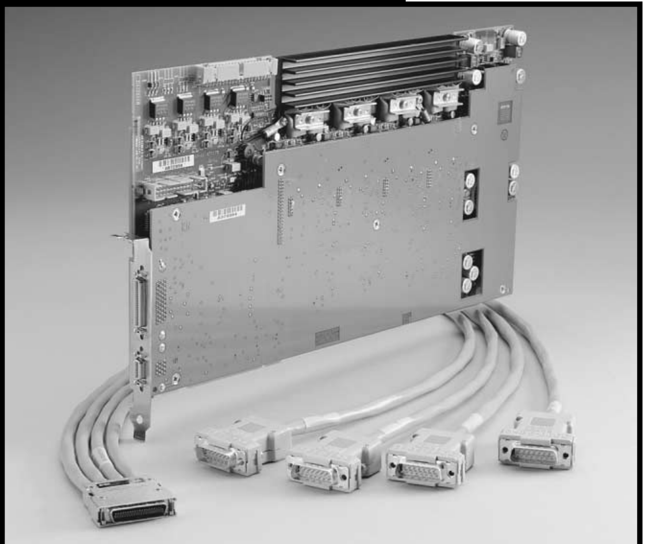
4500-QIVC
4501-QIVC

Low Power Quad I-V Card
High Power Quad I-V Card



Quad I-V Cards

The Model 4500-QIVC Low Power Quad I-V Card and the Model 4501-QIVC High Power Quad I-V Card are the first of a series of cards optimized for high throughput automated testing with the Model 4500-MTS. Each card incorporates four independent, isolated measurement channels, each of which provides:

- Programmable, multi-range current sourcing with programmable voltage clamp, source readback, and precision voltage measurement.
- Programmable voltage sourcing with source readback and precision multi-range current measurement.

The Model 4500-QIVC provides ideal source ranges for characterizing tunable laser diodes and VCSELs, as well as a 500mA range for transmitter modules and low power pump lasers. Each of four channels provides a drive current source, Kelvin voltage measurements, and photocurrent measurement channels with programmable voltage bias. The Model 4501-QIVC provides CW/DC testing up to 1A per channel, and higher currents by using up to four current source channels in parallel. These features and high throughput dramatically reduce the cost of test for multi-wavelength Raman pump modules, high output transmitter modules, and EDFA pump lasers.

- **Four source-measure channels per card provide high channel density at lower cost per channel**
- **Source up to 1A per channel (with 4501-QIVC card) to test medium power pump laser diodes**
- **Each channel has its own 5½-digit A/D converter to accelerate measurement speed**
- **All channels can source and measure simultaneously for high throughput**
- **DUT shorting protects sensitive devices from potential ESD damage**

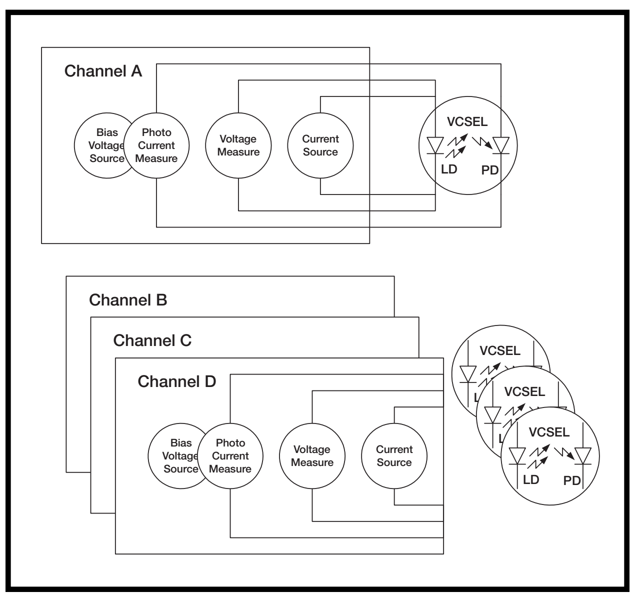
Real-time Embedded Controller Accelerates Testing

Each Series 4500 card has a real-time embedded controller to coordinate high speed test sequences independently from the PC controller. This real-time controller allows the cards to execute complex tests, such as nested sweeps, with precision timing because it is unaffected by any latencies in the operating system of the chassis's PC controller. Furthermore, the real-time processor coordinates the test sequence using the trigger bus signals. This allows synchronized test execution in real time using resources on multiple Series 4500 cards.

