6530 TeraOhm Bridge-Meters

Dual Mode, Ultra Accurate, High Resistance Measurement Standards

6530 Series 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 volts
- DC Current Measurement Range 10^{-5} Amps to 10^{-13} Amps
- Existing 6520's can be Upgraded to any of the four NEW 6530 Models
- 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 NEW Guildline 6564 Resistance Scanner
- TeraCal™ Data Acquisition Software Automates Operation
- SCPI compliant IEEE-488.2 and RS232C Built-In as Standard
- Rear Input Option

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 (20^{E15}) with the best uncertainties of any *commercially available* resistance measurement instrument above 1 GΩ.

With the NEW 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.

Guildline's NEW 6530-XP & XPR Models Achieve the Highest Accuracy, Lowest Uncertainties, and Widest Resistance Measurement Ranges of Any Commercially Available High Resistance Measurement Instrument Today!

Equally important, upgrade paths are provided allowing complete user investment protection. In addition, existing Guildline 6520 Teraohmmeter customers can upgrade to any of the four 6530 TeraOhm Bridge-Meter models. A complete software package TeraCal™, is supplied with every system. Whether used in automated solutions or in stand-along applications, the 6530 Series now provides a fully automated method for calibrating both high and ultra-high resistance values and allows for direct Surface and Volume Resistivity measurements.

When combined with Guildline's new 6564 High Resistance Scanner, fully automated multiple measurements can be made for values all the way to 10 PΩ's (10^{E15}) and with voltages to 1000 Vdc. This scanner capability is only available from Guildline. The new 6564 Scanner greatly improves measurement and calibration throughput for high and ultra-high ohm resistors since laboratories can easily and quickly automate measurements for single or multiple resistance values. This automation capability is not available with dual source bridges, or with other high resistance measurement instruments.

6530 TeraOhm Bridge-Meter Series

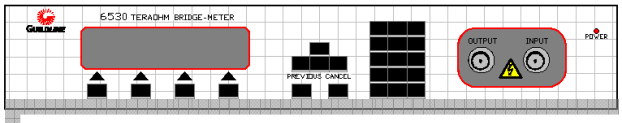
Modularity and Upgradeability – Investment Protection (even for 6520 Users)!

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, Functions as well as Uncertainties.

All models have the same unique design and engineering features described, however not all users require the same resistance ranges, functions or uncertainties for their individual laboratories.

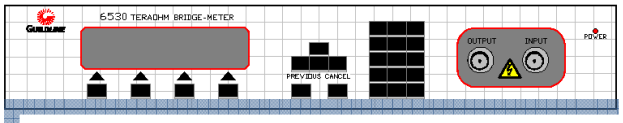
There are four models available in the 6530 Series. Each model can be upgraded if future workload requirements dictate additional capability. An optional current measurement function is also available for all models.

6530- **B**ase Model



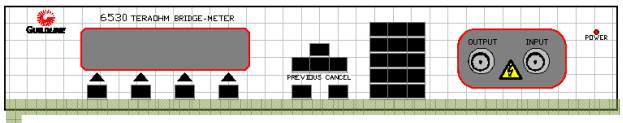
6530 B ► Range: 1 MΩ to 100 TΩ
Best Bridge Mode Uncertainty: 25 ppm
Best Direct Measurement Uncertainty: 150 ppm

6530 - e**X**tended **R**ange



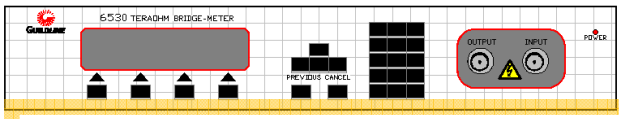
6530 XR ► Range: 100 kΩ to 20 PΩ
Best Bridge Mode Uncertainty: 15 ppm
Best Direct Measurement Uncertainty: 100 ppm

