EMCO ChannelMag CM2 Electromagnetic Flowmeter with 4411e Transmitter for Measurement of Bi-Directional Flow in Open Channels

Engineering Specifications

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1) INSTRUMENT

A) There shall be furnished an electromagnetic flowmeter suitable for fixed-site measurement of bi-directional flow in an open channel 6"-200 feet (150 mm – 60 m).

B) The flowmeter shall consist of a flat bed mean velocity sensor(s) for maximum cross sectional channel widths 10" – 20 feet (250 mm – 6 m), suitable for defined open channel dimensions and cross sectional shape. The flat bed sensor (s) shall be secured on the bed and/or the sides of the channel by integral brackets. For installation under flow conditions, a special retention frame shall be supplied.

C) For maximum cross sectional channel widths 6" – 20" (150 – 500mm) the mean velocity sensor shall consist of a cylindrical sensor, secured into the bed of the channel with a retainer.

D) A 2-wire loop powered level transducer shall measure the variation in media level in the channel. Signals from the mean velocity sensor(s) and level transducer shall be processed in a remote flow transmitter. The transmitter shall indicate bi-directional volumetric flow rate in the open channel and totalize the flow in the forward, reverse and net forward direction. It shall also transmit bi-directional analog flow signals from separate terminals, as well as a scaleable pulse frequency output. The mean velocity sensor(s) shall be field-interchangeable. They shall contain a reference coil, which measures and compensates for magnetic entrainments in the media, exciter coils to substantially fill the open channel cross section with magnetic flux, electrodes to measure the flow signal and a grounding artifice.

2) MEAN VELOCITY SENSOR(S)

A) The open channel cross section dimensions shall be _____ [1]

B) The mean velocity sensor wetted parts shall be high density polyethylene (HDPE) with AISI 316 stainless steel fixing brackets, grounding and optional ramps. Other wetted parts shall be [316 stainless steel] [Titanium] [Hastelloy C] 2 flow measuring electrodes, Viton electrode seals, PVC cable glands with elastomer seals and UL approved buryable and submersible sensor cables. [Ramps shall be attached each end of the mean velocity sensor(s) to avoid excessive turbulence when the sensor(s) are installed on the bed of the channel] 3

C) The mean velocity sensor(s) shall not be dependent on an insulating liner in the channel. Accuracy shall not be affected by superfluous cuts or scratches in the HDPE sensor body.

D) Each mean velocity sensor shall incorporate integral grounding. Other grounding artifices shall not normally be necessary.

Note: For transmission to a remote transmitter > 100 feet (30 m), or when excessive unequal potentials exist between the media and the flowmeter cable shields, it may be necessary to have an additional grounding arrangement installed. Such excessive unequal potentials are beyond the control of the magmeter manufacturer and additional cost of remedy is extra to that of the magmeter normal supply.

E) The sensors shall have solid state design, with the reference coils, exciter coils and electrodes encapsulated in an HDPE body. The mean velocity sensor(s) shall be field-replaceable and field-interchangeable without the need for recalibration.

F) The mean velocity sensor(s) shall use unipolar Pulsed AC electromagnetic excitation from the remote transmitter, with a typical magnetizing current of 1 – 5.5 A base to peak, dependent on sensor size, and frequency of not less than 2/3 of power supply frequency (40 Hz for a 60 Hz power supply frequency) for all size flowtubes. This shall ensure a high signal-to-media noise ratio, whereby such media coatings as sewage grease, algae, calcium carbonate or similar do not affect accuracy. There shall be an auto zero feature, such that there shall be no zero offset due to this relatively high exciter frequency.

G) The minimum media conductivity shall be 1 microS/cm.

For media conductivity less than 5 microS/cm and cable lengths > 100 feet (30 m) a pre-amp shall be installed in a remote junction box. The junction box will be supplied with re-enterable potting gel for potting cables on-site. [4]

H) The maximum media temperature shall be 140º F (60º C).

