CM100

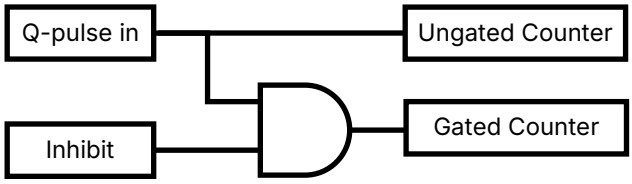
Control and Charge Monitoring Unit for Particle Therapy Treatment Control Rooms

Features

- Designed to meet the requirements of IEC 60601-2-64:2014
- Non-volatile charge recorder (over 20 minutes duration)
- Key switch access for preparing and enabling irradiation
- Illuminated physical switches to start and pause irradiation
- Audible dose rate output with internal speaker and audio jack
- Latching emergency stop button with direct connection to rear panel connector
- Relay to stop irradiation if total dose exceeds target plus allowed tolerance
- 7″ color LCD touch screen for real-time display of dose delivered, dose target and system state
- Built-in self-diagnostics
- Automatic irradiation stop if internal failure detected
- Checks that critical cable connections are made
- Ethernet connectivity to compatible dosimetry and session management systems
- Maintains a record of pencil beam spot number when used with compatible dosimetry systems

Applications	• Particle therapy treatment control • Independent redundant non-volatile charge recording • Independent overdose interlocking

Specifications

Charge recording	
Signal type	Selectable from: - Fiber optic 820/640 nm pulses The dosimetry system that the CM100 works with defines the quantum of dose that corresponds to one pulse
Maximum pulse rate	2 MHz, 100 ns minimum pulse width
Dose per pulse	Configurable MU recorded per pulse received
Counting scheme	Upwards from zero to set dose
Count limit	Automatic interlock if count reaches configurable limit, typically 120% of set dose
Counter depth	64 bits minimum
Data retention and display	Data recorded to flash memory card. CM100 display and function maintained for greater than 30 minutes after power loss using built-in re-chargeable battery pack.
Gating	One inhibit input to allow charge monitoring into a gated counter channel to be temporarily disabled, for example if the beam is known to be absent by other means and any apparent dose would be spurious. A use case example is to prevent counting apparent dose from an imaging X-ray shot when the particle beam is known to be blocked by a beam stop. A parallel non-gated charge monitoring counter remains active. 
Audio	
Output	Internal speaker, adjustable volume (muting not allowed) and parallel audio line output jack
Sound	Selectable sound. Audio frequency of beep option selectable.
Scaling	Configurable pulse rate to audio tick rate.
Source	Ungated channel.

Specifications (continued)

Beam disable	
Pause	Safety-rated relay (Tyco SR4) with mechanically-guided contacts and sensing of welded contacts. Normally open contacts. Relay closed if pause button not pressed, CM100 is in BEAM ON state with no errors.
Overflow	Safety-rated relay (Tyco SR4) with mechanically-guided contacts and sensing of welded contacts. Normally open contacts. Relay closed if Max MU threshold is not exceeded, CM100 is in READY or BEAM ON state with no errors.
EMO	Mechanically-latching emergency off switch contacts connect directly to rear panel connector. Contacts open when switch depressed.
Processor	
Type	TI Sitara AM335x (ARM Cortex A8) 1 GHz with dual PRU.
Operating system	QNX running IGX
Watchdog	Relays open (hardware action) and forced processor reset if watchdog is not tickled every msec.
Connectivity	
Ethernet	Ethernet 10/100 Mbps. Auto MDIX. Embedded EPICS channel access server allows client software to monitor and control device function.

