

# 7520 PRECISION AUTOMATED VOLTAGE DIVIDER

First Automated and Self Calibrating Sub-ppm Voltage Divider



## FEATURES

- Patented Automated Self-Alignment (i.e. True Self-Calibration) Incorporated into the Divider
- NO External Standards Required for Self-Alignment!
- Built-In Wheatstone Bridge, Built-in Voltage Reference, and Built-in Null Detector
- Advanced Internal Temperature Control Chamber for Resistive Divider Networks
- Sub-ppm Ratio Uncertainties
- Provides for Wide Range of Ratios: 1:1, 1:10, 1:100, 1:1000 and Reverse
- Fully Automated Operation with SCPI Command Set
- Automates Calibration of Voltage References
- Calibrates Precision Sources Including Calibrators
- Calibrates Voltage Measurements including DMMs
- Color Screen Touch Menu Operation
- Ethernet / IEEE-488.2 and USB Ports
- Replaces Old Divider Technology such as the Fluke 752A and Measurements International (MI) 8000B/8001B or Manual Dividers like MI 1340A

**GUILDLINE INSTRUMENTS 7520 PRECISION AUTOMATED VOLTAGE DIVIDER** is the latest innovation in DC Voltage Dividers. The 7520 is a unique patented voltage divider that provide self-alignment (i.e. true self-calibration) via an internal Wheatstone bridge, internal Zener based voltage source, and an internal optical null detector. All measurement and self-alignment components operate inside a temperature stabilized and EMI shielded chamber!

These 7520 components utilize an advanced design to provide the self-alignment process that is used to achieve long term sub-ppm ratio measurements. The 7520 is designed to replace old voltage dividers like the Fluke 752A or MI 8000B, or manual voltage dividers like the MI 1340A.

**GUILDLINE'S NEW 7520 VOLTAGE DIVIDER PROVIDES THE LATEST IN NEW PATENTED TECHNOLOGY AND INNOVATION – ACHIEVING INDUSTRY LEADING SUB-PPM MEASUREMENTS WITH BUILT-IN SELF-ALIGNMENT (I.E. SELF-CALIBRATION)!**

Eliminating the need to calibrate before use, or every 30 days, the 7520 Divider provides very low uncertainties by using the simple and innovative built-in self-alignment (i.e. self-calibration) circuitry. In theory the automated self-alignment process means that a 7520 only needs to be calibrated once! With the built-in Wheatstone Bridge, built-in Zener voltage reference, and a unique optical null detector developed by Guildline, all voltage ratios automatically self-align back to their original calibration.

The new Guildline 7520 Voltage Divider includes a wider ratio range up to 1000:1, wider voltage ranges up to 1100 V, is fully automated with a color touch screen, and provides Ethernet/IEEE and USB interfaces. This fully automated instrument is priced in the range of a traditional voltage divider.

# Model 7520 Precision Automated Voltage Divider

Guildline's 7520 Precision Voltage Divider, with extremely low thermal offsets and built-in temperature control, is ideal for voltage ratio measurements to sub-ppm accuracy and uncertainties. Input voltages in the range of 1 to 1100 volts can be divided by ratios of 1:1, 10:1, 100:1 and 1000:1 with respective uncertainties of 0.05, 0.1, 0.2 and 0.5  $\mu\text{V/V}$ . These are the lowest uncertainties of any commercial voltage divider!

## 21<sup>st</sup> Century Innovation Available Today – and Only from Guildline Instruments!

In the past 7 years Guildline has been granted or applied for 30 patents with respect to our latest Metrology Standards. In contrast competitors make minor changes and reintroduce the same 25-year old products or technology as “new”; or simply incorporate standards made by other manufacturers and rebrand them as “new” products. Guildline's new products are truly unique, innovative, patent protected, and incorporate the latest in next generation technology.

The 7520 design includes innovative self-alignment (i.e. true self-calibration) and automation never seen before in a precision Voltage Divider. In fact, the model 7520 is so good - multiple patents have been filed under “**Methods and Devices for High Stability Precision Voltage Divider**” (Patent Application Serial No. 2,958,470 Filed 21-Feb-2017, Patent Application Serial No. 15/458,241 Filed 14-Mar-2017 and Patent Application Serial No. 17 000 330.5 Filed 2-Mar-2017).