I) The minimum media level shall be 4.0" (100 mm) with ramps or 1.0" (25 mm) without ramps. For mean velocity sensors mounted on a frame on the base of the channel, suitable for installation under flow conditions, the minimum media level shall be 5.0" (125 mm).

J) The mean velocity sensor shall be used singularly or in multiples to achieve either a high calibrated accuracy or relaxed calibrated accuracy. [5] When used in multiples the mean velocity sensor electrode pairs shall be connected in parallel to a single remote transmitter, via a junction box remote from the channel.

K) The mean velocity measurement range shall be infinitely adjustable in the remote transmitter from 0 to 2 feet per second (0 to 0.6 meters per second) to 0 to 10 feet per second (0 to 3 meters per second).

L) The minimum detectable mean velocity shall be 0.02 feet per second (0.006 meters per second). However, a default low flow cut-off relay shall actuate at 2% of full scale, unless otherwise specified.

M) [The calibrated high accuracy of the CM2 sensor(s) shall be:

± 2% of rate for > 2 fps (0.6 m/s)

± 0.04 fps (0.012 m/s) for < 2 fps (0.6 m/s)]

[The relaxed calibrated accuracy of the CM2 sensor(s) shall be:

± 4% of rate for > 2 fps (0.6 m/s)

± 0.08 fps (0.024 m/s) for < 2 fps (0.6 m/s)] [6]

N) A non-full channel condition shall be indicated by a user-supplied signal using one of the contact inputs on the flow transmitter, or by detection of

the level dropping below the mean velocity sensor electrodes. Both these options shall be programmable in the remote transmitter

O) For mean velocity sensor(s) there shall be one cable between the mean velocity sensor(s) and the transmitter, with a separate cable and integral breather tube for an optional hydrostatic level transducer. The mean velocity sensor cable shall contain three sets of individually shielded 2-core, multi-stranded wires and shall be overall shielded, each core being 18 SWG (0.75 mm^2). The cable shall have a standard length of [50 feet (15m)] [_____feet (_____m)] [7] to a junction box. The cable to the junction box shall be buryable and submersible PVC jacketed to a minimum 0.04" (1 mm) thickness to UL Standard 1424 and 13 and shall meet or exceed TIA 455 – 82B Water Infiltration Test. In accordance with USA National Electrical Code (NEC) the cables shall not require further conduit protection. There shall be a further 3 separate cables from the junction box to the remote transmitter, each cable having 2-cores, multi-stranded and overall shielded, each core being 18 SWG (0.75 mm^2). The set of three cables shall have a length of [50 feet (15m)] [_____feet (_____m)] [8]

P) The mean velocity and optional hydrostatic sensor(s) shall be indefinitely submersible to NEMA 6 and IP68 to 30 feet (10 m) water column.

Q) The mean velocity sensor(s) shall be Entela approved to [UL and CSA Standards for use in Ordinary Locations] [NEC and CSA Standards for use in Class 1, Division 2 explosive atmospheres] [ATEX Zone 2 explosive atmospheres] 9, with the remote transmitter safe area.

R) [For optional installation under flow conditions there shall be furnished a specially designed Insertion Frame, manufacture from Galvaneal steel and shaped to the cross section of the channel. The Insertion Frame shall have the mean velocity sensors fixed to them, such that they may be removed if necessary.

The Insertion Frame shall be designed with lifting points suitable for a hoist to insert the assembly into the channel for a maximum recommended media velocity of 1 fps (0.3 m/s) and maximum channel width of 10 feet (3000mm).

The frame shall be suitable for stowing the cable runs from the sensor(s). The Insertion Frame shall be suitably bolted to the side walls of the channel][18].

