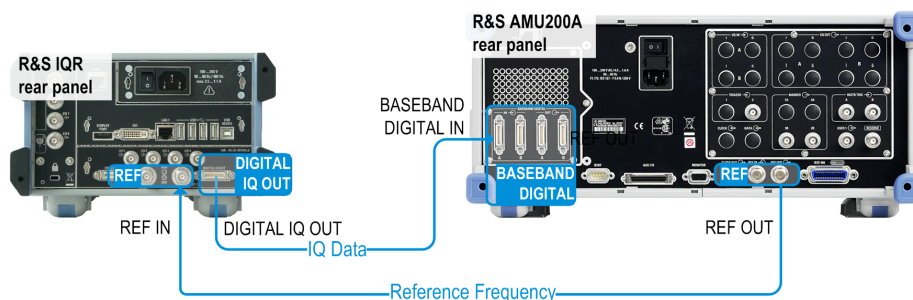
Figure 2-3: Basic test setup for data replay

2. Ensure that both instruments are switched on and that the R&S AMU200A is configured to use an external reference frequency and receive data at BASEBAND DIGITAL IN. Refer to the R&S AMU200A operating manual for details.

Checking the connection

After the R&S IQR has completed its startup procedure, the "Dest. Instrum." control block of the "Player" window shows the connected instrument with its serial number and digital output connector.

2.4.1 Basic Operating Sequence

In the following example, the data file `2june16` recorded in section Recording Data is replayed using manual trigger mode.

1. If the R&S IQR is still in "Recorder" mode, tap "Goto Player".
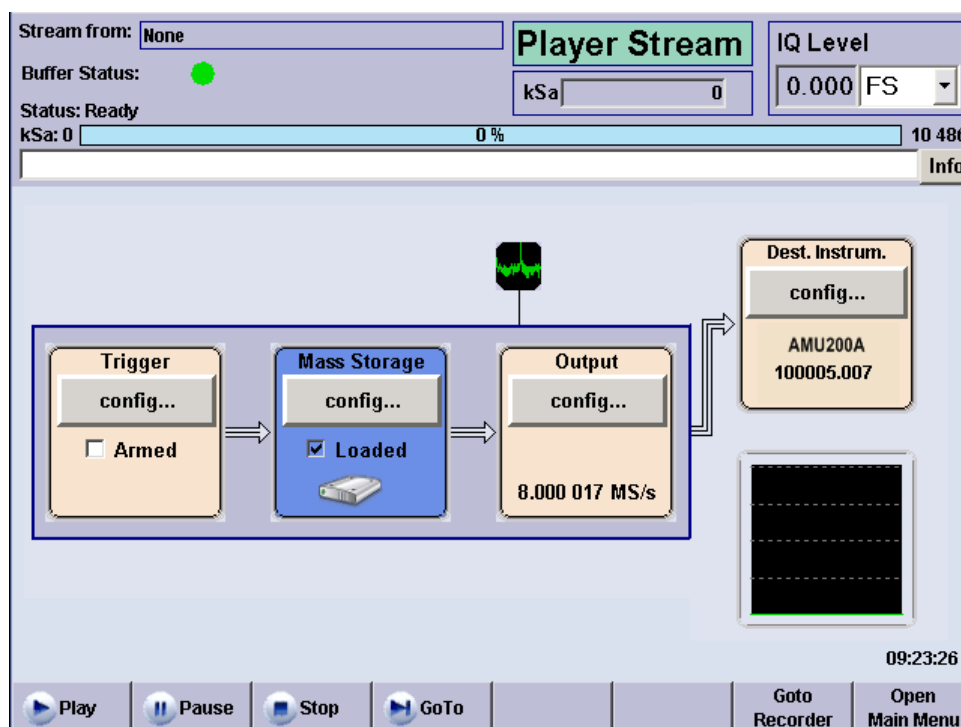
2. Tap "Mass Storage > config...".

3. In the dialog opened, select the data file `2june16` on drive e:\. See also Chapter 4.1, "General Description", on page 59.
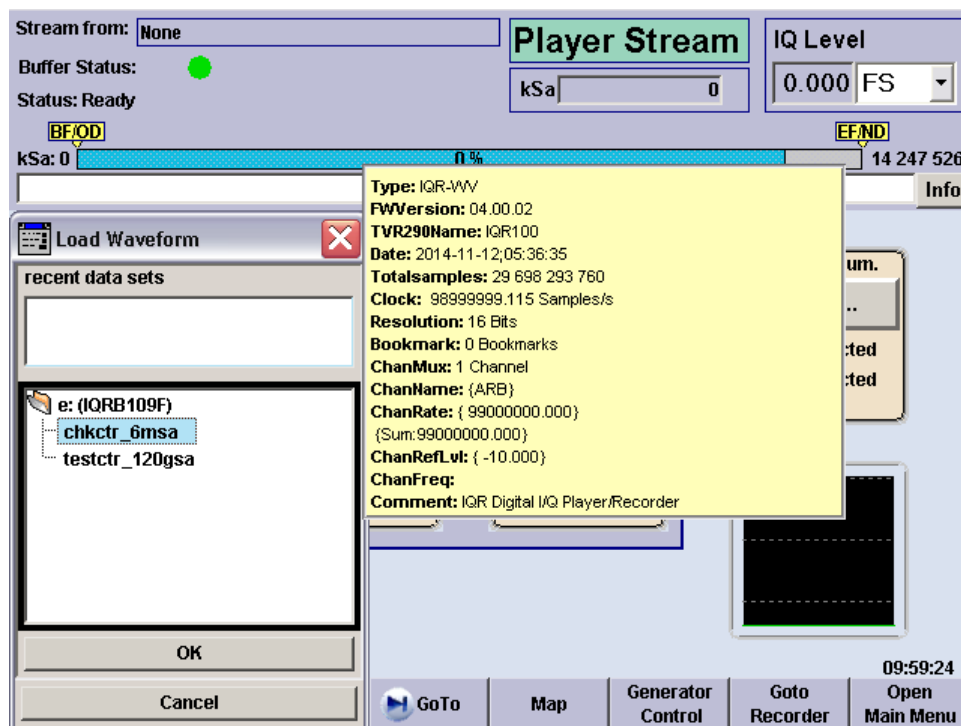
4. Tap "OK" to close the "Load Waveform" dialog.

Configuration is finished when the box with the progress bar is closed and the status message "Please wait..." has disappeared.

5. Tap the "Play" control button in the lower left corner of the dialog to start the replay. Tap "Stop" or "Pause" if you wish to stop or interrupt replay.

    The progress bar and the "kSa:" output field in the upper part of the main window show the replay progress. Data replay is terminated, and a message is displayed, when the entire file has been replayed.
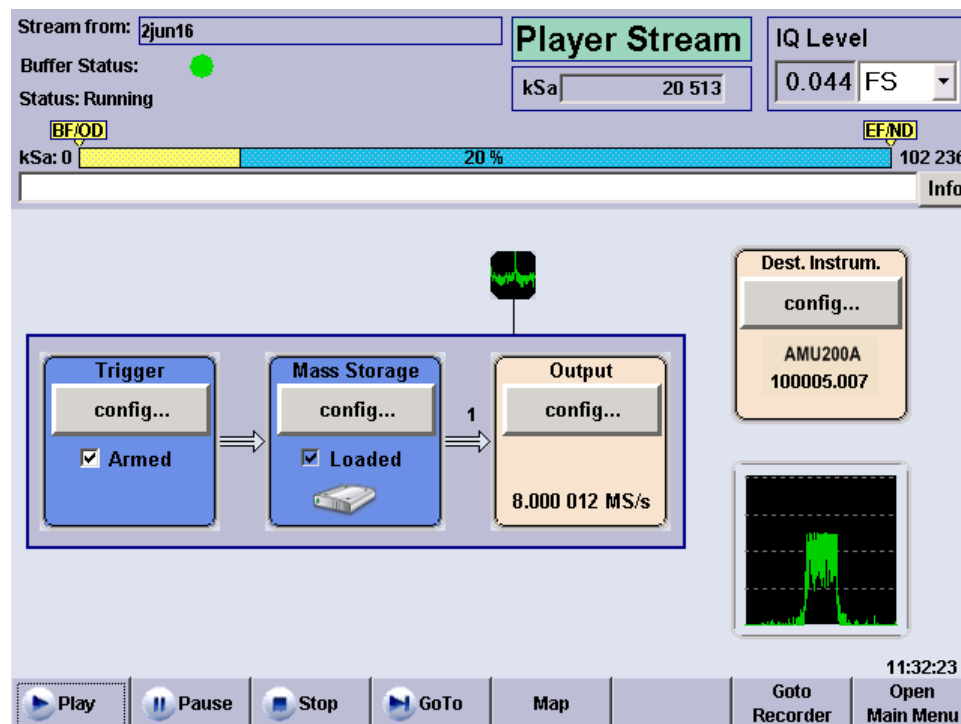
6. If you wish to repeat data replay using the same data file, you can simply tap "Play" again.

Data replayed in "Streaming" mode is transferred in blocks with a 10 MByte block size. When replay is stopped, the currently replayed data block is discarded; only complete 10 MByte blocks are transferred.

2.4.2 Possible Extensions

If you want to replay part of the stored samples only, you can tap "GoTo" and define the start and stop sample numbers. If the replayed file contains bookmarks, you can use these bookmarks to define the start and stop samples.

You can modify the trigger settings to refine the amount of recorded data; you can also replay waveform (ARB) files and modify the replayed data. For an overview of replay features refer to Chapter 3.1.1, "Trigger System", on page 40.

You can also feed the replayed I/Q data stream to an appropriate signal generator (e.g. an R&S SMU200A) in order to re-generate and analyze the modulated RF signal under laboratory conditions.

2.5 Replaying Data Using Generator Control

An Rohde & Schwarz signal generator (like R&S SMBV100A, R&S SMU, R&S SFC, R&S SFE) with a digital I/Q interface can be used for data replay. If the R&S IQR is equipped with option R&S IQR-K2, "Generator Control", you can configure the Rohde & Schwarz signal generator from the R&S IQR, preset the device, control measurement parameters, and replay the measured I/Q data. No additional control device is required.

To establish the test setup and prepare the instruments

1. Connect the R&S IQR to the signal generator as shown below. Use the I/Q data cable which you received with your R&S IQR to establish the digital I/Q data connection. Use a LAN cable to enable control of the signal generator by R&S IQR-K2. For accurate sampling rates of the replayed data, use one of the four delivered BNC cables for a reference frequency connection.
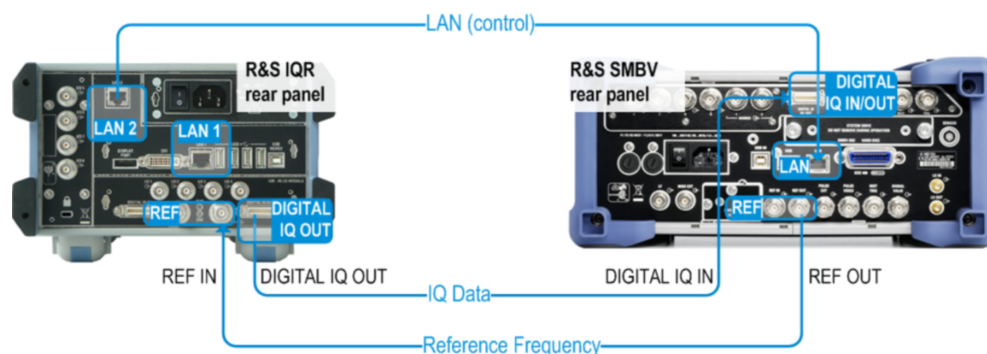
Figure 2-4: Test setup for data replay using Generator Control

2. Switch on both instruments.

    If option R&S IQR-K2 is unlocked and enabled, the "Player" window of the R&S IQR contains a "Generator Control" button. Tap the "Generator Control" to load the control interface.

For further details on R&S IQR-K2, see Chapter 6.2, "R&S Generator Control (R&S IQR-K2)", on page 96 .

3 Data Recording

This chapter describes the use of the R&S IQR in "Recorder" mode, where it can record an I/Q data stream and store it in a file on its internal disk.

3.1 General Description

In "Recorder" mode, the R&S IQR records the digital data stream that it receives via the DIGITAL IQ IN connector. The essential stages of data recording are shown below, together with the corresponding configuration blocks and controls of the R&S IQR. The light brown configuration blocks can be activated in arbitrary order. Perform the necessary settings, then arm the trigger system before you start recording.
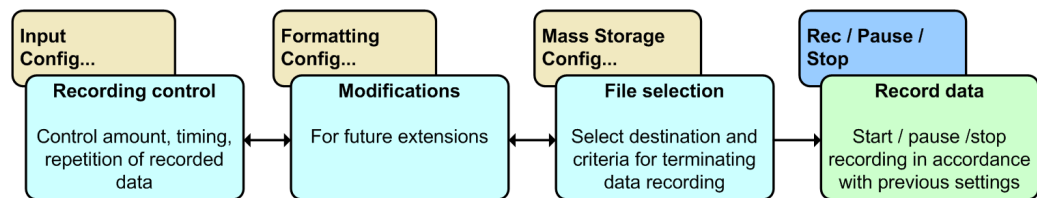
Figure 3-1: Basic data recording stages

The data is usually provided by a source instrument with a compatible R&S Digital I/Q Interface, e.g a signal generator or a network scanner. A typical test setup with an R&S AMU200A Baseband Signal Generator and Fading Simulator is shown in Chapter 2.2, "Recording Data", on page 24.

Related information

● Measurement example, including necessary preparations; see Chapter 2.2, "Recording Data", on page 24

● GUI reference, see Chapter 3.2, "GUI Reference", on page 43

● Programming example, see Chapter 8.2, "Recording Data", on page 109

● Remote control command reference, see Chapter 9.3, "Recorder Commands", on page 122

The following sections give a general description of the essential concepts and data transfer settings.

3.1.1 Trigger System

The trigger system starts and stops data recording. With a suitable combination of trigger settings, an exact control of the amount of recorded data and their timing is possi-

ble. The recorder trigger system is very similar to the trigger system for "Player" mode, however, the settings do not overwrite each other. Refer to Chapter 4.1.1, "Trigger System", on page 60 for a detailed description of the trigger modes, observing the information in the remainder of this section.

Note the following differences compared to "Player" mode.

- In "Recorder" mode, the trigger system controls data recording.
- The amount of recorded data is defined by the "Terminate Condition" in the "Mass Storage" dialog. Recording stops when a maximum file size or recording duration has been reached, or when the disk is full.
- Recording stops when the "Terminate Condition" is satisfied. No continuous recording is supported.
- Data recording may be triggered by the recorded data stream itself; see Chapter 3.1.1.2, "Additional Trigger Sources for Recording", on page 42.
- Different synchronized operation; see Chapter 3.1.1.1, "Standalone and Synchronized Operation", on page 41

Trigger system and recorder control buttons

Data recording is controlled using the "Rec", "Pause", and "Stop" buttons across the bottom of the GUI. The trigger settings are effective after you check the "Input > Armed" box and tap "Rec". "Pause" and "Stop" discontinue recording, irrespective of the trigger settings.

While data recording is "Running", all control elements of the GUI except "Pause", "Stop" and spectrum display handling are disabled.

3.1.1.1 Standalone and Synchronized Operation

The R&S IQR may operate as an independent unit or in combination with a second instrument.

The following "Synchronization Modes" are available:

- **Stand Alone:** The R&S IQR operates as an independent unit, recording a single data stream. The full range of "Recorder Trigger" settings is available. If an external trigger source is selected, the trigger signal must be applied to the I/O connectors selected via "Control Line Setup > Trigger Start / Gate On" and "Trigger Stop".
- **Master:** The R&S IQR acts as a master for a second R&S IQR; both instruments can record two I/Q data streams, starting at the same time. The recording times of the master and slave R&S IQR may differ from one another, depending on the sampling rates of the source instruments and the "Terminate Condition" settings. The "Recorder Trigger" settings can be used without restriction, however, I/O 7 is reserved for the external trigger signal destined for the slave instrument. Establish a trigger connection to the slave instrument as shown in the drawing. The sample clock connection is not needed; the sampling rates for master and slave are determined by the source instruments.
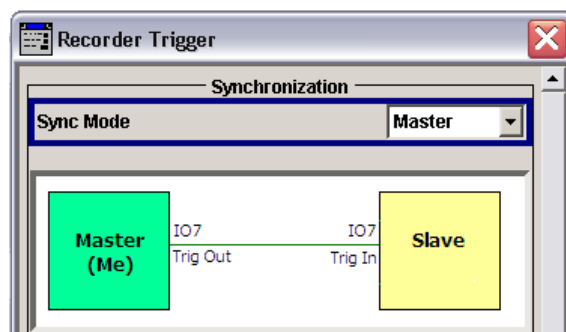
Possible master configuration: External trigger from a third instrument. "Trigger Start / Gate On: I/O 2", "Trigger Stop: Off".
Slave configuration: "Sync Mode: Slave". This means that the slave instrument uses the "Trigger Start / Gate On" signal fed in at I/O 7. No "Trigger Stop" signal is used.

● **Slave:** Data recording of the R&S IQR is controlled by a second, master R&S IQR. The master instrument can use arbitrary trigger and clock source settings; see above. The slave instruments enables recording typically 100ns after the master instrument. Note that on low sample rates it can take considerable time until the first sample is received after recording has been enabled. The slave R&S IQR is set to external trigger mode; the trigger signal is fed in via I/O 7.
Establish a trigger connection to the master instrument as shown in the drawing. The sample clock connection is not needed; the sampling rates for master and slave are determined by the source instruments.
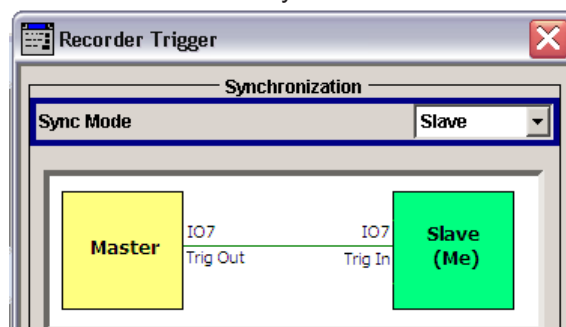
3.1.1.2   Additional Trigger Sources for Recording

In "Recorder" mode, the R&S IQR supports all trigger sources described in Chapter 4.1.1, "Trigger System", on page 60. In addition, recording may be triggered by the information in the received I/Q data stream.

● **I/Q Level**: The R&S IQR evaluates the level of each data sample and starts recording as soon as a specific threshold value ("Level") is exceeded.

- **DIG IQ GP:** One of the digital general purpose signals GP1 to GP4 provides the trigger events. The GP signals must be included in the recorded data stream; they are fed in via the DIGITAL IQ IN connector; along with the I and Q samples. Most of the trigger settings described in Chapter 3.2.3.1, "Trigger Settings", on page 49 are valid for the "DIG IQ GP" trigger source. The GP trigger signals can be used in two different ways: In "Edge Trigger" mode each rising or falling edge of the selected GP signal provides a single trigger event. In "Gated Trigger" mode, recording is restricted to the high periods of the GP signals.
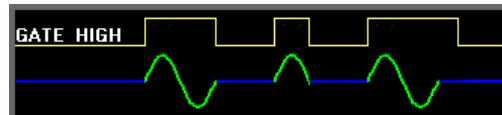
3.1.2 Streaming Files

When recording data, the R&S IQR creates a pair of I/Q data files of equal size. The files have the extensions `*.ws1` and `*ws2`; they are stored to drives `e:\` and `f:\` of the removable memory. It is sufficient to specify the `*.ws1` file on drive `e:\`; the R&S IQR will automatically create the associated `*.ws2` file. See also Chapter 4.1.2, "Streaming Mode", on page 64.

The R&S IQR inserts a tagged waveform header at the beginning of each I/Q data file.

3.1.3 General Purpose Signals

General purpose (GP) signals are digital control signals which are included in the recorded I/Q data stream: Each I/Q sample transmitted over the R&S Digital I/Q Interface is extended by 6 GP bits. The R&S IQR can use the general purpose signals GP1 to GP4 as trigger signals (trigger source "DIG IQ GP"; see Chapter 3.1.1.2, "Additional Trigger Sources for Recording", on page 42).

In a typical application scenario, a source instrument generates a GP signal to label different points in time or time intervals within the transmitted I/Q data stream. The R&S IQR uses the "DIG IQ GP" trigger in order to restrict recording to the time intervals of interest.

For the time being there are no source instruments generating GP signals.

3.2 GUI Reference

The following sections provide reference information about the elements of the Graphical User Interface (GUI) which control the R&S IQR in "Recorder" mode. For an introduction and general features refer to Chapter 3, "Data Recording", on page 40.

3.2.1　Main Application Window (Recorder)

The main window is divided into three parts:

- The upper part shows the current configuration of the R&S IQR in "Recorder" mode and information concerning the instrument status and the current recording session.

- The center part shows the four main configuration blocks for data recording ("Source Instrum.", "Input", "Formatting", "Storage"). Additionally a Spectrum Display is provided, see Chapter 3.2.6, "Spectrum Display", on page 55. These blocks are described in the following sections.
  The "Input" control block turns blue as soon as the trigger system is "Armed" (ready to receive trigger events in order to start recording).
  Note that in "Armed" state the R&S IQR ignores messages from the source instrument (other sample rate, reference level, added channels). Also the DIG IQ cable must not be removed or plugged in while the R&S IQR is armed, else the source instrument will not be detected reliably.
  The "Storage" block turns blue as soon as a file for the recorded data has been selected. Recording can be started as soon as both configuration blocks are blue; see Chapter 2.2, "Recording Data", on page 24.
  Input connectors for external trigger signals are also shown in the central part (see green symbols in the figure below). The connectors are assigned in the "Input" configuration block.
  The current time is displayed in the lower right corner; this information is relevant e.g. for the time trigger (see Chapter 4.1.5, "Time Trigger", on page 63).

- The lower part provides buttons to control recording and access the main windows for replay, optional extensions, and administrative tasks.
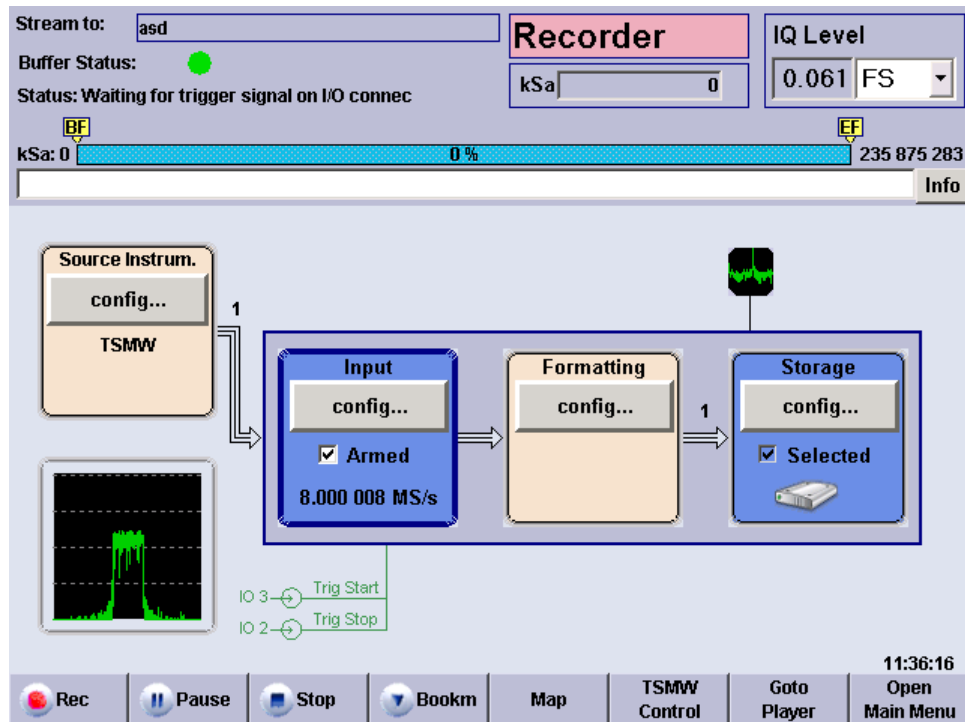
Figure 3-2: Main application window in recorder mode

Instrument status

The upper part of the main application window provides the following information.

"Stream to"   Name of the selected storage file. See Chapter 3.2.5, "Storage Set-
                  tings", on page 54.

"Buffer Status"   A green dot indicates normal operation (no error). A red dot indicates
                  that recording was stopped, most likely because the input buffer was
                  empty (no data available, error).

"(Trigger)   Trigger status message. All messages are self-explanatory. "Run-
Status"   ning" indicates that data is being recorded. "Ready" means that the
                  trigger system has paused or stopped recording.

"kSa"	Sample counter and progress bar. The default bookmark labels "BF" and "EF" (beginning and end of file) appear in yellow boxes at the beginning and the end of the progress bar. Additional, user-defined bookmarks are displayed with their index numbers; see Chapter 3.2.7, "Bookmarks", on page 57. Click on a bookmark label to retrieve detailed information and to switch between all bookmarks in the file.
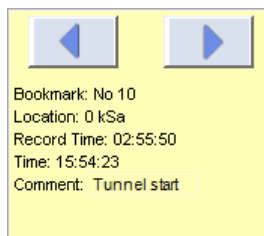
The unit of the progress bar is configurable; see "GUI Configuration..." on page 80.

"Info"	Opens a dialog with a record of error messages. "Static" error messages are still pending (i.e. they refer to the current state of the R&S IQR). The error "History" also contains messages from the past. "Volatile" messages are not stored when the R&S IQR is shut down, so they are no longer visible in later sessions. Non-volatile messages persist. You can delete some or all of the messages from the history list. The "History" dialog is also used for remote control error messages; see Chapter 7.1.1, "Activating Remote Control Mode", on page 106.

Remote command:

STATus:RECorder?

TRIGger:RECorder:STATe?

MEASure:IQ:SAMPles?

I/Q Level

Level of the recorded I/Q samples. The R&S IQR subdivides the recorded data into groups of 32 consecutive samples. The average level is calculated for each group. The reported "I/Q Level" is the peak value of these average levels within a time interval of 1/2 s. The result is updated every 1/2 s.

"I/Q Level" can be retrieved as a ratio relative to full scale (FS) level ("FS"), as a percentage ("% FS"), or as a logarithmic value ("dBFS"). The three units are related as follows:

x %FS = (0.01*x) FS; x dBFS = 20 * log(x FS)

The R&S IQR uses the scaling convention where is RMS value of a full-scale sine wave is designated 100 %FS (0 dBFS). Consequently, the I/Q levels can range up to 141.4 % FS (+3.010 dBFS).

Remote command:

MEASure:IQ:AMPLitude?

Control buttons

The control bar across the bottom of the screen is filled with buttons:

- "Rec" / "Pause" / "Stop" control data recording, together with the trigger settings. See Chapter 3.1.1, "Trigger System", on page 40.

  To record data, a file must be loaded, and the trigger must be armed. Check the trigger status information in the upper part of the dialog in case the "Rec" button does not work. The control elements of the GUI (except "Pause" and "Stop") are disabled while recording is in progress.

- "Bookm" allows you to add bookmarks to the recorded file which you can later use for replay control; see Chapter 3.2.7, "Bookmarks", on page 57.

- "Map" is available if option R&S IQR-K102, "GPS Data Recording", and option R&S IQR-K103, "GPS Map", is installed. The button opens a map view of the measurement track; see Chapter 6.5, "GPS Map (R&S IQR-K103)", on page 100.

- The remaining buttons switch to other main windows and are self-explanatory. In general, switchover is disabled while the trigger system is armed.

| Rec | Pause | Stop | Bookm | Map | TSMW Control | Goto Player | Open Main Menu |

Tip: You can add buttons to the bar in order to start executable programs (such as "TSMW Control" shown in the figure above); see Chapter 3.2.2, "Source Instruments", on page 47.

Remote command:

`TRIGger:RECorder:STARt`

`TRIGger:RECorder:PAUSe`

`TRIGger:RECorder:STOP`

`TRIGger:RECorder:EXECute`

3.2.2 Source Instruments

The "Source Instrum." control block shows the intrument at the DIGITAL IQ IN connector with its serial number and digital output connector name. "Digital IQ In Disconnected" is displayed if no compatible source instrument is detected. Refer to the data sheet for a list of compatible source instruments.

The "Config..." button in the "Dest. Instrum." configuration block opens a context menu with two entries:

- "Rem. Control" opens a configuration dialog where you can install control software for destination instruments; see below.

  The "Browse..." buttons in the "Configure Source Instruments" dialog open a selection dialog for the executable programs (*.exe) which are accessible from the R&S IQR. If a program is selected, a button with its symbolic name appears in the "Recorder" main application window. The button starts the program. The "TSMW Control" application desribed in Chapter 6, "Software Options", on page 92 is entered automatically when the option is unlocked.
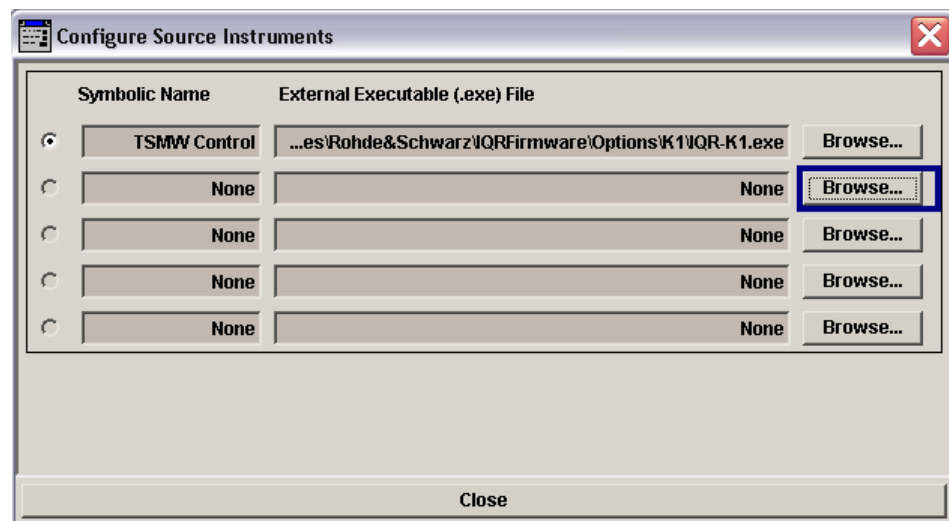
Figure 3-3: Configure source instruments

- "Dig. I/Q Info" shows detailed information about the connected source instrument. "Mappping" indicates the number of data streams the device is able to transmit. MAP3 means multiple streams and MAP1 means only one stream is possible.
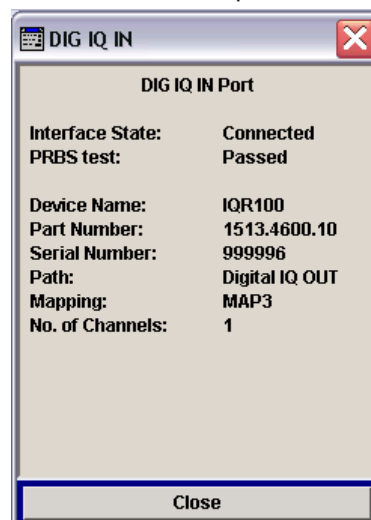
Figure 3-4: Digital IQ Information e.g for an R&S IQR

SCPI command:

SYSTem:INSTrument:SOURce:IDENtification?

SYSTem:APPLication:SOURce:SELect<ch>

SYSTem:APPLication:SOURce:SYMBolic<ch>

SYSTem:APPLication:SOURce:FILename<ch>

SYSTem:APPLication:SOURce:RUNNing?

3.2.3 Input Configuration

The "Config..." button in the "Dest. Instrum." configuration block opens a context menu with two entries:

- The "Trigger..." button in the "Input" configuration block (see Figure 3-2) gives access to the trigger system for data recording.
- The "IQ Channels..." button in the "Input" configuration block (see Figure 3-2) gives access to the IQ channel settings, see Chapter 3.2.3.2, "IQ Channel Settings", on page 52.

