

6622A-QHR Bridge

QUANTUM HALL RESISTANCE DCC BRIDGE

Introducing the World's Most Advanced QHR DCC Bridge!



6622A-QHR FEATURES

- ◆ Full 10 Digits (0.1 ppb) Display Resolution!
- ◆ Built-in Screen Display Providing Complete Measurement Results and Graphs!
- ◆ Change All Key parameters "on-the-fly" while the measurement is running!
- ◆ Linearity: ± 0.005 ppm of Full Scale!
- ◆ Measurement Accuracy: ± 0.02 ppm of Reading for 1 Ω to 10 k Ω Resistance Range!
- ◆ Fully Programmable USB, IEEE 488.2!
- ◆ Industry Standard SCPI Programming Command Language!
- ◆ BridgeWorks™ Data Acquisition Software!
- ◆ Unique Calibration Support Strategy!
- ◆ Complete Automated QHR Measurement Systems Available!

GUILDLINE INSTRUMENTS 6622A-QHR RESISTANCE BRIDGE

has been designed to provide better uncertainties and more operational capability in Direct Current Comparator (DCC) Resistance Bridges used with Quantum Hall Resistance Systems (i.e. QHRs).

The 6622A-QHR incorporates many new design and measurement technologies to provide a Precision Resistance Bridge operating at room temperature that will scale from the quantum Hall resistance value of 12 906.4035 Ω to nominal resistance values of 1 k Ω , 10 k Ω , and 100 k Ω . The 6622A-QHR full operating range is from 0.01 Ω to 100 k Ω .

The 6622A-QHR Bridge, utilizing an internal calibrated Nano-voltmeter as the null detector, is used to measure Hall resistances (R_{xy}) and longitudinal (R_{xx}) resistances and contact resistance of a quantum Hall device. The 6622A-QHR is capable of making the measurements necessary to ensure the accuracy of the QHR Resistance Standard.

The 6622A-QHR Provides the Best Measurement Performance of Any DCC Bridge Manufactured Today at the Convenience of Room Temperature Operation!

The 6622A-QHR incorporates a unique toroid design, internal Nano-voltmeter (i.e. null detector), and new firmware. The 6622A-QHR interface is easy to use while providing complete functionality for measurements and addressing the requirements for 17025 Accreditation of resistance measurements

The 6622A Series, which includes the QHR Model, incorporates the most advanced design and best operational features of any QHR Bridge. The 6622A is based on over 50 Years of Guildline's experience designing and manufacturing DCC Bridges; and incorporates customer feedback from over a two hundred Guildline 6622A Bridges in use at NIMs, militaries, and calibration laboratories.

6622A-QHR DCC Bridge

The many design concepts incorporated into the 6622A-QHR Bridge have been the result of over 50 years designing and manufacturing DCC Bridges. While the design enhancements are not visible, the end measurement results are clearly visible.



These techniques and designs allow for considerably less noise, faster measurement cycles, improved stability and repeatability, and an advanced operator interface. Guildline provides a separate data sheet for the 6622A-QHR as it is the only 6622A Bridge model that is not upgradeable, or able to work with other options such as the Temperature Option, Range Extender Series, and Voltage Outputs etc. The 6622A-QHR also incorporates a resistance range and ratios specifically targeting QHR Measurements.

The 6622A-QHR Bridge can be used to build up or down from the quantum Hall value of 12 906.4035 Ω to nominal resistance values of 1 k Ω , 10 k Ω , and 100 k Ω with a relative accuracy of 2×10^{-8} (i.e. 20 ppb at 2 sigma level) or better. In addition the 6622A-QHR operates across a resistance range from 0.01 Ω to 100 k Ω . The 6622A-QHR Bridge can be used stand-alone, with Guildline's Bridgeworks software or, with its advanced IEEE-488.2 Structure and Industry Standard SCPI Command Set. A customer

can easily use their own software to make automated measurements. An available 6664C Low Thermal Quad Matrix Scanner is also available to automate this process.

6622A-QHR – The Absolute Best in Engineering Design and Innovation

For quality in measurements, you must have quality design and quality manufacturing in your standard. If you examine the internal layout of the 6622A-QHR Bridge you will see the absolute quality in the entire bridge with special attention paid to insulating and use of ground planes to reduce noise, the latest in modern components to reduce affects due to temperature and power, increased resolution and stability in voltage and current, increased reliability, and faster measurement cycles. Add to this the latest and advanced designs and a carefully thought out and designed internal layout, and you will find a Bridge that will meet customer QHR requirements today, as well as years into the future.

Every effort has been taken in the 6622A-QHR design to reduce noise and error. **Thermal EMF effects are eliminated** by automatic current reversal. The **unique architecture** of the bridge and its **control algorithm** further removes gain and offset errors in the **Nano-voltmeter balance detector** and the **precision toroid**. The end results are shown by **long term accuracy and linearity** without the need for routine, frequent verification tests or calibrations. The 6622A-QHR incorporates unique 'self-calibration' functionality for the embedded null detector which is performed as part of each measurement. In addition, via the standard interchange technique, the bridge automatically performs a 'self-calibration' of the measurement ratios to $< 0.02 \times 10^{-6}$.



The Bridge provides a full 10 digits of resolution (i.e. 1 part in 10^{10} for all resistance values) and the ability to **graphically see** the data (trending). You can have the data presented in a **summary or detailed format** right on the Bridge Screen or available via PC Base BridgeWorks Software. Measurement and **Uncertainty Analysis** you need as a Metrologist or to meet the requirements of ISO 17025 Accreditation!