Special care has been taken to minimize thermal offsets and noise during use, and during the 7520 self-alignment/self-calibration. The resistive voltage divider networks, Wheatstone Bridge, voltage reference, and optical null detector are all inside a thermally regulated and EMI shielded chamber. The ultra-low thermal switches used are high isolation relays. In addition, the use of a newly designed optical null detector guarantees high isolation and low noise during the self-alignment process.



Internal safety circuits are used to protect the devices connected to the 7520 Divider from being damaged by operator error or internal failure.

The resistance elements comprising the divider network are a special Guildline design. These elements are hand-selected and measured to ensure repeatability and stability. These resistive elements are then inserted into a temperature stabilized chamber. This temperature chamber maintains a very stable internal environment, meaning changes in the outside laboratory environment will have at most a few parts per billion (ppb) effect on the voltage divider networks. The temperature chamber is isolated and EMI shielded, using engineering designs and manufacturing techniques proven to produce sub ppm measurements in many Guildline Standards.

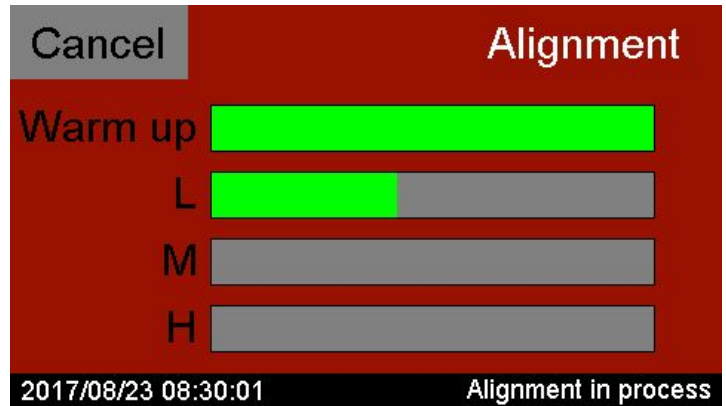
Enabling automated testing and calibration setups, the 7520 is controllable via the Ethernet/IEEE 488.2 bus interface, or via a USB interface. A complete SCPI command set enables customers to develop their own automated calibration or measurement processes. Additionally, full manual operation is achieved via an internal micro-processor and front panel, color, touch sensitive screen.

## 7520 Self-Alignment / Self-Calibration

The self-verification process incorporated into the 7520 is a true self-calibration. Unlike the Fluke 752A, MI 1340A, or MI 8000B/8001B, NO additional external standards are needed. All of these competitive voltage dividers have to be calibrated before use or at least once every 30 days. The calibration process can take up to an hour and requires a skilled technician. In comparison to the competition, the 7520 automated self-alignment process takes a few seconds to initiate and automatically returns the 7520 to its original calibration state. The result is large cost savings in terms of operation and maintenance.

### New Design for Self-Alignment with No Additional Standards or Operator Intervention Required!

The 7520's built-in Wheatstone Bridge, voltage reference, and optical null detector are used to automatically perform the self-alignment of the voltage ratios, returning the 7520 to its original calibration state. The built-in multiple Zener voltage reference is temperature stabilized guaranteeing the short-term stability necessary to calibrate a voltage divider network to sub ppm uncertainties. This automated 7520 process is initiated in a few seconds via the front panel or a SCPI command, takes less than 2 hours to complete, and once performed is good for at least 140 hours (i.e. 1 week). Note that the 7520 self-alignment can be run anytime – such as when you leave the laboratory at the end of the day or over the weekend.



## Automated Operation

All operations are performed via a front panel touch screen or can be automated via a computer connected by Ethernet/IEEE or USB. Manual configuration and control of the divider output is performed by simply pressing the appropriate screen entry. Both the touch screen and Ethernet/GPIB/USB interfaces are controlled by a microprocessor which is kept isolated from the temperature controlled analogue circuits that are part of the voltage divider network and self-alignment circuitry. This high isolation ensures no offsets will be present in measurements due to leakage or noise from the rest of the circuitry inside the 7520. An easy to use Operating Menu is provided as per the screen image to the left. An operator has five selections from the Main Menu.



