R&S®EX-IQ-Box
Digital Signal Interface Module
Flexible digital baseband I/O for Rohde & Schwarz signal generators/ analyzers

ROHDE & SCHWARZ

R&S®EX-IQ-Box Digital Signal Interface Module

At a glance

The R&S®EX-IQ-Box is a digital interface module that provides flexible digital baseband inputs and outputs for Rohde & Schwarz signal generators and signal analyzers.

When used with this box, a Rohde & Schwarz vector signal generator delivers realistic digital baseband signals for testing digital transceivers or other components. The generator covers all common state-of-the-art standards such as LTE, WiMAX™ and 3GPP including HSPA/HSPA+, and also provides user-defined signals and effects such as fading, AWGN and I/Q impairments. The R&S®EX-IQ-Box together with a Rohde & Schwarz signal analyzer can analyze digital baseband components. The box comes with breakout boards equipped with the most common connectors. The boards in conjunction with user-selectable data rates, formats and logic levels make for easy connection of the device under test (DUT). Parameters can conveniently be set via the user interface of the signal generator or analyzer.

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R&S®EX-IQ-Box Digital Signal Interface Module

Benefits and key features

High-end T&M equipment from Rohde&Schwarz for the digital baseband

❙ Generation of standard-compliant digital baseband signals (together with a Rohde&Schwarz signal generator)
  ▪ Bidirectional digital I/Q interface for signal generators and analyzers
  ▪ An R&S®SMU200A, R&S®SMJ100A or R&S®AMU200A signal generator produces standard-compliant digital baseband signals when combined with the R&S®EX-IQ-Box
  ▪ Support of all important state-of-the-art standards such as EUTRA/LTE, 3GPP FDD, HSPA/HSPA+, WLAN, WiMAX™, GSM/EDGE
❙ Versatile signal processing capabilities (e.g. fading, AWGN, I/Q impairments)
❙ Simple and flexible conversion of digital baseband signals to analog IF or RF signals (together with an R&S®SMU200A or R&S®AMU200A)
❙ Vector signal analysis of digital baseband signals of all important modern standards such as EUTRA/LTE, 3GPP FDD, HSPA/HSPA+, WLAN, WiMAX™, GSM/EDGE (together with an R&S®FSQ or R&S®FMU)
❙ Realtime conversion of RF or analog baseband signals to digital formats (together with an R&S®FSQ or R&S®FSG)
▷ page 4

Flexible signal interface and clock generation

❙ Flexible data formats
  ▪ Maximum data rate of 100 MHz, variable resampling in conjunction with the Rohde&Schwarz instrument
  ▪ Variable word size from 4 bit to 20 bit for I and Q
  ▪ Parallel and serial formats
  ▪ SDR and DDR data rates
  ▪ Non-interleaved and I/Q and Q/I interleaved formats
  ▪ Selectable bit order and word alignment
  ▪ Two's complement and binary offset representation
  ▪ Negate I and Q data
  ▪ Positive and negative logic
❙ Flexible clock generation
  ▪ Variable clock rate of 1 kHz up to 100 MHz for parallel formats and up to 400 MHz for serial formats; suitable for slow I/Q operation
  ▪ Internal and external clock reference
  ▪ Selectable clock phase (90° steps) and skew (±5 ns)
❙ Variable signal interface
  ▪ LVTTL, CMOS (1.5 V, 1.8 V, 2.5 V and 3.3 V) and LVDS logic standards
  ▪ Three breakout boards included (single-ended, differential and 68-pin SCSI) for connection of the DUT
▷ page 6

Intuitive operation

❙ Control via user interface of Rohde&Schwarz instrument
▷ page 7

High-end T & M equipment from Rohde & Schwarz for the digital baseband

Rohde & Schwarz signal generators and analyzers are optimally equipped to handle all tasks encountered in the research, development and production of modern digital communications systems. Whether EUTRA/LTE, HSPA+ or WiMAX™, the instruments from Rohde & Schwarz offer extensive capabilities for testing base stations, terminal equipment and modules. The R&S®EX-IQ-Box now makes the wide scope of functions of the Rohde & Schwarz generators and analyzers available also for measurements via digital interfaces. It allows these measurements to be performed with test signals identical to those used for tests on RF modules, complete base stations or terminal equipment. This simplifies comparative analysis and reduces the number of possible error sources.

