Four-channel Fast Current Measurement Device

Features

- Four independent fully parallel four-range I-V converters
- Dynamic range 0.1 nA to 1mA
- Integrated digitization and filtering
- On-board data buffer
- Fiber-optic, RS-232 / RS-485 and Ethernet interfaces.
- Integrated calibration test sources
- Independent channel gain control
- External trigger capability
- Four independent frequency monitor outputs.
- Analog voltage outputs and inputs.
- Servo controller option.
- HV and LV bias output options

Applications	• Quadrant photodiode readout • Beam position monitors • Segmented Faraday collectors • Current and charge measurement • Servo control based on current measurement
Options	• Auxiliary HV output options up to + or - 3000 V • Precision low-voltage bias option + or - 20 V • Dual servo controller option

Specifications

Operating principle	Multi-range transconductance amplifier (I-V converter)
Current ranges	Four, independently selectable for each channel. Range 4: +/-1 µA full scale; Range 3: +/-10 µA full scale Range 2: +/-100 µA full scale; Range 1: +/-1 mA full scale
Input impedance	<= 40 ohm
Input protection	Back to back diodes and spark gaps
Noise	< 0.01% of full scale rms noise (with 1 msec averaging)
Absolute accuracy	Readings within +/- 0.1% full scale relative to a traceable external standard current source.

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Specifications (continued)

Stability	Output drift < 5 ppm hr-1 + 5 ppm C-1 hr-1 with recalibration Output drift < 10 ppm hr-1 + 10 ppm C-1 hr-1 without recalibration
Analog bandwidth	DC to >40 kHz (- 3dB)
Current sources	Two internal precision calibration sources, 833 nA and 83.06 µA, used for automatic calibration. Calibration factors stored in flash memory.
Digitization	16 bit successive approximation bipolar, 250 kHz, fully parallel.
Digital filtering	Block averaging of successive conversions for each reading, 1 to 250000 samples.
Accumulation	Charge accumulation provided via numeric integration.
Sensor compensation	Independent gain and offset factors provided for sensor compensation. Stored in flash memory.
Data buffering	On-board buffering of up to 50000 contiguous samples at any data rate up to maximum.
Triggering	External trigger line can start, pause and stop acquisition via TTL level signal to gate input. Input impedance 2.5 kohm.
HV bias supply	(Factory option) 0 to 200/500/1000/2000/3000 V programmable (polarity and maximum voltage factory selectable), 1 watt max output. Noise and ripple < 0.1% (up to 2000V), <0.2% (3000V)
HV monitoring	Voltage divider on output (20 Mohm), 16 bit digitization with calibration.
LV bias supply	(Factory option, alternative to HV bias) 0 to >= 20 V programmable (polarity factory selectable), > 20mA max output. Accuracy better than +/- 0.01 V. HF noise and ripple < 0.02 V pk-pk.
LV monitoring	Voltage divider on output (110 kohm), 16 bit digitization with calibration.
Analog inputs	Two, 16-bit +/- 10 V. Accuracy better than +/-0.5% of full scale.
Analog outputs	Four, 16 bit +/- 10V (used for servo and monitor outputs). Accuracy better than +/-0.1% of full scale.
Digital outputs	Four, TTL levels into 50 ohms (used for monitor outputs).
Controls	Two rotary switches for loop address and comms mode/baud rate.
Processor	PTC A60 processor board
Displays	Four status LEDs, "HV on" LED.
Power input	+24V (+/- 2V) DC, 300mA typical, 500mA max. PTC fuse 500 mA.

Specifications (continued)

Case material	Stainless steel sheet
Weight	1.64kg (3.6 lb).
Operating environment	10 to 35C (15 to 25 C recommended to reduce drift and offset) , < 70% humidity, non-condensing, vibration < 0.1g all axes (1 to 100 Hz) Vibration must be as low as possible to measure at the lower limit of the dynamic range.
Shipping and storage environment	-10 to 50C, < 80% humidity, non-condensing, vibration < 2g all axes, 1 to 100 Hz