6530 - e**X**tended **P**erformance



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

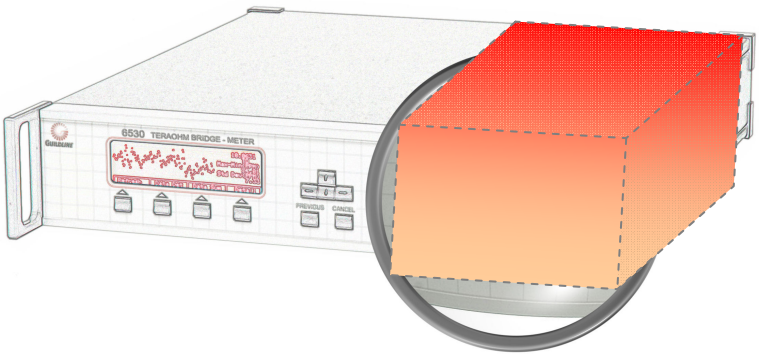
6530 - e**X**tended **P**erformance & **R**ange



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 new 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 +/- 2 °C. Air flow is also directed to maximize cooling efficiency while keep any air movement away from the measurement circuitry.



This **controlled, shielded chamber** provides clear advantages when compared to commercially available dual source bridges that typically have a temperature coefficient of 10 ppm / °C, which can more than triple 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!

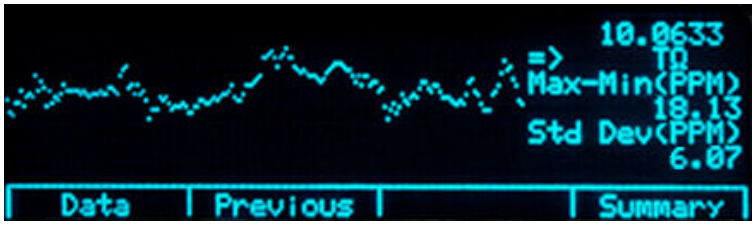
The Front Panel provides all measured values and can graphically display on-going measurements as well as environmental conditions. This provides an easy method of determining the settling time of a measurement and the stability of a resistor. The system can also internally calculate and display Min, 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 (1V to 1000V) 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 and more….

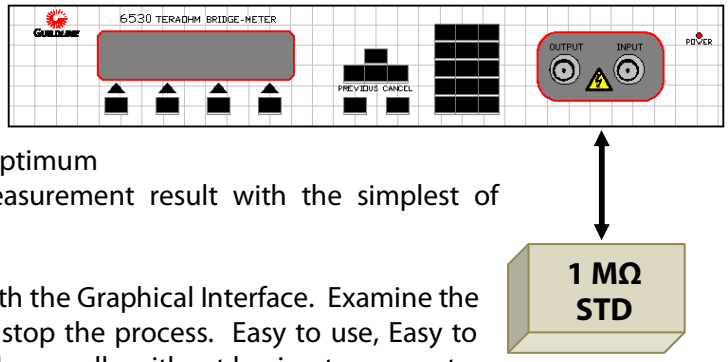
Trending Measurements – The ability to see measurement trends allows users an unparalleled look at the measurement cycle. Visually see the measurement affects when changing setup variables such as voltage polarities, integration times or capacitance values. Also see the measurement affects due to temperature, 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



