

Manual



External Signal Interface Module

R&S[®] EX-IQ-Box

1409.5505.02



Test and Measurement

Dear Customer,

throughout this manual, the External Signal Interface Module R&S[®] EX-IQ-Box is abbreviated as R&S EX-IQ-Box.

R&S[®] is a registered trademark of Rohde & Schwarz GmbH & Co. KG.

Trade names are trademarks of the owners.

Contents Overview

Data Sheet

Supplement to Specifications

Safety Instructions

Customer Information Regarding Product Disposal

Certificate of Quality

EC Certificate of Conformity

List of R&S Representatives

Support-Center Address

User documentation for the External I/Q Signal Interface Module R&S EX-IQ-Box

Supplement to Firmware Release of Signal Generators

Putting into Operation

Getting Started

Instrument Settings ...

... for R&S SMx and R&S AMU Signal Generators

Remote Control Commands

... for R&S FSx and R&S FMU Signal Analyzers

Remote Control Commands

Interfaces

Service and Maintenance

Alphabetical List of Commands

Index

Annex

Drawing Z-Dok Adapter Board Connection

R&S[®] EX-IQ-Box

Supplement to Specifications PD 5213.9511.22

The function for the following specifications is not supported in this firmware release.

1.

I/Q Data

Negate data		I, Q, I+Q
Logic type		positive, negative

Clock

Clock polarity	User interface	positive, negative
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This missing function is temporary and can be eliminated with the next firmware update. The related R&S AMU200A / R&S SMU200A firmware will be probably available from March 2008.

2.

I/Q Data

Signal type		I/Q, IF (complex)
IF frequency		(clock rate)/4

This missing function IF (complex) is temporary and can be eliminated with the next firmware update. The related R&S AMU200A / R&S SMU200A firmware will be probably available from July 2008.

Firmware updates can be downloaded from www.rohde-schwarz.com.

Grouped Safety Messages









Make sure to read through and observe the following safety instructions!







All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Symbols and safety labels

							
Observe product documentation	Weight indication for units >18 kg	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Attention! Electrostatic sensitive devices

					
Supply voltage ON/OFF	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double/reinforced insulation

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Tags and their meaning

DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	NOTICE indicates a property damage message. In the product documentation, the word ATTENTION is used synonymously.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 2000 m above sea level, max. transport altitude 4500 m above sea level.
A tolerance of $\pm 10\%$ shall apply to the nominal voltage and of $\pm 5\%$ to the nominal frequency.
2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).

Grouped Safety Messages

3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.
4. If products/components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.
6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.
7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.
10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.

Grouped Safety Messages

12. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.
15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
16. For measurements in circuits with voltages $V_{\text{rms}} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.
18. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a license electrician.
20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.
21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.
22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.
23. Rohde & Schwarz products are not protected against penetration of liquids, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock for the user or damage to the product, which can also lead to personal injury.
24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.
25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.
26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries. If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells).

Grouped Safety Messages

Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.
30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).
31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.
33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the product documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.
34. Prior to cleaning, disconnect the product from the AC supply. Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluent for cellulose lacquers.

Informaciones elementales de seguridad

¡Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.







Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones de la correspondiente documentación de producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos profundos y conocimientos básicas del idioma inglés. Por eso se debe tener en cuenta que el producto sólo pueda ser operado por personal especializado o personas minuciosamente instruidas con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto y entréguela a usuarios posteriores.

Símbolos y definiciones de seguridad

							
Ver documentación de producto	Informaciones para maquinaria con un peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construcción con peligro de carga electroestática

Informaciones elementales de seguridad

					
Potencia EN MARCHA/PARADA	Indicación Stand-by	Corriente continua DC	Corriente alterna AC	Corriente continua/alterna DC/AC	El aparato está protegido en su totalidad por un aislamiento de doble refuerzo

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas Rohde & Schwarz bajo la denominación de „producto“, entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
AVISO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo. En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación de producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue:
como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4.500 m sobre el nivel del mar.
Se aplicará una tolerancia de $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ sobre la frecuencia nominal.
2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal especializado autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutenzione y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de la corriente conductora, control de funcionamiento).
3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se produjeran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.
4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.
5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberán ser tenidas en cuenta las prescripciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescripciones de seguridad especiales en la descripción del producto.

6. Ciertos productos, como por ejemplo las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética. El empresario/usuario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.
7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del producto.
9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.
10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. Puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro que es controlado su estado técnico de seguridad.
11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá instalar el interruptor al nivel de la instalación.
12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.

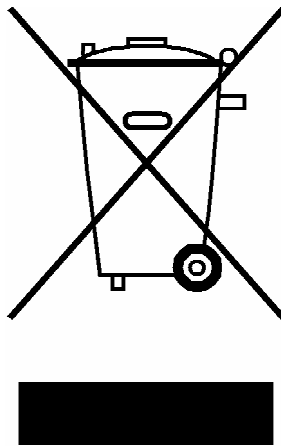
16. En las mediciones en circuitos de corriente con una tensión de entrada de $U_{eff} > 30 \text{ V}$ se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos del estándar IEC950/EN60950.
18. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.
19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir cortocircuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.
22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.
23. Los productos R&S no están protegidos contra líquidos si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente para el usuario o de daños en el producto lo cual también puede llevar al peligro de personas.
24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.
25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.
26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.
27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención células de litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.
28. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.

29. El producto puede poseer un peso elevado. Muévelo con cuidado para evitar lesiones en la espalda u otras partes corporales.
30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).
31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean observadas. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.
32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo. El fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
33. Dado el caso de que esté integrado un producto de láser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación de producto. De otra manera pondrá en peligro su salud, ya que el rayo láser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo láser.
34. Antes de proceder a la limpieza, desconecte el producto de la red. Realice la limpieza con un paño suave, que no se deshilache. No utilice de ninguna manera agentes limpiadores químicos como, por ejemplo, alcohol, acetona o nitrodiluyente.

Customer Information Regarding Product Disposal

The German Electrical and Electronic Equipment (ElektroG) Act is an implementation of the following EC directives:

- 2002/96/EC on waste electrical and electronic equipment (WEEE) and
- 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).



Product labeling in accordance with EN 50419

Once the lifetime of a product has ended, this product must not be disposed of in the standard domestic refuse. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Rohde & Schwarz GmbH & Co. KG has developed a disposal concept for the environmental-friendly disposal or recycling of waste material and fully assumes its obligation as a producer to take back and dispose of electrical and electronic waste in accordance with the ElektroG Act.

Please contact your local service representative to dispose of the product.



Certified Quality System

DIN EN ISO 9001 : 2000

DIN EN 9100 : 2003

DIN EN ISO 14001 : 2004

DQS REG. NO 001954 QM UM

QUALITÄTSZERTIFIKAT

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Managementsystems entwickelt, gefertigt und geprüft.

Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

CERTIFICATE OF QUALITY

Dear Customer,

you have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.

The Rohde & Schwarz quality management system is certified according to:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

CERTIFICAT DE QUALITÉ

Cher Client,

vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.

Le système de gestion qualité de Rohde & Schwarz a été homologué conformément aux normes:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004



ROHDE & SCHWARZ



Certificate No.: 2007-59

This is to certify that:

Equipment type	Stock No.	Designation
EX-IQ-BOX	1409.5505.02	Digital I/O Adapter Module for SMU, AFQ, AMU and FSQ

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits
(2006/95/EC)
- relating to electromagnetic compatibility
(2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61010-1 : 2001
EN 61326 : 2006
EN 55011 : 1998 + A1 : 1999 + A2 : 2002, Class A

For the assessment of electromagnetic compatibility, the limits of radio interference for Class A equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2007

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Munich, 2007-10-25

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Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish.

We will take care that you will get the right information.

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* 0.14 €/Min within the German fixed-line telephone network, varying prices for the mobile telephone network and in different countries.



Supplement to R&S[®] EX-IQ-Box

External Signal Interface Module



Operating the External Signal Interface Module R&S EX-IQ-Box requires the firmware version **2.04.303.16 or higher** on the connected R&S signal generator. Up to firmware version 2.04.303.16 the functionality for the R&S EX-IQ-Box is not provided.

The current R&S AFQ100A, R&S AMU200A, R&S SMU200A, R&S SMJ100A firmware can be downloaded from the respective product site at www.rohde-schwarz.com.

Contents

R&S EX-IQ-Box - The External I/Q Signal Interface Module	1
Putting into Operation	2
Legend for Front Panel View	2
Legend for Rear Panel View.....	4
Unpacking the R&S EX-IQ-Box	7
Safety instructions	8
EMC Safety Precautions	8
Connecting the R&S EX-IQ-Box to the AC Supply	9
Connecting the R&S EX-IQ-Box, the R&S Instrument and the DUT	10
Switching ON.....	10
Switching OFF	11
Getting started	11
Instrument Settings	13
Settings for R&S SMx and R&S AMU Signal Generators.....	13
General Settings - BBIN/BBOUT	16
Data Setup	24
Clock Setup.....	32
Remote Control Commands for Signal Generators.....	39
Clock Subsystem	46
Settings for R&S FSx and R&S FMU Signal Analyzers	64
FSx/FMU Ex-IQ-Box Settings	67
Transfer the Settings to the Ex-IQ-Box	85
Remote Control Commands for Signal Analyzers.....	86

Interfaces	109
User Interface of the R&S EX-IQ-Box	109
Z-DOK-Adapter Board Connector	109
Pin Assignment	109
Common Pin Assignment of the User Interface Connector X1	110
Pin Description of the User Interface Connector X1	110
Breakout Boards	112
Breakout Board Single Ended 090002-22x	112
Breakout Board Differential 090002-23x	115
Breakout Board SCSI 090002-21x	118
Service and Maintenance	121
Service for the R&S EX-IQ-Box by Operating with R&S Signal Generators	121
Protection	122
Selftest	122
Troubleshooting	126
Firmware Update	127
Firmware Update for Operating with R&S Signal Generators	127
Firmware Update for Operating with R&S Signal Analyzers	129
Maintenance	130
Cleaning the Outside and Storing	130
Alphabetical List of Commands	131
Index	135

R&S EX-IQ-Box - The External I/Q Signal Interface Module

The R&S EX-IQ-Box is a digital signal interface module providing parallel or serial signal transmission from R&S Instruments to external devices and vice versa.

Featuring different signal protocols, external baseband instruments or devices usually require to adjust either the physical interface or the test signal. The R&S EX-IQ-Box as a configurable device interface is the module to resolve the differences of the physical interfaces or the variety of signaling and data formats.

The R&S EX-IQ-Box converts the internally used LVDS transmission protocol to parallel or serial data formats. In the input mode, the R&S EX-IQ-Box matches the digital input to the R&S Instruments' baseband system. In connection with an R&S Signal Generator the R&S EX-IQ-Box can modulate a digital baseband signal to the required RF frequency. Connected to an R&S Signal Analyzer various digital signal standards can be analyzed.

In the output mode, generated ARB and real-world test signals of the R&S Signal Generator can be delivered directly to the DUT.

Multiple clock scenarios as internal or device clocking (external) are provided for data transmission.

Additionally, the R&S EX-IQ-Box can be equipped with various breakout boards to get adjusted to further interfaces or digital standards.

The following picture shows the assembly of an R&S EX-IQ-Box with a breakout board connected to an R&S AMU 200A Baseband Signal Generator and Fading Simulator:



Putting into Operation

"Putting into Operation" explains the control elements and connectors of the R&S EX-IQ-Box with the aid of the front and rear views and describes how to put the device into operation.

The connection of the currently available breakout boards is described in this section also. A description of the device interfaces is given in section "Interfaces of the R&S EX-IQ-Box". Specifications of interfaces can be seen in the data sheet.

Legend for Front Panel View

This section gives an overview of the control elements and the connectors on the front panel of the R&S EX-IQ-Box. Each element/connector is briefly described and a reference is given to the chapters containing detailed information.

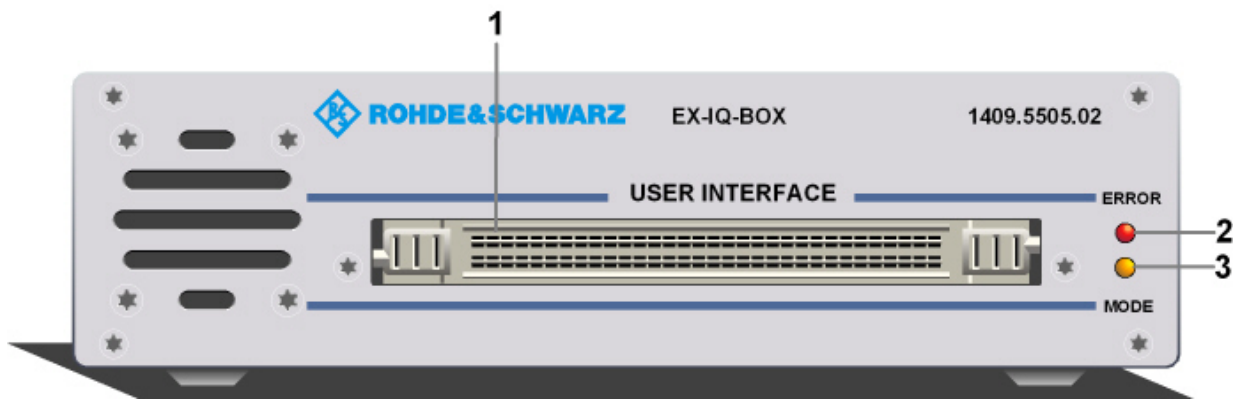
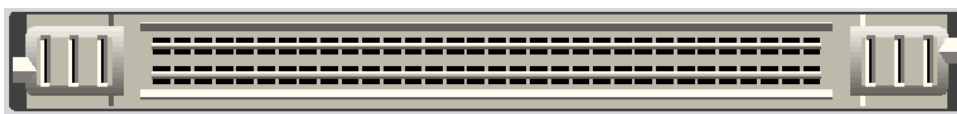


Figure 1: Front panel view

1 56 pairs TYCO Z-DOK Connector



USER INTERFACE

Interface for serial or parallel transmission of digital I/Q data (up to 20 bit wide data bus), data clock and control signals, connected by a 56 pair connector, type TYCO Z-DOK.

This interface is used to connect the breakout boards.

see [Z-Dok Adapter Board connector](#)

2 ERROR - LED



ERROR

The ERROR LED indicates an error of the R&S EX-IQ-Box.

- ◆ **Off** denotes that no error occurred.
- ◆ **Red** denotes that an error has been detected. The connected R&S Instrument displays an error message.

3 MODE - LED



MODE

The MODE LED indicates current activities of the R&S EX-IQ-Box.

- ◆ **Off** denotes that there is no configuration file (FPGA (Field Programmable Gate Array)) loaded. Therefore, data transmission is not possible.
- ◆ **Yellow blinking** denotes that the initialization (initial image) is loading.
- ◆ **Yellow continuous** denotes that the initialization (initial image) is currently active.
- ◆ **Green blinking** denotes that the configuration file (user image) is loading.
- ◆ **Green continuous** denotes that the configuration file (user image) is currently active. Data transmission is possible.

Legend for Rear Panel View

This section gives an overview of the control elements and the connectors on the rear panel of the R&S EX-IQ-Box. Each element/connector is briefly described and a reference is given to the chapters containing detailed information.

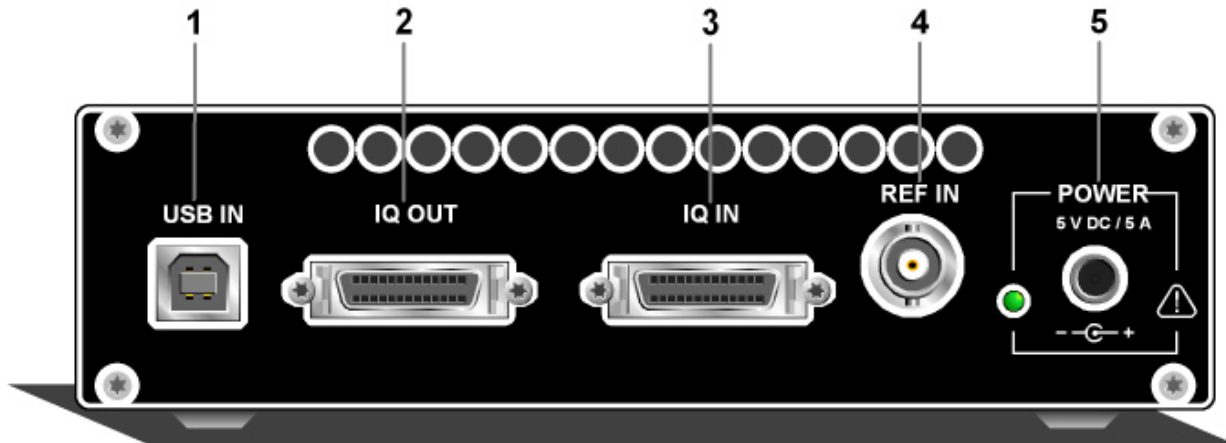


Figure 2: Rear panel view

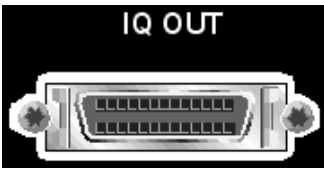
1 USB IN - USB interface type B



USB 2.0

(universal serial bus) interface of type B (device USB). This port is used for communication with the host instrument. An USB cable for the connection is included in delivery.

2 IQ OUT - Digital interface



IQ OUT

Connector for the output of the digital I/Q signal. This socket provides a multiplexed output to connect to an R&S Instrument. The cable for the connection between the digital I/Q interfaces of the R&S EX-IQ-Box and an R&S Instrument is included in delivery.

3 IQ IN - Digital interface



IQ IN

Connector for the input of a digital I/Q signal of an R&S Instrument. The cable for the connection between the digital I/Q interfaces of the R&S EX-IQ-Box and an R&S Instrument is included in delivery.

4 REF IN - Reference signal input



REF IN

BNC connector for input of a reference signal provided by the R&S Instrument.

5 POWER - Power supply



The R&S EX-IQ-Box is supplied with an external power supply unit and a separate power cable. The external power supply unit provides all required voltages for the hardware.

Power supply: 30 W switching power supply adapter with an input voltage of 100 to 240 VAC.

The Power LED indicates the different operating modes of the device, depending on the state of the external voltages.

- ◆ **OFF** denotes that the external power supply unit is not connected (**Power Off Mode**).
- ◆ **Yellow** denotes that the main power of the device is **on** but the **USB** power is **off** (**Standby Mode**).
- ◆ **Green** denotes that the main power and the **USB** power are **on**. The device is ready for operation.

CAUTION Danger of shock hazard!



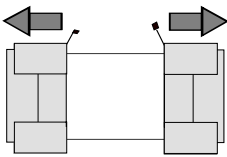
The device is still power-supplied while it is in standby mode.

Unpacking the R&S EX-IQ-Box

The following section describes the procedure for putting the R&S EX-IQ-Box into operation. It contains general safety instructions for operation.

CAUTION**Device damage caused by disregarding the precautions!**

Make sure to follow the instructions of the following sections in order not to endanger to people or to avoid damage to the device. This is of particular importance when you use the device for the first time. Also observe the general **Safety Instructions** at the beginning of this manual.



Remove protective covers

1. Remove the R&S EX-IQ-Box from its packaging and check the equipment for completeness using the delivery list.
2. Remove the two protective covers from the front and rear panel of the R&S EX-IQ-Box and carefully check the device for damage.
3. If there is damage, immediately contact the carrier who delivered the device. In this case, make sure not to discard the box and packing material.
4. Keep the box and packing material until you have verified that the contents are complete and until the R&S EX-IQ-Box has been tested electrically and mechanically.
5. The original packaging is also useful for transporting or shipping the R&S EX-IQ-Box later on. Keep at least the two protective covers to prevent control elements and connectors from being damaged.

Safety instructions

General Precautions

NOTICE

Device damage caused by disregarding the following precautions!

Any non-compliance with the following precautions may cause damage to the R&S EX-IQ-Box. Prior to putting the device into operation, check the following:

- ◆ Make sure that the air can escape freely through the vents at the rear and at the front. The minimum distance to the wall should therefore be at least 10 cm.
- ◆ Make sure that the interfaces of the device are correctly connected.
- ◆ The signal levels at the inputs and outputs do not exceed permissible limits.
- ◆ The device should only be operated in horizontal position on an even surface.
- ◆ The ambient temperature must not exceed the range specified in the data sheet.

Please also observe the instructions in the following sections and the general safety instructions at the beginning of this manual.

Protection against Electrostatics



Risk of damaging the electronic components!

To avoid damaging the electronic components of the EUT due to electrostatic discharge produced by contact, the use of appropriate protective measures is recommended.

EMC Safety Precautions

To avoid electromagnetic interference (EMI) only suitable, shielded signal and control cables must be used.

Connecting the R&S EX-IQ-Box to the AC Supply

NOTICE **Danger of instrument damage when using a power supply other than specified below!**

Use only with the approved power supply of type:

Vendor: CINCON ELECTRONICS CA.,LTD.

Model: TR45A05-11A01

Input: 100-240VAC 1.5A 50-60Hz

Output: 5VDC 6.0A



The R&S EX-IQ-Box is power supplied with an external power supply unit and a separate power cable. The external power supply unit provides all required voltages of the hardware. The Power LED indicates the different operating modes of the device, dependent on the state of the external voltages (see also [5 POWER - Power supply](#), on page 6).

CAUTION **Danger of shock hazard!**



The device is still power-supplied while it is in standby mode.

Connecting the R&S EX-IQ-Box, the R&S Instrument and the DUT

The R&S EX-IQ-Box provides signal transmission from an R&S Instrument to an external Device Under Test (DUT) and from a DUT to an R&S Instrument, respectively.

The following schematic diagram shows the signal transmission from an R&S signal generator to the R&S EX-IQ-Box and from there to the DUT via the breakout board.

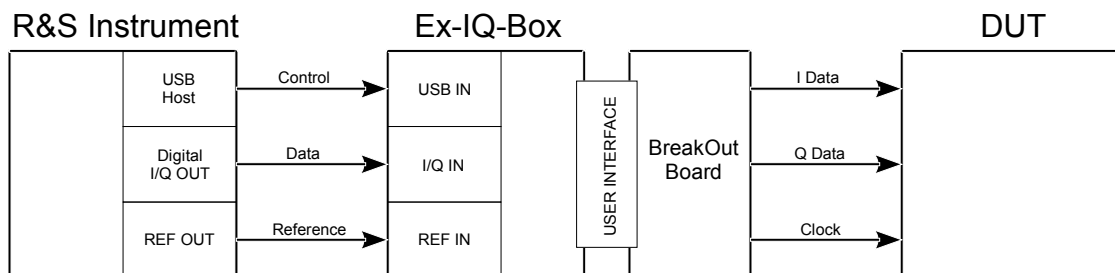


Figure 3: Circuit arrangement: R&S Signal Generator, R&S EX-IQ-Box, Breakout Board and DUT

Switching ON



The R&S EX-IQ-Box can be operated only together with R&S Instruments.

Setting-up operation does not require a strict course of action, but we recommend the following sequence of steps:

1. Switch on the R&S Instrument.
2. Connect the power supply to R&S EX-IQ-Box.
3. Establish the USB connection (Host USB of the R&S Instrument to the USB IN connector of the R&S EX-IQ-Box).
4. Establish the connection for the reference frequency (REF IN/REF OUT BNC connectors).
5. Establish the connection between the digital I/Q interfaces (LVDS, Digital I/Q IN/ I/Q OUT).

A flashing green power LED indicates that the main power and the USB power are on. The R&S EX-IQ-Box is ready for operation.

After the LVDS and USB connections are established, the R&S Instrument identifies the connected R&S EX-IQ-Box automatically and assigns the R&S EX-IQ-Box to the corresponding path and input or output. A connection test is executed. Further data required for operation are exchanged, e.g. information on max. data rate etc..

The parameters for operating the R&S EX-IQ-Box can be set in the corresponding digital input or digital output dialogs of the R&S Instrument.

Switching OFF

By switching off the R&S Instrument the R&S EX-IQ-Box changes to Standby Mode (yellow power LED).

Getting started

The digital signal interface module (R&S EX-IQ-Box) provides the bidirectional transmission of I/Q data between R&S Instruments and external devices (DUTs).

For R&S Instruments the digital signals are input or output via digital interfaces by using the signaling system LVDS (Low Voltage Differential Signaling). Therefore, an R&S Instrument has to be equipped with the option for digital Baseband Input or Output, respectively. The R&S EX-IQ-Box is connected to the digital I/Q interface Baseband Digital IN or Digital I/Q Out of the R&S Instrument.

For external devices various signaling and data protocols are used. These data and signal formats have to be converted to the digital transmission protocol LVDS used by R&S Instruments or vice versa.

Different breakout boards are available for adjustment to external signaling formats (see [Breakout Boards](#)). The external device is connected to the R&S EX-IQ-Box via a breakout board.

The R&S EX-IQ-Box can be operated together with R&S Signal Generators and R&S Signal Analyzers.

Overview of the R&S Instruments working with the R&S EX-IQ-Box

R&S Instruments	Digital Baseband Input, Option:	Digital I/Q Output, Option:
Signal Generation		
R&S AMU 200A Baseband Signal Generator and Fading Simulator	R&S AMU-B17 ^[1]	R&S AMU-B18 ^[2]
R&S SMU 200A ^[3] Vector Signal Generator	R&S SMU-B17	R&S SMU-B18 ^[2]
R&S SMJ 100A ^[3] Vector Signal Generator	-	R&S SMJ-B18
R&S AFQ 100A ^[3] I/Q Modulation Generator	-	R&S AFQ-B18

R&S Instruments	Digital Baseband Input, Option:	Digital I/Q Output, Option:
Signal Analysis		
R&S FSQ Signal Analyzer	R&S FSQ-B17	R&S FSQ-B17
R&S FSG Signal Analyzer	R&S FSQ-B17	R&S FSQ-B17
R&S FMU36 Baseband Signal Analyzer	R&S FSQ-B17	R&S FSQ-B17

^[1] For two path-instruments, equipped with a second option for Digital Baseband Input a second R&S EX-IQ-Box can be connected.

^[2] For two path-instruments, equipped with a second option for Digital I/Q Output a second R&S EX-IQ-Box can be connected.

^[3] Currently the application for co-operating with the R&S EX-IQ-Box is intended for future use.

Depending on the connected R&S Instrument, the dialogs for setting the parameters of the R&S EX-IQ-Box are different. For description on the instrument of your interest see either [Settings for R&S SMx and R&S AMU Signal Generators](#) or [Settings for R&S FSx and R&S FMU Signal Analyzers](#).

Instrument Settings

Settings for R&S SMx and R&S AMU Signal Generators

The graphical user interfaces (GUIs) of the signal generators R&S AMU 200A, R&S SMU 200A and R&S SMJ 100A display the architecture and the signal flow in a block diagram. If an R&S EX-IQ-Box is connected, the R&S Instrument recognizes this module automatically and indicates a labeled symbol of the R&S EX-IQ-Box at the corresponding function block (BBIN or I/Q Out) (e.g. see below: [Display of the R&S AMU 200A Baseband Signal Generator and Fading Simulator](#)).

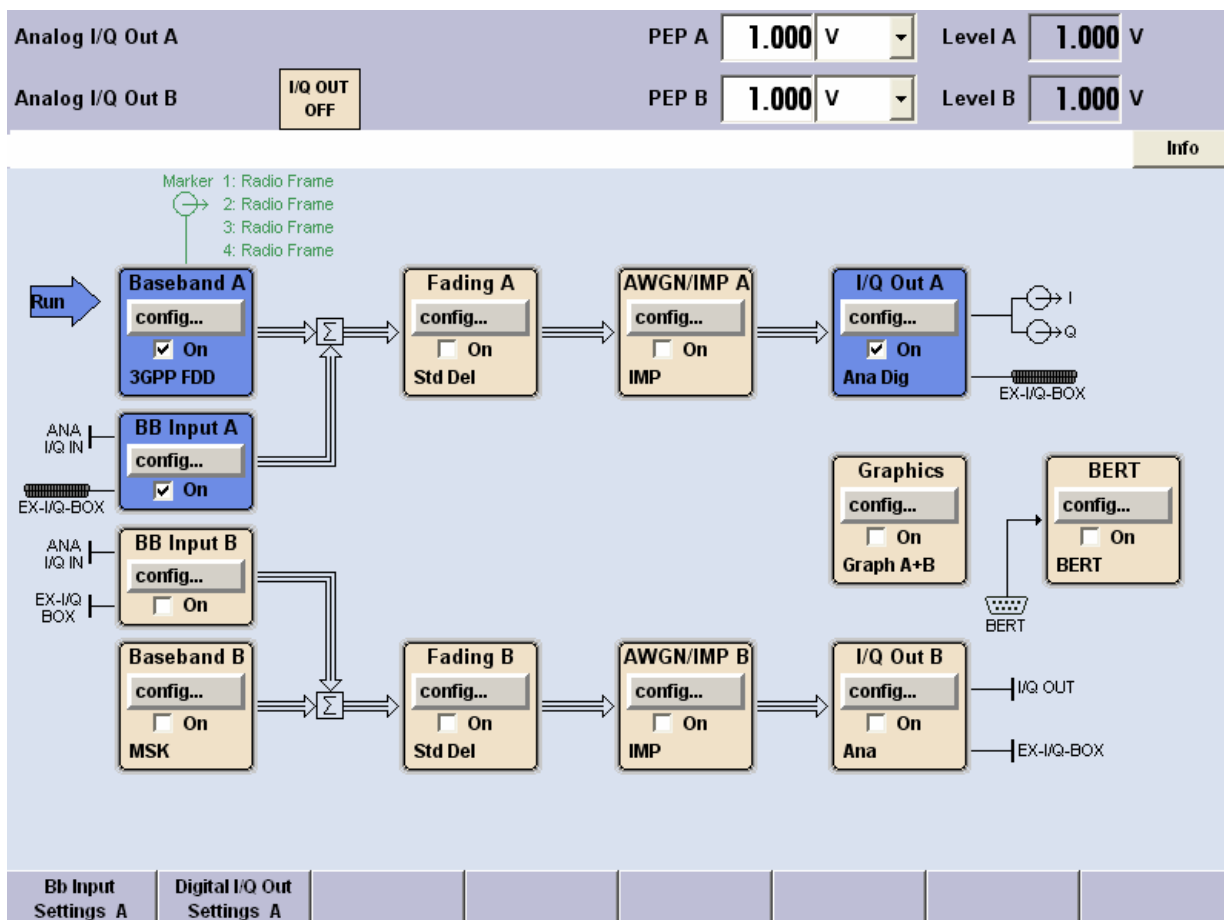


Figure 4: Display of the R&S AMU 200A Baseband Signal Generator and Fading Simulator



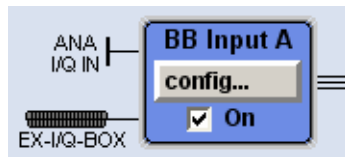
Connecting an R&S EX-IQ-Box during operation

The R&S EX-IQ-Box can be connected or disconnected while the R&S Instrument is in operating mode.

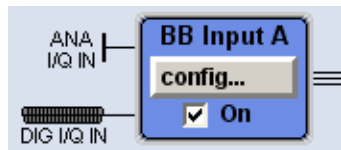
- ◆ After establishing the USB and LVDS connection, the R&S Instrument identifies the R&S EX-IQ-Box and establishes the connection. A brief message is indicated in the **Info** line.



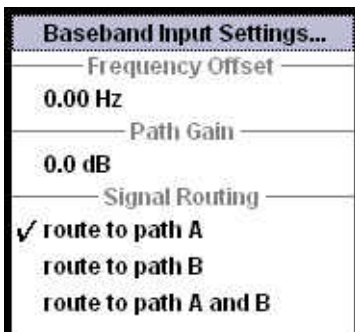
The labeled symbol of the R&S EX-IQ-Box is indicated in the block diagram.



