6530 TERAOHM BRIDGE-METER SERIES

OUTPERFORMS COMMERCIAL DUAL-SOURCE DEVICES

Dual Mode, Ultra Accurate, High Resistance Measurement Standards

GUILDLINE Instruments 6530 TeraOhm Bridge-Meter Series is the latest innovation in High Resistance and Ultra-High Resistance Measurements. These Bridge-Meters incorporate the latest technology for high resistance measurements providing Metrologists with measurement results superior to that of commercially available Dual Source Bridges. The 6530 Series allows users to make Direct Resistance Measurements as well as Bridge Ratio Measurements up to 20 PΩ with the best uncertainties above 1 GΩ of any *commercially available* resistance measurement instrument.

GUILDLINE'S 6530-XP & XPR MODELS ACHIEVE THE HIGHEST ACCURACY, LOWEST UNCERTAINTIES, AND WIDEST RESISTANCE MEASUREMENT RANGES OF ANY COMMERCIALLY AVAILABLE HIGH RESISTANCE MEASUREMENT INSTRUMENT TODAY!

FEATURES

- Bridge Mode and Direct Measurement Mode of Operation
- Resistance Range 100 kΩ to Over 10 PΩ
- Bridge Mode Multi-Ratios up to 1000:1
- Test Voltages 1 to 1000 V
- Optional DC Current Measurement Range 10 µA to 100 fA
- Automatic Ranging for Resistance, Integration Time and Threshold Voltage
- Better Performance & More Functionality than Commercially Available Dual Source Bridges
- Surface and Volume Resistivity Measurements with 65221 Test Fixture
- Environmental Monitoring with 65220 Sensors
- Logging, Graphical Display and Analysis of Measurements
- Sofcal™ for On-Board Intelligence and Front Panel Calibration
- Automation of Multiple Measurements with Guildline 6564 Resistance Scanner
- TeraCal™ Data Acquisition Software Automates Operation
- SCPI compliant IEEE-488.2 and RS232C Built-In as Standard
- Rear Input Option

With the 6530 Series of TeraOhm Bridge-Meters, the choice and selection are uniquely tailored to customers' measurement and workload requirements. The 6530 Series has four models providing customer selection for resistance measurements and uncertainties based on individual requirements.

Upgrade paths are provided allowing complete user investment protection. Existing Guildline 6530 Teraohmmeter customers can upgrade to any of the four eXtended Performance and Range models. A complete software package TeraCal™, is supplied with every system. Whether used in automated solutions or in stand-alone applications, the 6530 Series provides a fully automated method for calibrating both high and ultra-high resistance values and allows for direct Surface and Volume Resistivity measurements.

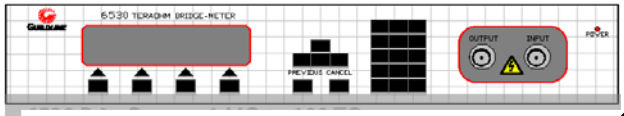
With Guildline's 6564 High Resistance Scanner, fully automated multiple measurements can be made for values all the way to 10 PΩ's, with voltages to 1000 VDC. The 6564 Scanner greatly improves measurement and calibration throughput for multiple high and ultra-high ohm resistors. This is automation capability not available with dual source bridges, or with other high resistance measurement instruments.

Modularity and Upgradeability – *Investment Protection*

Like our **highly successful 6622A** Series of Direct Current Comparator Bridges, the 6530 TeraOhm Bridge-Meter is a complete Series with models providing customer choices in Resistance Ranges, Functionality, and Uncertainties.

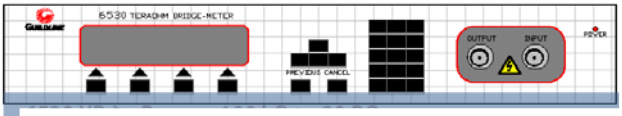
All models have the same **unique design and engineering features** described, however not all users require the same resistance ranges or uncertainties for their individual laboratories. There are **four models available** in the 6530 Series. Each model can be upgraded if future workload requirements dictate additional capability. An optional current measurement function is also available for all models.