Optimized for Testing Active Opto Components

The architecture of the cards is optimized for testing active optoelectronic devices, such as tunable laser diodes, VCSELs, transmitter modules, etc. **Figure 1** shows a single Series 4500 card configured to test four VCSEL devices simultaneously.

Figure 1. The programmable current source is configured to sweep the VCSEL driver current while measuring the forward voltage drop across the VCSEL. At the same time, the monitor photodiode's output current is recorded using the same channel's resources. This configuration is then repeated for all four VCSELs. The 4500-MTS can be configured to test 36 VCSEL simultaneously by installing nine Series 4500 cards. Typical VCSEL test times range from 20ms to 200ms, depending on configuration and test requirements.



Ordering Information

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Figure 2 shows a Series 4500 card configured for testing a four-section tunable laser diode. A device of this type usually requires precision control of injection currents to generate a specific output wavelength. In this example, a grating and a pair of monitor diodes in the DUT forms a wavelength measurement system. During characterization, the injection currents are swept through all possible source combinations, while the forward voltages and monitor currents are recorded.

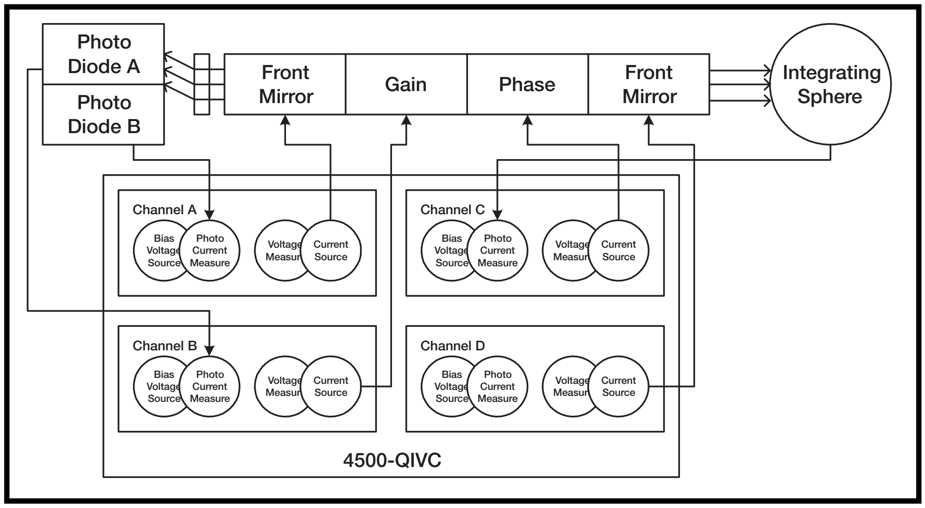

Figure 2. All four current sources of the Series 4500 cards are used to control injection currents. Three of the four current measurement channels are used to record photocurrents—two for wavelength measurement and one for recording optical output power. Typical characterizations generate from 250,000 to 1,500,000 measurements, which must be recorded and analyzed. The Model 4500-MTS's ability to transfer large data sets quickly, as well as the high channel count and multiple A/D converters built into the Series 4500 cards, makes this system well suited for applications of this type.

APPLICATIONS

Production testing of:

- **Tunable laser diode test (edge emitters)**
- **Multi-wavelength Raman pump modules**
- **VCSEL (Vertical Cavity Surface-Emitting Laser) arrays**
- **Transmitter laser diode modules**