Generation of standard-compliant digital baseband signals (together with a Rohde & Schwarz signal generator)

An R&S®SMU200A, R&S®SMJ100A or R&S®AMU200A signal generator together with the R&S®EX-IQ-Box provides digital baseband signals for all important mobile radio and wireless standards such as EUTRA/LTE, 3GPP, HSPA/HSPA+, GSM/EDGE, WiMAX™ IEEE 802.16 and WLAN IEEE 802.11n. All signal generation functions of the instrument are also available for generating digital baseband signals, plus all signal processing functions to yield effects such as fading, AWGN or I/Q impairments. This allows bit and block error ratio measurements on baseband receiver chips to be performed accurately and reproducibly. (1)

Simple and flexible conversion of digital baseband signals to analog IF or RF signals (together with an R&S®SMU200A)

When using the R&S®EX-IQ-Box as a receiver together with an R&S®SMU200A with baseband inputs, baseband signals from a DUT can be upconverted to the RF. The R&S®SMU200A's capabilities of introducing signal effects are available also for this application. The generator can simulate the RF section of a transmitter, enabling the baseband section to be tested independently of the RF section. (2)

Vector signal analysis of digital baseband signals of all important modern standards (together with an R&S®FSQ or R&S®FMU)

To analyze digital baseband signals, the R&S®EX-IQ-Box is operated in the receiver mode together with an R&S®FSQ or R&S®FMU signal analyzer. The analyzers' wide range of functions, including modulation and code domain analysis, is available for carrying out transmitter measurements on baseband chips. Moreover, I/Q signals can be stored for postprocessing, e.g. for BER analysis. (3)
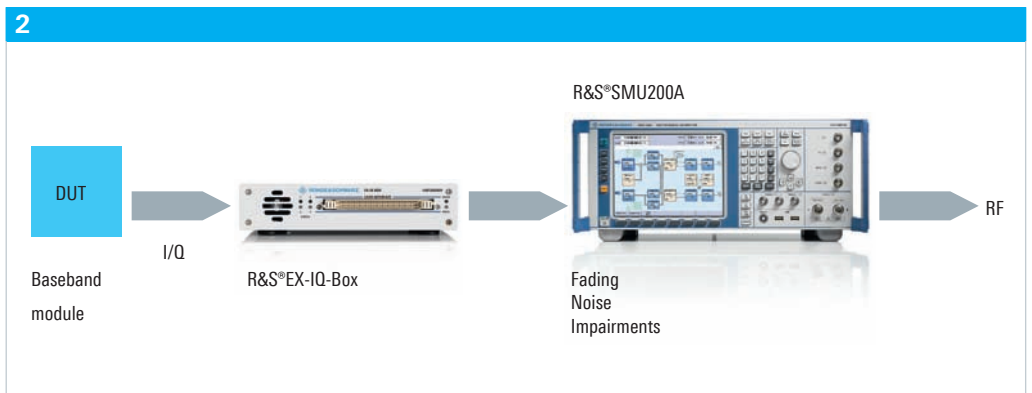
Realtime conversion of RF or analog baseband signals to digital formats (together with an R&S®FSQ or R&S®FSG)