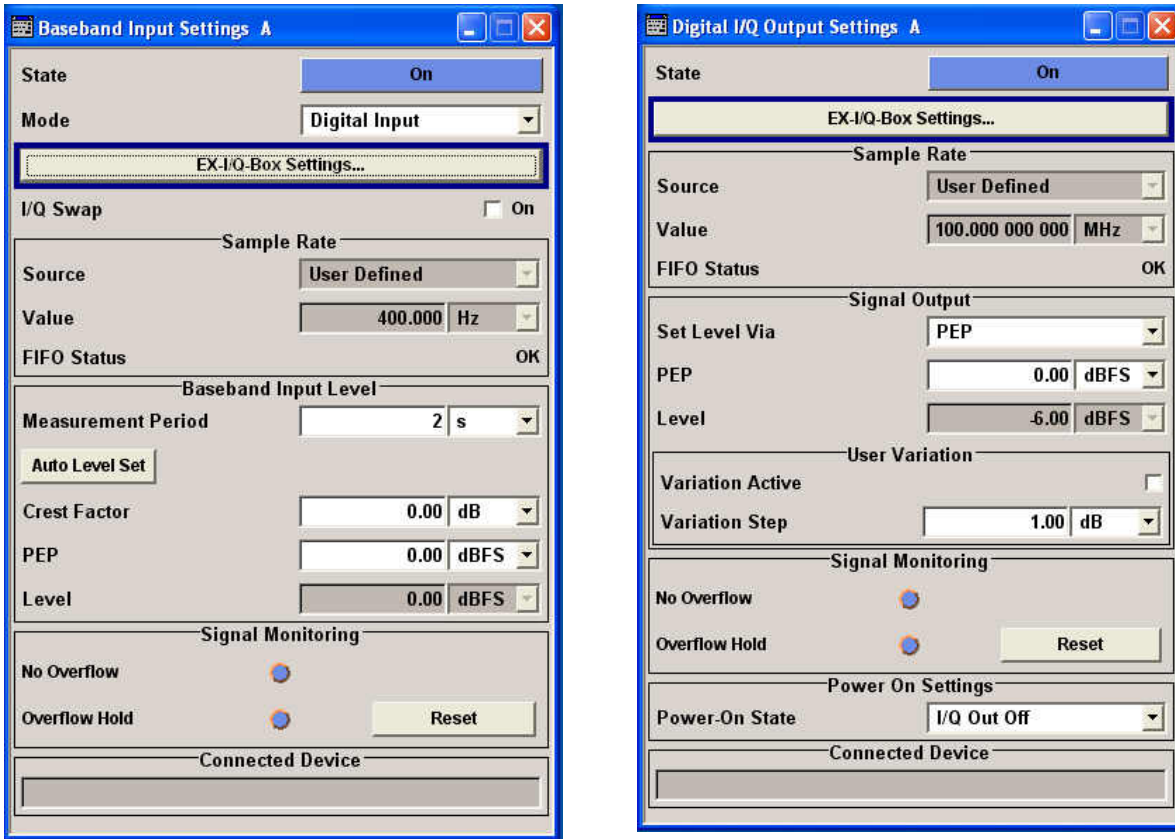
- ◆ After cutting the USB or LVDS connection, the active dialogs of the R&S EX-IQ-Box are closed automatically. In the block diagram label and symbol change to the common symbol DIG I/Q IN or DIG I/Q OUT.



The R&S EX-IQ-Box is configured in the main settings dialogs **Baseband Input Settings...** or **Digital I/Q Output Settings ...** of the associated function block, either **BB Input** or **I/Q Out**.



Selecting the respective menu item opens the settings dialog **Baseband Input Settings...** or **Digital I/Q Output Settings...**



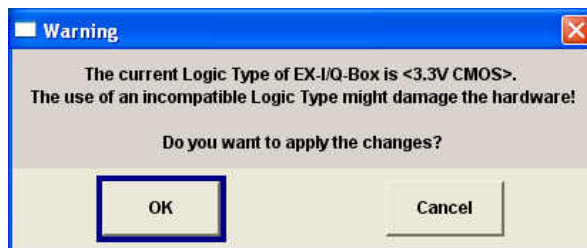
Clicking on the **EX-IQ-Box Settings...** button opens the main settings dialog of the R&S EX-IQ-Box (see [General Settings - BBIN/BBOUT](#), on page 16).

The baseband signal transmission between R&S EX-IQ-Box and R&S Instrument is activated by switching on in the **Baseband Input / Digital I/Q Output** settings dialogs.

NOTICE Danger of hardware damage!

The logic type of the DUT connected must be compatible to the selected logic type for the R&S EX-IQ-Box. If the logic types do not fit, the R&S EX-IQ-Box will be damaged because of the differing voltage values.

Therefore, a change of logic type during operation is only enabled after the following warning message has been confirmed.



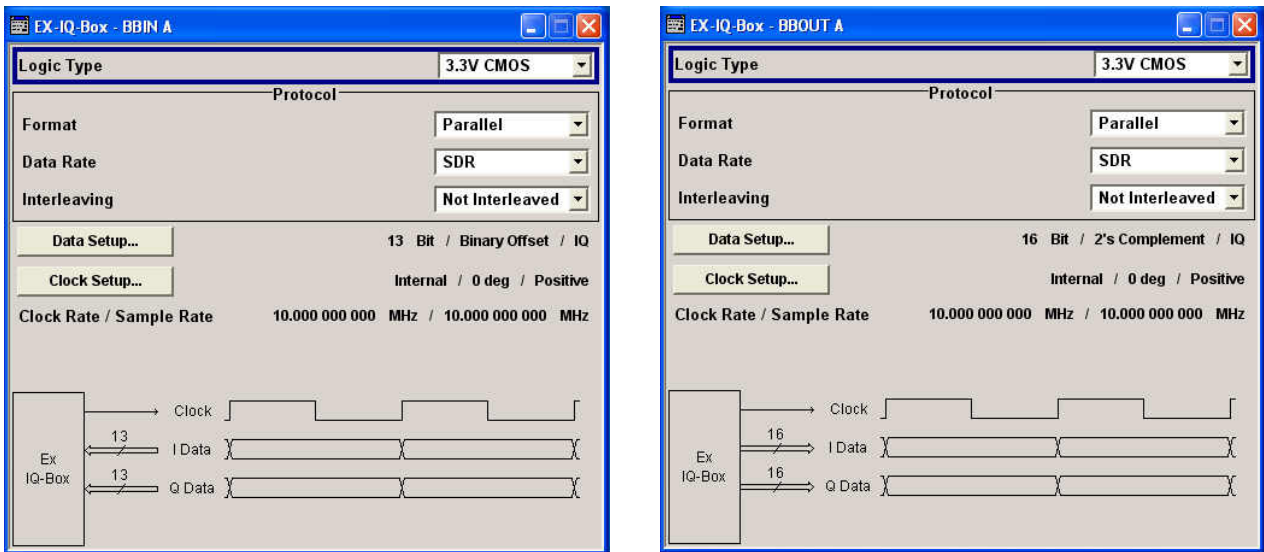
- Select **OK** if the correct logic type is selected.
- Select **Cancel** if an incompatible logic type is selected. In this case, the correct logic type has to be set in the R&S EX-IQ-Box Setting menu.

General Settings - BBIN/BBOUT

The configuration dialogs including the associated remote-control commands are described in detail in this chapter.

The R&S EX-IQ-Box main settings dialog contains the selection of the logic type, the protocol settings and displays the set **Data** and **Clock** parameters. Data and clock parameters can be configured in the **Data Setup...** and **Clock Setup...** dialogs.

Corresponding to the current settings the I/Q data and clock signals are displayed graphically in the lower section of the dialog.



The dialogs for baseband input and output are identical. The heading of each dialog indicates the currently selected R&S EX-IQ-Box.

Logic Type - EX-IQ-Box BBIN / BBOUT

Selects the signaling system used for transmitting the baseband signal from/to the DUT.

LVDS

The signal is transmitted by using the signaling system LVDS (**L**ow **V**oltage **D**ifferential **S**ignaling).

Remote-control command for **digital I/Q In**:

SOUR[1] | 2 : BBIN : EXT : LOG : TYPE LVDS

Remote-control command for **digital I/Q Out**:

SOUR[1] | 2 : IQ : OUTP : EXT : LOG : TYPE LVDS

- LVTTTL** The signal is transmitted by using LVTTTL technology (**L**ow **V**oltage **T**ransistor **T**ransistor **L**ogic) with a voltage level of 3.3 V.
Remote-control command for **digital I/Q In**:
SOUR[1] | 2:BBIN:EXT:LOG:TYPE LVTTTL
Remote-control command for **digital I/Q Out**:
SOUR[1] | 2:IQ:OUTP:EXT:LOG: TYPE LVTTTL
- 3.3V CMOS** The signal is transmitted by using the CMOS Technology (**C**omplementary **M**etal **O**xid **S**emiconductor) with a voltage level of 3.3 V.
Remote-control command for **digital I/Q In**:
SOUR[1] | 2:BBIN:EXT:LOG:TYPE CMOS33
Remote-control command for **digital I/Q Out**:
SOUR[1] | 2:IQ:OUTP:EXT:LOG: TYPE CMOS33
- 2.5V CMOS** The signal is transmitted by using the CMOS Technology (**C**omplementary **M**etal **O**xid **S**emiconductor) with a voltage level of 2.5 V.
Remote-control command for **digital I/Q In**:
SOUR:BBIN:EXT:LOG:TYPE CMOS25
Remote-control command for **digital I/Q Out**:
SOUR[1] | 2:IQ:OUTP:EXT:LOG:TYPE CMOS25
- 1.8V CMOS** The signal is transmitted by using the CMOS Technology (**C**omplementary **M**etal **O**xid **S**emiconductor) with a voltage level of 1.8 V.
Remote-control command for **digital I/Q In**:
SOUR[1] | 2:BBIN:EXT:LOG:TYPE CMOS18
Remote-control command for **digital I/Q Out**:
SOUR[1] | 2:IQ:OUTP:EXT:LOG: TYPE CMOS18

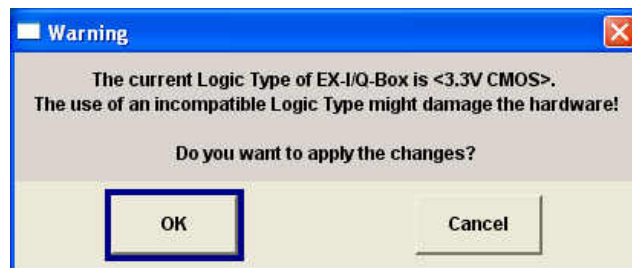
1.5V CMOS The signal is transmitted by using the CMOS Technology (**C**omplementary **M**etal **O**xid **S**emiconductor) with a voltage level of 1.5 V.
Remote-control command for **digital I/Q In**:
SOUR[1]|2:BBIN:EXT:LOG:TYPE CMOS15

Remote-control command for **digital I/Q Out**:
SOUR[1]|2:IQ:OUTP:EXT:LOG: TYPE CMOS15

NOTICE **Danger of hardware damage!**

The logic type of the DUT connected must be compatible to the selected logic type for the R&S EX-IQ-Box. If the logic types do not fit, the R&S EX-IQ-Box will be damaged because of the differing voltage values.

Therefore, a change of logic type during operation is only enabled after the following warning message has been confirmed.

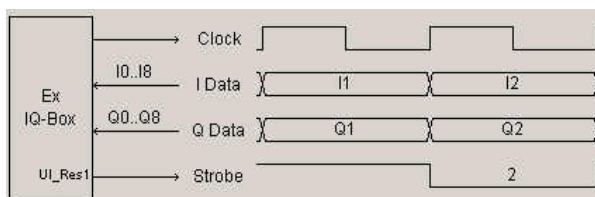


- Select **OK** if the correct logic type is selected.
 - Select **Cancel** if an incompatible logic type is selected. In this case, the correct logic type has to be set in the R&S EX-IQ-Box Setting menu.
-

In the **Protocol** section of the **EX-IQ-Box BBIN / BBOUT** dialog the parameters of the signal transmission from DUT to R&S EX-IQ-Box or vice versa can be set.

Format - EX-IQ-Box BBIN / BBOUT Sets the signal transmission protocol of the R&S EX-IQ-Box for receiving/sending a baseband signal from/to an external device (DUT) via the user interface of the R&S EX-IQ-Box.

Serial The baseband signal is transmitted serially from the DUT to the R&S EX-IQ-Box or vice versa. The currently set signal transmission is displayed graphically. The following graph shows an example for an incoming serial I/Q signal from the DUT



Remote-control command for **digital I/Q In:**

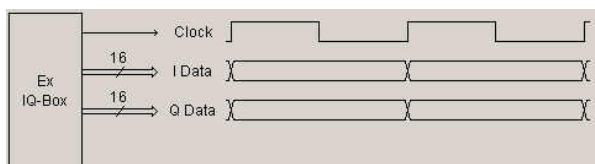
`SOUR[1] | 2:BBIN:EXT:FORM SER`

Remote-control command for **digital I/Q Out:**

`SOUR[1] | 2:IQ:OUTP:EXT:FORM SER`

Parallel The baseband signal is transmitted parallel from the DUT to the R&S EX-IQ-Box or vice versa. The graphical display shows the currently set signal transmission.

Example: parallel signal output to the DUT



Remote-control command for **digital I/Q In:**

`SOUR[1] | 2:BBIN:EXT:FORM PAR`

Remote-control command for **digital I/Q Out:**

`SOUR[1] | 2:IQ:OUTP:EXT:FORM PAR`

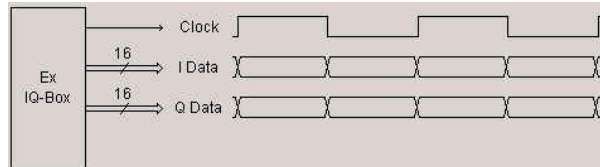
Data Rate - EX-IQ-Box BBIN / BBOUT Sets the data rate mode of the R&S EX-IQ-Box for receiving/sending a baseband signal from/to an external device (DUT).

SDR The baseband signal is transmitted in single data

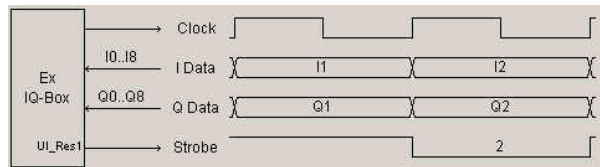
rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge of the data clock.

The characteristics of the signal transmission are shown in the graphic.

Example: parallel signal output in single data rate



Example: serial signal input in single data rate:



Remote-control command for **digital I/Q In:**

`SOUR[1] | 2 : BBIN : EXT : DRAT SDR`

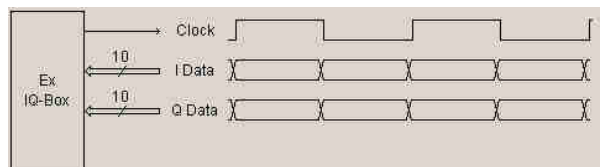
Remote-control command for **digital I/Q Out:**

`SOUR[1] | 2 : IQ : OUTP : EXT : DRAT SDR`

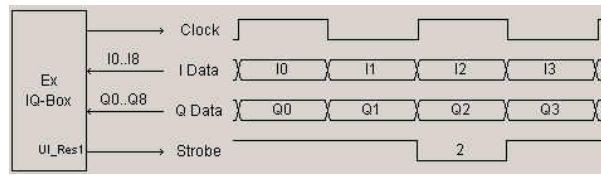
DDR

The baseband signal is transmitted in double data rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge and the falling edge of the data clock (double speed transfer).

The signal transmission is also shown in the graph. Example: parallel signal input in double data rate:



Example: serial signal input in double data rate:



Remote-control command for **digital I/Q In**:

SOUR[1] | 2 : BBIN : EXT : DRAT DDR

Remote-control command for **digital I/Q Out**:

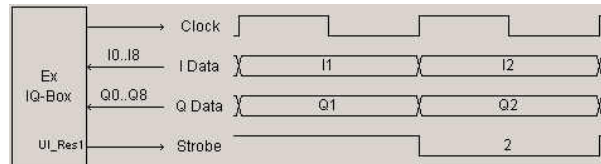
SOUR[1] | 2 : IQ : OUTP : EXT : DRAT DDR

Interleaving - EX-IQ-Box BBIN / BBOUT

Switches on or off interleaving and selects the interleaving mode. Depending on the parameters **Format** and **Data Rate** the baseband signal is transmitted in different orders (I/Q or Q/I), lines and transfer rates (single or double rated) from the external device to the R&S EX-IQ-Box or vice versa (see [Format - EX-IQ-Box BBIN / BBOUT](#) and [Data Rate - EX-IQ-Box BBIN / BBOUT](#)).

Not Interleaved

The baseband signal is transmitted on the I and Q data lines as indicated in the graph below.



Remote-control command for **digital I/Q In**:

SOUR[1] | 2 : BBIN : EXT : ILE OFF

Remote-control command for **digital I/Q Out**:

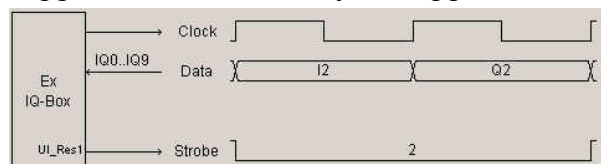
SOUR[1] | 2 : IQ : OUTP : EXT : ILE OFF

I/Q Interleaved

The baseband signal is transmitted on the I data line starting with I data.

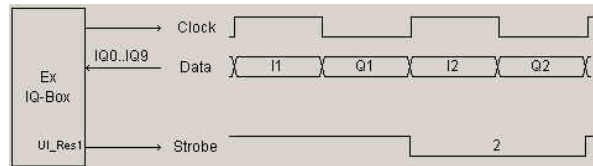
Serial transmission, SDR:

The strobe signal (UI_Res1) lasts for 2 clock cycles. With the first clock cycle the I data is triggered, the second cycle triggers the Q data.



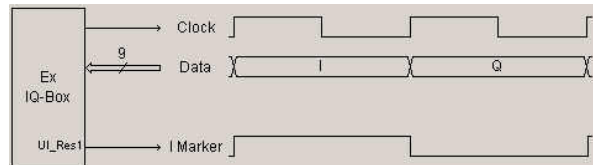
Serial transmission, DDR:

The strobe signal (UI_Res1) lasts for 1 clock cycle. The rising edge triggers the I data, the falling edge triggers the Q data.



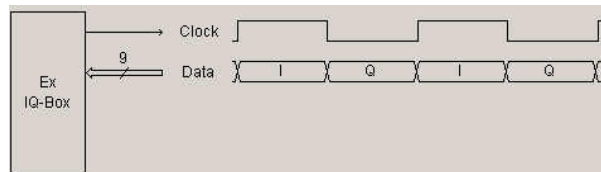
Parallel transmission, SDR:

The I marker output at the Reserved1 pin (UI_Res1) of the user interface marks the I data.



Parallel transmission, DDR:

The rising edge of the clock signal triggers the I data, the falling edge triggers the Q data.



Remote-control command for **digital I/Q In:**

```
SOUR[1] | 2 : BBIN : EXT : ILE IQ
```

Remote-control command for **digital I/Q Out:**

```
SOUR[1] | 2 : IQ : OUTP : EXT : ILE IQ
```

Q/I Interleaved

The baseband signal is transmitted on the I data line starting with Q data.

With interchanged order of the I and Q data the I/Q signal is transferred similarly as described above (see [I/Q Interleaved](#)).

Remote-control command for **digital I/Q In:**

```
SOUR[1] | 2 : BBIN : EXT : ILE QI
```

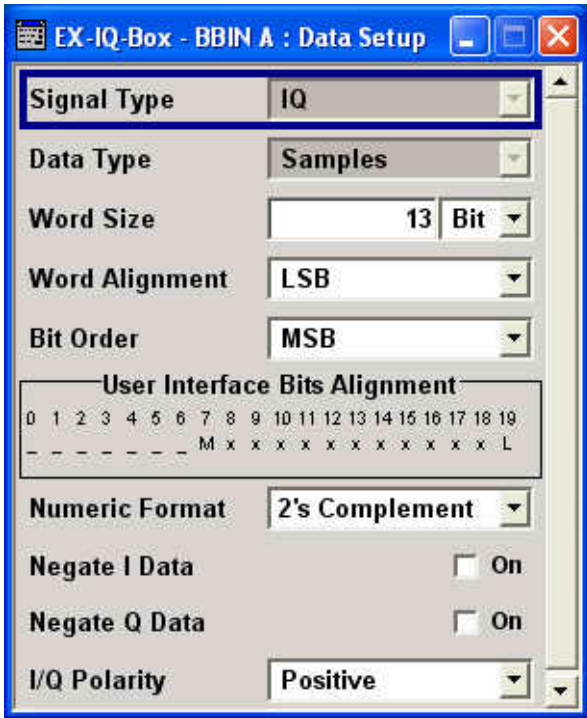
Remote-control command for **digital I/Q Out:**

```
SOUR[1] | 2 : IQ : OUTP : EXT : ILE QI
```

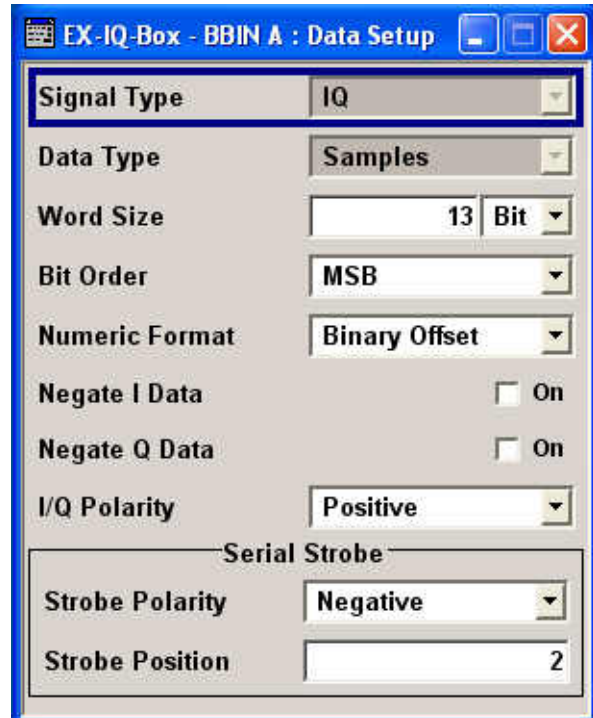
Data Setup... - EX-IQ-Box BBIN / BBOU	<p>Opens the Data Setup... dialog (see Data Setup).</p> <p>Right to the button the significant parameters Word Size, Numeric Type and Signal Type are displayed.</p> <p>Remote-control command for digital I/Q In: -</p> <p>Remote-control command for digital I/Q Out: -</p>
Clock Setup... - EX-IQ-Box BBIN / BBOU	<p>Opens the Clock Setup... dialog (see Clock Setup).</p> <p>Right to the button Clock Setup... the significant parameters Clock Source, Clock Phase and Clock Polarity are displayed.</p> <p>Remote-control command for digital I/Q In: -</p> <p>Remote-control command for digital I/Q Out: -</p>
Clock Rate / Sample Rate - EX-IQ-Box BBIN / BBOU	<p>Displays the current values of the clock frequency and the sample rate (see Clock Rate - EX-IQ-Box BBIN / BBOU : Clock Setup, on page 33).</p> <p>Remote-control command for digital I/Q In:</p> <pre>SOUR [1] 2 : BBIN : EXT : CLOC : RATE ? SOUR [1] 2 : BBIN : EXT : SRAT ?</pre> <p>Remote-control command for digital I/Q Out:</p> <pre>SOUR [1] 2 : IQ : OUTP : EXT : CLOC : RATE ? SOUR [1] 2 : IQ : OUTP : EXT : SRAT ?</pre>

Data Setup

Data Setup of protocol format **Parallel**



Data Setup of protocol format **Serial**



In this dialog the data parameters can be set. For parallel signal transmission, the currently set word parameters are graphically displayed in the **User Interface Bits Alignment** section. A signal diagram is displayed in the main settings dialog of the R&S EX-IQ-Box (EX-IQ-Box:BBIN or EX-IQ-Box:BBOUT).

Signal Type - EX-IQ-Box BBIN / BBOU T : Data Setup



Currently the signal type is firmly set to **IQ** and read only. Signal type **IF** is intended for future use.

Data Type - EX-IQ-Box BBIN / BBOU T : Data Setup



Currently the data type is firmly set to **Samples** and read only. Data type **Pre-FIR Samples** is intended for future use.

Word Size - EX-IQ-Box BBIN / BBOUT : Data Setup Sets the word size of a sample. Depending on the R&S Instrument 4 to 20 bit words are available. For R&S SMx and R&S AMU instruments only 4 to 16 bit words are provided.

Remote-control command for **digital I/Q In:**

```
SOUR[1] | 2:BBIN:EXT:DATA:SIZE 8
```

Remote-control command for **digital I/Q Out:**

```
SOUR[1] | 2:IQ:OUTP:EXT:DATA:SIZE 8
```

Word Alignment - R&S EX-IQ-Box BBIN / BBOUT : Data Setup **Parallel mode only!**

Sets the alignment of the data bits on the data lines. Either the MSB or the LSB is mapped firmly to one data line. Depending on the word size the equivalent bit moves to the appropriate data line.

MSB The MSB (**M**ost **S**ignificant **B**it) is mapped firmly to the same data line and the data line of the LSB varies in dependency of the word size. The currently set word alignment is displayed graphically.

Examples:

word size = 5, bit order = MSB



word size = 9, bit order = MSB



Remote-control command for **digital I/Q In:**
 SOUR[1] | 2:BBIN:EXT:DATA: ALIG MSB

Remote-control command for **digital I/Q Out:**
 SOUR[1] | 2:IQ:OUTP:EXT:DATA: ALIG MSB

LSB

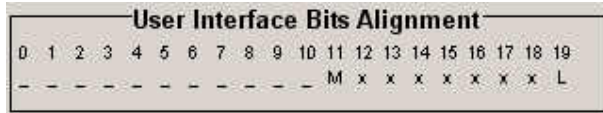
The **LSB (Last Significant Bit)** is mapped firmly to the same data line and the data line of the **MSB** varies in dependency of the word size.

Examples:

word size = 5, bit order = MSB



word size = 9, bit order = MSB



Remote-control command for **digital I/Q In**:

SOUR[1] | 2:BBIN:EXT:DATA: ALIG LSB

Remote-control command for **digital I/Q Out**:

SOUR[1] | 2:IQ:OUTP:EXT:DATA: ALIG LSB

**Bit Order - EX-IQ-Box
BBIN / BBOUT : Data
Setup**

Sets the order of the data bits. In **Parallel mode**, either the **LSB** or the **MSB** is transmitted on the first used data line. In **Serial mode** mode either the **LSB** or the **MSB** is transmitted as first bit.

MSB

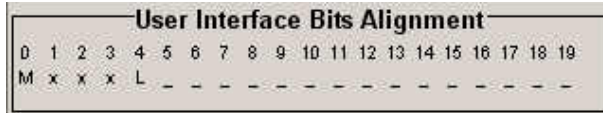
Parallel transmission:

The **MSB (Most Significant Bit)** is transmitted on the first used data line, depending on the word size and alignment.

The graphical display shows the currently set bit order.

Examples:

word alignment = MSB, word size = 5



word alignment = LSB, word size = 9



Serial transmission:

The MSB (**M**ost **S**ignificant **B**it) is transmitted first.

Remote-control command for **digital I/Q In:**

SOUR[1] | 2:BBIN:EXT:DATA:BORD MSB

Remote-control command for **digital I/Q Out:**

SOUR[1] | 2:IQ:OUTP:EXT:DATA: BORD MSB

LSB

Parallel transmission:

The LSB (**L**ast **S**ignificant **B**it) is transmitted on the first data line.

Examples:

word alignment = MSB, word size = 5



word alignment = LSB, word size = 5



Serial transmission:

The LSB (**L**ast **S**ignificant **B**it) is transmitted first.

Remote-control command for **digital I/Q In:**

SOUR[1] | 2:BBIN:EXT:DATA:BORD LSB

Remote-control command for **digital I/Q Out:**

SOUR[1] | 2:IQ:OUTP:EXT:DATA: BORD LSB

**Numeric Format - EX-IQ-Box BBIN / BBOU
: Data Setup**

Sets the format of the transmitted data.

Allowed number range for n Bit: $-2^{n-1} \leq n < 2^{n-1}$

2's Complement

The most significant bit has a value of -2^{n-1} , the bits of lesser significance follow as $+2^{n-2} \dots 2^0$.

Binary Offset

A binary offset of 2^{n-1} is added such that the final values are always positive.

Example: $n = 4 \Rightarrow -8 \leq z < 8$

z	2's Complement	Binary Offset
-8	1 0 0 0	0 0 0 0
-7	1 0 0 1	0 0 0 1
-6	1 0 1 0	0 0 1 0
-5	1 0 1 1	0 0 1 1
-4	1 1 0 0	0 1 0 0
-3	1 1 0 1	0 1 0 1
-2	1 1 1 0	0 1 1 0
-1	1 1 1 1	0 1 1 1
0	0 0 0 0	1 0 0 0
1	0 0 0 1	1 0 0 1
2	0 0 1 0	1 0 1 0
3	0 0 1 1	1 0 1 1
4	0 1 0 0	1 1 0 0
5	0 1 0 1	1 1 0 1
6	0 1 1 0	1 1 1 0
7	0 1 1 1	1 1 1 1

2's Complement

The value of the transmitted data is formatted in two's-complement.

Remote-control command for **digital I/Q In:**

SOUR[1] | 2:BBIN:EXT:DATA:NFOR TCOM

Remote-control command for **digital I/Q Out:**

SOUR[1] | 2:IQ:OUTP:EXT:DATA:NFOR TCOM

Binary Offset The value of the transmitted data is formatted in binary offset.

Remote-control command for **digital I/Q In**:
`SOUR[1]|2:BBIN:EXT:DATA:NFORt OBIN`

Remote-control command for **digital I/Q Out**:
`SOUR[1]|2:IQ:OUTP:EXT:DATA:NFOR OBIN`

Negate I Data - EX-IQ-Box BBIN / BBOUT : Inverts the sign of the I sample values. The values are multiplied by -1.

Data Setup

Remote-control command for **digital I/Q In**:
`SOUR[1]|2:BBIN:EXT:DATA:INEG ON | OFF`

Remote-control command for **digital I/Q Out**:
`SOUR[1]|2:IQ:OUTP:EXT:DATA:INEG ON | OFF`

Negate Q Data - EX-IQ-Box BBIN / BBOUT : Inverts the sign of the Q sample values. The values are multiplied by -1.

Data Setup

Remote-control command for **digital I/Q In**:
`SOUR[1]|2:BBIN:EXT:DATA:QNEG ON | OFF`

Remote-control command for **digital I/Q Out**:
`SOUR.IQ:OUTP:EXT:DATA:QNEG ON | OFF`

I/Q Polarity - EX-IQ-Box BBIN / BBOUT : Sets the polarity of the I and Q data lines of the R&S EX-IQ-Box.

Data Setup

Positive High level stands for a logic 1, low level for a logic 0.

Remote-control command for **digital I/Q In**:
`SOUR[1]|2:BBIN:EXT:DATA:POL:IQ POS`

Remote-control command for **digital I/Q Out**:
`SOUR[1]|2:IQ:OUTP:EXT:DATA:POL:IQ POS`

Negative High level stands for a logic 0, low level for a logic 1.

Remote-control command for **digital I/Q In**:
`SOUR[1]|2:BBIN:EXT:DATA:POL:IQ NEG`

Remote-control command for **digital I/Q Out**:
`SOUR[1]|2:IQ:OUTP:EXT:DATA:POL:IQ NEG`

In the **Serial Strobe** section of the **Data Setup - EX-IQ-Box - BBIN / BBOUT** dialog the strobe parameters can be set. These parameters are enabled only for serial signal transmission.

Strobe Polarity - EX-IQ-Box BBIN / BBOUT : Data Setup

Serial data transmission only!

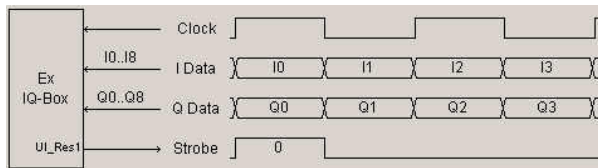
Describes the polarity of the strobe marker signal. During a serial data transmission every data sample is marked by the strobe marker signal.