6530- **B**ASE MODEL



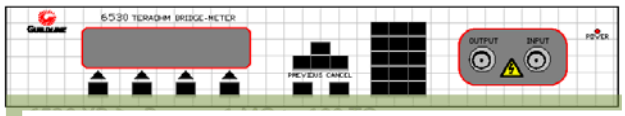
6530 B ► Range: 1 MΩ to 100 TΩ
Best Bridge Mode Uncertainty: 25 ppm
Best Direct Measurement Uncertainty: 150 ppm

6530 - E**X**TENDED **R**ANGE



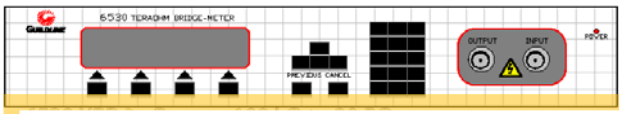
6530 XR ► Range: 100 kΩ to 20 PΩ
Best Bridge Mode Uncertainty: 15 ppm
Best Direct Measurement Uncertainty: 100 ppm

6530 - E**X**TENDED **P**ERFORMANCE



6530 XP ► Range: 1 MΩ to 100 TΩ
Best Bridge Mode Uncertainty: 8 ppm
Best Direct Measurement Uncertainty: 80 ppm

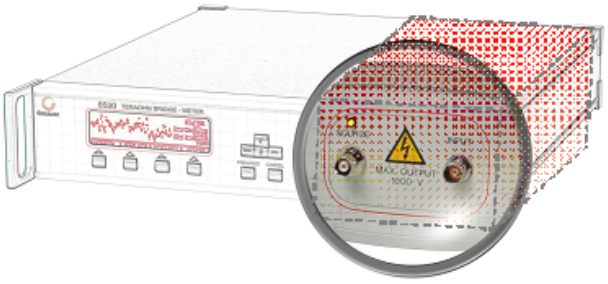
6530 - E**X**TENDED **P**ERFORMANCE & **R**ANGE



6530 XPR ► Range: 100 kΩ to 20 PΩ
Best Bridge Mode Uncertainty: 8 ppm
Best Direct Measurement Uncertainty: 80 ppm

Incorporating Innovation in Engineering and Design

Take a look at the **Guildline 6530 TeraOhm Bridge-Meter Series** and you will find it has been completely re-engineered to provide this improved performance. The unique ***temperature controlled measurement chamber*** behind the input and source terminals keeps all internal measurements at the same temperature. This chamber is also **heavily shielded** for protection against noise. Thus, the 6530 Series is **not affected** by changes in **temperature from (23±5) °C.** Air flow is also directed to maximize cooling efficiency while keep any air movement away from the measurement circuitry.



This **controlled and shielded chamber** provides clear advantages when compared to commercially available dual source bridges that typically have a temperature coefficient of 10 µΩ/Ω per °C, which means that the actual uncertainties when using a dual source bridge are typically 3x to 10x larger than their reported uncertainties in a normal laboratory environment. Additionally, since the 6530 is **not a potentiometer based measurement**, it provides **better EMI shielding** and is not affected by outside environment factors. In contrast dual source bridge measurements are very environmental sensitive and even having an operator present while measurements are made will affect the results!

Measurement Collection – It's not enough anymore to just collect the measurements. **Variables that affect** the measurement must be **identified and analyzed**. The **6530 Series provides the ability** to collect, store and time stamp temperature, relative humidity and barometric pressure. All variables that adversely impact high resistance measurements!

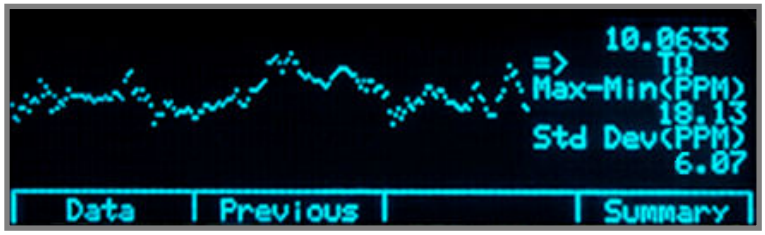
The Front Panel **provides all measured values** and can graphically display on-going measurements as well as environmental conditions. This provides an easy method of determining the settling time of a measurement and the stability of a resistor. The system can also **internally calculate and display Min, Max, Average, and Standard Deviation values** that allow analysis of measurements, all without the need for a computer. In fact, the 6530 displays a warning right on the display anytime you are trying to use parameters that would invalidate the measurement results!

Measurements Setups – The 6530 Series **allows the user**, not the manufacture, to define the measurement sample and test parameters. While Guildline provides recommended setups, **all test configurations can be easily changed** and **even saved into one of 36 user profiles** for fast and controlled measurement setups.