3.2.3.1 Trigger Settings

The "Trigger" dialog gives access to the recorder trigger settings. The contents of the trigger dialog depend on the trigger source; an example is shown below.
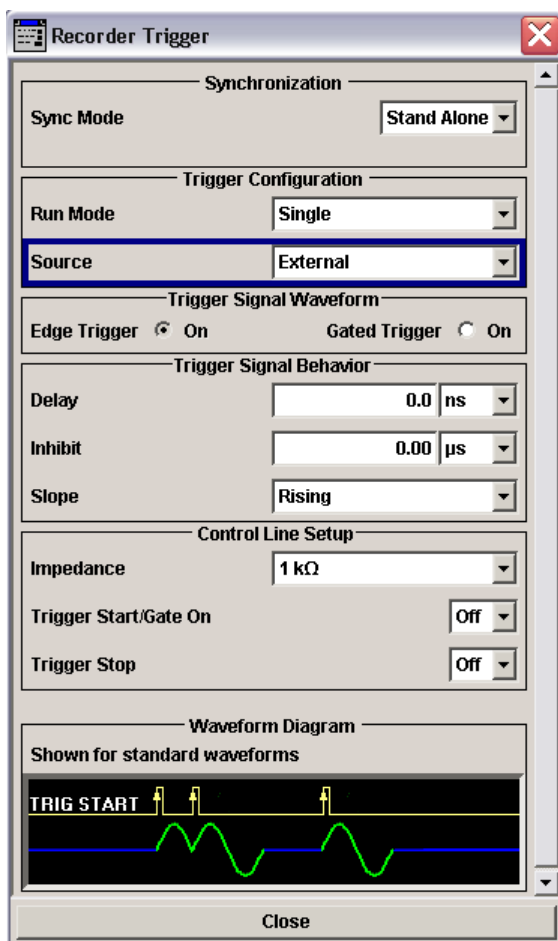
Figure 3-5: Trigger settings (external trigger)

General description

The recorder trigger system is similar to the trigger system for replay. For detailed information, including the dependencies between the different settings, refer to Chapter 3, "Data Recording", on page 40 and Chapter 4.1.1, "Trigger System", on page 60.

Synchronization

Configures the R&S IQR for stand-alone operation or for simultaneous data recording with a second, interconnected R&S IQR; see Chapter 3.1.1.1, "Standalone and Synchronized Operation", on page 41.

Remote command:
TRIGger:RECorder:SYNC

Trigger Configuration

Basic trigger settings as described in Trigger System. In "Recorder" mode, "Run Mode: Single" is supported only.

"Source"	Source of the trigger events as described in Chapter 4.1.1.3, "Manual / SCPI via LAN Trigger ", on page 62 and in Chapter 3.1.1.2, "Additional Trigger Sources for Recording", on page 42. The settings in the "Trigger" dialog are adjusted to the selected trigger source. The following "Trigger Configuration" settings are available for a particular trigger source only.
"Execute"	Arms the "Manual" trigger.
"General Purpose Signal"	Selects one of the general purpose signals GP1 to GP4 to create "DIG IQ GP" trigger events. See Chapter 3.1.3, "General Purpose Signals", on page 43.
"Level"	Threshold level for the "IQ Level" trigger. Recording starts as soon as the I/Q level of a recorded sample exceeds the threshold.
"Start Time / Stop Time"	Start and stop time for "Time" trigger. Recording is enabled in the period between the start and the stop time.

Remote command:
TRIGger:RECorder:MODE
TRIGger:RECorder:SOURce
TRIGger:RECorder[:IQ]:GPSignal
TRIGger:RECorder[:IQ]:LEVel
TRIGger:RECorder[:STARt]:TIME
TRIGger:RECorder:STOP:TIME
TRIGger:RECorder:ARM

Trigger Signal Waveform

Defines how an "External" trigger signal or an "DIG IQ GP" trigger signal controls data recording; see Chapter 4.1.1.4, "External Trigger", on page 63.

"Edge Trigger"   Each trigger pulse generates a single trigger event.

"Gated Trig- Recording is restricted to the active high or active low periods of the
ger"   trigger signal, depending on the "Trigger Signal Behavior > Gate
            Polarity" setting.

Remote command:
TRIGger:RECorder:TYPE

Trigger Signal Behavior
Defines the relationship between an "External" or "DIG IQ GP" trigger signal and the
actual start of recording.

"Delay"   Time offset between the trigger event and the start of recording.
                 Recording starts <Delay> s after the R&S IQR receives a trigger
                 event.

"Inhibit"   Holdoff time after each detected trigger event during which the
                 R&S IQR is inhibited from acting on any new trigger.

"Slope"   Qualifies whether the event occurs on the rising or falling edge of the
                 "Edge Trigger" signal. In "Gated Trigger" mode, this setting is
                 replaced by the "Gate Polarity".

"Gate Polarity" Qualifies whether recording is enabled during the active high or active
                 low periods of the "Gated Trigger" signal. In "Edge Trigger" mode,
                 this setting is replaced by the "Slope".

Remote command:
TRIGger:RECorder:DELay
TRIGger:RECorder:HOLDoff
TRIGger:RECorder:SLOPe
TRIGger:RECorder:POLarity

Control Line Setup
Selects and configures the input connectors for the "External" trigger signal (see speci-
fication in Chapter 4.1.1.4, "External Trigger", on page 63).

"Threshold"   Threshold voltage of the trigger inputs (rear panel connectors I/O 1 to
                 I/O 8). Trigger events are generated when the voltage at the selected
                 "Trigger Start/Gate On" and "Trigger Stop" connectors reaches the
                 threshold. A low threshold may be required to ensure that the
                 R&S IQR actually detects all trigger pulses. A higher threshold can
                 prevent unintentional trigger events.

"Impedance"   Input impedance of the trigger inputs (rear panel connectors I/O 1 to
                 I/O 8). Select the impedance in accordance with the output impe-
                 dance of your trigger source and the impedance of the connecting
                 cable to avoid reflections.

"Trigger Start/ Input connector for the trigger signals, one of the rear panel connec-
Gate on and   tors I/O 1 to I/O 8. If an external clock source is selected for replay,
Trigger Stop"   I/O 1 is reserved for the external sampling clock signal (see Chap-
                 ter 4.2.4.1, "Clock", on page 72. "Off" means that no external trigger
                 signal is used.
                 In "Edge Trigger" mode, it is possible to use two different external
                 trigger signals to start and stop recording. In "Gated Trigger" mode, a
                 single "Gate on" signal is used.

Remote command:
TRIGger:RECorder:THReshold
TRIGger:RECorder:IMPedance
TRIGger:RECorder[:STARt]:INPut
TRIGger:RECorder:STOP:INPut

Waveform Diagram
The waveform diagram visualizes the effect of the current trigger settings; see Chap-
ter 4.1.1.2, "Waveform Diagrams", on page 62.

3.2.3.2 IQ Channel Settings

The "IQ Channels..." dialog is used to configure which channels should be recorded.
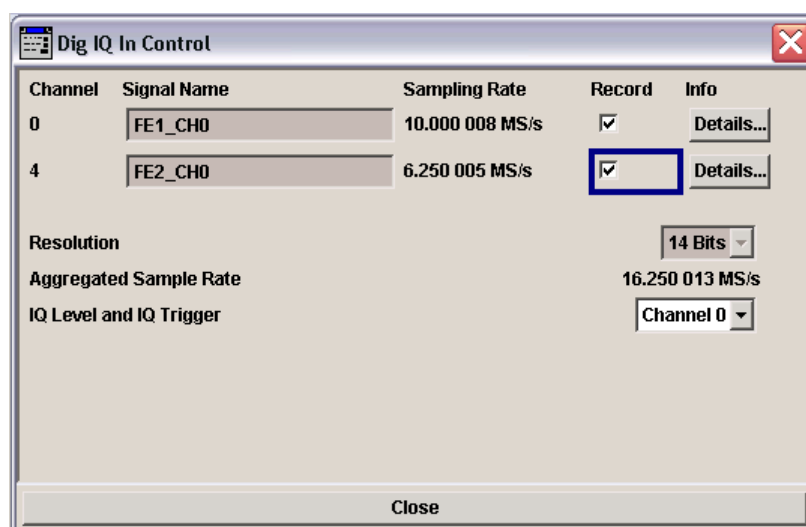
Channel
The channel numbers received by the R&S IQR

Signal name
The signal name for each channel as advertised by the source instrument.

Sampling rate
The sampling rate as advertised by the source instrument.

Record
Check this box to record the corresponding channel. To record more than one channel
the R&S IQR-K105 option is required.

Details
Opens the following dialog box that shows the reference level for the corresponding
channel and the time at which this reference level was received. Note that the level can
shift due to variations in temperature in the source instrument. These changes are not
registered.

Resolution
The IQ data resolution the R&S IQR will store. The resolution for a multi channel recording is 14 bits instead of 16 bits for one channel. Every single data value will be rounded to the next integer value

Aggregated Sample Rate
The aggregated sample rate is the sample rate sum of all selected channels. If this value exceeds the capability of the R&S IQR the value becomes red. Note that this value is not measured by the R&S IQR but calculated from the individual channel sample rates as advertised by the source instrument.

IQ Level and IQ Trigger
Defines which channel is used for the trigger system and the IQ level display in the upper right corner.

3.2.4 Formatting Settings

Formatting Settings are not supported within this version.

The "Config..." button in the "Formatting" configuration block opens a dialog which shows the basic format of the recorded data.
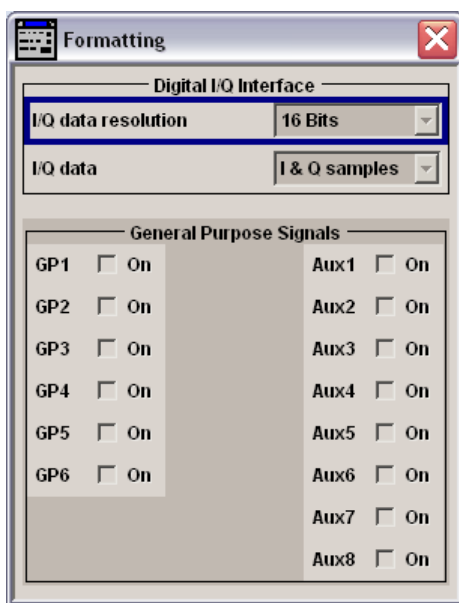
Figure 3-6: Formatting settings

Digital I/Q Interface
Shows the basic format of the recorded I/Q data. All settings are fixed.

"I/Q Data Res-   Each single recorded I or Q sample comprises 16 bits.
olution"

"I/Q Data"   The R&S IQR records the complete I/Q data.

General Purpose Signals
For future extensions.

3.2.5 Storage Settings

The "Config..." button in the "Storage" configuration block gives access to the storage file settings; see Figure 3-2.
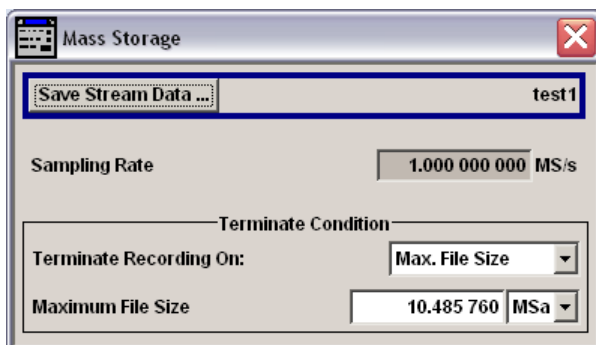
Figure 3-7: Storage settings

Save Stream Data

Opens a dialog for the selection of a destination file for the recorded I/Q data. See Chapter 3.1.2, "Streaming Files", on page 43.

The expected sampling rate (i.e. the number of I/Q samples recorded per second) is displayed for information. The sampling rate is reported by the source instrument using the control lines of the R&S Digital I/Q Interface; it does not depend on any R&S IQR settings.

Remote command:

INPut:RECorder:WAVeform:SELect

MEASure:IQ:CLOCk?

Terminate Condition

Defines the criteria for the end of the recording process. If no other criterion is met, recording is terminated when the disk is full.

"Max. File Size"	Terminate recording when the amount of data specified by the "Maximum File Size" has been recorded. This generates a storage file of definite size.
	Note: Recorded data is stored in blocks with a 10 MByte (10 * 2^{20} Byte = 10,485,760 Byte) block size. The entered "Max. File Size" is rounded up to the next integer multiple of 10 MByte. The recorded data is always stored in a pair of files, each with a size of <header size> + n * 5 MByte (n = 1, 2, 3...); <header size> ≪ 5 MByte. This means that the recorded file sizes are 2 * <header size> + 10,485,760 Byte, 2 * <header size> + 2 * 10,485,760 Byte, 2 * <header size> + 3 * 10,485,760 Byte...
"Max. Rec. Duration"	Terminate recording when the specified "Maximum Record Duration" has elapsed. This generates a storage file with data from a definite period of time.
"Full Disk"	Terminate recording when the removable disk is full - store the maximum amount of data.

Remote command:

INPut:RECorder:LIMits:CONDition

INPut:RECorder:LIMits:DURation

INPut:RECorder:LIMits:FILesize

3.2.6 Spectrum Display

The block "Spectrum Display" shows the spectrum of the input signal in the left lower corner. The small Spectrum Icon indicates where the spectrum is taken from. Before the start of the measurement the icon is connected to "Input".

During record the spectrum icon is connected to "Storage". The values for the calculation of the spectrum are read from main memory shortly before saving data on the hard disk. Because of large data buffers the displayed spectrum will not match the actual spectrum at the moment.
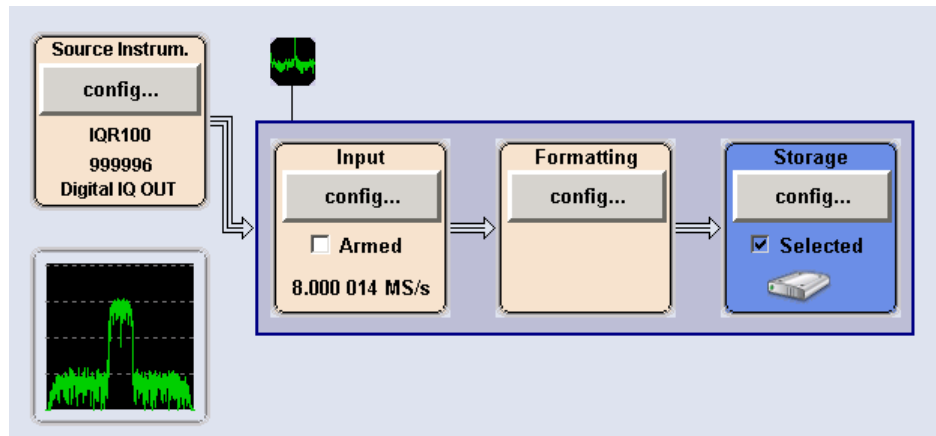
Figure 3-8: Spectrum Display - Before recording
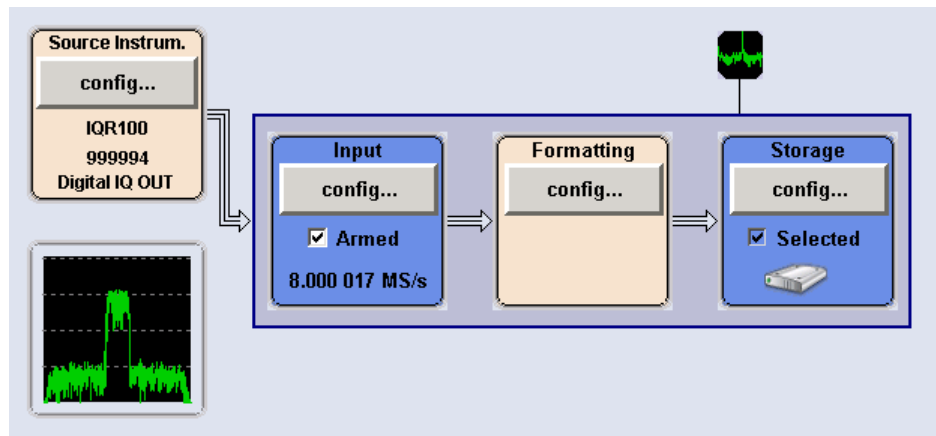
Figure 3-9: Spectrum Display - Recording running

Baseband Spectrum

Double clicking the spectrum preview will open the "Baseband Spectrum" window where a rectangle zoom can be performed in the following way. First choose a corner point with the cursor, hold the left button on the cursor down and move to the opposite corner point after that release the button.

● **Ref.Level**
   Shows the reference level at record start time. If "AGC" is enabled in the IQ Data Source (requires option R&S IQR-K104), the reference level is changed according to the signal strength.
● **Mode**
   Possibility for the change between Power Spectrum and I/Q values.
● **Channel**
   Selection of the displayed channel in case of a multi channel source.
● **Undo Zoom**
   The view will go back to the last zoom level.
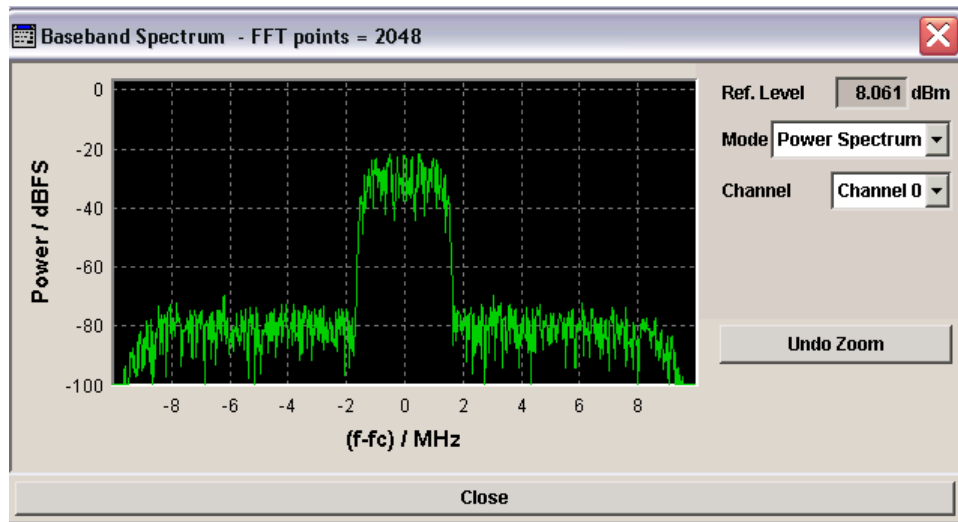
Figure 3-10: Baseband Spectrum - Mode: Power Spectrum
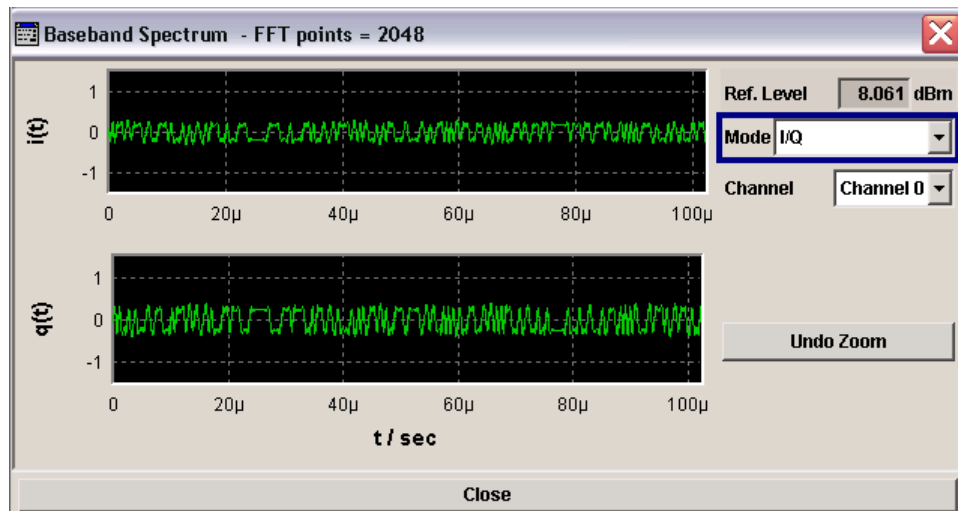
Figure 3-11: Baseband Spectrum - Mode: I/Q

Note: R&S IQR is not used to be an analyzer, thats why no accuracy is assured.

3.2.7   Bookmarks

The "Bookm" button in the control bar opens a dialog which allows you to add book-marks to the recorded file. The "Bookm" button is enabled while a data set is recorded (after "Rec").
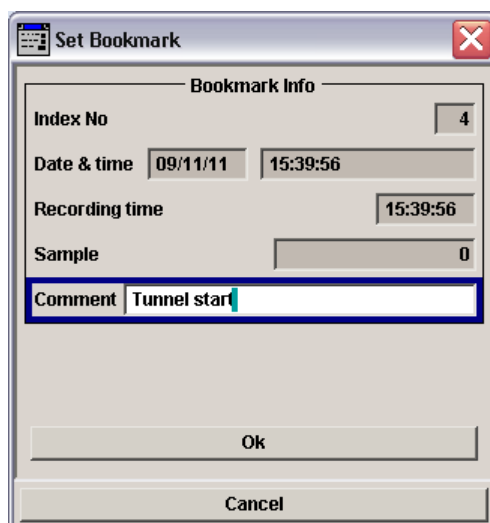
A bookmark is an identification mark for events that occurred during recording (and may have an impact on the recorded data). For instance, suppose you encountered a tunnel during a test drive and you want to label this in your recorded data stream. Simply tap the bookmark button and enter an appropriate "Comment" as shown above.

The following R&S IQR functionality is related to bookmarks:

- "Bookm" button: Define up to ten bookmarks while recording I/Q data.
- Progress bars: Show the position of the default bookmarks ("BF" or "BF/OD" for "beginning of file / oldest data" and "EF" or "EF/ND" for "end of file / newest data") and of all user-defined bookmarks within the recorded or replayed file.
- "GoTo" button: Select a sample range around a particular bookmark for replay; see Chapter 4.2.6, "Selective Replay (GoTo)", on page 77.

Non-editable fields
The fields in the upper part of the dialog are automatically filled at the time when the "Bookm" button is tapped. They determine the position of the bookmark within the file, irrespective of the additional time you need to enter your comment and close the dialog ("OK").

The "Index No." is automatically incremented whenever a new bookmark is created. A maximum of 10 user-defined bookmarks can be defined, in addition to the default bookmarks "BF" and "EF". The "Recording Time" is the time since the start of the recording session. After "Pause", this time information is lost.

Remote command:
INPut:RECorder:BOOKmark:SET
INPut:RECorder:BOOKmark:RESet

Comment
The bookmark labels above the toolbar contain the index numbers. The "Comment" appears in the detailed info box when you tap a bookmark label; see "Instrument status" on page 45.

Remote command:
INPut:RECorder:BOOKmark<ch>:COMMent

4 Data Replay

This chapter describes the use of the R&S IQR in "Player" mode, where it can replay recorded I/Q data ("streaming" mode) or act as an arbitrary waveform generator. The chapter is divided into the following main parts.

4.1 General Description

In "Player" mode, the R&S IQR transmits data from a file or from the Random Access Memory (RAM) at its DIGITAL IQ OUT connector. The data may be modified prior to transmission. The essential stages of data replay are shown below, together with the corresponding configuration blocks and controls of the R&S IQR. The light brown configuration blocks can be activated in arbitrary order.

Trigger Config...		Mass Storage Config...		Output Config...		Play / Pause / Stop	
Replay control		**Data selection**		**Modifications**		**Run replay**	
Control amount of replayed data, timing, repetition	⟷	Contents of a waveform file or waveform data stored in RAM	⟷	Generate markers, add impairments	→	Start / pause /stop replay in accordance with previous settings	
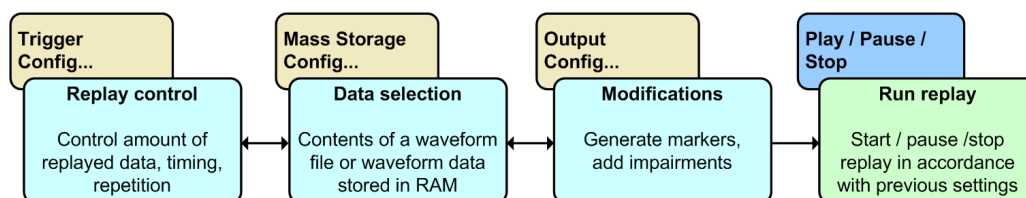
Figure 4-1: Basic data replay stages

The data can be routed to a destination instrument with a compatible R&S Digital I/Q Interface where it is analyzed or further processed. R&S IQR and destination instrument should be synchronized using the 10 MHz reference signal. A typical test setup with an R&S AMU200A Baseband Signal Generator and Fading Simulator is shown in Chapter 2.4, "Replaying Data", on page 36.

Related information

- Measurement example, including necessary preparations; see Chapter 2.4, "Replaying Data", on page 36
- GUI reference, see Chapter 4.2, "GUI Reference", on page 64
- Programming example, see Chapter 8.3, "Replaying Data", on page 111
- Remote control command reference, see Chapter 9.4, "Player Commands", on page 139

The following sections give a general description of the essential concepts and data transfer settings.

4.1.1 Trigger System

The trigger system starts and stops the replayed data stream. With a suitable combination of trigger settings, an exact control of the amount of replayed data, their timing and repetition is possible.

The following basic trigger settings define the replay mechanism in principle:

- **Run Mode:** Single or continuous data transmission. Single transmission means that data replay stops after one replay cycle, i.e. after all selected data (typically, the contents of a waveform file) has been transmitted. Continuous transmission means that the data is transmitted repeatedly without delay (the R&S IQR cycles through the data set/file).
- **Source:** Source of the trigger events, as described in the following sections.

For most combinations of the basic settings, the R&S IQR provides additional parameters to specify the trigger mode in detail. This yields a large number of possible scenarios, however, the "Waveform Diagrams" in the "Trigger" dialog will help you find the settings that are best suited to your needs (see Waveform Diagrams).

Trigger system and replay control buttons

Data replay is controlled using the "Play", "Pause", and "Stop" buttons across the bottom of the GUI. The trigger settings are effective after you check the "Trigger > Armed" box and tap "Play". "Pause" and "Stop" discontinue the replay, irrespective of the trigger settings.

While a data replay is "Running", all control elements of the GUI except "Pause", "Stop" and spectrum display handling are disabled.

4.1.1.1 Standalone and Synchronized Operation

The R&S IQR may operate as an independent unit or in combination with a second instrument.

The following "Synchronization Modes" are available:

- **Stand Alone:** The R&S IQR operates as an independent unit, providing a single data stream. The full range of "Player Trigger" settings is available. If an external trigger source is selected, the trigger signal must be applied to the I/O connectors selected via "Control Line Setup > Trigger Start / Gate On" and "Trigger Stop". If an external clock source is selected, the external clock signal must be applied to I/O 1.
- **Master:** The R&S IQR acts as a master for a second R&S IQR; both instruments can provide two synchronized I/Q data streams. The "Player Trigger" settings can be used without restriction, however, I/O 7 and I/O 8 are reserved for the external trigger and sample clock signals destined for the slave instrument.
  Connect the R&S IQR to the slave instrument as shown in the drawing:
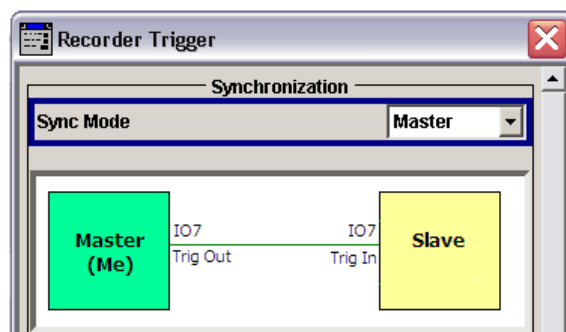
Possible master configuration: External trigger from a third instrument. "Trigger Start / Gate On: I/O 2", "Trigger Stop: Off". External clock from the third instrument at input connector I/O 1.
Slave configuration: "Sync Mode: Slave". This means that the slave instrument uses the external sampling clock and "Trigger Start / Gate On" signals fed in at I/Q 1 and I/O 7, respectively. No "Trigger Stop" signal is used.

● **Slave:** Data replay of the R&S IQR is controlled by a second, master R&S IQR. The slave R&S IQR is set to external clock source and external trigger mode; the external sample clock and trigger signals are fed in via I/O 1 and I/O 7, respectively.
Connect the R&S IQR to the master instrument as shown in the drawing:
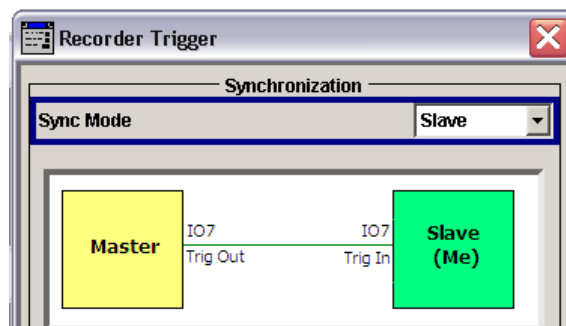
The master instrument can use arbitrary trigger and clock source settings; see above. The slave instruments start replay typically 100ns after the master instrument.

The setup and cabling shown above is useful if during record the source instruments were synchronised and sent the same sample rates to the R&S IQRs. If the source instruments had different sample rates during recording, but still were synchronised, change the master / slave setup as follows:

● Remove the cable for sampling clock from IO8 (master) and IO1 (slave)

● Connect REFOUT at the master to REFIN at the slave

● Set the slave to internal sample clock and external reference clock

● check the sample rate on master and slave. For maximum sample rate precision, enter exactly the sample rates that were present during recording.

Also see Chapter 4.2.4.1, "Clock", on page 72.

4.1.1.2 Waveform Diagrams

The waveform diagrams in the "Trigger" dialog provide a graphical representation of the different trigger scenarios. They comprise the following graphical elements:

- A narrow rectangular pulse with an arrow denotes a trigger event (edge trigger), e.g. a an external TTL signal fed in at one of the rear panel BNC connectors I/O 1 to I/O 8. A positive/negative pulse with an arrow pointing up/down indicates that the trigger event occurs on the rising/falling edge of the trigger signal.
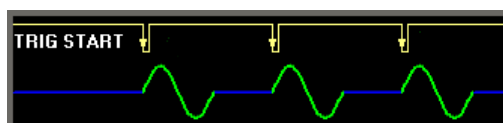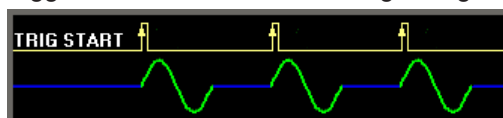
- A rectangular pulse signal with variable low and high periods indicates a gate signal. Depending on the "Gate Polarity" setting, replay is enabled as long as the gate signal is high or low.
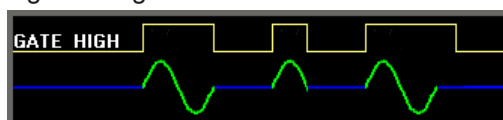
- For "Time" trigger, two pins indicate the start and stop times.
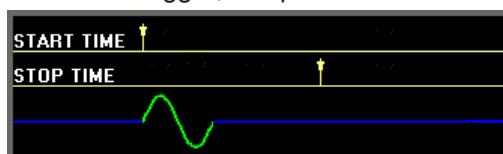
Some additional waveform diagrams occur in "Recorder" mode; see .

4.1.1.3 Manual / SCPI via LAN Trigger

The following trigger sources provide simple trigger mechanisms, with no need for additional trigger settings.

- **SCPI via LAN:** After data transmission is enabled (check the "Trigger > Armed" box and tap "Play"), a `TRIGger:PLAYer:EXECute` command from a controller PC provides the trigger event. The data is transmitted in accordance with the "Run Mode" and "Enable Retrigger" settings.

- **Manual:** The hotkeys across the bottom of the GUI start, pause, or stop the replay; other trigger events are ignored. The data is transmitted in accordance with the "Run Mode". "Execute" arms the trigger system (and thus enables manual trigger mode), provided that a storage file has been loaded.

The waveform diagrams for the trigger sources are similar. In single mode, each trigger event starts a complete replay cycle.
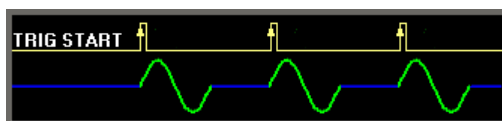
In continuous mode, the replay cycle is repeated continuously.
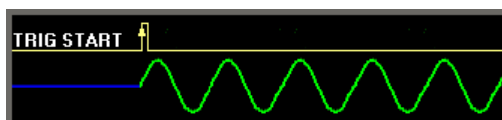
4.1.1.4 External Trigger

If the "External" trigger source is active, one or two digital signals, to be fed in at the BNC connectors I/O 1 to I/O 8, provide the trigger events for the start and stop of the data transmission.
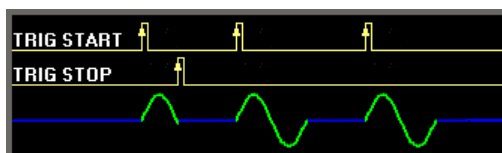
Specification of external trigger signals

The external trigger signals must be low-level TTL signals with a minimum pulse length of 10 ns.

The data is transmitted in accordance with the "Run Mode" settings (see Manual / SCPI via LAN Trigger). Most of the trigger settings described in Chapter 4.2.2, "Trigger Settings", on page 68 are valid for the "External" trigger source. The trigger signals can be used in two different ways: In "Edge Trigger" mode each trigger pulse generates a single trigger event. In "Gated Trigger" mode, replay is restricted to the gate high periods.
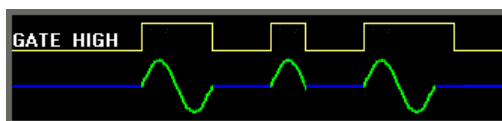
4.1.1.5 Time Trigger

Time trigger means that data transmission is restricted to the interval between the "Start Time" and the "Stop Time". Single and continuous transmission is supported within this interval; the waveform diagram for single transmission is shown below.
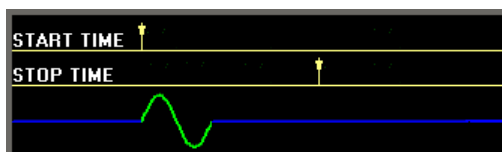
Time settings

The "Start Time" and "Stop Time" definition depends on the "Date and Time" settings of your R&S IQR. To change the date and time or the time zone, open the "Start > Control Panel > Date and Time" menu of Windows® XP Embedded. To access Windows® XP Embedded, use the on-screen keyboard or connect an external keyboard to your R&S IQR and press the Windows key + D.

