

Model 451x-QIVC Series

The 451x-QIVC cards incorporate four independent, isolated measurement channels on a single card.

Each channel consists of a:

- Programmable multi-range current source with programmable voltage clamp, source read-back, and precision voltage measurement.
- Programmable voltage source with source read-back and precision multi-range current measurement.

The 451x-QIVC cards are recommended for use only with the 4500-MTS Product.

CURRENT SOURCE

Range	Model	Programming Resolution	Programming Accuracy (1 Year) (23°C ±5°C)			Programming Accuracy (24 hr) ¹ (23°C ±1°C)			Noise Typical (peak to peak) 0.1Hz – 150kHz
			±(%rdg. + amps + amps* $[(V_o/V_{fs}) - I_o/I_{fs}])^5$			±(%rdg. + amps + amps* $[(V_o/V_{fs}) - I_o/I_{fs}])^5$			
±30.000mA	4510	2µA	0.08%	7.4µA	4.3µA	0.065%	3.5µA	4.3µA	100µA
±100.000mA	4510/11	5µA	0.08%	25µA	14.3µA	0.065%	13µA	14.3µA	100µA
±300.000mA	4511	15µA	0.08%	75µA	43µA	0.065%	40µA	43µA	200µA
±500.000mA	4510	25µA	0.08%	122µA	72µA	0.065%	42µA	72µA	250µA
±1.000A	4511	50µA	0.08%	250µA	144µA	0.065%	84µA	144µA	500µA

Range	Model	Default Measurement Resolution	Measurement Accuracy (1 Year) (23°C ±5°C)			Measurement Accuracy (24 hr) ¹ (23°C ±1°C)			Typical ⁷ Output Slew Rate mA/µs
			±(%rdg. + amps + amps* $[(V_o/V_{fs}) - I_o/I_{fs}])^5$			±(%rdg. + amps + amps* $[(V_o/V_{fs}) - I_o/I_{fs}])^5$			
±30.000mA	4510	0.1µA	0.065%	2.5µA	4.3µA	0.065%	1.5µA	4.3µA	.3
±100.000mA	4510/11	1µA	0.065%	8µA	14.3µA	0.065%	4µA	14.3µA	1
±300.000mA	4511	3µA	0.065%	12µA	43µA	0.065%	9µA	43µA	3
±500.000mA	4510	5µA	0.065%	20µA	72µA	0.065%	10µA	72µA	5
±1.000A	4511	10µA	0.065%	40µA	143µA	0.065%	20µA	143µA	10

CURRENT OUTPUT SETTLING TIME: 150µs to 0.1% of final value typical, resistive load after command is processed³.

CURRENT SOURCE SHORTING RELAY: Shorts load when output is turned off or when interlock condition exists.

CURRENT SOURCE OVERSHOOT: < 0.1%, full-scale step, resistive load.

CURRENT SOURCE LONG TERM STABILITY: ±20 ppm/hour typical, ±1°C ambient, 30 minute warm-up required.

OVER TEMPERATURE PROTECTION: Internally sensed temperature overload puts unit in standby mode.

LOAD INDUCTANCE: 200µH maximum⁴.

CURRENT SOURCE LOAD VOLTAGE MEASUREMENT

Range	Measurement Accuracy (1 Year) (23°C ±5°C) ±(%rdg. + volts)	Measurement Accuracy (24 hr) ¹ (23°C ±1°C) ±(%rdg. + volts)	Default Measurement Resolution
±6.0000V	0.06% + 2mV	0.025% + 250µV	10µV

REMOTE/LOCAL SENSE: Automatic; remote sense and proper zero are required to meet rated accuracy.

REMOTE SENSE: Up to 0.5V drop from card bracket to DUT.

CURRENT SOURCE VOLTAGE COMPLIANCE:

Range	Programming Resolution	Programming Accuracy (1 Year) (23°C ±5°C) ±(%rdg. + volts)	Programming Accuracy (24 hr) ¹ (23°C ±1°C) ±(%rdg. + volts)
±6.000V	200µV	0.1% + 4.7mV	0.07% + 3.7mV

MINIMUM COMPLIANCE VOLTAGE: 100 mV.