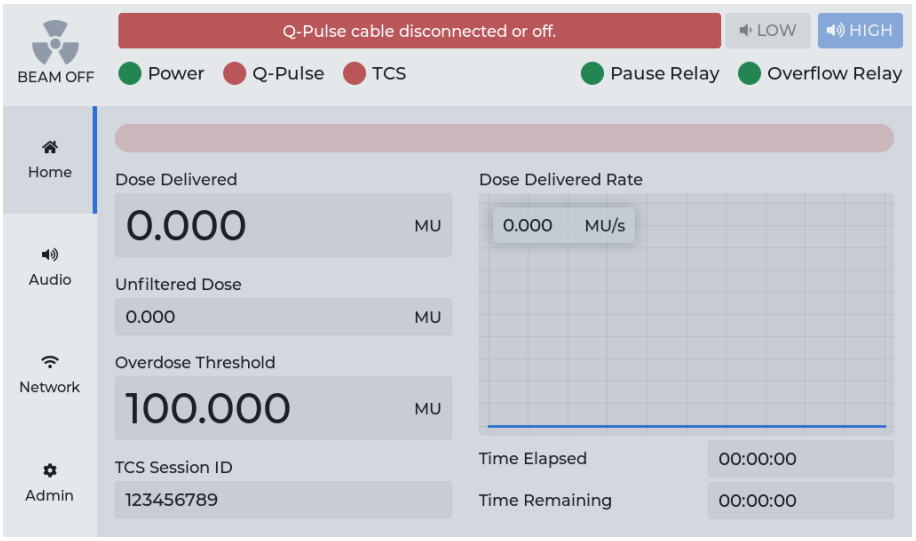
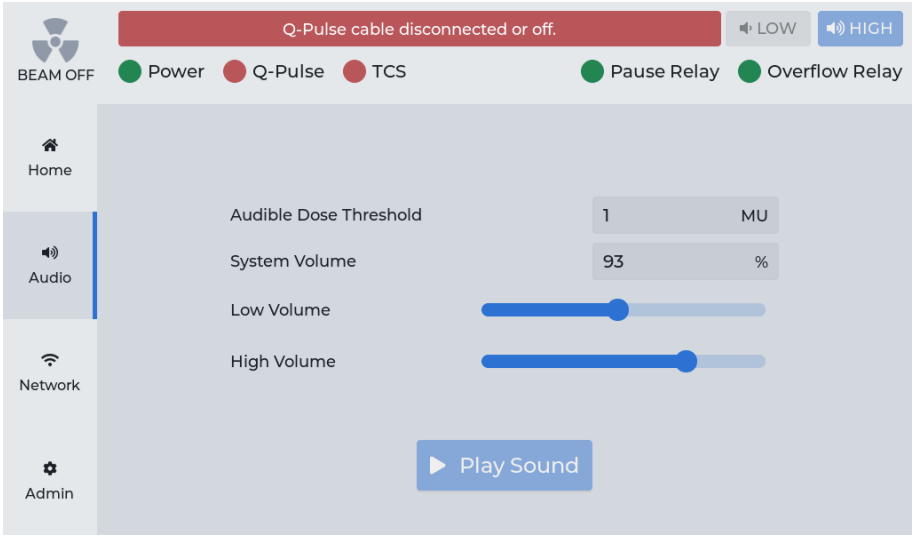
Specifications (continued)

Audio	
Configuration	Audio line output in parallel to the internal speaker (connecting to jack does not disable internal speaker)
Level	2 V rms max
Power	
Power input	24 V (+/- 2V) DC, 1000 mA typ, 1500 mA max.
Battery backup	Operation of device including user interface continues for not less than 30 minutes if power is removed. Alert if battery pack is missing, low performance or not in good condition. Battery pack type: 4x Lithiumwerks LiFePO4 18650, 3.3 V, 1200 mAh with TI BQ24630 charge controller. > 1000 cycle life, battery pack factory replaceable.
Case	
Configuration	Desk-mounting console. See figures for dimensions
Protection rating	IP30 (protection against 2.5mm or greater solid objects)
Weight	4.5 kg (10.0 lb)
Environment	
Intended location	Particle therapy treatment rooms (one CM100 per room)
Operating environment	10 to 35 C (15 to 25 C recommended) , < 70% humidity, non-condensing, vibration < 0.2g 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