Interfacing

Interfaces	RS-232 or RS-485, 8-bit ASCII. Selectable baud rate up to 115 kbos. The electrical interface can be set to be RS-232 levels, or full-duplex differential RS-485.
	Fiber-optic loop, 10 Mbit/sec serial, 9-bit asynchronous binary.
	Ethernet 10/100/1000BaseT, auto MDIX . TCP/IP protocol. Average continuous data rate to host up to 1 kHz typical; higher in lightly-loaded systems.
Host computer	ASCII serial communications based on SCPI. Example GUI available using LabVIEW™. IG2 EPICS interface service allows control from any EPICS-compatible client, including LabVIEW™, Control System Studio, Matlab™, C#, C++, Python. PSI DiagnosticG2 host software supplied with each F460.
Slave devices	Up to 15 slave devices may be connected to the fiber optic loop and thus be accessed through the F460 Ethernet connection. Example devices include general purpose I/O devices, other current measurement devices, magnetic field measurement devices.

Monitor outputs

Number	Four, independent analog voltage Four, independent frequency TTL levels
Signal type	Analog voltage +/- 10V into 10 kohm, 16 bit. Frequency 0 to 1 MHz 5V square wave, 20 mA max, .

Software-selectable output parameter options	Current, (relative to selected full scale for relevant input) all outputs active
	
	Independent position, two outputs
	  X = (INA - IND) / (INA + IND)
	  Y = (INB - INC) / (INB + INC)
	
	Quadrant position, two outputs active
	  X = ((IN1A + INC) - (INB + IND)) / (INA + INB + INC + IND)
	  Y = ((IN1A + INB) - (INC + IND)) / (INA + INB + INC + IND)
	
	Servo command, one analog outputs reserved per servo controller.

Servo control option

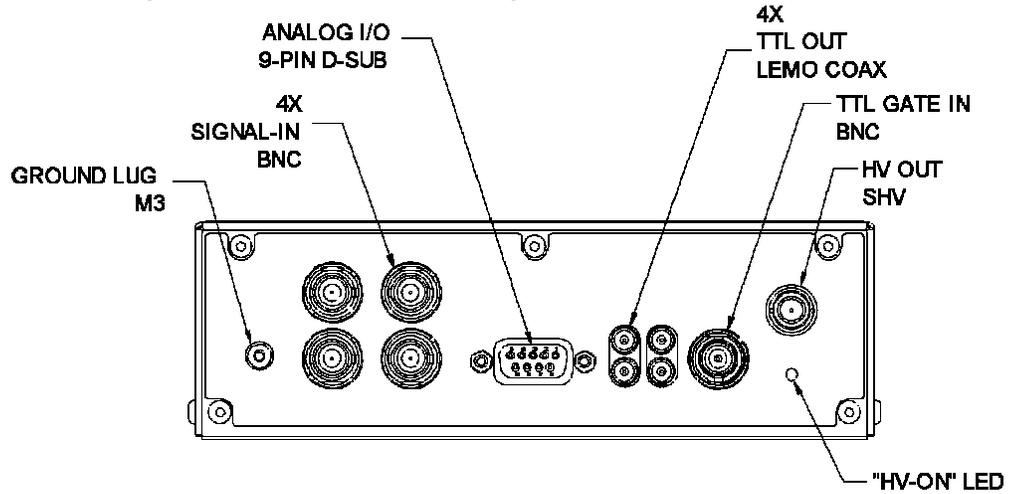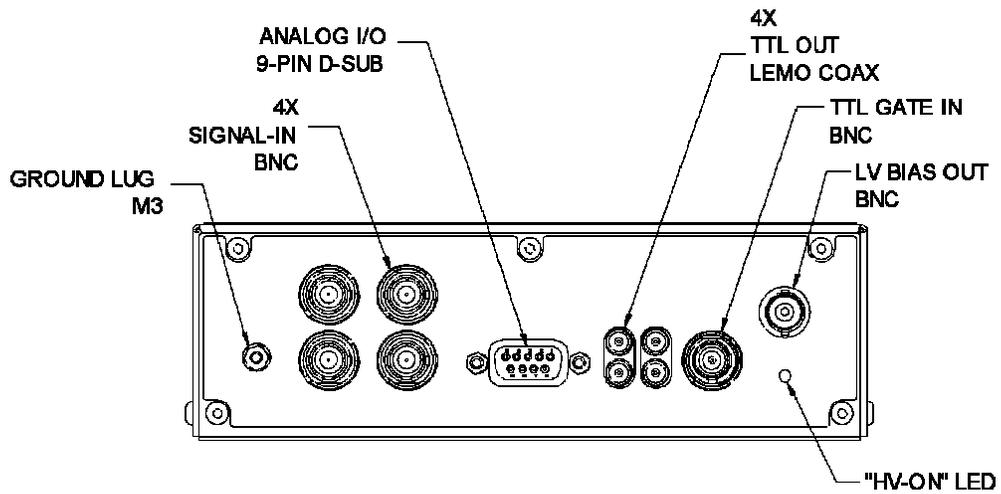|	
Principle	The F460 measures four currents, from devices such as ionization chambers, photodiodes, or secondary electron emission electrodes. The value of a process variable formed as an arithmetic function of the measured currents is maintained by adjusting a +/- 10 V control output using a PI control algorithm. An analog input can be used for any direct feedback from the controlled device..
Typical applications	Beam intensity stabilization for Double Crystal Monochromators Beam position control in charged particle or photon beamlines. Beam current stabilization in particle beam systems.
Number of controllers	The F460 can run two independent PID controllers, each using a process variable comprising an arithmetic combination of the measured currents.
Process variable options	Individual currents, sums or differences of currents, ratios of currents, ratios of sums and differences of currents. These options allow position functions to be defined as process control variables.
Servo frequency	2000 Hz maximum
Automated functions	Peak scan Suspend on defined control output limits Suspend on low input signal(s) Input signals ratio to value sent by the host system (for example electron synchrotron ring current, so that servo does not attempt to track ring current decay).

