

AccuBridge® Model

6511D, 6011D/150, 6011D/200, 6011D/300



Direct Current Comparator High Current Range Extenders

- *Modular designed base unit with expanded capabilities to 3000 A*
- *Comparator sensitivity = 2 μ AT = 0.02 ppm*
- *Stand-alone operation or extends the range of Measurements International (MI) 6010D/6242D series of resistance bridges*
- *MI 6100A series of high current linear supplies*
- *Shunt and DCCT Calibration*
- *Bench or Rack-Mount configurations*
- *Make MI your partner in ISO 17025 accreditation through coaching, system design and implementation, calibration services and ongoing expert support*

MODEL INFORMATION

Since its introduction in 1993, MI's 6011 series of range extenders has earned a worldwide reputation for performance, dependability, and quality. Our units are the range extenders of choice for electrical calibration throughout government and industry. The new 6011D series uses the ratio of two windings on a direct current comparator (DCC) to measure the ratio of two currents and divide high currents down to workable levels. Measurements International is the only commercial laboratory that can provide accredited ratio calibrations to 0.2 ppm.

Typical applications are shown below for current source calibration using the 6511D with built-in current source to 10 A (see Figure 1) and the 6011D with our 6150A Linear Power Supply (see Figure 2).

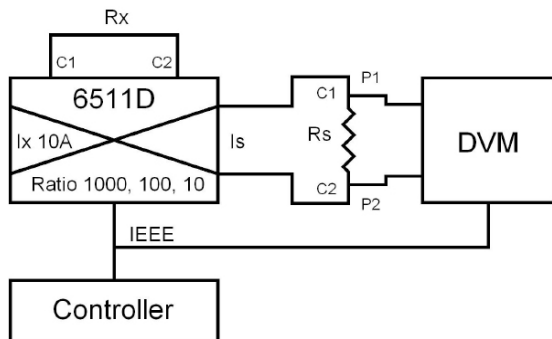


Figure 1—6511D in Stand-Alone Configuration

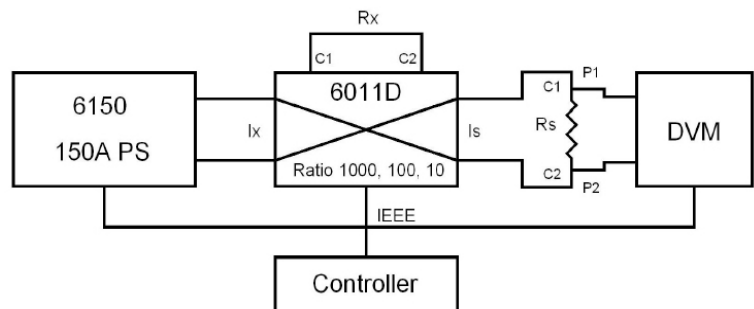


Figure 2—6011D in Stand-Alone Configuration

The 6011D series can also increase the range of our AccuBridge® 6010D Resistance Bridge—the world's number one resistance bridge—and our AccuBridge® 6242D Resistance Bridge for calibrating shunts and direct-current comparator transformers (DCCT) with greater accuracy compared to using a digital multimeter (DMM). The 6011D series provides cost flexibility with the highest precision available. These are real solutions that address both current and future workload solutions while addressing ever tightening budget constraints.

At MI, it's not only about the equipment and science, it's about what you can do and the ease with which you can do it.

>183.65546 67616.12281 9555
 >198.65546 65612.232829 9555
 >198.65546 65612.232829 95555
 >152.698016 68818.282399 92356
 >198.643636 78617.732289 783
 >124.634546 78672.237779 683
 >458.11142 83417.782397 876
 >145.523286 64486.222889 986
 >140.77060 32814.077060 328

The 6011D series consists of three models: 6511D/10, 6011D/150, and 6011D/300. As a stand-alone unit, each 6011D has front panel pushbuttons for selecting the ranges and reversing the current. Select the current ranges by pressing the 10, 100, or 1000 ratio keys. Alternatively, control the unit using the IEEE488 Interface Bus. Each model has a built-in reversing switch you activate by pressing the Normal/Reverse key located on the front panel.