3. LEVEL TRANSDUCER

A) There shall be {[a **hydrostatic level** transducer embodied in one of the ramps of the mean velocity to measure media level in the open channel] [hydrostatic level transducer mounted at the side of the channel in a stilling well when a ramp is not used] [10] The hydrostatic level transducer shall be sealed against the ingress of particles or damage from solids. The cable shall be supplied with the transducer and shall incorporate a breather tube within the cable jacket to compensate for barometric pressure change.}[{an **ultrasonic level** transducer mounted above the level of the media, with a minimum dead band of 10" (250 mm)] [11]

B) [The hydrostatic level transducer accuracy shall be ± 0.2% of full scale or ± 0.72" (1.8 mm), whichever is greater.] [The ultrasonic level transducer shall be ± 0.2% of full scale or 0.4" (10 mm), whichever is greater.] [12] The hydrostatic level transducer shall be suitable for a minimum range of 0"-6" (150 mm). The ultrasonic level transducer shall be suitable for a minimum range of 0"-12" (300 mm).

C) The level transducer shall be a single cable and generically 2 core, multi-stranded and overall shielded, each core being 18 SWG (0.75 mm^2). The length of the cable shall be the same as the mean velocity sensor(s).

   For a hydrostatic level transducer cable up to 50 feet (15 m) the integral breather tube shall terminate with the cable within the transmitter enclosure. For hydrostatic transducer cable lengths > 50 feet (15 m) an intermediate junction box to NEMA 4X shall be supplied, such that the breather tube terminates in the junction box. Normal generic cable, without the breather tube, shall be extended from the junction box for the required length to the transmitter.

D) The level transducer shall be [for use in ordinary locations] [for use in ordinary locations, but approved to CSA standards] [FM intrinsically safe to Class 1, Division 1, Gas Groups A-D] [CSA intrinsically safe Class 1, Division 1, Gas Groups A-D].[13]

E) The level transducers shall be 4-20mA loop powered be the remote flow transmitter, with a nominal supply of 18 Vdc.

F) [The hydrostatic level transducer wetted parts shall be AISI 316 stainless steel body, aluminum trioxide ceramic sealed diaphragm, Gore-Tex Teflon filter, Viton seals, high density polyethylene (HDPE) protective cap, with polyethylene jacketed cable. The hydrostatic level transducer shall be submersible to NEMA 6 indefinitely to 700 feet (200 m) water column.] [The ultrasonic level transducer shall embody a PVDF sensor and EPDM seal. The integral electronics shall be housed in an aluminum enclosure, chromed and fusion bonded epoxy and sea water resistant, with a ½" NPT cable entry. The transducer shall be mounted with a 2" NPT male

connection and be submersible to NEMA 6 for 24 hours to 6 feet (1.8 m) water column.] 14

4. FLOW TRANSMITTER

A) The flow transmitter shall be a remote, microprocessor based Pulsed AC technology with an auto zero feature to allow exciter frequencies of 2/3 x power frequency for all size flowtubes, without zero offset.

B) The flow transmitter shall have an input impedance of 10^{12} ohms.

C) The flow transmitter shall have a time constant of not less than 30ms.

D) The flow transmitter shall include bi-directional isolated, internally powered 4 – 20mA outputs from separate terminals into a maximum load of 800 Ohms. A scaleable pulse frequency output shall be available, with a frequency mode 0 – 1000Hz to 0 – 10000Hz, 30Vdc, 250mA or externally powered relay 125Vac, 1A, 30VA. The transmitter shall incorporate RS 232 and HART communication.

E) The flow transmitter shall be Entela certified for use with the mean velocity sensor(s) approved for [Entela approved to UL and CSA standards for use in ordinary locations][Entela approved to NEC and CSA standards for Class 1, Division 2 explosive atmospheres, with the transmitter located in the safe area] [Entela approved to ATEX standards for Zone 2 explosive atmospheres] 15

F) The flow transmitter shall operate on [120Vac, 60Hz][230Vac, 50Hz][120Vac, 50Hz] 16 line power. Typical power consumption shall be 15W.