For both automated and manual operation **users have control over important test parameters** such as Integration Times, Threshold and Test Voltages, and Voltage Reversal Rates. However, **an Auto mode allows the 6530 Series** to determine appropriate resistance range, integration time and applied voltage for any measurement. A combination of selected integration times (5 mSec to 1000 Sec) and selected test voltages (1 V to 1000 V) also allow the user to **measure voltage coefficients** for resistivity and resistance measurements.

Measurement Analysis – The 6530 Series provides the capability to **fully analyze all measurements** without having to use a computer. **Important information** is available on the instrument display, such as calculated average reading, standard deviations of the measurements, measurement sample size, minimum and maximum readings achieved, etc. – all there **at the push of a button**.

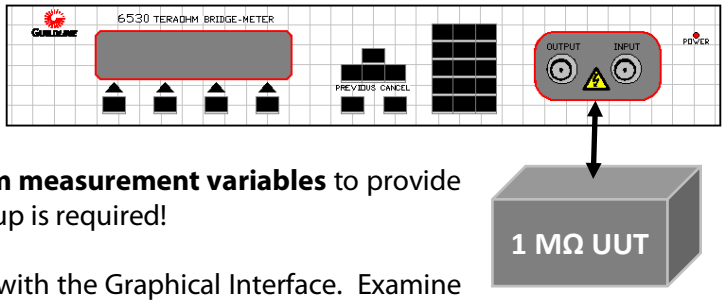
Trending Measurements – The ability to **see measurement trends** allows users an **unparalleled look** at the **measurement cycle.** Visually see the measurement affects when changing setup variables such as voltage polarities, integration times or capacitance values. Also **see the measurement affects** due to temperature, pressure or humidity changes. The 6530 Series allows you **to see the complete or immediate measurement processes** at your leisure, not ours. See what you have been missing!



The 6530 Series utilizes internal firmware menus (Sofcal™) **to configure the IEEE-488.2 and the RS232C** interfaces that come standard. In addition, Sofcal™ provides supply and reference voltage diagnostics, protection resistor compensation, integrator linearity check and standard calibration from the front panel. An **Artifact calibration** is simply achieved by connecting a known reference resistor to the input connectors (accessory 9336-100M) and starting the Artifact calibration procedure. The on-board firmware also provides **self-test and diagnostic help features**.

6530 Series Dual Modes of Operations

Direct Measurement Mode

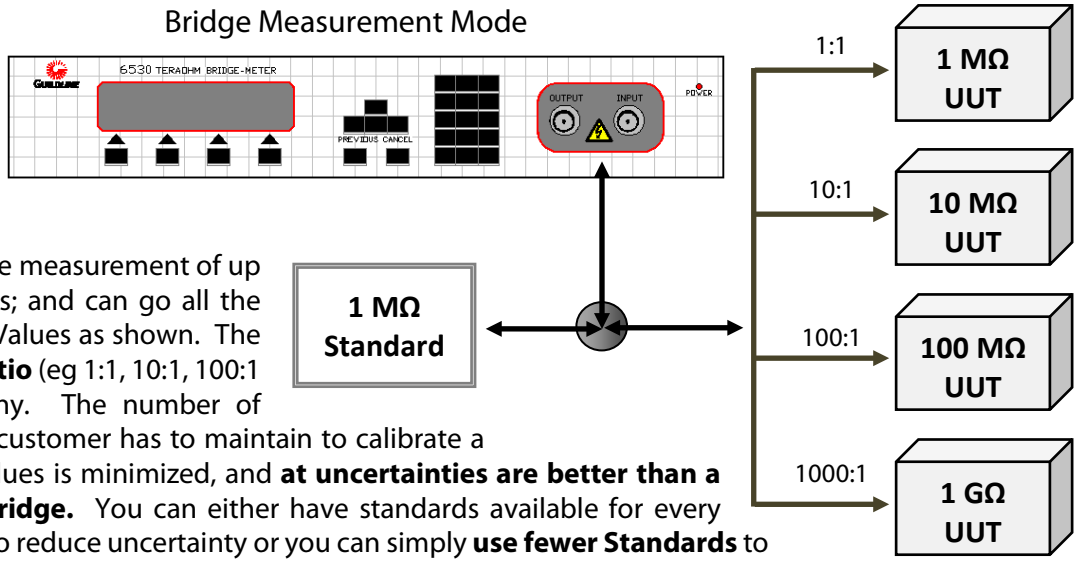


Direct Measurement Mode – The direct measurement mode is just as the name implies – **a direct measurement of a Standard connected** to the terminals. This is the easiest mode to operate. Simply connect a Standard to the terminals and press AUTO. The **6530 will find the optimum measurement variables** to provide the **best possible measurement result. NO** operational setup is required!

