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Model RCM

Low Flow Magnetic Flowmeter

Installation & Operation Manual



IMPORTANT !!!! Read this manual before attempting any installation, wiring or operation.

BadgerMeter,Inc.

Bulletin No. 941536

November 2000

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INTRODUCTION

The device consists of 2 individual parts:

1. The RCM flow sensor with its ceramic flow tube and 2 excitation coils
2. The CHECKPOINT converter that drives the excitation coils and amplifies the micro-volt signal to a 4-20 mA and/or pulse output.

Operating Principle:
The flowmeter contains a nonconductive ceramic tube mounted in a stainless steel housing. Two DC pulsed electromagnetic coils are mounted in the stainless housing outside of the tube. Two platinum electrodes are inserted into the ceramic tube perpendicular to the coils. When the coils are energized, a magnetic field is created across the whole diameter of the tube. When a conductive fluid flows through this magnetic field, a voltage is induced across the electrodes. This voltage is directly proportional to the average flow velocity of the fluid and is picked up by the two electrodes. This induced voltage is then amplified and processed digitally by the converter to produce a very accurate analog or digital output signal. The signal can then be used to indicate flow rate and totalization or to communicate to remote controllers. The main advantages of this technology are that with no parts in the flow stream, there is no pressure loss, the accuracy is not affected by temperature, pressure, viscosity, density or flow profile and with no moving parts, there is practically no maintenance required.

The CHECKPOINT converter provides:
- Isolated 4-20mA analog output.
- Pulse output selectable from 2.44Hz (for 100% flowrate) up to 10000Hz (for 100% flowrate).
- An optional display scaled in engineering units with flow volume totalization.

QUICK INSTALLATION & START UP PROCEDURE
CHECKPOINT Circuit Board

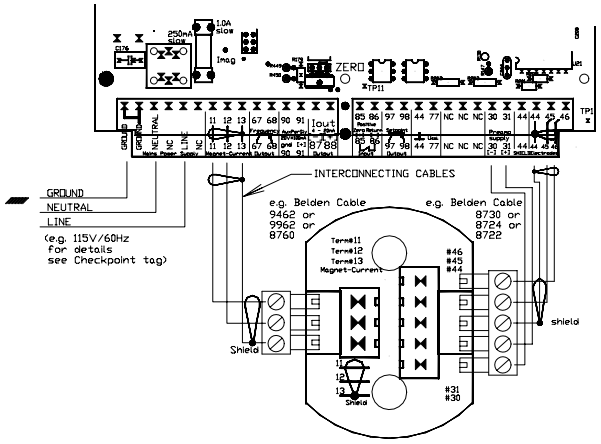


Fig. 1 - RCM Interconnect Board with built-in Pre-amplifier

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QUICK INSTALLATION & START UP PROCEDURE

1. Install RCM flow sensor in process line.
   - Standard process connection of sensor is 3/8" N.P.T. - female thread.
   - Arrow on sensor tag indicates flow direction.
2. Mount CHECKPOINT converter at the desired location.
3. Install interconnecting wires between RCM flow sensor and CHECKPOINT converter.
   - Cable specification:
     Magnet-Current cable:
     2 conductor common shield (foil-shield or braid-shield) AWG 18 to 22 e.g. Belden Cable 9462; 9962; 8760 (22AWG / 20AWG / 18AWG).
     Electrode Cable:
     4 conductor (2 conductor foil-shield 2 conductor unshielded) AWG 22 e.g. Belden Cable 8730; 8724; 8722 (22AWG).
4. **Shield needs to be connected on both ends of each cable.**
   - Connect shield to terminal 44 in flow sensor and converter respectively.
   - Connect shield to terminal 13 in flow sensor and converter respectively.
     Important: Do not strip the shield more than 1 inch (2.5 cm) from conductors!
5. Connect power supply (e.g.120VAC) to CHECKPOINT converter terminal Line/ Neutral/ Ground.

Unit operates in accordance with values on the CHECKPOINT tag.

If required, connect load (chart recorder/Indicator/PLC) to the isolated 4-20mA output (Terminal 88 = positive / Terminal 87 = reference). The maximum value for a connected load should not exceed 1000Ω. If an optional rate indicator / totalizer is built-in, the actual flow rate will be indicated in engineering units.

