Datasheet **I6400**

Integrated Controller and Readout for Position-sensitive Ionization Chambers

Features

- 64 parallel integrator channels for strip or wire readout.
- Multirange I-V converter and gated integrator input for dose plane readout.
- Integrated digitization and calibration using precision current sources
- Dose plane summing option for scattering and raster scanning systems
- External trigger input and trigger passthrough
- Dose target, dose accumulation and beam control
- On-board processors for real time beam position and shape verification, dose control and map execution
- Fiber optic fast beam control line
- Monitor pulse output
- Fast Ethernet connection and internal buffering allows contiguous data at high rates
- Integrated HV supply with loopback verification
- Integrated analog and digital input/output lines for ionization chamber environmental sensor read-out or other purposes
- Integrated pneumatic actuator control
- Integrated dosimetry safety features including beam enable safety relay and override switch
- Dual fiber-optic loop controller capability to handle multiple slave device
- Multiple host interface options

Applications	• Particle therapy beam position measurement and dosimetry • Suitable for continuous and pulsed beam measurements • Multistrip and multiwire ionization chamber readout. • Particle range verifier readout • General multichannel low-current measurement.
Options	• HV range and polarity selections • Dose plane input A, A+B selectable (default A, B selectable)

Specifications

Strip inputs	
Number and type	64, parallel independent gated integrators
Measurement type	Charge, 0 to not less than +/-10 nC. Absolute maximum input current 200 µA.
Ranges	>320 pC (420 pC nominal), >9 nC (10 nC nominal) with selectable 40 pF and 1000 pF feedback capacitors.
Dynamic range	<0.5 pA to >80 µA on each channel
Input impedance	< 4 kohm typical (40 pF capacitor), < 2 kohm typical (1000 pF capacitor)
External accuracy	Better than 0.2% of full scale (up to 80 µA)
Calibration accuracy	Calibration source external accuracy better than 0.01%
Input noise current	< 100 fA one sigma at 25 C (1 second integration, 40 pF capacitor, <= 25 C ambient). Typical < 60 fA
Input offset current	< +/-10 pA at 25 C ambient (before zero correction). Typical < +/- 5 pA.
Drift	< 100 fA / hour at 25 +/- 1 C ambient after stabilization.
Digitization	64 parallel 16 bit successive approximation bipolar converters.
Charge integration time	50 µsec to 1 sec. Typical reset and settle time 50 µsec.

Specifications (continued)

Dose plane input	
Number and type	One, connected to input pin A or B (software selectable), and connected to multirange I-V converter or gated integrator input amplifier (software selectable). Build time option (-DSUM): Input pin A or pins A+B routed to input amplifier (software selectable).
Measurement type	Current, 0 to +/-100 µA (I-V converter) Charge 0 to +/- 36 nC (gated integrator). Absolute maximum input current 200 µA.
Ranges	100 µA, 25 µA, 5 µA, 1 µA (I-V converter) 1.0 nC, 36 nC (gated integrator, with 100 pF and 3300 pF feedback).
Dynamic range	< 100 pA to 100 µA (I-V converter) < 1 pA to > 100 µA (gated integrator)
External accuracy	Better than 0.1% of full scale (I-V converter) Better than 0.2% of full scale (gated integrator, up to 80 µA)
Calibration accuracy	Calibration source external accuracy better than 0.01%
Input impedance	<= 200 ohm (I-V converter); < 2 kohm (gated integrator)
Input noise current	< 0.05% of full scale current rms (>1 msec averaging; I-V converter) < 100 fA one sigma (gated integrator, 1 second integration)
Analog bandwidth	DC to >60 kHz (-3 dB) unloaded (I-V converter).
Digitization	Successive approximation 16 bit bipolar, 250 kSa/s (I-V converter) Integration ramp sampling (gated integrator)
Averaging	Block averages, selectable number of samples per reading (I-V converter)

Specifications (continued)