Feel free to **monitor the measurement while it is running** with the Graphical Interface. Examine the intermediate and summary results without ever having to stop the process. **Easy to use**, easy to monitor and unlike a Dual Source Bridge, measurements can be made without having to connect a PC and **without the need of a reference resistance standard**.

Bridge Measurement Mode – The Bridge Measurement Mode **provides the best possible uncertainties**, while at the same time allowing for the minimum number of standards used to cover the broadest possible range of High Resistance Measurements. **This measurement mode has the capability to ratio up** to measure values as high as 1000x more than the Reference Resistance Standard. The process is simple and completely automated. Just connect the Reference Resistance Standard you wish to ratio up from (such as a 1 MΩ). The **TeraCal Software characterizes** the ratio errors and stores the Bridge Mode uncertainties you can use for the day.

Bridge Measurement Mode



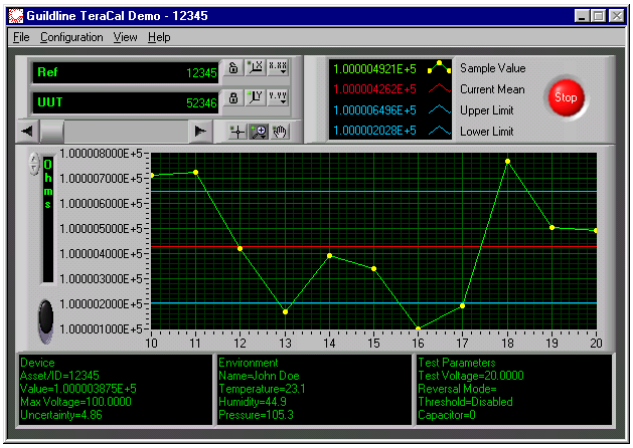
The 6530 Bridge Mode will allow for example, a 1 MΩ Resistor to calibrate or measure Resistance standards to **very low uncertainties up to 100:1 Ratios** which would allow the measurement of up to 100 MΩ Resistance Values; and can go all the way to a maximum of 1 GΩ Values as shown. The **advantages of this multi-ratio** (eg 1:1, 10:1, 100:1 and 1000:1) mode are many. The number of Resistance Standards that a customer has to maintain to calibrate a wide range of Resistance Values is minimized, and **at uncertainties are better than a commercial Dual Source Bridge.** You can either have standards available for every decade and cross reference to reduce uncertainty or you can simply **use fewer Standards** to calibrate a wide Range of High Value Resistance Values (UUTs). And of course in Direct Measurement Mode you do not need any Reference Standards.

This process is **completely automated with the TeraCal software** that is provided. Add a 6564 Scanner, and now you are talking about **true automation** and the cross-verification of results. In contrast a **dual source bridge does not have this flexibility**.

Production line testing, calibration of electrometers, semiconductor testing, capacitance leakage measurement, film surface and volume resistivity measurement, and other applications (performed in the past by previous Teraohmmeters) **can all be automated by using the 6530 Series**. Guildline's **6564 High Resistance Scanner** allows multiple automated measurements to be made **up to 10 PΩ's with isolation >100 PΩ**. In the current mode, the 6530 Series can also be used to measure chemical reaction rates, photo-electric effects and ionization effects. This is the **widest range of supported applications available** from any high resistance instrument.

TeraCal™ Software

A 6530 **can be remotely controlled and automated** via Guildline's TeraCal™ software by using the IEEE-488.2 interface. TeraCal™ is a convenient Windows®-based software program, developed using the National Instruments LabVIEW™ platform and designed specifically for Metrologists. The latest version of the TeraCal™ software provides **full SCPI based GPIB control of the 6530 TeraOhm Bridge-Meter**. It provides data storage, report/certificate generation, and utilities to allow a variety of other resistance characteristics to be measured. Data can also be **easily exported to Microsoft Excel**. TeraCal™ calculates expanded uncertainty by either using expanded or alternatively uncertainties can be arithmetically summed.