The settings of **Clock Phase** or **Clock Skew** do not affect the strobe marker signal.

Positive

The strobe position is indicated by high level, displayed in the graph of the dialog.



Remote-control command for **digital I/Q In**:

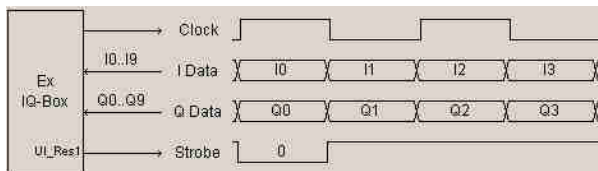
`SOUR[1] | 2 : BBIN : EXT : DATA : SPOL POS`

Remote-control command for **digital I/Q Out**:

`SOUR[1] | 2 : IQ : OUTP : EXT : DATA : SPOL POS`

Negative

The strobe position is indicated by low level, also shown in the graph.



Remote-control command for **digital I/Q In**:

`SOUR[1] | 2 : BBIN : EXT : DATA : SPOL NEG`

Remote-control command for **digital I/Q Out**:

`SOUR[1] | 2 : IQ : OUTP : EXT : DATA : SPOL NEG`

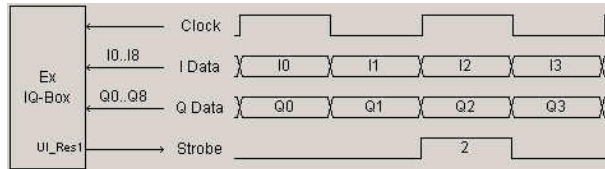
Strobe Position - EX-IQ-Box BBIN / BBOUT : Data Setup

Serial data transmission only!

Sets the sample position of the strobe marker output.
Value range: 0 to word size -1.

The set sample position is graphically displayed in the Clock Setup dialog.

Example: strobe position = 2, strobe polarity = Positive.



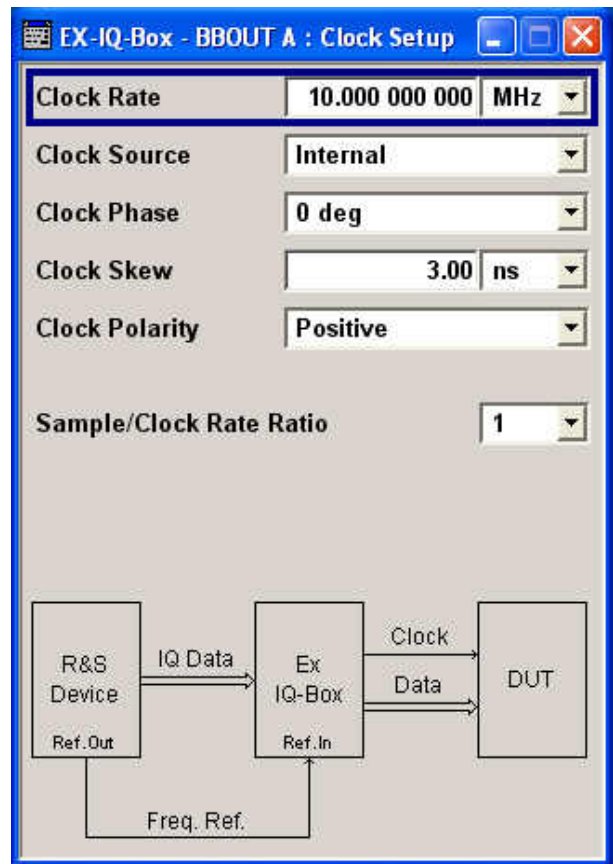
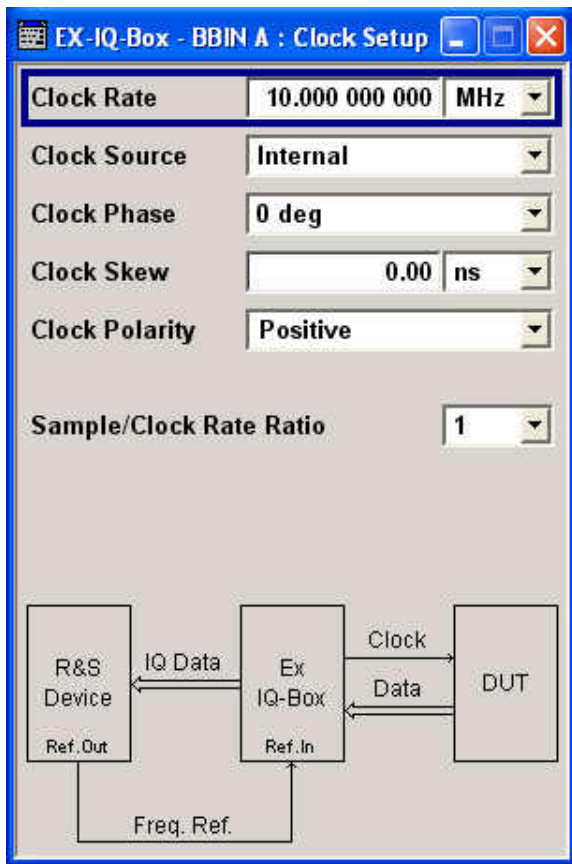
Remote-control command for digital I/Q In:

`SOUR[1] | 2 : BBIN : EXT : DATA : SPOS 10`

Remote-control command for digital I/Q Out:

`SOUR[1] | 2 : IQ : OUTP : EXT : DATA : SPOS 10`

Clock Setup



In this dialog the clock parameters can be set. Data flow, clock signal and reference frequency signal are graphically displayed.

Clock Rate - EX-IQ-Box BBIN / BBOUT : Clock Setup Sets the clock rate (frequency) for signal transmission between the R&S EX-IQ-Box and the external device (DUT). Depending on the logic type and the clock source the clock rate range varies (see below: value range of f_{CLK}).

$$f_{CLK} = \frac{f_s \cdot WS \cdot Int}{DDR \cdot SCR}$$

f_s = Sample rate

Value range: 1 kHz ... 100 MHz

f_{CLK} = Clock rate

Value range:

Logic level LVDS: 1 kHz (100 kHz) ... 400 MHz

Logic level LVTTTL/CMOS: 1 kHz (100 kHz) ... 100 MHz

(1 kHz stands for the internal clock source, fed in from the R&S Instrument, 100 kHz stands for the external reference from the user interface).

WS = Word size

Int = Interleaving mode

DDR = Double data rate

SCR = Sample/Clock rate ratio

WS	4 ... 16 (serial mode)	1 (parallel mode)
Int	1 (non interleaved)	2 (I/Q and Q/I interleaved)
DDR	1 (SDR)	2 (DDR)

SCR = 1, $\frac{4}{5}$, $\frac{2}{5}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$

Remote-control command for **digital I/Q In:**

SOUR[1] | 2:BBIN:EXT:CLOC:RATE 100MHZ

Remote-control command for **digital I/Q Out:**

SOUR[1] | 2:IQ:OUTP:EXT:CLOC:RATE 100MHZ



The value range for the clock rate depends on the parameter settings of **Protocol, Logic Type** and **Signal Type**.

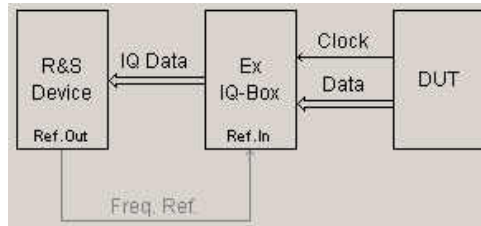
Clock Source - EX-IQ-Box BBIN / BBOUT : Clock Setup

Selects the clock source for data transmission and clock generation. Either the R&S Instrument or the external device (DUT) can be set for delivering the reference, irrespective of the direction of transmission.

Currently the following scenarios for data transmission are possible:

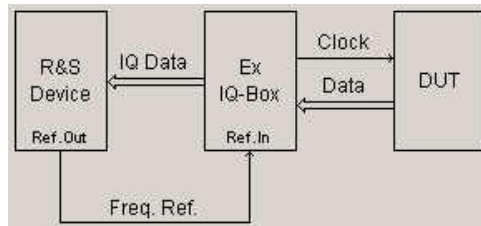
1. Signal input by using an external clock source.

Data and data clock are transmitted from the external device, as shown in the graph of the Clock Setup dialog.



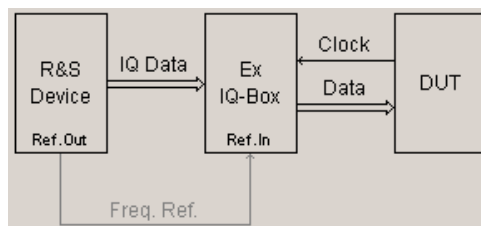
2. Signal input by using the internal clock source.

The clock source of the R&S Instrument is sent to the external device for triggering the data input to the R&S EX-IQ-Box.



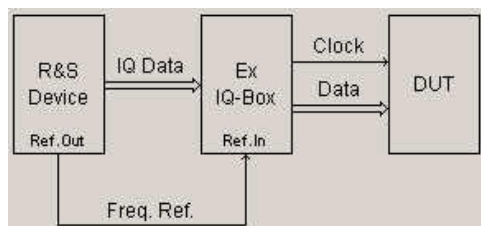
3. Signal output by using an external clock source.

Synchronized by an external data clock, data are output from the R&S Instrument.



4. Signal output by using the internal clock source.

Data and data clock are delivered from the R&S Instrument.



Internal

The clock reference of the R&S Instrument is used. The R&S EX-IQ-Box forwards the data clock to the external device.

Remote-control command for **digital I/Q In:**

```
SOUR[1] | 2:BBIN:EXT:CLOC:SOUR INT |  
EXT
```

Remote-control command for **digital I/Q Out:**

```
SOUR[1] | 2:IQ:OUTP:EXT:CLOC:SOUR INT  
| EXT
```



When using the internal clock frequency, the reference output of the R&S Instrument must be connected to the REF IN of the R&S EX-IQ-Box (see [Legend for Rear Panel View](#)).

The connection can be kept during the entire operation even if an external clock reference is used.

External

The clock reference is fed in from the external device (DUT) to the user interface of the R&S EX-IQ-Box.

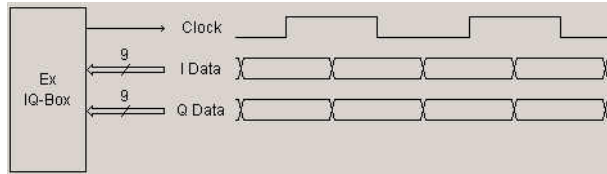
Remote-control command for **digital I/Q In:**

```
SOUR[1] | 2:BBIN:EXT:CLOC:SOUR EXT
```

Remote-control command for **digital I/Q Out:**

```
SOUR[1] | 2:IQ:OUTP:EXT:CLOC: SOUR EXT
```

Clock Phase - EX-IQ-Box BBIN / BBOUT : Sets a phase shift of the active clock edge in 90° steps related to the data bits.
Clock Setup The phase shift is graphically displayed in main settings dialog.
 Example: clock phase 90°



Remote-control command for **digital I/Q In:**

SOUR[1] | 2 : BBIN : EXT : CLOC : PHAS 0 | 90 | 180 | 270

Remote-control command for **digital I/Q Out:**

SOUR[1] | 2 : IQ : OUTP : EXT : CLOC : PHAS 0 | 90 | 180 | 270

Clock Skew - EX-IQ-Box BBIN / BBOUT : Sets a time shift of the active clock edge related to the data bits.
Clock Setup Value range: -5 ns ... + 5 ns

Remote-control command for **digital I/Q In:**

SOUR[1] | 2 : BBIN : EXT : CLOC : SKEW 2.5ns

Remote-control command for **digital I/Q Out:**

SOUR[1] | 2 : IQ : OUTP : EXT : CLOC : SKEW 2.5ns

Clock Polarity - EX-IQ-Box BBIN / BBOUT : Sets the polarity of the active clock edge for triggering the signal transmission.
Clock Setup

Positive Sets the rising edge of the clock signal as the active.

Remote-control command for **digital I/Q In:**

SOUR[1] | 2 : BBIN : EXT : CLOC : POL POS

Remote-control command for **digital I/Q Out:**

SOUR[1] | 2 : IQ : OUTP : EXT : CLOC : POL POS

Negative

Sets the falling edge of the clock signal as the active.

Remote-control command for **digital I/Q In**:

SOUR[1] | 2 : BBIN : EXT : CLOC : POL NEG

Remote-control command for **digital I/Q Out**:

SOUR[1] | 2 : IQ : OUTP : EXT : CLOC : POL NEG



Setting the Clock Polarity **negative** is equivalent to setting the clock phase to 180°.

Sample/Clock Rate Ratio - EX-IQ-Box BBIN / BBOUT : Clock Setup

Parallel data transmission only!

Sets the sample clock rate ratio. This parameter characterizes the ratio of the sample rate to the clock rate.

For SCR < 1:

- ◆ dummy samples are added.
- ◆ the signal SCR_VALID output at the Reserved0 pin (UI_RESERVE_P0) of the user interface marks the validity of the data.

Values: **SCR** = 1, $\frac{4}{5}$, $\frac{2}{5}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$

The values of the sample/clock rate depend on the parameter settings of **Word Size**, **Interleaving** and **Data Rate** (see also [Clock Rate - EX-IQ-Box BBIN / BBOUT : Clock Setup](#), on page 33).

Remote-control command for **digital I/Q In**:

SOUR[1] | 2 : BBIN : EXT : SCR SCR1 | SCR4D5 | SCR2D5 | SCR1D5 | SCR1D10 | SCR1D20

Remote-control command for **digital I/Q Out**:

SOUR[1] | 2 : BBIN : EXT : SCR SCR1 | SCR4D5 | SCR2D5 | SCR1D5 | SCR1D10 | SCR1D20

Remote Control Commands for Signal Generators

The digital signal interface module (R&S EX-IQ-Box) provides the bidirectional transmission of I/Q data between R&S Instruments and external devices. For R&S Instruments the digital signals are input or output via digital interfaces by using the signaling system LVDS (**L**ow **V**oltage **D**ifferential **S**ignaling).

Therefore an R&S Instrument has to be equipped with the option for Baseband input or output, respectively. The R&S EX-IQ-Box is then connected at the digital interface **Baseband Digital IN** or **Digital I/Q Out** of the R&S Instrument. For external devices various signaling and data protocols are used. These data and signal formats have to be converted to the digital transmission protocol LVDS or vice versa, used by R&S Instruments.

The following Remote Control Command description contains the commands for setting the external digital baseband signals of the R&S EX-IQ-Box. These settings define the parameters of the signal transmission like logic type, protocol, data and clock settings.

The dialogs for baseband input and output are identical. With the aid of the remote-control command the appropriate R&S EX-IQ-Box can be addressed. Both, the I/Q In and I/Q Out remote-control commands are listed in the description of each parameter.

Example:

```
[SOURce<[1] | 2>:]BBIN:EXTernal:LOGic[:TYPE] = command for digital I/Q In  
[SOURce<[1] | 2>:]IQ:OUTPut:EXTernal:LOGic[:TYPE] = command for digital I/Q Out
```

The numerical suffix at SOURce distinguishes between path A and path B for two-path instruments:

SOURce<1> = path A

SOURce2 = path B

The keyword SOURce is optional with commands for path A and can be omitted. For path B, the command must include the keyword with the suffix 2.

Provided that an R&S Instrument is configured as a two-path instrument, the external baseband signal A can be routed to path A, path B, or both paths. An external baseband signal B can be routed to path B only.

Main Settings Subsystem

Table of commands

Command	Parameter	Default unit	Comment
[SOURce<[1] 2>:]BBIN:EXternal:DRATe [SOURce<[1] 2>:]IQ:OUTPut:EXternal:DRATe	SDR DDR		
[SOURce<[1] 2>:]BBIN:EXternal:FORmat [SOURce<[1] 2>:]IQ:OUTPut:EXternal:FORmat	SERial PARallel		
[SOURce<[1] 2>:]BBIN:EXternal:ILEaving [SOURce<[1] 2>:]IQ:OUTPut:EXternal:ILEaving	OFF IQ QI		
[SOURce<[1] 2>:]BBIN:EXternal:LOGic[:TYPE] [SOURce<[1] 2>:]IQ:OUTPut:EXternal:LOGic[:TYPE]	LVTTTL LVDS CMOS33 CMOS25 CMOS18 CMOS15		
[SOURce<[1] 2>:]BBIN:EXternal:SCRatio [SOURce<[1] 2>:]IQ:OUTPut:EXternal:SCRatio	SCR1 SCR4D5 SCR2D5 SCR1D5 SCR1D10 SCR1D20		
[SOURce<[1] 2>:]BBIN:EXternal:SRATe [SOURce<[1] 2>:]IQ:OUTPut:EXternal:SRATe			Query only

Description of Commands

[SOURce<[1]|2>:]BBIN:EXternal:DRATe SDR | DDR

[SOURce<[1]|2>:]IQ:OUTPut:EXternal:DRATe SDR | DDR

This command sets the data rate mode of the R&S EX-IQ-Box for receiving/sending a baseband signal from/to an external device (DUT).

Parameter: SDR (Single Data Rate)

The baseband signal is transmitted in single data rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge of the data clock.

DDR (Double Data Rate)

The baseband signal is transmitted in double data rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge and the falling edge of the data clock (double speed transfer).

Example: Command for digital I/Q In:

"SOUR:BBIN:EXT:FORM SDR"

Command for digital I/Q Out:

"SOUR:IQ:OUTP:EXT:FORM SDR"

'sets the data rate mode to single.

*RST value	Resolution	SCPI
SDR	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:FORMAT SERIAL | PARALLEL

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:FORMAT SERIAL | PARALLEL

This command sets the signal transmission protocol of the R&S EX-IQ-Box for receiving/sending a baseband signal from/to an external device (DUT) via the user interface of the R&S EX-IQ-Box.

Parameter: Serial

The baseband signal is transmitted serially from the DUT to the R&S EX-IQ-Box or vice versa. .

Parallel

The baseband signal is transmitted parallel from the DUT to the R&S EX-IQ-Box or vice versa.

Example: Command for digital I/Q In:

"SOUR:BBIN:EXT:FORM PAR"

Command for digital I/Q Out:

"SOUR:IQ:OUTP:EXT:FORM PAR"

'sets the transmission protocol of the R&S EX-IQ-Box to parallel.

*RST value	Resolution	SCPI
PARALLEL	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:ILEAVING OFF | IQ | QI

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:ILEAVING OFF | IQ | QI

This command switches on or off interleaving and selects the interleaving mode.

Depending on the parameters **Format** and **Data Rate** the baseband signal is transmitted in different orders (I/Q or Q/I), lines and transfer rates (single or double rated) from the external device to the R&S EX-IQ-Box or vice versa.

Parameter: OFF (Not Interleaved)

The baseband signal is transmitted on the I and Q data lines.

IQ (I/Q Interleaved)

The baseband signal is transmitted on the I data line starting with I data.

- ◆ Serial transmission, SDR:
The strobe signal (UI_Res1) lasts for 2 clock cycles. With the first clock cycle the I data is triggered, the second cycle triggers the Q data.
- ◆ Serial transmission, DDR:
The strobe signal (UI_Res1) lasts for 1 clock cycle. The rising edge triggers the I data, the falling edge triggers the Q data.
- ◆ Parallel transmission, SDR:
The I marker output at the Reserved1 pin (UI_Res1) of the user interface marks the I data.
- ◆ Parallel transmission, DDR:
The rising edge of the clock signal triggers the I data, the falling edge triggers the Q data.

QI (Q/I Interleaved)

The baseband signal is transmitted on the I data line starting with Q data. With interchanged order of the I and Q data the I/Q signal is transferred similarly as described under I/Q Interleaved.

Example:

Command for digital I/Q In:

```
"SOUR:BBIN:EXT:ILE IQ"
```

Command for digital I/Q Out:

```
"SOUR:IQ:OUTP:EXT:ILE IQ"
```

'sets the interleaving mode of the R&S EX-IQ-Box to I/Q.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:LOGIC[:TYPE] LVTTTL | LVDS | CMOS33 | CMOS25 | CMOS18 | CMOS15 TYPE

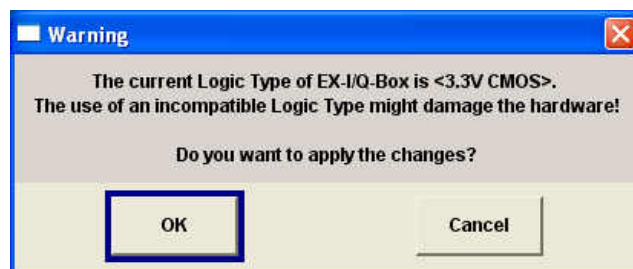
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:LOGIC[:TYPE] LVTTTL | LVDS | CMOS33 | CMOS25 | CMOS18 | CMOS15 TYPE

This command selects the signaling system used from the DUT for transmitting the baseband signal.

NOTICE **Danger of hardware damage!**

The logic type of the DUT connected must be compatible to the selected logic type for the R&S EX-IQ-Box. If the logic types do not fit, the R&S EX-IQ-Box will be damaged because of the differing voltage values.

Therefore, a change of logic type during operation is only enabled after the following warning message has been confirmed.



- Select **OK** if the correct logic type is selected.
 - Select **Cancel** if an incompatible logic type is selected. In this case, the correct logic type has to be set in the R&S EX-IQ-Box Setting menu.
-

Parameter: **LVDS**

The signal is transmitted by using the signaling system LVDS.

LVTTTL

The signal is transmitted by using the LVTTTL technology with a level voltage of 3.3 V.

CMOS33

The signal is transmitted by using the CMOS technology with a level voltage of 3.3 V.

CMOS25

The signal is transmitted by using the CMOS technology with a level voltage of 2.5 V.

LVDS

The signal is transmitted by using the signaling system LVDS.

LVTTL

The signal is transmitted by using the LVTTL technology with a level voltage of 3.3 V.

CMOS33

The signal is transmitted by using the CMOS technology with a level voltage of 3.3 V.

CMOS25

The signal is transmitted by using the CMOS technology with a level voltage of 2.5 V.

CMOS18

The signal is transmitted by using the CMOS technology with a level voltage of 1.8 V.

CMOS15

The signal is transmitted by using the CMOS technology with a level voltage of 1.5 V.

Example:

Command for digital I/Q In:

`BBIN:EXT:LOG LVDS`

Command for digital I/Q Out:

`IQ:OUTPut:EXT:LOG LVDS`

'sets the logic type of the R&S EX-IQ-Box to LVDS for receiving a LVDS signal from an external device.

*RST value	Resolution	SCPI
CMOS33	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTernal:SCRatio SCR1 | SCR4D5 | SCR2D5 | SCR1D5 | SCR1D10 | SCR1D20

[SOURCE<[1]>:]IQ:OUTPut:EXTernal:SCRatio SCR1 | SCR4D5 | SCR2D5 | SCR1D5 | SCR1D10 | SCR1D20

Parallel data transmission only!

This command sets the sample clock rate ratio. This parameter characterizes the ratio of the sample rate to the clock rate.

For SCR < 1:

- ◆ dummy samples are added.
- ◆ the signal SCR_VALID output at the Reserved0 pin (UI_RESERVE_P0) of the user interface marks the validity of the data.

Values: **SCR** = 1, $\frac{4}{5}$, $\frac{2}{5}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$

The values of the sample/clock rate depend on the parameter settings of **Word Size**, **Interleaving** and **Data Rate** (see also [SOURCE-BBIN/BBOUT-External - Clock Rate](#), on page 47).

Example: Command for digital I/Q In:
 "BBIN:EXT:SCR SCR4D5"
 Command for digital I/Q Out:
 "IQ:OUTPut:EXT:SCR SCR4D5"
 'sets the sample clock rate ratio to $\frac{4}{5}$.

*RST value	Resolution	SCPI
1	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTernal:SRATE?

[SOURCE<[1]>:]IQ:OUTPut:EXTernal:SRATE?

This command queries the current sample rate of the external digital baseband signal. The command is a query command and therefore does not have an *RST value.

Example: Command for digital I/Q In:
 "BBIN:EXT:SRAT?"
 Command for digital I/Q Out:
 "IQ:OUTPut:EXT:SRAT?"
 'queries the sample rate of the external baseband signal.

*RST value	Resolution	SCPI
-	-	Device-specific

Clock Subsystem

Table of commands

Command	Parameter	Default unit	Comment
[SOURce<[1] 2>:]BBIN:EXTernal:CLOCK:PHASe [SOURce<[1] 2>:]IQ:OUTPut:EXTernal:CLOCK:PHASe	0 90 180 270	deg	
[SOURce<[1] 2>:]BBIN:EXTernal:CLOCK:POLarity [SOURce<[1] 2>:]IQ:OUTPut:EXTernal:CLOCK:POLarity	POSitive NEGative		
[SOURce<[1] 2>:]BBIN:EXTernal:CLOCK:RATE [SOURce<[1] 2>:]IQ:OUTPut:EXTernal:CLOCK:RATE	1 kHz ... 400 MHz	Hz	
[SOURce<[1] 2>:]BBIN:EXTernal:CLOCK:SKEW [SOURce<[1] 2>:]IQ:OUTPut:EXTernal:CLOCK:SKEW	-5...+5 ns	ns	
[SOURce<[1] 2>:]BBIN:EXTernal:CLOCK:SOURce [SOURce<[1] 2>:]IQ:OUTPut:EXTernal:CLOCK:SOURce	INTernal EXTernal		

Description of Commands

[SOURce<[1]|2>:]BBIN:EXTernal:CLOCK:PHASe 0 | 90 | 180 | 270

[SOURce<[1]|2>:]IQ:OUTPut:EXTernal:CLOCK:PHASe 0 | 90 | 180 | 270

This command sets a phase shift of the active clock edge in 90° steps related to the data bits.

Example: Command for digital I/Q In:
"SOUR:BBIN:EXT:CLOC:PHASe 180"

Command for digital I/Q Out:
"SOUR:IQ:OUTP:EXT:CLOC:PHAS 180"

'sets the phase shift of the clock edge to 180 degree.

*RST value	Resolution	SCPI
0°	90°	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:POLARITY POSitive | NEGative

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:POLARITY POSitive | NEGative

The command sets the polarity of the active clock edge for triggering the signal transmission.

Parameters: POSitive

Sets the rising edge of the clock signal as the active.

NEGative

Sets the falling edge of the clock signal as the active. .



Setting the Clock Polarity **negative** is equivalent to setting the clock phase to 180°.

Example:

Command for digital I/Q In:

"SOURCE:BBIN:EXT:CLOCK:POL NEG"

Command for digital I/Q Out:

"SOURCE:IQ:OUTP:EXT:CLOCK:POL NEG"

'sets the clock polarity to negative.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:RATE 1 kHz ...400 MHz

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:RATE 1 kHz ...400 MHz

The command sets/queries the clock rate (frequency) for signal transmission between the R&S EX-IQ-Box and the external device (DUT). Depending on the logic type and the clock source the clock rate range varies).

$$f_{CLK} = \frac{f_s \cdot WS \cdot Int}{DDR \cdot SCR}$$

f_s = Sample rate

Value range: 1 kHz ... 100 MHz

f_{CLK} = Clock rate

Value range:

Logic level LVDS: 1 kHz (100 kHz) ... 400 MHz

Logic level LVTTTL/CMOS: 1 kHz (100 kHz) ... 100 MHz

(1 kHz stands for the internal clock source, fed in from the R&S Instrument, 100 kHz stands for the external reference from the user interface).

WS = Word size

Int = Interleaving mode

DDR = Double data rate

SCR = Sample/Clock rate ratio

WS	4 ... 16 (serial mode)	1 (parallel mode)
Int	1 (non interleaved)	2 (I/Q and Q/I interleaved)
DDR	1 (SDR)	2 (DDR)

$$SCR = 1, \frac{4}{5}, \frac{2}{5}, \frac{1}{5}, \frac{1}{10}, \frac{1}{20}$$



The value range of the clock rate depends on the parameter settings of **Protocol**, **Logic Type** and **Signal Type**.

Example:

Query command for digital I/Q In:

"SOUR:BBIN:EXT:CLOC:RATE?"

Query command for digital I/Q Out:

"SOUR:IQ:OUTP:EXT:CLOC:RATE?"

'queries the current frequency of the clock signal of the R&S EX-IQ-Box.

Command for digital I/Q In:

"SOUR:BBIN:EXT:CLOC:RATE: 100MHZ"

Command for digital I/Q Out:

"SOUR:IQ:OUTPut:EXT:CLOC:RATE: 100MHZ"

'sets the clock rate of the R&S EX-IQ-Box to 100 MHz.

*RST value	Resolution	SCPI
10 MHz	1 mHz	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:SKEW -5...+5 ns

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:SKEW -5...+5 ns

This command sets a time shift of the active clock edge related to the data bits.

Example: Command for digital I/Q In:

"SOUR:BBIN:EXT:CLOC:SKEW 2.5ns"

Command for digital I/Q Out:

"SOUR:IQ:OUTPUT:EXT:CLOC:SKEW 2.5ns"

'sets the time shift of the clock edge to 2.5 nano seconds.

*RST value	Resolution	SCPI
0.000 ns	50 ps	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:SOURCE INTERNAL | EXTERNAL

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:SOURCE INTERNAL | EXTERNAL

This command selects the clock source for data transmission and clock generation. Either the R&S Instrument or the external device (DUT) can be set for delivering the reference, irrespective of the direction of transmission.

Currently the following scenarios for data transmission are possible:

1. Signal input by using an external clock source.

Data and data clock are transmitted from the external device.

2. Signal input by using the internal clock source.

The clock source of the R&S Instrument is sent to the external device for triggering the data input to the R&S EX-IQ-Box.

3. Signal output by using an external clock source.

Synchronized by an external data clock, data are output from the R&S Instrument.

4. Signal output by using the internal clock source.

Data and data clock are delivered from the R&S Instrument.



When using the internal clock frequency the reference output of the R&S Instrument must be connected to the REF IN of the R&S EX-IQ-Box.

The connection can be kept during the entire operation even if an external clock reference is used.

Parameters: INTernal

The clock reference of the R&S Instrument is used. The R&S EX-IQ-Box forwards the data clock to the external device.

EXTernal

The clock reference is fed in from the external device (DUT) to the user interface of the R&S EX-IQ-Box.

Example:

Command for digital I/Q In:

"SOUR:BBIN:EXT:CLOC:RATE?"

"SOUR:BBIN:EXT:CLOC:RATE 100MHZ"

Command for digital I/Q Out:

"SOUR:IQ:OUTP:EXT:CLOC:RATE?"

"SOUR:IQ:OUTP:EXT:CLOC:RATE 100MHZ"

'queries the current frequency of the clock signal of the R&S EX-IQ-Box.

'sets the clock rate of the R&S EX-IQ-Box to 100 MHz.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

Data Subsystem

Table of Commands

Command	Parameter	Default unit	Comment
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:ALIGNment [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:ALIGNment	MSB LSB		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:BORDER [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:BORDER	MSB LSB		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:INEGate [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:INEGate	ON OFF 1 0		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:IQSWap [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:IQSWap	ON OFF 1 0		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:NFORmat [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:NFORmat	TComplement OBINary		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:POLarity:IQ [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:POLarity:IQ	POSitive NEGative		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:QNEGate [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:QNEGate	ON OFF 1 0		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:SIZE [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:SIZE	4 Bit ... 16 Bit	Bit	
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:SPOlarity [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:SPOlarity	POSitive NEGative		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:SPOsition [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:SPOsition	0 .. Word Size (max 20)		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:STYPe [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:STYPe	IQ IF		
[SOURCE<[1]]2>:BBIN:EXTERNAL:DATA:TYPe [SOURCE<[1]]2>:IQ:OUTPUT:EXTERNAL:DATA:TYPe	SAMPles PFSamples		currently Samples only

Description of Commands

[SOURCE<[1]|2>:]BBIN:EXTernal:DATA:ALIGNment MSB | LSB
 [SOURCE<[1]|2>:]IQ:OUTPut:EXTernal:DATA:ALIGNment MSB | LSB

Parallel mode only!

