MeasureReady™ 155
Precision I/V Source

An ultra-low noise, high-precision current/voltage source for scientific and other demanding applications
The MeasureReady™ 155 Precision I/V source combines premium performance with unprecedented simplicity for materials scientists and engineers requiring a precise source of current and voltage.

With extensive experience in low-noise instrumentation for research, Lake Shore has leveraged the latest electronic technologies to reduce in-band and out-of-band noise floors for the MeasureReady 155 source to levels previously only possible using add-on filters. The result is a combination AC/DC current and voltage source that is well-suited to the challenges of characterizing sensitive materials and devices, where lower excitation signals are needed and minimum injection of noise into the measurement is required.

While sophisticated on the inside, the 155 is uncommonly straightforward to operate. Leading product designers observe that simple is much harder to accomplish than complex — just putting a touchscreen on a complex product doesn’t make it simpler. Lake Shore’s modern, user-focused design for the MeasureReady 155 presents an uncluttered and intuitive interface that instantly feels familiar and natural to anybody who owns a smartphone.

**MeasureReady™ 155 Source features**
- Bipolar, 4-quadrant I/V source
- DC and AC modes, up to 100 kHz*
- Full scale ranges—voltage: 10 mV to 100 V, current: 1 µA to 100 mA
- 0.001% programming resolution (from 100 nV/10 pA)
- In-phase reference output for use with a lock-in amplifier (155-AC only)
- Ultra-low noise: from 200 nV/7 pA RMS
- Manual and autorange function
- Front and rear output connectors
- Touchscreen user interface

*MeasureReady 155-AC

**Full connectivity**
USB and LAN connectivity provide convenient integration with systems using LabVIEW®, IVI.NET, and other software. Interfacing is straightforward using IVI-class drivers and industry-standard SCPI commands.

**From precision thermometry to advanced measurement**
For decades, Lake Shore has advanced science by providing cryogenic temperature and magnetic instrumentation to researchers and engineers. At the heart of these instruments are special low-noise current and voltage sources that excite the attached sensors. This has led us to develop ultra-low noise voltage and current sources as standalone instruments for a wider range of demanding applications. The all-new design of the 155 source offers premium performance, easy operation, and modern convenience, backed by Lake Shore’s quality and service.
For applications where noise matters

The MeasureReady 155 is designed for demanding scientific and engineering applications, where a high-quality, low-noise source of current or voltage is required, such as:

- Precision DC I-V and C-V curve measurements of novel materials and early-stage devices
- AC impedance measurements
- Accurate resistance, magneto-resistance, and resistivity measurements
- Low-noise bias voltages/currents for characterizing new heterostructures
- High-accuracy device testing
- Very low power excitation of sensitive materials like organics
- Controlled characterization of low resistance and superconducting materials
- Low-noise excitation of sensors for improved measurement accuracy
- Hall effect measurements to determine carrier concentrations/mobilities
- Variable temperature device/material characterization using a cryogenic probe station
- Sensitive electrochemical experiments

See and operate more easily with TiltView™

This unique feature makes seeing the screen and operating the touch interface comfortable from any angle, even when mounted in a rack.

A perfect pair

Combined with a quality digital meter such as the Keysight 34420A, the 155 I/V source provides greater measurement flexibility and performance when compared to some traditional all-in-one source-measure units (SMUs):

- The ability to select the meter performance best suited to experiment needs
- The ability to measure at contact points independent of the source contacts
- Well-suited to cryogenic probing, using standard or quasi-Kelvin probes
- Simple triggering link available between the 155 and meter
Lower noise for better measurements

No filters needed
Characterization of sensitive new electronic materials often requires both AC and DC excitation signals, with source noise directly impacting measurement sensitivity.

To ensure high performance and functionality in an AC source, typically DC noise performance is compromised (and vice versa) because the filtering most often used to quiet DC noise also dampens AC signals and affects stepping and pulse width modulation. The 155 was purposefully engineered to achieve low-noise levels without additional filtering, enabling exceptional output performance in both DC and AC modes.