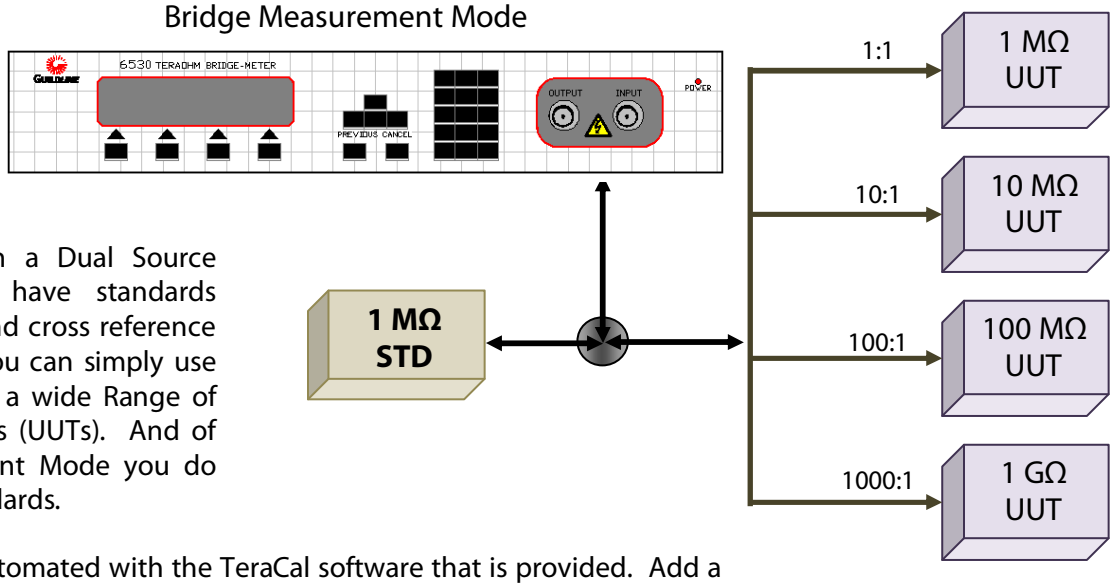
Direct Measurement Mode – The direct measurement mode is just as the name implies – a direct measurement of a Standard connected to the terminals. This is the easiest mode to operate. Simply connect a Standard to the terminals and press AUTO. The 6530 will find the optimum measurement variables to provide the best possible measurement result with the simplest of operational setups 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, can be completed manually without having to connect a PC and without the need of a reference resistance standard.

Bridge Measurement Mode – The Bridge Measurement Mode design 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 1MΩ). Run the Software program to characterize the ratio errors and now for measurements you have the Bridge Mode uncertainties you can use for the day.

Not limited like a Dual Source TeraΩBridge, this laddering will allow for example, a 1 MΩ Resistor to calibrate and verify 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) ladder 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 better than a Dual Source Bridge. You can either have standards available for every decade and cross reference to enhance 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.

Bridge Measurement Mode

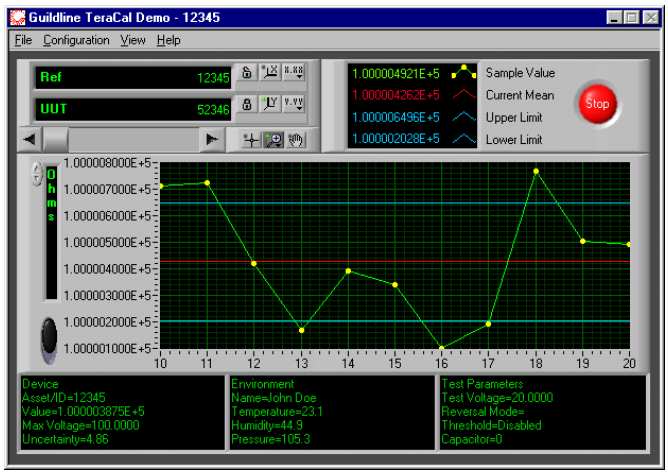


This process is completely automated with the TeraCal software that is provided. Add a 6564 Scanner, and now you are talking about true automation and the cross-verification of results.

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 new 6564 Scanner allows multiple automated measurements to be made up to 10 PΩ's with isolation $>10^{15}$. 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 6530TeraOhm 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 uncertainty by either using expanded uncertainties in accordance with ISO/IEC 17025:2005 requirements or alternatively uncertainties can be arithmetically summed.