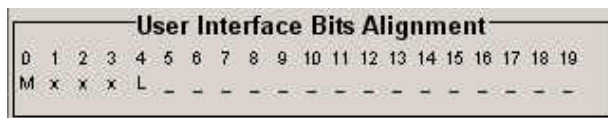
This command sets the alignment of the data bits on the data lines. Either the MSB or the LSB is mapped firmly to one data line. Depending on the word size the equivalent bit moves to the appropriate data line.

Parameters: MSB

The MSB (**M**ost **S**ignificant **B**it) is mapped firmly to the same data line and the data line of the LSB varies in dependency of the word size.

Examples:

word size = 5, bit order = MSB



word size = 9, bit order = MSB



LSB

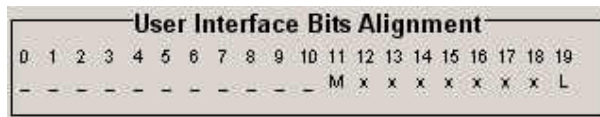
The LSB (**L**ast **S**ignificant **B**it) is mapped firmly to the same data line and the data line of the MSB varies in dependency of the word size.

Examples:

word size = 5, bit order = MSB



word size = 9, bit order = MSB



Example:

Command for digital I/Q In:
 "SOUR:BBIN:EXT:DATA:ALIG LSB"
 Command for digital I/Q Out:
 "SOUR:IQ:OUTP:EXT:DATA:ALIG LSB"
 'sets the data alignment to LSB.

*RST value	Resolution	SCPI
MSB	-	Device-specific

```
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:BORDER MSB | LSB
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:BORDER MSB | LSB
```

This command sets the order of the data bits. In **Parallel mode**, either the LSB or the MSB is transmitted on the first used data line. In **Serial mode** mode either the LSB or the MSB is transmitted as first bit.

Parameter: MSB

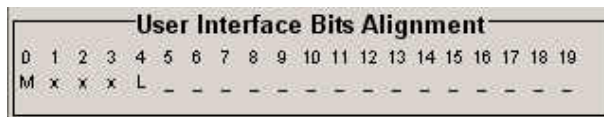
◆ **Parallel transmission**

The MSB (**M**ost **S**ignificant **B**it) is transmitted on the first used data line, depending on the word size and alignment.

The graphical display shows the currently set bit order.

Examples:

word alignment = MSB, word size = 5



word alignment = LSB and word size = 9



◆ **Serial transmission**

The MSB (**M**ost **S**ignificant **B**it) is transmitted first.

LSB

◆ **Parallel transmission**

The LSB (**L**ast **S**ignificant **B**it) is transmitted on the first data line.

Examples:

word alignment = MSB, word size = 5



word alignment = LSB, word size = 5



◆ **Serial transmission**

The LSB (**L**ast **S**ignificant **B**it) is transmitted first.

Example: Command for digital I/Q In:
 "SOUR:BBIN:EXT:DATA:BORD MSB"
 Command for digital I/Q Out:
 "SOUR:IQ:OUTP:EXT:DATA:BORD MSB"
 'sets the data border to MSB.

*RST value	Resolution	SCPI
LSB	-	Device-specific

[SOURCE<[1]|2>:]BBIN:EXTernal:DATA:INEGate ON | OFF | 1 | 0
 [SOURCE<[1]|2>:]IQ:OUTPut:EXTernal:DATA:INEGate ON | OFF | 1 | 0

This command inverts the sign of the I sample values. The values are multiplied by -1.

Example: Command for digital I/Q In:
 "SOUR:BBIN:EXT:DATA:INEG ON"
 Command for digital I/Q Out:
 "SOUR:IQ:OUTP:EXT:DATA:INEG ON"
 'inverts the values of the I samples.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTernal:DATA:NFORmat TCOMplement | OBINary
[SOURCE<[1]>:]IQ:OUTPut:EXTernal:DATA:NFORmat TCOMplement | OBINary

This command sets the format of the transmitted data.

Allowed number range for n Bit: $-2^{n-1} \leq n < 2^{n-1}$.

2's Complement

The most significant bit has a value of -2^{n-1} , the bits of lesser significance follow as $+2^{n-2} \dots 2^0$.

Binary Offset

A binary offset of 2^{n-1} is added such that the final values are always positive.

Example:

$n = 4 \Rightarrow -8 \leq z < 8$

z	2's Complement				Binary Offset			
-8	1	0	0	0	0	0	0	0
-7	1	0	0	1	0	0	0	1
-6	1	0	1	0	0	0	1	0
-5	1	0	1	1	0	0	1	1
-4	1	1	0	0	0	1	0	0
-3	1	1	0	1	0	1	0	1
-2	1	1	1	0	0	1	1	0
-1	1	1	1	1	0	1	1	1
0	0	0	0	0	1	0	0	0
1	0	0	0	1	1	0	0	1
2	0	0	1	0	1	0	1	0
3	0	0	1	1	1	0	1	1
4	0	1	0	0	1	1	0	0
5	0	1	0	1	1	1	0	1
6	0	1	1	0	1	1	1	0
7	0	1	1	1	1	1	1	1

Parameter: TCOMplement

The value of the transmitted data is formatted in two's-complement.

OBINary

The value of the transmitted data is formatted in binary offset.

Example: Command for digital I/Q In:

"SOUR:BBIN:EXT:DATA:NFOR TCOM"

Command for digital I/Q Out:

"SOUR:IQ:OUTP:EXT:DATA:NFOR TCOM"

'sets the numeric format to two's-complement.

*RST value	Resolution	SCPI
TCOMplement	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:POLarity:IQ POSitive | NEGative
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:POLarity:IQ POSitive | NEGative

The command sets the polarity of the I and Q data lines of the R&S EX-IQ-Box.

- Parameter: Positive**
High level stands for a logic 1, low level for a logic 0.
- Negative**
High level stands for a logic 0, low level for a logic 1.

Example: Command for digital I/Q In:
`"SOUR:BBIN:EXT:DATA:POL:IQ NEG"`
 Command for digital I/Q Out:
`"SOUR:IQ:OUTPut:EXT:DATA:POL:IQ NEG"`
 'sets the inversion of the I and Q data signal.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:QNEGGate ON | OFF | 1 | 0
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:QNEGGate ON | OFF | 1 | 0

This command inverts the sign of the Q sample values. The values are multiplied by -1.

Example: Command for digital I/Q In:
`"SOUR:BBIN:EXT:DATA:QNEG ON"`
 Command for digital I/Q Out:
`"SOUR:IQ:OUTP:EXT:DATA:QNEG ON"`
 'inverts the values of the Q samples.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURCE<[1]|2>:]BBIN:EXTERNAL:DATA:SIZE 4 Bit ... 16 (max. 20) Bit

[SOURCE<[1]|2>:]IQ:OUTPUT:EXTERNAL:DATA:SIZE 4 Bit ... 16 (max. 20) Bit

This command sets the word size of a sample. Depending on the R&S Instrument 4 to 20 bit words are available. For R&S SMx and R&S AMU instruments only 4 to 16 bit words are provided.

Example: Command for digital I/Q In:
"SOUR:BBIN:EXT:DATA:SIZE 8"

Command for digital I/Q Out:
"SOUR:IQ:OUTP:EXT:DATA:SIZE 8"

'sets the word size of a sample to 8 bit.

*RST value	Resolution	SCPI
16 Bit	-	Device-specific

[SOURCE<[1]|2>:]BBIN:EXTERNAL:DATA:SPOLarity POSitive | NEGative

[SOURCE<[1]|2>:]IQ:OUTPUT:EXTERNAL:DATA:SPOLarity POSitive | NEGative

Serial data transmission only!

This command describes the polarity of the strobe marker signal. During a serial data transmission every data sample is marked by the strobe marker signal.



The settings of **Clock Phase** or **Clock Skew** do not affect the strobe marker signal.

Parameter: **Positive**

The strobe position is indicated by high level.

Negative

The strobe position is indicated by low level.

Example: Command for digital I/Q In:
"SOUR:BBIN:EXT:DATA:SPOL NEG"

Command for digital I/Q Out:
"SOUR:IQ:OUTPUT:EXT:DATA:SPOL NEG"

'sets the inversion of the strobe marker signal.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

[SOURCE<[1]|2>:]BBIN:EXTernal:DATA:SPOSITION 0 ... word size-1 (max. 20)

[SOURCE<[1]|2>:]IQ:OUTPut:EXTernal:DATA:SPOSITION 0 ... word size (max. 20)

Serial data transmission only!

The command sets the sample position of the strobe marker output.

Example:

Command for digital I/Q In:

"SOUR:BBIN:EXT:DATA:SIZE 10"

"SOUR:BBIN:EXT:DATA:SPOS 2"

Command for digital I/Q Out:

"SOUR:IQ:OUTP:EXT:DATA:SIZE 10"

"SOUR:IQ:OUTPut:EXT:DATA:SPOS 2"

'sets the word size of a sample to 10 bit.

'sets the strobe marker output to sample position 2.

*RST value	Resolution	SCPI
0	1	Device-specific

Test Subsystem

Table of Commands

Command	Parameter	Default unit	Comment
[TEST<[1] 2>:]BBIN:EXTernal:IQConnection? TEST<[1] 2>:]IQ:OUTPut:EXTernal:IQConnection?			Query only
[TEST<[1] 2>:]BBIN:EXTernal:UITMode [TEST<[1] 2>:]IQ:OUTPut:EXTernal:UITMode	ON OFF		

Description of Commands

[TEST<[1]|2>:]BBIN:EXTernal:IQConnection?

[TEST<[1]|2>:]IQ:OUTPut:EXTernal:IQConnection?

The command executes the IQ connection test from the R&S EX-IQ-Box. The result (success or failed) is displayed in the status field next to the **Check IQ Connection** button.

The command is a query command and therefore does not have an *RST value.

Example: Command for digital I/Q In:
"TEST:BBIN:EXT:IQC?"

Command for digital I/Q Out:
"TEST:BBO:EXT:IQC?"

'checks the IQ connection from the R&S EX-IQ-Box.

Response: "0" on success, "1" on fail

*RST value	Resolution	SCPI
-	-	Device-specific

Performing the IQ connection test:

1. Check that the I/Q data cable is connected properly:
 - from the R&S Instrument **Digital I/Q Output** to the **IQ IN** of the R&S EX-IQ-Box.
 - from the R&S EX-IQ-Box **IQ OUT** to the **Digital I/Q Input** of the R&S Instrument.
2. Click on the button **Check IQ Connection** to perform a connection test or enter the remote-control command, respectively.
After a few seconds the test will be finished and the result will be displayed.

[TEST<[1]>:]BBIN:EXTernal:UITMode ON | OFF
 [TEST<[1]>:]IQ:OUTPut:EXTernal:UITMode ON | OFF

The command selects the user interface test mode.

Parameter: On

The R&S EX-IQ-Box generates a defined test pattern, which is output on the user interface.

Off

The R&S EX-IQ-Box operates in regular data mode.

Example: Command for digital I/Q In:
 "TEST:BBIN:EXT:UITM ON"

Command for digital I/Q Out:
 "TEST:OUTP:EXT:UITM ON"

'selects the mode for testing with a defined test pattern.

*RST value	Resolution	SCPI
Off	-	Device-specific

Performing the User Interface test:

1. Disconnect all devices from the user interface to be tested. Only passive adapter boards (breakout boards) should be connected during this test.
2. Connect the **REF IN BNC** of the **R&S EX-IQ-Box** with the **REF OUT** of the **R&S Instrument**.
3. Switch **On** the particular **User Interface Test Mode** or enter the remote-control command, respectively.
4. Use an oscilloscope or a frequency counter to verify the test pattern output on the user interface.

A 16-Bit counter signal is expected with frequencies from 1.53 kHz (counter bit 15) to 50 MHz (counter bit 0). The correct test pattern is given in the following table.

UIF Signal	UIF Pin	Counter Bit	f [kHz]
UI_I_0	F2	10	48.83
UI_I_1	C2	11	24.41
UI_I_2	D4	0	50000.00
UI_I_3	A4	1	25000.00
UI_I_4	F4	0	50000.00
UI_I_5	C4	1	25000.00
UI_I_6	D6	2	12500.00
UI_I_7	A6	3	6250.00
UI_I_8	F6	4	3125.00
UI_I_9	C6	5	1562.50
UI_I_10	D8	6	781.25

R&S EX-IQ-Box Settings for R&S SMx and R&S AMU Signal Generators

UIF Signal	UIF Pin	Counter Bit	f [kHz]
UI_I_11	A8	7	390.63
UI_I_12	F8	8	195.31
UI_I_13	C8	9	97.66
UI_I_14	D10	10	48.83
UI_I_15	A10	11	24.41
UI_I_16	F10	12	12.21
UI_I_17	C10	13	6.10
UI_I_18	D12	14	3.05
UI_I_19	A12	15	1.53
UI_TRIGGER_0	C12	4	3125.00
UI_MARKER_0	F12	15	1.53
UI_RESERVE_0	D14	9	97.66
UI_VALID	F14	8	195.31
UI_Q_0	C14	13	6.10
UI_Q_1	D16	14	3.05
UI_Q_2	A16	2	12500.00
UI_Q_3	F16	3	6250.00
UI_Q_4	C16	0	50000.00
UI_Q_5	D18	1	25000.00
UI_Q_6	A18	2	12500.00
UI_Q_7	F18	3	6250.00
UI_Q_8	C18	4	3125.00
UI_Q_9	D20	5	1562.50
UI_Q_10	A20	6	781.25
UI_Q_11	F20	7	390.63
UI_Q_12	C20	8	195.31
UI_Q_13	D22	9	97.66
UI_Q_14	A22	10	48.83
UI_Q_15	F22	11	24.41
UI_Q_16	C22	12	12.21
UI_Q_17	D24	13	6.10
UI_Q_18	A24	14	3.05
UI_Q_19	F24	15	1.53
UI_TRIGGER_1	D26	5	1562.50
UI_MARKER_1	C24	6	781.25
UI_RESERVE_1	A26	12	12.21

Update Subsystem

Table of Commands

Command	Parameter	Default unit	Comment
[SOURce<[1]]2>:]BBIN:EXTernal:FIRMWare:INSTalled? [SOURce<[1]]2>:]IQ:OUTPut:EXTernal:FIRMWare:INSTalled?			Query only
[SOURce<[1]]2>:]BBIN:EXTernal:FIRMWare:SUPPorted? [SOURce<[1]]2>:]IQ:OUTPut:EXTernal:FIRMWare:SUPPorted?			Query only
[SOURce<[1]]2>:]BBIN:EXTernal:FIRMWare:UPDate? [SOURce<[1]]2>:]IQ:OUTPut:EXTernal:FIRMWare:UPDate			Query only

Description of Commands

[SOURce<[1]]2>:]BBIN:EXTernal:FIRMWare:INSTalled?

[SOURce<[1]]2>:]IQ:OUTPut:EXTernal:FIRMWare:INSTalled?

The command indicates the currently installed firmware of the R&S EX-IQ-Box
The command is a query command and therefore does not have an *RST value.

Example: Command for digital I/Q In:
"BBIN:EXT:FIRM:INST?"

Command for digital I/Q Out:
"IQ:OUTPut:EXT:FIRM:INST?"

'checks the currently installed firmware version of the R&S EX-IQ-Box.

Response: x.xx.xxx.xx

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:FIRMWARE:SUPPORTED?

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:FIRMWARE:SUPPORTED?

The command queries the R&S EX-IQ-Box firmware available in the current software of the R&S Instrument

The command is a query command and therefore does not have an *RST value.

Example: Command for digital I/Q In:
"BBIN:EXT:FIRM:SUPP?"

Command for digital I/Q Out:
"IQ:OUTPUT:EXT:FIRM:SUPP?"

Response: x.xx.xxx.xx

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]>:]BBIN:EXTERNAL:FIRMWARE:UPDATE?

[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:UPDATE?

This command executes an update to the firmware supported by the R&S Instrument software. After a few seconds the update will be performed.

The command is a query command and therefore does not have an *RST value.

Example: Command for digital I/Q In:
"BBIN:EXT:FIRM:UPD"
"BBIN:EXT:FIRM:UPD?"

Command for digital I/Q Out:
"IQ:OUTPUT:EXT:FIRM:UPD"
"IQ:OUTPUT:EXT:FIRM:UPD?"

'updates the firmware.

'an error result is delivered.

*RST value	Resolution	SCPI
-	-	Device-specific

Settings for R&S FSx and R&S FMU Signal Analyzers

The graphical user interfaces (GUIs) of the R&S FSx and R&S FMU Analyzer display an “EXIQ” hotkey if the B17 option is installed.

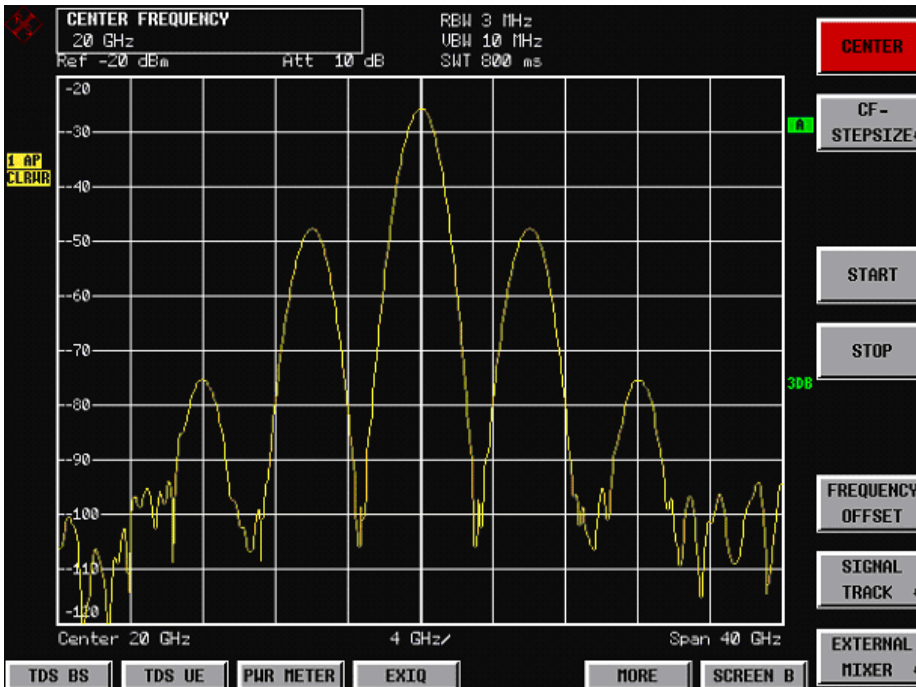


Figure 5: Display of the R&S FSQ Signal Analyzer with B17 option

1. To configure the EX-IQ-Box base settings press the “EXIQ” hotkey. The configuration dialog opens.

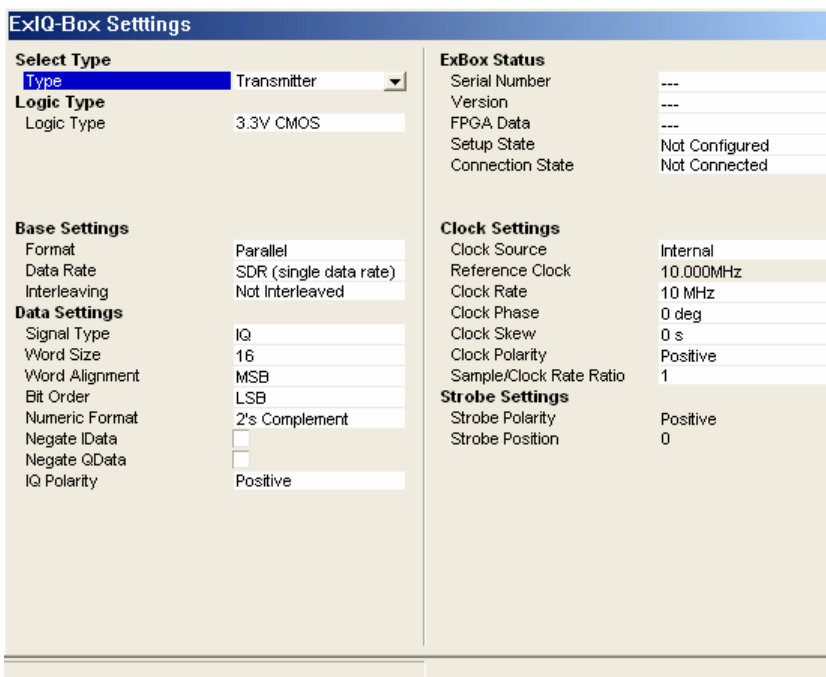


Figure 6: Display of the Ex-IQ Box configuration dialog for Logic Type CMOS 3.3V

The user has the ability to select the appropriate input type (Transmitter or Receiver) for the EX-IQ-Box.

“Transmitter” means, that the connected box receives data from the analyzer (which transmits the data). “Receiver” means, that the connected box transmits data to the analyzer (which receives the data). To toggle between the different types, press the appropriate softkey (TX SETTINGS, RX SETTINGS) or select the type from the combo box.

To leave the configuration dialog the user must press the “EXIT” hotkey.

All parameters of the EX-IQ-Box are stored and available again after switching the Analyzer off and on.

Additionally the settings can be saved with the “Save/Recall” Manager.

The modified parameters are not automatically sent to the EX-IQ-Box. The user must send the configured parameters to the box, by pressing the “SEND TO” hotkey to the box. Note that the transfer to the EX-IQ-Box is only possible if a box is connected to the analyzer (USB and IQ)

Please note that there are two different dialogs for the different logic types. The Logic Types CMOS x.x V, LVTTTL and LVDS are sharing one dialog. For the SSI Modes SSI 1.8 V and SSI 2.8 V an extra dialog is shown.

- To configure the EX-IQ-Box SSI settings press the “EXIQ” hotkey.
The configuration dialog **ExIQ-Box Settings / SSI** opens.

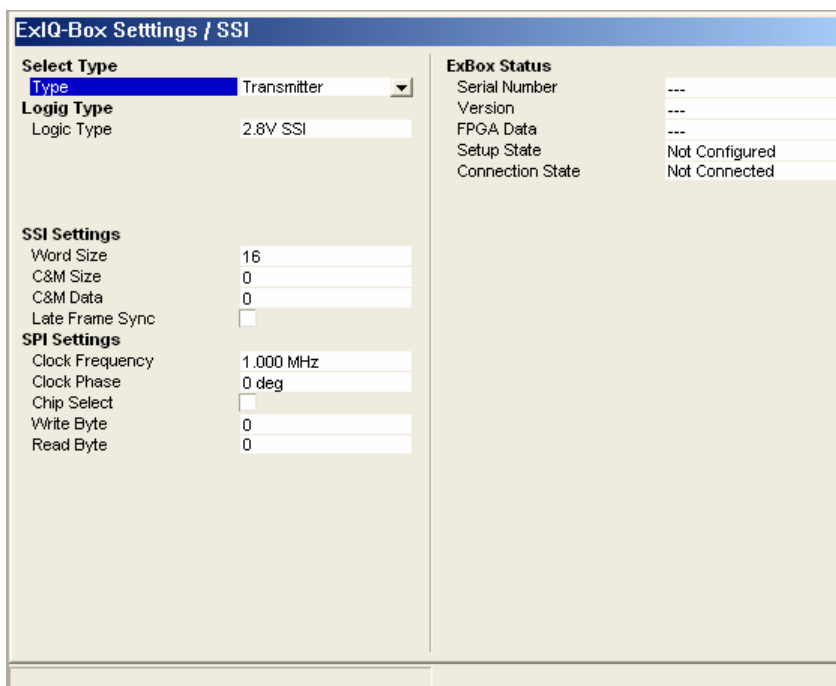


Figure 7: Display of the Ex-IQ Box configuration dialog for Logic Type SSI 2.8V



Connecting an R&S EX-IQ-Box during operation

The R&S EX-IQ-Box can be connected or disconnected while the R&S Signal Analyzer is in operating mode.

- ◆ After establishing the USB and LVDS connection, the R&S Signal Analyzer identifies the R&S EX-IQ-Box and establishes the connection. The **ExBox Status** information field is updated with some information, which is read from the box.

ExBox Status	
Serial Number	02
Version	01
FPGA Data	01 / 00.00-1.35
Setup State	Not Configured
Connection State	Connected

- ◆ After cutting the USB or LVDS connection, the **ExBox Status** is updated with the new state for the box.

ExBox Status	
Serial Number	---
Version	---
FPGA Data	---
Setup State	Not Configured
Connection State	Not Connected

- ◆ Note that unplugging the IQ Data while the digital interface is activated, may cause unexpected results. Before unplugging the IQ interface, disable the digital interface.

NOTICE Danger of hardware damage!

The logic type of the DUT connected must be compatible to the selected logic type for the R&S EX-IQ-Box. If the logic types do not fit, the R&S EX-IQ-Box will be damaged because of the differing voltage values.

FSx/FMU Ex-IQ-Box Settings

The configuration dialog including the associated remote-control commands is described in detail in this chapter.



The dialogs for transmitter and receiver configuration are nearly identical. The following description applies for both configuration dialogs. If there are any differences between the modes, they are described in detail.

Base Settings / Logic Type	Selects the signaling system used for transmitting the baseband signal from/to the DUT
LVDS	<p>The signal is transmitted by using the signaling system LVDS (Low Voltage Differential Signaling).</p> <p>Remote-control command for transmitter: <code>SOUR:TRAN:LOG:TYPE LVDS</code></p> <p>Remote-control command for receiver: <code>SOUR:REC:LOG:TYPE LVDS</code></p>
LVTTL	<p>The signal is transmitted by using LVTTL technology (Low Voltage Transistor Transistor Logic) with a voltage level of 3.3 V.</p> <p>Remote-control command for transmitter: <code>SOUR:TRAN:LOG:TYPE LVTT</code></p> <p>Remote-control command for receiver: <code>SOUR:REC:LOG:TYPE LVTT</code></p>
3.3V CMOS	<p>The signal is transmitted by using the CMOS Technology (Complementary Metal Oxid Semiconductor) with a voltage level of 3.3 V.</p> <p>Remote-control command for transmitter: <code>SOUR:TRAN:LOG:TYPE CM33</code></p> <p>Remote-control command for receiver: <code>SOUR:REC:LOG:TYPE CM33</code></p>

- 2.5V CMOS** The signal is transmitted by using the CMOS Technology (**C**omplementary **M**etal **O**xide **S**emiconductor) with a voltage level of 2.5 V.
- Remote-control command for **transmitter**:
SOUR:TRAN:LOG:TYPE CM25
- Remote-control command for **receiver**:
SOUR:REC:LOG:TYPE CM25
- 1.8V CMOS** The signal is transmitted by using the CMOS Technology (**C**omplementary **M**etal **O**xide **S**emiconductor) with a voltage level of 1.8 V.
- Remote-control command for **transmitter**:
SOUR:TRAN:LOG:TYPE CM18
- Remote-control command for **receiver**:
SOUR:REC:LOG:TYPE CM18
- 1.8V SSI** The signal is transmitted by using the SSI Technology (**S**erial **S**ynchronous **I**nterface) with a voltage level of 1.8 V.
- Remote-control command for **transmitter**:
SOUR:TRAN:LOG:TYPE SS18
- Remote-control command for **receiver**:
SOUR:REC:LOG:TYPE SS18
- 2.8V SSI** The signal is transmitted by using the SSI Technology (**S**erial **S**ynchronous **I**nterface) with a voltage level of 2.8 V.
- Remote-control command for **transmitter**:
SOUR:TRAN:LOG:TYPE SS28
- Remote-control command for **receiver**:
SOUR:REC:LOG:TYPE SS28

NOTICE **Danger of hardware damage!**

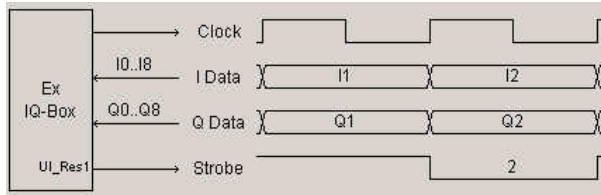
The logic type of the DUT connected must be compatible to the selected logic type for the R&S EX-IQ-Box. If the logic types do not fit, the R&S EX-IQ-Box will be damaged because of the differing voltage values.

Base Settings / Format

Sets the signal transmission protocol of the R&S EX-IQ-Box for receiving/sending a baseband signal from/to an external device (DUT) via the user interface of the R&S EX-IQ-Box.

Serial

The baseband signal is transmitted serially from the DUT to the R&S EX-IQ-Box or vice versa. The currently set signal transmission is displayed graphically. The following graph shows an example for an incoming serial I/Q signal from the DUT



Remote-control command for **transmitter**:

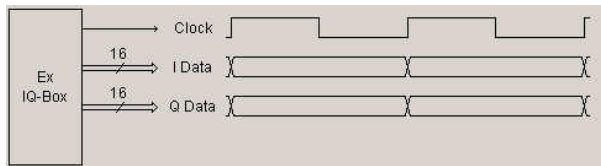
SOUR:TRAN:FORM SER

Remote-control command for **receiver**:

SOUR:REC:FORM SER

Parallel

The baseband signal is transmitted parallel from the DUT to the R&S EX-IQ-Box or vice versa. The graphical display shows the currently set signal transmission. Example: parallel signal output to the DUT



Remote-control command for **transmitter**:

SOUR:TRAN:FORM PAR

Remote-control command for **receiver**:

SOUR:REC:FORM PAR

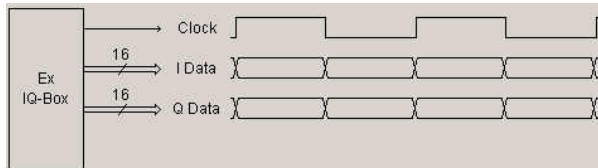
Base Settings / Data Rate

Sets the data rate mode of the R&S EX-IQ-Box for receiving / sending a baseband signal from/to an external device (DUT).

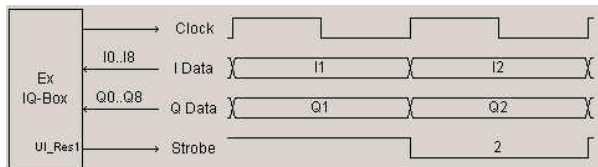
SDR

The baseband signal is transmitted in single data rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge of the data clock. The characteristics of the signal transmission are shown in the graphic.

Example: parallel signal output in single data rate



Example: serial signal input in single data rate:



Remote-control command for **transmitter**:

SOUR:TRAN:DRAT SDR

Remote-control command **receiver**:

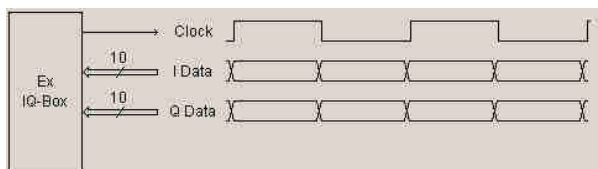
SOUR:REC:DRAT SDR

DDR

The baseband signal is transmitted in double data rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge and the falling edge of the data clock (double speed transfer).

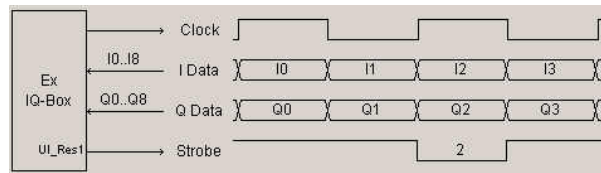
The signal transmission is also shown in the graph.

Example: parallel signal input in double data rate:



DDR

Example: serial signal input in double data rate:



Remote-control command for **transmitter**:

SOUR:TRAN:DRAT DDR

Remote-control command for **receiver**:

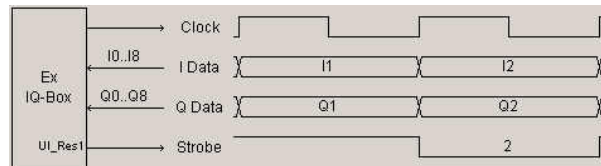
SOUR:REC:DRAT DDR

Base Settings / Interleaving

Switches on or off interleaving and selects the interleaving mode. Depending on the parameters **Format** and **Data Rate** the baseband signal is transmitted in different orders (I/Q or Q/I), lines and transfer rates (single or double rated) from the external device to the R&S EX-IQ-Box or vice versa.