You can also use the remote control commands `SYSTem:DATE` and `SYSTem:TIME`) to change the date and time.

4.1.2 Streaming Mode

An I/Q data file (streaming file) is replayed at a selectable sampling rate (no. of replayed data samples per second). The file must be stored on the removable memory pack; see Chapter 4.1, "General Description", on page 59. File sizes can reach up to the size of the memory pack.

Mapping of network drives

The data partition of the internal hard disk is mapped to drive d:\. The data partitions of the removable memory are mapped to drives e:\ and f:\. Additional mass storage devices (e.g. a USB stick which is connected to one of the front or rear panel connectors) are assigned to drives i:\, j:\...

Streaming files must be located on drives e:\ and f:\ (see Chapter 4.1, "General Description", on page 59).

Streaming Files

Streaming data is stored in pairs of I/Q data files of equal size. The files have the extensions `*.ws1` and `*.ws2`; they must be stored to drives `e:\` and `f:\` of the removable memory.

When preparing a replay session, make sure that an appropriate pair of streaming files is available. It is sufficient to select the `*.ws1` file on drive `e:\` for replay; the R&S IQR will automatically include the associated `*.ws2` file. An error message is displayed if a streaming file is corrupt (or empty), or if no valid `*.ws2` partner file is available on drive `f:\`.

4.2 GUI Reference

The following sections provide reference information about the elements of the Graphical User Interface (GUI) which control the R&S IQR in "Player" mode. For an introduction and general features refer to Chapter 4.1, "General Description", on page 59.

4.2.1   Main Application Window (Player)

The main window is divided into three parts:

- The upper part shows the current configuration of the R&S IQR in "Player" mode and information concerning the instrument status and the current replay session. .

- The center part shows the four main configuration blocks for data replay ("Trigger", "Mass Storage", "Output", "Dest. Instrum."). These blocks are described in the following sections. Additionally a Spectrum Display is provided in the lower right corner. fot details of the "Spectrum Display" refer to Chapter 3.2, "GUI Reference", on page 43.
  The "Trigger" control block turns blue as soon as the trigger system is "Armed" (ready to receive trigger events in order to start the replay).
  Note that in "Armed" state the DIG IQ cable must not be removed or plugged in, else the destination instrument will not be detected reliably.
  The "Mass Storage" block turns blue as soon as a file for replay has been selected. Data replay can be started as soon as both configuration blocks are blue; see Chapter 2.4, "Replaying Data", on page 36.
  Input connectors for external trigger signals are also shown in the central part (see green symbols in the figure below). The connectors are assigned in the corresponding configuration blocks. The current time is displayed in the lower right corner; this information is relevant e.g. for the time trigger (see Chapter 4.1.1.5, "Time Trigger", on page 63).
  The current time is displayed in the lower right corner; this information is relevant e.g. for the time trigger (see Chapter 4.1.1.5, "Time Trigger", on page 63).

- The lower part provides buttons to control the replay and access the main windows for recording and administrative tasks.
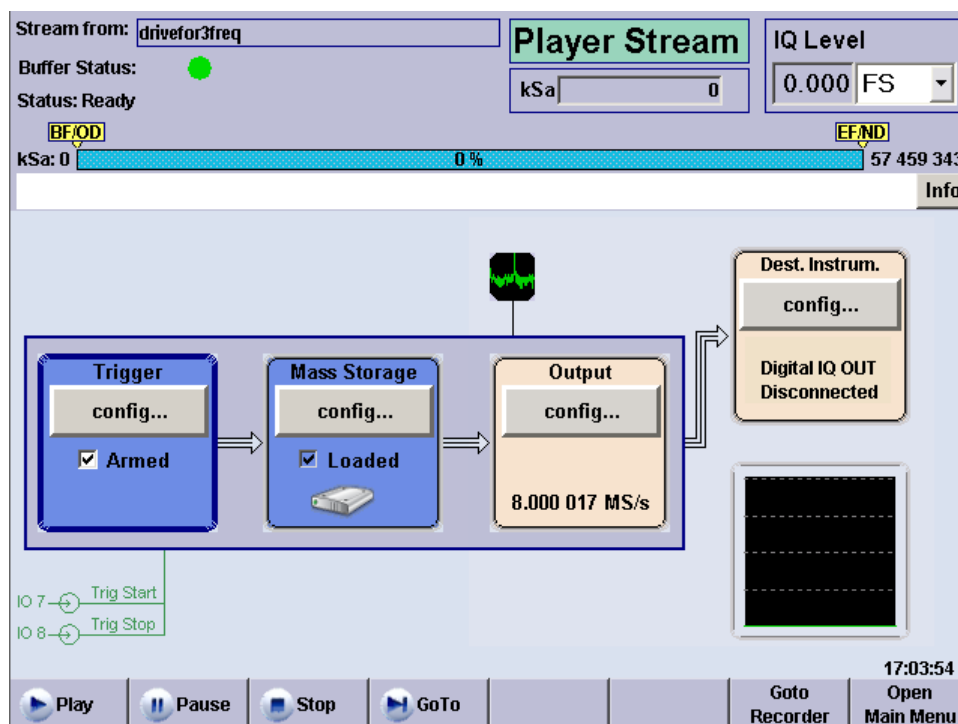
Figure 4-2: Main application window in player mode

Instrument status

The upper part of the main application window provides the following information.

"Stream from / Waveform "	Indication of streaming or arbitrary waveform generator (ARB generator) mode. The frame shows the name of the selected waveform file. See Chapter 4.2.3, "Mass Storage Settings", on page 71.
"Buffer Status"	A green dot indicates normal operation (no error). A red dot indicates that data replay was stopped, most likely because the output buffer was empty (no data for replay available, error).
"(Trigger) Status"	Trigger status message. All messages are self-explanatory. "Running" indicates that data is being replayed. "Ready" means that the trigger system has paused or stopped the replay.

"kSa"	Sample counter and progress bar. The default bookmark labels "BF/OD" and "EF/ND" (beginning of file / oldest data and end of file / newest data) appear in yellow boxes at the beginning and the end of the progress bar. Additional, user-defined bookmarks are displayed with their numbers; see Chapter 3.2.7, "Bookmarks", on page 57. Click on a bookmark label to retrieve detailed information and to switch between all bookmarks in the file.

Bookmark: No 10
Location: 0 kSa
Record Time: 02:55:50
Time: 15:54:23
Comment: Tunnel start
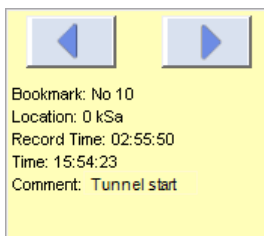
	The unit of the progress bar is configurable; see "GUI Configuration..." on page 80. Moreover, the progress bar changes its appearance if only a subrange of samples within a file is displayed; see Chapter 4.2.6, "Selective Replay (GoTo)", on page 77.
"Info"	Opens a dialog providing a record of error messages. "Static" error messages are still pending (i.e. they refer to the current state of the R&S IQR). The error "History" also contains messages from the past. "Volatile" messages are not stored when the R&S IQR is shut down, so they are no longer visible in later sessions. Non-volatile messages persist. You can delete some or all of the messages from the history list.
	The "History" dialog is also used for remote control error messages; see Chapter 7.1.1, "Activating Remote Control Mode", on page 106.

Remote command:

`STATus:PLAYer?`

`TRIGger:PLAYer:STATe?`

`[OUTPut:]IQ:SAMPles?`

I/Q Level

Level of the replayed I/Q samples, measured and averaged over 32 samples (moving average). While the R&S IQR operates in "Streaming" or "ARB" mode, the values are updated in regular time intervals. When data replay is paused or stopped, the last value is maintained.

The "Output > Impairments > Gain" setting adjusts the average I/Q level for data replay: If a constant envelope signal (e.g. a CW signal) with a level of 1.0 FS is replayed, the I/Q level is equal to the selected gain.

"I/Q Level" can be displayed as a ratio relative to full scale (FS) level ("FS"), as a percentage ("% FS"), or as a logarithmic value ("dBFS"). The three units are related as follows:

x %FS = (0.01*x) FS; x dBFS = 20 * log(x FS)

The R&S IQR uses the scaling convention where is RMS value of a full-scale sine wave is designated 100 %FS (0 dBFS). Consequently, the I/Q levels can range up to 141.4 % FS (+3.010 dBFS).

Remote command:
[OUTPut:]IQ:LEVel?

Control buttons

The "Play" / "Pause" / "Stop" buttons control data replay, together with the trigger settings. See Chapter 4.1.1, "Trigger System", on page 60.

To replay data, a file must be loaded, and the trigger must be armed. Check the trigger status information in the upper part of the dialog in case that the "Play" button does not work. The control elements of the GUI (except "Pause" and "Stop" are disabled while a replay is in progress.

"GoTo" opens a dialog where you can select a sub-range of samples within the file for replay; see Chapter 4.2.6, "Selective Replay (GoTo)", on page 77.

The remaining buttons switch to other main windows and are self-explanatory. In general, switchover is disabled while the trigger system is armed.

Tip: You can add buttons to the bar in order to start executable programs; see Chapter 4.2.5, "Destination Instruments", on page 76.

Remote command:
TRIGger:PLAYer:STARt
TRIGger:PLAYer:PAUSe
TRIGger:PLAYer:STOP
TRIGger:PLAYer:EXECute

4.2.2 Trigger Settings

The "Config..." button in the "Trigger" configuration block gives access to the replay trigger settings; see Figure 4-2. The contents of the trigger dialog depend on the trigger source; an example is shown below.
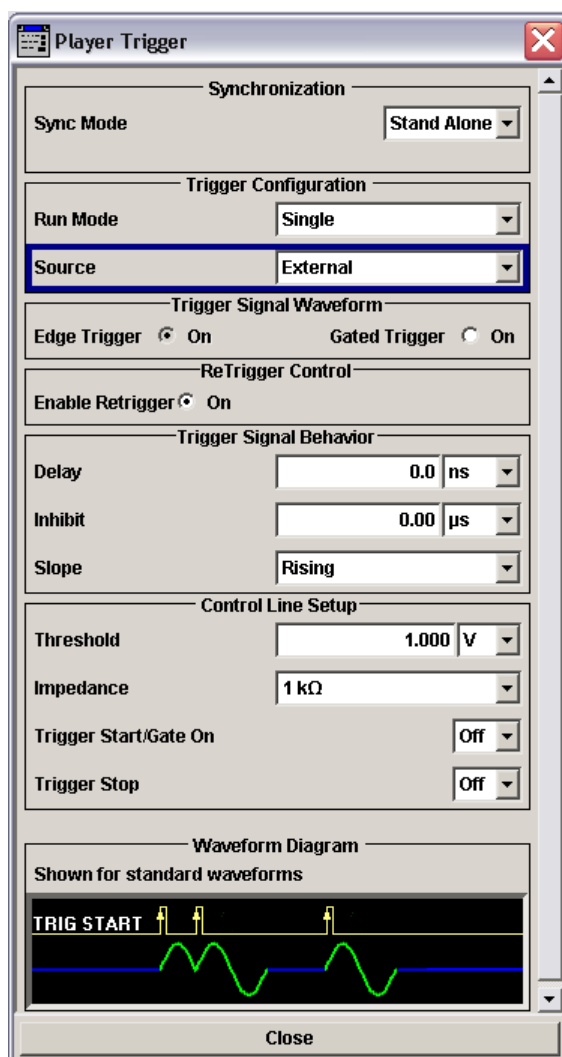
Figure 4-3: Trigger settings (external trigger)

General description

For detailed information about the trigger system, including the dependencies between the different settings, refer to Chapter 4.1.1, "Trigger System", on page 60.

Synchronization

Configures the R&S IQR for stand-alone operation or for simultaneous data replay with a second, interconnected R&S IQR. See Chapter 4.1.1.1, "Standalone and Synchronized Operation", on page 60.

Remote command:
TRIGger:PLAYer:SYNC

Trigger Configuration

Basic trigger settings as described in Trigger System.

"Run Mode"   Single data transmission (one replay cycle) or continuous data transmission.

"Source"   Source of the trigger events as described in Chapter 4.1.1.3, "Manual / SCPI via LAN Trigger ", on page 62 and in the subsequent sections.
The settings in the "Trigger" dialog are adjusted to the selected trigger source. The following "Trigger Configuration" settings are available for a particular trigger source only.

"Execute"   Arms the "Manual" trigger.

"Start Time /   Start and stop time for "Time" trigger. Replay is enabled in the period
Stop Time"   between the start and the stop time.

Remote command:
TRIGger:PLAYer:MODE
TRIGger:PLAYer:SOURce
TRIGger:PLAYer[:STAR]:TIME
TRIGger:PLAYer:STOP:TIME
TRIGger:PLAYer:ARM

Trigger Signal Waveform
Defines how an "External" trigger signal controls the replay process; see Chapter 4.1.1.4, "External Trigger", on page 63.

"Edge Trigger"   Each trigger pulse generates a single trigger event.

"Gated Trig-   Replay is restricted to the active high or active low periods of the trig-
ger"   ger signal, depending on the "Trigger Signal Behavior > Gate Polarity" setting.

Remote command:
TRIGger:PLAYer:TYPE

Trigger Signal Behavior
Defines the relationship between an "External" trigger signal and the actual start of the replay.

"Delay"   Time offset between the trigger event and the start of the replay. The replay starts <Delay> s after the R&S IQR receives a trigger event.

"Inhibit"   Holdoff time after each detected trigger event during which the R&S IQR is inhibited from acting on any new trigger.

"Slope"   Qualifies whether the event occurs on the rising or falling edge of the "Edge Trigger" signal. In "Gated Trigger" mode, this setting is replaced by the "Gate Polarity".

"Gate Polarity"   Qualifies whether data transmission is enabled during the active high or active low periods of the "Gated Trigger" signal. In "Edge Trigger" mode, this setting is replaced by the "Slope".

Remote command:
TRIGger:PLAYer:DELay
TRIGger:PLAYer:HOLDoff
TRIGger:PLAYer:SLOPe
TRIGger:PLAYer:POLarity

Control Line Setup

Selects and configures the input connectors for the "External" trigger signal (see speci-
fication in Chapter 4.1.1.4, "External Trigger", on page 63). The settings are also valid
for the external clock signal connectors and overwrite the settings in the "Clock" dialog;
see "Input Line Setup" on page 74.

"Threshold" Threshold voltage of the trigger and external sample clock inputs
(rear panel connectors I/O 1 to I/O 8). Trigger events are generated
when the voltage at the selected "Trigger Start/Gate On" and "Trigger
Stop" connectors reaches the threshold. A low threshold may be
required to ensure that the R&S IQR actually detects all trigger pul-
ses. A higher threshold can prevent unintended trigger events.

"Impedance" Input impedance of the trigger and external sample clock inputs (rear
panel connectors I/O 1 to I/O 8). Select the impedance in accordance
with the output impedance of your trigger source and the impedance
of the connecting cable to avoid reflections.

"Trigger Start/ Input connector for the trigger signals. The rear panel connectors I/O
Gate on and 1 to I/O 8 are available. If an external clock source is selected, I/O 1
Trigger Stop" is reserved for the external sampling clock signal (see Chap-
ter 4.2.4.1, "Clock", on page 72. "Off" means that no external trigger
signal is used.
In "Edge Trigger" mode, it is possible to use two different external
trigger signals to start and stop data transmission. In "Gated Trigger"
mode, a single "Gate on" signal is used.

Remote command:
TRIGger:PLAYer:THReshold
TRIGger:PLAYer:IMPedance
TRIGger:PLAYer[:STAR]:INPut
TRIGger:PLAYer:STOP:INPut

Waveform Diagram

The waveform diagram visualizes the effect of the current trigger settings; see Chap-
ter 4.1.1.2, "Waveform Diagrams", on page 62.

4.2.3 Mass Storage Settings

The "Config..." button in the "Mass Storage" configuration block gives access to the
data selection settings; see Figure 4-2.

The "Streaming" dialog selects the I/Q data file for replay and enables streaming
mode.
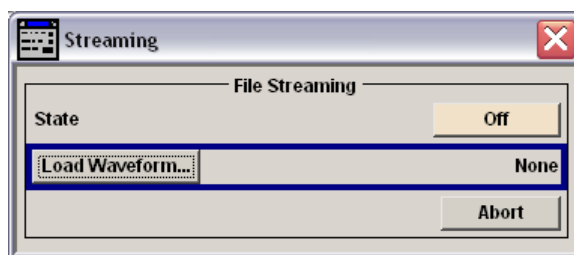
Figure 4-4: Streaming settings

File Streaming

"Load Waveform" opens a streaming file selection dialog. "State > On / Off" enables / disables streaming mode; this corresponds to the "Armed" checkbox in the "Trigger" configuration block. You must select a `*.ws1` file from network drive `e:\` before you can enable streaming mode. For more information refer to Chapter 4.1.2, "Streaming Mode", on page 64 and the subsection on streaming files.

4.2.4 Output Configuration

The "Config..." button in the "Output" configuration block (see Figure 4-2) gives access to several dialogs. These dialogs control and modify the I/Q data stream and configure additional signals which the R&S IQR can generate when replaying data.

4.2.4.1 Clock

The "Clock" dialog selects the sampling and reference clock signals and configures the input connectors for a possible external clock signal.

Sampling rates in "Recorder" mode

The settings in the "Clock" dialog are relevant for data replay. The clock rate for data recording is controlled by the source instrument through the R&S Digital I/Q interface.
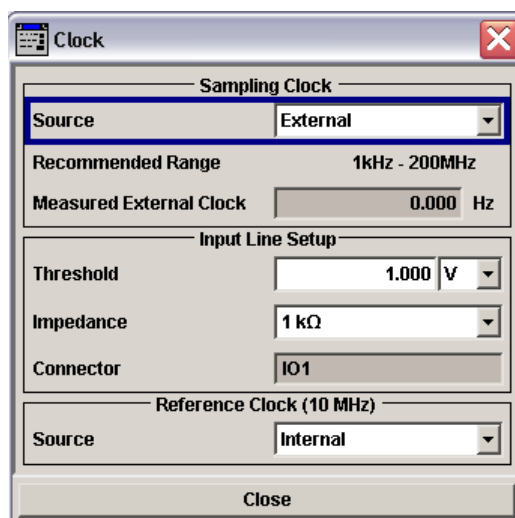
Figure 4-5: Sampling and reference clock settings

Sampling Clock

Selects an internal or external signal as a "Sampling Clock" signal. The sampling clock signal defines the number of samples that the R&S IQR replays per unit of time ("Sampling Rate").

In basic configuration mode the internal sampling clock source is used. The I/Q data file is replayed at the sampling rate at which it was recorded. The recorder sampling rate is measured and stored in the file header of any I/Q data file; its inaccuracy is better than ±10 ppm.

Note: To obtain sampling rates with maximum accuracy, establish a reference clock connection as shown in Figure 2-1 and adjust the "Sampling Rate" to exactly the value that was present during recording. Note that the value read from the data file header probably has not enough resolution. This test setup is necessary e.g. for OFDM(A), GPS, and DVB-T signals.

Example: An R&S AMU200A transmits I/Q data at 10 MSa/s. During recording the R&S IQR measures and stores a sampling rate of 10.0001 MSa/s. In the basic configuration mode, this (inaccurate) sampling rate is also used for replay. To replay the data at the exact sampling rate of 10 MSa/s, establish an reference clock connection and select "Sampling Rate: 10.000 000 000 MSa/s".

It is also possible to use an external sampling clock signal. The external clock signal must be applied to the I/O 1 input connector. The R&S IQR measures the external clock frequency and displays it for information. The "Input Line Setup" settings are valid for external clock source only.

Remote command:

INPut:CLOCk:SOURce

[OUTPut:]IQ:CLOCk

INPut:CLOCk:FREQuency?

Input Line Setup

Selects and configures the input connectors for the external clock signal. The settings are also valid for the external trigger signal in replay mode and overwrite the settings in the "Trigger" dialog; see Chapter 4.2.2, "Trigger Settings", on page 68.

"Threshold"   Threshold voltage of the external sample clock and trigger inputs (rear panel connectors I/O 1 to I/O 8). For correct operation in replay mode, the sample clock level that the R&S IQR detects at the I/O 1 input connector must exceed the threshold. A low threshold may be required to ensure that the R&S IQR actually detects all clock pulses. A higher threshold can prevent unintentional detections.

"Impedance"   Input impedance of the external sample clock and trigger inputs (rear panel connectors I/O 1 to I/O 8). Select the impedance in accordance with the output impedance of your external clock source and the impedance of the connecting cable to avoid reflections.

"Connector"   The fixed input connector I/O 1 for the external clock signal is displayed for information.

Remote command:
TRIGger:PLAYer:THReshold
TRIGger:PLAYer:IMPedance

Reference Clock (10 MHz)

Selects an internal or external 10 MHz reference signal. A common reference clock improves the accuracy of the sampling rate in replay mode; see "Sampling Clock" on page 73.

In "Recorder" mode the R&S IQR adjusts its sampling rate to the sampling rate of the source instrument through the R&S Digital I/Q interface. No reference clock connection is needed.

"Internal"   The reference frequency signal is generated by the R&S IQR and can be tapped at the REF OUT rear panel connector to synchronize external devices.

"External"   The R&S IQR uses a 10 MHz reference frequency signal from an external device which is fed to its REF IN rear panel connector. The external reference frequency signal is also routed to REF OUT for synchronization of additional devices.

Remote command:
SYSTem:REFerence:FREQuency:SOURce

4.2.4.2 IQ Channel Settings

The "IQ Channels..." dialog is used to configure which channels should be played and shows informations about the IQ data channel.
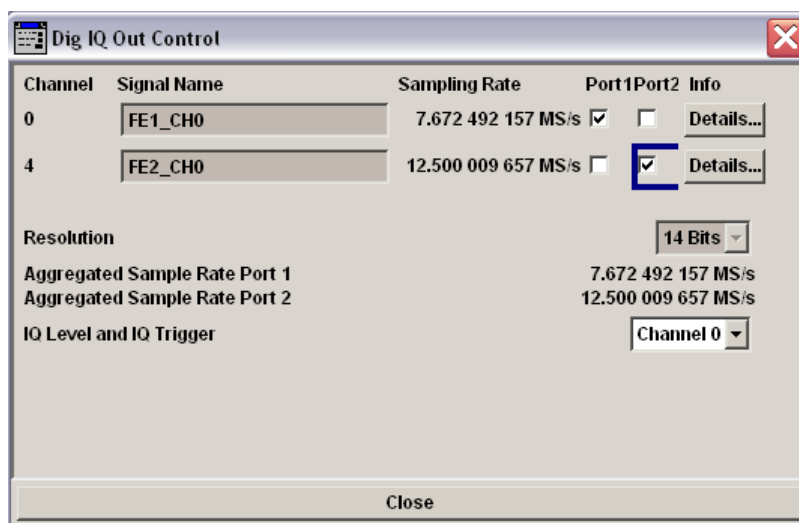
Channel
The channel numbers stored in the file.

Signal name
The signal name for each channel as stored in the file.

Sampling rate
The sampling rate as stored in the file. Note that this value was advertised by the source instrument before recording started.

Port1/Port2
Check this box to play the corresponding channel to the selected digital IQ Out Port(s). To play more than one channel option R&S IQR-K105 is required.

Details
Opens the following dialog box that shows the reference level for the corresponding channel at record start as advertised by the source instrument. Note that the level probably has shifted due to variations in temperature in the source instrument during the recording session. These changes are not registered.

Resolution

The IQ data resolution as stored in the file. The resolution for a multi channel recording is 14 bits instead of 16 bits for one channel.

Aggregated Sample Rate

Shows the sampling rate which the R&S IQR has measured during the recording session for that file. If the user changes the value via "Output"→"Clock" it will become red. "Output"→"Clock"always describes the reading speed of the hard disk. This must be the sum of all sample rates.

Remote command:
[OUTPut<hw>:]IQ:AGGRate? on page 141

4.2.5 Destination Instruments

The "Dest. Instrum." control block shows the instrument at the DIGITAL IQ OUT connector with its serial number and digital input connector name. "Digital IQ Out Disconnected" is displayed if no compatible destination instrument is detected. Refer to the data sheet for a list of compatible destination instruments.

The "Config..." button in the "Dest. Instrum." configuration block opens a context menu with two entries:

- "Rem. Control" is analogous to the Rem. Control option in the recorder window (see). This feature is intended for future control software for destination instruments.
- "Dig. I/Q Info"is analogous to the Digital I/Q Info in the recorder window (see Chapter 3.2.2, "Source Instruments", on page 47).

DIG IQ OUT

DIG IQ OUT Port

Interface State:	Connected
PRBS test:	Done
Device Name:	SMU200A
Part Number:	
Serial Number:	101927
Path:	In A
Mapping:	MAP1
No. of Channels:	1

Close
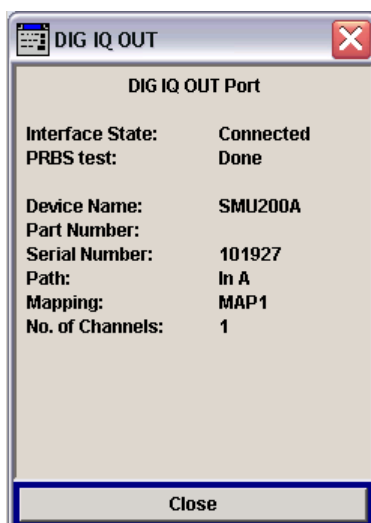
SCPI command:

`SYSTem:INSTrument:DESTination:IDENtification?`

4.2.6 Selective Replay (GoTo)

The "GoTo" button in the control bar opens a dialog where you can select a sub-range of samples within the file for replay. The dialog also indicates the number and the positions of the default bookmarks at the beginning and the end of the file and all user-defined bookmarks. By default, the entire file is replayed.

"GoTo" is available as long as the player is not armed.

- Use the "Prev" and "Next" buttons in the dialog to select a sample range between two bookmarks for replay.
- Enter a recording time or sample number to modify the current replay range. Sample numbers are rounded down ("Start/Jump to") and up ("Stop") to the next 10 MByte block boundary; see "Terminate Condition" on page 55.

Simplified "Go To" dialog

If the replayed file contains no user-defined bookmarks, a simplified version of the "Go To" dialog without the "File" (bookmark) panel is displayed. This dialog also contains a "Start" and a "Stop" field to define the replay range.

The non-editable fields in the dialog show information about the replayed file and the bookmarks:

- The "File" panel shows the total number of bookmarks, the date and time when recording was started and stopped, the recording time and number of recorded samples.

- The "Start/Jump" and "Stop" panels show the properties of the bookmarks that you select to in order to define the replay range.

SCPI commands:

The `OUTPut:PLAYer:WAVEform...` and the `OUTPut:PLAYer:JUMP...` commands correspond to the "Go To" functionality; see Controlling and Monitoring Data Replay.

Go To

When you tap "Go To" to close the dialog, the progress bar shows the selected replay range within the entire file length. "Play" initiates a replay of the sub-range instead of the entire file contents. In the example below, a replay range between the user-defined bookmarks no. 1 and no. 5 is active. 41 % of the samples in the replay range have been replayed already. The sample ranges between the beginning of the file and bookmark no. 1 and from bookmark no. 5 to the end of the file are not replayed.

Remote command:

[OUTPut:]PLAYer:JUMP:ACTivate

5 General and Administrative Tasks

The dialogs described in this chapter complement the functionality of the "Player" and "Recorder" control blocks. They are accessible via the toggle buttons across the bottom of the R&S IQR main window.

5.1 Main Application Window (General)

The main window is divided into three parts:

- The "Status" line and the "Info" dialog in the upper part contain the selftest error messages.
- The center part shows the four bottons to access the dialogs for general tasks. These dialogs are described in the following sections.
- The lower part provides softkeys to access the main windows for replay and recording.
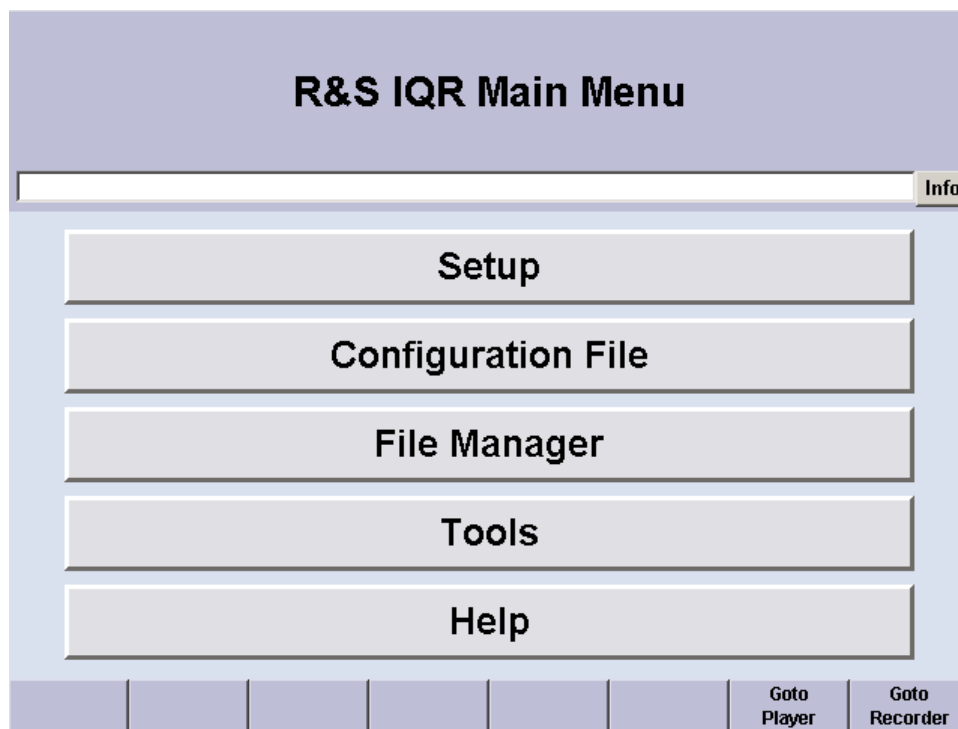
Figure 5-1: Buttons for general tasks

5.2 Setup

"Setup" opens a context menu from where you can access the dialogs for system administration, GUI configuration, selftest, and password protection.
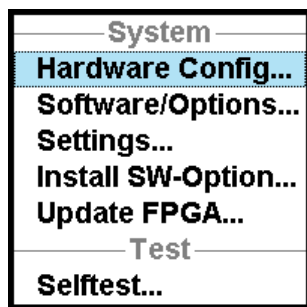
Figure 5-2: Context menu of the Setup button

Hardware Config...

Opens a dialog that gives you an overview of the hardware assemblies of your instrument, together with their part number, serial number, and revision. If needed, you can use this information to obtain assistance from a Rohde & Schwarz service representative.

Software/Options

Opens a dialog that gives you an overview of the software installed on your instrument. The software version information is important to decide whether an update is useful. It can be important for service purposes, too. See also Chapter 10.4, "Firmware Recovery to Delivery State", on page 182.

The "Software/Options" information is divided into the following sections:

●   **Firmware:** The R&S IQR application software installed on your instrument, consisting of the R&S COMPASS software platform plus the STREAM base software and the currently active FPGA version. Both software packages can be installed/updated independently.
●   **Software:** List of software options and licenses. The software options are described in Software Options.
●   **Loaded Modules:** List of all software modules of the firmware, together with their version no. and a short description. Mainly for service purposes.

Remote command:

SYSTem:OPTion:EXPT?
SYSTem:OPTion:GPSM?
SYSTem:OPTion:GPSR?
SYSTem:OPTion:TSMW?

GUI Configuration...

Opens a dialog where you can ...

●   ... select the unit (scale) of the progress bar in the "Player"
●   ... observe and change the IP address of the LAN interfaces. Note that for chaning the mode (DHCP on/off) you still have to enter Windows

"Samples"	The first and last recorded or replayed kilosample (kSa) of data is displayed at the beginning and at the end of the progress bar. The sample count always starts at 0 kSa. The last recorded kSa depends on the "Max. File Size" selected in the "Mass Storage" dialog. The last replayed kSa is given by the size of the replayed file.
"Percent"	The progress bar is scaled between 0 % and 100 %.
"Time"	The start and stop time of data recording or replay is displayed at the beginning and at the end of the progress bar. The stop time depends on the "Max. Rec. Duration" selected in the "Mass Storage" dialog. "--:--:--" denotes an unknown stop time, this is displayed e.g. before recording is started.