In side-by-side tests, the 155 demonstrated a cleaner output signal with a lower noise floor than other commercial sources costing far more. That's a key reason why the 155 provides a solid foundation for researchers performing I/V curve, Hall effect, resistance, resistivity, and other fundamental measurements of novel materials and early-stage devices.

Uncompromised noise performance
The 155 generates just 200 nV RMS (1 µV p-p) of low frequency (<10 Hz) noise and 9 µV RMS of higher frequency (10 Hz to 100 kHz) noise in the 10 mV range. With a programming resolution of 100 nV, the 155 is ideal when a very clean, ultra-low voltage output is required. For low current signals, the 155 is equally capable — just 7 pA RMS of low frequency noise and a very low 1 nA RMS of higher frequency noise in the 1 µA range, with a 10 pA setting resolution.

As easy to use as your smartphone
Made for the way you work today, the MeasureReady 155 source features an uncluttered touch display with a unique TiltView™ screen, presenting a natural and engaging user interface.

With no confusing buttons or long learning curves, the 155 is simple and intuitive to operate. You’ll quickly recognize the icons, gestures, and menu styles that follow familiar smartphone technology standards.
The MeasureReady 155 offers multiple ways to adjust settings, including a “slider” control for fast adjustments. You can use the zoom control (below main slider) for more precise control.

Swiping up or down on the screen allows single digit adjustments using the “stepper” control for slower, incremental changes.

Changing settings is simple and intuitive.

Portrait orientation

Need more space on your lab bench? Turn the 155 vertically and the display adjusts automatically.
Options

**GPIB-LAN-CONVERT** GPIB to LAN converter

For applications requiring IEEE-488 communications, this converter plugs into the instrument’s LAN port and creates a GPIB-compatible interface. Note that network timing may be affected when using parallel to serial converters. Delays vary with the amount of data transferred and the converter’s activity as messages are received.

Be future-ready with **MeasureReady**

With free online software updates, your instrument can always have the most current capabilities. And as Lake Shore introduces new options in the future, you can purchase and download them to your instrument. This allows the 155 to grow as your measurement needs evolve.

Specifications

**Voltage source specifications**

<table>
<thead>
<tr>
<th>DC/peak ranges</th>
<th>Maximum peak power</th>
<th>Programming resolution (0.001%)</th>
<th>DC accuracy (1 year) calibration temperature °C ± 5 °C + (% setting + offset)¹</th>
<th>AC accuracy (1 year) calibration temperature °C ± 5 °C + (% setting + % range)¹</th>
<th>Temperature coefficient/°C 10 °C to 35 °C ± (% setting + offset)²</th>
<th>Typical noise (pk-pk/RMS) 0.1 Hz to 10 Hz²</th>
<th>Typical noise (pk-pk/RMS) 10 Hz to 100 kHz²</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 mV</td>
<td>100 mA</td>
<td>1 mV</td>
<td>100 nV</td>
<td>0.2% + 140 µV</td>
<td>0.014% + 2 µV</td>
<td>1 µV/200 nV</td>
<td>45 µV/9 µV</td>
</tr>
<tr>
<td>100 mV</td>
<td>10 mW</td>
<td>10 mV</td>
<td>10 µV</td>
<td>0.055% + 140 µV</td>
<td>0.0014% + 2 µV</td>
<td>1 µV/200 nV</td>
<td>45 µV/9 µV</td>
</tr>
<tr>
<td>1 V</td>
<td>100 mW</td>
<td>10 µV</td>
<td>170 µV</td>
<td>0.045% + 170 µV</td>
<td>0.0007% + 3 µV</td>
<td>1.5 µV/300 nV</td>
<td>45 µV/9 µV</td>
</tr>
<tr>
<td>10 V</td>
<td>100 µW</td>
<td>100 µV</td>
<td>100 µV</td>
<td>0.045% + 500 µV</td>
<td>0.0007% + 30 µV</td>
<td>10 µV/2 µV</td>
<td>75 µV/15 µV</td>
</tr>
<tr>
<td>100 V</td>
<td>1 W</td>
<td>100 µV</td>
<td>6 mV</td>
<td>0.055% + 6 mV</td>
<td>0.0009% + 300 µV</td>
<td>100 µV/20 µV</td>
<td>750 µV/150 µV</td>
</tr>
</tbody>
</table>