General I/O	
Analog inputs	Four, differential, +/-12 V, DC to 35 kHz (- 3dB) 16 bit bipolar conversion, 250 kSa/s
Analog outputs	Two, +/- 10V 16 bit resolution, ultra-low transition glitch, update rate up to 100 kHz
Digital inputs	Four, TTL levels, active low (5V internal pull-up)
Digital outputs	Four, TTL levels, 6 mA maximum source or sink
Actuator control	
Solenoid control	24 VDC output, 200 mA fused, plus isolated control relay contact pair n/o
Limit switch sense	Two, opto-isolated, active low; 10 kohm series current limiting.
Dose monitor pulse	
Pulse type	TTL or NIM-standard fast negative-going; transformer isolated (jumper selectable) Able to drive 50 ohm load
Charge quantum	Software configurable, derived from integral plane input reading
Measurement gates	
Gate in	TTL levels, Schmidt trigger buffered 2.5 kohm input impedance
Gate out	TTL levels Able to drive 50 ohm load
Dosimetry interlocks	
Enable input	Opto isolated digital input pair (anode and cathode)
Enabled output	Potential-free relay contact pair n/o
Mode switch output	Potential-free key switch contact pair
Interlock output	Potential-free safety-rated relay contact pair n/o (Tyco SR4D4)
Utility output	Potential-free relay contact pair n/o
Beam control	
Beam enable out	Fiber optic on/off (640 nm)
Status out	Fiber optic on/off (640 nm)

Specifications (continued)

High voltage	
Voltage range options	20 V to 200 V. Line <0.01%, Load <0.05%, Ripple <0.01% 50 to 500 V. Line <0.01%, Load <0.01%, Ripple <0.01% 100 to 1250 V. Line <0.001%, Load <0.005%, Ripple <0.001% 200 to 2000 V Line <0.01%, Load <0.01%, Ripple <0.001% Supplies can be either polarity (specify at time of order)
Output power	1 watt
Line regulation	< 0.001%

General	
Power input	+24 V (+/- 2V) DC, 750 mA typ, 1500 mA max.
Power outputs	+24 VDC, 200 mA (two places) +5 VDC, 200 mA
Controls	Front panel override key-switch; key retained in override state. Two rear panel rotary switches for fiber optic loop address and comms mode/baud rate.
Displays	Front panel indicator for power on Front panel LEDs for override switch position and HV on Four rear panel LEDs for device status
Case	1U 19” rack mounting steel chassis with Al alloy front panel Filtered cooling fan fitted to rear panel. Ventilation outlet holes on rear panel 4.8 mm diameter.
Weight	3.5 kg (7.7 lb)
Operating environment	10 to 35 C (15 to 25 C recommended to reduce drift and offset) , < 70% humidity, non-condensing, vibration < 0.1g all axes (1 to 100 Hz)
Shipping and storage environment	-10 to 50 C, < 80% humidity, non-condensing, vibration < 1g all axes, 1 to 100 Hz

Interfacing

Interfaces	Ethernet 10/100/1000 Mbps. UDP and TCP/IP. Auto MDIX.
	Fiber-optic loop, 640 nm, 10 Mbit/sec serial, 9-bit asynchronous binary. Two fiber-optic receiver/transmitter pairs. Configurable as peer to peer synchronization channels or as slave device loop control ports.
	Serial for diagnostics and configuration. Baud rate 115 kbps. The electrical interface is fully isolated and can be set to RS-232 or full duplex differential RS-485.

Connectors

Strip signal inputs

Two high-density 44-pin DSub female. Shields connect to chassis.

Inputs 1 to 32

1	In29	16	In31	31	In32
2	In28	17	In30	32	Gnd
3	In26	18	In27	33	Gnd
4	In24	19	In25	34	Gnd
5	In22	20	In23	35	Gnd
6	In20	21	In21	36	Gnd
7	In18	22	In19	37	Gnd
8	In16	23	In17	38	Gnd
9	In14	24	In15	39	Gnd
10	In12	25	In13	40	Gnd
11	In10	26	In11	41	Gnd
12	In08	27	In09	42	Gnd
13	In06	28	In07	43	Gnd
14	In04	29	In05	44	In03
15	In02	30	In01		

Inputs 33 to 64

1	In61	16	In63	31	In63
2	In60	17	In62	32	Gnd
3	In58	18	In59	33	Gnd
4	In56	19	In57	34	Gnd
5	In54	20	In55	35	Gnd
6	In52	21	In53	36	Gnd
7	In50	22	In51	37	Gnd
8	In48	23	In49	38	Gnd
9	In46	24	In47	39	Gnd
10	In44	25	In45	40	Gnd
11	In42	26	In43	41	Gnd
12	In40	27	In41	42	Gnd
13	In38	28	In39	43	Gnd
14	In36	29	In37	44	In35
15	In34	30	In33		

Connectors

Integral plane input

Four pin Lemo 0B-size female.