Install SW Option

Entry of an option key for activating pre-installed R&S IQR software options; see

Update FPGA

Opens a dialog box to initiate an update of the "PCI-FPGA" software. Use this function after a firmware update, if you receive a notification during the boot process.

Important note: Impairment of instrument functions

To avoid problems, the update of the "PCI-FPGA" must not be cancelled, and the R&S IQR must not be switched off during the update.

Selftest

Opens a dialog box from where you can initiate selftests and read the results. A selftest checks whether a particular module of the R&S IQR is fully functional. "Running" indicates that the selftest is still ongoing; "Succeeded" or "Failed" characterize the result. If an error occurs, a more detailed error message appears in the "Status" line in the upper part of the main window; see Figure 5-1.

Note: Some of the selftests, e.g. the "Disk Performance" test, take some time. Others, e.g. the "I/O Connector Test", require external cabling.
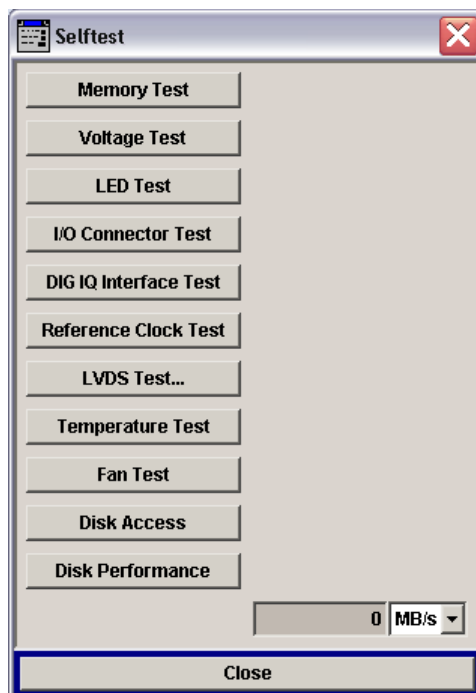
Figure 5-3: Selftest dialog

The R&S IQR provides selftests for the following modules:

- **Memory Test:** hardware test of the DDR2 memory module mounted on the I/Q Stream Board
- **Voltage Test:** limit check of voltages on the I/Q Stream Board
- **LED Test:** RUN and ERR LEDs at the rear panel will blink for several seconds. The test involves a visual check of the LEDs.
- **I/O Connector Test:** I/O rear panel connectors. To perform the test, connect 4 BNC cables from I/O 1 to I/O 5, I/O 2 to I/O 6, I/O 3 to I/O 7, I/O 4 to I/O 8.
- **Digital I/Q Interface Test:** loopback test on digital interfaces DIGITAL IQ IN / OUT on the rear panel. Connect DIGITAL IQ IN to DIGITAL IQ OUT using the cable supplied with the R&S IQR.
- **Reference Clock Test:** internal or external reference clock signal, depending on the "Player > Output > Clock" setting
- **LVDS Test:** only used for production
- **Temperature Test:** internal temperature limit check
- **Fan Test:** internal fan, is driven to full speed for a couple of seconds
- **Disk Access:** verifies that Windows® can access all disk partitions of the memory pack R&S IQR-Bxxx
- **Disk Performance:** checks the read and write performance of the memory pack disks and reports the slower of the read/write data rate values

Remote command:

TEST:MEMory?

TEST:VOLTage?

TEST:LEDS?

TEST:NOPRompt:LEDS?

TEST:BNC?

```
TEST:IQIO<hw>?
TEST:NOPRompt:IQIO<hw>?
TEST:REFClk?
TEST:TEMPerature?
TEST:FAN?
TEST:NOPRompt:FAN?
TEST:DRIVe:PRESence?
TEST:DRIVe:PERForm?
```

5.3 Configuration File

"Configuration File" opens a context menu from where you can reset the configuration of your instrument, re-load and save configurations. A configuration comprises all instrument settings in "Player" and "Recorder" mode.
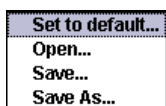
Set to Default
Resets the current configuration of the R&S IQR to the preset (factory) state. The destination instrument settings in "Player" mode and the source instrument settings in "Recorder" mode are not affected.

Remote command:
SYSTem:PRESet
*RST; see Common Commands

Open / Save / Save As
Opens file selection dialogs to load and activate a configuration stored previously, and to save the current settings to a file. Configurations are stored in "Save/Recall Files" with the file extension *.savrcl.

Remote command:
MMEMory:STORe:STATe
MMEMory:LOAD:STATe
*SAV, *RCL; see Common Commands

5.4 File Manager

Opens the "File Manager" dialog. Use this dialog to manage the files on the internal hard disk, the removable memory packs, and additional drives for external storage devices. Network drive e:\ is the location for streaming files; see Chapter 4.1.2, "Streaming Mode", on page 64.

> **Streaming files**
>
> When a streaming file (`*.ws1` or `*.ws2`) is deleted, renamed, cut, or copied, the R&S IQR prompts for confirmation to delete, rename, cut, or copy the partner file as well. See Chapter 4.1, "General Description", on page 59.
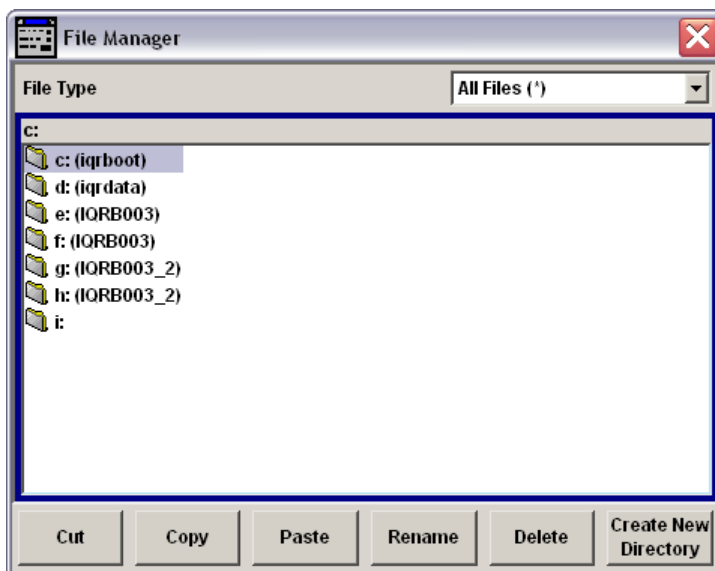
Figure 5-4: File Manager dialog

Control Elements

"File Type" selects either all files or frequently used file types (e.g. configuration files `*.savrcl`, waveform files `*.wv`) for display in the directory overview. The control buttons at the bottom of the dialog are self-explanatory.

Remote command:
All file manager commands belong to the SCPI system `MMEMory:...` see Chapter 9.5.2, "Instrument Configurations and File Management", on page 161.

5.5 Tools

"Tools" opens a menu where you can select to archive/export or import data.

"Import/Export/Archiving" opens a dialog for transferring I/Q data from/to an USB mass storage device or a network share (mounted in Windows as a drive letter) via LAN.

Data Transfer via USB Media

If a USB mass storage device is used for this purpose, it is recommended to have this media formatted in the NTFS file system, as the data volume to be exported or archived is typically big.

Data Transfer via Network Share

Working with a network share requires a PC connected to the R&S IQR via a network. On that PC, a folder has to be shared with full privileges (read/write, see PC operating system help for details, especially if the access should be restricted to a defined user group).

For mounting the network share on the R&S IQR, follow this procedure:

1. Open Windows Explorer on the R&S IQR

2. From the "Tools" menu, click "Map Network Drive...".

   The "Map Network Drive" window opens.

3. Choose an available drive letter from the dropdown list located next to the "Drive:" option.

4. Enter the path including the name of the folder to map the drive. Alternatively, click the "Browse…" button to find the correct folder by browsing available network shares.

5. Click the "Reconnect at login" checkbox if this network drive should be mapped permanently. Otherwise, this drive will un-map when the user logs out of this computer.

6. Click "Finish".

7. Return to R&S IQR firmware.

5.5.1 I/Q Data Export/Archiving

"I/Q Data Export/Archiving" opens a dialog for archiving or exporting raw data.
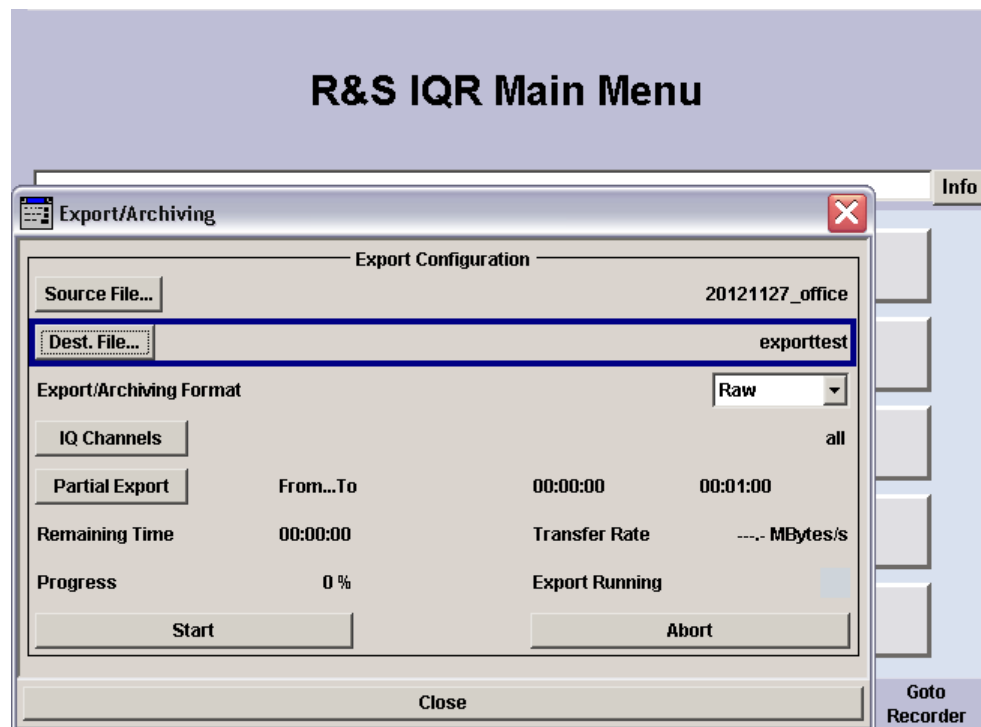
1. Select source file

2. Select destination file

3. Select format

4. Press Start

SCPI commands:

The `SYSTem:ARCHive...` commands control data export or archiving. See Chapter 9.5.3, "Data Export and Archiving", on page 166.

5.5.2 I/Q Data Import

"I/Q Data Import" opens a dialog for importing raw or archieved data.

For details on the supported data formats, see Chapter 5.5.3, "Supported Data Formats", on page 87.

R&S IQR Main Menu

| Info |

Import   ✕

─── Import Configuration ───

| Source File... | None

| Dest. File... | None

Remaining Time   00:00:00   **Transfer Rate**   ---.- MBytes/s

Progress   0 %   **Import Running**

| Start | | Abort |

| Close |

| Goto Recorder |
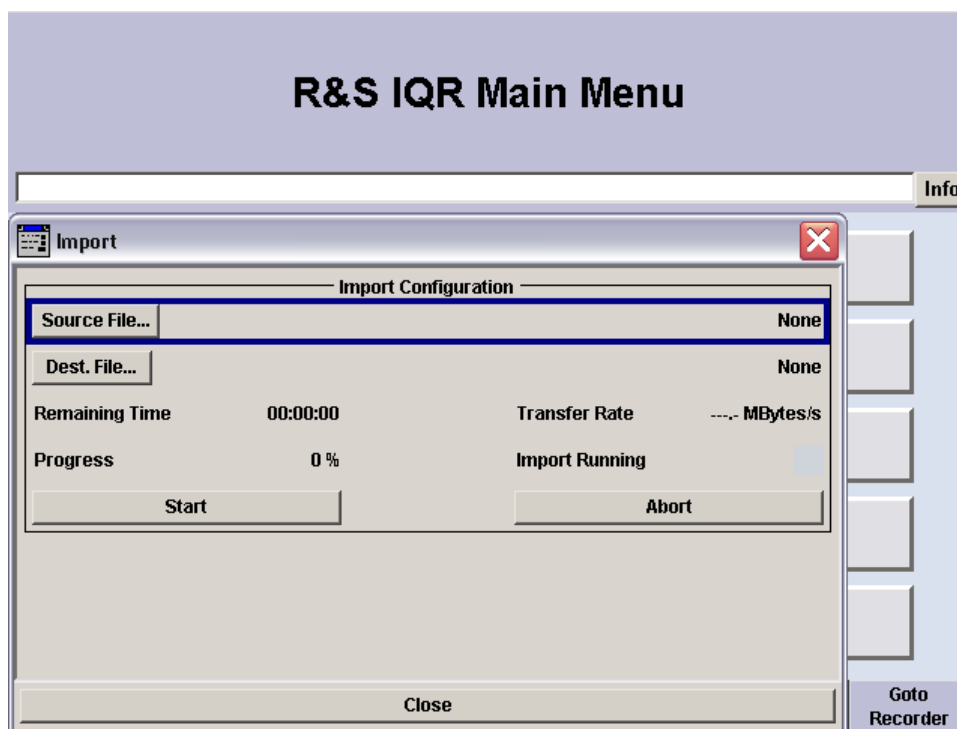
Source Files

All *.wva archive files and *.wvh header for raw data files are listed in the source file selection dialog.

SCPI commands:

The SYSTem:IMPort... commands control data import. See Chapter 9.5.3, "Data Export and Archiving", on page 166.

5.5.3 Supported Data Formats

5.5.3.1 WV-Archive

I/Q data is stored as an encrypted *.wva backup file for later re-import.

5.5.3.2 Raw Data

Raw I/Q data is stored in a *.wvd data file (e.g. for analysis with MATLAB®) in combination with a corresponding *.wvh header file (giving necessary information about sample rate etc.)

WVD Data Files

*.wvd data files contain raw (unencrypted) alternating I/Q samples as 16-bit two's complement signed integers in little-endian byte-order (the least significant byte precedes the most significant byte; see example below) .

> Raw data is only available if option R&S IQR-K101 is unlocked, refer to Chapter 6, "Software Options", on page 92.

Example:

Recorded I/Q samples

```
I[0] = 0xAABB Q[0] = 0xCCDD
I[1] = 0x1122 Q[1] = 0x3344
I[2] = 0xBEEF Q[2] = 0xCAFE
...
```

Hexadecimal storage dump of the resulting `*.wvd` file

```
<address><byte 0..3>
00000000  BB AA DD CC
00000004  22 11 44 33
00000008  EF BE FE CA
...
```

WVH Header Files

`*.wvh` header files contain tags in the following format: `{TAGNAME:VALUE}`. The tags `TYPE`, `COMPONENTS` and `CLOCK` are mandatory.

Example:

Mandatory tags of a `*.wvh` header file

```
{TYPE:RAW16LE}
{COMPONENTS:IQ}
{CLOCK:10249995.000000}
```

Optional tags of a `*.wvh` header file

```
{RESOLUTION:14}
{COMMENT:FE1_CH0}
{FWVERSION:3.10.02}
{SAMPLES:16917463039}
{REFLEVEL:-5.789000}
{FREQUENCY:2159700000.000000}
{DATE:2013-12-18;08:52:19}
{COPYRIGHT:2009 Rohde&Schwarz IQR}
```

The example file contains the following information:

- `TYPE` defines the I/Q data file format: raw data in 16-bit little-endian data format. `TYPE` must be RAW16LE.

- `COMPONENTS` states the created `*.wvd` files contains alternating I and Q samples. `COMPONENTS` must be IQ.

- `CLOCK` is the sampling clock rate in Sa/s.

- `RESOLUTION` defines the significant bits in the 16 bit word. For multi channel recordings, the R&S IQR exports 14 significant bits left aligned, so the 2 LSBs are set to 00. This tag is ignored for import, as import will always read 16 bits.

- FWVERSION is the information about the IQR firmware with which the file was created.

- SAMPLES is the number of samples in the file. The R&S IQR file format has an internal granularity of 2,621,440 IQ samples. That means any number of samples not matching this boundary will be rounded to the next larger multiple of 2,621,440. Additional samples are set to I=Q=0.

- REFLEVEL is the initial reference level in dBm. It is a seeting from the IQ data source.

- FREQUENCY is the center frequency of the signal, reported by the TVR290 interface based on IQ Data signal source information.

- DATE is the date and time of the I/Q sample file creation.

- COPYRIGHT specifies current year and Rohde & Schwarz product type.

5.5.3.3 Multichannel Files

By default all channels of a multichannel recording are exported. For raw data export individual channels may be selected through the "IQ Channels" button
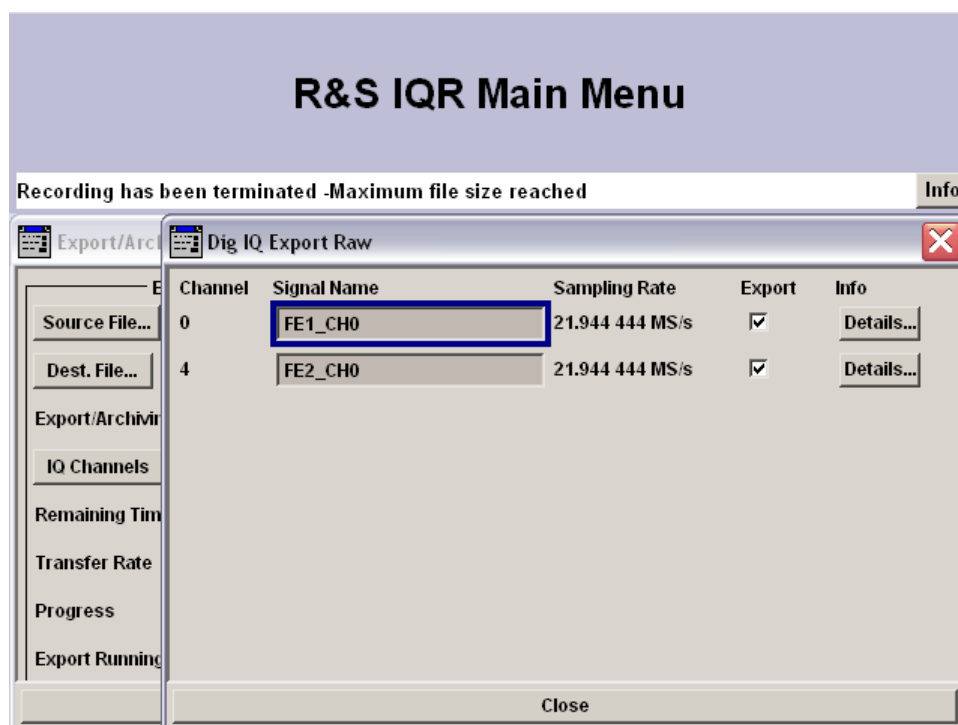
For each channel separate *_CH<nn>.wvd data files and *_CH<nn>.wvh header files will be saved (<nn>= channel number 00…15).

Raw data import only supports single files.

Archive files always contain all recorded channels.

5.5.3.4   GPS Data Files

If a `*.wsm` GPS data file with a corresponding name is found, it will automatically be imported/exported from/to the selected source/destination.

5.5.4   Partial Raw Export

Partial export, which is available for RAW export format, allows the export of a specific portion of a file. "Begin" and "End" of that portion are based either on a bookmark, time or sample number.

Partial raw export - based on time stamps - is available via SCPI commands.

5.5.5   Notes

Limitations for raw export

I/Q data recorded from the following instruments can be exported as raw data:

- Spectrum analyzers R&S FSV, R&S FSVR, R&S FSQ, R&S FSG, R&S FMU36, R&S FSW
- Universal Radio Network Analyzer R&S TSMW

Recordings from other instruments can only be exported if the source instrument indicated during recording that raw data export is allowed.

Data transfer times

The transfer rate is limited by the speed of the external storage medium and the LAN or USB interface. In view of the large capacity of the memory disks, data transfer may

take some time. With a transfer rate of 25MBytes/s, exporting 100GBytes of data takes a little more than 1 hour.

> Additional network traffic, firewalls, or virus scanners may reduce the transfer rate and performance.

5.6 Help

Gives access to the help system of the R&S IQR. The contents of the help system are identical to the operating manual. Navigation in the help system is self-explanatory.

6 Software Options

The functionality of the R&S IQR can be extended by additional software options. For a complete list of options and ordering information refer to the R&S IQR product brochure. The purpose and use of the software options is described below.

Unlocking software options

All software options are integrated in the R&S IQR firmware. If you purchase an additional option for your instrument, you will receive an option key. Select "Setup > Install SW-Option..." and enter the option key in the dialog box opened. The software option is ready for use after you close the "Install SW Option" dialog.

If your R&S IQR is equipped with an older firmware version, a software upgrade may be required before you can activate the option. Proceed as described in Chapter 10.5, "Firmware Update", on page 183.

6.1 R&S TSMW Control (R&S IQR-K1)

The option R&S IQR-K1 provides a control interface for the "Universal Radio Network Analyzer" R&S TSMW. The TSMW control interface allows you to configure the R&S TSMW from the R&S IQR, start a measurement, and record the measured I/Q data. A detailed measurement example is reported in Chapter 2.3, "Recording Data Using TSMW Control", on page 30.

If option R&S IQR-K1 is unlocked, the "TSMW Control" softkey appears in the control bar of the "Recorder" dialog.

● Rec	❚❚ Pause	■ Stop	▼ Bookm	Map	TSMW Control	Goto Player	Open Main Menu

"TSMW Control" starts the R&S TSMW control interface.
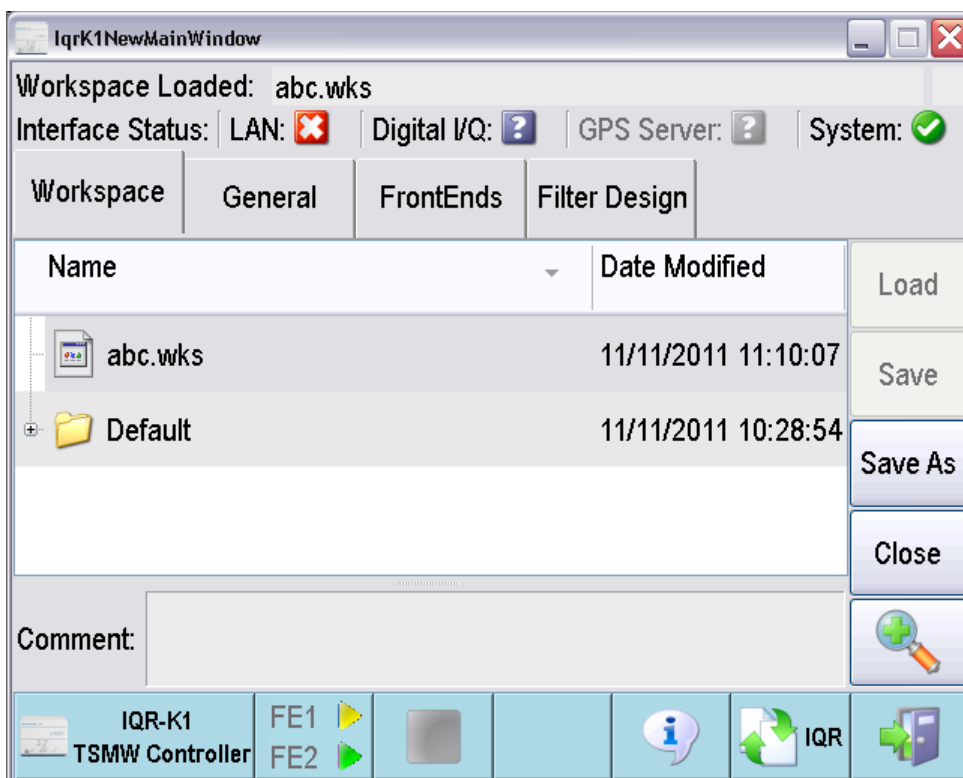
The interface provides detailed embedded help; simply tap the 🛈 softkey in the control bar and then a control element. The following table describes the concepts in brief.

Table 6-1: Concepts of R&S TSMW Control

Control element	Description
Workspace	A workspace file (`*.wks`) stores a R&S IQR-K1 configuration including all settings in the "General" and "Front Ends" tabs.
	Workspace files are stored to the directory `C:\Program Files\Rohde&Schwarz\IQRFirmware\Options\K1\Workspace` on the internal hard disk of the R&S IQR; this directory is shown when the control interface is opened. "Save As" opens a file manager where you can view the file properties, create subdirectories, rename files, and navigate in the directory tree.
Interface Status	The R&S IQR and the R&S TSMW are connected as follows: • A LAN connection is required to control the R&S TSMW via R&S IQR-K1. • A "Digital I/Q" connection is required to transfer the acquired data from the R&S TSMW to the R&S IQR. • GPS Server is for future extensions. Use the USB interface to transfer GPS meta data from the R&S TSMW to the R&S IQR; see Figure 2-2.
	A standard connection via LAN and Digital I/Q is shown in Figure 2-2. The icons in the "Interface Status" bar visualize the status of each of the connections. "System" denotes the R&S IQR-K1 software.
General	The R&S TSMW is identified by its IP address. The "General" tab shows the factory-set IP address of the R&S TSMW. Change this number only when required (e.g. after a change of the IP address of the R&S TSMW).

Control element	Description
Front Ends	The R&S TSMW can be equipped with two front ends numbered 1 and 2 for parallel measurements. The two front ends provide independent RF analyzer settings; activate and configure them according to your requirements.
	Filters are selected from a file list (`*.flt`). The filter bandwidth and sample rate are read from the filter file. If `no_filter.flt` is selected, the R&S TSMW uses the full bandwidth of 20 MHz and its maximum sample rate.
	Open the "Filter Design" tab to create new filter files with your own settings.
	Note that with R&S IQR-K104 (Ref. level controlled recording and replay of RF signals for AGC) "Simple AGC" can be enabled for "RF Mode". For more details, refer to Chapter 6.6, "Ref. level controlled recording and replay of RF signals for AGC (R&S IQR-K104)", on page 103 and Chapter 6.1.1, "R&S TSMW Automatic Gain Control", on page 94.
Filter Design	R&S IQR-K1 allows you to define new filter configurations and store them to filter files (tap "Save As"). According to the Nyquist-Shannon sampling theorem, the condition for a uniquely recoverable signal (no aliasing) is that the sample rate exceeds the bandwidth. A factor 1.25 between the bandwidth and the sample rate is recommended. At its full bandwidth of 20 MHz, the R&S TSMW achieves a slightly smaller sample rate.
Control bar	The control buttons across the bottom of the R&S IQR-K1 dialog provide information about the R&S IQR-K1 application, start and stop streaming, hide the on-screen keyboard (opened when an input field is active), provide embedded help, hide the R&S IQR-K1 control interface behind the R&S IQR application window (tap "TSMW Control" to return to the TSMW control interface), and close R&S IQR-K1.
	Note that the start ▶ and stop ■ icons replace the recorder trigger system.

6.1.1 R&S TSMW Automatic Gain Control

The R&S IQR-K104 option includes an **A**utomatic **G**ain **C**ontrol (AGC) feature, which was introduced with TSMW firmware 1.15. AGC can be activated in R&S IQR-K1 by selecting "Simple AGC" for "RF Mode" in the "Front Ends" control element.

This feature can be used to prevent RF level overflows and maintain good signal quality in case of low signal strength.

The R&S TSMW is constantly evaluating the strength of the received RF signal and is able to react on too low and too high signal strength by:

- activate/deactivate the preamplifier
- adjust the attenuation

The target value range for the signal is between -30 dBFS and -60 dBFS for IQ data. The adjustment takes place in seven steps of 4 dB each.
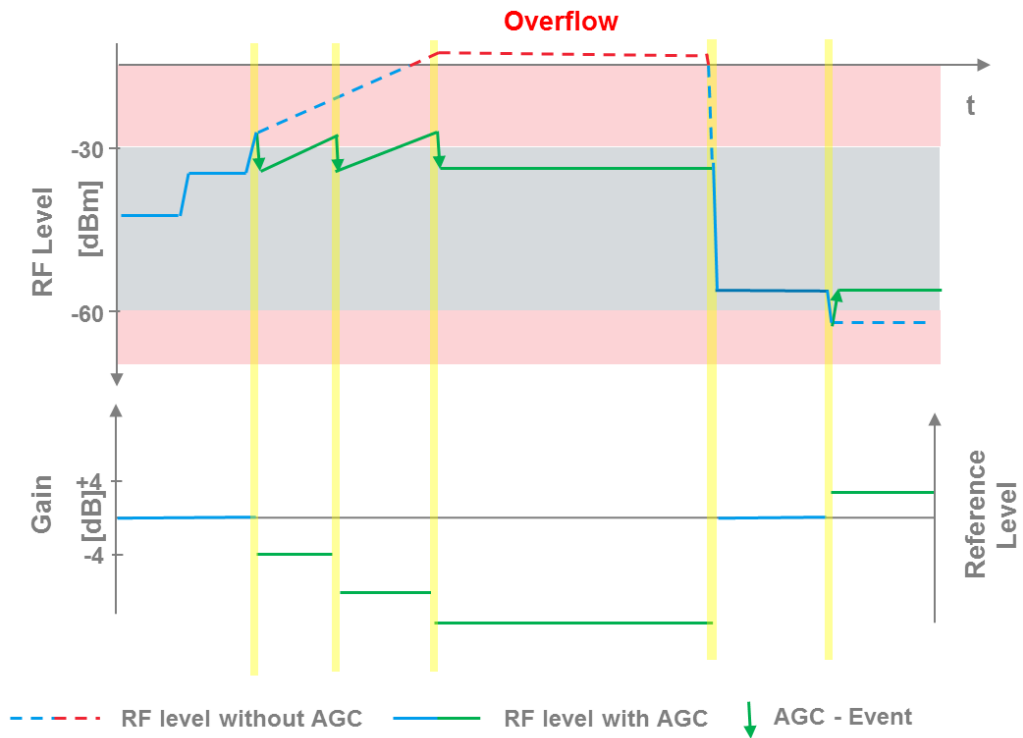
Figure 6-1: AGC compensates for too high (Overflow) or too low RF signal levels. After a given detection time, the gain is adjusted, resulting in IQ data levels in the target value range.

These changes are reported to R&S IQR firmware and stored together with the IQ data. This information can be used for accurate RF level replay by using the R&S IQR-K2 option for generator control.

Option R&S TSMW-K1 can also be controlled via SCPI commands. The R&S IQR is switched to remote control as soon as it receives a command from the controller. Return to manual control is performed via the "Switch to Local" button.
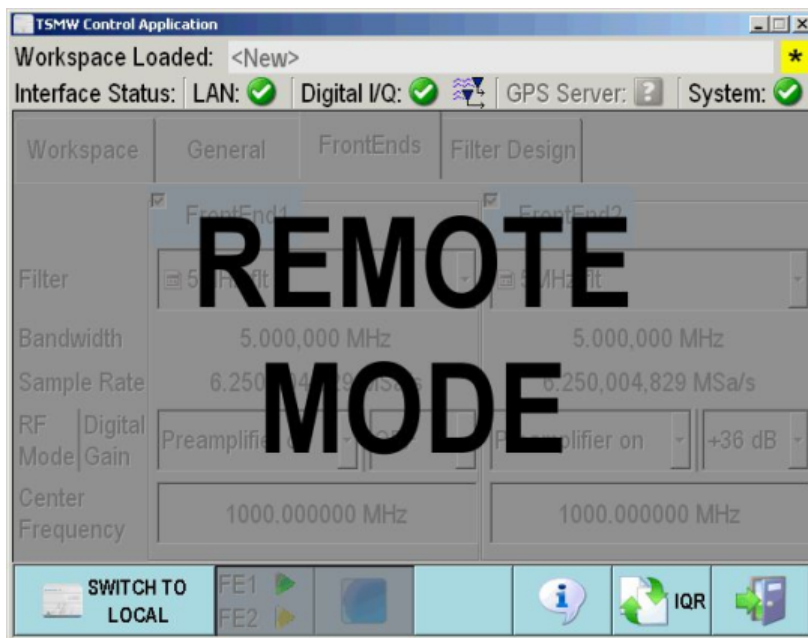
6.2 R&S Generator Control (R&S IQR-K2)

Option R&S IQR-K2 provides a control interface for the Rohde & Schwarz signal generators like R&S SMBV100A, R&S SMU, R&S SFC or R&S SFE. The signal generator control interface allows you to configure the R&S signal generators from the R&S IQR.