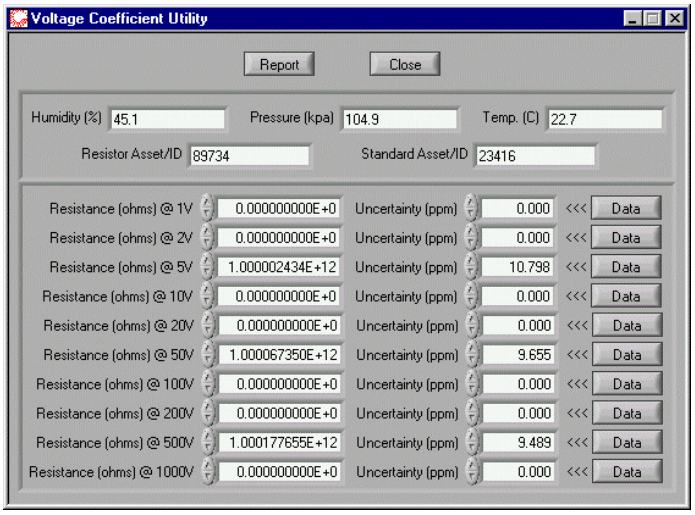


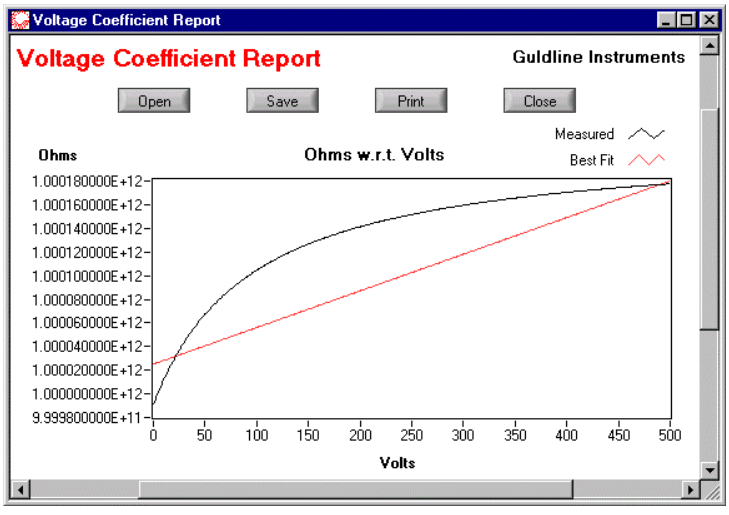
Features of TeraCal include

- ***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***
- ***New 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.

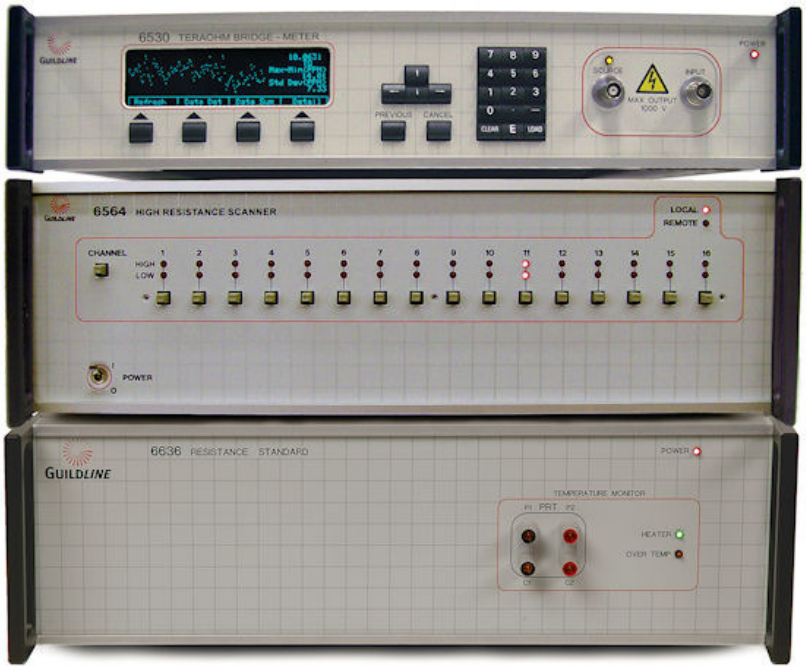
Utilities located within TeraCal™ make test setups easy to do, and the reports allow powerful analysis of the data. Utilities take full advantage of the unique automation feature that Guildline Standards provide. Whether you want to use the 6564 Scanners for multiple measurements or for the ease of Bridge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





