Measurements International

Metrology is Our Science, Accuracy is Our Business™

TRANSPORTABLE & AFFORDABLE QHR STANDARD

MODEL 6800B

- Accuracy to < 0.02 ppm
- Features Accubridge® Technology
- Built in Rxx (uVolt) Measurements for Sweep Check, Contact Resistance Measurements
- Built in Rxy (nVolt) Measurements for Dissipation Measurements
- Direct Transfer to 1 kΩ and 10 kΩ Std
- System Range 0.1 Ω to 100 kΩ
- Helium Recovery System Feeds the Cryostat Boil-Off Directly to the Helium Re-Liquefier
- Average Liquefaction Rate of 20 Liters/Day
- Power Failure Battery Backup Detection
- Built in Safety Shutdown Feature
- Fully Automated Build Up or Build Down from QHR Value
- Manual or IEEE-488 Controlled
- 8 Tesla or 9 Tesla Magnet
- Room Temperature DCC Requires No Liquid Helium to Operate
- Sample Interchange Design
- System, Bridge, Samples Calibrated/Verified by NMI
- Graphic Compatible
- 6800B Chosen By NIST For Graphic Research Collaboration

MODEL 6800B QHR STANDARD

The Quantized Hall Resistance Standard is internationally recognized as the representation of the ohm and is the most stable resistance standard known. Many national laboratories and industries are finding a need to provide highly accurate, traceable reference standards in support of their “hi-tech” environments. The 6800B system has been developed to meet the needs of national laboratories and primary industrial laboratories around the world.

The MI 6800B (Quantized Hall Resistance Standard) is a fully automated primary standard developed as an economic means to provide a highly reproducible resistance standard. This system is a completely “turn-key” system and requires little to no manual intervention. A wide neck storage dewar and instrumentation rack are mounted on castors for portability. A variable temperature pumped ^{4}He refrigerator with integral 8 Tesla, or optional 9 Tesla magnet can be installed.

With the integrated helium re-liquification system, you have your own helium store. Liquid helium shortages, erratic deliveries and steady price increases have become common place. This shortage with the continuous price increases causes many labs to have difficulty efficiently completing their measurement goals. Measurements International solves this problem with their re-liquification helium liquefier; which is like having your own liquid helium store.

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MI has integrated a super-conducting magnet system into a small, laboratory helium liquefier allowing for near zero-loss of this system. There are minimal fees associated with the operation of the liquefier that are far outweighed by the high cost of liquid helium. Traditionally, depending upon liquid helium usage, a system will pay for itself within two years of continuous operation.

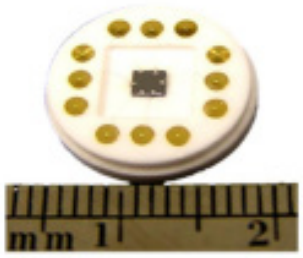
System Operation time can be defined as follows:

1. Cool Down of System – 2 days.
2. Sample checks – ½ day.
3. QHR measurements vs. 1 kΩ – ½ day.
4. Scaling down to 0.1 Ω or up to 100 kΩ – 1 day.

Within one week all system operation can be completed.

The system is a development of many years of experience in Quantized Hall System Design, Resistance Measurements, and Cryogenics.

The 6800B system is the first portable Quantized Hall Resistance Standard in the world and consists of three parts, all of which are supplied and described on the following page.



Sample: The 6800B Resistance Standard sample provides the absolute value of resistance related to the von Klitzing constant of 25 812.807 459 3045 Ω. Operating on step i = 2 and i = 4 plateau, the 6800B compares the QHR value of 12 906.40373 Ω and 6453.201865 Ω to either a 10 kΩ or 1 kΩ resistor. The reference or sample, developed at the National Research Council of Canada (NRCC) is maintained at 1.2 K in a mobile 40 L helium-filled dewar with fields to 8 T or 9 T supplied by the integral magnet. Due to its integrated helium recovery system, 6800B is designed to operate continuously. Special precautions have been taken to avoid contaminating or damaging the sample.

Cryogenics: The 6800B consists of a 40 liters dewar with a pumped ^{4}He refrigerator, an 8 Telsa or 9 Telsa superconducting magnet with support assembly, temperature sensor, heater and a 19" instrument rack with superconducting magnet power supply, temperature controller, helium level sensor and an oil-free mechanical vacuum pump.