Figure 3-6011D rear panel connections

The 6011D's precision DCC uses a two-core magnetic modulation technique in a feedback loop to generate a secondary current. This secondary current is further modified by a circuit that monitors the primary current and the turns ratio of the comparator toroid. Together, these two circuits create an effective loop gain in excess of 10^7 , forcing the secondary ampere-turns to be equal the primary ampere-turns to better than 0.02 ppm, thereby making the instrument act as a precision DCCT. Offsets and thermals of the DCC are removed by reversing the I_x current. You make all connections to the 6511D and 6011D on their rear panels (see Figure 3).

The I_x and I_r connectors have full current inputs (150 A/300 A) as well as 30 A inputs. If you are using the 6011D at currents below 30 A, high current cables are not required.

Calibrating the 6011D

The 6011D is a ratio device, the ratio being determined by the number of turns on the Master (N_x) windings and the slave (N_s) winding. A ratio calibration technique is used to calibrate the 6011D using the stable ratio of standard resistors and MI's 6010 or 6242 series of resistance bridges as the reference.

A single output for the 6011D is located on the rear panel (see Figure 3). For current source calibration, you can connect a standard 1 Ω to 100 Ω resistor to the output and read the voltage using a DMM as shown in figures 1 and 2. An MI 6150A (150 A) or 6250A (300 A) series power supply can be configured in a rack with the 6011D/150 or 6011D/300. The drivers for Keysight Technologies's 6600 series current sources are included in the software.

The input and output currents for the 6011D are shown in the General Specifications table at the end of this document. Full-scale output current of the 6011D/150 is 100 mA on Range 10 and 100, and 150 mA on Range 1000. Full-scale output current for the 6011D/200 and 6011D/300 is 100 mA on all ranges.

For complete automation of several 30 A shunts see our 20-channel 4220/30 four terminal 30 A Matrix Scanner.

6011D Applications

Perform shunt calibration or DCCT calibration using two precision DMMs to compare the shunt or DCCT output voltage with the voltage across the standard resistor R_s (see figures 4 and 5). Special automated software is available (Model 6300) to configure the system for automated shunt and DCCT measurements up to 3000 A. For greater accuracy, the 6010D or 6242D may also be used in place of the DMMs to calibrate shunts and DCCTs (see Figure 6 and 7).

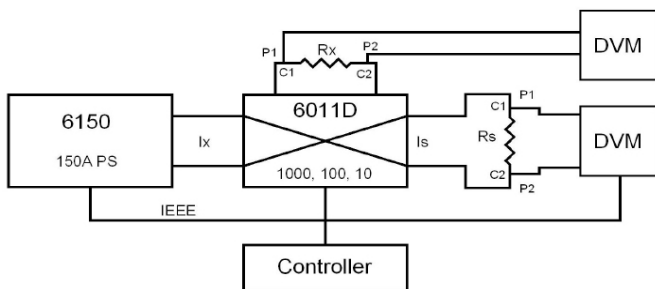


Figure 4-Model 6300 Shunt Calibration System

See the Model 6300 High Precision Shunt Measurement System Brochure

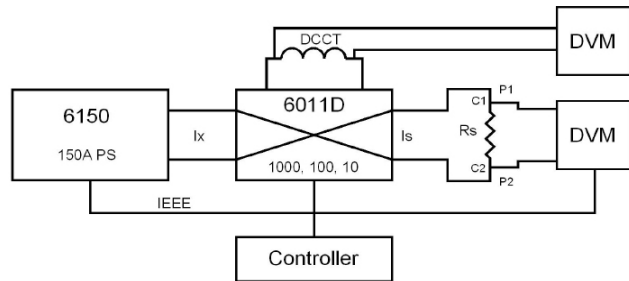


Figure 5-Model 6300 DCCT Calibration System

See the Model 6300 High Precision shunt Measurement System Brochure

The 6511D Range Extender (Figure 6) may also be used in conjunction with the MI Model 6010D or MI 6242D Resistance Bridges. The 6011D/150 and the 6011D/300 Range Extender (Figure 7) may also be used with the MI 6010D or 6242D and the MI 6150A (maximum 150 A) and 6250A (maximum 300 A) Power Supplies or the Keysight Technologies 6600 series of DC Power Supplies.