Not Interleaved

The baseband signal is transmitted on the I and Q data lines as indicated in the graph below.



Remote-control command for **transmitter**:

SOUR:TRAN:ILE OFF

Remote-control command for **receiver**:

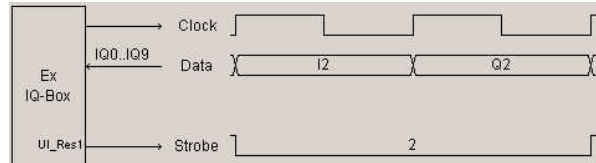
SOUR:REC:ILE OFF

I/Q Interleaved

The baseband signal is transmitted on the I data line starting with I data.

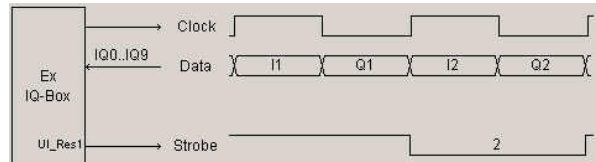
Serial transmission, SDR:

The strobe signal (UI_Res1) lasts for 2 clock cycles. With the first clock cycle the I data is triggered, the second cycle triggers the Q data.



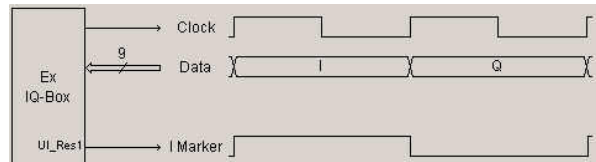
Serial transmission, DDR:

The strobe signal (UI_Res1) lasts for 1 clock cycle. The rising edge triggers the I data, the falling edge triggers the Q data.



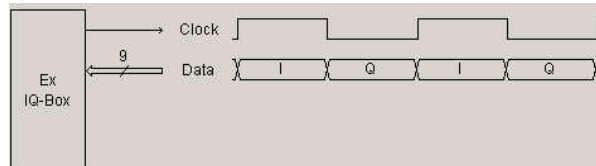
Parallel transmission, SDR:

The I marker output at the Reserved1 pin (UI_Res1) of the user interface marks the I data.



Parallel transmission, DDR:

The rising edge of the clock signal triggers the I data, the falling edge triggers the Q data.



Remote-control command for transmitter:

SOUR:TRAN:ILE IQ

Remote-control command for receiver:

SOUR:REC::ILE IQ

Q/I Interleaved The baseband signal is transmitted on the I data line starting with Q data
 With interchanged order of the I and Q data the I/Q signal is transferred similarly as described above.

Remote-control command for **transmitter**:

SOUR:TRAN:ILE QI

Remote-control command for **receiver**:

SOUR:REC:ILE QI

Data Settings / Signal Type (TX only)

Selects the signal mode of the transmission. The digital I and Q signals are either transmitted separately or the I and Q samples are assembled to a carrier signal and shifted to an intermediate frequency.



For signal input the signal type is firmly set to **IQ** and read only. Signal type **IF** is available in output mode only.

IQ Transmits the digital I and Q signals separately.

Remote-control command for **transmitter**:

SOUR:TRAN:DATA:STYP IQ

IF **Parallel signal output only!**

Assembles and modulates the digital I and Q samples to a carrier frequency (IF). The frequency of the IF signal is set to a quarter of the clock rate, e.g. with a clock rate of 400 MHz the value of the IF frequency is 100 MHz.

Remote-control command for **transmitter**:

SOUR:TRAN:DATA:STYP IF

Data Settings / Word Size

Sets the word size of a sample. Depending on the R&S Instrument. 4 to 20 bit words are available. For R&S FSQ and R&S FMU Analyzers only 4 to 16 bit words are provided.

Remote-control command for **transmitter**:

```
SOUR:TRAN:DATA:SIZE 8
```

Remote-control command for **receiver**:

```
SOUR:REC:DATA:SIZE 8
```

Data Settings / Word Alignment**Parallel mode only!**

Sets the alignment of the data bits on the data lines. Either the MSB or the LSB is mapped firmly to one data line. Depending on the word size the equivalent bit moves to the appropriate data line.

MSB

The MSB (**M**ost **S**ignificant **B**it) is mapped firmly to the same data line and the data line of the LSB varies in dependency of the word size.

Remote-control command for **transmitter**:

```
SOUR:TRAN:DATA:ALIG MSB
```

Remote-control command for **receiver**:

```
SOUR:REC:DATA:ALIG MSB
```

LSB

The LSB (**L**ast **S**ignificant **B**it) is mapped firmly to the same data line and the data line of the MSB varies in dependency of the word size.

Remote-control command for **transmitter**:

```
SOUR:TRAN:DATA:ALIG LSB
```

Remote-control command for **receiver**:

```
SOUR:REC:DATA:ALIG LSB
```

Data Settings / Bit Order

Sets the order of the data bits. In **Parallel mode**, either the LSB or the MSB is transmitted on the first used data line. In **Serial mode** either the LSB or the MSB is transmitted as first bit.

MSB**Parallel transmission:**

The MSB (**M**ost **S**ignificant **B**it) is transmitted on the first used data line, depending on the word size and alignment.

Serial transmission:

The MSB (**M**ost **S**ignificant **B**it) is transmitted first.

Remote-control command for transmitter:

SOUR:TRAN:DATA:BORD MSB

Remote-control command for receiver:

SOUR:REC:DATA:BORD MSB

LSB**Parallel transmission:**

The LSB (**L**ast **S**ignificant **B**it) is transmitted on the first data line

Serial transmission:

The LSB (**L**ast **S**ignificant **B**it) is transmitted first.

Remote-control command for transmitter:

SOUR:TRAN:DATA:BORD LSB

Remote-control command for receiver:

SOUR:REC:DATA:BORD LSB

Data Settings / Numeric Format

Sets the format of the transmitted data.

Allowed number range for n Bit: $-2^{n-1} \leq n < 2^{n-1}$

2's Complement

The most significant bit has a value of -2^{n-1} , the bits of lesser significance follow as $+2^{n-2} \dots 2^0$.

Binary Offset

A binary offset of 2^{n-1} is added such that the final values are always positive.

Example: $n = 4 \Rightarrow -8 \leq z < 8$

z	2's Complement				Binary Offset			
-8	1	0	0	0	0	0	0	0
-7	1	0	0	1	0	0	0	1
-6	1	0	1	0	0	0	1	0
-5	1	0	1	1	0	0	1	1
-4	1	1	0	0	0	1	0	0
-3	1	1	0	1	0	1	0	1
-2	1	1	1	0	0	1	1	0
-1	1	1	1	1	0	1	1	1
0	0	0	0	0	1	0	0	0
1	0	0	0	1	1	0	0	1
2	0	0	1	0	1	0	1	0
3	0	0	1	1	1	0	1	1
4	0	1	0	0	1	1	0	0
5	0	1	0	1	1	1	0	1
6	0	1	1	0	1	1	1	0
7	0	1	1	1	1	1	1	1

2's Complement The value of the transmitted data is formatted in two's-complement.

Remote-control command for **transmitter**:

SOUR:TRAN:DATA:NFOR TCOM

Remote-control command for **receiver**:

SOUR:REC:DATA:NFOR TCOM

Binary Offset The value of the transmitted data is formatted in binary offset.

Remote-control command for **transmitter**:

SOUR:TRAN::NFOR OBIN

Remote-control command for **receiver**:

SOUR:REC:DATA:NFOR OBIN

Data Settings / Negate I Data Inverts the sign of the I sample values. The values are multiplied by -1.

Remote-control command for **transmitter**:

SOUR:TRAN:INEG ON | OFF

Remote-control command for **receiver**:

SOUR:REC:DATA:INEG ON | OFF

Data Settings / Negate Q Data Inverts the sign of the Q sample values. The values are multiplied by -1.

Remote-control command for **transmitter**:

SOUR:TRAN:DATA:QNEG ON | OFF

Remote-control command for **receiver**:

SOUR:REC:DATA:QNEG ON | OFF

Data Settings / I/Q Polarity Sets the polarity of the I and Q data lines of the R&S EX-IQ-Box.

Positive High level stands for a logic 1, low level for logic 0.

Remote-control command for **transmitter**:

SOUR:TRAN:DATA:POL POS

Remote-control command for **receiver**:

SOUR:REC:DATA:POL POS

Negative High level stands for logic 0, low level for logic 1.

Remote-control command for **transmitter**:

SOUR:TRAN:DATA:POL NEG

Remote-control command for **receiver**:

SOUR:REC:DATA:POL NEG

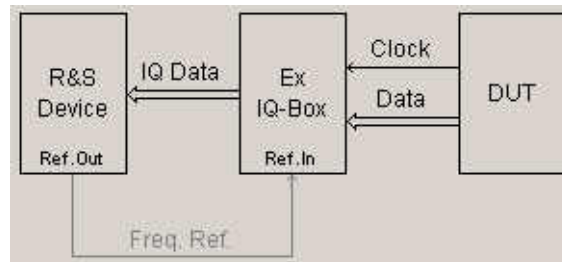
Clock Settings / Clock Source

Selects the clock source for data transmission. Either the R&S Instrument or the external device (DUT) can be set for delivering the reference, irrespective of the direction of transmission.

Currently the following scenarios for data transmission are possible:

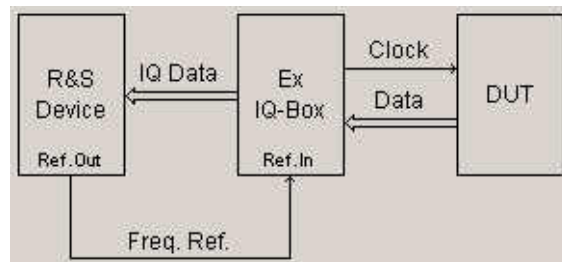
1. Signal input by using an external clock source.

Data and data clock are transmitted from the external device, as shown in the graph of the Clock Setup dialog.



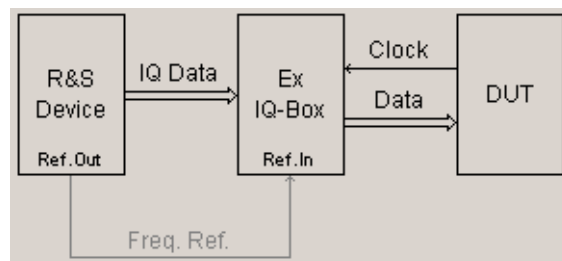
2. Signal input by using the internal clock source.

The clock source of the R&S Instrument is sent to the external device for triggering the data input to the R&S EX-IQ-Box.



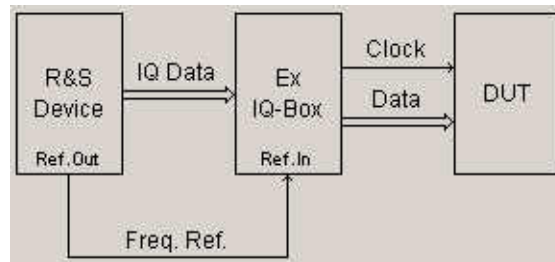
3. Signal output by using an external clock source.

Synchronized by an external data clock, data are output from the R&S Instrument.



4. Signal output by using the internal clock source.

Data and data clock are delivered from the R&S Instrument.



Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:SOUR INT|EXT

Remote-control command for **receiver**:

SOUR:REC:CLOC:SOUR INT|EXT

Clock Settings / Reference Clock

Defines the frequency of the reference clock (only available if external clock is selected), which are 5 MHz, 10 MHz or 13 MHz.

Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:REF RF5|RF10|RF13

Remote-control command for **receiver**:

SOUR:REC:CLOC:REF RF5|RF10|RF13

Clock Settings / Clock Rate

Sets the clock rate (frequency) for signal transmission between the R&S EX-IQ-Box and the external device (DUT). Depending on the logic type and the clock source the clock rate range varies (see below: value range of f_{CLK}).

$$f_{CLK} = \frac{f_s \cdot WS \cdot Int}{DDR \cdot SCR}$$

f_s = Sample rate
Value range: 1 kHz ... 100 MHz

f_{CLK} = Clock rate
Value range:

Logic level LVDS: 1 kHz (100 kHz) ... 400 MHz

Logic level LVTTL/CMOS: 1 kHz (100 kHz) ... 100 MHz

(1 kHz stands for the internal clock source, fed in from the R&S Instrument, 100 kHz stands for the external reference from the user interface).

WS = Word size

Int = Interleaving mode

DDR = Double data rate

SCR = Sample/Clock rate ratio

WS	4 ... 16 (serial mode)	1 (parallel mode)
Int	1 (non interleaved)	2 (I/Q and Q/I interleaved)
DDR	1 (SDR)	2 (DDR)

SCR = 1, $\frac{4}{5}$, $\frac{2}{5}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$

Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:RATE 10MHZ

Remote-control command for **receiver**:

SOUR:REC:CLOC:RATE 10MHZ

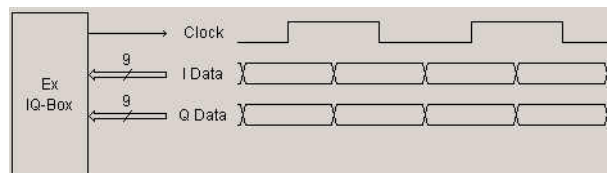


The value range for the clock rate depends on the parameter settings of **Protocol**, **Logic Type** and **Signal Type**.

Clock Settings / Clock Phase

Sets a phase shift of the active clock edge in 90° steps related to the data bits.

Example: clock phase 90°



Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:PHAS P0 | P90 | P180 | P270

Remote-control command for **receiver**:

SOUR:REC:CLOC:PHAS P0 | P90 | P180 | P270

Clock Settings / Clock Skew

Sets a time shift of the active clock edge related to the data bits.

Value range: -5 ns ... + 5 ns

Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:SKEW 2.5NS

Remote-control command for **receiver**:

SOUR:REC:CLOC:SKEW 2.5NS

Clock Settings / Clock Polarity

Sets the polarity of the active clock edge for triggering the signal transmission.

Positive

Sets the rising edge of the clock signal as the active.

Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:POL POS

Remote-control command for **receiver**:

SOUR:REC:CLOC:POL POS

Negative

Sets the falling edge of the clock signal as the active.

Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:POL NEG

Remote-control command for **receiver**:

SOUR:REC:CLOC:POL NEG



Setting the Clock Polarity **negative** is equivalent to setting the clock phase to 180°.

Clock Settings / Sample/Clock Rate Ratio**Parallel data transmission only!**

Sets the sample clock rate ratio. This parameter characterizes the ratio of the sample rate to the clock rate.

For SCR <1:

- ◆ dummy samples are added.
- ◆ the signal SCR_VALID output at the Reserved0 pin (UI_RESERVE_P0) of the user interface marks the validity of the data.

Values: **SCR** = 1, $\frac{4}{5}$, $\frac{2}{5}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$

The values of the sample/clock rate depend on the parameter settings of **Word Size**, **Interleaving** and **Data Rate**.

Remote-control command for **transmitter**:

SOUR:TRAN:CLOC:SCR 1 | 0.8 | 0.4 | 0.2 | 0.1 | 0.05

Remote-control command for **receiver**:

SOUR:REC:CLOC:SCR 1 | 0.8 | 0.4 | 0.2 | 0.1 | 0.05

In the **Strobe Settings** section of the configuration dialog the parameters are enabled only for serial signal transmission.

**Strobe Settings /
Strobe Polarity**

Serial data transmission only!

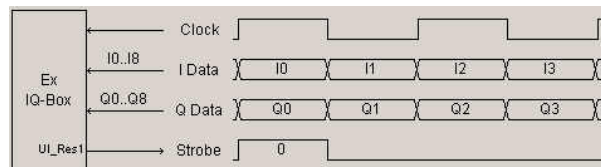
Describes the polarity of the strobe marker signal. During a serial data transmission every data sample is marked by the strobe marker signal.



The settings of **Clock Phase** or **Clock Skew** do not affect the strobe marker signal.

Positive

The strobe position is indicated by high level.



Remote-control command for **transmitter**:

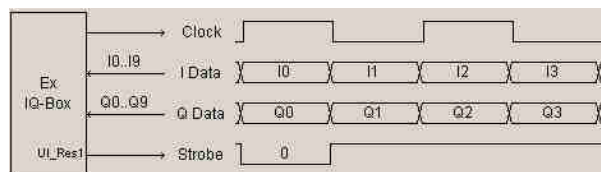
SOUR:TRAN:DATA:SPOL POS

Remote-control command for **receiver**:

SOUR:REC:DATA:SPOL POS

Negative

The strobe position is indicated by low level.



Remote-control for **transmitter**:

SOUR:TRAN:DATA:SPOL NEG

Remote-control command for **receiver**:

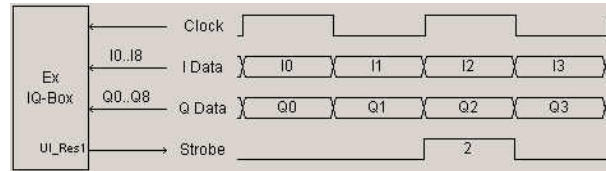
SOUR:REC:DATA:SPOL NEG

**Strobe Settings /
Strobe Position**

Serial data transmission only!

Sets the sample position of the strobe marker output.
Value range: 0 to word size -1.

Example: strobe position = 2, strobe polarity = Positive.



Remote-control for transmitter:

SOUR:TRAN:DATA:SPOS 10

Remote-control command for receiver:

SOUR:REC:DATA:SPOS 10

**SSI Settings / Word
Size**

Defines the size in bits of an I or Q data word. The size is defined from 4 up to 24 bits.

Remote-control command for transmitter:

SOUR:TRAN:SSI:SIZE 16

Remote-control command for receiver:

SOUR:REC:SSI:SIZE 16

**SSI Settings / C&M
Size**

Defines the number of the Control & Management Bits which follows the I/Q data word. The size is defined from 0 up to 32 bits.

Remote-control command for transmitter:

SOUR:TRAN:SSI:CMSize 16

Remote-control command for receiver:

SOUR:REC:SSI:CMSize 16

SSI Settings / C&M Data

Defines the number of the Control & Management Bit word as defined in the C&M Size parameter. Only can be changes if the instrument is in transmitter mode, otherwise the parameter is only displayed.

Remote-control command for **transmitter**:

```
SOUR:TRAN:SSI:CMDData 16
```

Remote-control command for **receiver**:

```
SOUR:REC:SSI:CMDData 16
```

SSI Settings / Late Frame Sync

Defines if the sync signal appears at the first period of a data bit (parameter set to On) or if the sync signals appears one period before (parameter is Off).

Remote-control command for **transmitter**:

```
SOUR:TRAN:SSI:LFSY ON|OFF
```

Remote-control command for **receiver**:

```
SOUR:REC:SSI:LFSY ON|OFF
```

SSI Settings / Gain File (Receiver only)

Defines a binary file which includes a gain table. For the format of the gain table, refer to the appropriate Generator section.

Remote-control command for **receiver**:

```
SOUR:REC:SSI:GAIN:FSEL <string>
```

SSI Settings / Enable Automatic Gain

(Receiver only)

Enables (On) or Disables (Off) the Automatic Gain Handling, for details refer to the appropriate Generator section.

Remote-control command for **receiver**:

```
SOUR:REC:SSI:GAIN:STAT ON|OFF
```



The SPI Settings are reserved for future use, please do not manipulate any parameters

Transfer the Settings to the Ex-IQ-Box

All parameters of the configuration dialog are not sent immediately to the Ex-IQ-Box. The setup of the box must be initiated by the user. To do this the user must press “SEND TO” hotkey or send the following remote command to the analyzer:

Remote-control for **transmitter**:

SOUR : TRAN : SEND

Remote-control command for **receiver**:

SOUR : REC : SEND



The setup of the new data may be taking up to 15 seconds, depending if the logic type has been changed or not. During the configuration in the “Setup State” line a message is displayed that the configuration is in progress. Note that during the configuration no interaction with the GUI is possible.

ExBox Status	
Serial Number	02
Version	01
FPGA Data	01 / 00.00-1.35
Setup State	Configuring box...
Connection State	Connected

After the configuration the result of the setup is displayed in the “Setup State” line.

ExBox Status	
Serial Number	02
Version	01
FPGA Data	01 / 00.00-1.35
Setup State	Box is configured
Connection State	Connected

Remote Control Commands for Signal Analyzers

The digital signal interface module (R&S EX-IQ-Box) provides the bidirectional transmission of I/Q data between R&S Instruments and external devices. For R&S Instruments the digital signals are input or output via digital interfaces by using the signaling system LVDS (Low Voltage Differential Signaling).

Therefore an R&S Instrument has to be equipped with the option for Baseband input or output, respectively. The R&S EX-IQ-Box is then connected at the digital interface **IQ DATA IN** or **IQ DATA OUT** of the R&S Instrument. For external devices various signaling and data protocols are used. These data and signal formats have to be converted to the digital transmission protocol LVDS or vice versa, used by R&S Instruments.

The following Remote Control Command description contains the commands for setting the external digital baseband signals of the R&S EX-IQ-Box. These settings define the parameters of the signal transmission like logic type, protocol, data and clock settings.

Both, the I/Q In and I/Q Out remote-control commands are listed in the description of each parameter.

Example:

```
SOUR:TRAN:DRAT DDR
```

```
SOUR:REC:DRAT DDR
```

Main Settings Subsystem

Table of commands

Command	Parameter	Default unit	Comment
SOURce:TRANsmitter:DRATe SOURce:RECeiver:DRATe	SDR DDR		
SOURce:TRANsmitter:FORMat SOURce:RECeiver:FORMat	SERial PARallel		
SOURce:TRANsmitter:ILEaving SOURce:RECeiver:ILEaving	OFF IQ QI		
SOURce:TRANsmitter:LOGictype SOURce:RECeiver:LOGictye	LVTT LVDS CM33 CM25 CM18 CM15 SS28 SS18		
SOURce:TRANsmitter:SENDto SOURce:RECeiver:SENDto			

Description of Commands

SOURce:TRANsmitter:DRATe SDR | DDR**SOURce:RECEiver:DRATe** SDR | DDR

This command sets the data rate mode of the R&S EX-IQ-Box for receiving/sending a baseband signal from/to an external device (DUT).

Parameter: **SDR** (Single Data Rate)

The baseband signal is transmitted in single data rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge of the data clock.

DDR (Double Data Rate)

The baseband signal is transmitted in double data rate mode from the DUT to the R&S EX-IQ-Box or vice versa. The data transmission is triggered by the rising edge and the falling edge of the data clock (double speed transfer).

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:DRAT SDR"
```

Remote-control command receiver:

```
"SOUR:REC:DRAT SDR"
```

'sets the data rate mode to single.

*RST value	Resolution	SCPI
SDR	-	Device-specific

SOURce:TRANsmitter:FORMat SERIAL | PARAllel**SOURce:RECEiver:FORMat** SERIAL | PARAllel

This command sets the signal transmission protocol of the R&S EX-IQ-Box for receiving/sending a baseband signal from/to an external device (DUT) via the user interface of the R&S EX-IQ-Box.

Parameter: **Serial**

The baseband signal is transmitted serially from the DUT to the R&S EX-IQ-Box or vice versa.

Parallel

The baseband signal is transmitted parallel from the DUT to the R&S EX-IQ-Box or vice versa.

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:FORM SER"
```

Remote-control command for receiver:

```
"SOUR:REC:FORM SER"
```

'sets the transmission protocol of the R&S EX-IQ-Box to serial.

*RST value	Resolution	SCPI
PARAllel	-	Device-specific

SOURce:TRANsmitter:ILEaving OFF | IQ | QI

SOURce:RECEiver:ILEaving OFF | IQ | QI

This command switches on or off interleaving and selects the interleaving mode.

Depending on the parameters **Format** and **Data Rate** the baseband signal is transmitted in different orders (I/Q or Q/I), lines and transfer rates (single or double rated) from the external device to the R&S EX-IQ-Box or vice versa.

Parameter: OFF (Not Interleaved)

The baseband signal is transmitted on the I and Q data lines.

IQ (I/Q Interleaved)

The baseband signal is transmitted on the I data line starting with I data.

◆ Serial transmission, SDR:

The strobe signal (UI_Res1) lasts for 2 clock cycles. With the first clock cycle the I data is triggered, the second cycle triggers the Q data.

◆ Serial transmission, DDR:

The strobe signal (UI_Res1) lasts for 1 clock cycle. The rising edge triggers the I data, the falling edge triggers the Q data.

◆ Parallel transmission, SDR:

The I marker output at the Reserved1 pin (UI_Res1) of the user interface marks the I data.

◆ Parallel transmission, DDR:

The rising edge of the clock signal triggers the I data, the falling edge triggers the Q data.

QI (Q/I Interleaved)

The baseband signal is transmitted on the I data line starting with Q data.

With interchanged order of the I and Q data the I/Q signal is transferred similarly as described under I/Q Interleaved.

Example: Remote-control command for transmitter:

"SOUR:TRAN:ILE IQ"

Remote-control command for receiver:

"SOUR:REC:ILE IQ"

'sets the interleaving mode of the R&S EX-IQ-Box to I/Q.

*RST value	Resolution	SCPI
OFF	-	Device-specific

SOURce:TRANsmitter:LOGictype LVTT | LVDS | CM33 | CM25 | CM18 | CM15 | SS18 | SS28
SOURce:RECEiver:LOGictype LVTT | LVDS | CM33 | CM25 | CM18 | CM15 | SS18 | SS28

This command selects the signaling system used from the DUT for transmitting the baseband signal.

NOTICE **Danger of hardware damage!**

The logic type of the DUT connected must be compatible to the selected logic type for the R&S EX-IQ-Box. If the logic types do not fit, the R&S EX-IQ-Box will be damaged because of the differing voltage values.

Parameter: **LVDS**

The signal is transmitted by using the signaling system LVDS.

LVTT

The signal is transmitted by using the LVTTTL technology with a voltage level of 3.3 V.

CM33

The signal is transmitted by using the CMOS technology with a voltage level of 3.3 V.

CM25

The signal is transmitted by using the CMOS technology with a voltage level of 2.5 V.

CM18

The signal is transmitted by using the CMOS technology with a voltage level of 1.8 V.

CM15

The signal is transmitted by using the CMOS technology with a voltage level of 1.5 V.

SS18

The signal is transmitted by using the SSI Technology (**S**erial **S**ynchronous Interface) with a voltage level of 1.8 V.

SS28

The signal is transmitted by using the SSI Technology (**S**erial **S**ynchronous Interface) with a voltage level of 2.8 V.

Example: Remote-control command for transmitter:

"SOUR:TRAN:LOG:TYPE SS18"

Remote-control command for receiver

"SOUR:REC:LOG:TYPE SS18"

'sets the logic type of the R&S EX-IQ-Box to LVDS for receiving a LVDS signal from an external device.

*RST value	Resolution	SCPI
CM33	-	Device-specific

SOURce:TRANsmitter:SENDto**SOURce:RECeiver:SENDto**

This command transfers the current configuration data into the R&S EX-IQ-Box.

Example: Remote-control command for transmitter:

"SOUR:TRAN:SEND"

Remote-control command for receiver:

"SOUR:REC:SEND"

'setup th the R&S EX-IQ-Box with the current configuration data

Data Subsystem**Table of Commands**

Command	Parameter	Default unit	Comment
SOURce:TRANsmitter:DATA:ALIGnment SOURce:RECeiver:DATA:ALIGnment	MSB LSB		
SOURce:TRANsmitter:DATA:BORDer SOURce:RECeiver:DATA:BORDer	MSB LSB		
SOURce:TRANsmitter:DATA:INEGate SOURce:RECeiver:DATA:INEGate	ON OFF 1 0		
SOURce:TRANsmitter:DATA:NFORmat SOURce:RECeiver:DATA:NFORmat	TCOMplement OBINary		
SOURce:TRANsmitter:DATA:POLarity SOURce:RECeiver:DATA:POLarity	POSitive NEGative		
SOURce:TRANsmitter:DATA:QNEGate SOURce:RECeiver:DATA:QNEGate	ON OFF 1 0		
SOURce:TRANsmitter:DATA:SIZE SOURce:RECeiver:DATA:SIZE	4 Bit ... 16 Bit	Bit	
SOURce:TRANsmitter:DATA:SPOLarity SOURce:RECeiver:DATA:SPOLarity	POSitive NEGative		
SOURce:TRANsmitter:DATA:SPOStion SOURce:RECeiver:DATA:SPOStion	0..20		
SOURce:TRANsmitter:DATA:STYPe	IQ IF		

Description of Commands

SOURce:TRANsmitter:DATA:ALIGNment MSB | LSB
SOURce:RECEiver:DATA:ALIGNment MSB | LSB

Parallel mode only!

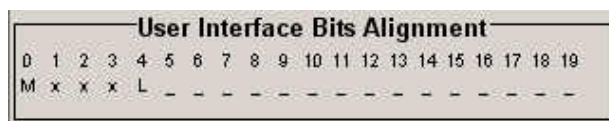
This command sets the alignment of the data bits on the data lines. Either the MSB or the LSB is mapped firmly to one data line. Depending on the word size the equivalent bit moves to the appropriate data line.

Parameters: MSB

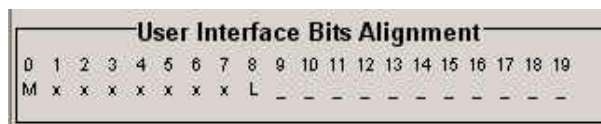
The MSB (**M**ost **S**ignificant **B**it) is mapped firmly to the same data line and the data line of the LSB varies in dependency of the word size.

Examples:

word size = 5, bit order = MSB



word size = 9, bit order = MSB



LSB

The LSB (**L**ast **S**ignificant **B**it) is mapped firmly to the same data line and the data line of the MSB varies in dependency of the word size.

Examples:

word size = 5, bit order = MSB



word size = 9, bit order = MSB



Example: Remote-control command for transmitter:

"SOUR:TRAN:DATA:ALIG LSB"

Remote-control command for receiver:

"SOUR:REC:DATA:ALIG LSB"

'sets the data alignment to LSB.

*RST value	Resolution	SCPI
MSB	-	Device-specific

SOURce:TRANsmitter:DATA:BORDER MSB | LSB

SOURce:RECEiver:DATA:BORDER MSB | LSB

This command sets the order of the data bits. In **Parallel mode**, either the LSB or the MSB is transmitted on the first used data line. In **Serial mode** mode either the LSB or the MSB is transmitted as first bit.

Parameter: MSB

◆ **Parallel transmission**

The MSB (**M**ost **S**ignificant **B**it) is transmitted on the first used data line, depending on the word size and alignment.

The graphical display shows the currently set bit order.

Examples:

word alignment = MSB, word size = 5



word alignment = LSB and word size = 9



◆ **Serial transmission**

The MSB (**M**ost **S**ignificant **B**it) is transmitted first.

LSB

◆ **Parallel transmission**

The LSB (**L**ast **S**ignificant **B**it) is transmitted on the first data line.

Examples:

word alignment = MSB, word size = 5



word alignment = LSB, word size = 5



◆ **Serial transmission**

The LSB (Last Significant Bit) is transmitted first.

Example: Remote-control command for transmitter:

"SOUR:TRAN:DATA:BORD MSB"

Remote-control command for receiver:

"SOUR:REC:DATA:BORD MSB"

'sets the data border to MSB.

*RST value	Resolution	SCPI
LSB	-	Device-specific

SOURce:TRANsmitter:DATA:INEGate ON | OFF | 1 | 0

SOURce:RECEiver:DATA:INEGate ON | OFF | 1 | 0

This command inverts the sign of the I sample values. The values are multiplied by -1.

Example: Remote-control command for transmitter:

"SOUR:TRAN:DATA:INEG ON"

Remote-control command for receiver:

"SOUR:REC:DATA:INEG ON"

'inverts the values of the I samples.