**Current source specifications — low voltage compliance**

<table>
<thead>
<tr>
<th>DC/peak ranges</th>
<th>Peak compliance voltage</th>
<th>Maximum peak power</th>
<th>Programming resolution (0.001%)</th>
<th>DC accuracy (1 year) calibration temperature °C ± 5 °C + (% setting + offset)¹</th>
<th>AC accuracy (1 year) calibration temperature °C ± 5 °C + (% setting + % range)¹</th>
<th>Temperature coefficient/°C 10 °C to 35 °C ± (% setting + offset)²</th>
<th>Typical noise (pk-pk/RMS) 0.1 Hz to 10 Hz²</th>
<th>Typical noise (pk-pk/RMS) 10 Hz to 100 kHz²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 µA</td>
<td>10 V</td>
<td>10 µW</td>
<td>10 pA</td>
<td>0.05% + 500 µA</td>
<td>1% + 0.2% (up to 20 kHz)</td>
<td>0.0008% + 4 pA</td>
<td>40 pA/8 pA</td>
<td>10 µA/2 nA</td>
</tr>
<tr>
<td>10 µA</td>
<td>100 µW</td>
<td>100 pA</td>
<td>15 nA</td>
<td>0.05% + 1.5 nA</td>
<td>0.0008% + 40 pA</td>
<td>200 pA/40 pA</td>
<td>10 nA/2 nA</td>
<td></td>
</tr>
<tr>
<td>100 µA</td>
<td>100 µW</td>
<td>100 pA</td>
<td>15 nA</td>
<td>0.05% + 15 nA</td>
<td>0.0008% + 400 pA</td>
<td>2000 pA/400 pA</td>
<td>10 µA/2 nA</td>
<td></td>
</tr>
<tr>
<td>1 mA</td>
<td>100 µW</td>
<td>100 nA</td>
<td>2.5 µA</td>
<td>0.05% + 2.5 µA</td>
<td>0.0008% + 40 nA</td>
<td>200 nA/40 nA</td>
<td>100 µA/40 nA</td>
<td></td>
</tr>
<tr>
<td>10 mA</td>
<td>1 W</td>
<td>1 µA</td>
<td>70 µA</td>
<td>0.1% + 70 µA</td>
<td>0.0008% + 400 nA</td>
<td>2000 nA/400 nA</td>
<td>2 µA/400 nA</td>
<td></td>
</tr>
</tbody>
</table>