INSTALLATION GUIDELINES

For trouble-free operation of the device, follow these installation guidelines:

RCM flow sensor location

- Choose the flow sensor location, so that you can ensure that the sensor is always completely filled with fluid.
- In vertical pipe runs, the fluid should move upwards.
- Sensor should be mounted on ”pressurized system side”, (upstream of the valve). This is a must on the low flow applications 250cc/min and smaller. For diaphragm and piston pumps contact us for instructions.
- The flow direction should be in accordance with the arrow on the flow sensor.

CHECKPOINT converter location

- Do not expose converter to vibration or direct sunlight. If outdoor installation is required and intense sunlight is expected, provide a sun shade for the converter.
- On multiple device installations, connect the RCM and the CHECKPOINT converter with matching serial numbers together.

Interconnecting cables

- Each of the interconnecting signal cables should not exceed 300 ft (100m) in length.
- The shield of each cable should not be stripped of its conductors by more than 1 inch (2.5 cm).
- The shield of each cable **must** be connected on each side to the appropriate terminal;
  "**there will be no groundloop in the system"**

Power supply:

- See CHECKPOINT converter tag for correct supply voltage. Standard is 120V/60Hz (220V/50Hz optional).
- Make sure you connect the ”ground wire” from the mains power supply line to the ”Ground”- terminal on the CHECKPOINT converter board. **FOLLOW ALL SAFETY PRECAUTIONS AND LOCAL CODES TO PREVENT ELECTRICAL SHOCK AND/OR DAM AGE OF THE ELECTRONIC COMPONENTS!**

Analog Output

- The flow signal output is a 4 - 20mA output into any load (chart recorder/PLC) up to 1000Ω.
  Terminal 88 = (+) Terminal 87 = (reference).

TERMINAL DIAGRAM & EXPLANATION

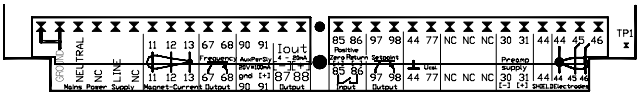


Fig. 2

Mains Power Supply

Value	: 115V / 60Hz or 230V / 50Hz
Fuse	: 250mA slow blow or 125mA slow blow
Terminal Line	: phase or ”hot” wire
Terminal Neutral	: neutral wire
Terminal Ground	: earth or ground wire

Magnet-Current or Excitation Current

Value	: ~ 20Vdc to 30Vdc pulsed
Fuse	: 1A slow blow
Cable type	: e.g. Belden Cable 9462, 9962, or 8760
Terminal 11	: conductor (18 to 22 AWG)
Terminal 12	: conductor (18 to 22 AWG)
Terminal 13	: shield

Frequency Output

Output type	: optical isolated open collector/ emitter npn transistor output
Values max	: V_{max} = 40Vdc / I_{max} = 10mA
Terminal 67	: collector (+)
Terminal 68	: emitter (-)

—See also ”Connecting the Frequency Output”—

Auxiliary Power Supply

Value	: 25Vdc to 30Vdc
Values max	: I_{max} = 100mA
Terminal 91	: [+] (positive)
Terminal 90	: gnd (reference)

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I_{out} 4 - 20mA Output (analog)

Output type : isolated 4-20mA current output
$Load_{max}$: 1000Ω
Terminal 88 : [+] (positive)
Terminal 87 : [-] (reference)

Low Flow Cutoff / Positive Zero Return (PZR Input)

Input type : optical isolated
Values max : dry contact resistance # 100Ω max
Terminal 85 : [+] (positive)
Terminal 86 : [-] (reference)
—See also "Connecting the PZR Input"—

Setpoint Output

Output type : optical isolated open collector/ emitter npn transistor output
Values max : V_{max} = 40Vdc / I_{max} = 10mA
Terminal 97 : collector (+)
Terminal 98 : emitter (-)
—See also "Connecting the Setpoint Output"—

Calibration Output

Output type : non isolated voltage output
Value : 0 - 5 Vdc
$Load_{min}$: 5kΩ
Terminal 44 : reference
Terminal 77 : 5 Vdc

Supply Preamp

Value : ± 5Vdc / 10mA
Cable type : together with electrodes
Terminal 30 : -5Vdc conductor (22AWG)
Terminal 31 : +5Vdc conductor (22AWG)

Electrodes / Flowsignal

Value : ~ mV
Cable type : e.g. Belden Cable 8730, 8724, or 8722
Terminal 44 : shield
Terminal 45 : conductor (22 AWG)
Terminal 46 : conductor (22 AWG)