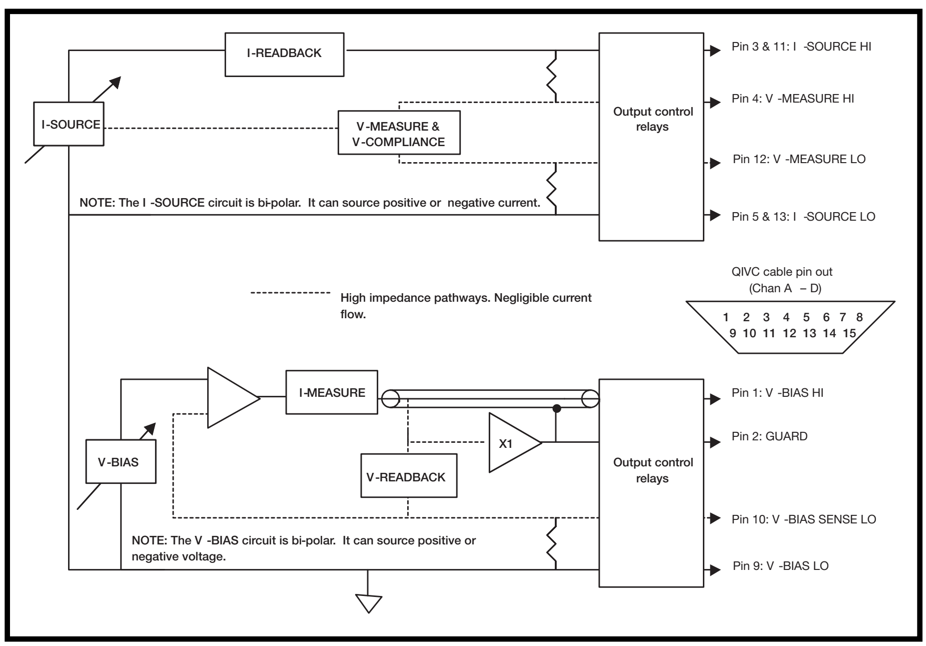

Figure 3. Basic block diagram of source measurement components of the Series 4500-QIVC cards.

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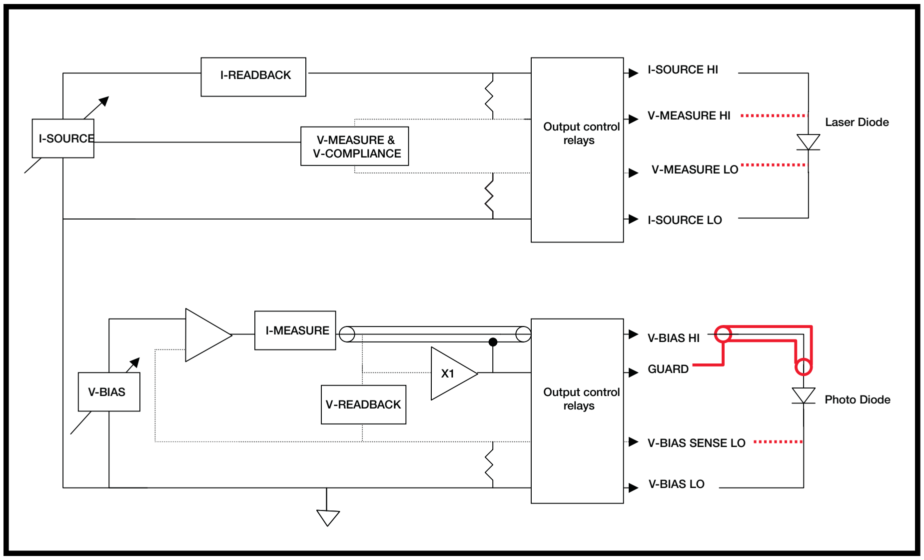

Figure 4. Red GUARD signal connection helps reduce leakage current errors that can become significant when the photo current is small. V-MEASURE HI, V-MEASURE LO, and V-BIAS SENSE LO connections (indicated by dashed lines) eliminate IR drop errors that can become significant when the laser current is large.

The 450x-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 450x-QIVC cards are recommended for use only with the 4500-MTS Product.

CURRENT SOURCE

RANGE		PROGRAMMING RESOLUTION	PROGRAMMING ACCURACY (1 Year) (23°C ±5°C) ±(%rdg. + amps + amps * ($V_O/V_{fs} - I_O/I_{fs}$)) [5]			PROGRAMMING ACCURACY (24 Hr.) [1] (23°C ±1°C) ±(%rdg. + amps + amps * ($V_O/V_{fs} - I_O/I_{fs}$)) [5]			NOISE TYPICAL [2] (peak to peak) 0.1Hz – 150kHz
±30.0000 mA	4500	2 µA	0.08%	7.4 µA	4.3 µA	0.065%	3.5 µA	4.3 µA	100 µA
±100.000 mA	4500/4501	5 µA	0.08%	25 µA	14.3 µA	0.065%	13 µA	14.3 µA	100 µA
±300.000 mA	4501	15 µA	0.08%	75 µA	43 µA	0.065%	40 µA	43 µA	200 µA
±500.000 mA	4500	25 µA	0.08%	122 µA	72 µA	0.065%	42 µA	72 µA	250 µA
±1.000 A	4501	50 µA	0.08%	250 µA	144 µA	0.065%	84 µA	144 µA	500 µA