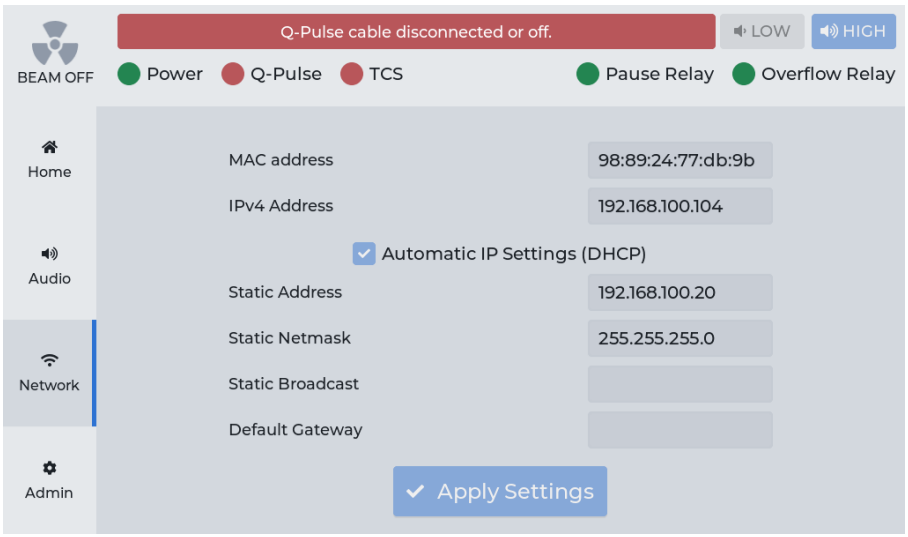
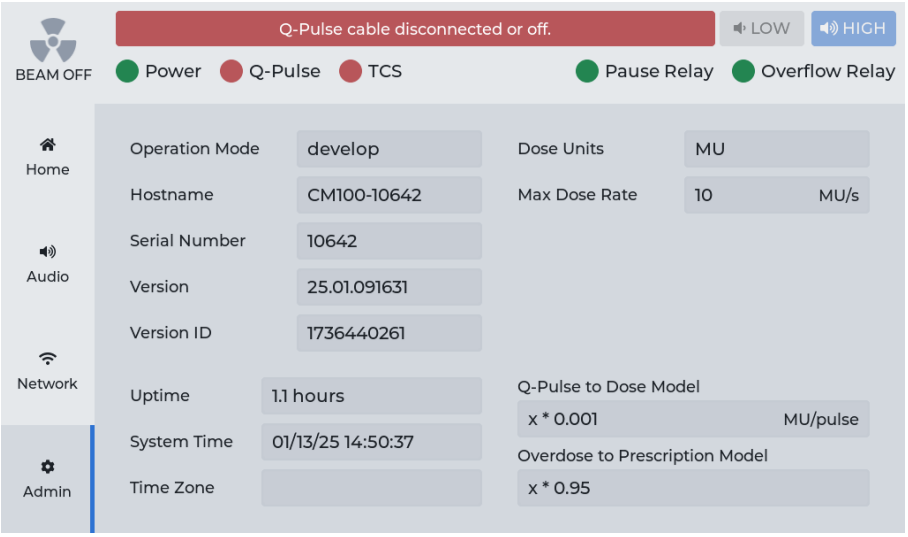
Controls