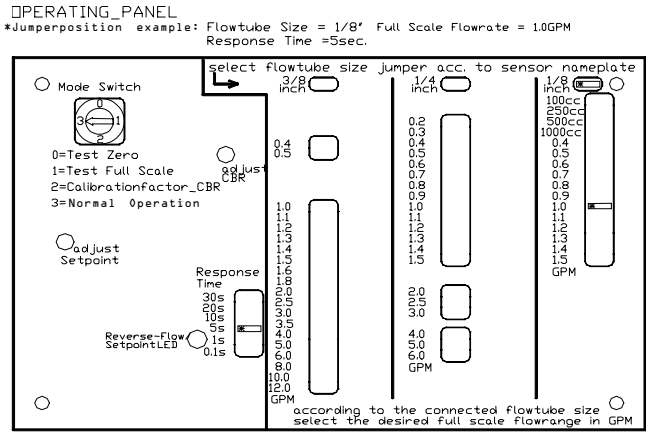


Fig. 3

TESTING AND CALIBRATION PROCEDURE

After installing the flow sensor and converter according to the "Quick Installation and Start up Procedures" the unit can be tested and calibrated as follows. If the measurements are not as described proceed to the troubleshooting section.

Using a small flat head screwdriver, turn the Mode Switch through the following settings. Measure the output with a multimeter at terminal 77 (Ucal) and terminal 44 (common).

Mode Switch – Select "0" (Zero output)

- The multimeter should read 0 VDC.
- If you are also monitioring the 4-20mA output, it should be at 4mA.
- Rate indicator should be at zero and the totalizer should not be increasing.

Mode Switch – Select "1" (Full Scale)

- The multimeter should read 5 VDC.
- The 4-20mA output should be at 20mA.
- Rate indicator should be at your designated full scale and the totalizer should be increasing at the same rate.

Mode Switch – Select "2" (CBR Factor)

- The multimeter should read the same value, in volts DC, as the CBR factor on the RCM sensor tag.
- If you have connected a new or different RCM flow sensor readjust the CBR value to match the CBR factor on the RCM sensor tag. This adjustment is done at the "adjust CBR" location noted on the operating panel. See Figure 4.

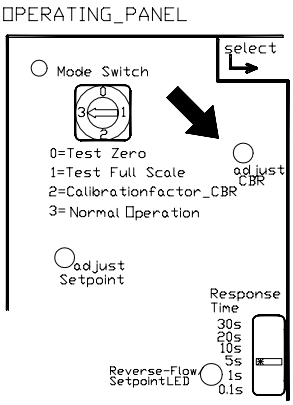


Fig. 4

Mode Switch – Select "3" (Normal Operation)

The switch must be in this position for the unit to register normal flow.

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CONNECTING THE 4 - 20mA CURRENT OUTPUT

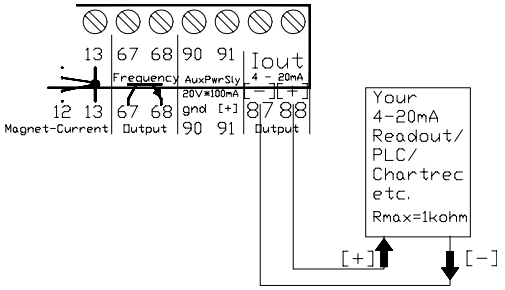


Fig. 4

The maximum value for the connected load is 1000 ohms.

CONNECTING THE FREQUENCY OUTPUT

The frequency output is achieved through an optical isolated npn transistor output.
The transistor will handle up to 10kHz, if:

- the connected cable length WILL NOT exceed 5ft (1.5m) for 10kHz— 10ft (3m) for 5kHz— 20ft (6m) for 2.5kHz etc....and
- the current you want to turn on and off is not too high.