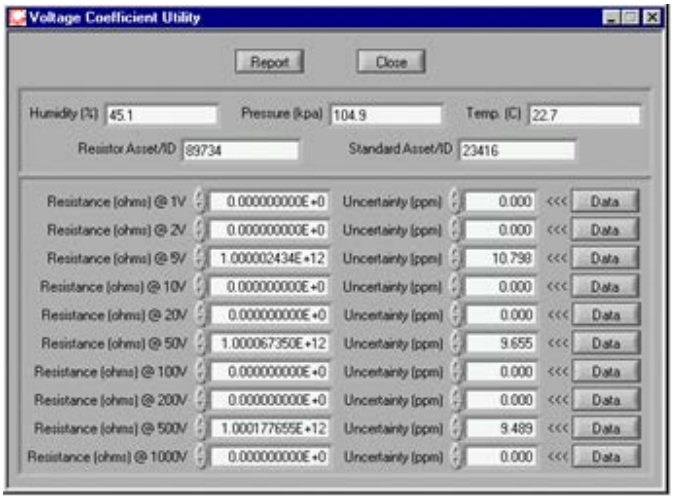


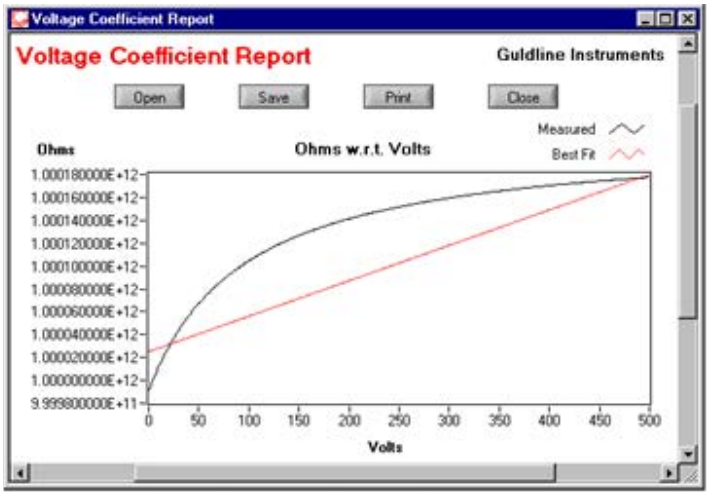
Features of TeraCal include

- ***Measurement Automation***
- ***Surface/Volume Resistivity***
- ***Voltage Coefficient Measurements***
- ***Export to Excel, Crystal, and HTML***
- ***Data and Trend Analysis***
- ***Uncertainty Calculation***
- ***Data Logger Acquisition***
- ***Device Profiling***
- ***3D Graphical Look***

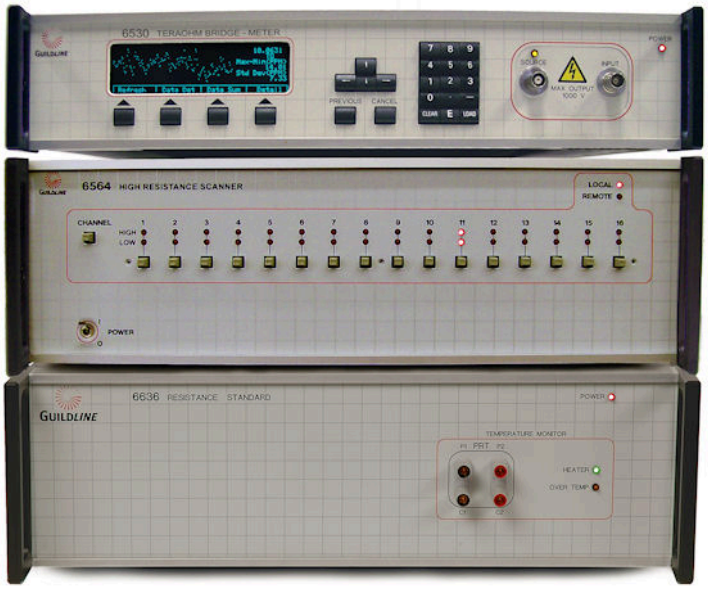
TeraCal™ provides **easy to use controls, data storage, report generation** and utilities for the performance of a variety of resistance measurements. When used with the **65221 test fixture**, this **includes surface and volume resistivity**. When the optional **65220 environmental sensors** are installed, the ambient temperature, humidity and pressure **can be recorded**.