6530 TeraOhm Bridge-Meter

Now 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 NEW 6564 Series of High Resistance Scanners (both 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 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 ppm for a 5°C temperature change vs 250 ppm PER degree for our best Air Stabilized 100GΩ Resistance Standard.

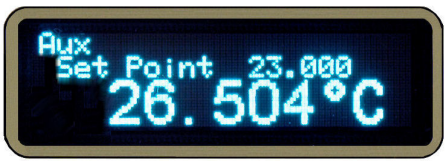
Complete the system with either our 8 or 16 channel 6564 High Resistance Scanner and then simply run a batch measurement from the TeraCal™ Software and you can easily address multiple and difficult high resistance measurements with a cost effective and time saving solution. For example a complete range 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 Standard, 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.

And we have the other side covered too! 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!

5032 Programmable Air Bath



6530 Additional 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**	**±0.3% (+ sensor error)**
Humidity:	**0% to 100% RH**	**±0.3% (+ sensor error)**
Atmospheric Pressure:	**15 to 115 kPa**	**±0.3% (+ sensor error)**

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 new 6530 TeraOhm Bridge-Meter.

And an important option for existing 6520 customers is to upgrade to any of the four 6530 Models to provide better performance and uncertainties.

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. Though Artifact calibration is not accepted for 17025 accreditation calibration, this verification 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 Mohm 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).

Additionally the 6530 Series allows Calibration Laboratories to use their own set of standard resistors for verifying linearity and producing drift history. Guildline also produces standard "AIR" and temperature stabilized resistors, models 6636, 9336 and 9337, with values up to 10 Peta Ohm 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] (Ohms)	Applied Voltage[2] Threshold	24 Hour Bridge Mode 1:1 and 10:1 (± ppm of Reading[3]) 23°C ± 2°C			
		Base[4]	XR[4]	XP[4]	XPR[4]
90k to 200k	1V	NA	50	NA	40
200k to 2M	1V	NA	15	NA	8
2M to 20M	1V	25	15	8	8
20M to 200M	1V to 10V	25	15	8	8
200M to 2G	1V to 100V	25	15	8	8
2G to 20G	1V to 1000V	25	20	10	10
20G to 200G	10V to 1000V	25	20	15	15
200G to 2T	100V to 1000V	80	70	50	50
2T to 20T	1000V	500	200	120	120
20T to 200T	1000V	700	500	200	200
200T to 2P	1000V	NA	1500	NA	800
2P to 20P	1000V	NA	3500	NA	2000

6530 Series Direct Mode Measurement Specifications

Measurement Range[1] (Ohms)	Applied Voltage[2] Threshold	12 Month Uncertainty Direct Measurement Mode[3] (± ppm of Reading[3]) 23°C ± 2°C			
		Base	XR	XP	XPR
90k to 200k	1V	NA	200	NA	150
200k to 2M	1V	NA	200	NA	150
2M to 20M	1V	250	200	150	150
20M to 200M	1V to 10V	150	100	80	80
200M to 2G	1V to 100V	200	150	150	150
2G to 20G	1V to 1000V	600	500	400	400
20G to 200G	10V to 1000V	800	700	600	600
200G to 2T	100V to 1000V	1200	1100	1000	1000
2T to 20T	1000V	3500	3000	2500	2500
20T to 200T	1000V	6000	5000	4000	4000
200T to 2P	1000V	NA	20,000	NA	15,000
2P to 20P	1000V	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 hour warm up, with operating in Auto mode to 1T ohms and with a soak time of 5 seconds or more above 1T Ohm and when the current is no less than one picoampere through the unknown resistor.
4. Bridge Mode does not include instabilities of the Transfer Resistance Standard or the test resistance (e.g. dielectric effects, Voltage coefficient, etc)