1	Signal in A	3	Signal in B
2	AGnd	4	Chassis

General I/O

25 pin DSub female. Screen to chassis.

1	24 V rtn	14	24 VDC out fused
2	Chassis	15	Gnd
3	Analog in 1 +	16	Analog in 1 -
4	Dig out 1	17	Dig out 2
5	Analog in 2 +	18	Analog in 2 -
6	Analog in 3 +	19	Analog out 1
7	Analog in 3 -	20	Analog out 2
8	Analog in 4 -	21	+ 5V out fused
9	Gnd	22	Dig out 3
10	Dig out 4	23	Analog in 4 +
11	Dig in 4	24	Dig in 3
12	Dig in 2	25	Dig in 1
13	Gnd		

Actuator control

9 pin DSub female

1	Relay pole A	6	Relay pole B
2	24 V rtn	7	Opto in 2
3	n/c	8	24 V rtn
4	24 VDC out fused	9	24 VDC out fused
5	Opto in 1		

Gate in

Lemo 00 coaxial

Gate out

Lemo 00 coaxial

Monitor out

Lemo 00 coaxial

Connectors

Enable

Phoenix 8 pin 3.81 mm female

1	24 V rtn	5	Enabled out relay contact
2	24 VDC out fused	6	Enabled out relay contact
3	Enable in opto anode	7	Override mode switch sense contact
4	Enable in opto cathode	8	Override mode switch sense contact

Interlock

Phoenix 5 pin 3.81 mm female

1	24 V rtn	4	Safety relay contact
2	24 VDC out fused	5	n/c
3	Safety relay contact		

Relay output

Phoenix 4 pin 3.81 mm female

1	24 V rtn	3	Relay contact
2	24 VDC out fused	4	Relay contact

High voltage out

SHV

High voltage sense

SHV

RS-232 / RS-485

Six pin mini-DIN (“PS/2”)

1	Tx / RS-485 Tx+	4	Mode sense
2	Rx / RS-485 Rx+	5	RS-485 Tx-
3	Isolated gnd	6	RS-485 Rx+

Fiber optics

Two receiver transmitter pairs (communication loops)
Two transmitter outputs
Avago HFBR ST bayonet (compatible with 1 mm POF and 200 µm HCS fiber)