If option R&S IQR-K2 is unlocked, the "Generator Control" softkey appears in the control bar of the "Player" dialog.
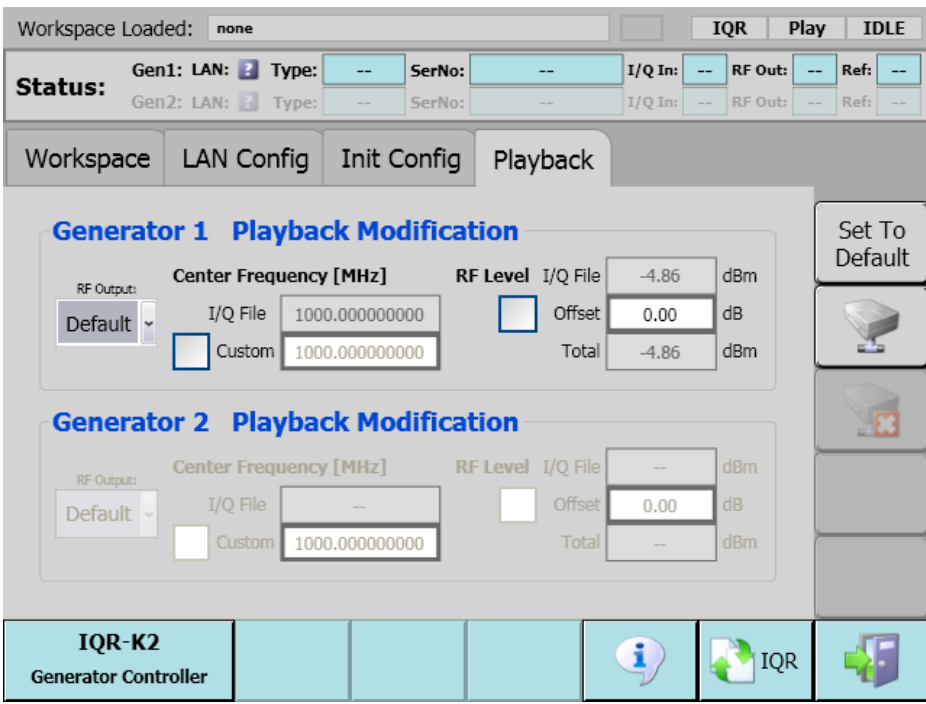
"Generator Control" starts the signal generator control interface.
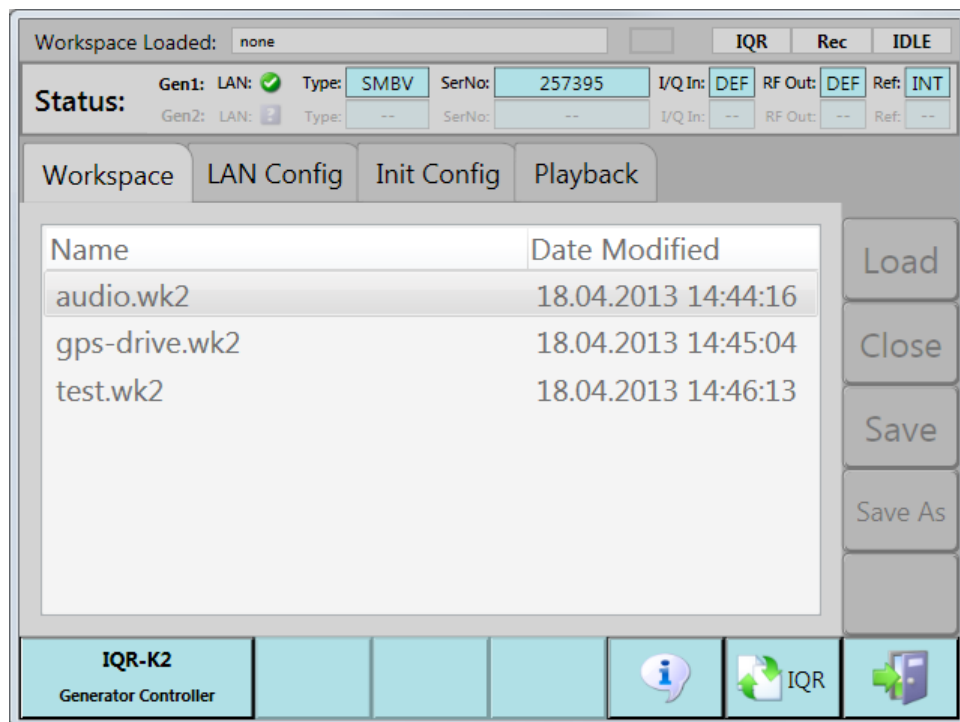
The interface provides detailed embedded help; simply tap the ⓘ softkey in the control bar and then a control element. The following table describes the concepts in brief.

Table 6-2: Concepts of R&S Generator Control

Control element	Description

Status Bar	• "Workspace Loaded": File name of the loaded workspace
	• "IQR" information on R&S IQR status:
	  – "Rec | Play": R&S IQR usage mode (recorder or player)
	  – "IDLE | ARM | RUN | PAUSE": Trigger system information

Generator Status	• "LAN ": LAN connection status (Unknown ▯, Connected ✅, Disconnected ❌) • "Type": Type of connected signal generator • "SerNo": Serial number of connected signal generator • "I/Q In": Default input, CH1 or CH2 • "RF Out": Default output, CH1 or CH2 • "Ref": Reference frequency source, internal or external (INT or EX)
Workspace	"Workspace": A workspace file (`*.wk2`) stores a R&S IQR-K2 configuration including all settings in the "LAN Config", "Init Config" and "Playback" tabs. Workspace files are stored to the following directory, on the internal hard disk of the R&S IQR; this directory is shown when the control interface is opened. `C:\Program Files\Rohde&Schwarz\IQRFirmware\Options\K2\Workspace` There are the following tabs in the "Workspace" view: • "Load" opens the selected workspace. • "Close" discards the changes currently made in a workspace. • "Save": Changes loaded in the workspace will be saved in this workspace. • "Save As" saves the current settings to a new workspace.

| Control element	Description
LAN Config	The "LAN Config" control element enables settings of the attached generator(s) • "IP Address": IP Address of the signal generator attached to R&S IQR • "Initial Reset": The device is set to preset before applying the settings of "Init Config" There are the following tabs in the "LAN Config" view: • "Set To Default": Resets settings for "LAN Config", "Init Config" and "Playback". • Connect to device 🖉: Connect to generator • Disconnect from device 🖩: Disconnect from generator • "IQR LAN Info": Detailed R&S IQR LAN Information
Init Config	The "Init Config" control element enables connected generator(s) initialization: • "Reference Frequency Input": Internal or external • "Dig. I/Q Input": Default, CH1 or CH2 There are the following tabs in the "Init Config" view: • "Set To Default": Resets settings for "LAN Config", "Init Config" and "Playback". • Connect to device 🖉: Connect to generator • Disconnect from device 🖩: Disconnect from generator
Playback	 The "Playback" control element enables connected generator(s) playback configuration: • "RF Output": Default, CH1 or CH2 • "Center Frequency": the center frequency can be taken from IQ data file or set by customer. • " RF Offset": Usually an IQ data file contains a reference level - dynamic (in case of IQR-K104 Automatic Gain Control) or initial (obtained at the beginning of recording). A specific offset can be added to this level. The tabs in the "Playback" view are the same as in the "Init Config" view.

6.3 Import/Export of Waveform Files and Meta Data Files (R&S IQR-K101)

R&S IQR-K101 enables RAW file format for import and export see Chapter 5.5, "Tools", on page 84.

6.4 GPS Data Recording (R&S IQR-K102)

With option R&S IQR-K102, the R&S IQR can record Global Positioning System (GPS) information along with the I/Q data. A typical application is a test drive where a network scanner is combined with a GPS receiver in order to trace back the geographical position of the recorded I/Q data (e.g. network coverage) measurements. The GPS information appears in the "Info" bar as long as an I/Q data file is recorded or replayed.

Stream to:	test			**Recorder**		IQ Level	
Buffer Status:	●			kSa	636 685	1.000 FS ▼	
Status: Running							
kSa: 0			64 %			1 000 000	
Metadata - Info: GPS: UTC 12:14:20, LAT 48.1269683, LON 011.6115638							Info
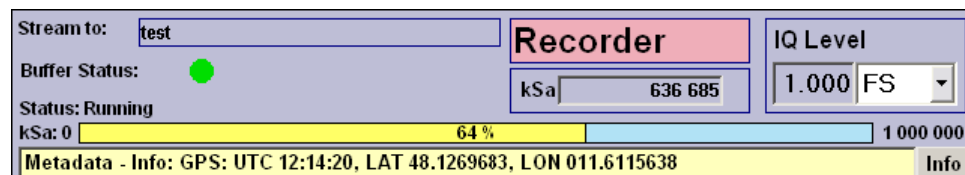
If option R&S IQR-K103 is unlocked in addition, you can load a map into the I/Q Data Recorder in order to view the measurement track; see Chapter 6.5, "GPS Map (R&S IQR-K103)", on page 100.

GPS info during I/Q recorder configuration

The GPS information is shown in the "Info" bar as soon as the recorder trigger system is armed. You can check the position before you actually start recording I/Q data. The GPS information is written to a `*.wsm` file (see below) as soon as I/Q data recording is started.

In a replay session, the display of GPS information is always synchronous to the replayed I/Q data stream.

Option R&S IQR-K102 is compatible with the following GPS data sources:

- R&S® TSMW Universal Radio Network Analyzer (with integrated GPS)
- R&S® TSMX-PPS GPS Module (GPS receiver module with PPS output)

To record GPS data with the R&S® TSMX-PPS:

1. Connect an I/Q data source instrument to the DIGITAL IQ IN connector on the rear panel of the R&S IQR.

2. Connect the R&S® TSMX-PPS to one of the master USB connectors on the front or rear panel.

   The driver software is loaded automatically so that the R&S IQR is ready to record the GPS data.

3. Start data recording and observe the display of metadata in the "Info" bar.

File format for GPS data

The GPS information does not modify the I/Q data files. When a file
`e:\<file_name>.ws1` is recorded and a GPS source instrument is active, the GPS
information is written to an additional file `e:\<file_name>.wsm`. The `*.wsm` file is
created automatically. A sample counter in each GPS record line relates the GPS infor-
mation to the I/Q data samples. The following figure shows the contents of a sample
`*.wsm` file.

```
RMH    0           test;15;15;46863;985322
GPS    46863       $GPRMC,121413.00,A,4807.61737,N,01136.69596,E,0.045,38.50,080611,,,A*54
GPS    113820      $GPRMC,121414.00,A,4807.61746,N,01136.69568,E,0.024,38.62,080611,,,A*52
GPS    194257      $GPRMC,121415.00,A,4807.61747,N,01136.69561,E,0.020,39.11,080611,,,A*5A
GPS    261292      $GPRMC,121416.00,A,4807.61756,N,01136.69534,E,0.039,36.57,080611,,,A*5C
GPS    314914      $GPRMC,121417.00,A,4807.61770,N,01136.69495,E,0.025,35.25,080611,,,A*58
GPS    381948      $GPRMC,121418.00,A,4807.61781,N,01136.69465,E,0.024,33.37,080611,,,A*52
GPS    448974      $GPRMC,121419.00,A,4807.61794,N,01136.69427,E,0.021,32.12,080611,,,A*52
```

The file starts with a header line (`RMH...`). The header information is used internally
for data replay; it can be ignored by other applications. The header is followed by the
GPS record lines, listed in chronological order. Each line consists of the following ele-
ments, separated by tabulators:

● `GPS` identifier (fixed string)

● R&S IQR sample counter (kSa)

● GPS data in NMEA 0183 Recommended Minimum Sentence C (RMC) data format.
    The numbers in the GPS record denote the UTC time, the geographical latitude
    and longitude, the speed over the ground in knots, the track angle in deg, the date,
    and a checksum.

In the example above the first GPS record was acquired at the sample counter 46863
kSa and at 12:14:13 UTC. The measured geographical latitude was 48 deg 07.61737'
North, the longitude 11 deg 36.69596' East. A speed of 0.045 knots at an angle of 38.5
deg was recorded. The recording date of all GPS data is June 8th, 2011.

GPS information in the "Info" bar

The recording rate of the GPS source instruments is generally larger than the update
rate of the "Info" bar. Only part of the recorded GPS information is displayed.

6.5 GPS Map (R&S IQR-K103)

With option R&S IQR-K103, "GPS Map for GPS Meta Data", you can display a mea-
surement track on a map or load your own map into the R&S IQR. Option R&S IQR-
K103 is an ideal complement to option R&S IQR-K102, "GPS Data Recording"; see
Chapter 6.4, "GPS Data Recording (R&S IQR-K102)", on page 99.

The map view is available during recording and during replay. It is based on the `*.wsm`
file containing the GPS information that the R&S IQR records along with the I/Q data.
In a replay session, you can view I/Q data files with an associated `*.wsm` file.

If option R&S IQR-K103 is unlocked, the "Map" button appears in the control bar of the "Recorder" and "Player" dialogs.

"Map" loads the map which is stored on the internal hard disk of the R&S IQR. The control buttons across the bottom of the map are used to load a new map, hide the map behind the R&S IQR application window (tap "Map" to return to the map view), and close the map view.


Map resolution

The repeated "Zoom In" function 🔍 works until the maximum resolution of the map is reached; afterwards a new "Zoom In" removes the map. Tap "Zoom Out" 🔍 to return to the map. Create and load your own map if higher resolution is required ("Level of Detail"); see Chapter 6.5.2, "R&S IQR-K103 Downloader", on page 102.

When a file with associated GPS information is displayed, a car symbol on the map shows the current position of the map; a red line indicates the measurement track. The car symbol 🚗 in the upper right corner of the map view centers the map around the current position.
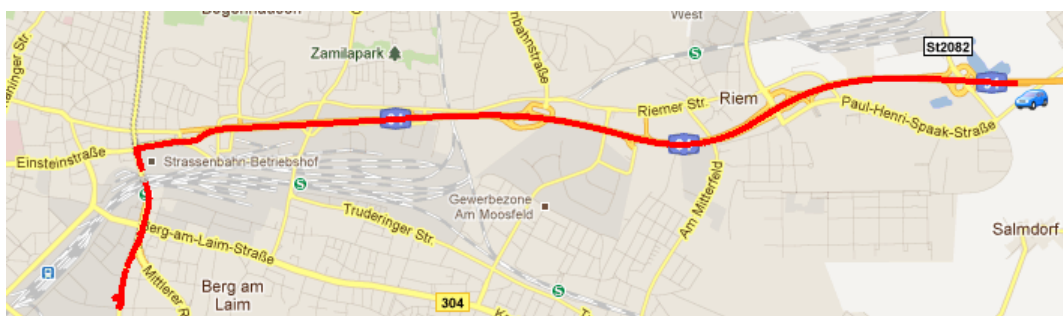
"GoTo" button

During replay you can combine the map view with the functionality of the "GoTo" button described in Chapter 4.2.6, "Selective Replay (GoTo)", on page 77.

6.5.1 Replacing the Map

The R&S IQR stores a single map on its internal hard disk. The maximum file size for maps is 1 GB. The pre-installed world map is sufficient for most applications; it can be restored from the R&S IQR documentation CD-ROM.

The resolution ("Level of Detail") of a map depends on its file size and the covered area: At fixed file size, a smaller area increases the resolution and vice versa. If the resolution of the pre-installed map is not sufficient (or if only a limited area is required), the pre-installed map can be replaced by another one that is better suited.

To replace the map,

1. Connect a USB storage device with a valid map file (`*.map`) in its root directory to your R&S IQR or copy the file to a mounted network drive.

2. Tap "Map" to open the map view.

3. In the control bar across the bottom of the map view, tap the icon to open the map file manager dialog.

4. Select the new map file in the file list and tap "Install".

   The R&S IQR prompts you to confirm the replacement of the currently installed map and starts the installation. This may take some time, depending on the size of the maps.

5. "Close" the map file manager.

   In the map view, the new map has replaced the previous one.

To create maps, Rohde & Schwarz provides a software utility described in

---

Storing several maps

The R&S IQR hard disk can store a single map; a new map always replaces the old one. If several maps are required, they have to be stored on an external storage device.

6.5.2 R&S IQR-K103 Downloader

The "R&S IQR-K103 Downloader" is a software utility that defines the size and resolution ("Level of Detail") of a map and stores it to a map file. An installation version of the downloader is available on the R&S IQR documentation CD-ROM. Double-click the installer file and follow the instructions in the installation wizard to install the software on an external PC. Use the integrated uninstaller if you wish to remove the downloader from your PC.

When working with the downloader, your company's network security policy may force you to enter your internet user name and password before you can access the Google Maps web server or download a map.

The application window of the downloader is divided into a "Download" pane in the left-hand part and the map pane. It is opened with a large question mark in the center of the map pane.

To create a map that is suited for the R&S IQR,

1. Double-click the question mark to obtain a world map.

2. Perform one or several of the following actions: Double-click the map to zoom in; drag and drop to move the map within the pane; re-size the main application window to select a smaller or larger rectangular portion of the map.
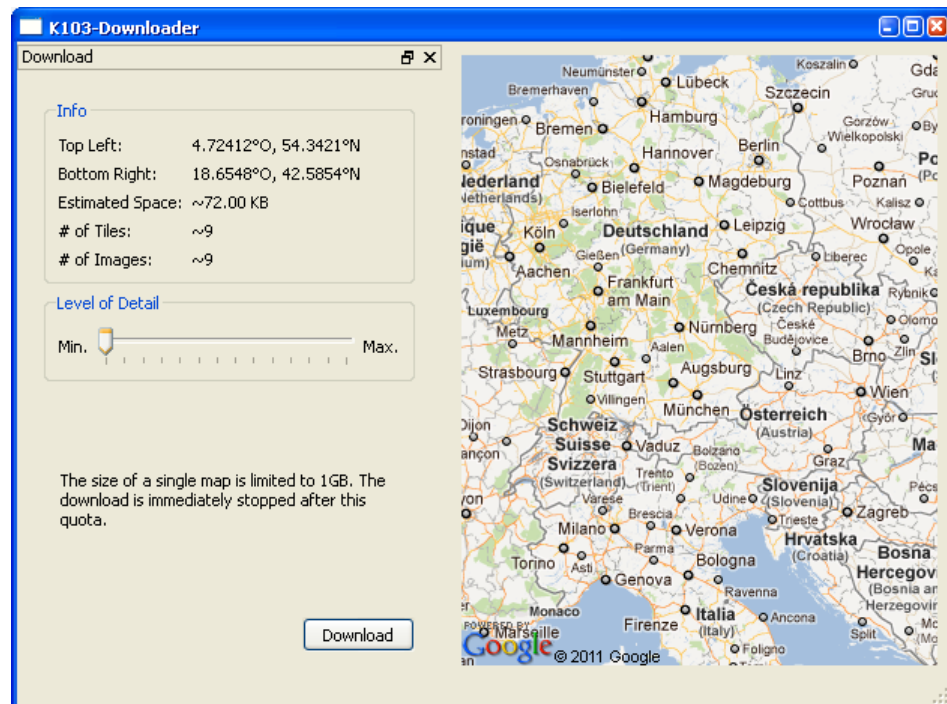
3. Once you have selected your preferred map section, adjust the "Level of Detail" so that the map size does not exceed the limit of 1GB.

4. Click "Download" and store your map (`*.map`) to a USB storage medium or to a network location that is accessible from your R&S IQR.

Troubleshooting

A ⚠ icon in the upper right corner of the map pane indicates an error. Double-click the icon to obtain detailed information.

The target directory for the downloaded map must not be write-protected. Besides, a download failure can be caused by a failed connection to the Google Maps server or by an authentication error.

You can create and store several maps in a single session of the downloader. Load your preferred map into the R&S IQR as described in Chapter 6.5.1, "Replacing the Map", on page 101.

6.6 Ref. level controlled recording and replay of RF signals for AGC (R&S IQR-K104)

The R&S IQR-K104 option enables the R&S IQR to accurately record and replay the RF level throughout the whole signaling chain - from the IQ data source to the R&S IQR to the IQ data sink. Therefore, the IQ data source submits changes of the

reference level via the IQ interface. These changes are written into an R&S IQR's meta data file (see Chapter 11, "File Extensions", on page 186).

During replay the reference level is taken from the meta data file and used to control the signal generators level via the R&S IQR-K2 option. Thus, replay requires R&S IQR-K104 and R&S IQR-K2 to be installed in order to send level information to the corresponding IQ data sink.

For the function of AGC in context of R&S TSMW see Chapter 6.1, "R&S TSMW Control (R&S IQR-K1)", on page 92.

6.7 Network Attached Streaming (R&S IQR-K108)

With Option R&S IQR-K108, "Network Attached Streaming", the R&S IQR is able to replay I/Q data files that are hosted on an external storage server (e.g. R&S IQR-NAS 1517.5199.02 - R&S IQR Storage Extension Server, up to 48 TByte).

For this purpose, the storage server is connected directly via Ethernet to the LAN 2 port of the R&S IQR. The storage server provides SMB network shares that are mapped on the local device with the help of R&S IQR-K108. The whole management of the connection and the I/Q data files is performed automatically by the option, the user only has to provide basic connection information, as shown in Figure 6-2.
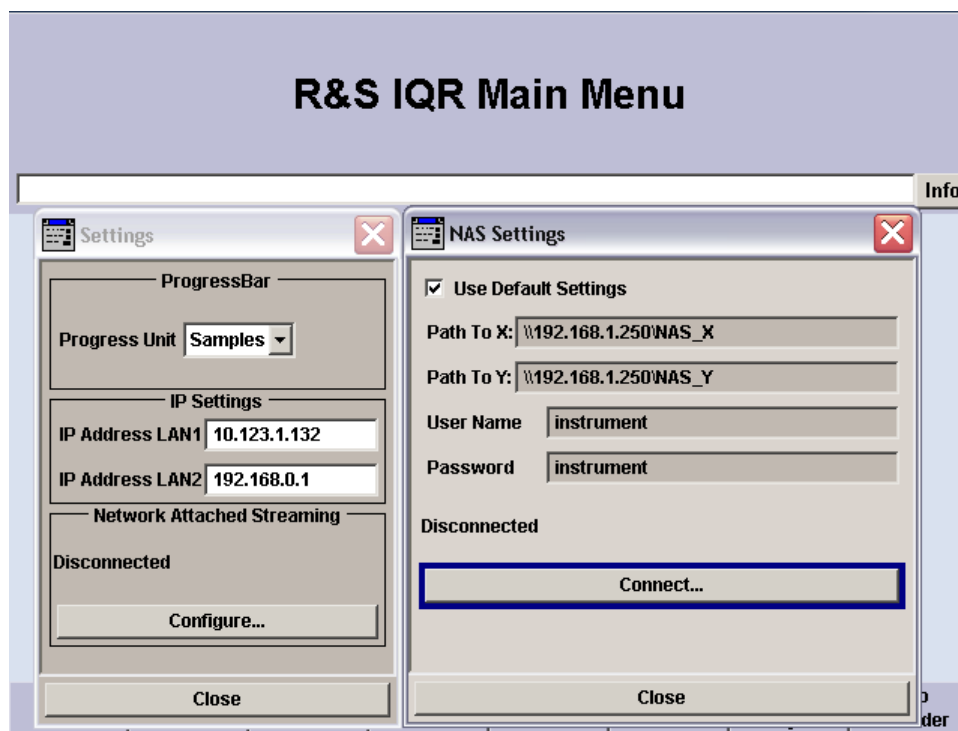
Figure 6-2: R&S IQR-K108 dialog for basic connection information

Path To X	Server IP address and path of the network share containing *.ws1 files (e.g. \ \192.168.1.250\NAS_X)
Path To Y	Server IP address and path of the network share containing *.ws2 files (e.g. \ \192.168.1.250\NAS_Y)
User Name	User name of a user that has access to the paths (e.g. user)
Password	The corresponding password (e.g. pass)

R&S IQR-K108 is for replay only. The replay speed is limited to 22 MSa/s.

Remote commands:

SYSTem:NAS:CONNect on page 157

SYSTem:NAS:PATH:X on page 157

SYSTem:NAS:PATH:Y on page 157

SYSTem:NAS:SETTing:DEFault on page 158

SYSTem:NAS:STATus? on page 158

SYSTem:NAS:USER:NAME on page 158

SYSTem:NAS:USER:PASSword on page 158

SYSTem:OPTion:NAS? on page 174

7 Remote Control – Basics

This chapter provides instructions on how to set up the R&S IQR for remote control and a brief description of the status registers. For examples and reference information about the remote control commands, refer to Chapter 8, "Programming Examples", on page 109 and Chapter 9, "Command Reference", on page 120).

7.1 Remote Control Operation

The R&S IQR supports remote control connections over a Local Area Network (LAN) connection using the VXI-11 protocol. Use one of the connectors LAN 1 or LAN 2 on the rear panel and connect to the company network or to your controller PC as described in Chapter 1.6.4, "Connecting a LAN Cable", on page 22.

A remote control connection requires a VISA installation but no additional hardware on the controller PC. VISA is a standardized software interface library providing input and output functions to communicate with instruments. The LAN I/O channel is selected at initialization time by means of the following VISA resource string (also termed address string):

```
TCPIP::<host address>::INST0::INSTR,
```

e.g. `TCPIP::10.113.10.231::INST0::INSTR`

A VISA alias (short name) is generally used to replace the complete resource string. The host address is either the R&S IQR's computer name or its IP address. Proceed as described in Chapter 10.2.2, "Remote Desktop Connection", on page 179 to determine the relevant address information.

7.1.1 Activating Remote Control Mode

The R&S IQR is switched to remote control as soon as it receives a command from the controller. A REMOTE label appears in the upper part of the main dialogs. You can send a `&GTL` interface command to remove the label at the end of your remote session. The "Info" status line shows possible error messages. Tap "Info" and open the "History" dialog to obtain a detailed error log.

The R&S IQR is ready to be controlled manually any time. No explicit switchover from remote to manual mode is necessary.

7.2 Status Reporting System

The status reporting system stores information on the operating state of the R&S IQR and on possible errors. The R&S IQR uses the basic status registers shown in the fol-

lowing figure. No STATus:OPERation... and STATus:QUEStionable... registers are used.
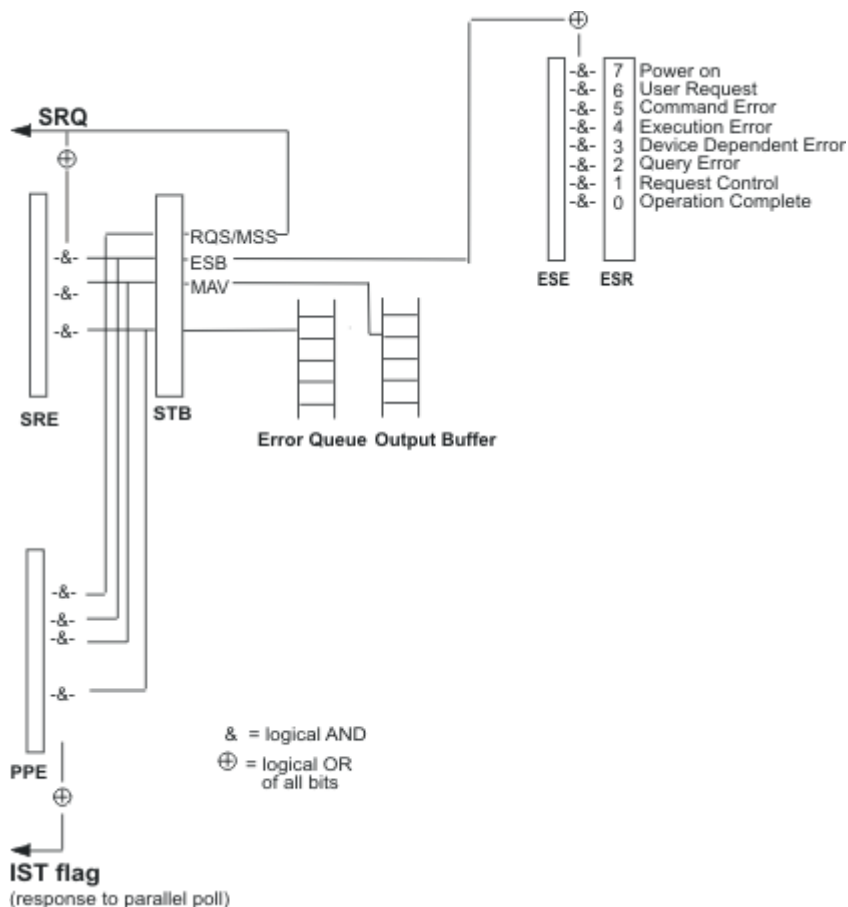
The status registers can be configured and read using common commands such as *ESE and *ESR?; see Chapter 9.1, "Common Commands", on page 120. The contents of the error queue are read (and cleared) by means of the SYSTem:ERRor... commands. For an introduction to status register handling refer e.g. to the operating manual for the R&S SMU200A Vector Signal Generator, which is available for download on the R&S internet.

7.3 Block Data Format

Block data is a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter with definite length has the following structure:

Example: HEADer:HEADer #45168xxxxxxxx

The hash symbol # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmis-

sion of these data bytes all End or other control signs are ignored until all bytes are transmitted.

A #0 combination introduces a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

8 Programming Examples

This chapter provides simple programming examples for the R&S IQR. The purpose of the examples is to present "all" commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the examples as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

8.1 Key Features

The R&S IQR provides independent settings, and thus independent remote command sets, for "Player" and "Recorder" mode.

- Most of the "Player" commands belong to the SCPI systems `[OUTPut:]...` and `TRIGger:PLAYer...`.
- Most of the "Recorder" commands belong to the SCPI systems `INPut:...` and `TRIGger:RECorder...`.

`INSTrument[: SELect]: MODE PLAYer | RECorder` switches between the basic modes. Some additional commands perform tasks which are not related to replay or recording, e.g. the selftest commands (`TEST:...`).