Examples of Actual 6622A Display Pictures Taken at Trade Shows - Note Std Dev is in ppm showing **ppb performance!**

The 6622A-QHR can be used in either a **fixed or automatic** mode of operation. In fixed mode, **measurement rate** is programmable, updating measurements from **every 2 seconds** to 14 minutes. A unique computerized measurement mode provides automatic reversal rates, optimizing the measurement rate to the required uncertainty. The 6622A-QHR, when used with the **Guildline Instruments Model 6634A Temperature Stabilized Resistance Standards**, effectively **eliminates errors** due to the effects of temperature environment.

6622A BridgeWorks Software

Not only does Guildline provide unique DCC Bridge hardware, but we offer complete solutions for software as well. Guildline's proven **BridgeWorks** software provides for setup, control, measurements, and reporting. BridgeWorks is provided free with any of the Bridges in the 6622A Series. **Optional BridgeWorks plug-ins** are available to expand BridgeWorks functionality, including control of a QHR System. BridgeWorks software is extremely powerful, yet **straight forward and user friendly**. The software comes with all of the useful and convenient features commonly found in **Windows based** commercial software programs. **On-line context help** is available to provide added assistance in understanding the functions of the software. BridgeWorks was **developed in LabVIEW®** offering direct compatibility to all National Instruments GPIB interfaces. These interfaces come in a wide variety of connection options to your PC such as **USB, FireWire, Ethernet, PCI, PCMCIA, IEEE 488.2 RS232/485** and more. Guildline can even provide a complete Resistance Measurement System with the 6622A Series by adding Resistance Standards, Scanners, and software. **Complete turnkey solutions!**

The BridgeWorks QHR plug-in software controls the 6622A-QHR Resistance Bridge, superconducting magnet and the rest of the QHR system. The QHR plug-in has routines to: check the remote connection of the instruments connected to the entire QHR System; display and change all system variables; and to modify control parameters and variables in order to optimize the QHR System to improve measurement uncertainty and speed. Note that the Guildline 6622A-QHR Bridge is the **only commercially available resistance bridge that allows dynamic changes to the measurement parameters** without having to stop the bridge and associated measurement. All other manufacturers require the measurement to be stopped in order to change key system variables.

For a **complete, automated resistance** measuring system, a 6622A-QHR Bridge can be used with Guildline's 6664C Low Thermal Scanners and Guildline's 6634A Temperature Stabilized Resistance Standards. When the Bridge is used with a Guildline low **thermal matrix scanner**, the software can turn the bridge into a **multiple-channel** calibration and measurement system. Timed, sequenced single or multiple tests can be initiated while the bridge is unattended.

All user **definable test variables**, such as excitation current, measurement speed, reversal rate, etc. can be **programmed on a per test basis**, giving the **users full control and flexibility** in conducting well designed experiments. Additionally, internal utilities reside within the software to enhance and **simplify the calibration of the 6622A Series DCC Bridge** by using the Guildline 6634A Series of Temperature Stabilized Resistance Standards.

6622A-QHR DCC Bridge

6622A-QHR Series Specifications

RESISTANCE STANDARD	RATIO SPECIFICATIONS			
ACTUAL RATIO	0.008 > Rx < 0.08	0.08 > Rx < 0.8	0.8 > Rx < 6.3	6.3 > Rx < 13.4
NOMINAL RATIO	0.01 : 1	0.1 : 1	1 : 1	10 : 1
1 Ω	± 0.6 ppm	± 0.3 ppm	± 0.02 ppm	± 0.02 ppm
10 Ω	± 0.6 ppm	± 0.3 ppm	± 0.02 ppm	± 0.02 ppm
100 Ω	± 0.6 ppm	± 0.3 ppm	± 0.02 ppm	± 0.02 ppm
1 kΩ	± 0.6 ppm	± 0.3 ppm	± 0.02 ppm	± 0.02 ppm
10 kΩ	± 0.6 ppm	± 0.3 ppm	± 0.02 ppm	± 0.1 ppm

Specifications are relative, 2 Sigma (95 % Confidence Level) and include a ±1 °C Temperature Environment. Specifications are valid for 1 year

GENERAL SPECIFICATIONS			
Linearity	± 0.005 ppm (1:1 to 13.4:1 Ratios)		
Display resolution (ppm)	Selectable (Programmable) from 0.0001 ppm to 10 ppm		
Temperature Coefficient	0.01 ppm/°C of reading (Outside Operating Temperature)		
Automatic current reversal rate (in seconds)	4 to 1637 programmable, increment of 1 second		
Fastest Measurement Sample Rate	2 seconds		
Communication	USB, IEEE 488.2, SCPI Based Language Instructions		
Test current (for measurements to 100 kΩ)	Range (±30Vdc compliance)	10 μA to 150 mA	
	Resolution (μA)	1 μA	
	Accuracy [error(ppm) + offset(A)]	±100 ppm ± 10 μA	
Bridge Operating Temperature to Full Specifications	21 °C to 25 °C	69.8 °F to 77 °F	
Bridge Maximum Operating Range (<50 % RH)	+18 °C to +28 °C	+65 °F to +82 °F	
Bridge Temperature Storage Range	-20 °C to +60 °C	-4 °F to +140 °F	
Power Requirements	Vac: 100 V, 120 V, 220 V, 230 V and 240 V; All ± 10 % 50 or 60 Hz ±5 %, Or 45 Hz – 65 Hz		
Dimensions (Width x Height x Depth)		Weight	
440 mm x 200 mm x 465 mm		17.3" x 7.8" x 18.3"	27 kg 59.5 lbs

ORDERING INFORMATION	
6622A-QHR	QHR Bridge
	Includes Calibration Certificate, Operator and Software manual, and one set of Rs/Rx Low Thermal Leads
/RC	Report of Calibration Available at Nominal Charge
/RT	Specifies Rear Terminals versus Front Terminals (Default)