An R&S®FSQ or R&S®FSG signal analyzer in conjunction with the R&S®EX-IQ-Box can be used as a realtime RF digitizer to replace RF frontends not yet completed, or simply to record RF signals over extended periods of time. (4)
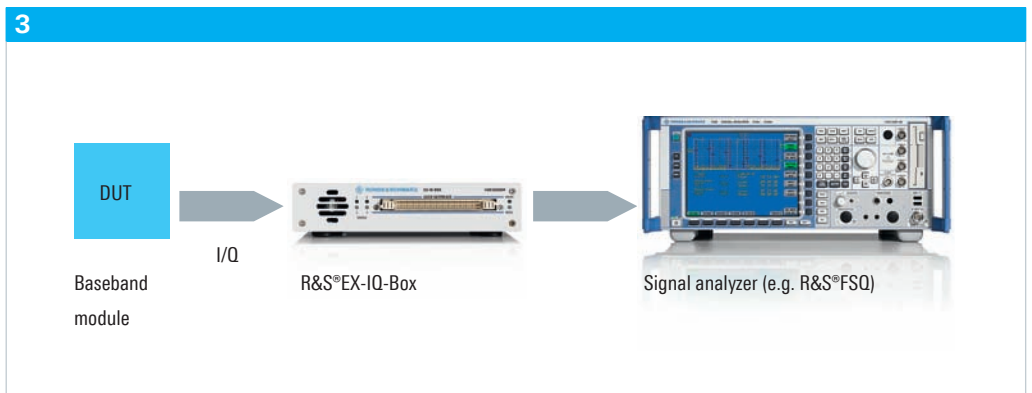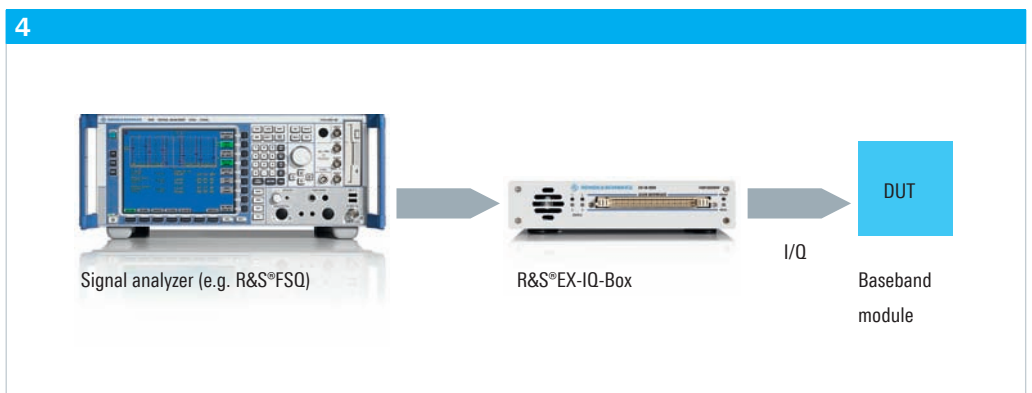
Receiver measurement on a
basebandm odule.

1

R&S®SMU200A or R&S®AMU200A

DUT

I/Q

Fading
Noise
Impairments

R&S®EX-IQ-Box
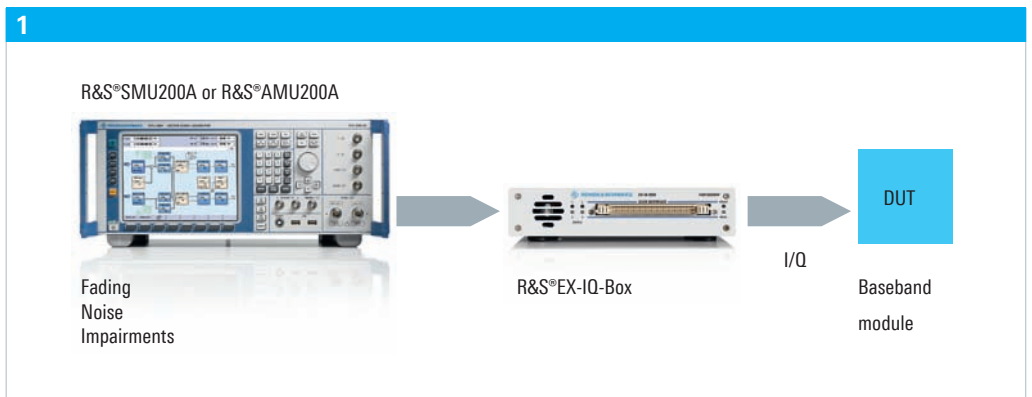
Baseband
module

Signal generator simulating an
RF board.

2

R&S®SMU200A

DUT

I/Q

RF

Baseband
module

R&S®EX-IQ-Box

Fading
Noise
Impairments

Transmitter measurement on a
baseband module.

3

DUT

I/Q

Baseband
module

R&S®EX-IQ-Box

Signal analyzer (e.g. R&S®FSQ)

Signal analyzer as a realtime
RF digitizer.