RANGE		DEFAULT MEASUREMENT RESOLUTION	MEASUREMENT ACCURACY (1 Year) (23°C ±5°C) ±(%rdg. + amps + amps * ($V_O/V_{fs} - I_O/I_{fs}$)) [5]			MEASUREMENT ACCURACY (24 Hr.) [1] (23°C ±1°C) ±(%rdg. + amps + amps * ($V_O/V_{fs} - I_O/I_{fs}$)) [5]			TYPICAL [2, 7] OUTPUT SLEW RATE mA/ms
±30.0000 mA	4500	0.1 µA	0.065%	2.5 µA	4.3 µA	0.065%	1.5 µA	4.3 µA	.3
±100.000 mA	4500/4501	1 µA	0.065%	8 µA	14.3 µA	0.065%	4 µA	14.3 µA	1
±300.000 mA	4501	3 µA	0.065%	12 µA	43 µA	0.065%	9 µA	43 µA	3
±500.000 mA	4500	5 µA	0.065%	20 µA	72 µA	0.065%	10 µA	72 µA	5
±1.000 A	4501	10 µA	0.065%	40 µA	143 µA	0.065%	20 µA	143 µA	10

CURRENT OUTPUT SETTLING TIME: 150ms to 0.1% of final value typical, resistive load after command is processed [3].

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: 200mH maximum [4].

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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
±6.0000 V	0.06% + 2 mV	0.025% + 250 µV	10 µV

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)
±6.000 V	200 µV	0.1% + 4.7 mV	0.07% + 3.7 mV

MINIMUM COMPLIANCE VOLTAGE: 100mV.

VOLTAGE SOURCE

FULL SCALE	PROGRAMMING RESOLUTION	PROGRAMMING[6] ACCURACY (1 Year) (23°C ±5°C) ±(%rdg. + volts)	PROGRAMMING ACCURACY (24 Hour[1]) (23°C ±1°C) ±(%rdg. + volts)	DEFAULT MEASUREMENT RESOLUTION	MEASUREMENT ACCURACY (1 Year) (23°C ±5°C) ±(%rdg. + volts)	MEASUREMENT ACCURACY (24 Hour[1]) (23°C ±1°C) ±(%rdg. + volts)
±5.000 V	200 µV.	0.1% + 3 mV	0.07% + 2 mV	10 mV	0.05% + 510 mV	0.03% + 260 mV

VOLTAGE OUTPUT SETTLING TIME: < 150ms to 0.1% typical, resistive load after command is processed[3].

VOLTAGE OUTPUT SLEW RATE: < 0.01V/ms typical[2], resistive load after command is processed.

VOLTAGE NOISE: 10mV rms, 0.1Hz to 10Hz typical[2].

CURRENT LIMIT: 11 mA to 30 mA[3, 8].

MAXIMUM CAPACITVE LOAD: 20nF on 100uA range. 35nF on 1mA and 10mA ranges.

MISCELLANEOUS

AUTOMATIC OFFSET COMPENSATION: The user can command the 450x-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 Hour)[1] (23°C ±1°C) ±(%rdg. + current)	DEFAULT MEASUREMENT RESOLUTION
±100.000 mA	0.1% + 14 nA	0.063% + 11 nA	1 nA
±1.00000 mA	0.1% + 140 nA	0.063% + 110 nA	10 nA
±10.0000 mA	0.1% + 1.4 µA	0.063% + 1.1 µA	100 nA

VOLTAGE BURDEN: <14mV[3].

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 _ amp) and Ground.

OVERRANGE: 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	×3	×3
18° – 28°C	×1	×3
>28° – 40°C	×3	×5

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

NOTES:

1. 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.
2. Typical calculated for now, to be replaced with 95% CI based on measured data on 20? Sample units.
3. As guaranteed by design.
4. Includes cable inductance.
5. For example the total uncertainty of a current of 1A on the 1A range into a perfect short of 0V would be: (0.065% × 1A) + (84µA) + ((|0V/6V – 1A/1A|) × 144µA) = (65µA) + (84µA) + (144µA) = 293µA.
   Figure 5 shows the additional uncertainty due to the third error term, Amps · ($V_{out}/V_{FS} - I_{out}/I_{FS}$):
6. Does not include IR drop in DUT leads.
7. Slew rates apply for resistive loads: R_{load} < 200Ω for 30mA range, R_{load} <60Ω for 100mA range, and R_{load} <12Ω for 500mA range.
8. Hardware limited.

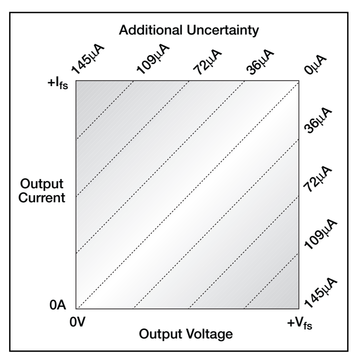

Figure 5. Additional Uncertainty

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