G) The flow transmitter shall be housed in a wall mounting, UV ray resistant fiber glass enclosure. It shall be watertight, dust-tight and corrosion resistant to NEMA 4X and IP65. The enclosure shall embody lockable stainless steel latches, as well as a screwed down lid. Electrical connections shall be suitable for conduit connections.

H) The transmitter shall have a waterproof and backlit LCD display, 4 lines with 20 characters.

I) The transmitter shall be programmable using a tactile feedback, waterproof and sealed keypad. All necessary diagnostics, user security password readings and system status shall be available using the keypad. A separate calibration box shall be unnecessary.

5. The open channel flowmeter shall be a ChannelMag CM2 magnetic flow sensor and [hydrostatic level transducer FMX 167] [ultrasonic level transducer FMU 40] [17] with remote 4411e transmitter, or equal.

Notes:

1. Specify the cross section dimensions and shape. See ChannelMag CM2 data sheet ordering code.

2. Specify electrode material.

3. Specify ramps when CM2 sensors are placed on the bed of the channel.

4. While the junction box will be suitable for submersion when filled with re-enterable potting gel, the junction box is not intended for permanent submersion in the media.

5. See ChannelMag CM2 Data Sheet

6. Specify accuracy.

7. Specify cable length to the junction box.

8. Specify cable lengths from the junction box.

9. Specify Ordinary, Class 1, Div. 2 or ATEX Zone 2 locations.

10. Specify level installation for hydrostatic transducers only.

11. Specify either hydrostatic or ultrasonic level transducer.

12. Specify level accuracy, dependent on transducer type.

13. Specify level transducer type of location.

14. Specify level transducer materials, dependent on transducer type.

15. Specify transmitter for use with sensor(s) in which type of location.

16. Specify line power.

17. Specify level transducer type.

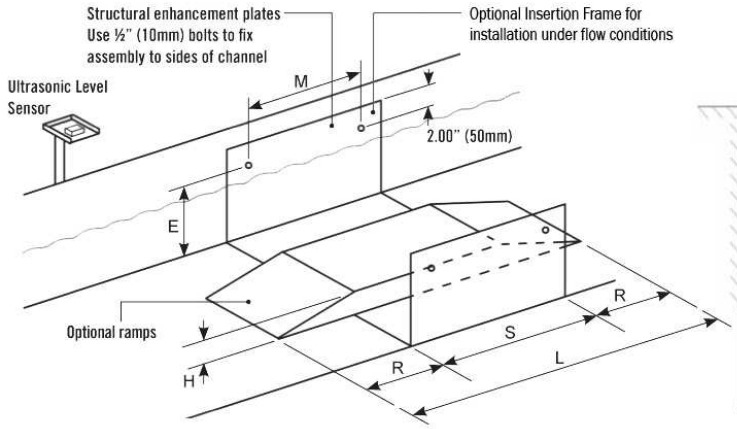
18. Specify for installation under flow conditions.

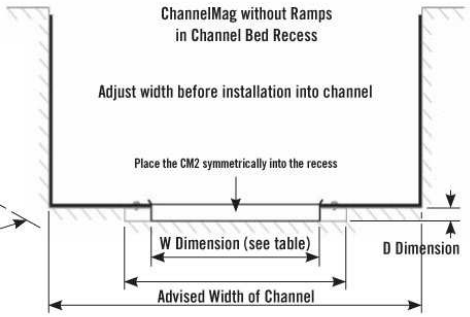
ChannelMag CM2 Mean Velocity Sensor Dimensions & Weights for Flow Measurement in Open Channels

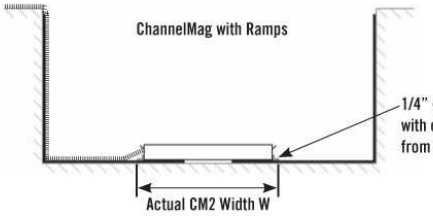
Nominal CM2 Width		Actual CM2 Width		L		S		R		H*		M		Weight Each	
Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm
8”	200	10.0”	254	40.0”	1016	8.0”	203	14.5”	370	2.5”	64	6.0”	152	55	25

NOTE: The height “E” of the structural enhancement plates is custom made and normally extends 4” (100mm) nominally above the maximum level. The width W is adjustable to fit the channel width. M includes the mounting brackets.