Therefore, the selected pull up resistor shown in the diagram below should never be smaller than 5kΩ. One way to connect the external totalizer is shown in Fig. 6.:

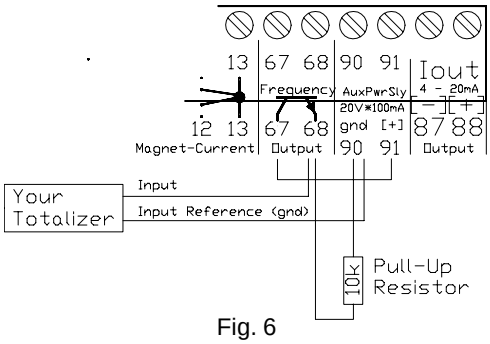


Fig. 6

ADJUSTING THE FREQUENCY OUTPUT TO A DIFFERENT NUMBER OF PULSES PER VOLUMETRIC INCREMENT

The CHECKPOINT converter generates a maximum frequency of 10kHz for the maximum flow (100% ; Full Scale). This may be reduced by selecting a dividing factor through a jumper on the control board called the "Dividing Factor Adjustment"

Example:
Full-scale flowrate jumper set to 1 GPM.
Dividing factor set to 1.

In one minute:
1 gallon liquid = 600,000 pulses

Or: 1 FL. OZ = 4687.5 pulses (600,000/128)

Or: 1 cc = 158.5 pulses (600,000/3785)

For practical reasons this frequency may be too high. In order to achieve fewer pulses per volumetric increment you can select a larger dividing factor via a jumper on the CHECKPOINT converter board.

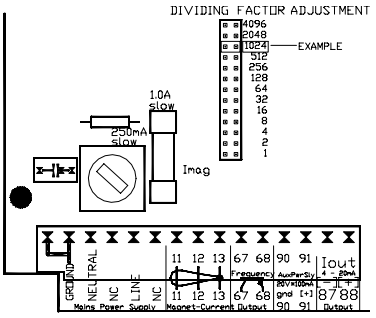


Fig. 7

Example:
Full-scale flow rate jumper set to 1 GPM.
Dividing Factor set to 1024.

The new pulse output per volume unit is:

1 gallon = 586 pulses (600,000/1024)

Or: 1 FL. OZ = 4.578 pulses

Or: 1 cc = 0.155 pulses

CONNECTING THE SETPOINT OUTPUT

If your PLC-card has supply voltage and a pull-up resistor on board, connect terminal 97/98 in accordance with polarity.

If you need an active signal from the CHECKPOINT converter, review Fig. 8.

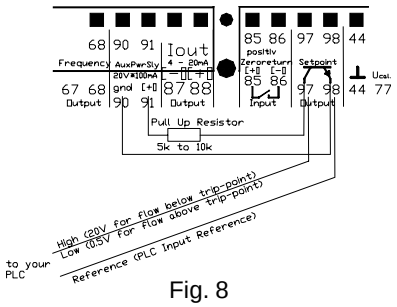


Fig. 8

ADJUSTING THE TRIP-POINT FOR THE DESIRED SET-POINT VALUE

1. Connect your multimeter to terminal 44 (common) and testpoint "SETPOINT - VALUE" (located 2 inches straight above Mains-terminal "NEUTRAL" on the left board edge.).

2. You can adjust the trip-point value anywhere from 0Volt=0% to 5.0Volt=100% using the potentiometer. "Adjust setpoint" on the operating Panel. See also Fig. 9.

If flow gets higher than trippoint the setpoint is active. Setpoint active means the red LED is "on", as well as the isolated Setpoint transistor switch (optocoupler) terminal 97 and terminal 98 is closed; (conductive between terminal 97 and terminal 98).

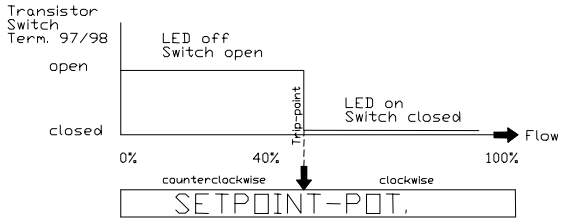


Fig. 9

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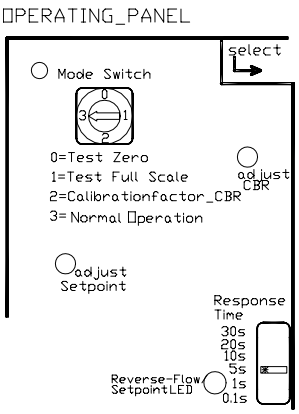


Fig. 10

CONNECTING THE LOW FLOW CUTOFF (POSITIVE ZERO RETURN) INPUT

The PZR input is a cut-off feature that can drive all the CHECKPOINT **outputs to zero** (no totalization of pulses and 4.00mA) **regardless what really happens in the pipe**. If you get empty pipe conditions when you turn off the pump (e.g. leaking check valve) connect an unused status **switch** (e.g. "normally closed" contact from your pump relays) to the PZR input terminals 85/86. Whenever the contact is closed, all the CHECKPOINT outputs go to zero.