Optional 6530 Current Measurement Specifications

Range (A)	1 Year Uncertainty ±% of reading @ 23°C ± 2°C	Temperature[1] Coefficient ±% of reading/°C
$10^{-6} \le I < 10^{-5}$	0.1	0.005
$10^{-7} \le I < 10^{-6}$	0.1	0.005
$10^{-8} \le I < 10^{-7}$	0.2	0.03

Range (A)	1 Year Uncertainty ±% of reading @ 23°C ± 2°C	Temperature[1] Coefficient ±% of reading/°C
$10^{-12} \le I < 10^{-11}$	2.0	0.2
$10^{-13} \le I < 10^{-12}$	10.0	1

1. The temperature coefficient only needs to be used when the laboratory operating environment is outside the 23°C + /2°C.

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 100MOhm resistor was calibrated at 100 Volts, but being used at a 50 Volt level, than 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 MOhm.

6520 Customers – Investment protection as well for our 6520 Customers! You can upgrade to any of the 6530 Models listed in this datasheet. In fact, all the accessories you have bought for your 6520 will continue to work with the 6530. For more information about this upgrade, please contact sales@guildline.com.

General Specifications

Measurement Ranges	
Resistance Mode	10^{5} to 10^{16} ohms
Current Mode	10^{-5} to 10^{-13} amps

Front Panel Connections	
Input Connector:	3 lug Triax
Source connector:	High Voltage BNC

Input Impedance	
Resistance Mode	100 k ohms
Current Mode	100 kohms, 100 Ohms above 10 µA

User Profiles	36 Programmable
Display Resolution:	4 to 8 Digits (Selectable)
Measurement time:	5ms to > 1000 seconds

Power (50 VA)	
50 or 60 Hz (± 5%)	100, 120, 220 and 240 VAC (± 10%)

Standard Interfaces	
IEEE 488.2	RS232

Available Test Voltages	1, 3 , 10, 30, 100, 300, and 1000 Vdc

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
Metric	89 mm	500 mm	444 mm
US	3.5"	19.7"	17.5"

Weight		
Instrument	25 lbs	11.4 kg
Shipping	40 lbs	18.2 kg

6530 TeraOhm Bridge-Meter Series

Unparalleled Support

Guildline Instruments provides an industry leading two 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.

Certified by A2LA's Accreditation Program , Guildline can provide some of the best uncertainties you will find from any manufacturer. With an Accredited Range from 1 uΩ (micro ohm) to 10 PΩ (Peta Ohm's), Guildline can calibrate not only our own standards, but other manufacturer's as well. Call us today for pricing and turn-around times.

For Nuclear Customers, Guildline has passed a NUPIC audit.

Ordering Information	
6530-B	TeraOhm Meter-Bridge Base Model
6530-XR	Extended Range TeraOhm Bridge-Meter
6530-XP	eXtended Performance TeraOhm Meter-Bridge
6530-XPR	eXtended Performance & Range TeraOhm Meter-Bridge
TeraCal™	Data Acquisition software (included) Requires optional computer and NI IEEE-488.2 Card
/CC	Calibration Certificate included.
/RC	Report of Calibration Available at Additional Charge
/Amp	Current Calibration Available at Additional Charge
/TM6530	Technical Manual included.
6564 Series	8 or 16 Channel, 1000 Volt High Resistance Scanners
9336-100M	100 MOhm 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

6530 Options (See 6520A Series Options datasheet 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)

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