Connectors

Signal inputs	Four BNC isolated from chassis.
HV bias out	SHV
LV bias out (option)	BNC isolated from chassis.
External gate in	BNC isolated from chassis.
Monitor outputs (TTL)	Four Lemo coax size 00
Analog signals	DSub female 9 pin

1	Analog gnd	6	Analog out 1 (servo 1)
2	Analog in 2	7	Analog in 1
3	+24 V, 200 mA out	8	0V
4	Analog out 2	9	Analog out 3
5	Analog out 4		

RS-232 / RS485	Six pin mini-DIN ("PS/2")

1	Tx / RS-485 Tx-	4	n/c
2	Rx / RS-485 Rx+	5	RS-485 Tx+
3	Gnd	6	RS-485 Rx-

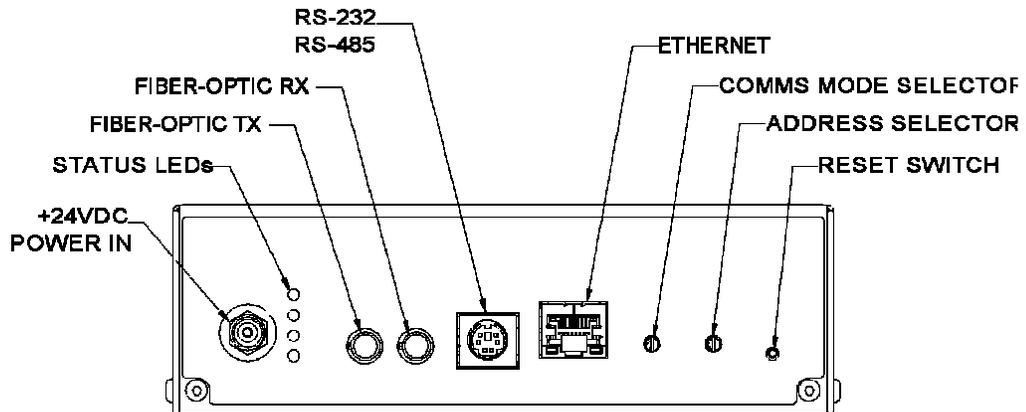|	
Fiber optics	TX & RX ST bayonet, suitable for 1mm plastic fiber or 200 µm HCS fiber.
Ethernet	RJ-45 jack
Power in	2.1mm threaded jack. Mates with Switchcraft S761K or equivalent.
Ground	M3 threaded stud