The dewar is mounted on heavy-duty castors for transportability from one room to another. The system can also be shipped cold from one facility to another as a primary reference transfer standard.

Recent design improvements to the system have been implemented to allow for the addition of an easier method for sample interchange. By including this into the design, users of the 6800B can now easily interchange samples at their convenience without exposing the sample to atmosphere until it has reached room temperature.

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The model 6800B has been designed to address customers need for a more economical system helping relieve the dependence for having to purchase liquid helium every time you wish to operate the system.

Previous systems required the purchase of 100 liters of liquid helium. The cost of liquid helium is still increasing and will increase going forward. With the 6800B system, customers can now cool down the system using helium gas cylinders (9 – 10 required) at an estimated cost of approximate $100/cylinder.

MI is ONLY commercial supplier of the QHR system.

Further to this, MI can also offer the optional direct helium recovery system where the boil off gas is captured and stored in a separate space aged portable gas storage tank.

Making it the ideal solution for long term shutdown. With system closed loop operation, no external plumbing or gas bag is required. The 6800B provides a system which has an average liquefaction rate of 18 liters per day.

Measurement System: An improved Direct Current Comparator Bridge (Model **Accubridge® 6020Q**) operating in room temperature air which allows two resistors to be compared with accuracies to 2 part in 10^{-8}. The Accubridge® 6020Q Bridge is used to compare the QHR device directly to either a 10 kΩ or 1 kΩ standard resistor. The bridge can also be used to measure the field dependence of Rxx and Rxy, to make precision measurements of Rxx and to measure the contact resistance of the QHR device: in short, to carry out all the measurements necessary to ensure the accuracy of the QHR resistor. The bridge and low thermal matrix scanner can then be used to build up or down from the 1 kΩ resistor to establish values for 1, 10, 100, 1 k, 10 k and 100 kΩ primary resistors to a very high level of accuracy. The 6020Q Bridge can be used stand-alone or with Measurements International's 6800B software for automated measurements.

The 6800B system is modular in design and the three parts, the 6800B sample, the 6800B Cryogenics and the 6020Q Bridge may be purchased separately. Several options are available to the user including extra QHR samples, a stainless steel liquid helium transfer line to allow continuous operation.

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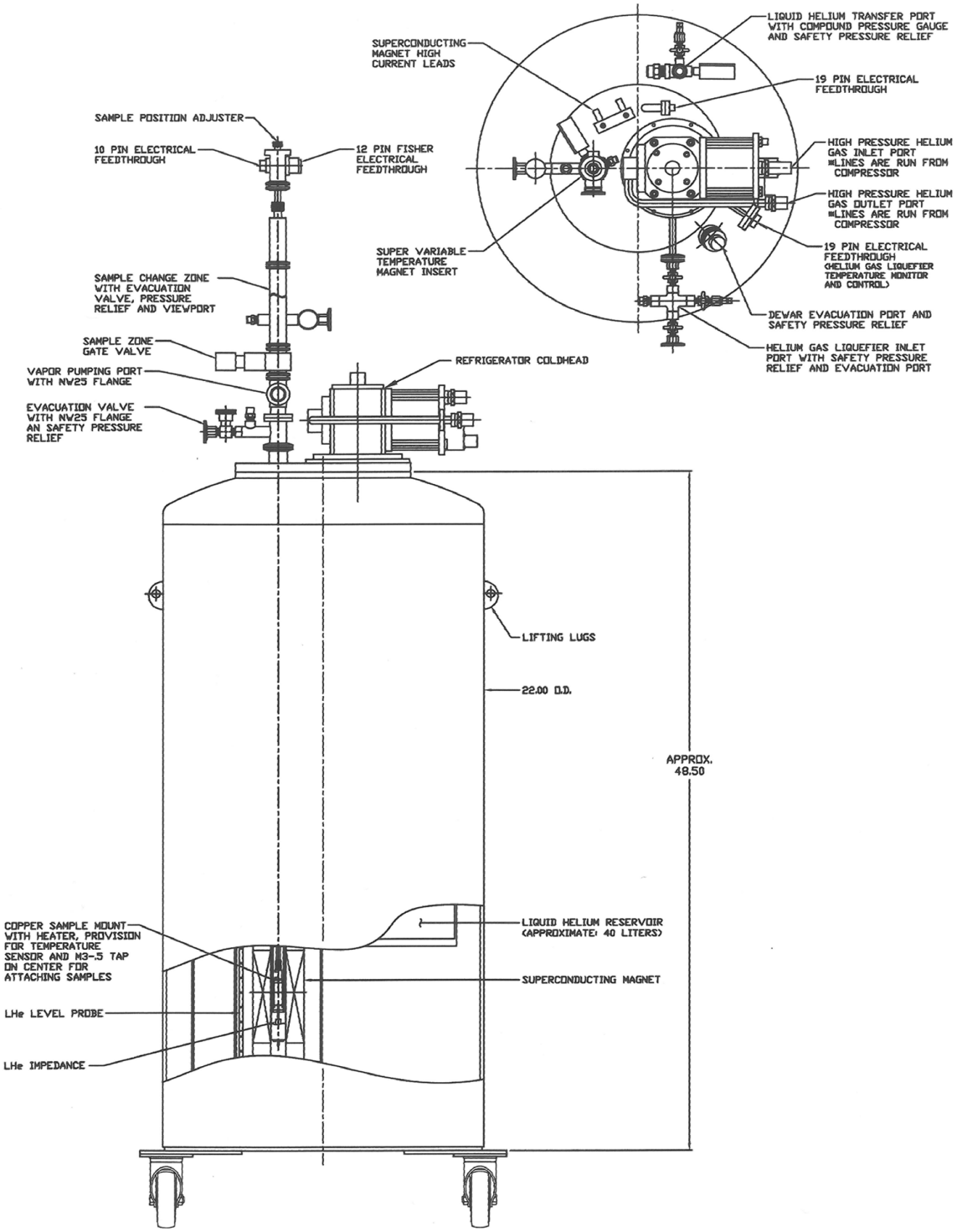