To activate this feature you have to set the PZR-Jumper to its left position, (see arrow in Fig. 11) and connect your "status switch" in accordance with the drawing.
If you use a semiconductor switch, please pay attention to its polarity.

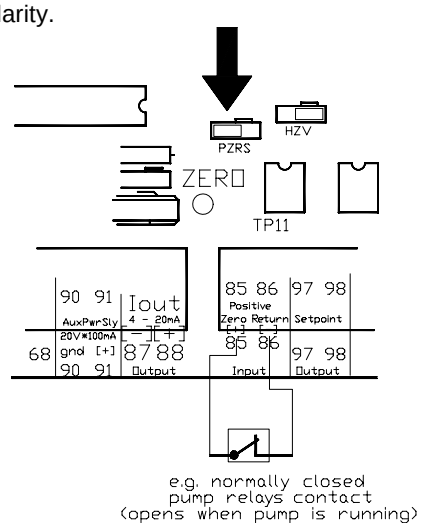


Fig. 11

TROUBLESHOOTING

The Research Control Mag meter should give you many years of maintenance free operation. However, should it malfunction, there are certain things that we recommend you check before contacting our technical support department or your local Badger Meter Representative.

Unit does not have an output

- Check for incoming AC power. If there is proper AC input, disconnect the power before checking the following items. Do this by unplugging the unit or removing the fuse in the black plastic fuse holder.
- Check cable connections to terminals 11, 12 and 13 for switched leads or bad terminal connections. The transmitter must be connected for the electronics to work properly.
- Check the "Magnetic Current" fuse behind terminal 11 on the pc-board.
- Check the connections on the transmitter itself. Loosen the strain reliefs on the lid and then remove the lid. Allow the cable to slide through the strain relief as you lift the lid. Check the connectors under the lid. **Important** – Do not go any further into the transmitter than removing the lid. This will cause damage to the transmitter that is repairable only at the factory level.
- With AC power re-applied, check for –5 VDC and +5 VDC at terminals 30 and 31. Use terminal 44 for ground.

Using a small flat head screwdriver, turn the Mode Switch through the following settings. Measure the output with a multimeter at terminal 77 (Ucal) and terminal 44 (common).

Mode Switch – Select "1" Test (Full Scale)

- Does not indicate 5.000 VDC: To re-adjust for 5.000 VDC adjust the SPAN-POT centered on the main pc-board as indicated in the diagram to the right. Be careful not to adjust the HYZ-POT positioned below the SPAN-POT. Accuracy goes in accordance with the 5.000 VDC value. A minor variation of 4.995 or 5.005 volts will equal to an error of 0.1%.
- Does not indicate 20mA: Loads greater than 1000 Ohms may pull down the maximum output signal. Check the specifications of the data-recording device or PLC.

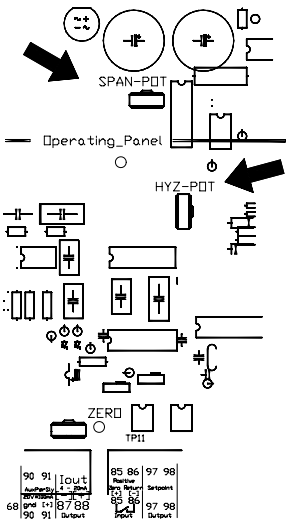


Fig. 12

Mode Switch – Select "2" (CBR Factor)

- Does not correspond with the CBR factor on the RCM transmitter: Readjust the CBR factor according to the "Test and Calibration" procedure. Re-check the Full Scale value is at 5.000 VDC. Accuracy goes in accordance with this value.

Mode Switch – Select "3" (Normal Operation)

- Unstable zero readings:

1. Make sure that the pipe is full. An empty pipe will always cause erratic and unpredictable readings. Reference the "Positive Zero Return" feature in this

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manual to stabilize the reading with an empty pipe.
2. Make sure the jumpers on the operating panel are in place.
3. Make sure the shields of the interconnecting cables are connected at both ends (terminals 44/44 and 13/13). Make sure the shield is not stripped more than 1" (2.5 cm) from the leads.
4. Eliminate spare wire in the junction box.
5. The cable must be a continuous cable. Do not splice or use a junction box.
6. Change the response time to a longer value to enable you to get a more stable signal.