You can choose to use the 7520 as a “**Divider**” taking the voltage from an input reference and generating an output voltage based on 1:1, 1:10, 1:100 and 1:1000 ratios. For the 10:1 ratio there are three options with difference output impedances in order to optimize the measurement setup. This mode is typically used to calibrate a working voltage reference or the voltage measurement capability of a voltage meter or digital multi-meter (DMM). Alternatively, you can choose to use the 7520 as a “**Comparator**” to compare two external voltages. This mode is typically used to calibrate a voltage source including the DC voltage generated by a calibrator. These two modes of operation are easily selected from the main menu or automated via SCPI commands. The Setup and Status selections, which are also available on the main menu, provide an operator with an easy to use method to operate the 7520 Voltage Divider and to check on the current status.

# Model 7520 Precision Automated Voltage Divider

## 7520 Voltage Divider Mode of Operation

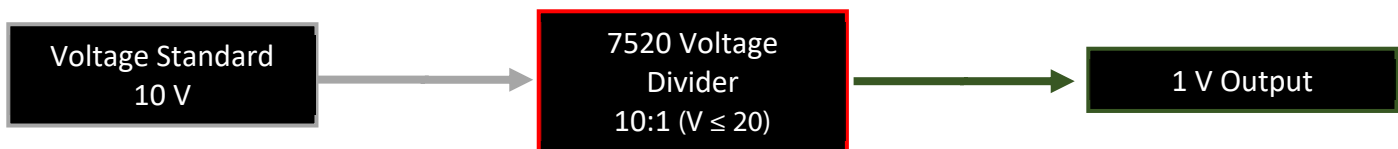
When the 7520 is used in the “**Divider**” mode of operation, a Voltage Reference, typically a 1 V or 10 V Zener reference, is connected to the Voltage Input Terminals and a voltage corresponding to the voltage reference and the divider ratio selected is provided at the 7520 Voltage Divider Output terminals. The purpose of this mode is to provide an accurate output voltage based on a reference voltage, with the Divider contributing only a very small uncertainty to the overall measurement.

The three 10:1 divider ratios have different output impedances and are designed to work with different input voltages as below:

- 10:1 ratio ( $V \leq 20$ )     $5.8 \text{ k}\Omega \pm 0.1 \%$
- 10:1 ratio ( $V \leq 100$ )     $43.2 \text{ k}\Omega \pm 0.1 \%$
- 10:1 ratio ( $V \leq 1000$ )     $270 \text{ k}\Omega \pm 0.1 \%$

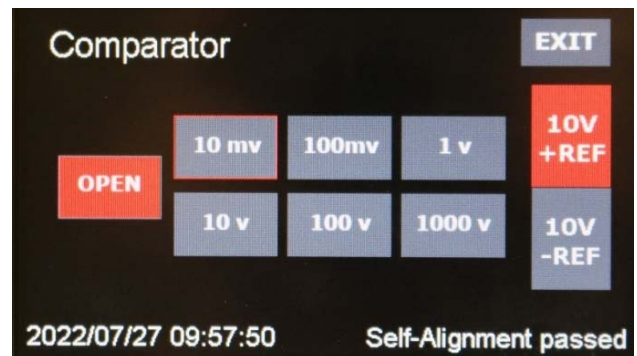
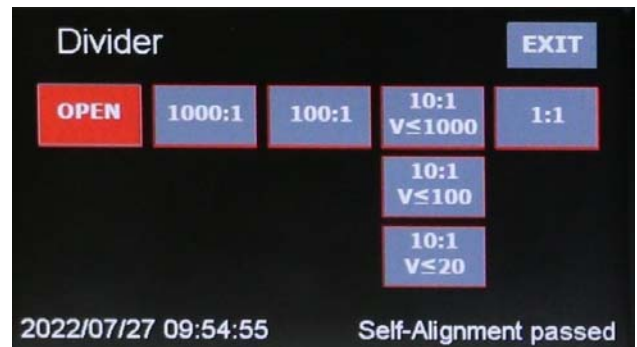
When using a DMM as a voltage meter connected to the 7520, it is best to use the 10:1 ratio with the lowest output impedance (i.e.  $5.8 \text{ k}\Omega$ ) for lower voltages such as 1 Volt and 10 Volt. However if comparing measurements to a Fluke 752 voltage divider the  $43.2 \text{ k}\Omega$  output impedance works best.