4

DUT

I/Q

Signal analyzer (e.g. R&S®FSQ)

R&S®EX-IQ-Box

Baseband
module

Flexible signal interface and clock generation

The R&S®EX-IQ-Box contains a flexible interface to the DUT offering comprehensive configuration options to accommodate for a wide variety of present and future interface designs.

Variable signal interface and flexible data formats

The signal interface to the DUT supports the LVTTL, CMOS and LVDS logic standards. The R&S®EX-IQ-Box comes with different breakout boards to match the most common connectors. The box supports parallel and serial buses, single data rate (SDR) and double data rate (DDR), as well as I/Q and Q/I interleaving.

The user can select the bit order and the word alignment as well as the numeric format (two's complement or binary offset). The word size is selectable between 4 bit and 20 bit for I and Q.

Variable resampling of the data rate is performed in conjunction with the Rohde & Schwarz instrument. This means that the user does not have to bother about data rate adaptation. The user sets the data rate once as required for the DUT. The data rate is then adapted automatically in the R&S®EX-IQ-Box.

Flexible clock generation

Clock generation can also be flexibly adapted to the measurement task. The R&S®EX-IQ-Box can be operated with an internal clock signal and deliver the clock signal to the DUT, or use a clock signal supplied by the DUT or another external source. The phase and delay of the clock signal can be varied with respect to the data signal, e.g. to compensate for different cable lengths or to test the receiver's response to clock variations. The R&S®EX-IQ-Box supports clock rates of 1 kHz up to 100 MHz for parallel and up to 400 MHz for serial formats. It is possible, for example, to perform measurements on hardware emulators with I/Q signals slowed down deliberately (slow I/Q signals).
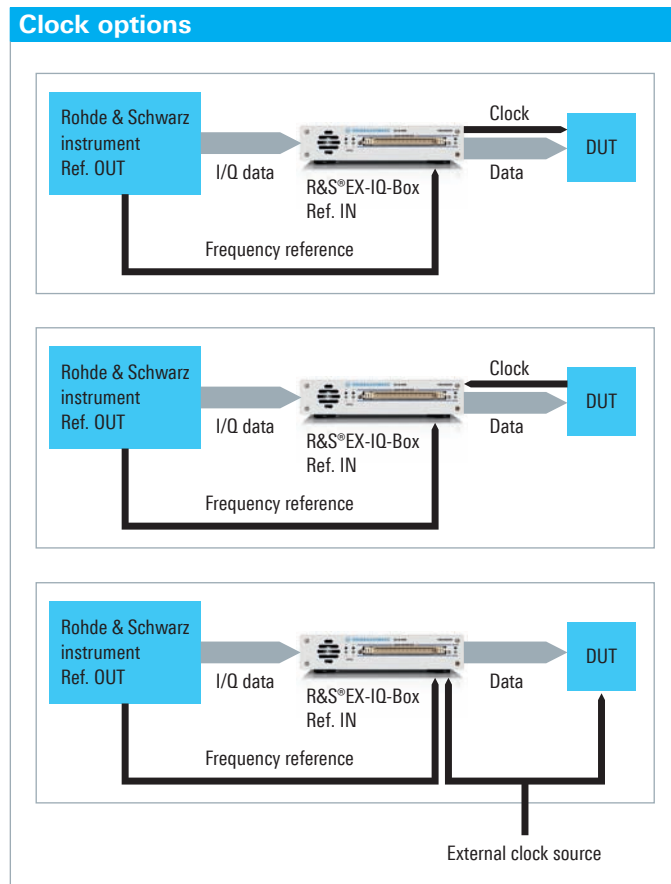
Clock options

Clock options of the R&S®EX-IQ-Box in the output mode:
Top: The R&S®EX-IQ-Box delivers data and the clock to the DUT.
Center: The R&S®EX-IQ-Box delivers data to the DUT; the DUT delivers the clock to the R&S®EX-IQ-Box.
Bottom: The R&S®EX-IQ-Box delivers data to the DUT; the clock for the R&S®EX-IQ-Box and the DUT is delivered by an external source.

Intuitive operation

The R&S®EX-IQ-Box is operated from the Rohde&Schwarz instrument. The control of the box is fully integrated into the instrument software. A box connected to the instrument is automatically detected and preconfigured as required for the instrument.