At the beginning of any remote control program, an instrument (p)reset is recommended to set the R&S IQR to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

8.2 Recording Data

In the following example we assume that a source instrument is connected to the R&S IQR as described in Chapter 2.2, "Recording Data", on page 24 and that both instruments are switched on.

```
// ***************************************************************
// Reset instrument first
// ***************************************************************

*RST; *CLS
//SYSTem:PRESet

// ***************************************************************
// Select Recorder operating mode
// Query connected instrument, its serial number and output connector
// Select I/Q data file for replay and specify terminate condition
```

```
                // Query expected sampling rate (assuming that a source instrument is
                // connected to the R&S IQR)
                // ******************************************************************


                INSTrument:SELect:MODE RECorder
                SYSTem:INSTrument:SOURce:IDENtification?
                INPut:RECorder:WAVeform:SELect 'e:/2june16'


                TRIGger:RECorder:STATe?
                // Make sure the instrument has finished its initialization phase
                // before proceeding to the next command.
                // The trigger state must be different from 'Please wait...'


                INPut:RECorder:LIMits:CONDition FILesize
                INPut:RECorder:LIMits:FILesize 1e+8


                INPut:RECorder:LIMits:CONDition DURation
                INPut:RECorder:LIMits:DURation 10


                MEASure:IQ:CLOCk?


                // ******************************************************************
                // Configure trigger system: Select stand-alone synchronization mode,
                // use manual trigger and start recording.
                // Query no. and amplitude of recorded samples, pause and stop
                // recording, check trigger status
                // You may have to confirm that you want to overwrite the data when
                // arming the trigger system repeatedly.
                // ******************************************************************


                TRIGger:RECorder:SYNC SALone
                TRIGger:RECorder:SOURce MANual
                TRIGger:RECorder:ARM ONYS


                TRIGger:RECorder:STARt
                MEASure:IQ:SAMPles?
                MEASure:IQ:AMPlitude?
                TRIGger:RECorder:PAUSe
                TRIGger:RECorder:STATe?
                STATus:RECorder?
                TRIGger:RECorder:STOP


                // ******************************************************************
                // Check other trigger sources
                // ******************************************************************


                TRIGger:RECorder:SOURce LAN
                TRIGger:RECorder:ARM ONYS
                TRIGger:RECorder:EXECute
                MEASure:IQ:SAMPles?
```

```
TRIGger:RECorder:STOP

TRIGger:RECorder:SOURce IQINput
TRIGger:RECorder:IQ:GPSignal GP1

TRIGger:RECorder:SOURce IQLevel
TRIGger:RECorder:IQ:LEVel 0.75

TRIGger:RECorder:SOURce TIME
TRIGger:RECorder:STARt:TIME '15:20:00'
TRIGger:RECorder:STOP:TIME '15:21:00'

TRIGger:RECorder:SOURce EXTernal
TRIGger:RECorder:TYPE EDGE
TRIGger:RECorder:SLOPe POSitive
TRIGger:RECorder:STARt:INPut IO1
TRIGger:RECorder:STOP:INPut IO2
TRIGger:RECorder:DELay 1e-6
TRIGger:RECorder:HOLDoff 1e-6
TRIGger:RECorder:THReshold 1.1
TRIGger:RECorder:IMPedance G1K

TRIGger:RECorder:TYPE GATE
TRIGger:RECorder:POLarity HIGHactive
TRIGger:RECorder:ARM ONNO
```

8.3 Replaying Data

In the following example we assume that a destination instrument is connected to the R&S IQR as described in Chapter 2.4, "Replaying Data", on page 36 and that both instruments are switched on.

```
// ****************************************************************
// Reset instrument
// ****************************************************************

*RST; *CLS
//SYSTem:PRESet

// ****************************************************************
// Ensure that the R&S IQR uses its internal 10 MHz reference signal
// Select Player/Streaming operating mode
// Query connected instrument, its serial number and input connector
// Select I/Q data file for replay
// ****************************************************************

SYSTem:REFerence:FREQuency:SOURce INTernal
```

```
INSTrument:SELect:MODE PLAYer
INSTrument:SELect:TYPE STReam
OUTPut:SYSTem:INSTrument:DESTination:IDENtification?


OUTPut:PLAYer:WAVeform:SELect 'e:/2june16'


TRIGger:PLAYer:STATe?
// Make sure the instrument has finished its initialization phase
// before proceeding to the next command.
// The trigger state must be different from 'Please wait...'

// ********************************************************************
// Configure trigger system: Select stand-alone synchronization mode,
// use manual trigger and start replay.
// Query replayed samples and amplitude, pause and stop replay,
// check trigger status
// ********************************************************************

TRIGger:PLAYer:SYNC SALone
TRIGger:PLAYer:SOURce MANual
TRIGger:PLAYer:MODE SINGle
TRIGger:PLAYer:ARM ON

TRIGger:PLAYer:STARt
OUTPut:IQ:SAMPles?
OUTPut:IQ:AMPlitude?
OUTPut:IQ:LEVel?
TRIGger:PLAYer:PAUSe
TRIGger:PLAYer:STATe?
STATus:PLAYer?
TRIGger:PLAYer:STOP


// ********************************************************************
// Check other trigger sources, then return to manual trigger
// ********************************************************************

TRIGger:PLAYer:SOURce LAN
TRIGger:PLAYer:ARM ON
TRIGger:PLAYer:EXECute
OUTPut:IQ:SAMPles?
TRIGger:PLAYer:STOP

TRIGger:PLAYer:SOURce TIME
TRIGger:PLAYer:STAR:TIME '15:20:00'
TRIGger:PLAYer:STOP:TIME '15:21:00'
TRIGger:PLAYer:ARM ON

TRIGger:PLAYer:ARM OFF
TRIGger:PLAYer:SOURce EXTernal
TRIGger:PLAYer:TYPE EDGE
```

```
TRIGger:PLAYer:SLOPe POSitive
TRIGger:PLAYer:STAR:INPut IO1
TRIGger:PLAYer:STOP:INPut IO2
TRIGger:PLAYer:DELay 1e-6
TRIGger:PLAYer:HOLDoff 1e-6
TRIGger:PLAYer:THReshold 1.1
TRIGger:PLAYer:IMPedance G1K

TRIGger:PLAYer:TYPE GATE
TRIGger:PLAYer:POLarity HIGHactive
TRIGger:PLAYer:ARM ON

TRIGger:PLAYer:ARM OFF
TRIGger:PLAYer:SOURce MANual

// *****************************************************************
// Check or (re-)define clock settings
// *****************************************************************

INPut:CLOCk:SOURce EXTernal
OUTPut:IQ:CLOCk?
INPut:CLOCk:FREQuency?
TRIGger:PLAYer:IMPedance?
TRIGger:PLAYer:THReshold?

// *****************************************************************
// Define and enable impairments
// *****************************************************************

OUTPut:IMPairment:GAIN:I -0.1
OUTPut:IMPairment:GAIN:Q -0.2
OUTPut:IMPairment:OFFSet:I 0.01
OUTPut:IMPairment:OFFSet:Q 0.02
OUTPut:IMPairment:PHASe 2

OUTPut:IMPairment:STATe ON
```

8.4 Bookmarks and "Go To"

In the following example we assume that both a source and a destination instrument is connected to the R&S IQR and that both instruments are switched on.

```
// *****************************************************************
// Reset instrument first
// *****************************************************************

*RST; *CLS
```

```
// *********************************************************************
// Select Recorder operating mode
// Select I/Q data file for replay
// *********************************************************************

INSTrument:SELect:MODE RECorder
INPut:RECorder:WAVeform:SELect 'e:/2june16'

TRIGger:RECorder:STATe?
// Make sure the instrument has finished its initialization phase
// before proceeding to the next command.
// The trigger state must be different from 'Please wait...'

// *********************************************************************
// Use manual trigger (default mode) and start recording.
// *********************************************************************

TRIGger:RECorder:STARt

INPut:RECorder:BOOKmark:SET
INPut:RECorder:BOOKmark:SET
INPut:RECorder:BOOKmark:SET
INPut:RECorder:BOOKmark:RESet
INPut:RECorder:BOOKmark2:COMMent "Tunnel start"
INPut:RECorder:BOOKmark3:COMMent "Tunnel stop"

TRIGger:RECorder:STOP

// *********************************************************************
// Go to "Player" operating mode,
// initiate replay of the recorded file
// *********************************************************************

INSTrument:SELect:MODE PLAYer

OUTPut:PLAYer:WAVeform:SELect 'e:/2june16'

TRIGger:PLAYer:STATe?
// Make sure the instrument has finished its initialization phase
// before proceeding to the next command.
// The trigger state must be different from 'Please wait...'

// *********************************************************************
// Query file properties: sample count at the beginning and at the
// end of the file, file version, encryption.
// *********************************************************************

OUTPut:PLAYer:WAVeform:BOF?
OUTPut:PLAYer:WAVeform:EOF?
OUTPut:PLAYer:WAVeform:ODAT?
```

```
OUTPut:PLAYer:WAVEform:NDAT?
OUTPut:PLAYer:WAVEform:VERSion?
OUTPut:PLAYer:WAVEform:ISUNencrypted?


// ********************************************************************
// Define a sub-range of samples within the file and replay the
// segment only (GoTo without bookmarks)
// ********************************************************************

OUTPut:PLAYer:JUMP:SAMPle:FIRSt?
OUTPut:PLAYer:JUMP:SAMPle:LAST?
// Select start and stop sample in the range.
OUTPut:PLAYer:JUMP:SAMPle:STARt 10000000
OUTPut:PLAYer:JUMP:SAMPle:STOP 200000000

OUTPut:PLAYer:JUMP:TIME:FIRSt?
OUTPut:PLAYer:JUMP:TIME:LAST?
// Query start and stop time of the replayed segment.
OUTPut:PLAYer:JUMP:TIME:STARt?
OUTPut:PLAYer:JUMP:TIME:STOP?


//OUTPut:PLAYer:JUMP:ACTivate

// ********************************************************************
// Alternative configuration: Use the user-defined bookmarks in the
// file to define a replayed segment.
// Query number of bookmarks and the properties of the user-defined
// bookmark no. 2 (numeric suffix: 3).
// Select a replayed segment between the user-defined bookmarks
// no. 1 and 2 (bookmark count: 2 and 3) and activate the selection.
// ********************************************************************

OUTPut:PLAYer:JUMP:BOOKmark:NUMBer?
OUTPut:PLAYer:JUMP:BOOKmark3:ID?
OUTPut:PLAYer:JUMP:BOOKmark3:SAMPle?
OUTPut:PLAYer:JUMP:BOOKmark3:RECTime?
OUTPut:PLAYer:JUMP:BOOKmark3:TIME?
OUTPut:PLAYer:JUMP:BOOKmark3:DATE?
OUTPut:PLAYer:JUMP:BOOKmark3:COMMent?

OUTPut:PLAYer:JUMP:BOOKmark:STARt 2
OUTPut:PLAYer:JUMP:BOOKmark:STOP 3

OUTPut:PLAYer:JUMP:STATe?
OUTPut:PLAYer:JUMP:ACTivate
OUTPut:PLAYer:JUMP:STATe?
// Jump state should have changed from 0 (OFF) to 1.


// ****************************************************************
// Start replay in the selected segment
```

```
// ******************************************************************

TRIGger:PLAYer:STARt
...
```

8.5 Additional and Optional Tasks

The following example shows data archiving and re-import, selftest handling and file management via remote control.

```
// ******************************************************************
// Query options, launch the GPS map.
// ******************************************************************

*RST; *CLS
SYSTem:OPTion:EXPT?
SYSTem:OPTion:GPSM?
SYSTem:OPTion:GPSR?
SYSTem:OPTion:TSMW?

SYSTem:APPLication:MAPPing:STARt
// Close the map manually to return to the R&S IQR application window.

// ******************************************************************
// Assuming that the TSMW Control option is installed,
// check the configuration of this application.
// ******************************************************************

SYSTem:APPLication:SOURce:FILename1?
SYSTem:APPLication:SOURce:SYMBolic?
SYSTem:APPLication:SOURce:SELect1 ON
SYSTem:APPLication:SOURce:RUNNing?

// ******************************************************************
// Archive and export data.
// ******************************************************************

SYSTem:ARCHive:SOURce:FILEname 'e:/2jun16'
SYSTem:ARCHive:DESTination:FILEname 'i:/2jun16'
SYSTem:ARCHive:FORMat WVARchive
SYSTem:ARCHive:STARt

SYSTem:ARCHive:DURation?
SYSTem:ARCHive:RATE?
SYSTem:ARCHive:PROGress?
SYSTem:ARCHive:RUNNing?
// SYSTem:ARCHive:STOP
```

```
// ********************************************************************
// IF SYSTem:ARCHive:RUNNing? <> 1
// Re-import the archived data (the data file 2jun16.ws1 must have
// been completely written to the USB device)
// ********************************************************************

SYSTem:IMPort:SOURce:FILEname 'i:/2jun16'
SYSTem:IMPort:DESTination:FILEname 'e:/2jun16'
SYSTem:IMPort:STARt

SYSTem:IMPort:DURation?
SYSTem:IMPort:RATE?
SYSTem:IMPort:PROGress?
SYSTem:IMPort:RUNNing?
// SYSTem:ARCHive:STOP


// ********************************************************************
// Launch all selftests and retrieve results
// ********************************************************************

TEST:MEMory?
TEST:VOLTage?
// This command requires user interaction: TEST:LEDS?
TEST:NOPRompt:LEDS?
TEST:BNC?
// This command requires user interaction: TEST:IQIO?
TEST:NOPRompt:IQIO?
TEST:REFClk?
TEST:TEMPerature?
// This command requires user interaction: TEST:FAN?
TEST:NOPRompt:FAN?

TEST:DRIVe:PRESence?
TEST:DRIVe:PERFormance?


// ********************************************************************
// Change an instrument setting and save the instrument configuration
// to a file. Reset the R&S IQR, then re-load the configuration file
// ********************************************************************

*RST; *CLS

TRIGger:PLAYer:SOURce EXTernal
*SAV 1
MMEMory:STORe:STATe 1, 'Test_setup.savrcl'
*RST
TRIGger:PLAYer:SOURce?
// Response: MAN (default setting)
MMEMory:LOAD:STATe 1, 'Test_setup.savrcl'
*RCL 1
```

```
TRIGger:PLAYer:SOURce?
// Response: EXT (stored setting)



// ********************************************************************
// File manager examples:
// Query the contents of the default drive and directory,
// query all drives
// ********************************************************************


*RST; *CLS


MMEMory:MSIS?
// Response: 'd:'


MMEMory:CDIRectory?
// Response: " " (root directory on drive d:\


MMEMory:CATalog?
// Possible response: 11638,28666482688,"firmware,DIR,0",
// "RECYCLER,DIR,0","System Volume Information,DIR,0","TEMP,DIR,0",
// "Test_setup.savrcl,BIN,11638"
// Means:11638 bytes used memory, 28666482688 free memory, two
// directories "TEMP" and "firmware" plus two system directories,
// one binary file "Test_setup.savrcl" with a size of 11638 bytes.


MMEMory:ATTRibute?
MMEMory:CATalog:LENGth?
// Response: 5 if the drive contains 1 file and 2 subdirectories
// as shown above


MMEMory:DRIVes?
// Possible response: "C:\","D:\","E:\","F:\","G:\","H:\","I:\"
// Means: internal hard disk drives C:\ and D:\,
// memory pack drives E:\,F:\ ... H:\,
// one external storage medium mapped to drive I:\


// ********************************************************************
// Suppose drive e:\ contains one I/Q data file '2june16.ws1'.
// Create new directory and a backup file in the new directory
// Query all subdirectories on drive e:\
// Remove backup file and directory
// ********************************************************************


MMEMory:MDIRectory 'e:/Backup_directory'


MMEMory:CDIRectory 'e:/Backup_directory'
MMEMory:COPY '../2june16.ws1', '2june16.bak'
// Alternative to the last two commands:
// MMEMory:CDIRectory 'e:'
```

```
// MMEMory:COPY '2June16.ws1', '2june16.bak'
// MMEMory:MOVE '2June16.bak', 'Backup_directory/2June16.bak'


// *******************************************************************
// Query all subdirectories on drive e:\
// Remove backup file from backup directory, remove backup directory
// *******************************************************************

MMEMory:CDIRectory 'e:'
MMEMory:DCATalog?
MMEMory:DCATalog:LENGth?
MMEMory:DELete 'Backup_directory/2june16.bak'
MMEMory:RDIRectory 'Backup_directory'


// *******************************************************************
// Create a test file on drive e:\ containing the five characters
// ABCDE (5 bytes). Read the file contents
// *******************************************************************

MMEMory:DATA 'Test.txt', #15ABCDE
// IEEE 488.2 block data format: use five bytes of data
// (5 characters ABCDE)
MMEMory:DATA? 'Test.txt'
// Response: #15ABCDE
```

9 Command Reference

The following sections provide detailed reference information on the remote control commands of the R&S IQR I/Q Data Recorder. The commands are grouped according to the main control entities of the graphical user interface.

Order of commands

The remote control commands for general settings, recording, replay, and general tasks are listed in separate sections. Related commands appear in the same section; similar commands are grouped together. An alphabetical list of all instrument-control commands is annexed at the end of this manual.

SCPI Compatibility

The R&S IQR uses SCPI commands for remote control. The instrument complies with the final SCPI version 1999.0. SCPI-confirmed commands are explicitly marked in the command reference chapters. Commands without SCPI label are device-specific, however, their syntax follows the rules described in the SCPI standard. These rules are also described in many operating manuals from Rohde & Schwarz which are posted on the internet.

Information in the command reference chapter

Each command description includes the command syntax, parameters (if applicable), a short description of the command, a description of the parameters with ranges and *RST values (if applicable), and a link to an example in Chapter 8, "Programming Examples", on page 109.

"Usage" describes the possible command types:

- "Query only" means that the command must be used with an annexed question mark ("?") in order to read data from the R&S IQR.

- "Event" means that the command initiates an action and has no query form.

- If no "Usage" is specified, the command can either write or read data to/from the R&S IQR, e.g. it may change an instrument setting or query the current setting. Reading data requires an annexed question mark. The majority of SCPI command are of this type.

The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

9.1 Common Commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devices. The headers of these commands consist of "*" followed by three letters. Many

common commands are related to the status reporting system; see Chapter 7.2, "Status Reporting System", on page 106.

Some of the commands in the following list are R&S IQR-specific but use the same syntax as common commands. They are marked "not IEEE 488.2-confirmed".

Table 9-1: List of common commands

Command	Parameters/Remarks	Short Description
*CLS – CLear Status	– no query	Sets the status byte (STB), the standard event register (ESR) and the EVENt part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.
*ESE – Event Status Enable	0...255	Sets the event status enable register to the value indicated. The query *ESE? returns the contents of the event status enable register in decimal form.
*ESR? – Event Status Read	– query only	Returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.
*IDN? – IDentification Query	– query only	Queries the instrument identification string of the R&S IQR, including the manufacturer, the instrument type, its serial number, and the software revision. A possible response is `Rohde&Schwarz,IQR100,10739,1.0013`. The IDN information appears in the "Setup > Hardware Config" dialog.
*IST? – Individual STatus query	– query only	Returns the contents of the IST flag in decimal form (0 | 1). The IST-flag is the status bit which is sent during a parallel poll.
*OPC – OPeration Complete	–	Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query form writes a "1" into the output buffer as soon as all preceding commands have been executed. This is used for command synchronization.
*OPT? – OPTion identification query	– query only	Queries the options included in the instrument and returns a list of the options installed. The response consists of arbitrary ASCII response data according to IEEE 488.2. The options are returned at fixed positions in a comma separated string. A zero is returned for options that are not installed.
*PRE – Parallel poll Register Enable	0...255	Sets parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.
*PSC – Power on Status Clear	0 | 1	Determines whether the contents of the ENABle registers is maintained or reset when the instrument is switched on. *PSC = 0 causes the contents of the status registers to be maintained. Thus a service request can be triggered on switching on in the case of a corresponding configuration of status registers ESE and SRE. *PSC = 0 resets the registers. Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.
*RCL – ReCaLl	0...99 no query, not IEEE 488.2-confirmed	Recalls a previously stored device state from a file with the specified number (see `MMEMory:STORe:STATe`).
*RST – ReSeT	– no query	Performs a factory preset of all instrument settings. The command is equivalent to `SYSTem:PRESet`.
*SAV – SAVe	0...99 no query, not IEEE 488.2-confirmed	Stores the current device state to a file with the specified number (see `MMEMory:LOAD:STATe`).

Command	Parameters/Remarks	Short Description
*SRE – Service Request Enable	0...255	Sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. The query *SRE? returns the contents of the service request enable register in decimal form. Bit 6 is always 0.
*STB? – STatus Byte query	– query only	Reads the contents of the status byte in decimal form.
*TRG – TRiGger	– no query	Triggers all actions waiting for a trigger event. In particular *TRG generates a manual trigger signal (Manual Trigger). This common command complements the ...TRIGger... commands of the subsystem.
*WAI – WAIt to continue	– no query	Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also *OPC).

9.2 General Instrument Settings

The following commands provide basic settings for the R&S IQR.

INSTrument[:SELect]:MODE <Mode>

Sets/returns the basic operating mode of the R&S IQR. Both operating modes (player and recorder) have their own set of remote control commands.

Parameters:

<Mode>   PLAYer | RECorder

                       *RST: PLAYer

Example: See Chapter 8.3, "Replaying Data", on page 111

9.3 Recorder Commands

The commands in the following sections control the R&S IQR in "Recorder" mode (INSTrument[:SELect]:MODE RECorder).

9.3.1 Controlling and Monitoring Data Recording

The following commands control data recording and monitor the progress. The corresponding control elements are located in the upper and lower part of the GUI.

SYSTem:INSTrument:SOURce:IDENtification?

Returns the name of the connected source instrument, its serial number, and the input connector. An empty string is returned if no instrument is connected.

Return values:

<Identification>   *RST: n/a

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Query only

SYSTem:INSTrument:SOURce:NAME?

Returns the name of the connected source instrument. An empty string is returned if no instrument is connected.

Return values:

<Name>   string

Usage: Query only

SYSTem:INSTrument:SOURce:SERial?

Returns the serial number of the connected source instrument. An empty string is returned if no instrument is connected.

Return values:

<Serial>   string

Usage: Query only

SYSTem:INSTrument:SOURce:STATus?

Returns the connection state for the recorder.

Return values:

<Status>   1 | OFF | ON | 0

Usage: Query only

MEASure:IQ:SAMPles? <Samples>

Returns the total number of recorded I/Q samples since recording was started.

Parameters:

<Samples>   Number of samples

                        Range: depending on R&S IQR model
                        Increment: 1

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Query only

MEASure:IQ:AMPLitude? <Level>

Returns the amplitude ("I/Q Level") of the recorded data.

Parameters:

<Level>	I/Q level
	Range: 0.0 to 1.0
	Increment: 0.001
	Default unit: FS (relative to full scale level, corresponds to 1.0)

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Query only

TRIGger:RECorder:EXECute

Starts data recoding. The command is valid while the I/Q Data Recorder is in recorder mode (`INSTrument[:SELect]:MODE` RECorder). It provides the trigger event for "SCPI via LAN" trigger mode (`TRIGger:RECorder:SOURce` LAN).

The trigger system must be armed (`TRIGger:RECorder:ARM` ON) to enable `TRIGger:RECorder:EXECute`.

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Event

TRIGger:RECorder:PAUSe

Pauses/suspends data recording until the next re-start (`TRIGger:RECorder:STARt`).

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Event

TRIGger:RECorder:STARt

Starts data recoding. The command is valid while the I/Q Data Recorder is in recorder mode (`INSTrument[:SELect]:MODE` RECorder) and in all trigger modes except "SCPI via LAN" (`TRIGger:RECorder:SOURce`).

The trigger system must be armed (`TRIGger:RECorder:ARM` ON) to enable `TRIGger:RECorder:STARt`.

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Event

TRIGger:RECorder:STOP

Stops data recording.

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Event

9.3.2 Input Configuration > Trigger

The following commands control the input trigger system for data recording.

TRIGger:RECorder:SYNC <Mode>

Selects the synchronization mode of R&S IQR in recorder mode.

Parameters:

<Mode>   SALone | MASTer | SLAVe

Stand-alone operation, master or slave

*RST: SALone

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:ARM <State>

Arms the trigger system for recorder mode.

Parameters:

<State>	OFF | ONYS | ONNO

OFF: Disables the armed trigger state

ONYS: Arms the trigger system. If the storage file selected via `INPut:RECorder:WAVeform:SELect` already exists on drive e:\, a message is generated. Confirm this message manually to overwrite the data.

ONNO: Arms the trigger system. The R&S IQR overwrites an existing file without generating a message.

*RST:　　OFF

Example:　　See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:STATe? <Status>

Returns the current trigger state as a string message. The string contents correspond to the status message that the R&S IQR displays in the upper part of its main window.

Response	Meaning
"Ready"	Instrument ready for recording
"Recording"	Data is being recorded
"Please wait..."	Instrument not ready (during configuration phase)
"Paused... Press "Pause/Play" to continue"	Recording has been paused (after `TRIGger:RECorder:PAUSe` on page 124)
"Waiting for LAN remote trigger command" "Press "Play\Rec" button to start" "Waiting for trigger signal on I/O connector" "Waiting for trigger signal on DIG IQ" "Waiting for DIG IQ level > trigger tresh." "Waiting for time to elapse"	Trigger system armed, instrument is waiting for trigger event according to the selected trigger source (`TRIGger:RECorder:SOURce`)

Parameters:

<Status>	Trigger status message, see description above.

*RST:　　"Ready"

Example:　　See Chapter 8.2, "Recording Data", on page 109

Usage:　　Query only

TRIGger:RECorder:MODE <Mode>

Selects the trigger mode. In the present firware version, only single recording is supported.

Parameters:

<Mode>	SINGle

*RST:　　SINGle

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:SOURce <Source>

Selects the source of the trigger events for recording. Many of the other source trigger settings depend on the trigger source.

Parameters:

<Source>   LAN | MANual | IQINput | EXTernal | TIME | IQLevel

                    SCPI via LAN, Manual, DIG IQ GP, External, Time, I/Q Level

                    *RST: MANual

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder[:IQ]:GPSignal <GPSignal>

Selects the general purpose signal for trigger source "DIG IQ GP" (`TRIGger:RECorder:SOURce IQINput`).

Parameters:

<GPSignal>   GP1 | GP2 | GP3 | GP4 | 1 | 2 | 3 | 4

                    GPn and n (n = 1 to 4) are equivalent

                    *RST: GP1

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder[:IQ]:LEVel <Level>

Sets the trigger level for trigger source "I/Q Level" (`TRIGger:RECorder:SOURce IQLevel`).

Parameters:

<Level>   Trigger level

                    Range: 0.0 to 1.0
                    Increment: 0.001
                    *RST: 0.7
                    Default unit: FS (relative to full scale level, corresponds to 1.0)

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder[:STARt]:TIME <Time>
TRIGger:RECorder:STOP:TIME <Time>

Sets the time at which a start and stop trigger event occurs. This setting is valid for the "Time" trigger source (`TRIGger:RECorder:SOURce TIME`).

Parameters:

<Time>   String variable, 'HH:MM:SS'

                    *RST: '00:00:00'

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:TYPE <Type>

Selects either edge trigger or gated trigger mode. This setting is valid for the "External" and "DIG IQ GP" trigger sources (TRIGger:RECorder:SOURce).

Parameters:

<Type> EDGE | GATE

*RST: EDGE

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:DELay <Delay>

Sets a delay time between the trigger events and the start of data recording. This setting is valid for the "External" and "DIG IQ GP" trigger sources (TRIGger:RECorder:SOURce).

Parameters:

<Delay> Trigger delay

Range: 0.0 to 10.0
Increment: 1E-10
*RST: 0.0
Default unit: s

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:HOLDoff <Time>

Defines a holdoff time after each detected trigger event during which the R&S IQR is inhibited from acting on any new trigger. This setting is valid for the "External" and "DIG IQ GP" trigger sources (TRIGger:RECorder:SOURce).

Parameters:

<Time> Holdoff time

Range: 0.0 to 10.0
Increment: 1E-8
*RST: 0.0
Default unit: s

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:SLOPe <Slope>

Qualifies whether the event occurs on the rising or falling edge of the signal. This setting is valid for the "External" and "DIG IQ GP" trigger sources (TRIGger:RECorder:SOURce).

Parameters:

<Slope>	NEGative | POSitive
	*RST: POSitive

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:THReshold <Level>

Sets the threshold voltage of the trigger and external sample clock inputs. This setting is valid for the "External" trigger source (`TRIGger:RECorder:SOURce` EXTernal).

Parameters:

<Level>   Threshold voltage

Range: 0.013 to 1.998
Increment: 0.001
*RST: 1.0
Default unit: V

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:IMPedance <Impedance>

Selects the input impedance of the trigger inputs (rear panel connectors I/O 2 to I/O 8) in recorder mode.

Note: The imput impedance of the external sample clock input (rear panel connector I/O 1, `INPut:CLOCk:IMPedance`) and of the trigger inputs for replay mode (`TRIGger:PLAYer:IMPedance`) can be set independently.

Parameters:

<Impedance>	G1K | G50
	*RST: G1K

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder:POLarity <Polarity>

Sets the gate polarity ("Active High" or "Active Low") for gated trigger (`TRIGger:RECorder:TYPE` on page 128 GATE).

Parameters:

<Polarity>	HIGHactive | LOWactive
	*RST: HIGHactive

Example: See Chapter 8.2, "Recording Data", on page 109

TRIGger:RECorder[:STARt]:INPut <Connector>
TRIGger:RECorder:STOP:INPut <Connector>

Selects the input connector for the "Trigger Start / Gate On" and "Trigger Stop" signals. The setting is relevant for external trigger source (`TRIGger:RECorder:SOURce EXTernal`).

Parameters:

<Connector>   OFF | IO1 | IO2 | IO3 | IO4 | IO5 | IO6 | IO7 | IO8

No trigger start and stop signal or signal from rear panel BNC connectors "I/O 1" to "I/O 8"

*RST: OFF

Example: See Chapter 8.2, "Recording Data", on page 109

STATus:RECorder?

Returns the current recorder status.

Return values:

<Status>   OFF | ON

Recording is stopped/paused/not yet started (`OFF`) or running (`ON`)

Usage: Query only

9.3.3   Storage Configuration

The following commands configure a destination file for the recorded data.

INPut:RECorder:WAVeform:SELect <FileName>

Selects a destination file for the recorded I/Q data. The file must be located on network drive e:\, with an extension `*.ws1`; see also Chapter 4.1.2, "Streaming Mode", on page 64.

Note: After file selection, the R&S IQR needs some time for initialization. Query the trigger state (`TRIGger:RECorder:STATe?`) and ensure it is different from "Please wait..." before executing other commands.

Parameters:

<FileName>   String variable containing the file name and path, e.g. `'e:/`
                    `2june16'`. The extension `*.ws1` can be specified in addition;
                    the query returns the entered file name, e.g. `"e:/2june16"` or
                    `"e:/2june16.ws1"`.

Example: See Chapter 8.2, "Recording Data", on page 109

MEASure:IQ:CLOCk? <SamplingRate>

Returns the sampling rate of the recorded data.

Parameters:

<SamplingRate>   Sampling rate

                    Range: 1000 to 100000000
                    Increment: 1
                    Default unit: S/s (samples per second)

Example: See Chapter 8.2, "Recording Data", on page 109

Usage: Query only

MEASure:IQ:AGGExceed?

Returns true if the aggregated sample rate of the recorded data exceeds limit.

Return values:

<>   1 | OFF | ON | 0

Usage: Query only

MEASure:IQ:AGGRate?

Returns the aggregated sample rate of the recorded data.

Return values:

<AggregatedRate>   float

Usage: Query only

MEASure:IQ:INPut <Channel>

Selects the channel in the currently recorded multiplex stream used for level measurement.

Parameters:

<Channel>   CH0 | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8 | CH9 |
                    CH10 | CH11 | CH12 | CH13 | CH14 | CH15
                    *RST: CH0

INPut:RECorder:LIMits:CONDition <Condition>

Selects the stop condition for recording. The command is related to the following settings:

- Maximum file size: `INPut:RECorder:LIMits:FILesize`
- Maximum recording duration: `INPut:RECorder:LIMits:DURation`

Parameters:

<Condition>	FILesize | DURation | FULLdisk
	Terminate recording when maximum file size is reached, after a maximum recording duration, or after the disk is full.
	*RST: FULLdisk

Example: See Chapter 8.2, "Recording Data", on page 109

INPut:RECorder:LIMits:FILesize <Size>

Sets the maximum size of the recording file. This setting is valid if the maximum file size condition is set (`INPut:RECorder:LIMits:CONDition FILesize`).

See also "Terminate Condition" on page 55.

Parameters:

<Size>	Maximum file size (depending on R&S IQR model and free disk space)
	Range: 5242880 to 209715200000
	Increment: 1
	*RST: 10485760
	Default unit: Number of recorded samples

Example: See Chapter 8.2, "Recording Data", on page 109

INPut:RECorder:LIMits:DURation <Duration>

Defines the maximum recording time. This setting is valid if the maximum recording duration condition is set (`INPut:RECorder:LIMits:CONDition DURation`).

Parameters:

<Duration>	Maximum recording time
	Range: 1 to 10800
	Increment: 0.1
	*RST: 600
	Default unit: s

Example: See Chapter 8.2, "Recording Data", on page 109

9.3.4 Source Instrument Configuration

The following commands configure executable programs which are accessible from the R&S IQR. A typical example is the "TSMW Control" software (option R&S IQR-K1).

The user can load a worksapce with filename, start the R&S TSMW, query its status and disconnect. (Note: no stop command is required.)

SYSTem:APPLication:SOURce:SELect<ch> <Executable>

Selects an external executable numbered <ch> for launch.

Suffix:

<ch>   1..5

                          Current number of external executable

Parameters:

<Executable>   1 | OFF | ON | 0

                          Select or deselect executable.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

SYSTem:APPLication:SOURce:SYMBolic<ch> <Name>

Selects the symbolic name of an external executable numbered <ch> which can be launched by the R&S IQR.

Suffix:

<ch>   1..5

                          Current number of external executable

Parameters:

<Name>   String parameter containing the symbolic name.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

SYSTem:APPLication:SOURce:FILename<ch> <FileName>

Selects the path and filename of an external executable numbered <ch> which can be launched by the R&S IQR.

Suffix:

<ch>   1..5

                          Current number of external executable

Parameters:

<FileName>   string

String parameter containing the executable file (`*.exe`) with the complete path.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

SYSTem:APPLication:SOURce:RUNNing?

Queries whether the executable selected via `SYSTem:APPLication:SOURce:SELect<ch>` is running.

Return values:

<Status>   1 | OFF | ON | 0

"1" denotes "running", "0" denotes "closed".

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: Query only

INPut:RECorder:MAPPing?

Returns the mapping mode of the stream currently being recorded.

Return values:

<MapMode>   MAP1 | MAP3

Usage: Query only

SYSTem:OPTion:CONTrol:RECeiver:DISConnect

Disconnects the R&S TSMW receiver.

Usage: Event

SYSTem:OPTion:CONTrol:RECeiver:FILename <FILename>

Defines the R&S TSMW receiver workspace filename and launches the workspace.

Parameters:

<FILename>   string

SYSTem:OPTion:CONTrol:RECeiver:STARt

STarts the R&S TSMW receiver.

Usage: Event

SYSTem:OPTion:CONTrol:RECeiver:STATus?

Return the status of R&S TSMW receiver.

Return values:

<Status>   1 | OFF | ON | 0

Usage: Query only

9.3.5 Bookmarks

The following commands add bookmarks to the recorded file, define comments, and remove bookmarks.

INPut:RECorder:BOOKmark:SET

Puts a bookmark at the current sample count.

Example: See Chapter 8.4, "Bookmarks and "Go To"", on page 113

Usage: Event

INPut:RECorder:BOOKmark<ch>:COMMent <Comment>

Assign a comment to a user-defined bookmark no <ch>. The bookmark must be defined before (`INPut:RECorder:BOOKmark:SET`).

Suffix:

<ch>   1..12

Number of the user-defined bookmark. The default bookmark "BF" is counted as <ch> = 1; <ch> = 2 denotes the first user-defined bookmark.

Parameters:

<Comment>   string

Bookmark comment, string parameter.

Example: See Chapter 8.4, "Bookmarks and "Go To"", on page 113

INPut:RECorder:BOOKmark:RESet

Removes the last bookmark defined via `INPut:RECorder:BOOKmark:SET`.