* With optional Insertion Frame H = 3.50” (90mm)

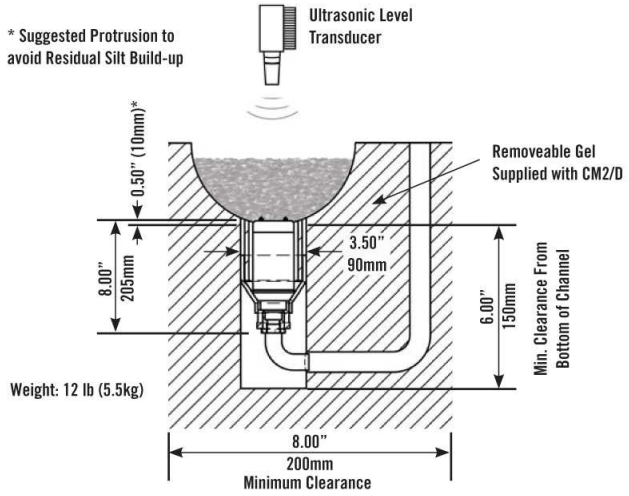


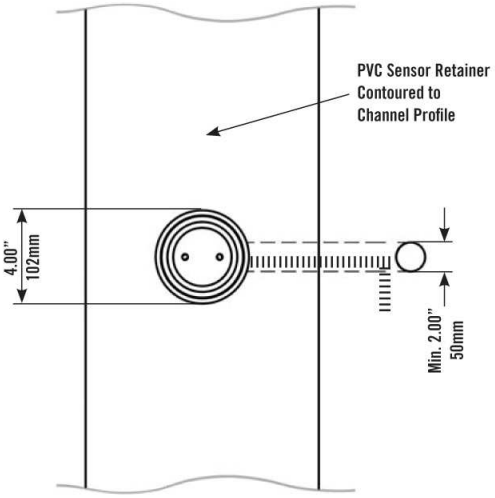




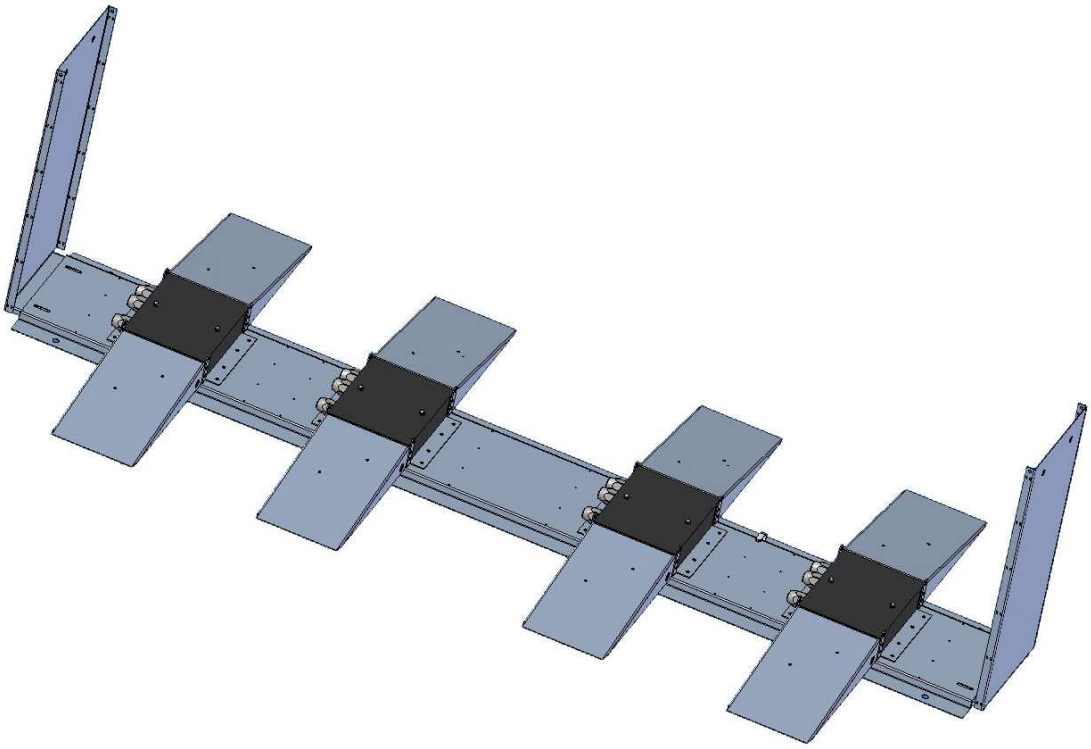
Nominal CM2 Width		Depth D		Width W		Length of Recess	
Inches	mm	Inches	mm	Inches	mm	Inches	mm
8"	200	2.25"	60	18.0"	460	42.0"	1100