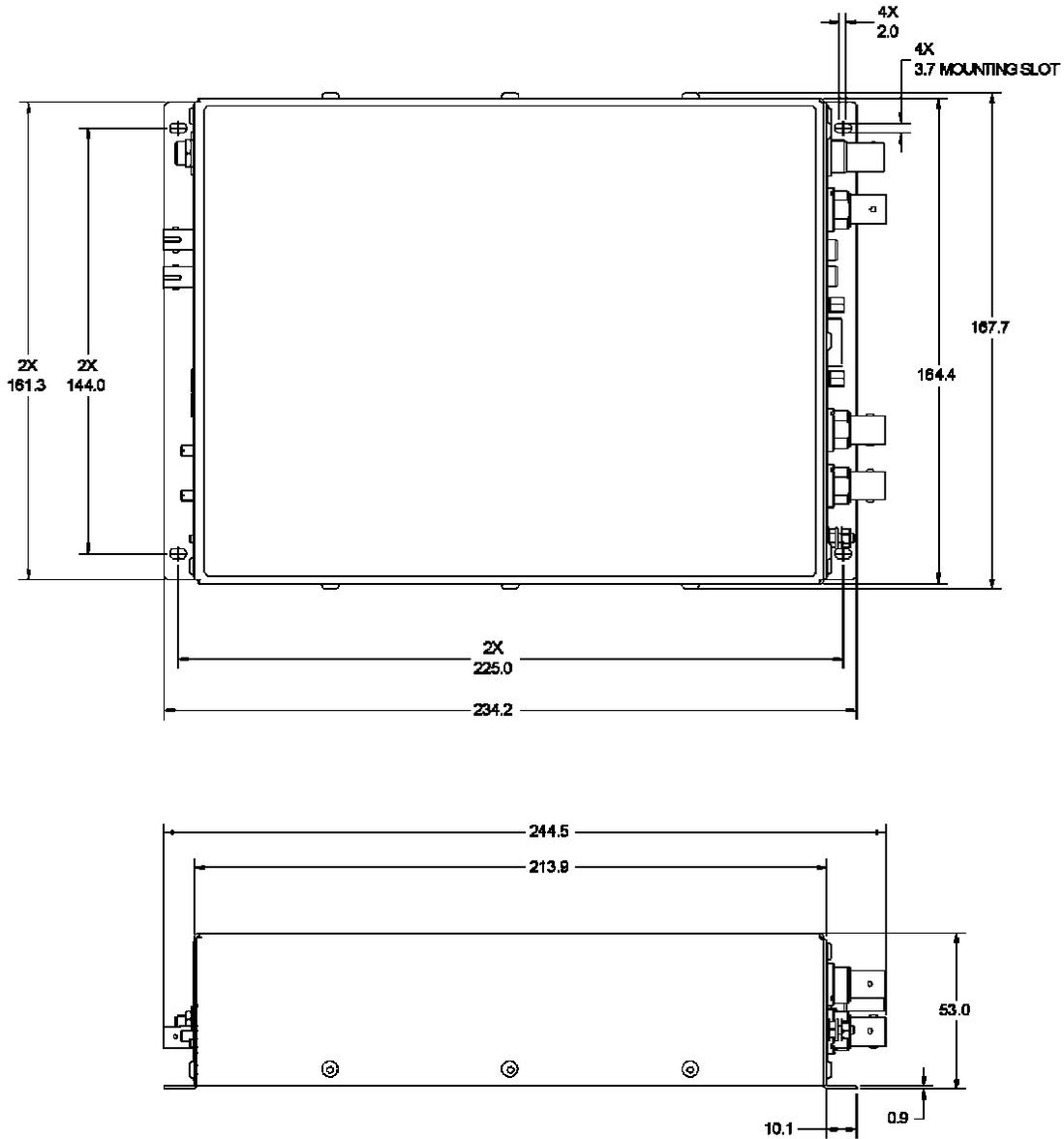**Signals and bias outputs—models with HV bias option**