Example: See Chapter 8.4, "Bookmarks and "Go To"", on page 113

Usage: Event

9.3.6 Channels

The following commands return the characteristics of the channels being played back.

INPut:RECorder:CHANnel:NUMBer?

Returns the number of channels present in the multiplex stream that is currently being recorded.

Return values:

<Channel>	float

Usage: Query only

INPut:RECorder:CHANnel:NUMRecord?

Returns number of channels being recorded.

Return values:

<Channel>	integer

Usage: Query only

INPut:RECorder:CHANnel<ch>:CLOCk?

Returns the sampling rate of the respective channel in the muxiplexed stream currently being recorded.

Suffix:

<ch>	0 to 15
	channel number

Return values:

<SampleRate>	float

Usage: Query only

INPut:RECorder:CHANnel<ch>:NAMed?

Returns the name of the respective channel in the multiplex stream currently being recorded.

Suffix:

<ch>	0 to 15
	channel number

Return values:

<ChannelName>   string

Usage: Query only

INPut:RECorder:CHANnel<ch>:PEP?

Returns the PEP of the respective channel in the multiplex stream currently being recorded.

Suffix:

<ch>   0 to 15
                      channel number

Return values:

<PEP>   float

Usage: Query only

INPut:RECorder:CHANnel<ch>:PRESent?

Returns if the respective channel is effectively present in the multiplex stream currently recorded.

Suffix:

<ch>   0 to 15
                      channel number

Return values:

<Present>   1 | OFF | ON | 0

Usage: Query only

INPut:RECorder:CHANnel<ch>:REFLevel?

Returns the reference level of the respective channel in the multiplex stream currently being recorded.

Suffix:

<ch>   0 to 15
                      channel number

Return values:

<RefLevel>   float

Usage: Query only

INPut:RECorder:CHANnel<ch>:RMS?

Returns the RMS power of the respective channel in the multiplex stream currently being recorded.

Suffix:

<ch>   0 to 15
                            channel number

Return values:

<RMS>   float

Usage: Query only

INPut:RECorder:CHANnel<ch>:SEL <Activate>

Sets if the respective channel in the multiplex stream is selected for recording.

Suffix:

<ch>   0 to 15
                            channel number

Parameters:

<Activate>   1 | OFF | ON | 0

                            *RST: OFF

9.3.7 Spectrum Mode

The following commands set/return the recorder spectrum display.

MEASure:SPECtrum:RECorder:CHANnel <Channel>

Sets the channel in the currently recorded multiplex stream used for the spectrum display.

Parameters:

<Channel>   CH0 | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8 | CH9 |
                            CH10 | CH11 | CH12 | CH13 | CH14 | CH15

                            *RST: CH0

MEASure:SPECtrum:RECorder:DATA?

Returns the current spectrum display data in player mode.

Return values:

<Data>

Usage: Query only

MEASure:SPECtrum:RECorder:MODE <Mode>

Sets/returns the current recorder spectrum display mode.

Parameters:

<Mode>	IQ | FFT	
	*RST:	FFT

9.4 Player Commands

The commands in the following sections control the replay of streaming or arbitrary waveform data ("Player" mode; `INSTrument[:SELect]:MODE` PLAYer).

9.4.1 Controlling and Monitoring Data Replay

The following commands control the replay of data in streamer and arbitrary waveform generator mode and monitor the progress. The corresponding control elements are located in the upper and lower part of the GUI.

[OUTPut<hw>:]SYSTem:INSTrument:DESTination:IDENtification?

Returns the name of the instrument connected to the digital I/Q output 1 or 2. Returns the name, serial number, and the input connector. An empty string is returned if no instrument is connected.

Suffix:

<hw>	1..2
	Digital I/Q output 1 or 2

Return values:

<IDENtification>	string

Example:	See Chapter 8.3, "Replaying Data", on page 111

Usage: Query only

[OUTPut<hw>:]SYSTem:INSTrument:DESTination:MAPPing?

Returns the mapping status of the destination instrument at the digital I/Q output 1 or 2.

Suffix:

<hw>   1..2
            Digital I/Q output 1 or 2

Return values:

<MAP>   MAP1 | MAP3

Usage: Query only

[OUTPut<hw>:]SYSTem:INSTrument:DESTination:NAME?

Returns the name of the destination instrument at the digital I/Q output 1 or 2.

Suffix:

<hw>   1..2
            Digital I/Q output 1 or 2

Return values:

<NAME>   string

Usage: Query only

[OUTPut<hw>:]SYSTem:INSTrument:DESTination:SERial?

Returns the serial number of the destination instrument at the digital I/Q output 1 or 2 in player mode.

Suffix:

<hw>   1..2
            Digital I/Q output 1 or 2

Return values:

<Serial>   string

Usage: Query only

[OUTPut<hw>:]SYSTem:INSTrument:DESTination:STATus?

Returns the connection state at the digital I/Q output 1 or 2 in player mode.

Suffix:

<hw>   1..2
            Digital I/Q output 1 or 2

Return values:

<State>   1 | OFF | ON | 0

Usage: Query only

SYSTem:INSTrument:DESTination:IDENtification?
SYSTem:INSTrument:DESTination:MAPPing?
SYSTem:INSTrument:DESTination:NAME?
SYSTem:INSTrument:DESTination:SERial?
SYSTem:INSTrument:DESTination:STATus?

These commands are alias commands for the digital IQ output 1
`[OUTPut1]SYSTem:...` commands above.

Usage: Query only

[OUTPut<hw>:]IQ:AGGRate?

Returns the sampling rate at the digital I/Q output 1 or 2 which the R&S IQR has measured during the recording session for that file.

Suffix:

<hw>   1..2
                      Digital I/Q output 1 or 2

Return values:

<Rate>   float
                      Increment: 0.001

Usage: Query only

[OUTPut:]IQ:LEVel?

Returns the measured amplitude ("I/Q Level") of the replayed data.

Example: See Chapter 8.3, "Replaying Data", on page 111

Usage: Query only

[OUTPut:]IQ:LVLSource <Source>

Selects the IQ level and IQ trigger channel source. In a multiplex file, users can choose the level source from the channel they are interested in.

Parameters:

<Source>   CH0 | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | CH7 | CH8 | CH9 |
                      CH10 | CH11 | CH12 | CH13 | CH14 | CH15
                      *RST: CH0

[OUTPut:]IQ:SAMPles? <Samples>

Returns the total number of IQ samples that the R&S IQR replayed since the last (re-)start of the replayed file. The counter is reset if the file is re-started due to a trigger event, or if it is replayed another time.

Parameters:

<Samples>	Range:	depending on R&S IQR model
	Increment:	1

Example:	See Chapter 8.3, "Replaying Data", on page 111

Usage:	Query only

[OUTPut:]IQ:AMPLitude <Level>

Sets the amplitude scaling factor ("Gain") of the replayed data.

Parameters:

<Level>	Range:	0.0 to 1.0
	Increment:	0.001
	*RST:	0.8

Example:	See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:EXECute

Starts replay (streaming). The command provides the trigger event for "SCPI via LAN" trigger mode (`TRIGger:PLAYer:SOURce` LAN).

The trigger system must be armed (`TRIGger:PLAYer:ARM` ON) to enable `TRIGger:PLAYer:EXECute`.

Example:	See Chapter 8.3, "Replaying Data", on page 111

Usage:	Event

TRIGger:PLAYer:PAUSe

Pauses/suspends replay (streaming). Use `TRIGger:PLAYer:STARt` to resume the replay.

Example:	See Chapter 8.3, "Replaying Data", on page 111

Usage:	Event

TRIGger:PLAYer:STARt

Starts replay (streaming). The trigger system must be armed (`TRIGger:PLAYer:ARM ON`) to enable `TRIGger:PLAYer:STARt`.

Example:	See Chapter 8.3, "Replaying Data", on page 111

Usage:	Event

TRIGger:PLAYer:STOP

Stops replay (streaming).

Example: See Chapter 8.3, "Replaying Data", on page 111

Usage: Event

9.4.2   File Properties and "Go To" Functionality

The following commands correspond to the functionality of the "GoTo" button and the related dialog.

[OUTPut:]PLAYer:WAVeform:ODAT?
[OUTPut:]PLAYer:WAVeform:NDAT?

Returns the sample count at the position of the oldest and the newest data in the file as a number of Sa.

Return values:

<Sample>   float

Example: See Chapter 8.4, "Bookmarks and "Go To"", on page 113

Usage: Query only

[OUTPut:]PLAYer:WAVeform:DATE?

Returns the creation time and date of the file loaded in the player.

Return values:

<Date>   string

Example: 2015-10-09;09:15:53

Usage: Query only

[OUTPut:]PLAYer:WAVeform:RESolution? <Resolution>
[OUTPut:]IQ:RESolution? <Resolution>

Returns the resolution (in bits) of the file loaded in the player. The resolution is the number of bits I and bits Q for each single replayed sample of the digital I/Q output.

Parameters:
<Resolution>

Usage: Query only

[OUTPut:]PLAYer:WAVeform:SAMPles?

Returns the total number of samples recorded in the file that is currently loaded in the player.

Return values:
<Sample>   float

Usage: Query only

[OUTPut<hw>:]PLAYer:WAVeform:CHANnel:NUMPlay?

Returns the number of channels being played back at the digital I/Q output 1 or 2.

Suffix:
<hw>   1..2
                            Digital I/Q output 1 or 2

Return values:
<Number>   float

Usage: Query only

[OUTPut:]PLAYer:WAVeform:CHANnel<ch>:CLOCk?

Returns the sampling rate of the respective channel in the muxiplexed stream currently being played.

Suffix:

<ch>	0 to 15
	channel number

Return values:

<ChannelRate>	float

Usage: Query only

[OUTPut:]PLAYer:WAVeform:CHANnel<ch>:NAMed?

Returns the name of the respective channel in the multiplex stream currently being played.

Suffix:

<ch>	0 to 15

Return values:

<Name>	string

Usage: Query only

[OUTPut:]PLAYer:WAVeform:CHANnel<ch>:PEP?

Returns the PEP of the respective channel in the multiplex stream currently being played.

Suffix:

<ch>	0 to 15
	channel number

Return values:

<PEP>	float

Usage: Query only

[OUTPut:]PLAYer:WAVeform:CHANnel<ch>:PRESent?

Returns if the respective channel is effectively present in the multiplex stream currently played.

Suffix:

<ch>	0 to 15
	channel number

Return values:

<Present>	1	OFF	ON	0

Usage: Query only

[OUTPut:]PLAYer:WAVeform:CHANnel<ch>:REFLevel?

Returns the reference level of the respective channel in the multiplex stream currently being played.

Suffix:

<ch>   0 to 15
                           channel number

Return values:

<RefLevel>   float

Usage: Query only

[OUTPut:]PLAYer:WAVeform:CHANnel<ch>:RMS?

Returns the RMS power of the respective channel in the multiplex stream currently being played.

Suffix:

<ch>   0 to 15
                           channel number

Return values:

<RMS>   float

Usage: Query only

[OUTPut<hw>:]PLAYer:WAVeform:CHANnel<ch>:SEL <Active>

Sets if the respective channel in the multiplex stream is selected for playing at the digital I/Q output 1 or 2.

Suffix:

<hw>   1..2
                           Digital I/Q output 1 or 2

<ch>   0..15
                           Multiplex stream 0 to 15.

Parameters:

<Active>   1 | OFF | ON | 0
                           *RST: OFF

[OUTPut:]PLAYer:WAVeform:MAPPing?

Returns the mapping mode of the stream currently being played.

Return values:

<MAPP>   MAP1 | MAP3

Usage: Query only

[OUTPut:]PLAYer:WAVeform:ISUNencrypted?

Returns if the file currently loaded in the player is unencrypted. A "1" indicates an unencrypted file, suitable for replay.

Return values:

<IsUnencrypted>	1 | OFF | ON | 0
Example:	See Chapter 8.4, "Bookmarks and "Go To"", on page 113
Usage:	Query only

[OUTPut:]PLAYer:JUMP:ACTivate

Executes a "Go To" operation.

Example:	See Chapter 8.4, "Bookmarks and "Go To"", on page 113
Usage:	Event

[OUTPut:]PLAYer:WAVeform:BOOKmark:NUMBer?

Return values:

<Bookmark>	float
	Number of bookmarks, including the default bookmarks "BF/OD" and "EF/ND".
Example:	See Chapter 8.3, "Replaying Data", on page 111
Usage:	Query only

[OUTPut:]PLAYer:JUMP:BOOKmark:STARt<ch> <Bookmark>
[OUTPut:]PLAYer:JUMP:BOOKmark:STOP<ch> <Bookmark>

Selects the bookmark at which the R&S IQR starts and stops playing.

Suffix:

<ch>	1..12

Parameters:

<Bookmark>	integer	
	Range:	1 to 12 (depending on the bookmarks in the replayed file)
	Increment:	1
	*RST:	1 (start) and 2 (stop), if the entire file is replayed.
Example:	See Chapter 8.3, "Replaying Data", on page 111	

[OUTPut:]PLAYer:JUMP:BOOKmark<ch>:COMMent?
[OUTPut:]PLAYer:JUMP:BOOKmark<ch>:DATE?
[OUTPut:]PLAYer:JUMP:BOOKmark<ch>:ID?
[OUTPut:]PLAYer:JUMP:BOOKmark<ch>:RECTime?

[OUTPut:]PLAYer:JUMP:BOOKmark<ch>:SAMPle?
[OUTPut:]PLAYer:JUMP:BOOKmark<ch>:TIME?

Returns the comment, the date, ID, recording time (relative to the beginning of the file), sample count, and absolute time of bookmark no. `<Ch>`.

Suffix:

<ch>	1..12

Example:	See Chapter 8.3, "Replaying Data", on page 111
Usage:	Query only

[OUTPut:]PLAYer:JUMP:TIME:STARt?
[OUTPut:]PLAYer:JUMP:TIME:STOP?

Returns the time corresponding to the start/stop sample of a replayed sub-range of samples (`[OUTPut:]PLAYer:JUMP:SAMPle:STARt` and `[OUTPut:]PLAYer:JUMP:SAMPle:STOP`).

Return values:

<StopTime>	String variable, 'HH:MM:SS'
	*RST: '00:00:00'

Example:	See Chapter 8.3, "Replaying Data", on page 111
Usage:	Query only

[OUTPut:]PLAYer:JUMP:TIME:FIRSt?
[OUTPut:]PLAYer:JUMP:TIME:LAST?

Returns the time corresponding to the first/last sample in the replayed file.

Return values:

<LastTime>	String variable, 'HH:MM:SS'
	*RST: '00:00:00'

Example:	See Chapter 8.4, "Bookmarks and "Go To"", on page 113
Usage:	Query only

[OUTPut:]PLAYer:JUMP:SAMPle:STARt <StartSample>
[OUTPut:]PLAYer:JUMP:SAMPle:STOP <StopSample>

Defines the sample index of the first/last sample in the replayed sub-range. Use `[OUTPut:]PLAYer:JUMP:SAMPle:FIRSt?` and `[OUTPut:]PLAYer:JUMP:SAMPle:LAST?` to query the sample range in the replayed file.

Parameters:

<StopSample>	integer
	Range: Depending on the replayed file
	*RST: 0

Example:	See Chapter 8.3, "Replaying Data", on page 111

[OUTPut:]PLAYer:JUMP:SAMPle:FIRSt?
[OUTPut:]PLAYer:JUMP:SAMPle:LAST?

Returns the sample index of the first/last sample in the replayed file.

Example:	See Chapter 8.4, "Bookmarks and "Go To"", on page 113
Usage:	Query only

[OUTPut:]PLAYer:JUMP:STATe?

Returns whether replay of a sub-range of samples (corresponding to the "GoTo" button) is currently active.

Example:	See Chapter 8.4, "Bookmarks and "Go To"", on page 113
Usage:	Query only

9.4.3 Trigger Configuration

The following commands control the trigger system for data replay.

TRIGger:PLAYer:SYNC <Mode>

Selects the synchronization mode of R&S IQR in player mode.

Parameters:

<Mode>	SALone | MASTer | SLAVe
	Stand-alone operation, master or slave
	*RST: SALone
Example:	See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:ARM <State>

Arms the trigger system for player mode (streaming).

Parameters:

<State>	OFF | ON
	*RST: OFF

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:STATe? <Status>

Returns the current trigger state as a string message. The string contents correspond to the status message that the R&S IQR displays in the upper part of its main window.

Response	Meaning
"Ready"	Instrument ready for replay
"Running"	Data is being replayed
"Please wait..."	Instrument not ready (during configuration phase)
"Paused... Press "Pause/Play" to continue"	Replay has been paused (after `TRIGger:PLAYer:PAUSe`)
"Waiting for LAN remote trigger command" "Press "Play\Rec" button to start" "Waiting for trigger signal on I/O connector" "Waiting for time to elapse"	Trigger system armed, instrument is waiting for trigger event according to the selected trigger source (`TRIGger:PLAYer:SOURce`)

Parameters:

<Status>	Trigger status message, see description above.
	*RST: "Ready"

Example: See Chapter 8.3, "Replaying Data", on page 111

Usage: Query only

TRIGger:PLAYer:MODE <Mode>

Selects single data transmission (one replay cycle) or continuous data transmission.

Parameters:

<Mode>	CONTinuous | SINGle
	*RST: SINGle

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:SOURce <Source>

Selects the source of the trigger events. Many of the other source trigger settings depend on the trigger source.

Parameters:

<Source>   LAN | MANual | EXTernal | TIME

SCPI via LAN, Manual, External, Time trigger

*RST: MANual

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer[:STAR]:TIME <Time>
TRIGger:PLAYer:STOP:TIME <Time>

Sets the time at which a start and stop trigger event occurs. This setting is valid for the "Time" trigger source (`TRIGger:PLAYer:SOURce TIME`).

Parameters:

<Time>   String variable, 'HH:MM:SS'

*RST: '00:00:00'

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:TYPE <Type>

Selects either edge trigger or gated trigger mode. This setting is valid for the "External" trigger source (`TRIGger:PLAYer:SOURce EXTernal`).

Parameters:

<Type>   EDGE | GATE

*RST: EDGE

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:DELay <Delay>

Sets a delay time between the trigger events and the start of data replay. This setting is valid for the "External" trigger source (`TRIGger:PLAYer:SOURce EXTernal`).

Parameters:

<Delay>   Trigger delay

Range: 0.0 to 10.0
Increment: 1E-10
*RST: 0.0
Default unit: s

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:HOLDoff <Time>

Defines a holdoff time after each detected trigger event during which the R&S IQR is inhibited from acting on any new trigger. This setting is valid for the "External" trigger source (`TRIGger:PLAYer:SOURce EXTernal`).

Parameters:

<Time>   Holdoff time

Range: 0.0 to 10.0
Increment: 1E-8
*RST: 0.0
Default unit: s

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:SLOPe <Slope>

Qualifies whether the trigger event occurs on the rising or falling edge of the trigger sig-
nal. This setting is valid for the "External" trigger source (`TRIGger:PLAYer:SOURce EXTernal`).

Parameters:

<Slope>   NEGative | POSitive

*RST: POSitive

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:THReshold <Level>

Sets the threshold voltage of the trigger and external sample clock inputs. This setting
is valid for the "External" trigger source (`TRIGger:PLAYer:SOURce` EXTernal).

Parameters:

<Level>   Threshold voltage

Range: 0.013 to 1.998
Increment: 0.001
*RST: 1.0
Default unit: V

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:IMPedance <Impedance>

Selects the input impedance of the trigger inputs (rear panel connectors I/O 1 to I/O 8)
in replay mode.

Note: The setting is also valid for the external sample clock input, if the external sam-
ple clock is set (rear panel connector I/O 1). The `TRIGger:RECorder:IMPedance`
setting is independent.

Parameters:

<Impedance>   G1K | G50

1 kΩ or 50 Ω

*RST: G1K

Example: See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer:POLarity <Polarity>

Sets the gate polarity ("Active High" or "Active Low") for gated trigger (`TRIGger:PLAYer:TYPE` GATE).

Parameters:

<Polarity>	HIGHactive	LOWactive
	*RST: HIGHactive
Example:	See Chapter 8.3, "Replaying Data", on page 111

TRIGger:PLAYer[:STAR]:INPut <Connector>
TRIGger:PLAYer:STOP:INPut <Connector>

Selects the input connector for the "Trigger Start / Gate ON" and for the "Trigger Stop" signal. The setting is relevant for external trigger source (`TRIGger:PLAYer:SOURce EXTernal`).

Parameters:

<Connector>	OFF	IO1	IO2	IO3	IO4	IO5	IO6	IO7	IO8
	No trigger start / stop signal or signal from rear panel BNC connectors I/O 1 to I/O 8
	*RST: OFF
Example:	See Chapter 8.3, "Replaying Data", on page 111

STATus:PLAYer?

Returns the current player or ARB generator status.

Return values:

<Status>	OFF	ON
	Replay is stopped/paused/not yet started (OFF) or running (ON)
Example:	See Chapter 8.3, "Replaying Data", on page 111
Usage:	Query only

9.4.4 Output Configuration

The following commands control and modify the I/Q data stream and configure additional signals which the R&S IQR generates when replaying data.

See also: `TRIGger:PLAYer:IMPedance`, `TRIGger:PLAYer:THReshold`

9.4.4.1 Clock Signals

The following commands select the sampling and reference clock signals and configures the input connectors for a possible external clock signal.

See also: `TRIGger:PLAYer:THReshold` and `TRIGger:PLAYer:IMPedance`.

INPut:CLOCk:SOURce <Source>

Select the internal or external sampling clock source for replay.

Parameters:

<Source>   INTernal | EXTernal

                    *RST: INTernal

Example: See Chapter 8.3, "Replaying Data", on page 111

[OUTPut:]PLAYer:WAVeform:CLOCk <SamplingRate>
[OUTPut:]IQ:CLOCk <SamplingRate>

Sets the sampling rate of the replayed data. The setting is valid for internal and external sampling clock source (`INPut:CLOCk:SOURce`). For external sampling clock source, the R&S IQR measures the frequency of the external clock signal (`INPut:CLOCk:FREQuency?`), which should be equal to the selected sampling rate.

Parameters:

<SamplingRate>   float

                    Sampling rate

                    Range: 1000.0 to 100000000.0
                    Increment: 0.001
                    *RST: 1000000.0
                    Default unit: Sa/s (samples per second)

Example: See Chapter 8.3, "Replaying Data", on page 111

INPut:CLOCk:FREQuency? <SamplingRate>

Returns the measured external clock frequency on I/O 1.

Parameters:

<SamplingRate>   Range: 1000 to 100000000
                    Increment: 1

Example: See Chapter 8.3, "Replaying Data", on page 111

Usage: Query only

SYSTem:REFerence:FREQuency:SOURce <Source>

Selects the source of the 10 MHz reference clock signal.

Parameters:

<Source>	INTernal | EXTernal
	*RST: INTernal

Example: See Chapter 8.3, "Replaying Data", on page 111

9.4.4.2 Impairments

The following commands modify the replayed data arithmetically.

See also: [OUTPut:]IQ:AMPLitude.

[OUTPut:]IMPairment:STATe <State>

Enables or disables the impairments to the replayed signal (all [OUTPut:]IMPairment... settings).

Parameters:

<State>	OFF | ON
	*RST: OFF

Example: See Chapter 8.3, "Replaying Data", on page 111

[OUTPut:]IMPairment:ACTive?

Returns the current impairment state.

Return values:

<Active>	1 | OFF | ON | 0

Usage: Query only

[OUTPut:]IMPairment:GAIN:I <Gain>
[OUTPut:]IMPairment:GAIN:Q <Gain>

Defines a gain factor for the replayed I and Q data. The gain multiplies all I and Q amplitudes; 0 dB means that the amplitudes are unchanged.

Parameters:

<Gain>	I and Q gain
	Increment: 0.001
	*RST: 0.0
	Default unit: dB

Example: See Chapter 8.3, "Replaying Data", on page 111

[OUTPut:]IMPairment:OFFSet:I <Offset>
[OUTPut:]IMPairment:OFFSet:Q <Offset>

Defines an offset for the replayed I and Q data. The offset is added to all I and Q amplitudes; 0 (FS) means that the amplitudes are unchanged.

Parameters:

<Offset>	I and Q offset
	Range: -0.1 to 0.1
	Increment: 0.001
	*RST: 0.0
	Default unit: FS (relative to full scale, corresponds to 1.0)

Example: See Chapter 8.3, "Replaying Data", on page 111

[OUTPut:]IMPairment:PHASe <Phase>

Defines a phase error for the replayed I and Q data. The phase rotates each I/Q amplitude around the origin of the constellation diagram; 0 deg means that the amplitudes are unchanged.

Parameters:

<Phase>	Phase error
	Range: -10.0 to 10.0
	Increment: 0.01
	*RST: 0.0
	Default unit: deg

Example: See Chapter 8.3, "Replaying Data", on page 111

9.4.5 Spectrum Mode

The following commands set/return the player spectrum display.

MEASure:SPECtrum:PLAYer:CHANnel?

Sets the channel in the currently played multiplex stream used for the spectrum display.

Return values:

<Channel>	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12	CH13	CH14	CH15
	*RST: CH0

Usage: Query only

MEASure:SPECtrum:PLAYer:DATA?

Returns the current spectrum display data in recorder mode.

Return values:
<Data>

Usage: Query only

MEASure:SPECtrum:PLAYer:MODE <Mode>

Sets the current player spectrum display mode.

Parameters:
<Mode>   IQ | FFT

                 *RST: FFT

9.4.6 Commands for Option R&S IQR-K108

The following commands are available with option R&S IQR-K108, "Network Attached Streaming".

SYSTem:NAS:CONNect

Establishes a direct connection between LAN2 connector of the R&S IQR to the storage server via Ethernet.

Usage: Event

SYSTem:NAS:PATH:X <Path>

Sets the server IP adress and path of the network share containing $*.\mathtt{ws1}$ files. (e.g. \\192.168.1.250\NAS_X)

Parameters:
<Path>   String

Example: SYSTem:NAS:PATH:X '\\192.168.1.250\NAS_X'

SYSTem:NAS:PATH:Y <Path>

Sets the server IP adress and path of the network share containing *.ws2 files. (e.g. \\192.168.1.250\NAS_Y)

Parameters:
<Path>   String

Example: SYSTem:NAS:PATH:X '\\192.168.1.250\NAS_Y'

SYSTem:NAS:SETTing:DEFault <status>

Activates the default user name and password for the R&S IQR-NAS server. A user name and passwort set via the `SYSTem:NAS:USER:NAME` and `SYSTem:NAS:USER:PASSword` are overwritten.

Parameters:

<status>   1 | OFF | ON | 0

SYSTem:NAS:STATus?

Returns the status of the network connection to the R&S IQR-NAS server.

Return values:

<status>   String

                            connected | disconnected | connection failed, <error code>

Usage: Query only

SYSTem:NAS:USER:NAME <Name>

Sets the user name that is used to access to the R&S IQR-NAS server. See also `SYSTem:NAS:SETTing:DEFault` on page 158.

Parameters:

<Name>   String

SYSTem:NAS:USER:PASSword <Password>

Sets the password that is used to access to the R&S IQR-NAS server. See also `SYSTem:NAS:SETTing:DEFault` on page 158.

Parameters:

<Password>   String

9.5   General Tasks

The following commands complement the commands for "Player" and "Recorder" mode. They correspond to the functions in the main menu; see Chapter 5, "General and Administrative Tasks", on page 79.

9.5.1   Selftest

The following queries launch selftest procedures and return the results.

TEST:MEMory?
TEST:VOLTage?
TEST:BNC?
TEST:REFClk?
TEST:TEMPerature?
TEST:DRIVe:PRESence?

The `TEST...` commands launch selftests and return the results. Possible results are identical for all commands. The different selftests are identified as follows:

`MEMory`: "Memory Test"; `VOLTage`: "Voltage Test"; `BNC`: "I/O Connector Test"; `REFClk`: "Reference Clock Test"; `TEMPerature`: "Temperature Test"; `DRIVe:PRESence`: "Disk Access" test.

Return values:

<Result>	FAIL | PASS

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage:	Query only

TEST:DRIVe:PERForm?

Launches the "Disk Performance" test and returns the result.

Return values:

<Result>	Data rate for reading/writing data from the data disk (smaller value)
	Range: 0.0 MByte/s to 1000.0 MByte/s

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage:	Query only

TEST:NOPRompt:LEDS?
TEST:LEDS?

Launches the "LED Test" and returns the result.

- `TEST:LEDS` causes the R&S IQR to display a message box describing the correct operation of the LEDs during the test. You must answer the message ("Yes" or "No") in order to receive a `PASS` or `FAIL` response.

- `TEST:NOPRompt:LEDS` launches the test and returns `PASS`. The response is true if the RUN and ERR LEDs on the rear panel were flashing alternately.

Return values:

<Result>	FAILed | PASSed

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage:	Query only

TEST:NOPRompt:IQIO<hw>?
TEST:IQIO<hw>?

Launches the "DIG IQ Interface Test" and returns the result.

- `TEST:IQIO` causes the R&S IQR to display a message box describing the required external connection during the test. You must establish the connection and tap OK in order to receive a `PASS` or `FAIL` response.

- `TEST:NOPRompt:IQIO` immediately launches the test. You must connect the I/Q input to the I/Q output before in order to obtain a correct result.

Suffix:

<hw>	1..2 Digital IQ output 1 or 2.

Return values:

<Result>	FAILed | PASSed

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage:	Query only

TEST:NOPRompt:FAN?
TEST:FAN?

Launches the "Fan Test" and returns the result.

- `TEST:FAN` causes the R&S IQR to display a message box describing the correct operation of the fan during the test. You must answer the message ("Yes" or "No") in order to receive a `PASS` or `FAIL` response.

- `TEST:NOPRompt:FAN` launches the test and returns `PASS`. The response is true if the fan operated at full speed for approx. 3 s, and then at normal speed for 3 s.

Return values:

<Result>	FAILed | PASSed

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage:	Query only

9.5.2 Instrument Configurations and File Management

The following `MMEMory...` commands store and load instrument configurations and provide a general file management functionality. Most of the commands are SCPI confirmed.

The <FileName> and <DirectoryName> parameters are strings. Some commands use a fixed directory; for others the <FileName> can contain the complete path including the drive name and all subdirectories, e.g. `D:\TEMP\TRASH\test.txt` for the file named `test.txt` in the `TEMP\TRASH` subdirectory of the internal hard disk drive `D:\`. If no complete path is specified, the file location is relative to the current directory (see `MMEMory:CDIRectory`). The file name itself may contain the period as a separator for extensions.

File and directory names can be chosen according to Windows® conventions; the restrictions placed on file names known from DOS systems do not apply. All letters and numbers are allowed, as well as the special characters "_", "^", "$", "~", "!", "#", "%", "&", "-", "{", "}", "(", ")", "@" and "`". Reserved file names are `CON, AUX, COM1, ..., COM4, LPT1, ..., LPT3, NUL` and `PRN`.

The use of wildcards ? and * is not allowed.

MMEMory:ATTRibute? '<File Name>', '<Attribute>'

Sets file attributes for the specified file. The setting command cannot be used for directories, however, the query also returns the attributes for directories.

Parameters:

'<File Name>'   String parameter to specify the path and name of the file. If no path is specified the R&S IQR uses the file in the current directory (see `MMEMory:CDIRectory`).

Return values:

<Attribute>	String parameter to specify the file attribute, e.g. '+R', '-A'. The string consists of two parts: Part 1: + sets an attribute, – removes the attribute Part 2: R (read-only file), A (file ready for archiving), S (system file), H (hidden file)

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only

MMEMory:CATalog? ['<DirectoryName>']

Returns information on the contents of the current or of a specified directory.

Parameters:

'<DirectoryName>'	String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory (see `MMEMory:CDIRectory`).

Return values:

<UsedSize>	Disk space in bytes used by the files in the directory, excluding subdirectories.
<FreeDiskSpace>	Available free disk space in bytes.
'<Information_1>' ... '<Information_n>'	Strings are returned for each file and subdirectory. The string indicates the file or directory name, the format (DIR | BIN | ASC) and the size in bytes. This information is separated by commas.

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only SCPI confirmed

MMEMory:CATalog:LENGth? ['<DirectoryName>']

Returns the number of files and subdirectories of the current or of a specified directory.

Parameters:

'<DirectoryName>'	String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory (see `MMEMory:CDIRectory`).

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only

MMEMory:CDIRectory '<DirectoryName>'

Changes the default directory for mass memory storage. The directory is used for all subsequent `MMEMory...` commands if no path is specified with them. It is also possible to change to the higher-level directory using two dots '..'.

Use `MMEMory:MSIS` to change or retrieve the network drive.

Parameters:

'<DirectoryName>'	String parameter to specify the directory.
	*RST: " " (root directory of drive d:)

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: SCPI confirmed

MMEMory:COPY '<FileSource>'[, '<FileDestination>']

Copies an existing file to a new file.