All settings required for the R&S®EX-IQ-Box and the instrument – from the signal parameters to the interface format – can be made on the instrument, e.g. the R&S®AMU200A, which acts as a master. The user also benefits from the numerous graphical control and display functions offered by the Rohde&Schwarz instrument. From the block diagram of the R&S®AMU200A, for example, the user can immediately identify active digital interfaces and any R&S®EX-IQ-Box connected to the generator.
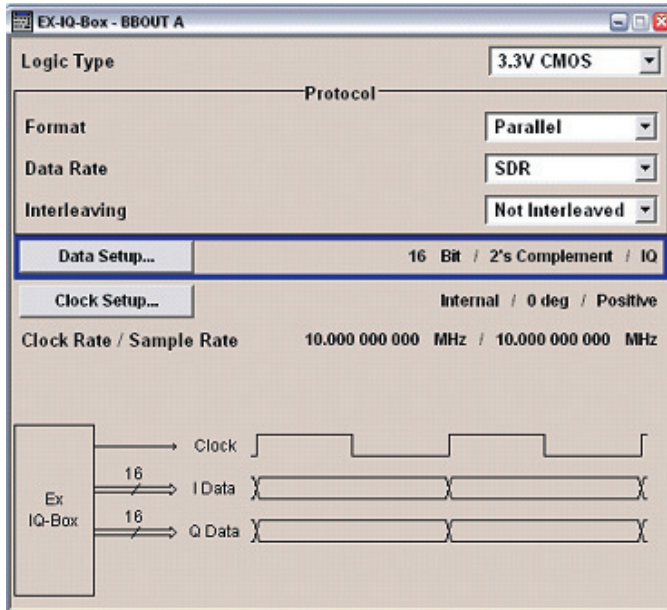
Control of the R&S®EX-IQ-Box from an R&S®AMU200A. Menu for configuring the user signal interface.
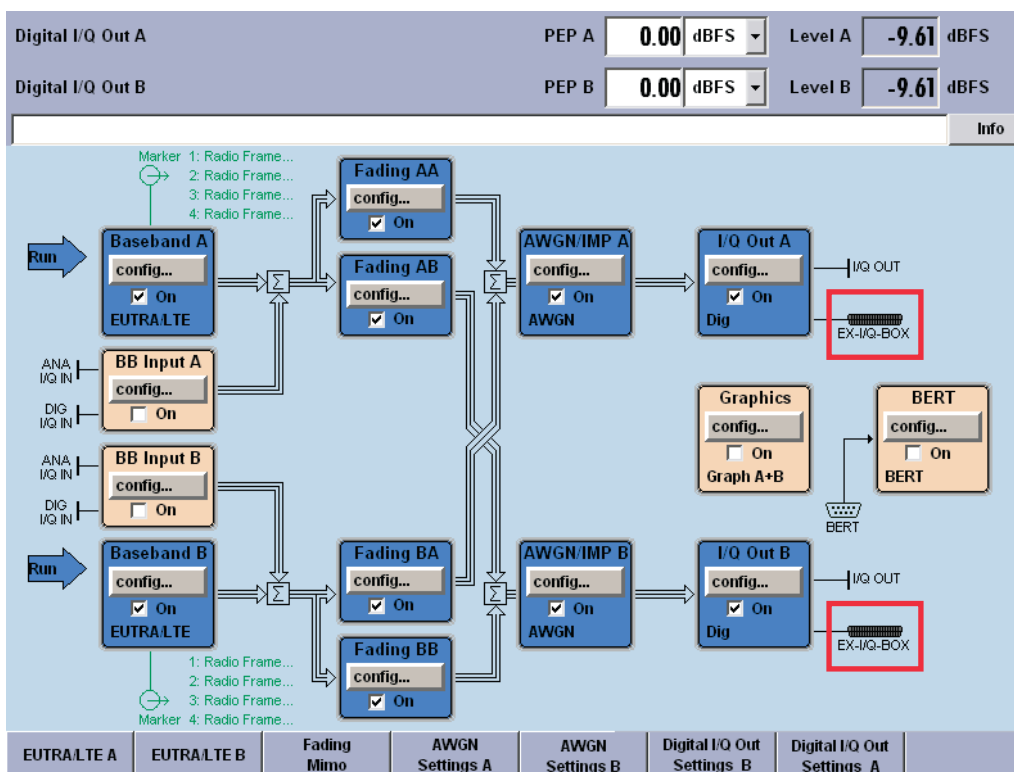
Block diagram of an R&S®AMU200A baseband signal generator and fading simulator, configured for 2x2 MIMO in this example, with an R&S®EX-IQ-Box connected to each of its digital I/Q outputs A and B (see red frames).