*RST value	Resolution	SCPI
OFF	-	Device-specific

SOURce:TRANsmitter:DATA:NFORmat TCOMplement | OBINary

SOURce:RECEiver:DATA:NFORmat TCOMplement | OBINary

This command sets the format of the transmitted data.

Allowed number range for n Bit: $-2^{n-1} \leq n < 2^{n-1}$

2's Complement

The most significant bit has a value of -2^{n-1} , the bits of lesser significance follow as $+2^{n-2} \dots 2^0$.

Binary Offset

A binary offset of 2^{n-1} is added such that the final values are always positive.

Example:

$n = 4 \Rightarrow -8 \leq z < 8$

z	2's Complement	Binary Offset
-8	1 0 0 0	0 0 0 0
-7	1 0 0 1	0 0 0 1
-6	1 0 1 0	0 0 1 0
-5	1 0 1 1	0 0 1 1
-4	1 1 0 0	0 1 0 0
-3	1 1 0 1	0 1 0 1
-2	1 1 1 0	0 1 1 0
-1	1 1 1 1	0 1 1 1
0	0 0 0 0	1 0 0 0
1	0 0 0 1	1 0 0 1
2	0 0 1 0	1 0 1 0
3	0 0 1 1	1 0 1 1
4	0 1 0 0	1 1 0 0
5	0 1 0 1	1 1 0 1
6	0 1 1 0	1 1 1 0
7	0 1 1 1	1 1 1 1

Parameter: TCOMplement

The value of the transmitted data is formatted in two's-complement.

OBINary

The value of the transmitted data is formatted in binary offset.

Example: Remote-control command for transmitter:

"SOUR:TRAN:DATA:NFOR TCOM"

Remote-control command for receiver:

"SOUR:REC:DATA:NFOR TCOM"

'sets the numeric format to two's-complement.

*RST value	Resolution	SCPI
TCOMplement	-	Device-specific

SOURce:TRANsmitter:DATA:POLarity POSitive | NEGative

SOURce:RECEiver:DATA:POLarity POSitive | NEGative

The command sets the polarity of the I and Q data lines of the R&S EX-IQ-Box.

Parameter: **Positive**

High level stands for a logic 1, low level for a logic 0.

Negative

High level stands for a logic 0, low level for a logic 1.

Example: Remote-control command for transmitter:

"SOUR:TRAN:DATA:POL NEG"

Remote-control command for receiver:

"SOUR:REC:DATA:POL NEG"

'sets the inversion of the I and Q data signal.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

SOURce:TRANsmitter:DATA:QNEGate ON | OFF | 1 | 0

SOURce:RECEiver:DATA:QNEGate ON | OFF | 1 | 0

This command inverts the sign of the Q sample values. The values are multiplied by -1.

Example: Remote-control command for transmitter:

"SOUR:TRAN:DATA:QNEG ON"

Remote-control command for receiver:

"SOUR:REC:DATA:QNEG ON"

'inverts the values of the Q samples.

*RST value	Resolution	SCPI
OFF	-	Device-specific

SOURce:TRANsmitter:DATA:SIZE 4 Bit ... 16 (max. 20) Bit

SOURce:RECEiver:DATA:SIZE 4 Bit ... 16 (max. 20) Bit

This command sets the word size of a sample. Depending on the R&S Instrument 4 to 20 bit words are available. For R&S FSQ and FMU instruments only 4 to 16 bit words are provided.

Example: Remote-control command for transmitter:

"SOUR:TRAN:DATA:SIZE 8"

Remote-control command for receiver:

"SOUR:REC:DATA:SIZE 8"

'sets the word size of a sample to 8 bit.

*RST value	Resolution	SCPI
16 Bit	-	Device-specific

SOURce:TRANsmitter:DATA:SPOLarity POSitive | NEGative**SOURce:RECEiver:DATA:SPOLarity** POSitive | NEGative**Serial data transmission only!**

This command describes the polarity of the strobe marker signal. During a serial data transmission every data sample is marked by the strobe marker signal.



The settings of **Clock Phase** or **Clock Skew** do not affect the strobe marker signal.

Parameter: Positive

The strobe position is indicated by high level.

Negative

The strobe position is indicated by low level.

Example: Remote-control for transmitter:

```
"SOUR:TRAN:DATA:SPOL NEG"
```

Remote-control command for receiver:

```
"SOUR:REC:DATA:SPOL NEG"
```

'sets the inversion of the strobe marker signal.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

SOURce:TRANsmitter:DATA:SPOSITION 0 ... word size-1 (max. 20)**SOURce:RECEiver:DATA:SPOSITION** 0 ... word size (max. 20)**Serial data transmission only!**

The command sets the sample position of the strobe marker output.

Example: Remote-control for transmitter:

```
"SOUR:TRAN:DATA:SPOS 10"
```

Remote-control command for receiver:

```
"SOUR:REC:DATA:SPOS 10"
```

'sets the strobe marker output to sample position 10.

*RST value	Resolution	SCPI
0	1	Device-specific

SOURce:TRANsmitter:DATA:STYPe IQ | IF

SOURce:RECeiver:DATA:STYPe IQ | IF

This command displays the signal mode of the transmission. The digital I and Q signals are transmitted separately).



For signal input the signal type is firmly set to **IQ** and read only. Signal type **IF** is available in output mode only.

Parameter:

IQ

Receives the digital I and Q signals separately.

IF (parallel signal output only)

Assembles and modulates the digital I and Q samples to a carrier frequency (IF). The frequency of the IF signal is set to a quarter of the clock rate, e.g. with a clock rate of 400 MHz the value of the IF frequency is 100 MHz.

Example:

Remote-control command for transmitter:

"SOUR:TRAN:DATA:STYP IQ"

*RST value	Resolution	SCPI
IQ	-	Device-specific

Clock Subsystem

Table of commands

Command	Parameter	Default unit	Comment
SOURce:TRANsmitter:CLOCK:PHASe SOURce:RECeiver:CLOCK:PHASe	P0 P90 P180 P270	deg	
SOURce:TRANsmitter:CLOCK:POLarity SOURce:RECeiver:CLOCK:POLarity	POSitive NEGative		
SOURce:TRANsmitter:CLOCK:RATE SOURce:RECeiver:CLOCK:RATE	1 kHz ... 400 MHz	Hz	
SOURce:TRANsmitter:CLOCK:REF SOURce:RECeiver:CLOCK:REF	RF5 RF10 RF13		
SOURce:TRANsmitter:CLOCK:SCRatio SOURce:RECeiver:CLOCK:SCRatio	1 0.8 0.4 0.2 0.1 0.05		
SOURce:TRANsmitter:CLOCK:SKEW SOURce:RECeiver:CLOCK:SKEW	-5...+5 ns	ns	
SOURce:TRANsmitter:CLOCK:SOURce SOURce:RECeiver:CLOCK:SOURce	INTernal EXTernal		

Description of Commands

SOURce:TRANsmitter:CLOCK:PHASe P0 | P90 | P180 | P270

SOURce:RECeiver:CLOCK:PHASe P0 | P90 | P180 | P270

This command sets a phase shift of the active clock edge in 90° steps related to the data bits.

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:CLOC:PHAS P180"
```

Remote-control command for receiver:

```
"SOUR:REC:CLOC:PHAS P180"
```

'sets the phase shift of the clock edge to 180 degree.

*RST value	Resolution	SCPI
0°	90°	Device-specific

SOURce:TRANsmitter:CLOCK:POLarity POSitive | NEGative

SOURce:RECeiver:CLOCK:POLarity POSitive | NEGative

The command sets the polarity of the active clock edge for triggering the signal transmission.

Parameters: **POSitive**

Sets the rising edge of the clock signal as the active.

NEGative

Sets the falling edge of the clock signal as the active. .



Setting the Clock Polarity **negative** is equivalent to setting the clock phase to 180°.

Example: Remote-control command for transmitter:

"SOUR:TRAN:CLOC:POL NEG"

Remote-control command for receiver:

"SOUR:REC:CLOC:POL NEG"

'sets the clock polarity to negative.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

SOURce:TRANsmitter:CLOCK:RATE 1 kHz ... 400 MHz

SOURce:RECEiver:CLOCK:RATE 1 kHz ... 400 MHz

The command sets/queries the clock rate (frequency) for signal transmission between the R&S EX-IQ-Box and the external device (DUT). Depending on the logic type and the clock source the clock rate range varies).

$$f_{CLK} = \frac{f_s \cdot WS \cdot Int}{DDR \cdot SCR}$$

f_s = Sample rate

Value range: 1 kHz ... 100 MHz

f_{CLK} = Clock rate

Value range:

Logic level LVDS: 1 kHz (100 kHz) ... 400 MHz

Logic level LVTTTL/CMOS: 1 kHz (100 kHz) ... 100 MHz

(1 kHz stands for the internal clock source, fed in from the R&S Instrument, 100 kHz stands for the external reference from the user interface).

WS = Word size

Int = Interleaving mode

DDR = Double data rate

SCR = Sample/Clock rate ratio

WS	4 ... 16 (serial mode)	1 (parallel mode)
Int	1 (non interleaved)	2 (I/Q and Q/I interleaved)
DDR	1 (SDR)	2 (DDR)

$$SCR = 1, \frac{4}{5}, \frac{2}{5}, \frac{1}{5}, \frac{1}{10}, \frac{1}{20}$$



The value range of the clock rate depends on the parameter settings of **Protocol, Logic Type** and **Signal Type**.

Example: Remote-control command for transmitter:

"SOUR:TRAN:CLOC:RATE 10MHZ"

Remote-control command for receiver:

"SOUR:REC:CLOC:RATE 10MHZ"

'sets the clock rate of the R&S EX-IQ-Box to 10 MHz.

*RST value	Resolution	SCPI
10 MHz	-	Device-specific

SOURce:TRANsmitter:CLOCK:REF RF5 | RF10 | RF13

SOURce:RECEiver:CLOCK:REF RF5 | RF10 | RF13

This command sets a corresponding reference clock.

Parameter: RF5

Sets the reference clock to 5 MHz

RF10

Sets the reference clock to 10 MHz

RF13

Sets the reference clock to 13 MHz

Example: Remote-control command for transmitter:

"SOUR:TRAN:CLOC:REF RF52"

Remote-control command for receiver:

"SOUR:REC:CLOC:REF RF5"

'sets the reference clock up to 5 MHz.

*RST value	Resolution	SCPI
10 MHz	-	Device-specific

SOURce:TRANsmitter:SCRatio 1 | 0.8 | 0.4 | 0.2 | 0.1 | 0.05

SOURce:RECEiver:SCRatio 1 | 0.8 | 0.4 | 0.2 | 0.1 | 0.05

Parallel data transmission only!

This command sets the sample clock rate ratio. This parameter characterizes the ratio of the sample rate to the clock rate.

For SCR < 1:

dummy samples are added.

the signal SCR_VALID output at the Reserved0 pin (UI_RESERVE_P0) of the user interface marks the validity of the data.

Values: **SCR** = 1, $\frac{4}{5}$, $\frac{2}{5}$, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$

The values of the sample/clock rate depend on the parameter settings of **Word Size**, **Interleaving** and **Data Rate** (see also [SOURce - TRANsmitter/RECEiver - Clock Rate](#), on page **Error! Bookmark not defined.**).

Example: Remote-control command for transmitter:

"SOUR:TRAN:CLOC:SCR 0.8"

Remote-control command for receiver:

"SOUR:REC:CLOC:SCR 0.8"

'sets the sample clock rate ratio to $\frac{4}{5}$.

*RST value	Resolution	SCPI
1	-	Device-specific

SOURce:TRANsmitter:CLOCK:SKEW -5...+5 ns

SOURce:RECEiver:CLOCK:SKEW -5...+5 ns

This command sets a time shift of the active clock edge related to the data bits.

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:CLOC:SKEW 2.5ns"
```

Remote-control command for receiver:

```
"SOUR:REC:CLOC:SKEW 2.5ns "
```

'sets the time shift of the clock edge to 2.5 nano seconds.

*RST value	Resolution	SCPI
0.000 ns	50 ps	Device-specific

SOURce:TRANsmitter:CLOCK:SOURce INTERNAL | EXTERNAL

SOURce:RECEiver:CLOCK:SOURce INTERNAL | EXTERNAL

This command selects the clock source for data transmission and clock generation. Either the R&S Instrument or the external device (DUT) can be set for delivering the reference, irrespective of the direction of transmission.

Currently the following scenarios for data transmission are possible:

1. Signal input by using an external clock source.

Data and data clock are transmitted from the external device.

2. Signal input by using the internal clock source.

The clock source of the R&S Instrument is sent to the external device for triggering the data input to the R&S EX-IQ-Box.

3. Signal output by using an external clock source.

Synchronized by an external data clock, data are output from the R&S Instrument.

4. Signal output by using the internal clock source.

Data and data clock are delivered from the R&S Instrument.



When using the internal clock frequency the reference output of the R&S Instrument must be connected to the REF IN of the R&S EX-IQ-Box.

The connection can be kept during the entire operation even if an external clock reference is used.

Parameters: INTernal

The clock reference of the R&S Instrument is used. The R&S EX-IQ-Box forwards the data clock to the external device.

EXTernal

The clock reference is fed in from the external device (DUT) to the user interface of the R&S EX-IQ-Box.

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:CLOC:SOUR INT"
```

Remote-control command for receiver:

```
"SOUR:REC:CLOC:SOUR INT"
```

'sets the internal clock.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

SSI Subsystem

Table of Commands

Command	Parameter	Default unit	Comment
SOURce:TRANsmitter:SSI:CMDData SOURce:RECEiver:SSI:CMDData	0 ... 255		
SOURce:TRANsmitter:SSI:CMSize SOURce:RECEiver:SSI:CMSize	0 ... 32		
SOURce:RECEiver:SSI:GAIN:FSElect			
SOURce:RECEiver:SSI:GAIN:STATE	ON OFF		
SOURce:TRANsmitter:SSI:LFSYnc SOURce:RECEiver:SSI:LFSYnc	ON OFF		
SOURce:TRANsmitter:SSI:SIZE SOURce:RECEiver:SSI:SIZE	4 ... 24		

Description of Commands

SOURce:TRANsmitter:SSI:CMDData 0 ... 255

SOURce:RECEiver:SSI:CMDData 0 ... 255

The command defines the number of the Control & Management Bit word as defined in the C&M Size parameter..

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:SSI:CMDData 16"
```

Remote-control command for receiver:

```
"SOUR:REC:SSI:CMDData 16"
```

'set the size of the C&M bits up to 16.

*RST value	Resolution	SCPI
0	-	Device-specific

SOURce:TRANsmitter:SSI:CMSize 0 ... 32

SOURce:RECEiver:SSI:CMSize 0 ... 32

The command defines the number of the Control & Management Bits which follows the I/Q data word. The size is defined from 0 up to 32 bits

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:SSI:CMSize 16"
```

Remote-control command for receiver:

```
"SOUR:REC:SSI:CMSize 16"
```

'set the size of the C&M bits up to 16.

*RST value	Resolution	SCPI
0	-	Device-specific

SOURce:RECeiver:SSI:GAIN:FSElect <string>

The command defines a binary file which includes a gain table. For the format of the gain table, please refer to the generator section.

Parameter: Filename which contains the gain table.

Example: Remote-control command for receiver:
 "SOUR:REC:SSI:GAIN:FSEL C:\Data\GainTable.bin"
 'selects the gain table file in the given drive and path.

*RST value	Resolution	SCPI
-	-	Device-specific

SOURce:RECeiver:SSI:GAIN:STATE ON | OFF

The command Enables (On) or Disables (Off) the Automatic Gain Handling, for details please refer to the appropriate Generator section.

Parameter: **On**
 Enables the automatic gain handling.
Off
 Disables the automatic gain handling.

Example: Remote-control command for receiver:
 "SOUR:REC:SSI:GAIN:STAT OFF"
 'disables the automatic gain handling.

*RST value	Resolution	SCPI
ON	-	Device-specific

SOURce:TRANsmitter:SSI:LFSYnc ON | OFF**SOURce:RECEiver:SSI:LFSYnc** ON | OFF

The command defines if the sync signal appears at the first period of a data bit (parameter set to On) or if the sync signals appears one period before (parameter is Off)

Parameter: **On**

The sync signal appears at the first period of a data bit.

Off

The sync signals appears one period before.

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:SSI:LFSY ON"
```

Remote-control command for receiver:

```
"SOUR:REC:SSI:LFSY ON"
```

'sets the Late Frame sync to ON

*RST value	Resolution	SCPI
ON	-	Device-specific

SOURce:TRANsmitter:SSI:SIZE 4 ... 24**SOURce:RECEiver:SSI:SIZE** 4 ... 24

The command defines the size in bits of an I or Q data word. The size is defined from 4 up to 24 bits.

Example: Remote-control command for transmitter:

```
"SOUR:TRAN:SSI:SIZE 16"
```

Remote-control command for receiver:

```
"SOUR:REC:SSI:SIZE 16"
```

'set the size of the I or Q data word up to 16.

*RST value	Resolution	SCPI
16	-	Device-specific

Update Subsystem

Table of Commands

Command	Parameter	Default unit	Comment
SOURce:TRANsmitter:FIRMware:UPDate SOURce:RECeiver:FIRMware:UPDate			

Description of Commands

SOURce:TRANsmitter:FIRMware:UPDate

SOURce:RECeiver: FIRMware:UPDate

This command executes an update to the firmware supported by the R&S Instrument software. After a few seconds the update will be performed.

The command is a query command and therefore does not have an *RST value.

Example: Remote-control command for transmitter:

"SOUR:TRAN:FIRM:UPD"

Remote-control command for receiver:

"SOUR:REC:FIRM:UPD"

'updates the firmware.

'an error result is delivered.

*RST value	Resolution	SCPI
-	-	Device-specific

Interfaces

The following chapter describes the characteristics of the user interface and the available breakout boards.

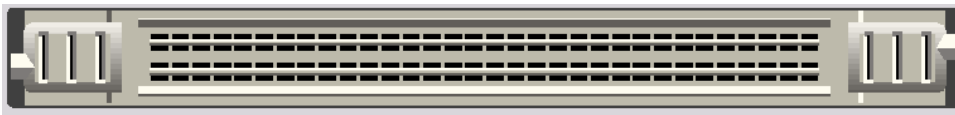
User Interface of the R&S EX-IQ-Box

This user interface provides the transmission of serial or parallel I/Q data, data clock and control signals.

Z-DOK-Adapter Board Connector

Type:	Z-DOK-Adapter Board Connector
Manufacturer:	Tyco Electronics
Part number:	1367557-1

Pin Assignment



The user interface consists of a specific part with pins assigned individually for each breakout board. They are located on the left and the right side of the connector. A common part with fixed pin assignment is located in the middle of the connector.

The pin assignment of the specific part is defined by designing the layout of the breakout boards.

The common pin assignment is shown in [Figure 5: Pin Assignment User Interface X1](#) (see next page), the specific pin assignments are pictured under **Pin Assignment of the Connector X1 - Front View** of the respective breakout board description.



Information on Z-DOK-Adapter Board Connector

For detailed information on the PC Board Footprint, Housing and Block Diagram Mating Face Configuration refer to the attached customer drawing.

Common Pin Assignment of the User Interface Connector X1

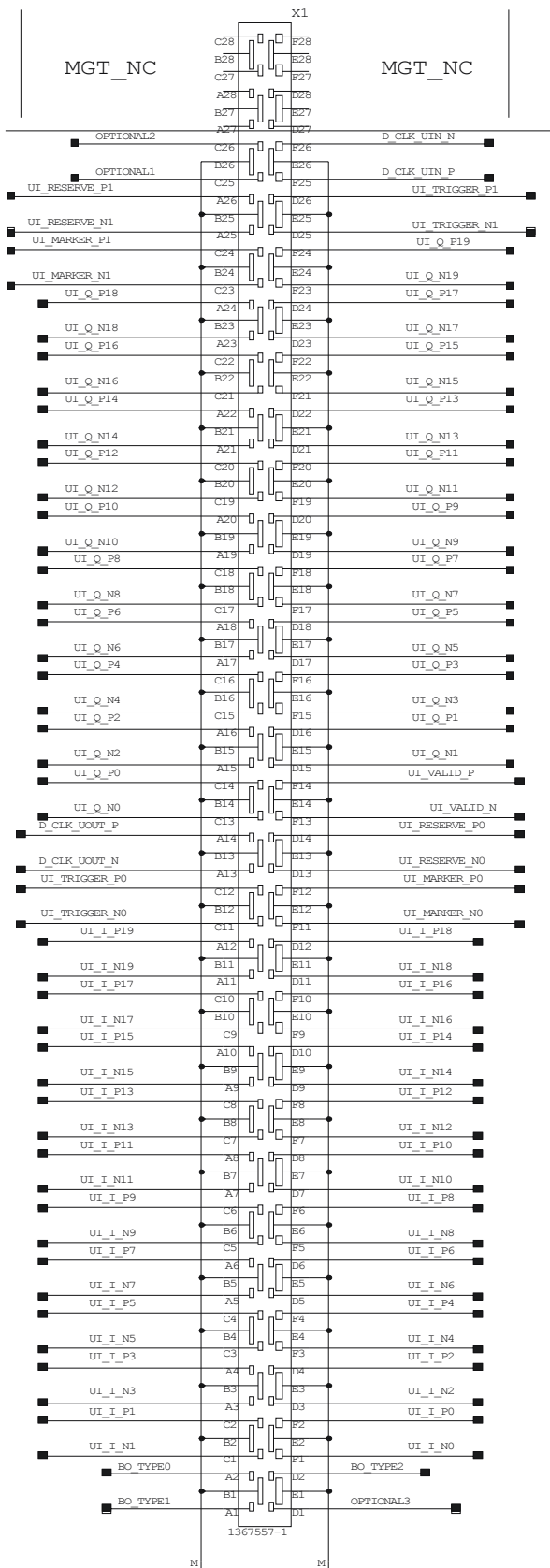


Figure 8: Pin Assignment User Interface X1
Pin Description of the User Interface Connector X1

Signal Name	Pin	Direction	Description
BO_TYPE0	A2	I	BreakOut-Board identification
BO_TYPE1	A1	I	
BO_TYPE2	D2	I	
OPTIONAL1	C25	I/O	for future use
OPTIONAL2	C26	I/O	
OPTIONAL3	D1	I/O	
UI_I_N/P0 ... UI_I_N/P19	F1/F2 ... A11/A12	I/O	I data (real part)
UI_Q_N/P0 ... UI_Q_N/P19	C13/C14 ... F23/F24	I/O	Q data (imaginary part)
UI_TRIGGER_N/P0	C11/C12	I/O	additional protocol dependent control / signaling
UI_TRIGGER_N/P1	D25/D26	I/O	
UI_MARKER_N/P0	F11/F12	I/O	
UI_MARKER_N/P1	C23/C24	I/O	
UI_RESERVE_N/P0	D13/D14	I/O	
UI_RESERVE_N/P1	A25/A26	I/O	
UI_VALID_N/P	F13/F14	I/O	indicates valid data blocks
D_CLK_UIN_N/P	F25/F26	I	interface clock input
D_CLK_UOUT_N/P	A13/A14	O	interface clock output



The N/P notation is concerned to differential interface standards (LVDS). For single ended standards (e.g. LVTTTL) only the P signals are used.

Breakout Boards

Currently three interchangeable breakout boards are available for adjusting customer specific signal formats to the common R&S signal format.

A breakout board is connected directly to the user interface on the front panel of the R&S EX-IQ-Box without using a cable.

The pin assignment for each breakout board is defined by the layout.

Breakout Board Single Ended 090002-22x

This breakout board consists of the connector to the R&S EX-IQ-Box and two connectors for adjusting the external user signals.

The breakout board is intended for testing single ended signals. The signals are assigned to two 25-pole connectors.

Connector Type

Type:	2x25-pole connector
Manufacturer:	Harting
Part number:	0919 550 6323

Specific Pin Assignment of the User Interface X1 - Front View (090002-222)

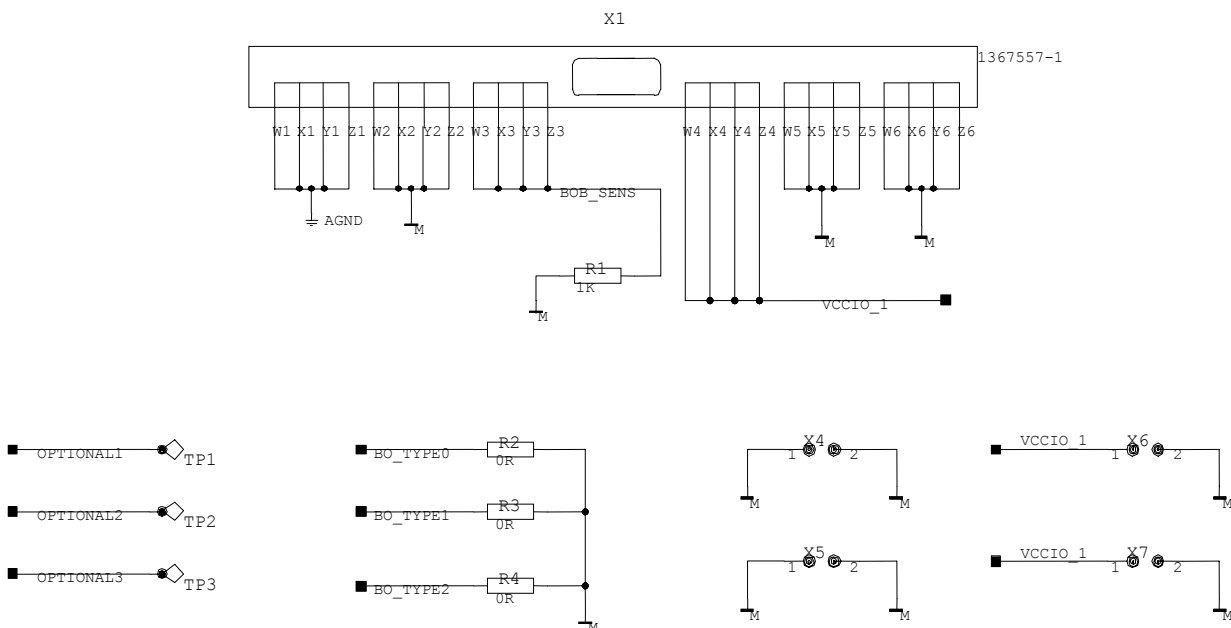


Figure 9: Breakout board Single Ended 090002-222: Pin Assignment X1 - Front View

Pin Assignment of the Connector X2 (090002-222)

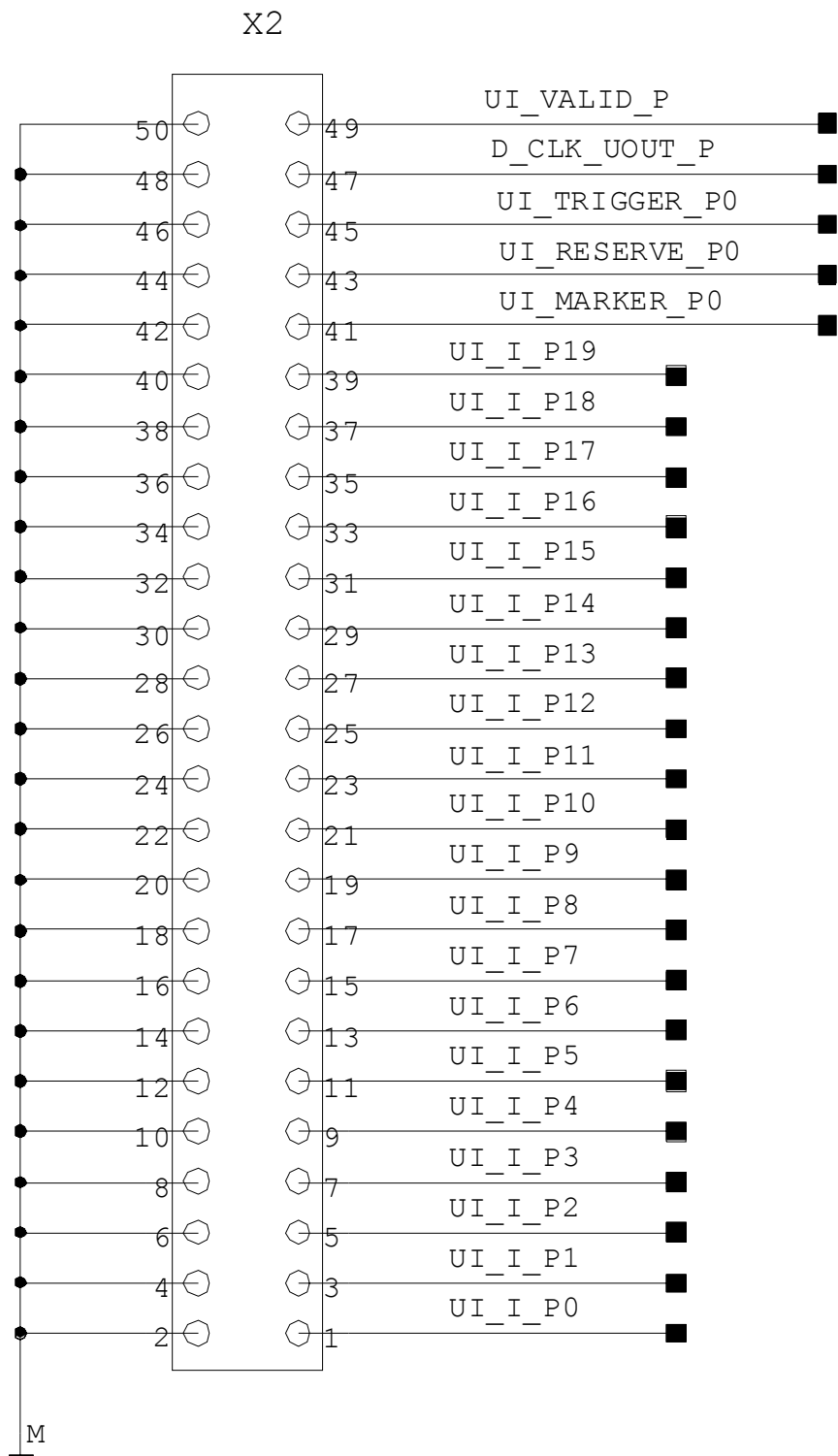


Figure 10: Breakout Board Single Ended 090002-222: Pin Assignment X2

Pin Assignment of the Connector X3 (090002-222)

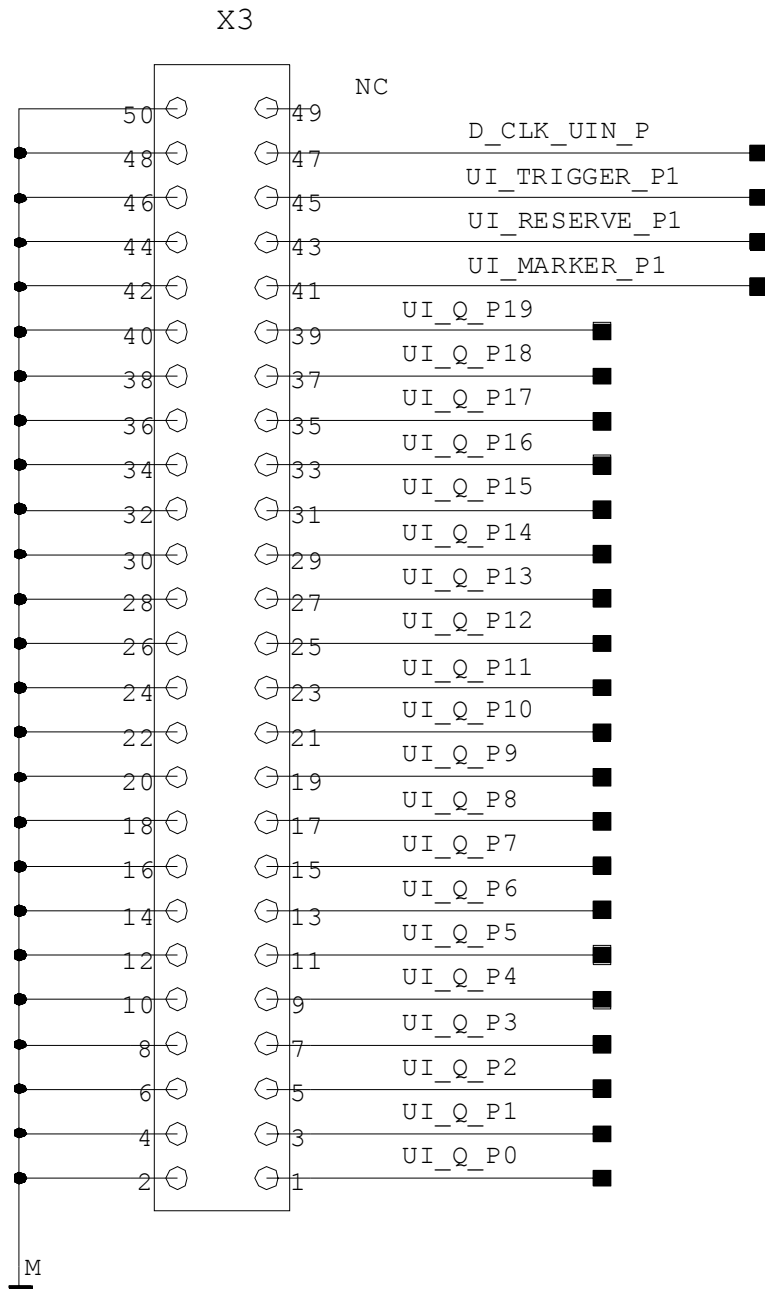


Figure 11: Breakout Board Single Ended 090002-222: Pin Assignment X3

Breakout Board Differential 090002-23x

This breakout board consists of the connector to the R&S EX-IQ-Box and two connectors for adjusting the external user signals.