VOLTAGE SOURCE

Full Scale	Programming Resolution	Programming ⁶ Accuracy (1 Year) (23°C ±5°C)	Programming Accuracy (24 hr) ¹ (23°C ±1°C)	Default Measurement Resolution	Measurement ² Accuracy (1 Year) (23°C ±5°C)	Measurement Accuracy (24 hr) ¹ (23°C ±1°C)
		±(%rdg. + volts)	±(%rdg. + volts)		±(%rdg. + volts)	±(%rdg. + volts)
±10.000V	400µV	0.1% + 6mV	0.07% + 4mV	10µV	0.1% + 1mV	0.06% + 540µV

VOLTAGE OUTPUT SETTLING TIME: < 300µs to 0.1% typical, resistive load after command is processed³.

VOLTAGE OUTPUT SLEW RATE: < 0.5V/µs typical, resistive load after command is processed.

VOLTAGE NOISE: 10µV RMS, 0.1Hz to 10Hz typical.

CURRENT LIMIT: 25mA typical^{3,8}.

MAXIMUM CAPACITIVE LOAD: 20nF on 10µA and 500µA range; 35nF on 10mA range.

MISCELLANEOUS

AUTOMATIC OFFSET COMPENSATION: The user can command the 451x-QIVC to disconnect itself from the device under test and measure and store any offsets in the source and measure circuitry so that future measurements are appropriately compensated.

VOLTAGE SOURCE CURRENT MEASUREMENT

Range	Measurement Accuracy (1 Year) (23°C ±5°C) ±(%rdg. + current)	Measurement Accuracy (24 hr) ¹ (23°C ±1°C) ±(%rdg. + current)	Default Measurement Resolution
±10.000uA	0.1% + 15nA	0.063% + 12nA	.1nA
±500uA	0.1% + 70nA	0.063% + 55nA	5nA
±10.000mA	0.1% + 1.4uA	0.063% + 1.1uA	100nA

VOLTAGE BURDEN: < 14 mV³.

OUTPUT RELAY ISOLATION

The GUARD signal is not isolated with a relay.

The following information applies when the output state is set to OFF-OPEN (HI-Impedance).

TYPICAL ISOLATION LEAKAGE CURRENT: 30nA

MAXIMUM ISOLATION VOLTAGE: 12V DC

MAXIMUM ISOLATION RELAY SETTling TIME: 10ms

GENERAL SPECIFICATIONS

DIGITAL INTERFACE:

Safety Interlock:

- Customer provided closed contact on a per-channel basis, to enable output.
- On a channel group basis, opening of customer provided contacts disconnects the sources from loads on the Voltage Sourced and Current Source. 5-volt level, 500Ω input impedance.

Supplies: +5V (fused ¼ amp) and Ground.

OVERRRANGE: 105% of Range (Source Functions), 110% of Measure (Measure Functions).

COMMON MODE VOLTAGE: ±20V DC maximum.

WARM UP TIME: 1 hour.

OVER-TEMPERATURE: Two on-board over-temperature detectors.

ENVIRONMENT: Accuracy specifications are multiplied by one of the following factors, depending upon the ambient temperature and humidity.

TEMPERATURE	% RELATIVE HUMIDITY	
	5-60	60-70
10°- <18° C	X3	X3
18°-28° C	X1	X3
>28°- 40° C	X3	X5

WEIGHT (approx.): 0.9kg (2lbs)

Notes:

- The 24 hour specification applies only for the 24 hour period immediately following an Auto-Offset, and ±1°C of the temperature at which the Auto-Offset was performed, and within 1 year of calibration.
- When I-SOURCE-LO and V-SOURCE-LO share a common connection, current flow through V-SOURCE-LO's parasitic ground resistance may cause up to 150mV of measurement error. This error is limited to measurement only and does affect voltage source accuracy.
- As guaranteed by design.
- Includes cable inductance.
- For example the total uncertainty of a current source of 1A on the 1A range into a perfect short of 0V would be: $(0.08\% \times 1A) + (250uA) + (144uA \times (|0V/6V| - |1A/1A|)) = (80uA) + (250uA) + (144uA) = 474uA$

The generic equation of the third error term is
$$Amps * \left| \left| \frac{V_{out}}{V_{FS}} \right| - \left| \frac{I_{out}}{I_{FS}} \right| \right|$$

- Includes 2 meter accessory cable while excluding IR drop in DUT leads.
- Slewrates apply for resistive loads: Rload < 200 Ω for 30mA range, Rload < 60 Ω for 100mA range, Rload < 12 Ω for 500mA range, and Rload < 6 Ω for 1A range.
- Hardware limited.