This is diagrammed below. For example, if a 10 V Reference with a 1 ppm uncertainty was connected to the divider, the output at a 10:1 ( $V \leq 20$ ) ratio would be 1 V; with the Divider only contributing 0.1 ppm to the overall uncertainty. When used in the Divider mode, the operator selects one of the divider ratio ranges (1:1 to 1000:1) for the output desired. This can be done manually or can be completely automated.



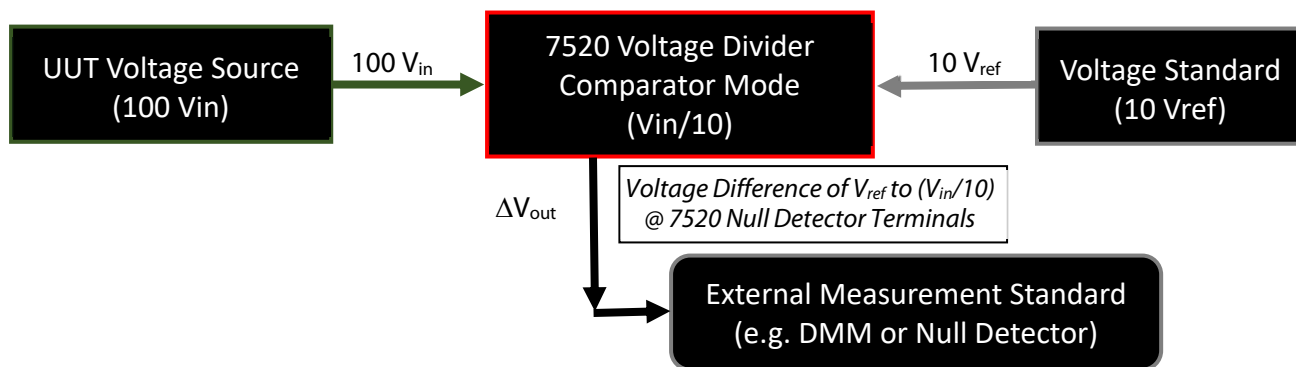
## 7520 Comparator Mode of Operation

When used in the “**Comparator**” mode of operation, an external Voltage Input ( $V_{in}$ ) is fed into the Voltage Input Terminals on the 7520. A second Voltage Standard ( $V_{ref}$ ) is connected to the Standard Terminals. If the  $V_{in}$  does not equal the nominal  $V_{ref}$  value, the  $V_{in}$  or  $V_{ref}$  is automatically divided internally by the 7520 and the voltage difference between the  $V_{in}$  and  $V_{ref}$  is then available as  $V_{out}$  on the 7520 Null Detector Terminals.



# Model 7520 Precision Automated Voltage Divider

This voltage difference can be measured with an external null detector or external long scale DMM. An example of how the Divider is used in the “Comparator” mode is shown below. A Calibrator Output of 100 V is connected to the Voltage Input of the 7520 Divider. A 10 Volt Reference Standard is placed on the 7520 Reference Standard Terminals. Note that the maximum voltage that can be used as  $V_{ref}$  is 12.5 V. The 100 V input is then divided down to equal the voltage reference of 10 V, allowing for a direction comparison of  $10 V_{in}$  to  $10 V_{ref}$ . The voltage difference of  $V_{in}$  and  $V_{ref}$  will be available at the 7520 Null Detector Terminals. Again, the divider contributes very little uncertainty to the overall measurement process.



In addition, when operated in the Comparator mode of operation, the polarity of the Voltage Reference can be switched inside the 7520 manually or automatically. This enables automated polarity switching for the Voltage Reference, thus the wires connecting the Voltage reference do NOT have to be manually switched to change the polarity. This also speeds up the calibration process because there is no wait time required due to switching the Voltage Reference leads.