ANALOG I/O
9-PIN D-SUB

4X
TTL OUT
LEMO COAX

TTL GATE IN
BNC

4X
SIGNAL-IN
BNC

HV OUT
SHV

GROUND LUG
M3

"HV-ON" LED

Signals and bias output—models with LV bias option

ANALOG I/O
9-PIN D-SUB

4X
TTL OUT
LEMO COAX

TTL GATE IN
BNC

4X
SIGNAL-IN
BNC

LV BIAS OUT
BNC

GROUND LUG
M3

"HV-ON" LED

Communications and power—all versions

RS-232
RS-485

ETHERNET

FIBER-OPTIC RX

COMMS MODE SELECTOR

FIBER-OPTIC TX

ADDRESS SELECTOR

STATUS LEDs

RESET SWITCH

+24VDC
POWER IN

Models with HV bias option

Ordering information

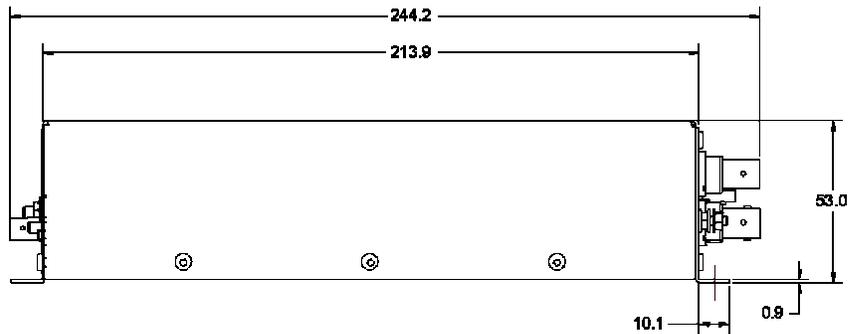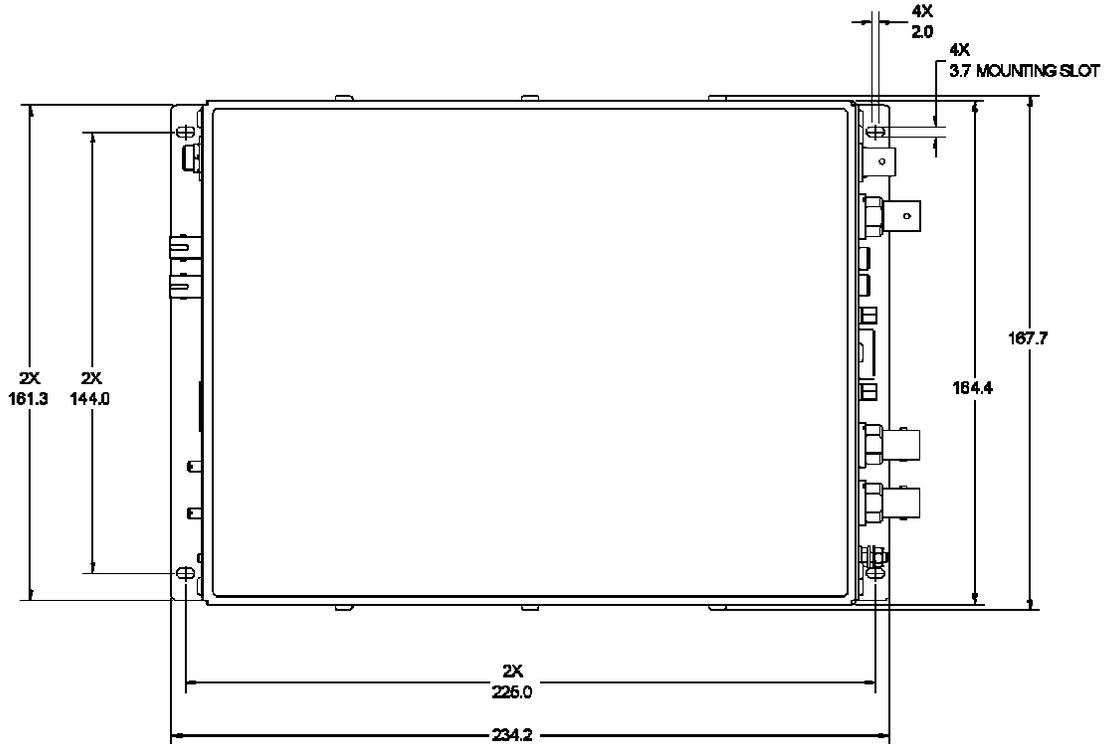|	
F460	F460 four channel electrometer, user manuals, software drivers, calibration data.
-XP30/20/10/05/02/002 (-XN)	Add auxiliary HV bias supply positive 3000 / 2000 / 1000 / 500 / 200 / 20 V (negative)
-S1	Add PID controller function

Models with LV bias option

4X
2.0

4X
3.7 MOUNTING SLOT

167.7

164.4

2X
161.3

2X
144.0

2X
226.0

234.2

244.2

213.9

53.0

10.1   0.9

Dims mm

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