TeraCal™ Utilities **make test setups easy to do**, and the reports allow **powerful analysis of the data**. Utilities take full advantage of the **unique automation features** that Guildline Standards provide. Whether you want to use the **6564 Scanners for multiple measurements,** or for the ease of Bridge Mode measurements, or to calculate or check Voltage Coefficients, or to **verify important temperature coefficients** for High Value Resistance Standards; Guildline has an automated solution for you! **Automated solutions that no-one else can provide!**





A Complete High Resistance Automated Solution



Looking for Complete Automation of **High Resistance Standards? Guildline Offers a Unique Solution.**

The 6530 becomes **even more powerful** when used with our **unique 6636 Series** of High Resistance Temperature Stabilized Resistance Standards and our **6564 Series of High Resistance Scanners** (shown at left).

The 6636 Resistance Standards provides up to **eight values from 100 kΩ to 100 TΩ** that are in their **own temperature stabilized** and **shielded environment**; and when used within a (23±5)°C laboratory environment, absolutely minimizes any affect from temperature or noise. For example, the **temperature coefficient** on a **100 GΩ** resistor is just 10 µΩ/Ω for a ±5 °C temperature change vs 250 µΩ/Ω per °C for our best Air Stabilized 100 GΩ Resistance Standard.

Complete the system with either our **8 or 16 channel 6564 High Resistance Scanner** and then simply run a batch measurement from the TeraCal™ Software and you can easily address multiple and difficult high resistance measurements with a **cost effective and time saving solution**. For example, a complete range of resistance standards from 100 kΩ to 100 TΩ can be calibrated in a single day **without operator intervention**. The 6564 Scanner **can handle the high output (1000V) voltage** of the 6530 Series and the entire range of the 6636 Resistance Standards, while adding minimal uncertainty for measurements less than 100 TΩ's. **Guildline** is the **only company that can offer so much** in such a compact and complete solution.

5032 Programmable Air Bath

Not only do we provide the **best on the measurement** side, but can **uniquely address the Resistors** you are calibrating! What about the effects of Noise, Temperature and **other variables** that also affect these devices?

Take a look at the **5030 Series of Programmable Temperature Air Baths**. These Stainless steel, double-walled, dual fan, 1 mK settable resolution Air Baths will not only provide **excellent temperature control**, but also provide **protection against affects** such as Noise or EMI due to the **excellent shielding and grounding** these Air Baths provide!

Like the 6530, this **Air Bath is fully programmable** via the Standard **IEEE 488.2 bus** with optional drivers already in the TeraCal™ Software or **you can program this Air Bath** right from the **front panel** with a full menu system!

6530 Options

65220 Environmental Monitors

With a **wide selection of options available**, the power of the 6530 Series is greatly increased.

Added features include the ability to automatically record the ambient temperature, humidity and pressure via the **65220 environmental option** or via user provided equipment. The **information is logged and time stamped** so a change in any of these conditions, which may have affected the measurement, is readily available.

Environmental Monitor (65220 Option)	Range	12 Month Uncertainty
Temperature	-50 °C to 100 °C	±0.5 °C
Humidity:	0 % to 100 % RH	±2 RH
Atmospheric Pressure:	15 to 115 kPa	±0.5 kPa

Other options including **Shielded and Environmental enclosures**, Surface and Volume Resistivity fixtures, Calibration Kits, and Lead Kits allow **Metrologists to support** their own 6530. Refer to the 6520 Series option datasheet for a description of available options – all of which work with the 6530 TeraOhm Bridge-Meter.

Life Cycle Support

User support of the 6530 Series **has never been easier**. Users have **choices in Calibration Philosophies**.

For easy verification, users can perform an **Artifact Calibration**. The Artifact calibration provides a high degree of confidence that the instrument is working within specifications and is **also a tool for adjusting the instrument**. This verification is achieved by the use of a single 100 MΩ standard resistor connected to the front or optional rear terminals. An internal program (SofCal™) then uses this resistor to **perform an automated procedure similar** to techniques used in other manufacturer's Artifact calibration routines.

When a **full calibration and verification is performed**, the 6530 Series is the most advanced and accurate high resistance measurement standard today. A full calibration is achieved by first performing an Artifact calibration, then using a series of precision high resistance standards to verify the remaining ranges required by the laboratory. Software constants are then programmed into the Bridge-Meter **allowing for lowest available uncertainties today**. At Guildline, every 6530 range is verified by a Resistance Standard that has been **calibrated by a National Measurement Institute (NMI).** Equally important Guildline's 6530 specifications include calibration uncertainty - in contrast to competitors like MI who do not include the calibration uncertainty in their specifications.