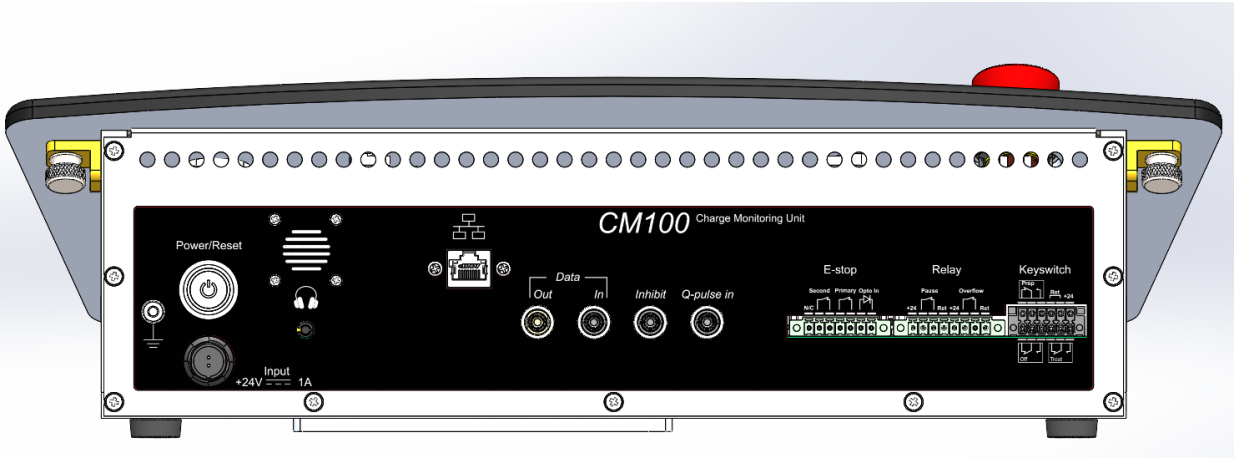
Key switch	Three-position switch with key retention. Positions correspond to stages in an irradiation as defined in IEC 60601-2-64: Off / Prepare / Treat. Backlit labels indicate PREP and TREAT conditions. Key can only be removed in OFF position.
Emergency Stop	Locking push switch with visual indication of actuation.
Start	Pushbutton with green illuminated bezel indicating availability to start or resume irradiation.
Pause	Pushbutton with blue illuminated bezel indicating availability to pause irradiation.
User interface	1024 by 600 backlit color LCD capacitive touch screen, 7” (17.8 cm) diagonal
Access rights	Clinical controls or service controls only enabled when authorization codes are received from a host system via Ethernet command.
Processor reset	Rear panel push-button.

Display

Home Screen	
Access	Screen is locked (read only) during irradiations
Key features	- Current monitor units (MU) or giga-protons (GP) - Target MU or GP - Dose rate - Session ID - Status - Time Elapsed/Time Remaining
Example	
Audio Screen	
Key features	Adjust the threshold and volume for the audio output
Example	

Display

Network Screen	
Key features	Set the IP address for the CM100
Example	
Admin Screen	
Key features	Access to CM100 configuration options (access rights required).
Example	



Connector details listed below are from right to left for view above

Key switch	Phoenix 1787056 12-position 3.5 mm. Locking mating connector Phoenix 1790331 (supplied). Changeover (SPDT) indication of key switch state to remote devices. Position 1: Off Position 2: Prepare Position 3: Treat (direct connection)

1	Key position 1 n/c	7	Key position 2 n/o
2	Key position 1 com	8	Key position 2 com
3	Key position 1 n/o	9	Key position 2 n/c
4	Key position 3 n/o	10	24 V rtn
5	Key position 3 com	11	24 V rtn
6	Key position 3 n/c	12	+24 VDC out

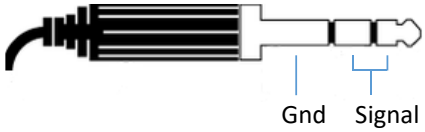
Relay	Phoenix 1827923 8-position 3.81 mm. Locking mating connector Phoenix 1851290 (supplied). Contact closure indication of pause state and counter exceeded limit state.