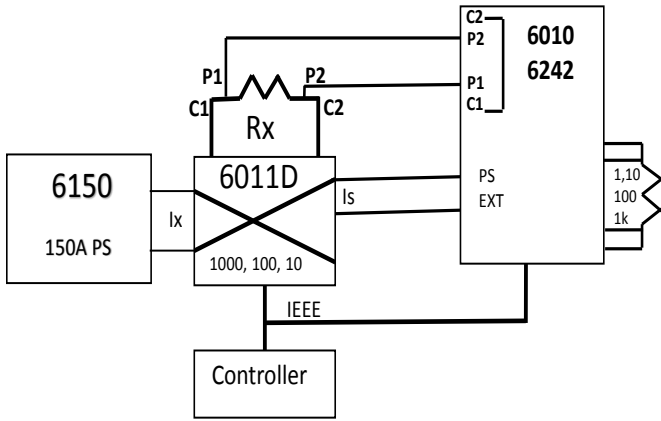


Figure 6-Shunt Calibration using the 6010D/6242D and 6511D

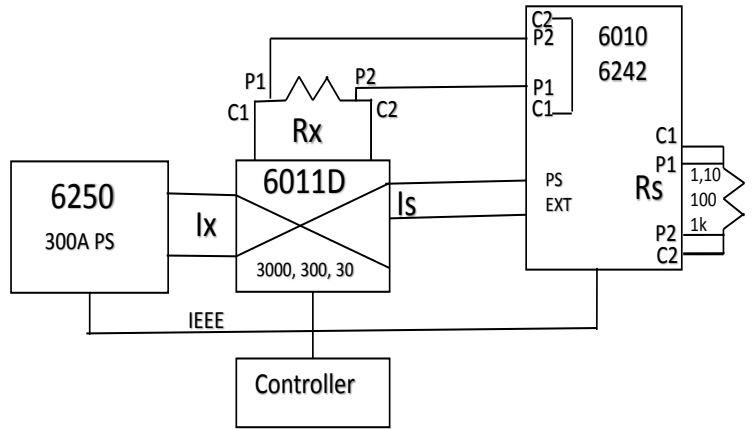


Figure 7-Shunt and DCCT Calibration with 6010D/6242D and 6511D



Figure 8-6242D/6011D/150 System

The following table indicates the 6011D ratio and 6010D or 6242D Resistance Bridge for ratios up to 1000:1 at 100% and 10% of current. Slave (S) and Master (M) windings in both the 6010D and 6011D are used to determine these ratios. When selecting ratios, the maximum current that the 6010D can supply (I_{rs}) is 150 mA and for the 6242D it is 150 mA. The 6011D/150 and 6150A are 150 A units. Figure 8 shows a 6242D/150 A system that can also be supplied as a 6242D/300 A system. Figure 9 shows a 6010D/300 A system. All connections are made at the front of the systems. For portability, both systems have wheels.



Figure 9-6010D/6011D/300 System

Technical Specification

6011/300								6010D or 6242D				
Rx	Test I	Range	Ratio ¹	Output	Range	Vrx	Unc ²	Rs	Ratio	Is	Vrs	Prs
Ω	A	A	S/M	A	%	V	ppm	Ω	M/S	A	V	W
0.1	3	3	30	0.1	100	0.1	0.210	1	1	0.1	0.1	0.01
0.1	0.3	3	30	0.01	10	0.01	0.300	1	1	0.01	0.01	0.0001
0.01	30	30	300	0.1	100	0.1	0.210	1	1	0.1	0.1	0.01
0.01	3	30	300	0.01	10	0.01	0.300	1	1	0.01	0.01	0.0001
0.001	300	300	3000	0.15	100	0.15	0.210	1	1	0.15	0.15	0.0225
0.001	30	300	3000	0.01	10	0.01	0.300	1	1	0.01	0.01	0.0001

Note 1: Ratio is calculated from the Slave and Master windings of the comparator. Maximum ratio on the 10 Ratio is 3:1. For ratio's <3, a 10 Ω standard resistor is required on Rs. **Note 2:** Uncertainty in ppm is indicated for 100% and 10% on each range and includes the 6010D/6242D/6011D uncertainties.

Currents Above 300 A

Figure 10 shows the block diagram for using the Model 6011D to measure currents of 1000 A, 2000 A, and 3000 A. See the Shunt Measurement Brochure for shunt and DCCT calibrations and for ratios up to 1,000,000:1. Figure 11 shows the 6010D/3000 A System.

The 1000 A system would consist of the 6680A, 6025, 6012M, and 6011D. The 2000 A system is comprised of 2 x 6680A, 6025M, 6012M, and 6011D and the 3000A system is comprised of 3 x 6680, 6024, 6014M, and 6011D. Both systems will operate with the 6010D or the 6242D.