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Additional Options

Option A: Direct Helium Gas Recovery System for Long Term Storage

Accessories

9400
Standard Resistor Oil Bath

9300A
Temperature Controlled Standard Resistor Air Bath with GPIB

9210A-1 (Primary)
1 Ω Resistor with Carrying Case

9331R (Primary)
Series of Four Terminal Air Resistors from 1 Ω to 100 kΩ

9331 (Secondary)
Series of Four Terminal Air Resistors from 1 mΩ to 100 MΩ

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Specifications: Rev 2

Accuracy QHR to 1 k	< 2 x 10^{-8}
Stability	< 1 x 10^{-8}
Insulation Resistance	> 10^{13} Ohms
Magnet Strength	8 Tesla or 9 Tesla
Plateaus	i=2, i=4
Temperature	^{4}He, 1.2 Kelvin
Dewar Size	40 Liters
Operating Environment	18 to 34 °C, 10 to 80 % RH
Warranty	1 Year Parts & Labour

Note:
Either R_s or R_x can be selected as the standard. Uncertainties specified at 2 sigma level (95 %) includes all secondary specifications such as linearity and noise with a ± 2 °C temperature variance

	0.1 Ω to 100 kΩ			
R_s or R_x	**Ratio & Uncertainty (ppm)**			
	0.1:1	**1:1**	**10:1**	**14:1**
1 Ω	< 0.05	< 0.015	< 0.015	< 0.02
10 Ω	< 0.02	< 0.015	< 0.015	< 0.02
100 Ω	< 0.02	< 0.015	< 0.015	< 0.02
1 kΩ	< 0.02	< 0.015	< 0.02	< 0.02
10 kΩ	< 0.02	< 0.02	< 0.05	

Measurement Mode	4-wire
Linearity	< 0.005 ppm of full scale
Operating Conditions	10 °C to 35 °C, 10 % to 90 % RH non-condensing
Test Current Range	10 µA to 150 mA
Test Current Resolution	18-bit
Interface	IEEE-488
Display	Touch Screen Display (No external keyboard), Resolution 0.001 ppm

Refer to 6020Q Spec Rev 0

Dimensions (L × W × H):
122 × 49 × 46 (cm) (Rack)

Weight:
137 kg

Shipping Weight:
160 kg

Operating Power:
100, 120, 220, 240 V - 50/60 Hz

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