The breakout board is intended for testing differential signals. The signals are assigned to two 50-pole SMD connectors.

Connector Type

Type:	2x50-pole connector
Manufacturer:	Samtec
Part number:	ASP-65067-01

Specific Pin Assignment of the User Interface X1 - Front View (090002-231)

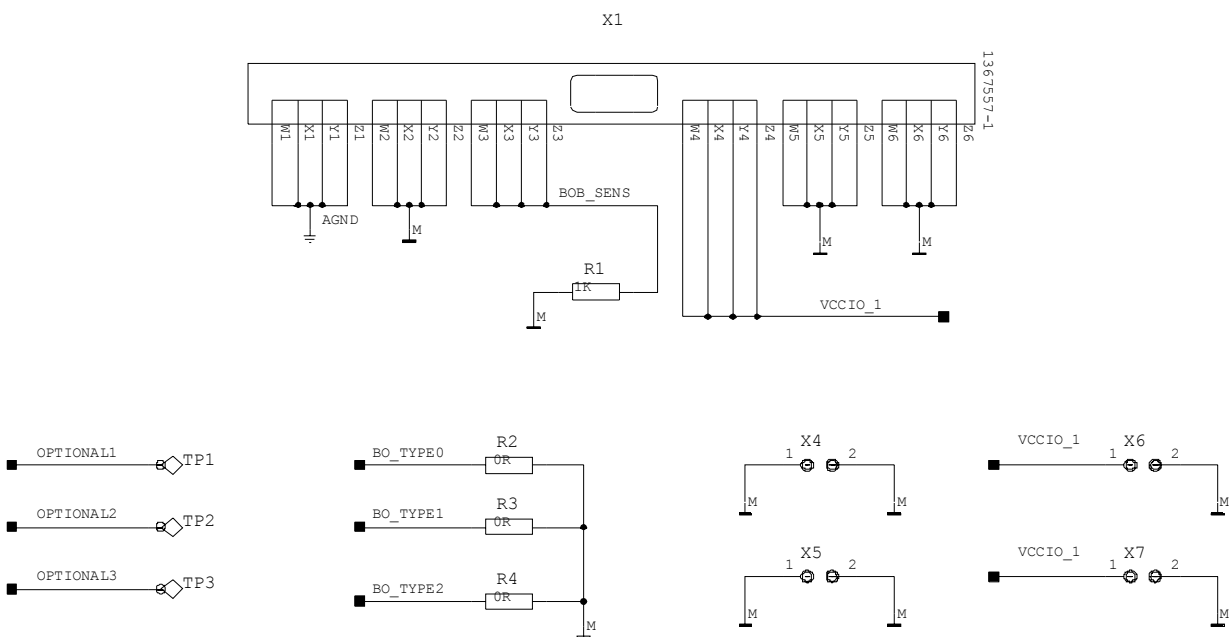


Figure 12: Breakout Board Differential 090002-231: Pin Assignment X1 - Front View

Pin Assignment of the Connector X2 (090002-231)

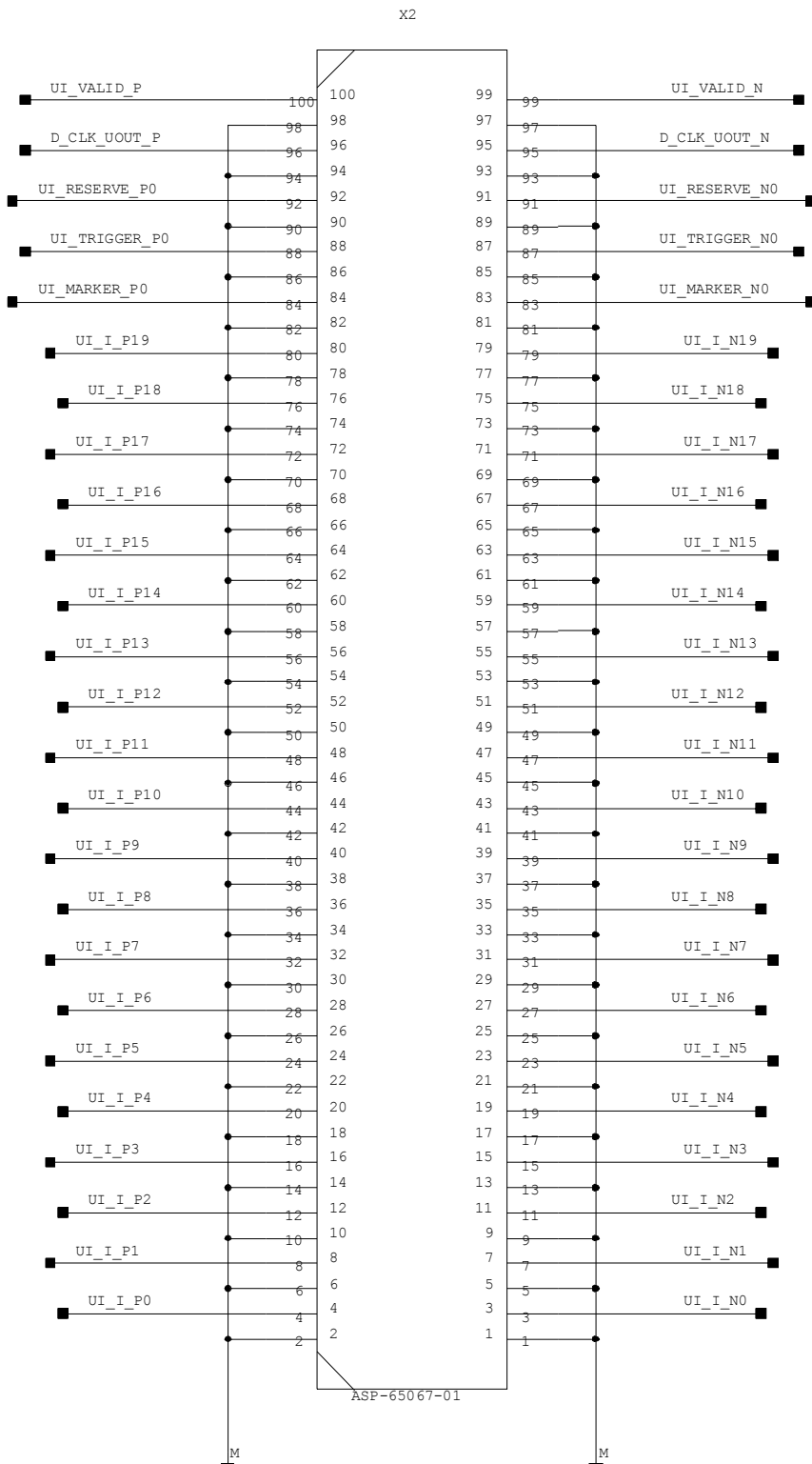


Figure 13: Breakout Board Differential 090002-231: Pin Assignment X2

Pin Assignment of the Connector X3 (090002-231)

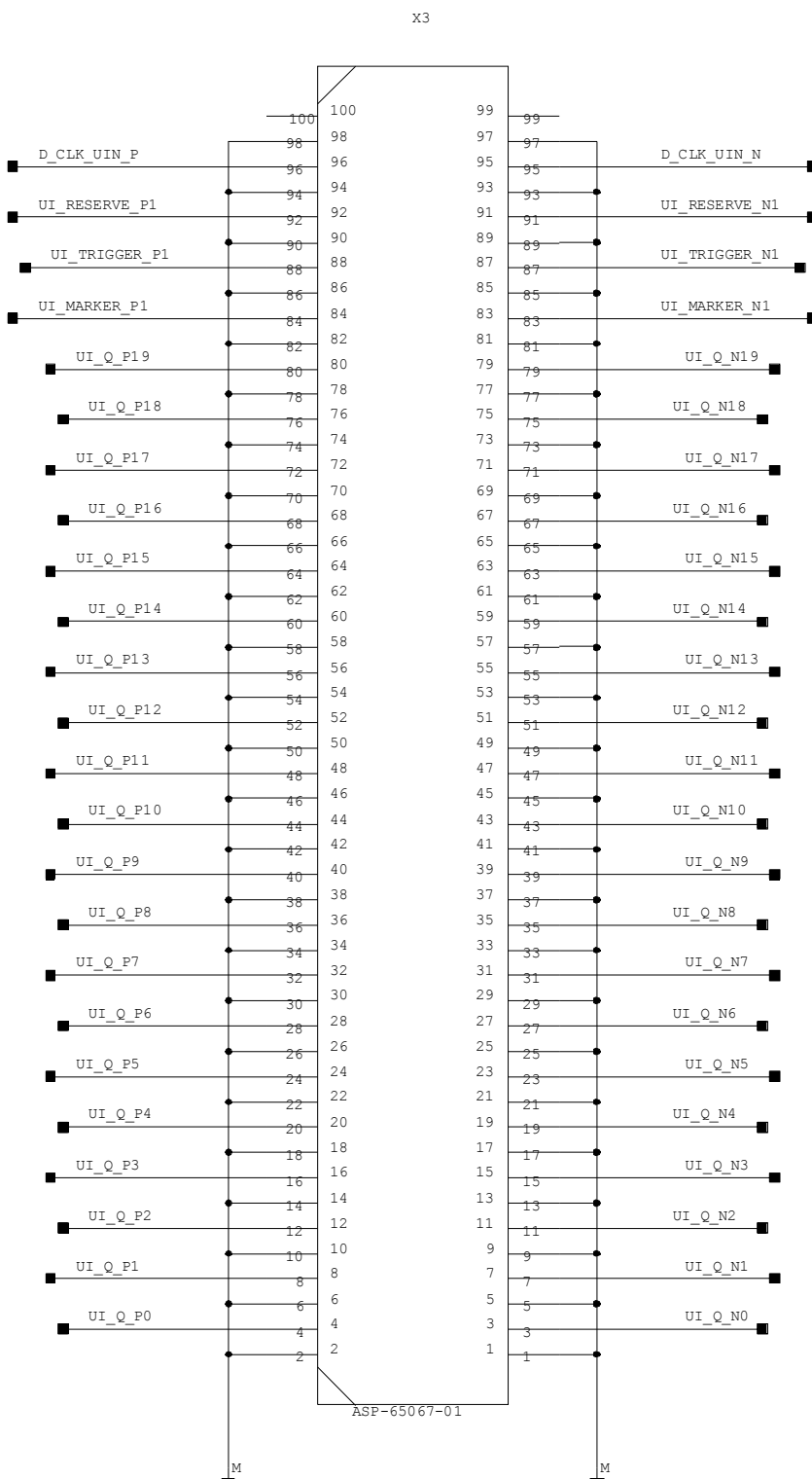


Figure 14: Breakout Board Differential 090002-231: Pin Assignment X3

Breakout Board SCSI 090002-21x

This breakout board consists of the connector to the R&S EX-IQ-Box and one connector for adjusting the external user signals. The breakout board is intended for testing single ended signals. The signals are assigned to a 68-pole SCSI connector.

Connector Type

Type:	68-pole D Subminiature SCSI connector
Manufacturer:	Tyco Electronics
Part number:	787170-7

Specific Pin Assignment of the User Interface X1 - Front View (090002-211)

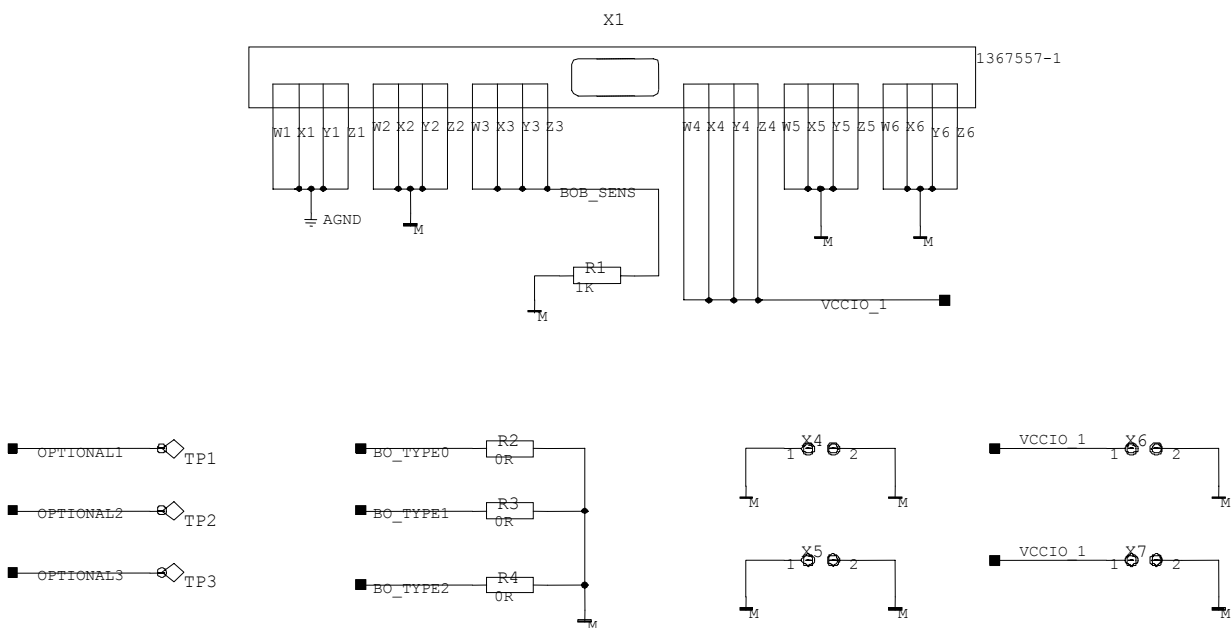


Figure 15: Breakout board SCSI 090002-211: Pin Assignment X1 - Front View

Pin Assignment of the Connector X2 (090002-211)

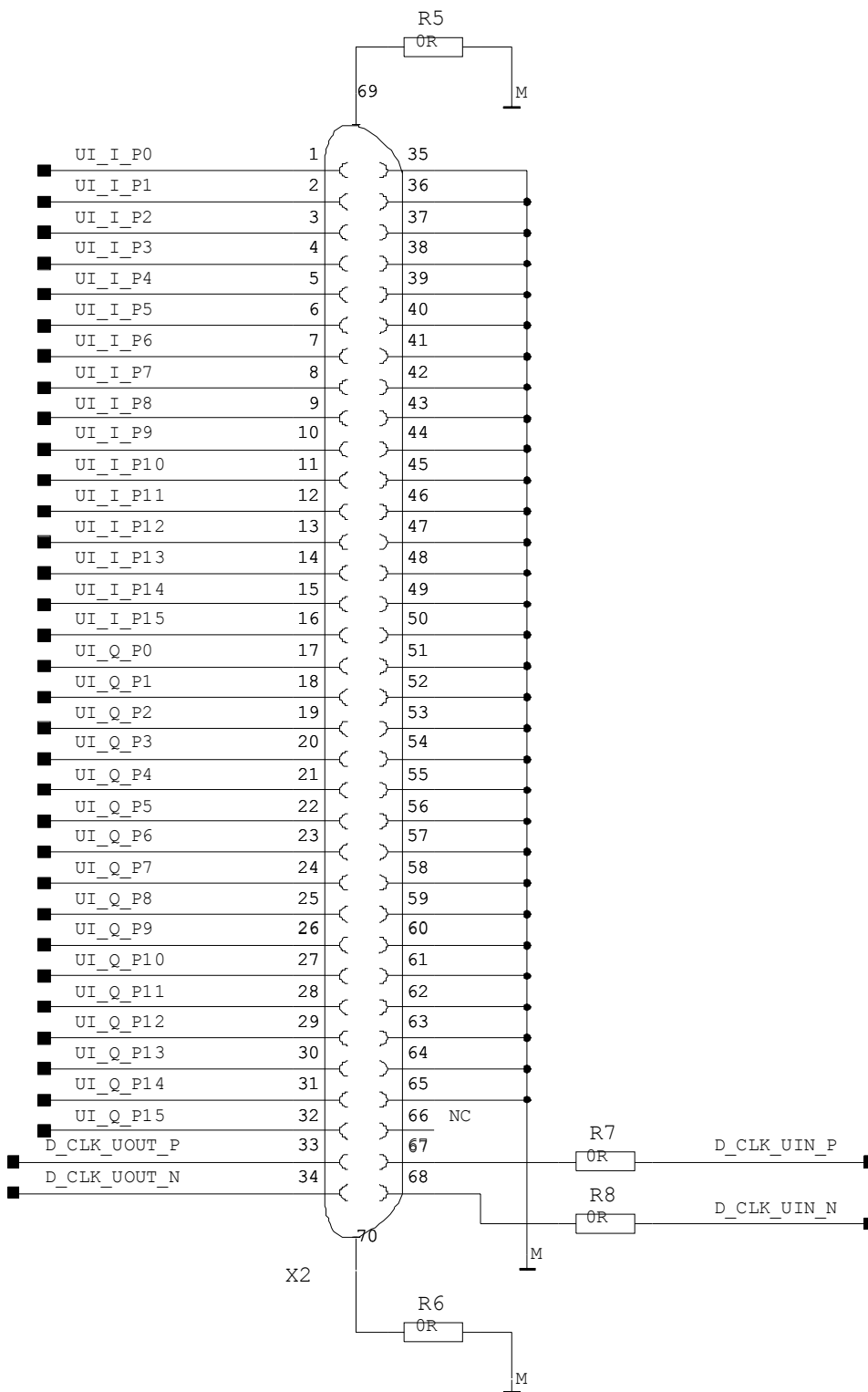


Figure 16: Breakout board SCSI 090002-211: Pin Assignment X2

Service and Maintenance

The following chapter describes the service functions provided for the R&S EX-IQ-Box, the procedure for a firmware update on the R&S Instrument and the maintenance of the R&S EX-IQ-Box.

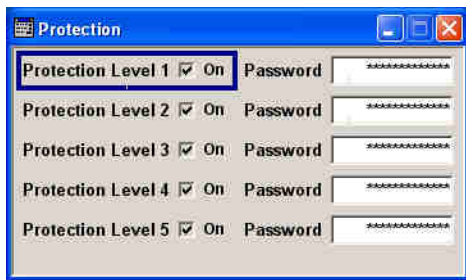
Service for the R&S EX-IQ-Box by Operating with R&S Signal Generators

A selftest is provided for service purposes. The selftest is a protected test procedure. It can be accessed if protection level 1 is disabled. The **Protection** dialog is called in the **Setup Menu** of the R&S Instrument.



This dialog provides access to the protected service functions. A correct password is required to disable the protection levels.

Protection



After the instrument has been switched on, the protection levels 1 to 5 are enabled (ON).

◆ Enter the password 123456 to disable Protection Level 1.

The selftest can be accessed now.

Remote-control command:

```
SYST:PROT1:STAT ON
```

```
SYST:PROT1:STAT OFF, 123456
```

Selftest

The **Selftest** dialog is called in the **Test** section of the **Setup Menu** of the R&S Instrument.



The selftest dialog provides various test functions for the R&S Instrument as well as test routines for connected R&S EX-IQ-Boxes. For further information on the instrument specific test routines, e.g. **Execute Fader Selftest** see chapter General Settings, section **Selftest** of the R&S Instrument's Operating Manual.

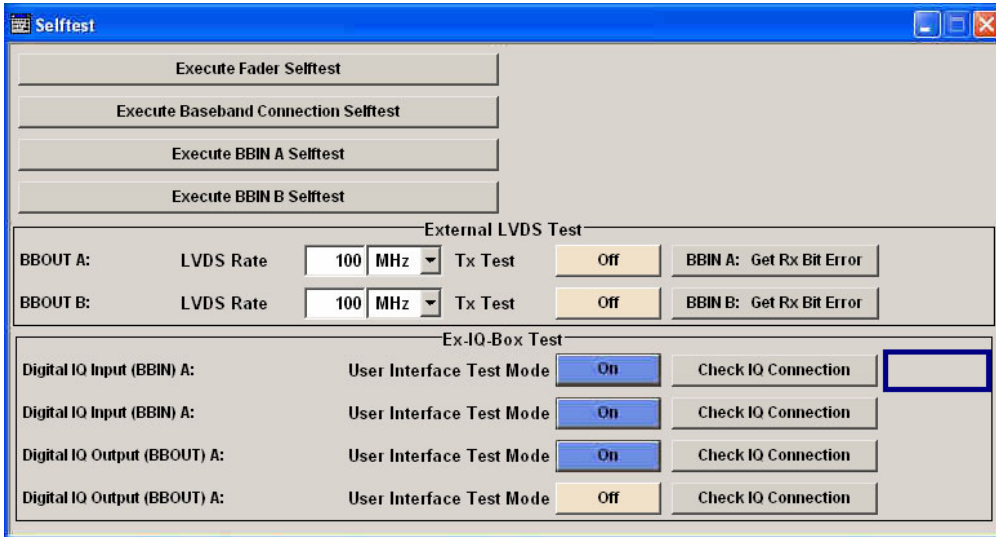


Figure 17: Selftest dialog of the R&S AMU 200A equipped with four R&S EX-IQ-Boxes

For each connected EX/IQ/Box a separate selftest is available in the **EX-IQ-Box Test** section.

Two different test cases are provided to check the R&S EX-IQ-Box operation:

User Interface Test

With the aid of an oscilloscope the user interface test is performed manually. This test is used to verify the FPGA and the user interface of the R&S EX-IQ-Box (DUT side).

IQ Connection Test

This test is performed automatically and checks the IQ data connection of the R&S EX-IQ-Box to the R&S Instrument.

User Interface Test Selects the user interface test mode.

Mode - EX-IQ-Box BBIN / BBOUT Selftest In test mode **Off**, the R&S EX-IQ-Box operates in regular data mode.

In test mode **On**, the R&S EX-IQ-Box generates a defined test pattern, which is output on the user interface.

Remote-control command for digital I/Q In:

```
TEST[1]|2:BBIN:EXternal:UITMode ON | OFF
```

Remote-control command for digital I/Q Out:

```
TEST[1]|2:BBOut:EXternal:UITMode ON | OFF
```

Performing the User Interface test:

1. Disconnect all devices from the user interface to be tested. Only passive adapter boards (breakout boards) should be connected during this test.
2. Connect the **REF IN** BNC of the **R&S EX-IQ-Box** with the **REF OUT** of the **R&S Instrument**.
3. Switch **On** the particular **User Interface Test Mode** or enter the remote-control command, respectively.
4. Use an oscilloscope or a frequency counter to verify the test pattern output on the user interface.

A 16-Bit counter signal is expected with frequencies from 1.53 kHz (counter bit 15) to 50 MHz (counter bit 0). The correct test pattern is given in the following table.

UIF Signal	UIF Pin	Counter Bit	f [kHz]
UI_I_0	F2	10	48.83
UI_I_1	C2	11	24.41
UI_I_2	D4	0	50000.00
UI_I_3	A4	1	25000.00
UI_I_4	F4	0	50000.00
UI_I_5	C4	1	25000.00
UI_I_6	D6	2	12500.00
UI_I_7	A6	3	6250.00
UI_I_8	F6	4	3125.00
UI_I_9	C6	5	1562.50
UI_I_10	D8	6	781.25
UI_I_11	A8	7	390.63
UI_I_12	F8	8	195.31
UI_I_13	C8	9	97.66
UI_I_14	D10	10	48.83
UI_I_15	A10	11	24.41
UI_I_16	F10	12	12.21
UI_I_17	C10	13	6.10
UI_I_18	D12	14	3.05
UI_I_19	A12	15	1.53
UI_TRIGGER_0	C12	4	3125.00
UI_MARKER_0	F12	15	1.53
UI_RESERVE_0	D14	9	97.66
UI_VALID	F14	High	0.00
UI_Q_0	C14	13	6.10
UI_Q_1	D16	14	3.05

UIF Signal	UIF Pin	Counter Bit	f [kHz]
UI_Q_2	A16	2	12500.00
UI_Q_3	F16	3	6250.00
UI_Q_4	C16	0	50000.00
UI_Q_5	D18	1	25000.00
UI_Q_6	A18	2	12500.00
UI_Q_7	F18	3	6250.00
UI_Q_8	C18	4	3125.00
UI_Q_9	D20	5	1562.50
UI_Q_10	A20	6	781.25
UI_Q_11	F20	7	390.63
UI_Q_12	C20	8	195.31
UI_Q_13	D22	9	97.66
UI_Q_14	A22	10	48.83
UI_Q_15	F22	11	24.41
UI_Q_16	C22	12	12.21
UI_Q_17	D24	13	6.10
UI_Q_18	A24	14	3.05
UI_Q_19	F24	15	1.53
UI_TRIGGER_1	D26	5	1562.50
UI_MARKER_1	C24	6	781.25
UI_RESERVE_1	A26	12	12.21

Table 1: User Interface: Test Pattern

Check IQ Connection - EX-IQ-Box BBIN / BBOUT : Selftest - Executes the IQ connection test from the R&S EX-IQ-Box. The result (success or failed) is displayed in the status field next to the **Check IQ Connection** button.

Remote-control command for digital I/Q In:

```
TEST[1] | 2:BBIN:EXternal:IQConnection?
```

Remote-control command for digital I/Q Out:

```
TEST[1] | 2:BBOut:EXternal:IQConnection?
```

Response: "0" on success, "1" on fail

Performing the IQ connection test:

1. Check that the I/Q data cable is connected properly:
 - from the R&S Instrument **Digital I/Q Output** to the **IQ IN** of the R&S EX-IQ-Box.
 - from the R&S EX-IQ-Box **IQ OUT** to the **Digital I/Q Input** of the R&S Instrument.
2. Click on the button **Check IQ Connection** to perform a connection test or enter the remote-control command, respectively.
After a few seconds the test will be finished and the result will be displayed.

Troubleshooting

If an error message is sent back from the R&S EX-IQ-Box or the selftest does not show clear results, we recommend that you ship the R&S EX-IQ-Box to our experts in the service centers (authorized personnel of R&S Service Departments only).

Please contact your Rohde & Schwarz support center or our spare parts express service if you need service or repair of your equipment or to order spare parts.

The list of the Rohde & Schwarz representatives and the address of our spare parts express service are provided at the beginning of the service manual of the R&S Instrument.

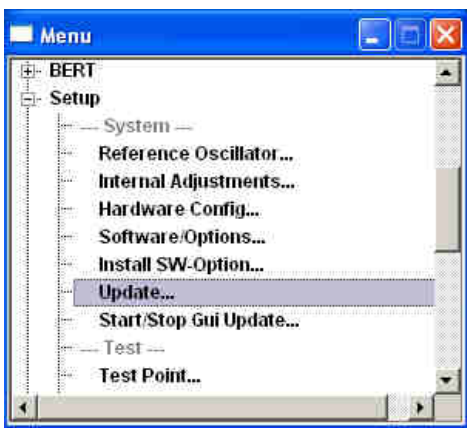
Firmware Update

Firmware Update for Operating with R&S Signal Generators

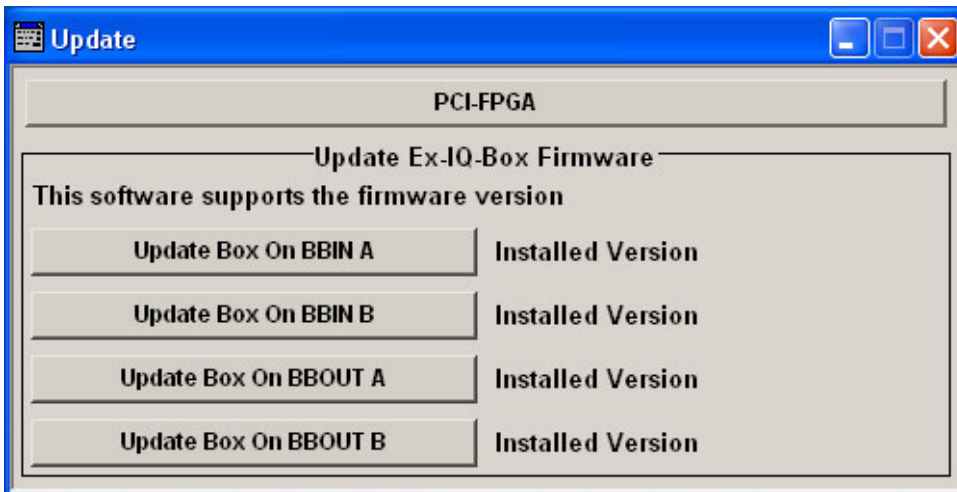
The R&S EX-IQ-Box is delivered with the latest firmware version available. Firmware updates are performed via a connected R&S Instrument.

The procedure for updating the R&S EX-IQ-Box firmware differs depending on the connected R&S Instrument. The following section describes the procedure for a firmware update of an R&S EX-IQ-Box connected with R&S Signal Generators.

The currently supported firmware is queried and updated in the **Setup Update...** menu of the R&S Instrument.



If the R&S Instrument is connected to one or more R&S EX-IQ-Boxes the **Update EX-IQ-Box Firmware** section is displayed in the **Update** dialog.



For each connected R&S EX-IQ-Box a separate update procedure can be executed in **Update EX-IQ-Box Firmware** section.

This software supports the firmware version - EX-IQ-Box BBIN / BBOUT Update

Queries the R&S EX-IQ-Box firmware available in the current software of the R&S Instrument. The response is displayed next to the line: **"This software supports the firmware version"**.

Remote-control command for digital I/Q In:

```
SOURce[1] | 2:BBIN:EXTernal:FIRMWare:SUPPorted?
```

Remote-control command for digital I/Q Out:

```
SOURce[1] | 2:IQ:OUTPut:EXTernal:FIRMWare:SUPPorted?
```

Response: x.xx.xxx.xx

Update Box On ... - EX-IQ-Box BBIN / BBOUT Update

Executes an update to the firmware supported by the R&S Instrument software. After a few seconds the update will be performed.

Remote-control command for digital I/Q In:

```
SOURce[1] | 2:BBIN:EXTernal:FIRMWare:UPDate
```

Remote-control command for digital I/Q Out:

```
SOURce[1] | 2:IQ:OUTPut:EXTernal:FIRMWare:UPDate
```

Response: "0" on success, "1" on fail

Installed Version - EX-IQ-Box BBIN / BBOUT Update

Indicates the currently installed firmware for the R&S EX-IQ-Box.

Remote-control command for digital I/Q In:

```
SOURce[1] | 2:BBIN:EXTernal:FIRMWare:INSTalled?
```

Remote-control command for digital I/Q Out:

```
SOURce[1] | 2:IQ:OUTPut:EXTernal:FIRMWare:INSTalled?
```

Response: x.xx.xxx.xx

Firmware Update for Operating with R&S Signal Analyzers

After the detection of the ExIQ-Box, the firmware version of the connected box is read and compared against the current available firmware version (which was installed by the last firmware update). If a different firmware version for the ExIQ-Box is detected, a softkey, called “Update Firmware”, is displayed. If the user press the button the firmware update starts. During the update process, which may take up to 30 seconds, the user should not disconnect or switch off the power of the ExIQ-Box.