Specifications in brief

Specifications in brief		
User signal interface	direction	input, output
	signals	bidirectional, dual 20-bit data buses for I and Q signals; two marker, trigger and auxiliary signals each
	logic level	
	single-ended	LVTTL, 1.5 V CMOS, 1.8 V CMOS, 2.5 V CMOS, 3.3 V CMOS
	differential	LVDS
I/Q data		
Format	parallel, serial	
	strobe position	0 to (word size – 1)
	strobe polarity	positive, negative
Sample rate	limited by format, word size, protocol, interleaving, and ratio of sample rate to clock rate	1 kHz to 100 MHz
Resampling		automatically performed by the Rohde & Schwarz instrument if required
I/Q impairments, I/Q swap		by the Rohde & Schwarz instrument
Signal type		I/Q, IF (complex)
IF frequency		(clock rate)/4
Numeric format		two's complement, binary offset
Word size		4 bit to 20 bit (depending on the Rohde & Schwarz instrument)
Data protocol		SDR, DDR
Clock		
Clock rate	reference source, internal	
	LVTTL/CMOS logic level	1 kHz to 100 MHz
	LVDS logic level	1 kHz to 400 MHz
	reference source, external	
	LVTTL/CMOS logic level	25 kHz to 100 MHz
	LVDS logic level	25 kHz to 400 MHz

For data sheet, see PD 5213.9511.22 and www.rohde-schwarz.com

Ordering information

Designation	Type	Order No.
Digital Signal Interface Module	R&S®EX-IQ-Box	1409.5505.02
including power supply, one USB and one LVDS cable, three breakout boards, one 168-pin Tyco Z-Dok connector, operating and service manual		
Recommended extras		
LVDS cable		
Cable for connecting digital baseband interfaces	R&S®SMU-Z6	1415.0201.02

Overview of Rohde & Schwarz analyzers, generators, and the options required for operation together with the R&S®EX-IQ-Box

Rohde & Schwarz instruments	Digital I/Q input option	Digital I/Q output option
Signal generation		
R&S®AMU200A baseband signal generator and fading simulator	R&S®AMU-B17 analog/digital baseband inputs [1]	R&S®AMU-B18 digital baseband output [2]
R&S®SMU200A vector signal generator	R&S®SMU-B17 analog/digital baseband inputs	R&S®SMU-B18 digital baseband output
R&S®SMJ100A vector signal generator	–	R&S®SMJ-B18 digital baseband output
Signal analysis		
R&S®FSQ signal analyzer	R&S®FSQ-B17 digital baseband interface	R&S®FSQ-B17 digital baseband interface
R&S®FSG signal analyzer	R&S®FSQ-B17 digital baseband interface	R&S®FSQ-B17 digital baseband interface
R&S®FMU36 baseband signal analyzer	R&S®FSQ-B17 digital baseband interface	R&S®FSQ-B17 digital baseband interface

[1] With two path-instruments equipped with a second digital baseband input option, a second R&S®EX-IQ-Box can be connected.
[2] With two path-instruments equipped with a second digital baseband output option, a second R&S®EX-IQ-Box can be connected.

Service options		
Two-Year Calibration Service	R&S®CO2EX-IQ-Box	Please contact your local Rohde & Schwarz sales office.
Three-Year Calibration Service	R&S®CO3EX-IQ-Box	
Five-Year Calibration Service	R&S®CO5EX-IQ-Box	
One-Year Repair Service following the warranty period	R&S®RO2EX-IQ-Box	
Two-Year Repair Service following the warranty period	R&S®RO3EX-IQ-Box	
Four-Year Repair Service following the warranty period	R&S®RO5EX-IQ-Box	

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment
▪ Energy-efficient products
▪ Continuous improvement in environmental sustainability
▪ ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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