1	+24 VDC out	5	+24 VDC out
2	Pause relay contact	6	Count limit relay contact
3	Pause relay contact	7	Count limit relay contact
4	24 V rtn	8	24 V rtn

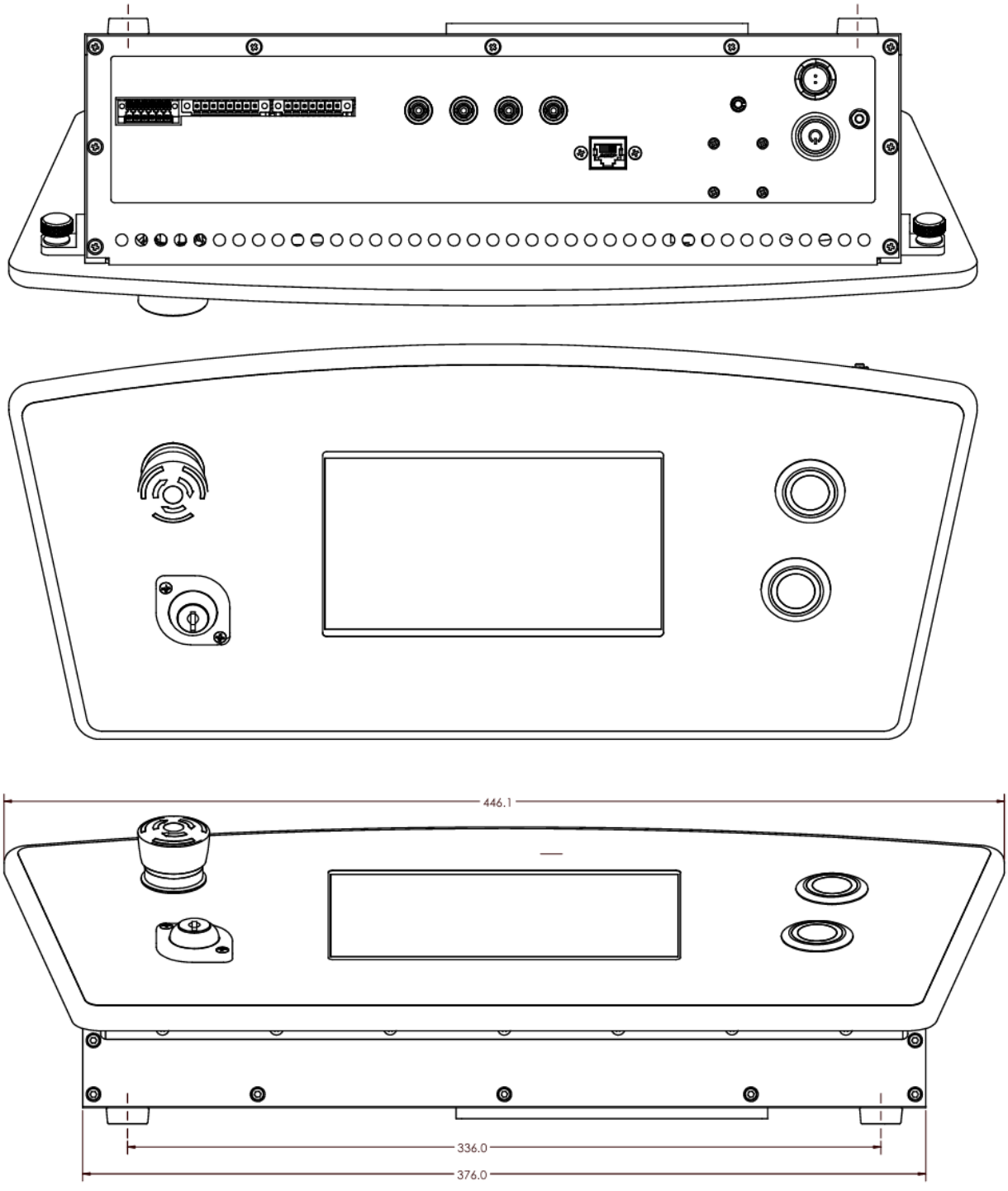
Emergency stop	Phoenix 1827910 7-position 3.81 mm. Locking mating connector Phoenix 1851287 (supplied). Emergency off switch contacts. Opto-coupled digital input.