Additionally the 6530 Series allows Calibration Laboratories to **use their own set of standard resistors for verifying** linearity and producing drift history. Guildline also **manufacturers standard "AIR" and temperature stabilized resistors standards**, models 6636, 9334A, 9336 and 9337, with values up to 10 PΩ capable of performing this verification. These resistance standards can also be used with the 6530 Series in Bridge Mode to **achieve the best commercially available uncertainties.**

An **optional current calibration is available** if 6530 Users require current measurement capabilities. This calibration provides 6530 users with another **resource for low current measurements**.

6530 Series Bridge Mode Specifications

Measurement Range[1] (Ω)	Applied Voltage[2] Threshold	24 Hour Bridge Mode 1:1 and 10:1 ±μΩ/Ω (ppm)[3] 23 °C ± 5 °C			
		Base[4]	XR[4]	XP[4]	XPR[4]
90 k to 200 k	1 V	NA	50	NA	40
200 k to 2 M	1 V	25	15	8	8
2 M to 20 M	1 V	25	15	8	8
20 M to 200 M	1 V to 10 V	25	15	8	8
200 M to 2 G	1 V to 100 V	25	15	8	8
2 G to 20 G	1 V to 1000 V	25	20	10	10
20 G to 200 G	10 V to 1000 V	25	20	15	15
200 G to 2 T	100 V to 1000 V	80	70	50	50
2 T to 20 T	1000 V	500	200	120	120
20 T to 200 T	1000 V	700	500	200	200
200 T to 2 P	1000 V	NA	1500	NA	800
2 P to 20 P	1000 V	NA	3500	NA	2000

6530 Series Direct Mode Measurement Specifications

Measurement Range[1] (Ω)	Applied Voltage[2] Threshold	12 Month Uncertainty Direct Measurement Mode[3] ±μΩ/Ω (ppm)[3] 23 °C ± 5 °C			
		Base	XR	XP	XPR
90 k to 200 k	1 V	NA	200	NA	150
200 k to 2 M	1 V	250	200	150	150
2 M to 20 M	1 V	250	200	150	150
20 M to 200 M	1 V to 10 V	150	100	80	80
200 M to 2 G	1 V to 100 V	200	150	150	150
2 G to 20 G	1 V to 1000 V	600	500	400	400
20 G to 200 G	10 V to 1000 V	800	700	600	600
200 G to 2 T	100 V to 1000 V	1200	1100	1000	1000
2 T to 20 T	1000 V	3500	3000	2500	2500
20 T to 200 T	1000 V	6000	5000	4000	4000
200 T to 2 P	1000 V	NA	20,000	NA	15,000
2 P to 20 P	1000 V	NA	250,000	NA	200,000

1. Ranges are automatically selected or may be chosen manually.
2. The maximum test voltage is selectable. In Auto Range, Voltage is set by 6530 TeraOhm Bridge-Meter.
3. 12 Month Specification applies after 6530 one hour warm up.
4. Bridge Mode does not include instabilities of the Transfer Resistance Standard or the test resistance (e.g. dielectric effects, Voltage coefficient, etc).

NOTE that the 6530 uncertainties include Calibration and Temperature Effect Uncertainties. Competitors only provide ratio uncertainties which mean their published uncertainties cannot be achieved under real measurement conditions.

Optional 6530 Current Measurement Specifications

Current Range (A)	6530 Series 1 Year Uncertainty (± %) 23 °C ± 5 °C			
	Base Model	6530-XR	6530-XP	6530-XPR
1 µA ► ◄ 10 µA	± 0.1 %	± 0.1 %	± 0.1 %	± 0.1 %
100 nA ► ◄ 1 µA	± 0.1 %	± 0.1 %	± 0.1 %	± 0.1 %
10 nA ► ◄ 100 nA	± 0.2 %	± 0.2 %	± 0.2 %	± 0.2 %
1 nA ► ◄ 10 nA	± 0.2 %	± 0.2 %	± 0.2 %	± 0.2 %
100 pA ► ◄ 1 nA	± 0.2 %	± 0.2 %	± 0.2 %	± 0.2 %
10 pA ► ◄ 100 pA	± 1 %	± 1 %	± 1 %	± 1 %
1 pA ► ◄ 10 pA	N/A	± 5 %	N/A	± 5 %
100 fA ► ◄ 1 pA	N/A	± 20 %	N/A	± 20 %