Remote-control for **transmitter**:

```
SOUR:TRAN:FIRM:UPD <string>
```

Remote-control command for **receiver**:

```
SOUR:RECE:FIRM:UPD <string>
```



The firmware update may be taking up to 30 seconds, depending on the size of the new firmware. During the update in the “Setup State” line a message is displayed that the firmware update is in progress. Note that during the firmware update no interaction with the GUI is possible.

ExBox Status	
Serial Number	02
Version	01
FPGA Data	01 / 00.00-1 .35
Setup State	Firmware Update...
Connection State	Connected

Maintenance

The following chapter contains information on the maintenance of the R&S EX-IQ-Box.

The R&S EX-IQ-Box does not need a periodic maintenance, but essentially needs cleaning from time to time.

Cleaning the Outside and Storing

NOTICE **Device damage caused by cleaning agents!**

Cleaning agents contain substances that may damage the module, e.g. solvent-containing cleaning agents may damage the front panel labeling or plastic parts.

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

The outside of the device is suitably cleaned using a soft, line-free dust cloth.

Cleaning agents contain substances that may damage the module, e.g. solvent-containing cleaning agents may damage the front panel labeling or plastic parts.

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

The outside of the device is suitably cleaned using a soft, line-free dust cloth.

The storage temperature range of the R&S EX-IQ-Box as well as operating temperature and further environmental conditions are given in the data sheet, section **Operating Data**. If the R&S EX-IQ-Box is to be stored for a longer period of time, it must be protected against dust. The original packing should be used, particularly the protective covers at the front and rear, when the R&S EX-IQ-Box is to be transported or dispatched. If the original packing is no longer available, use a sturdy cardboard box of suitable size and carefully wrap the R&S EX-IQ-Box to protect it against mechanical damage.

Alphabetical List of Commands

[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:RATE	47
[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:PHASE	46
[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:POLARITY	47
[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:SKEW	49
[SOURCE<[1]>:]BBIN:EXTERNAL:CLOCK:SOURCE	49
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:ALIGNMENT	51
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:BORDER	53
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:INEGATE	54
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:NFORMAT	54
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:POLARITY:IQ	56
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:QNEGATE	56
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:SIZE	57
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:SPOLEARITY	57
[SOURCE<[1]>:]BBIN:EXTERNAL:DATA:SPOSITION	58
[SOURCE<[1]>:]BBIN:EXTERNAL:DRATE	40
[SOURCE<[1]>:]BBIN:EXTERNAL:FIRMWARE:INSTALLED	62
[SOURCE<[1]>:]BBIN:EXTERNAL:FIRMWARE:SUPPORTED	63
[SOURCE<[1]>:]BBIN:EXTERNAL:FORMAT	41
[SOURCE<[1]>:]BBIN:EXTERNAL:ILEAVING	41
[SOURCE<[1]>:]BBIN:EXTERNAL:LOGIC:TYPE	43
[SOURCE<[1]>:]BBIN:EXTERNAL:SCRATIO	45
[SOURCE<[1]>:]BBIN:EXTERNAL:SRATE	45
[SOURCE<[1]>:]BBIN:EXTERNAL:UPDATE	63
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:PHASE	46
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:POLARITY	47
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:RATE	47
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:SKEW	49
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:CLOCK:SOURCE	49
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:ALIGNMENT	51
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:BORDER	53
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:INEGATE	54
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:NFORMAT	54
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:POLARITY:IQ	56
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:QNEGATE	56
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:SIZE	57
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:SPOLEARITY	57
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DATA:SPOSITION	58
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:DRATE	40
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:FIRMWARE:INSTALLED	62
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:FIRMWARE:SUPPORTED	63
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:FORMAT	41
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:ILEAVING	41
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:LOGIC:TYPE	43
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:SCRATIO	45
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:SRATE	45
[SOURCE<[1]>:]IQ:OUTPUT:EXTERNAL:UPDATE	63

SOURce:IRECEiver:FORmat	89
SOURce:RECEiver:CLOCK:POLarity	102
SOURce:RECEiver:CLOCK:PHASe	101
SOURce:RECEiver:CLOCK:RATE	103
SOURce:RECEiver:CLOCK:REF	104
SOURce:RECEiver:CLOCK:SKEW	105
SOURce:RECEiver:CLOCK:SOURce	106
SOURce:RECEiver:DATA:ALIGNment	94
SOURce:RECEiver:DATA:BORDER	95
SOURce:RECEiver:DATA:INEGate	96
SOURce:RECEiver:DATA:NFORmat	96
SOURce:RECEiver:DATA:POLarity:IQ	98
SOURce:RECEiver:DATA:QNEGate ON OFF	98
SOURce:RECEiver:DATA:SIZE	99
SOURce:RECEiver:DATA:SPOLarity	99
SOURce:RECEiver:DATA:SPOSition	100
SOURce:RECEiver:DRATe	88
SOURce:RECEiver:FIRMWare:INSTalled	110
SOURce:RECEiver:FIRMWare:UPDate	110
SOURce:RECEiver:ILEaving	90
SOURce:RECEiver:LOGicTYPE	91
SOURce:RECEiver:SCRatio	104
SOURce:RECEiver:SSI:CMDATA	107
SOURce:RECEiver:SSI:CMSIZE	108
SOURce:RECEiver:SSI:GAIN:FSElect	108
SOURce:RECEiver:SSI:GAIN:STATE	108
SOURce:RECEiver:SSI:LFSYnc	109
SOURce:RECEiver:SSI:SIZE	109
SOURce:TRANSmmitter:CLOCK:POLarity	102
SOURce:TRANSmmitter:CLOCK:PHASe	101
SOURce:TRANSmmitter:CLOCK:RATE	103
SOURce:TRANSmmitter:CLOCK:REF	104
SOURce:TRANSmmitter:CLOCK:SKEW	105
SOURce:TRANSmmitter:CLOCK:SOURce	106
SOURce:TRANSmmitter:DATA:ALIGNment	94
SOURce:TRANSmmitter:DATA:BORDER	95
SOURce:TRANSmmitter:DATA:INEGate	96
SOURce:TRANSmmitter:DATA:NFORmat	96
SOURce:TRANSmmitter:DATA:POLarity:IQ	98
SOURce:TRANSmmitter:DATA:QNEGate	98
SOURce:TRANSmmitter:DATA:SIZE	99
SOURce:TRANSmmitter:DATA:SPOLarity	99
SOURce:TRANSmmitter:DATA:SPOSition	100
SOURce:TRANSmmitter:DRATe	88
SOURce:TRANSmmitter:FIRMWare:INSTalled	110
SOURce:TRANSmmitter:FIRMWare:UPDate	110
SOURce:TRANSmmitter:FORmat	89
SOURce:TRANSmmitter:ILEaving	90
SOURce:TRANSmmitter:LOGicTYPE	91

<i>SOURce:TRANsmitter:SCRatio</i>	104
<i>SOURce:TRANsmitter:SSI:CMDATA</i>	107
<i>SOURce:TRANsmitter:SSI:CMSIZE</i>	108
<i>SOURce:TRANsmitter:SSI:LFSync</i>	109
<i>SOURce:TRANsmitter:SSI:SIZE</i>	109
<i>[TEST<[1]2>:]BBIN:EXTernal:IQConnection</i>	59
<i>[TEST<[1]2>:]BBIN:EXTernal:UITMode</i>	60
<i>[TEST<[1]2>:]IQ:OUTPut:EXTernal:IQConnection</i>	59
<i>[TEST<[1]2>:]IQ:OUTPut:EXTernal:UITMode</i>	60

Index

A

AMU Settings..... 13

B

Baseband Input Settings..... 15

Bit Order26, 53, 75, 95

Bit Order LSB

Parallel.....27, 53, 95

Serial27, 53, 95

Bit Order MSB

Parallel.....26, 53, 95

Serial26, 27, 53, 95

Breakout Board..... 116

Differential 119

SCSI 122

Single Ended 116

C

Check IQ Connection..... 59, 129

Cleaning..... 134

Clock Phase.....36, 46, 101

Clock Polarity.....36, 47, 102

Negative37, 47, 102

Positive.....36, 47, 102

Clock Rate33, 47, 103

Clock Settings

Clock Source 78

Clock Setup 23, 32

Clock Phase36, 46, 101

Clock Polarity.....36, 47, 102

Clock Rate33, 47, 103

Clock Skew.....36, 49, 105

Sample/Clock Rate Ratio...37, 45, 104

Clock Skew.....36, 49, 105

Clock Source34, 49, 78, 106

External35, 50, 106

Internal35, 50, 106

Clock/Sample Rate..... 23

Connecting..... 10

Connector

Differential X2 120

Differential X3 121

SCSI X2..... 123

Single Ended X2..... 117

Single Ended X3..... 118

TYCO Z-DOK..... 2, 113

D

Data Rate 20, 40, 88

Double 20, 40, 88

Single 20, 40, 88

Data Setup 23, 24

Bit Order 26, 53, 75, 95

I/Q Polarity.....29, 56, 98

Negate I Data29, 54, 96

Negate Q Data29, 56, 98

Numeric Format.....28, 54, 96

Strobe Polarity.....30, 57, 99

Strobe Position 31, 58, 100

Word Alignment.....25, 51, 94

Word Size.....25, 57, 99

DDR..... 20, 40, 88

Delivery list..... 7

Digital baseband input -

R&S EX-IQ-Box..... 5

Digital baseband output -

R&S EX-IQ-Box..... 5

Digital I/Q data interface 2

Digital interface - IQ IN 5

Digital interface - IQ OUT 5

E

Error - R&S EX-IQ-Box..... 3

Error LED - R&S EX-IQ-Box..... 3

EX-IQ-Box BBIN

Bit Order 26, 53

Check IQ Connection 59, 129

Clock Phase 36, 46

Clock Polarity 36, 47

Clock Rate 33, 47

Clock Setup..... 23, 32

Clock Skew.....36, 49

Clock Source 34, 49

Clock/Sample Rate..... 23

Data Rate 20, 40

Data Setup 23, 24

Format..... 19, 41

I/Q Polarity.....29, 56

Installed Version..... 62, 132

Interleaving..... 21, 41

Logic Type..... 16, 43

Negate I Data29, 54

Negate Q Data29, 56

Numeric Format.....28, 54

EX-IQ-Box BBIN

Sample Rate	45
Sample/Clock Rate Ratio	37, 45
Strobe Polarity	30, 57
Strobe Position	31, 58
Supported Firmware	63, 132
Update Firmware	63, 132
User Interface Test Mode	60, 127
Word Alignment	25, 51
Word Size	25, 57

EX-IQ-Box BBOU

Bit Order	26, 53
Check IQ Connection	59, 129
Clock Phase	36, 46
Clock Polarity	36, 47
Clock Rate	33, 47
Clock Setup	23, 32
Clock Skew	36, 49
Clock Source	34, 49
Clock/Sample Rate	23
Data Rate	20, 40
Data Setup	23, 24
Format	19, 41
I/Q Polarity	29, 56
Installed Version	62, 132
Interleaving	21, 41
Logic Type	16, 43
Negate I Data	29, 54
Negate Q Data	29, 56
Numeric Format	28, 54
Sample Rate	45
Sample/Clock Rate Ratio	37, 45
Strobe Polarity	30, 57
Strobe Position	31, 58
Supported Firmware	63, 132
Update Firmware	63, 132
User Interface Test Mode	60, 127
Word Alignment	25, 51
Word Size	25, 57

EX-IQ-Box Clock Settings

Clock Source	78
--------------	----

EX-IQ-Box Receiver

Bit Order	95
Clock Phase	101
Clock Polarity	102
Clock Rate	103
Clock Skew	105
Clock Source	106
Data Rate	88

EX-IQ-Box Receiver

Format	89
I/Q Polarity	98
Installed Version	110
Interleaving	90
Logic Type	91
Negate I Data	96
Negate Q Data	98
Numeric Format	96
Sample/Clock Rate Ratio	104
Strobe Polarity	99
Strobe Position	100
Update Firmware	110
Word Alignment	94
Word Size	99

EX-IQ-Box Transmitter

Bit Order	95
Clock Phase	101
Clock Polarity	102
Clock Rate	103
Clock Skew	105
Clock Source	106
Data Rate	88
Format	89
I/Q Polarity	98
Installed Version	110
Interleaving	90
Logic Type	91
Negate I Data	96
Negate Q Data	98
Numeric Format	96
Sample/Clock Rate Ratio	104
Strobe Polarity	99
Strobe Position	100
Update Firmware	110
Word Alignment	94
Word Size	99

F

Firmware update	131
Installed Version	62, 110, 132
Supported Firmware	63, 132
Update Firmware	63, 110, 132
Format	19, 41, 70, 89
Parallel	19, 41, 89
Serial	19, 41, 89

G

Getting started	11
-----------------	----

I

I/Q Polarity29, 56, 77, 98
 Negative30, 56, 98, 104
 Positive29, 56, 98, 104

Input

IQ IN 5
 REF IN 5
 Reference signal 5
 Installed Version62, 110, 132
 Interfaces 113
 Interleaving21, 41, 90
 I/Q Interleaved22, 42, 72, 90
 Not Interleaved21, 41, 90
 Q/I Interleaved23, 41, 42, 90
 IQ Connection Test 127
 IQ IN 5
 IQ OUT 5
 IQ Output Settings 15

L**LED**

Error - R&S EX-IQ-Box 3
 Mode - R&S EX-IQ-Box 3
 Power - R&S EX-IQ-Box 6
 Logic Type16, 43, 91
 1.5V CMOS 18, 43, 44, 91
 1.8V CMOS17, 44, 91
 2.5V CMOS 17, 43, 44, 91
 3.3V CMOS 17, 43, 44, 91
 LVDS16, 43, 44, 91
 LVTTTL 17

M

Maintenance 134
 Mode - R&S EX-IQ-Box 3
 Mode LED - R&S EX-IQ-Box 3

N

Negate I Data29, 54, 96
 Negate Q Data29, 56, 98
 Numeric Format28, 54, 96
 2's Complement28, 55, 97
 Binary Offset29, 55, 97

O**Output**

IQ OUT 5
 Overview R&S Instruments 12

P

Power LED - R&S EX-IQ-Box 6
 Power Supply - R&S EX-IQ-Box 6
 Protection 126

R

REF IN 5
 Reference signal
 Input 5

S

Safety instructions 8
 Sample Rate 45
 Sample/Clock Rate Ratio 37, 45, 104
 SDR 20, 40, 88
 Selftest 125
 Check IQ Connection 59, 127, 129
 User Interface Test 127
 User Interface Test Mode 60, 127
 Service 125
 Setup Update 131
 Strobe Polarity 30, 57, 99
 Negative 31, 57, 99
 Positive 30, 57, 99
 Strobe Position 31, 58, 100
 Supported Firmware 63, 132
 Switching Off 11
 Switching On 10

T

TYCO Z-DOK 113

U

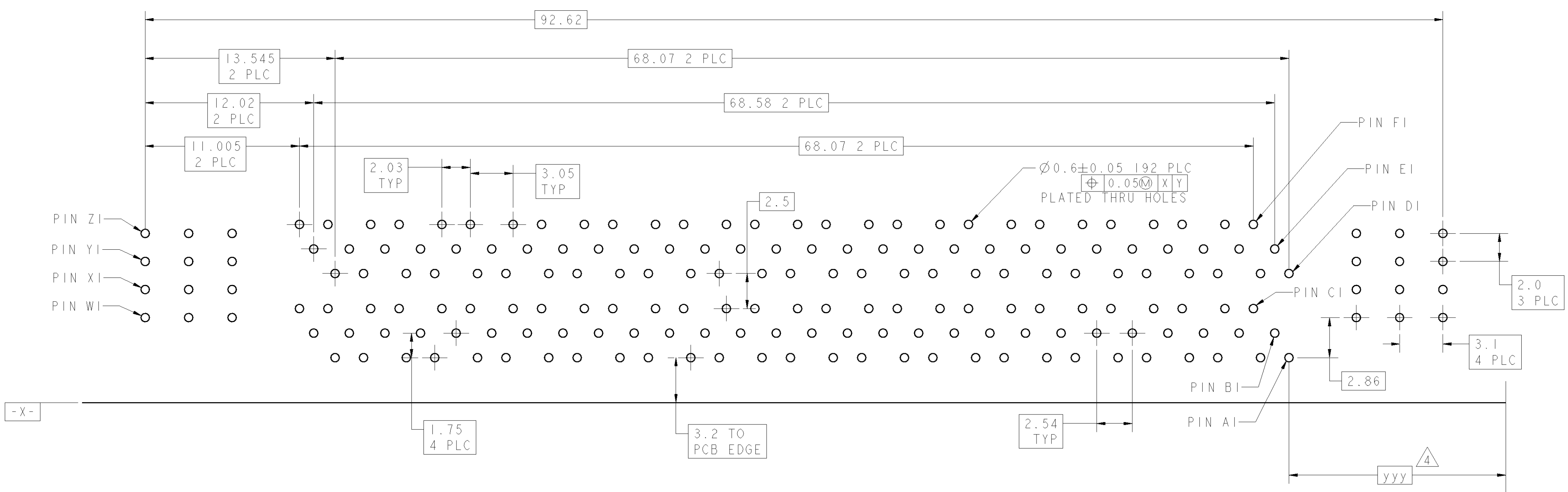
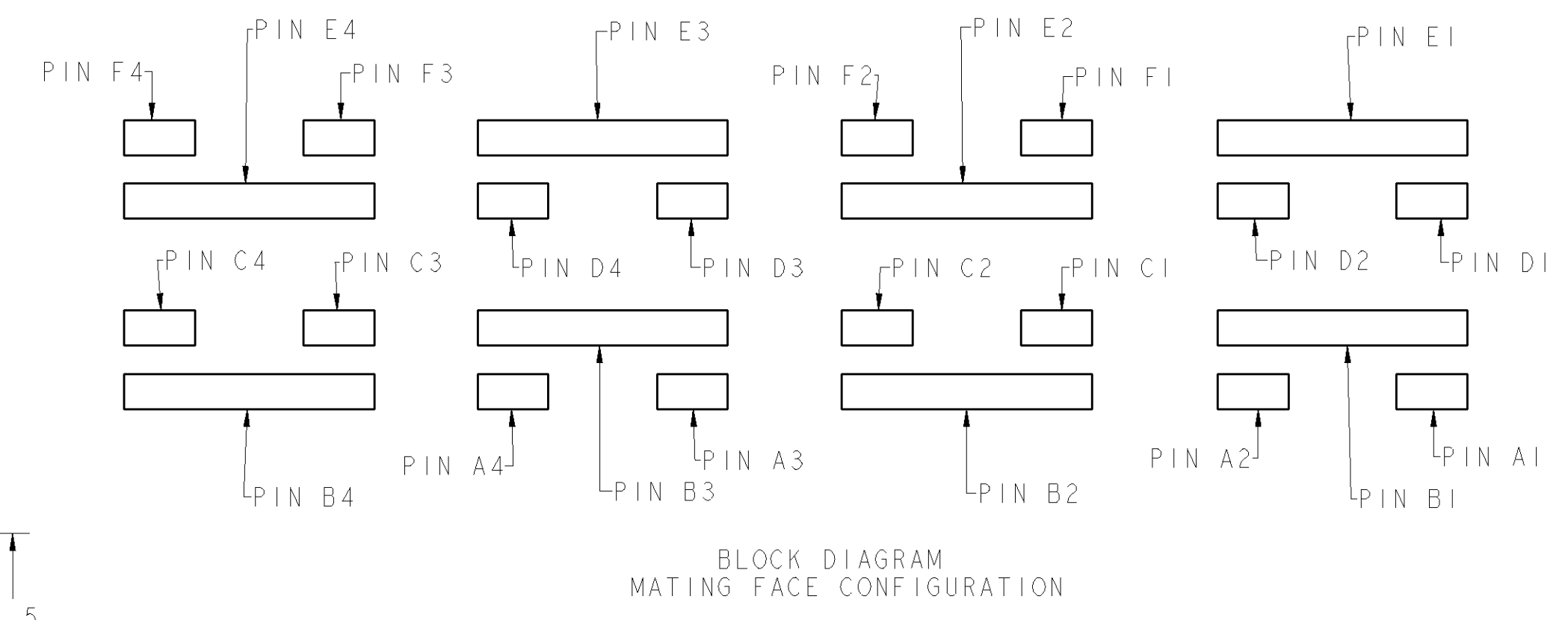
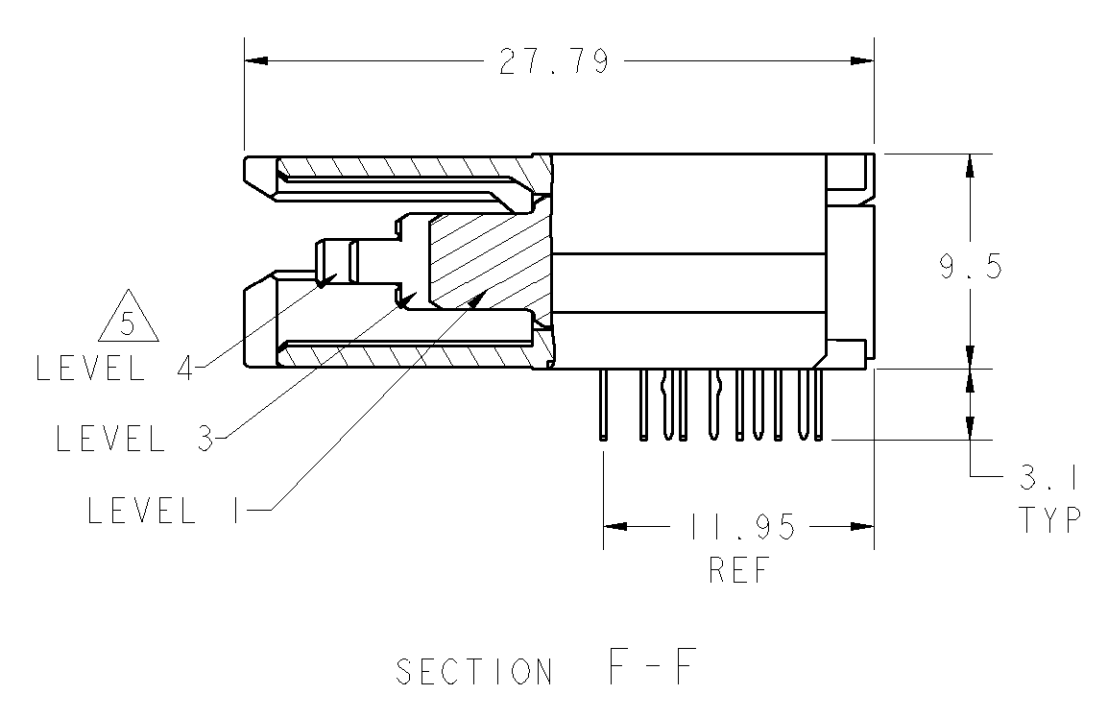
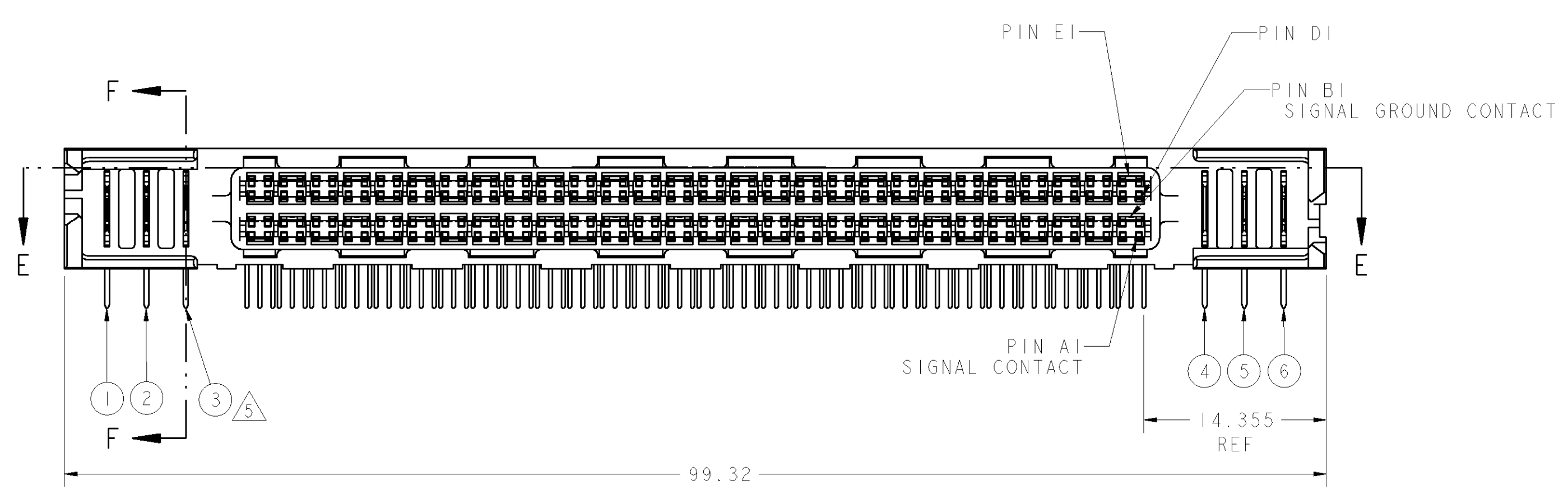
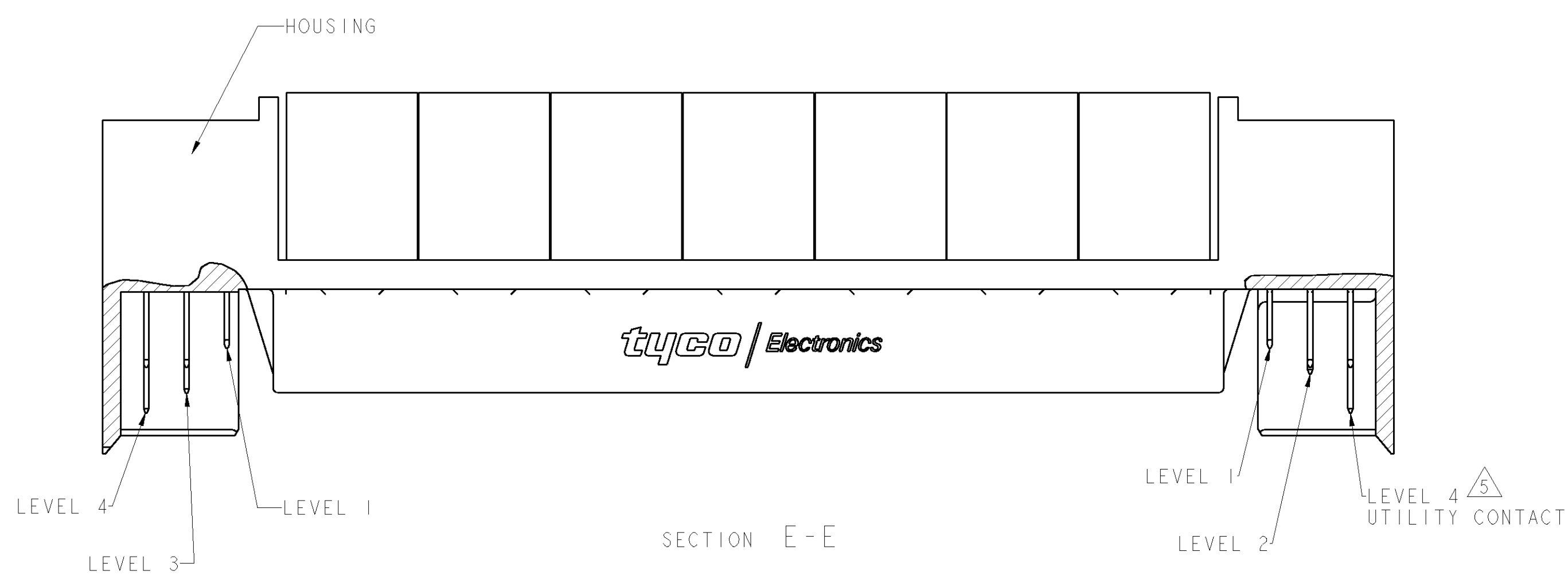
Update Firmware 63, 110, 132
 USB - Slave 4
 USB - Type B 4
 USB interface 4
 User interface 2
 User Interface 113
 Connector 113
 Pin Assignment 113
 User Interface Test 127
 User Interface Test Mode 60, 127

W

Word Alignment 25, 51, 94
 LSB 26, 52, 94
 MSB 25, 52, 94
 Word Size 25, 57, 99

LOC	DIST	REV	DATE	BY	APPD
GP	00	A	09SEP105	WVS	EB
		A1	01FEB2006	EDB	EDB

- 1. HOUSINGS; POLYESTER, UL 94V-0 RATED, NATURAL
 SIGNAL AND SIGNAL GROUND CONTACTS: COPPER ALLOY
 UTILITY CONTACTS: PHOSPHOR BRONZE
- 2. UTILITY CONTACTS: 0.76µm MIN GOLD IN CONTACT AREA,
 2.54µm MIN TIN-LEAD ON PCB TAILS, OVER 1.27µm MIN NICKEL OVER ALL.
 SIGNAL AND SIGNAL GROUND CONTACTS: 0.76µm MIN GOLD IN CONTACT AREA,
 2.54µm MIN TIN-LEAD ON PCB TAILS, OVER 1.27µm MIN NICKEL OVER ALL.
- 3. ROWS A, C, D, AND F ARE SIGNAL CONTACTS. ROWS B AND E ARE SIGNAL GROUND CONTACTS.
- 4. DIMENSIONS PER CUSTOMER BOARD LAYOUT.
- 5. SEE UTILITY CONTACT SEQUENCE TABLE FOR LOCATION AND LEVEL/LENGTH OF UTILITY CONTACTS FOR EACH PRODUCT PART NUMBER. UTILITY LEVEL 1 CAN BE USED FOR SENSING. UTILITY LEVELS 2, 3, AND 4 CAN BE USED FOR POWER, GROUND, OR ESD. SEQUENCING SHOWN IN SECTION E-E SHOWS THREE LEVELS FOR COMPARISON. UTILITY LEVEL 2 EQUALS THE SIGNAL GROUND CONTACT LEVEL. SIGNAL LEVEL IS BETWEEN UTILITY LEVELS 1 AND 2.
- 6. BLOCK DIAGRAM AND CONTACT IDENTIFICATION APPLY TO COPLANAR NON-INVERTED APPLICATION ONLY. CONTACT IDENTIFICATION REVERSES FOR INVERTED APPLICATIONS, I.E COPLANAR OR MID-BOARD INVERTED.



LEVEL	1	2	3	4	5	6	PART NUMBER
4	3	1	2	2	4	4	6367557-5
2	3	4	4	3	2	2	6367557-4
4	3	1	1	3	4	4	6367557-3
4	2	2	2	2	4	4	6367557-2
4	3	2	2	3	4	4	6367557-1

RECOMMENDED PC BOARD FOOTPRINT
 COMPONENT SIDE SHOWN
 SCALE 5:1

DIMENSIONS: mm TOLERANCES UNLESS OTHERWISE SPECIFIED: 0 PLC ± 1 PLC ±0.3 2 PLC ±0.25 3 PLC ± 4 PLC ± ANGLES ±		DWN: VAN SCYOC 09SEP105 ENR: E. BRIANT 09SEP105 APPD: E. BRIANT 09SEP105 PRODUCT SPEC: 108-1985 APPLICATION SPEC: 114-13068 WEIGHT: - CUSTOMER DRAWING		Tyco Electronics Harrisburg, PA 17105-3608 NAME: Z-DOK+ ADAPTER BOARD CONNECTOR ASSEMBLY, 56 SIGNAL DIFF. PAIR, 3 UTILITY CONTACTS PER SIDE SIZE: 00779 SCALE: 3:1 SHEET 1 OF 1 REV: A1	
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