Note: A CM2/8" is normally supplied with ramps



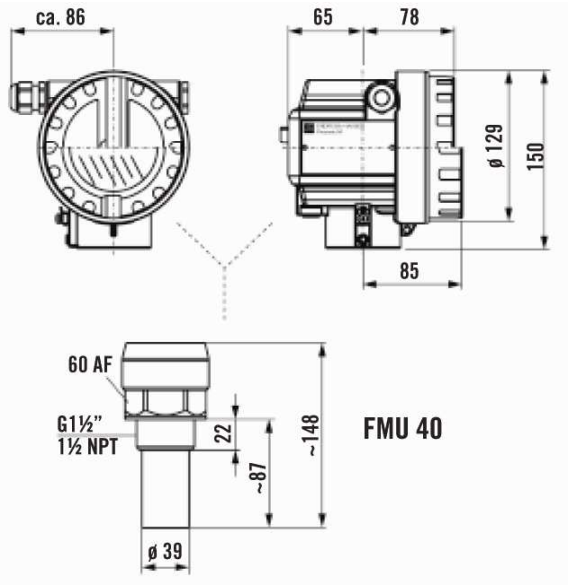


Typical Arrangement for ChannelMag Sensors on Frame for Installing Under Flow Conditions



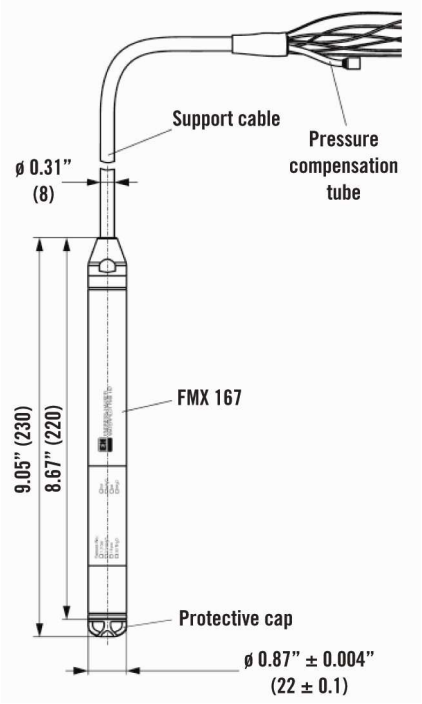
ChannelMag Level Transducer Dimensions & Weights