Parameters:

'<FileSource>' / '<FileDestination>'	String parameters to specify the name of the file to be copied and the name of the new file.
	If no file destination is specified the source file is written to the current directory (see `MMEMory:CDIRectory`).

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: Event
SCPI confirmed

MMEMory:DATA '<FileName>', <Data>
MMEMory:DATA? '<FileName>'

Loads <Data> into the file <FileName>. A query returns the contents of the file <FileName> in IEEE 488.2 block data format; see Chapter 7.3, "Block Data Format", on page 107.

Parameters:

<Data>	Data in block data format

Parameters for setting and query:

'<FileName>'	String parameter to specify the name of the file.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: SCPI confirmed

MMEMory:DCATalog? ['<DirectoryName>']

Returns the subdirectories of the current or of a specified directory.

Parameters:

'<DirectoryName>'	String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory (see `MMEMory:CDIRectory`).

Return values:

'<Directory_1>' ...	Names of the subdirectories separated by commas

Usage: Query only

See also Chapter 8.5, "Additional and Optional Tasks", on page 116

MMEMory:DCATalog:LENGth? ['<DirectoryName>']

Returns the number of subdirectories of the current or of a specified directory.

Parameters:

'<DirectoryName>'	String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory (see `MMEMory:CDIRectory`).
Example:	See also Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only

MMEMory:DELete '<FileName>'

Removes a file from the specified directory.

Parameters:

'<FileName>'	String parameter to specify the name and directory of the file to be removed.
Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Event SCPI confirmed

MMEMory:DRIVes?

Returns a comma-separated list of the drives of the instrument.

Usage:	Query only

See Chapter 8.5, "Additional and Optional Tasks", on page 116

MMEMory:LOAD:STATe <number>, <file_name>

Loads a previously stored configuration file (`*.savrcl`). After the file has been loaded, the instrument settings must be activated using an `*RCL` command.

Setting parameters:

<number>	Identifier for the loaded data set, to be used with the subsequent `*RCL` command
	Range: 0 to 99
<file_name>	String parameter to specify the file name with extension `*.savrcl`.
Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: Setting only
                    SCPI confirmed

MMEMory:MDIRectory '<DirectoryName>'

Creates a new directory for mass memory storage.

Parameters:
'<DirectoryName>'   String parameter to specify the directory.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: Event

MMEMory:MOVE '<FileSource>', '<FileDestination>'

Moves an existing file to a new location.

Parameters:
'<FileSource>'   String parameters to specify the name of the file to be moved
'<FileDestination>' and the name of the new file.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: Event
                    SCPI confirmed

MMEMory:MSIS <Msis>

The command selects a network drive. This can abbreviate the command syntax in
subsequent commands, omitting the need to specify the drive together with each file
name.

Parameters:
<Msis>   string
                    *RST: "d:\"

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: SCPI confirmed

MMEMory:RDIRectory '<DirectoryName>'

Removes an existing directory from the mass memory storage system.

Parameters:
'<DirectoryName>'   String parameter to specify the directory.

Example: See also Chapter 8.5, "Additional and Optional Tasks",
                    on page 116

Usage: Event

MMEMory:STORe:STATe <number>, '<file_name>'

Stores the current instrument settings to the specified configuration file (`*.savrcl`).
The instrument settings must first be stored internally using the common command
`*SAV <number>`.

Setting parameters:

<number>   Identifier for the data set stored internally via `*SAV <number>`

                          Range: 0 to 99

'<file_name>'   String parameter to specify a file name with extension
                          `*.savrcl`.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: Event
                   SCPI confirmed

9.5.3 Data Export and Archiving

The following `SYSTem...` commands control data (re-)import, data export and archiving.

SYSTem:IMPort:SOURce:FILename <FileName>
SYSTem:IMPort:DESTination:FILename <FileName>
SYSTem:ARCHive:SOURce:FILename <FileName>
SYSTem:ARCHive:DESTination:FILename <FileName>

Defines the source and destination file names for import and export/archiving.

Parameters:

<FileName>   String parameter containing the file name and path, e.g.
                    `'e:2june16'`. The extensions depend e.g. on the export/
                    archiving format (`SYSTem:ARCHive:FORMat`) and must not be
                    specified.

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

SYSTem:ARCHive:FORMat <Format>

Sets the export/archiving format. The `RAW` export format requires option R&S IQR-K101.

Parameters:

<Format>   WVARchive | RAW

                    WVARchive: Archive data to encrypted `*.wv` file
                    RAW: Export raw data to `*.wvd` file

                    *RST: WVARchive

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

SYSTem:IMPort:DURation?
SYSTem:ARCHive:DURation?

Returns the remaining import or export/archiving time.

Return values:

<Time>   String variable, 'HH:MM:SS'

                    *RST: '00:00:00'

Example: See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage: Query only

SYSTem:IMPort:RATE?
SYSTem:ARCHive:RATe?

Returns the current import or export/archiving transfer rate.

Return values:

<Rate>	Range:	Depending on external storage device
	*RST:	n/a
	Default unit: MBytes/s	

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only

SYSTem:IMPort:PROGress?
SYSTem:ARCHive:PROGress?

Returns the current import or export/archiving progress.

Return values:

<Progress>	Default unit: %

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only

SYSTem:IMPort:RUNNing?
SYSTem:ARCHive:RUNNing?

Returns the current import or export/archiving status.

Return values:

<State>	0	1
	No activity or export/archiving running

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only

SYSTem:IMPort:STARt
SYSTem:IMPort:STOP
SYSTem:ARCHive:STARt
SYSTem:ARCHive:STOP

Starts and aborts I/Q and meta data import or export/archiving.

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Event

SYSTem:ARCHive:PARTial:TIME:FROM <From>

Sets or queries the starting time for partial export/archiving in RAW export format.

Requires option R&S IQR-K101.

Parameters:

<From>   HH:MM:SS

                         The set or returned value string is "HH:MM:SS" for the start time in hours, minutes and seconds.

Example: Set starting time SYST:ARCH:PART:TIME:FROM '00:00:15'

SYSTem:ARCHive:PARTial:TIME:TO <To>

Sets or queries the ending time for partial export/archiving in RAW export format.

Requires option R&S IQR-K101.

Parameters:

<To>   HH:MM:SS

                         The set or returned value string is "HH:MM:SS" for the end time in hours, minutes and seconds.

Example: Set ending time SYST:ARCH:PART:TIME:TO '00:01:09'

SYSTem:ARCHive:WAVeform:CHANnel:NUMBer?

Returns the number of channels present in the multiplex stream that is currently being exported.

Return values:

<Channel>   float

Usage: Query only

SYSTem:ARCHive:WAVeform:CHANnel<ch>:CLOCk?

Returns the sampling rate of the respective channel in the muxiplexed stream currently being exported.

Suffix:

<ch>   0 to 15
                         channel number

Return values:

<ChannelRate>   float

Usage: Query only

SYSTem:ARCHive:WAVeform:CHANnel<ch>:NAMed?

Returns the name of the respective channel in the multiplex stream currently being being exported.

Suffix:

<ch>   0 to 15
                         channel number

Return values:

<Name>   string

Usage: Query only

SYSTem:ARCHive:WAVeform:CHANnel<ch>:PEP?

Returns the PEP of the respective channel in the multiplex stream currently being exported.

Suffix:

<ch>   0 to 15
                         channel number

Return values:

<PEP>   string

Usage: Query only

SYSTem:ARCHive:WAVeform:CHANnel<ch>:PRESent?

Returns if the respective channel is effectively present in the multiplex stream currently being exported.

Suffix:

<ch>   0 to 15
                         channel number

Return values:

<Present>   1 | OFF | ON | 0

Usage: Query only

SYSTem:ARCHive:WAVeform:CHANnel<ch>:REFLvl?

Returns the reference level of the respective channel in the multiplex stream currently being exported.

Suffix:

<ch>   0 to 15
                         channel number

Return values:

<RefLevel>   float

Usage: Query only

SYSTem:ARCHive:WAVeform:CHANnel<ch>:RMS?

Returns the RMS power of the respective channel in the multiplex stream currently being exported.

Suffix:

<ch>   0 to 15
                               channel number

Return values:

<RMS>   float

Usage: Query only

SYSTem:ARCHive:WAVeform:CHANnel<ch>:SEL <Activate>

Selects the respective channel in the multiplex stream for export

Suffix:

<ch>   0 to 15
                               channel number

Parameters:

<Activate>   1 | OFF | ON | 0

                               *RST: OFF

SYSTem:ARCHive:WAVeform:CHENable?

Returns true if all channels are selected for export.

Return values:

<AllChannels>   SELected | ALL

Usage: Query only

SYSTem:ARCHive:WAVeform:MAPPing?

Returns the mapping mode of the stream currently being exported.

Return values:

<MAPP>   MAP1 | MAP3

Usage: Query only

9.5.4 SYSTem Commands

The SYSTem... command group contains functions that are not related to instrument performance. Most of the commands are SCPI-confirmed.

SYSTem:APPLication:MAPPing:STARt

Example:	Launches the GPS map (option R&S IQR-K103).
Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Event

SYSTem:DATE <Year>, <Month>, <Day>

Sets the date of the internal calendar.

Parameters:

<Year>	Year, to be entered as a four-digit number (including the century and millenium information)
<Month>	Month, 1 (for January) to 12 (for December)
<Day>	Day, 1 to the number of days in the month from the previous parameter. Numbers entered are rounded to the closest integer value. *RST: a *RST does not affect the date settings
Example:	SYSTem:DATE? Query the current date. Possible response: 2010, 09, 20
Usage:	SCPI confirmed

SYSTem:ERRor:ALL?

Queries and at the same time deletes all entries in the error queue. The entry consists of an error number and a short description of the error. Positive error numbers are instrument-dependent. Negative error numbers are defined by the SCPI standard.

Example: SYSTem:ERRor:ALL?
Query all entries in the error queue. 0, "No error" is returned if the error queue is empty.

Usage: Query only
SCPI confirmed

SYSTem:ERRor:CODE:ALL?

Queries and at the same time deletes all entries in the error queue. The command returns the error numbers without any description of the errors. Positive error numbers are instrument-dependent. Negative error numbers are defined by the SCPI standard.

Example: SYSTem:ERRor:CODE:ALL?
Query all entries in the error queue. "0" is returned if the error queue is empty.

Usage: Query only
SCPI confirmed

SYSTem:ERRor:CODE[:NEXT]?

Queries and at the same time deletes the oldest entry in the error queue. The command returns the error number without any description of the error. Positive error numbers are instrument-dependent. Negative error numbers are defined by the SCPI standard.

Example: SYSTem:ERRor:CODE?
Query the oldest entry in the error queue. "0" is returned if the error queue is empty.

Usage: Query only
SCPI confirmed

SYSTem:ERRor:ALL?

Queries and at the same time deletes all entries in the error queue. The entry consists of an error number and a short description of the error. Positive error numbers are instrument-dependent. Negative error numbers are defined by the SCPI standard.

Example: SYSTem:ERRor:ALL?
Query all entries in the error queue. 0, "No error" is returned if the error queue is empty.

Usage: Query only
SCPI confirmed

SYSTem:ERRor[:NEXT]?

Queries and at the same time deletes the oldest entry in the error queue. The entry consists of an error number and a short description of the error. Positive error numbers are instrument-dependent. Negative error numbers are defined by the SCPI standard.

Example:	SYSTem:ERRor? Query the oldest entry in the error queue. 0,"No error" is returned if the error queue is empty.
Usage:	Query only SCPI confirmed

SYSTem:OPTion:AGC?
SYSTem:OPTion:CTLGen?
SYSTem:OPTion:EXPT?
SYSTem:OPTion:GPSM?
SYSTem:OPTion:GPSR?
SYSTem:OPTion:MUX?
SYSTem:OPTion:NAS?
SYSTem:OPTion:PLY2out?
SYSTem:OPTion:TSMW?

These commands query whether the following options are installed and unlocked on the instrument:

- AGC – option R&S IQR-K104 (Ref. level controlled recording and replay of RF signals for AGC)
- CTLGen – option R&S IQR-K2 (Generator Control)
- EXPT – option R&S IQR-K101 (Import/Export of Waveform Files and Meta Data Files)
- GPSM – option R&S IQR-K103 (GPS Map)
- GPSR – option R&S IQR-K102 (GPS Data Recording)
- MUX – option R&S IQR-K105 (Multiplexing I/Q Data)
- NAS – option R&S IQR-K108 (Network Attached Streaming)
- PLY2out – option R&S IQR-K107 (2nd Dig IQ Out)
- TSMW – option R&S IQR-K1 (TSMW Control)

Return values:

<Status>	1	OFF	ON	0
Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116
Usage:	Query only

SYSTem:OPTion:B010?
SYSTem:OPTion:B020?
SYSTem:OPTion:B110?
SYSTem:OPTion:B109F?

SYSTem:OPTion:B119F?
SYSTem:OPTion:B138F?

These commands query whether the following hardware options are installed:

- B010 – option R&S IQR-B010 (HDD Module 1 TB, 80 MByte/s)

- B020 – option R&S IQR-B020 (HDD Module 2 TB, 80 MByte/s)

- B110 – option R&S IQR-B110 (SSD Module 1 TB, 300 MByte/s)

- B109F – option R&S IQR-B109F (SSD Module 0.9 TB, 400 MByte/s)

- B119F – option R&S IQR-B119F (SSD Module 1.9 TB, 400 MByte/s)

- B138F – option R&S IQR-B138F (SSD Module 3.8 TB, 400 MByte/s)

Return values:

<Status>	1 | OFF | ON | 0

Example:	See Chapter 8.5, "Additional and Optional Tasks", on page 116

Usage:	Query only

SYSTem:PRESet

Performs a factory preset of all instrument settings. The command is equivalent to *RST (see Common Commands).

Example:	See Chapter 8.3, "Replaying Data", on page 111

Usage:	Event SCPI confirmed

SYSTem:SETTings:LAN1?

Returns the IP address of LAN1 port.

Return values:

<Addr>	string

Usage:	Query only

SYSTem:SETTings:LAN2?

Returns the IP address of LAN2 port.

Return values:

<Addr>	string

Usage:	Query only

SYSTem:SETTings:PROG <Unit>

Sets zhe unit of the progress indication.

Parameters:

<Unit>   SAMP | PERC | TIME

                              *RST: SAMPle

SYSTem:TIME <Hour>, <Minute>, <Second>

Sets the time of the internal clock.

Parameters:

<Hour>   Hour, 0 to 23

<Minute>   Minute, 0 to 59

<Second>   Second, 0 to 59 (60 due to rounding)
                              Numbers entered are rounded to the closest integer value.

                              *RST: a *RST does not affect the time settings

Example: SYSTem:TIME?
                              Query the current time. Possible response: 15, 09, 20

Usage: SCPI confirmed

SYSTem:VERSion?

Queries the SCPI version number to which the instrument complies. The R&S IQR complies to the final SCPI version 1999.0.

Usage: Query only
                              SCPI confirmed

10 Annexes

The following sections describe special tools of the R&S IQR and additional tasks which are not needed for regular operation of the I/Q Data Recorder.

10.1 On-Screen Keyboard

The "On-Screen Keyboard" pops up automatically when a numeric or data entry field is activated. It is also opened by the "osk" button 🖳 in the Windows® toolbar.

esc		F1	F2	F3	F4		F5	F6	F7	F8		F9	F10	F11	F12
`	1	2	3	4	5	6	7	8	9	0	-	=		bksp	
tab	q	w	e	r	t	y	u	i	o	p	[	]		#	
lock	a	s	d	f	g	h	j	k	l	;	'		ent		
shft	\	z	x	c	v	b	n	m	,	.	/		shft		
ctrl	⊞	alt				alt	▤	↑	↓	←	→				

The on-screen keyboard can replace all functions of an external keyboard: simply tab the keys on the R&S IQR's touchscreen display, or use the mouse to click the keys. Data entry by means of the on-screen keyboard is self-explanatory. Tap "ent" to confirm and terminate an entry. Tap on a point outside the keyboard to close the keyboard.

The following keys on the lower row of keys provide an additional functionality.

⊞ The "Windows" keys open the Windows® start menu and gives access to the functionality of the operating system. From there you can also open the on-screen keyboard using the "osk" button in the toolbar.

▤ The "Explorer" key opens the Windows® Explorer application for file management on the internal hard disk of the R&S IQR, the removable memory pack, or an external storage device (e.g. a USB memory stick).

10.2 Remote Operation in a LAN

The two LAN ports of the R&S IQR can be used to integrate the I/Q Data Recorder into a home/company network or to an external computer/test instrument (direct Ethernet connection). This offers several applications:

- Transfer of data between a controller and the tester, e.g. in order to run a remote control program.
- Transfer of recorded I/Q data and other data files from a remote computer/instrument and back.

● Access or control of the R&S IQR from a remote computer using the "Remote Desktop" application (or a similar tool).
● Access to external network devices.

> **NOTICE**
>
> **Virus protection**
>
> An efficient virus protection is a prerequisite for secure operation in a network. Never connect your R&S IQR to an unprotected network because this may cause damage to the instrument software.

10.2.1 Assigning IP Addresses

Depending on the network capacities, the TCP/IP address information for the R&S IQR can be obtained in different ways.

● If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.
● If the network does not support DHCP, or if the R&S IQR is set to use alternate TCP/IP configuration, the addresses must be set manually.

In the factory configuration, the LAN 1 interface "Local Area Connection" obtains its IP address via DHCP while the LAN 2 interface ("Local Area Connection 2") has a fixed IP address 192.168.0.1 assigned. It is recommended to use LAN 1 for the integration of the R&S IQR into the company network, leaving all IP address settings unchanged. LAN 2 is the recommended connector for TSMW control; see Chapter 2.3, "Recording Data Using TSMW Control", on page 30.

> **NOTICE**
>
> **Valid IP addresses**
>
> If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration of the LAN 1 interface, you must assign valid address information before connecting the R&S IQR to the LAN. Contact your network administrator to obtain a valid IP address, because connection errors can affect the entire network.

10.2.1.1 Manual TCP/IP Configuration

To disable dynamic TCP/IP configuration and enter the TCP/IP address information manually proceed as follows:

1. Obtain the IP address and subnet mask for the R&S IQR and the IP address for the local default gateway from your network administrator. If needed, also obtain the name of your DNS domain and the IP addresses of the DNS and WINS servers on your network.

2. Connect an external keyboard to your instrument and perform the startup procedure.

3. Access the operating system by pressing the Windows® key (or Ctrl + ESC) on the external keyboard. Open Windows® XP's control panel.

4. To adjust the IP address information for the LAN 1 interface, open the "Control Panel > Network Connections > Local Area Connection > Properties > Internet Protocol (TCP/IP) Properties" dialog and enter the address information, e.g.:
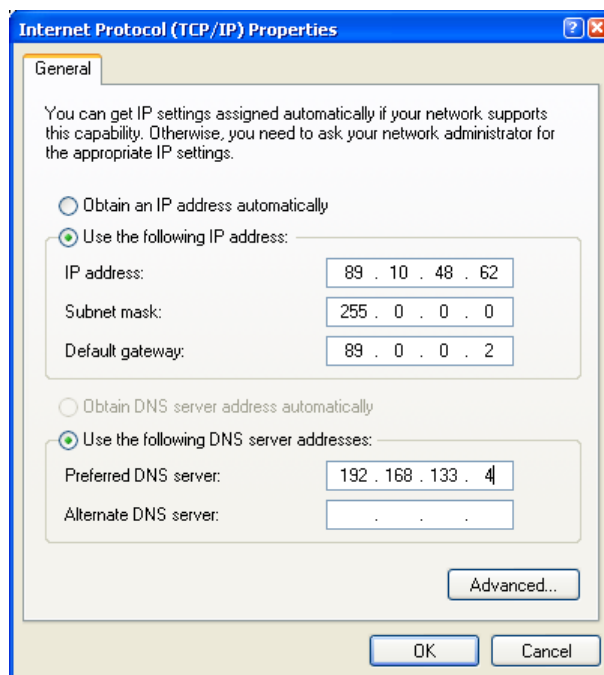
5. To adjust the IP address information for the LAN 2 interface, perform the same procedure for "Local Area Connection 2".

For more information, refer to the Windows® help system.

10.2.2 Remote Desktop Connection

"Remote Desktop" is a Windows® application which you can use to access and control the R&S IQR from a remote computer through a LAN connection. While the R&S IQR is operating, the GUI is displayed on the remote computer. "Remote Desktop" also provides access to all files on the internal hard disk.

To set up a "Remote Desktop" connection, proceed as follows:

1. Connect the R&S IQR to the network, see Chapter 1.6.4, "Connecting a LAN Cable", on page 22.

2. Access the operating system, e.g. by pressing the Windows® key on an external keyboard.

3. Open Windows® XP's Control Panel.
   Select "System" and open the "Remote" tab in the "System Properties" dialog.
   Enable "Allow users to connect remotely to this computer".

4. Determine the computer name ("Control Panel > System > Computer Name") or IP
   address ("Control Panel > Network Connections > Local Area Connection > Sup-
   port" or `ipconfig` command in the command prompt) of your R&S IQR. The com-
   puter name of a R&S IQR is always RSIQR<model>-<serialnumber>. Example :
   RSIQR100-102030.
   See also Assigning IP Addresses.

5. Click "Start > Programs > Accessories > Remote Desktop Connection" on the
   remote computer. Establish a connection using the R&S IQR's computer name or
   IP address. You can also use other utilities providing remote PC access, e.g. VNC.

Password protection

The R&S IQR uses a user name and password as credentials for remote access. In
the factory configuration, "instrument" is preset for both the user name and the pass-
word. To protect the I/Q Data Recorder from unauthorized access, it is recommended
to change the factory setting.

10.2.3 Windows® Firewall Settings

A firewall protects an instrument by preventing unauthorized users from gaining access
to it through a network. In the default configuration of the R&S IQR the firewall is
enabled.

Some actions require a different firewall configuration, e.g.:

● To transfer data with other hosts in the LAN, you have to allow "File and Printer
  Sharing".

● To open a LAN-based remote control channel, you have to disable the firewall.

To change the firewall settings proceed as follows:

1. Access the operating system by pressing the Windows key on the external key-
   board. Open the "Control Panel".

2. Select "Windows Firewall". Open the "Exceptions" tab in the "Windows Firewall"
   dialog to enable "File and Printer Sharing". Open the "General" tab to enable or
   disable the firewall.

For detailed information about the firewall refer to the Windows® XP Embedded help
system.

> **NOTICE**
>
> **Risks of changing the firewall settings**
>
> Disabling the firewall or allowing exceptions may make your instrument more vulnerable to viruses and intruders.
>
> It is recommend to restore the default firewall configuration after completing a task which requires modified settings.

10.3   Windows® XP Embedded

The R&S IQR is equipped with a Windows® XP Embedded operating system which has been configured according to the instrument's features and needs. Changes in the system configuration can be necessary in order to:

● establish a LAN connection, see Chapter 10.2, "Remote Operation in a LAN", on page 177
● customize the properties of the external accessories connected to the R&S IQR, see Chapter 1.6, "Connecting External Accessories", on page 20
● adjust the time and date settings

> **NOTICE**
>
> **Configuration of the operating system, updates**
>
> The operating system is adapted to the R&S IQR. To avoid impairment of instrument functions, only change the settings described in this documentation. Existing software must be modified only with update software released by Rohde & Schwarz. Likewise, only programs authorized by Rohde & Schwarz for use on the instrument must be executed.
>
> Never access and configure the operating system while data is being recorded or replayed.

Accessing the operating system

The desktop of the operating system is accessed by pressing the Windows key + D on an external keyboard. All necessary settings can be accessed from the "Start" menu, in particular from the "Control Panel".

You can also use Windows keys in the "On-Screen Keyboard" of the R&S IQR to open the "Start" menu. To access the on-screen keyboard, open one of the dialogs containing a numeric or data entry field (e.g. "Output > Impairments" in "Player" mode). See also Chapter 10.1, "On-Screen Keyboard", on page 177.

10.4 Firmware Recovery to Delivery State

The R&S IQR firmware is delivered on CD-ROM no. 1513.4552.08, together with all necessary documentation (e.g. this manual and the data sheet).

The firmware is most conveniently recovered from the CD-ROM, following the instructions on the CD-ROM's "Software" page. The CD-ROM also ensures a virus-free installation. When recovering your R&S IQR firmware, the configuration settings of your device will be reset to default values. To keep your current settings, you should save your configuration before updating the firmware; see Chapter 10.5, "Firmware Update", on page 183.

NOTICE

Virus protection
Ensure an efficient virus protection when installing R&S IQR firmware from your own USB stick.

Installing the R&S IQR firmware from a USB stick

If you do not have a USB CD-ROM drive at hand, you can use a USB stick for the installation. If an R&S IQR firmware is already installed on your R&S IQR, this firmware must be removed prior to a re-installation.

To remove an installed R&S IQR firmware,

1. Connect a mouse and a keyboard to the R&S IQR USB connectors.

2. Press the Windows key on the keyboard to access Windows® XP Embedded.

3. Open the "Control Panel" and select "Add or Remove Programs".

4. Select the "PenMount Windows Universal Driver..." and click "Change/Remove". Answer all questions with "Enter".

5. Select the "R&S IQR Firmware" and click "Remove".

6. Close the "Add or Remove Programs" dialog and the "Control Panel".

To install the new R&S IQR firmware,

1. Copy the `install` folder from the CD-ROM (or the downloaded firmware version) to any directory of the USB stick.

2. Insert the stick into any of the master USB connectors on the front or rear panel of the R&S IQR.

3. Run `COPYINSTALL.CMD` from the USB stick.

   The installer will copy the R&S IQR firmware to drive `D:firmware` and then call the installation functions for the firmware and the touchscreen driver. The R&S IQR will perform a re-start after the installation is completed. Note that this does not restore the map to the default map.

Windows® XP Embedded recovery from DVD

A Windows® XP Embedded recovery DVD (stock no. 1513.6149.00) is supplied with each R&S IQR. The recovery DVD allows you to restore your operating system in case it has become unusable.

When the instrument is switched from standby to ready state, it automatically checks for a recovery DVD at its USB interfaces.

NOTICE

Risk of data loss

Restoring the operating system while a memory pack is in place may cause data loss. Always remove the memory pack as described in Chapter 1.2.4, "Memory Pack", on page 15 before carrying out the installation procedure described below.

The installation process will reformat the internal hard disk of the R&S IQR and erase any user data, settings and applications. A re-installation of the R&S IQR firmware is required.

To re-install the Windows® XP Embedded system:

1. Switch the R&S IQR to standby state.

2. Insert the recovery DVD into a USB DVD drive and plug it into any of the USB connectors on the front or rear panel of the R&S IQR.

3. Press the standby key to boot the I/Q Data Recorder.

4. Confirm that you want to install the operating system.

   After the installation, the R&S IQR will automatically re-boot.

5. Remove the recovery DVD to ensure the R&S IQR boots the new Windows® XP Embedded installation on its internal hard disk.

6. Re-install the R&S IQR firmware as described above.

10.5 Firmware Update

Update versions of the firmware are available on the Rohde & Schwarz internet in the download section of the R&S IQR product pages (http://www2.rohde-schwarz.com/product/IQR.html).

When updating your R&S IQR firmware, the configuration settings of your device will be reset to default values. To keep your current settings, you should save your configuration before updating the firmware

To save the device configuration before updating the R&S IQR firmware,

1. Open the R&S IQR "Main Menu".

2. Tap "Configuration File" and choose "Save As" to enter a file selection dialog.

3. Select a directory and file where you want to save your settings and tap "Save".

To install an R&S IQR firmware version update,

1. Download a firmware file with the extension `*.IQR` on your computer and copy it to a USB stick.

2. Power down the R&S IQR.

3. Insert the stick into any of the master USB connectors on the front or rear panel of the R&S IQR.

4. Power up the R&S IQR again and wait for the firmware selection dialog.

5. **Firmware selection:** if there is only one firmware file on your memory stick, it will be shown already highlighted in the list. If there are multiple firmware files on your USB stick or if you have connected more than one USB stick containing firmware files, all different firmware versions will be shown in the list. Select the firmware you want to install.

6. Tap "Install" to continue the update process. Otherwise tap "Cancel" to quit the update and launch the currently installed firmware version.

7. A warning will appear to prevent you from losing your own device settings. If you have already saved your configuration or if you want to return to default values, tap "Install" to proceed to the firmware update. Otherwise tap "Cancel" to quit the update and launch the currently installed firmware version.

8. The firmware update process will take a few minutes. After a successful firmware update, the new firmware version will automatically be started.

9. Remove your USB stick.

To restore a saved device configuration after updating the R&S IQR firmware,

1. Open the R&S IQR "Main Menu".

2. Tap "Configuration File" and choose "Open" to enter a file selection dialog.

3. Go to the directory where you have previously saved your configuration, select the configuration file, and tap "Open" to restore the saved settings.

10.6 Maintenance

The R&S IQR I/Q Data Recorder does not require any special maintenance.

For our support center address and a list of useful R&S contact addresses refer to the documentation CD-ROM or the "Contact" page at the beginning of the Help system.

10.6.1 Storing and Packing the Instrument

The I/Q Data Recorder can be stored at the temperature range quoted in the data sheet. When it is stored for a longer period of time the unit should be protected against dust.

The original packing should be used when the unit is to be transported or dispatched; please also observe the notes in Chapter 1.1.1, "Unpacking and Checking the I/Q Data Recorder", on page 10.

11 File Extensions

RAW Export/Import (option R&S IQR-K101 is required)
I/Q binary data file and separate header file, non coded files

File	fw 1.4.06 or later	fw 1.3.x
I/Q data file	`*.wvd`	`*.dat`
I/Q header file	`*.wvh`	`*.wv`

Archive
I/Q data file, encoded file

File	
Archive file	`*.wva`

Data files of the memory pack (removable)
I/Q data file, encoded file

File	
File 1	`*.ws1` on disc e:
File 2	`*.ws2` on disc f:

I/Q data file of ARB generator
I/Q binary data file with header, non coded file, up to 1 GByte

File	
I/Q data file	`*.wv`

Meta Data (e.g. GPS, option R&S IQR-K102 is required)
Binary meta data file, non coded file

File	
GPS data file	`*.wsm`

MAP (option R&S IQR-K103 is required)
Binary data file, coded file

File	
Map file	`*.map`

Glossary: I/Q Data Recorder

A

AGC: Automatic Gain Control is a mechanism to adjust the attenuation and preamplification of the frontend to achieve the best possible level of the IQ data.

ARB (file): Arbitrary waveform (file). In "Player" mode, the R&S IQR can act as an arbitrary waveform generator and display test waveforms or waveform files.

Aux (signal): Auxiliary signal; a digital signal containing control information about the recorded or replayed data. During recording, the Aux signals (labeled Aux 1 to Aux 6) are fed in via I/O 1 to I/O 8 on the rear panel in order to be included in the recorded I/Q data file. During replay, they can be assigned to the I/O 1 to I/O 8 output connectors in order to synchronize external devices.

F

FS: Full scale level; the maximum representable amplitude of the replayed or recorded I/Q samples. I/Q amplitudes A_{IQ} are calculated from the I and Q values according to A_{IQ} = sqrt ($I^2 + Q^2$). The R&S IQR defines the amplitudes as a ratio or percentage of the full scale level or as a logarithmic value. The following relations hold:
x %FS = x FS / 100; x dBFS = 20 * log (x FS).

G

GP (signal): General purpose signal; a digital signal containing control information about the recorded or replayed data. GP signals (labeled GP 1 to GP 6) must be provided by the source instrument and included in the recorded I/Q data stream. During replay, they can be assigned to the I/O 1 to I/O 8 connectors in order to synchronize external devices.

GUI: Graphical User Interface, the set of dialogs and control elements which the R&S IQR displays in its touchscreen display.

H

HDD: Hard disk drive, the storage device used by the memory pack option R&S IQR-B010 or R&S IQR-B020 (for R&S IQR20 instruments).

I

I/Q Data: Digital samples of the baseband signal which is used to encode information on an RF carrier. The I/Q data show the changes in amplitude and phase of the RF carrier signal. An I/Q modulator mixes the I waveform ("in-phase" component) with the in-phase RF carrier wave, the Q waveform ("quadrature" component) with the same RF carrier wave yet with a 90 deg phase offset.

R

RAM: Random access memory; may be used to store waveform data for replay, as an alternative to storing files on the hard disk (HDD, SDD).

Recording cycle: Recording time of all I/Q data until a "Terminate Condition" (maximum file size, disk full ...) is satisfied. Depending on the trigger settings ("Run Mode", "Retrigger") the R&S IQR performs a single or several consecutive recording cycles, overwriting the previously recorded file.

Reference level: The Reference Level corresponds to the full scale level of the IQ data.

Replay cycle: Replay time for all data in the selected waveform or I/Q data file. Depending on the trigger settings ("Run Mode", "Retrigger") the R&S IQR performs a single or several consecutive replay cycles, starting to replay the selected file from the beginning.

S

SSD: Solid state drive, the storage device used by the memory pack options R&S IQRB110, R&S IQR-B109F, R&S IQR-B119F or R&S IQR-B138F (for R&S IQR100 instruments).

List of Commands

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