- Problems with accuracy –

1. Check your jumpers on the "Operating Panel" for the correct Full Scale flow.
2. Refer to Mode Switch – Select "1" troubleshooting procedure.
3. Refer to Mode Switch – Select "2" troubleshooting procedure.

MOUNTING DIMENSIONS

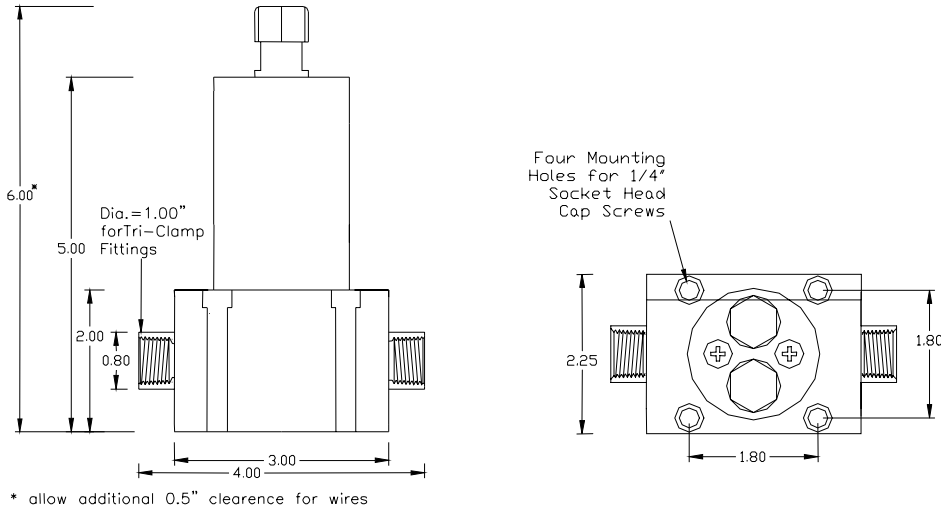


Fig. 13

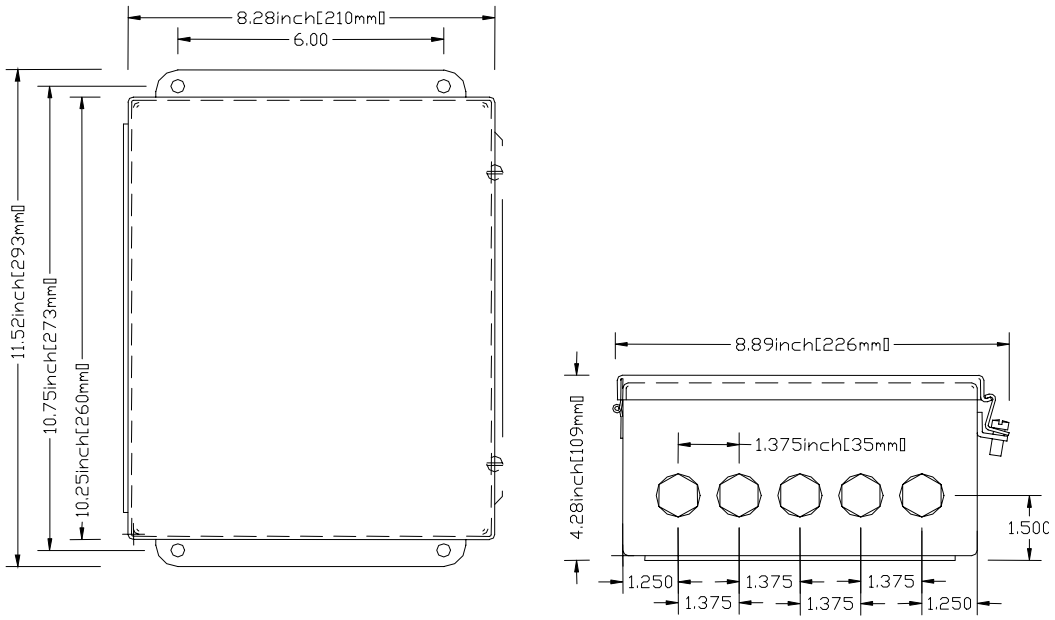


Fig. 14

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