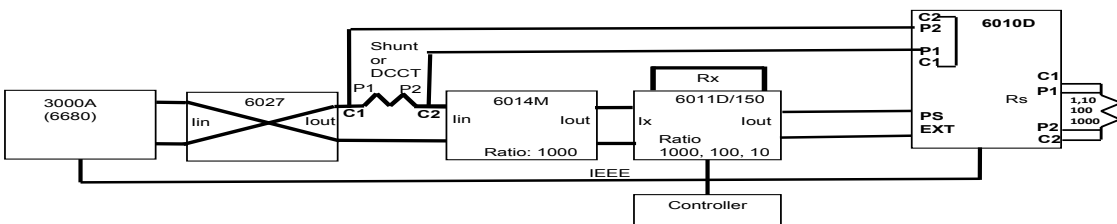


Figure 10-6010D/6011D/1000 A, 2000 A, 3000 A Block Diagram



Figure 11-6010D/3000 A System
UNC<20 ppm@10 u Ω



General Specifications:

Model	6511D/10	6011D/150	6011D/200	6011D/300
Ratio	1000, 100, 10	1000, 100, 10	2000, 200, 20	3000, 300, 30
Current Source ¹	Internal	INT/Ext	INT/Ext	INT/Ext
Max Input Current (A)	10, 10, 1	150, 10, 1	200, 20, 2	300, 30, 3
Output Current (mA)	10, 100, 100	150, 100, 100	100, 100, 100	100, 100, 100
Resistance Range	1 mΩ to 100 mΩ	100 μΩ to 100 mΩ	10 μΩ to 100 mΩ	10 μΩ to 100 mΩ
Linearity	<0.02	<0.02	<0.02	<0.02
Accuracy (ppm)	0.5, 0.2, 0.2	0.1, 0.1, 0.1	0.2, 0.2, 0.2	0.3, 0.2, 0.2
Output Compliance (V)	22	22	22	22
Operating Environment	18 °C to 34 °C	18 °C to 34 °C	18 °C to 34 °C	18 °C to 34 °C
Warranty	2 years	2 years	2 years	2 years

Note 1: 6511D has a built in 10 A power supply. 6011D/150 uses the 6150A and 6011D/300 uses the 6250A. External supplies offered are the Keysight Technologies 6600 Series.

Dimensions 6011D, 6011D/300 (L x W x H):

488 x 4259 x 170 mm, 488 x 425 x 215 mm

Weight:

20 kg max

Shipping Weight:

23 kg

Operating Power:

100 V, 120 V, 220 V, 240 V - 50/60 Hz

Accessories:

- 6150A–150 A Linear Power Supply
- 6250A–300 A Linear Power Supply
- 6013M/6023–400 A Range Extender and Reversing Switch
- 6012M/6025–2000 A Range Extender and Reversing Switch
- 6014M/6024–3000 A Range Extender and Reversing Switch
- 9331–Standard Air Resistors
- 9210B–Standard Oil Resistors
- 9332–Shunts (10 A to 3000 A)
- 9400–Standard Resistor Oil Bath
- 9300–Standard Resistor Air Bath
- 9300A–Standard Resistor Air Bath
- 9300A–Standard Resistor Air Bath/GPIB
- 6242B–Secondary Resistance Bridge
- 6010D–Primary Resistance Bridge

How to Order:

- Model: 6511D–Range Extender with 10 A Current Source
- Model 6011D/150–Range Extender
- Model 6011D/300–Range Extender
- Model 6011D Calibration/1 accredited/2 non accredited
- Model 6011D Accreditation Support Package

Distributed By:

Form MI 66, Rev. 8, Dated 13-03-18(QAP19, App. "N")

Data Subject to Change - Rev. B

Corporate Headquarters

Measurements International
 PO Box 2359, 118 Commerce Drive
 Prescott, Ontario, Canada K0E 1T0
 Phone: (613) 925-5934
 Fax: (613) 925-1195
 Email: sales@mintl.com
 Toll Free: 1-800-324-4988

Worldwide Offices

MI-USA
 Phone: (407) 706-0328
 Toll Free: 1-866-684-6393
 Email: sales@mintl.com

MI-China
 Phone: 86-10-64459890
 Email: sales@mintl.com

MI-Europe

Phone: +(420) 731-440-663
 Email: sales@mintl.com

MI-Japan

Phone: +(81) 72 39 64 660
 Email: kaz@mijpn.com

MI-India

Phone: +(91) 98 10 134 932
 Email: sales@MILLP.co.in



www.mintl.com