FMU 40 Ultrasonic Level Transducer



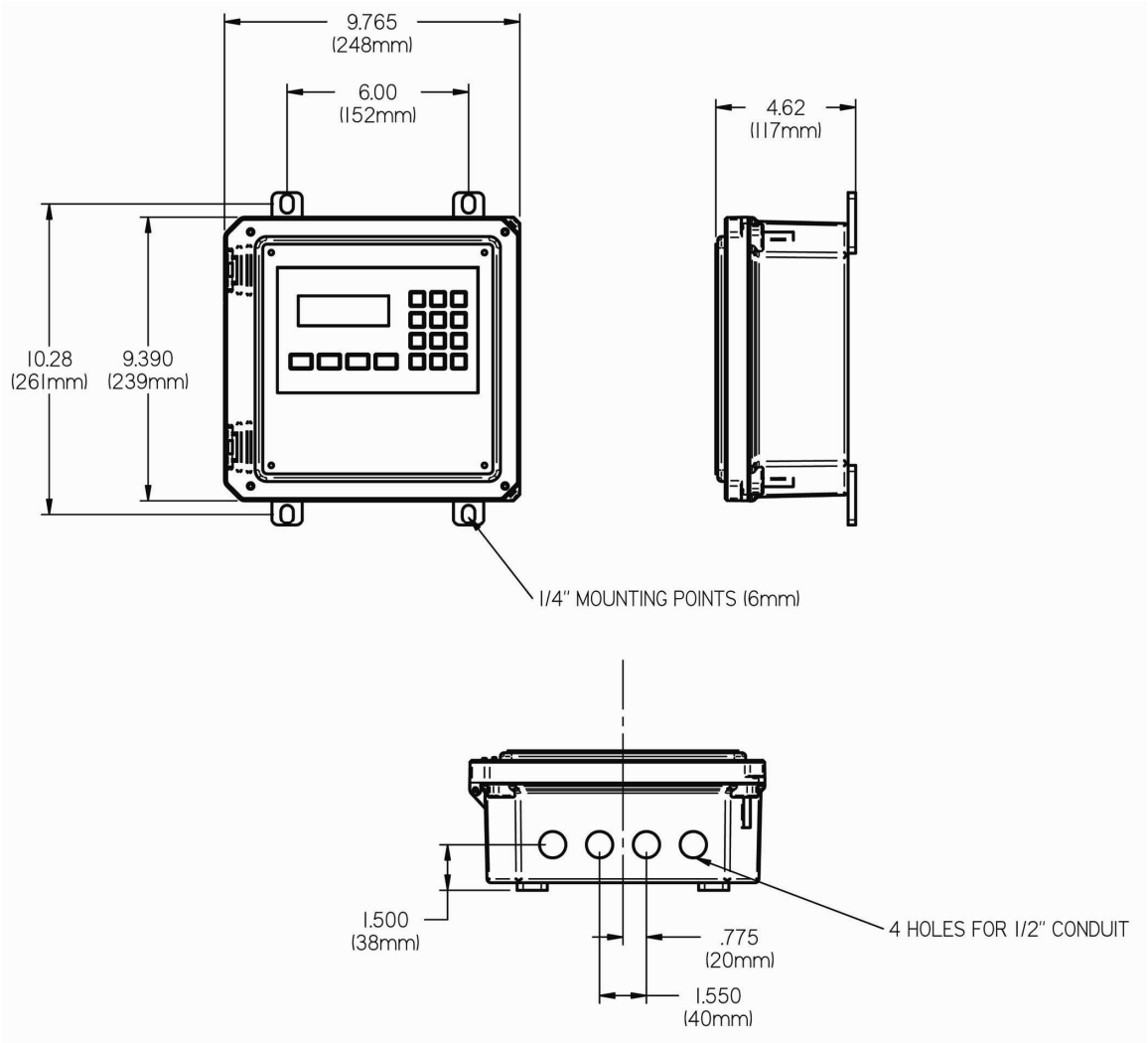
Weight: 5.5 lb (2.5 kg)

FMX 167 Hydrostatic Level Transducer



Weight: 0.63 lb (0.3 kg) plus cable ADD 0.13 lb/foot (0.05 kg/m)

4411e Flow Transmitter



Weight: 7 lb (3.2 kg)