**Current source specifications — high voltage compliance**

<table>
<thead>
<tr>
<th>DC/peak ranges</th>
<th>Peak compliance voltage</th>
<th>Maximum peak power</th>
<th>Programming resolution (0.001%)</th>
<th>DC accuracy (1 year) calibration temperature °C ± 5 °C + (% setting + offset)¹</th>
<th>AC accuracy (1 year) calibration temperature °C ± 5 °C + (% setting + % range)¹</th>
<th>Temperature coefficient/°C 10 °C to 35 °C ± (% setting + offset)²</th>
<th>Typical noise (pk-pk/RMS) 0.1 Hz to 10 Hz²</th>
<th>Typical noise (pk-pk/RMS) 10 Hz to 100 kHz²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 µA</td>
<td>100 V</td>
<td>100 µW</td>
<td>10 pA</td>
<td>0.08% + 500 µA</td>
<td>1% + 0.2% (up to 20 kHz)</td>
<td>0.0025% + 4 pA</td>
<td>35 pA/7 pA</td>
<td>5 nA/1 nA</td>
</tr>
<tr>
<td>10 µA</td>
<td>100 µW</td>
<td>100 pA</td>
<td>1.5 nA</td>
<td>0.08% + 1.5 nA</td>
<td>0.0025% + 40 pA</td>
<td>350 pA/7 nA</td>
<td>5 nA/1 nA</td>
<td></td>
</tr>
<tr>
<td>100 µA</td>
<td>100 µW</td>
<td>100 pA</td>
<td>15 nA</td>
<td>0.08% + 15 nA</td>
<td>0.0025% + 400 pA</td>
<td>2500 pA/500 nA</td>
<td>5 nA/1 nA</td>
<td></td>
</tr>
<tr>
<td>1 mA</td>
<td>100 µW</td>
<td>100 nA</td>
<td>150 nA</td>
<td>0.08% + 150 nA</td>
<td>0.0025% + 4 nA</td>
<td>2.5 nA/500 nA</td>
<td>40 nA/6 nA</td>
<td></td>
</tr>
<tr>
<td>10 mA</td>
<td>1 W</td>
<td>100 nA</td>
<td>1.5 µA</td>
<td>0.08% + 1.5 µA</td>
<td>0.0025% + 40 nA</td>
<td>25 nA/5 nA</td>
<td>400 nA/60 nA</td>
<td></td>
</tr>
</tbody>
</table>

¹ Calibration temperature is the ambient temperature during factor calibration, typically, 23 °C; reported by the instrument
² Specification guaranteed on the rear panel only
³ Guaranteed into load no greater than 100 pF
⁴ Loads for current settle time: 100 mA range: 100 Ω, 1 mA and 100 µA ranges: 10 kΩ, 10 µA, and 1 µA ranges: short
⁵ Representative values
⁶ Measured into 10 Ω resistor for 100 mA and 10 mA ranges with compliance voltage <10 V; measured into transimpedance amplifier with 1 kΩ feedback resistor for other cases
⁷ Calibrated into >10 GΩ load
Additional specifications

**Output selection modes**
Voltage or current

**Range selection modes**
Manual, autorange

**Current source compliance selection**
10 V or 100 V

**Programmable limits (DC only)**
I out: compliance voltage, V out: current limit

**Accuracy**
Positive output: +10%/-0% of setting (when setting is ≥10% of its full-scale range) Negative output: -10%/+0% of setting (when setting is ≥10% of its full-scale range)

**Programming resolution**
Current limit: 0.1% of full-scale current range (auto selected)
Voltage limit: 10 mV (10 V compliance), 100 mV (100 V compliance)

**Polarity**
Bipolar, 4-quadrant

**Load impedance**
Capable of driving any resistive load within the I and V limitations of the source; stability maintained with reactive loads up to 50 µF or 1 mH (with 100 Ω damping)

**AC frequency range**
100 mHz to 100 kHz

**AC frequency accuracy**
±0.06%

**AC signal types**
Sine

**Total harmonic distortion**
<0.1% from DC to 20 kHz, <1% from 20 kHz to 100 kHz

**Sample rate**
600 kilosamples per second

**Noise (10 Hz to 40 MHz)**
Voltage: ≤700 µV RMS, across all ranges
Current: ≤8 µA RMS (400 µV RMS across 50 Ω), across all ranges

**Load regulation**
Voltage: 10 V range and below: <0.2% of range, 100 V range: <0.01% of range; Current: 10 V compliance: <0.01% of range, 100 V compliance: <0.01% of range

**Setting times**
Voltage: time to reach final value at open load condition: 25 µs
Current: time to reach final value into a given load: 25 µs