Ethernet

RJ-45 jack

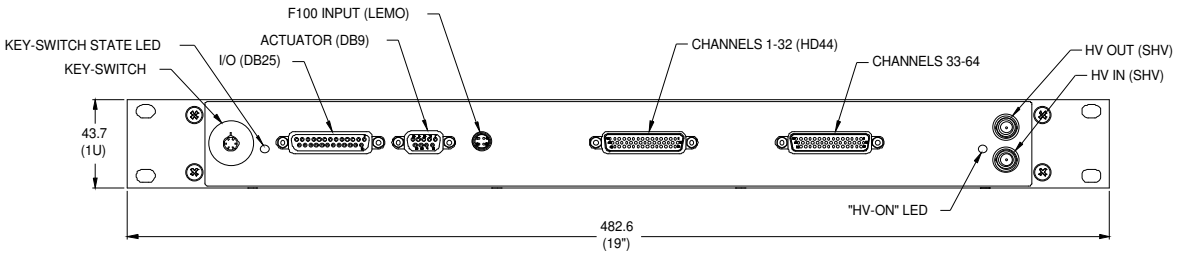
Power in

Lemo Redel PXG

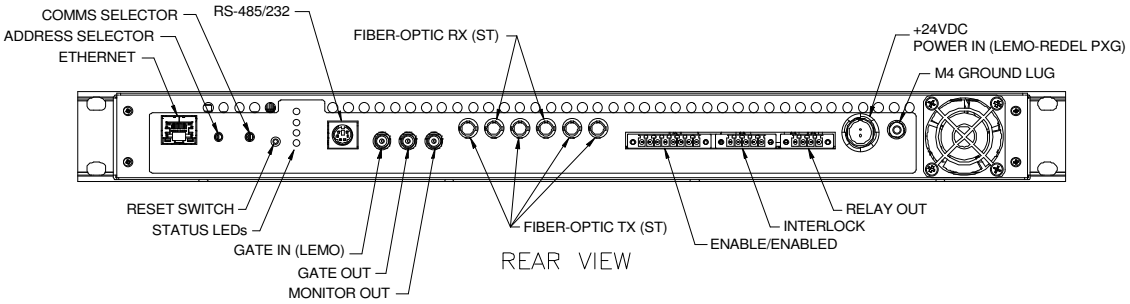
1	+24 VDC in
2	24 V rtn

Ground

M4 threaded stud



FRONT VIEW

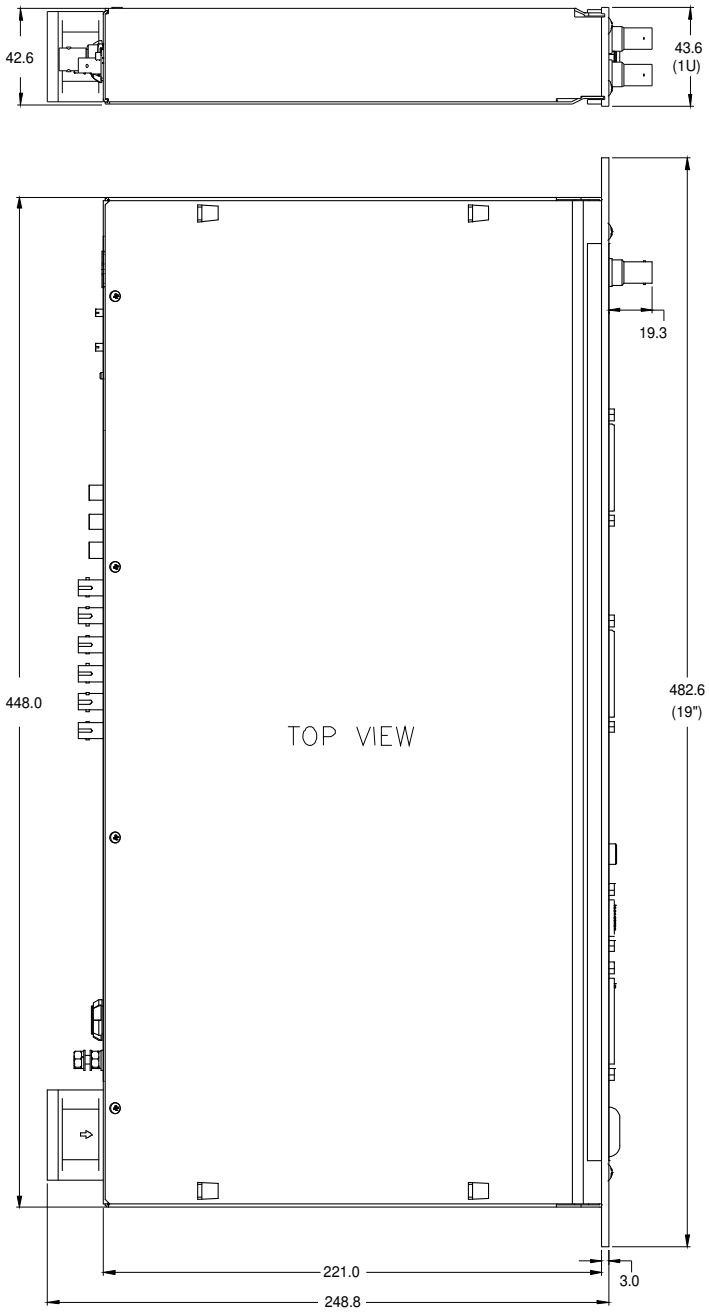


REAR VIEW

Dims mm

Ordering information

I6400	I6400 position sensing ionization chamber controller.
-XP20/12/05/02	Add HV supply positive 2000/1250/500/200 volts.
-XN20/12/05/02	Add HV supply negative 2000/1250/500/200 volts.
-DSUM	Dose plane input summing option.



Dims mm

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