1	n/c	5	Primary relay contact
2	Second relay contact	6	Opto input anode (1 kΩ)
3	Second relay contact	7	Opto input cathode (1 kΩ)
4	Primary relay contact		

Connectors (continued)

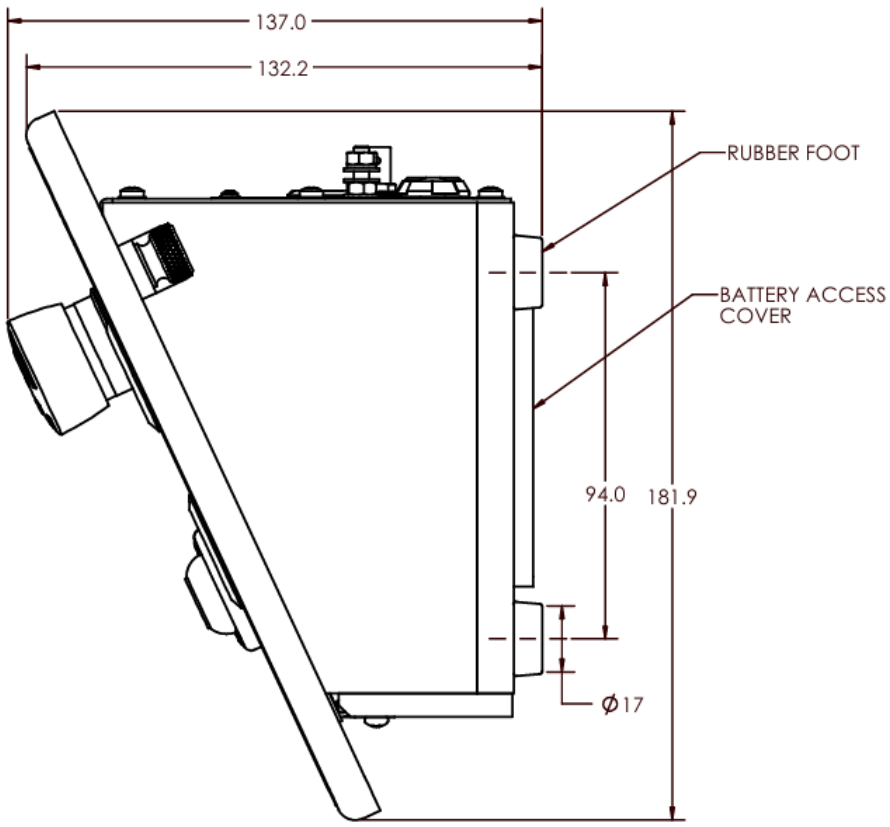
Charge pulse input	AFBR-2418TZ ST bayonet fiber optic receiver. Automatic detection of disconnected cable.
Charge pulse count inhibit input	One AFBR-2418TZ ST bayonet fiber optic receiver.
Data In/Out	AFBR-2418TZ ST + HFBR-1414PTZ ST bayonet fiber optic receiver and transmitter pair. Unused provision for future versions.
Ethernet	RJ-45 standard Ethernet connector. Communication with system controller for transfer of dose target and general control and readback. Standalone operation of the CM100 is also possible, with dose targets input by an authorized clinical user.
Power input	Lemo Redel PXG 1 +24 VDC in 2 24 V rtn
Audio out	3.5 mm audio jack. Mating connector: 
Ground lug	M4 threaded stud

Dimensions—Top, Front, and Back View



Dims mm

Dimensions—Side View



Dims mm

Ordering information

CM100	Control and Charge Monitoring Unit for particle therapy treatment control rooms.

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