**Output lead connections**
Output HI, Output LO, Guard, Chassis Ground

**Connector type**
Front: safety banana jack
Rear: BNC or triaxial (user selectable between front and rear panel)

**Guard output**
Maximum load current: 1 mA peak

**Power up protection**
Output terminals floating on power up

**Additional output features**
User-specified output setting limit, enable/disable output setting

**Warm-up time**
30 min (to achieve specified accuracy)

**Isolation**
Source output isolated from chassis ground

**Output capacitance**
Front: <100 pF, rear: <50 pF

**Reference output**
Signal type
Synchronous with the source output signal, referenced to chassis ground

**Amplitude**
0 to +3.3 V nominal

**Accuracy**
Voltage: ±3%, up to 10 kHz
Current: (≥100 µA range): ±4%, up to 10 kHz

**Phase compensation**
180.0° to +180.0° with 1° resolution

**Connector**
BNC

**Waveform**
Square wave

**Front panel**
Display
5 in capacitive touch, color TFT-LCD WVGA (800 × 480) with LED backlight

**Interface**
**USB host**
Type
USB 3.0, mass storage class (MSC) device
Function
Firmware updates, flash drive support
Location
Rear panel
Connector
USB Type-C™

**USB device**
Type
USB 2.0
Function
Emulates a standard RS-232 serial port
Protocol
Standard commands for programmable instruments (SCPI)
Baud rate
115,200
Connector
USB Type-B
Software support
LabVIEW™ and IVI.NET drivers (see www.lakeshore.com)

**Ethernet**
Function
TCP/IP command and control, mobile app
App. layer protocol
Standard commands for programmable instruments (SCPI)
Connector
RJ-45
Speed
1 Gb/s
Software support
LabVIEW™ and IVI.NET drivers (see www.lakeshore.com)

**Digital IO**
**Connector**
6-pin 3.5 mm detachable terminal block

**Output**
2 TTL compatible output (3.3 V<sub>sub</sub>nominal at 1 mA)

**Input**
2 TTL compatible input; V<sub>sub</sub>high nominal: 3.3 V; V<sub>sub</sub>low nominal: 0 V

**Grounding**
Referenced to chassis ground

**General**
**Safety interlock**
2-pin 5.0 mm detachable terminal block, maximum 10 Ω external circuit impedance

**Ambient temperature**
10 °C to 35 °C at rated accuracy; 5 °C to 40 °C at reduced accuracy

**Power requirement**
100 V to 240 V (universal input), 50 to 60 Hz, 30 VA

**Size**
217 mm W × 87 mm H × 369 mm D (8.5 in × 3.4 in × 14.5 in), half rack

**Weight**
3.2 kg (7 lb)

**Approval**
CE mark

LabVIEW™ is a trademark of National Instruments. Neither Lake Shore Cryotronics, nor any software programs or other goods or services offered by Lake Shore, are affiliated with, endorsed by, or sponsored by National Instruments.
Ordering Info

**MeasureReady™ 155 Sources**
- **155-AC** Precision I/V source for AC and DC operation—includes calibration certificate and 155-ACC-KIT
- **155-DC** Precision I/V source for DC operation only—includes calibration certificate and 155-ACC-KIT

**Options**
- **GPIB-LAN-CONVERT** GPIB to LAN converter; enables GPIB communications and control of a LAN instrument; GPIB data transfer rates not guaranteed and will be limited by LAN transfer rates

**Accessories**
- **RM-1/2** Kit for mounting a single half-rack instruments in a 483 mm (19 in) rack
- **RM-2** Kit for mounting two adjacent half-rack instruments in a 483 mm (19 in) rack
- **G-106-735** 2-pin voltage interlock connector with shorting connection (allows operation over 10 V)
- **G-106-741** 6-pin green Phoenix terminal block
- **119-155** MeasureReady 155 user manual
- **CAL-155-CERT** MeasureReady 155 recalibration with certificate
- **CAL-155-DATA** MeasureReady 155 recalibration with certificate and data

About Lake Shore Cryotronics, Inc.

Supporting advanced research since 1968, Lake Shore is a leading innovator in measurement and control solutions for materials characterization under extreme temperature and magnetic field conditions. High-performance product solutions from Lake Shore include cryogenic temperature sensors and instrumentation, magnetic test and measurement systems, probe stations, and precision materials characterizations systems that explore the electronic and magnetic properties of next-generation materials. Lake Shore serves an international base of research customers at leading university, government, aerospace, and commercial research institutions and is supported by a global network of sales and service facilities.