9334A's, 9336's and 9337's Resistance Standards are calibrated at one recommended and specified current or voltage. Guildline can calibrate at additional voltages or currents for a nominal fee. To calculate error due to voltage coefficients, simply look at the voltage the unit was calibrated with and the voltage the resistor is being used at. For example, if a 100 MΩ resistor was calibrated at 100 V, but being used at a 50 V level, then the voltage coefficient uncertainty can be calculated by (100V - 50V = 50V). 50V x 0.2 ppm/V = 10 ppm uncertainty error contributed to voltage differences. Voltage Coefficients are provided for all Guildline Standard Resistors above 1 MΩ.

General Specifications

Measurement Ranges		Front Panel Connections	
Resistance Mode	100 kΩ to 10 PΩ	Input Connector:	3 lug Triax
Current Mode	100 fA to 10 µA	Source connector:	Miniature High Voltage (MHV)

Input Impedance		User Profiles	36 Programmable
Resistance Mode	100 kΩ	Display Resolution:	4 to 8 Digits (Selectable)
Current Mode	100 kΩ	Measurement time:	5ms to > 1000 seconds

Power (50 VA)		Standard Interfaces	
50 or 60 Hz (± 5%)	100, 120, 220 and 240 VAC (± 10 %)	IEEE 488.2	RS232

Available Test Voltages	1, 3, 10, 30, 100, 300, and 1000 V_{DC}

Temperature	Operating		Storage	
	15 °C to 30 °C	59 °F to 86 °F	-30 °C to 70 °C	-22 °F to 158 °F
Humidity (non-condensing)	20 % to 50 % RH		15 % to 80 % RH	

Dimensions	Height	Length	Width	Weight		
Metric	89 mm	500 mm	444 mm	Instrument	25 lbs	11.4 kg
US	3.5"	19.7"	17.5"	Shipping	40 lbs	18.2 kg

Unparalleled Support

Guildline Instruments provides an **industry leading 2-year warranty** on every 6530 TeraOhm Bridge-Meter and all associated resistance standards. We know that the **6530 will work for you** out of the box and in the future… and we back it up.

Guildline can provide some of the best uncertainties you will find from any manufacturer. With an **ISO/IEC 17025 Accredited Range from 1 μΩ to 10 PΩ**, Guildline can calibrate not only our own standards, but other manufacturer's as well. Call us today for pricing and turn-around times.

6520 Customers – Accessories you have bought for your 6520 **will continue to work with the 6530.**
For more information, please contact sales@guildline.com.

Ordering Information	
6530-B	TeraOhm Bridge-Meter Base Model
6530-XR	Extended Range TeraOhm Bridge-Meter
6530-XP	eXtended Performance TeraOhm Bridge-Meter
6530-XPR	eXtended Performance & Range TeraOhm Bridge-Meter
TeraCal™	Data Acquisition software (included). Requires optional computer and NI IEEE-488.2 Card
/OM	Operators Manual included
/CC	Calibration Certificate included.
/RC	Report of Calibration Available at Additional Charge
/C	Current Option Available at Additional Charge

6530 Options (See 6530 Series Options datasheet for more information)	
6564 Series	8 or 16 Channel, 1000 Volt High Resistance Scanners
9336-100M	100 MΩ Artifact Calibration Resistor
9336/9337	See 9336/9337 Resistance Standards Data Sheet For More Information
6636	See 6636 Resistance Standards Data Sheet For More Information
5030 Series	See 5030 Series Programmable Precision Temperature Air Baths (EMI Shielded) for More Information
65201	Penn Airborne Adapter
65220	Environmental Monitor
65221	Surface/Volume Resistivity Test Fixture
65222	Large Shielded Sample Enclosure
65223	Small Shielded Sample Enclosure
65224	Zero Link
65225	Lead Set
65226	Calibration Kit (Includes 65224 & 9336-100M)

GUILD*LINE* IS DISTRIBUTED BY:

Guildline Instruments Limited
21 Gilroy Street, PO Box 99
Smiths Falls, Ontario
Canada K7A 4S9
Phone: (613) 283-3000
Fax: (613) 283-6082
Web: www.guild*line*.com
Email: sales@guildline.com