## Circuit Protection

The 7520 has internal protection features to help ensure the equipment used with the 7520 Voltage Divider, as well as the 7520 itself, will be safe from damage. This includes the external voltage reference and external device being calibrated. Critical voltages are monitored through the internal 7520 micro-processor which will disconnect inputs and outputs when over voltages are sensed.

The divider networks are protected from over voltages as there is only one high impedance input that is used for all divider ratio configurations. Voltages within the divider networks are monitored to ensure that improper divider output configurations are detected.

# Model 7520 Precision Automated Voltage Divider

## Internal Wheatstone Bridge, Internal Voltage Source, and Internal Null Detector

The internal Wheatstone Bridge, internal voltage source, and internal null detector are all optimized for the self-alignment of the 7520 Voltage Divider. They cannot be used independently.

## And the 7520 Provides Even More Advantages

There is even more functionality included with the 7520 Voltage Divider to improve the user interface and operation. These include:

- Automated operation initiated by front panel touch screen or via SCPI commands.
- Polarity reversal inside the 7520 for the Reference Voltage input. This will allow an operator to manually or automatically reverse the polarity of the Reference Voltage without making any lead changes which speeds up measurements and enables true automation.
- Real-time checking of the stability of the temperature chamber when the 7520 is turned on, during the Ratio Alignment Verification process, and during operation. If the temperature does not stabilize on start-up a warning will be provided. Similarly, if the temperature is not stable during the Ratio Alignment Verification process, or during the measurement process, operation will be stopped, and a failure message will be displayed. There is no need to manually monitor the temperature stability as this is done automatically.
- Real-time display of the progress of the temperature chamber warm-up upon start up; and real-time display of the progress of the Ratio Self-Alignment / Self-Calibration process for each ratio.
- The ability to have the internal temperature displayed in 'F' or in 'C'.
- Built-in Log that records self-alignment/self-calibration operations and pass/fail status.

## Unparalleled Support

Guildline Instruments provides an **industry leading two year warranty** on every 7520 Automated Voltage Divider and all associated standards. We know that the **7520 will work for you** out of the box and in the future... and we back it up.

# Model 7520 Precision Automated Voltage Divider

7520 SPECIFICATIONS			
Voltage Divider Ratio	Voltage Divider Ratios Output Uncertainty <sup>1,2</sup>		
1:1	0.05		
10:1	0.1		
100:1	0.2		
1000:1	0.5		
Maximum Voltages	Voltage Input Terminals		1100 V <sub>dc</sub>
	Reference Standard Terminals		12.5 V <sub>dc</sub>
Resistance	Ratios	Input <sup>3</sup>	Output
	1:1 ratio	direct connection to output	
	10:1 ratio (V≤20)	43.2 kΩ	5.8 kΩ
	10:1 ratio (V≤100)	270 kΩ	43.2 kΩ
	10:1 ratio (V≤1000)	2.303 MΩ	270 kΩ
	100:1 ratio	2.303 MΩ	43.2 kΩ
	1000:1 ratio	2.303 MΩ	5.8 kΩ
Communication	USB, IEEE 488.2, SCPI Based Language Instructions		
Environmental	Operating	Storage	
Temperature	+21 °C to +25 °C (69.8 °F to 77 °F)	-20 °C to +60 °C (-4 °F to 140 °F)	
Humidity	20 % to 70 % RH	15 % to 80 % RH (Non-Condensing)	
Power Requirements	VAC: 100 V to 240 V ± 10 % / 50 or 60 Hz ± 5 %, 60 VA		
Dimensions (Length x Width x Height)		Weight	
503 mm x 455 mm x 133 mm		11 kg	24 lbs

- 1 – Relative to Voltage Reference Standard using either a 10 Vdc or 1 Vdc reference. Maximum input to the 7520 Voltage Reference terminals is 12.5 Volts.  
 2 – After Self-Alignment or within 140 hours (i.e. 1 week) from last Self-Alignment.  
 3 – Applies to Both the Divider Chain and Driven Guard.

ORDERING INFORMATION	
<b>7520</b>	Precision Voltage Divider
/RC	Report of Calibration Available at Additional Charge
/OM7520	Operation and Instruction Manual included

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