



LITERATURE

POLARIZATION CELL REPLACEMENT (PCRHL)



DAIRYLAND
ELECTRICAL INDUSTRIES
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INTRODUCTION

The Polarization Cell Replacement for hazardous locations (PCRH) is a solid-state device commonly used in conjunction with cathodically protected structures. This product and its counterpart, the PCR, are an ideal replacement for electrochemical polarization cells because the solid-state design eliminates the maintenance requirements and the potentially hazardous electrolytes associated with polarization cells. Furthermore, the operating parameters offer a number of distinct advantages. Because the device has a higher DC blocking voltage, one device can often replace two or more polarization cells. The product is easy to apply because its operating parameters are precisely defined.

The PCRH is designed and certified to meet both Class 1, Div. 1, Groups B,C,D and Zone 1 Group IIB hazardous location requirements according to several industry standards.

Various PCRH versions can be ordered to meet either Class I, Division 1, Groups B, C, D, or Zone 1 Group IIB hazardous locations according to several different industry standards. Order the correct model to meet the intended hazardous classification and standards. For more information on the PCR device for Class I, Div. 2 or Zone 2 and non-hazardous locations, please see the separate PCR literature.

These products prevent the flow of DC current when the absolute voltage (i.e., the DC plus peak AC voltage) across the terminals is between -3.0 volts and + 1.0 volt while simultaneously providing a grounding (or coupling) path for steady-state AC current, if AC current is present. A symmetrical version, which blocks +/-2.0 volts is available as an option. Custom versions with other voltage blocking levels will be considered upon request. These products also provide over-voltage protection to both lightning and AC fault current.

COMMON APPLICATIONS

AC Voltage Mitigation

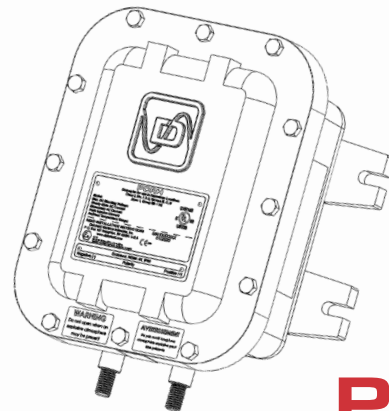
As an AC mitigation device, the PCRH can collapse the steady-state voltage between the connected points to a negligible level by providing continuous AC grounding for pipelines with induced AC while leaving cathodic protection unaffected.

Decoupling Electric Equipment Grounding Systems

When electrical equipment is mounted on a cathodically protected structure, the PCRH can provide DC isolation with fault rated AC continuity. As grounding codes apply, the PCRH is listed by UL for meeting the requirements of an effective AC grounding path per U.S. and Canadian electric codes.

Isolated Joint Protection

Isolated joints often need over-voltage protection against lightning and AC fault current, and in some cases, steady-state induced AC voltage. Due to the small clearance between opposite sides of the isolated flange, a protective device must provide a low clamping voltage, including the voltage effects of the conductors or bus bars used to connect the product (See the Dairyland technical articles on conductor length relating to lightning effects.)



PCRH
Polarization Cell Replacement
for Hazardous Locations

DID YOU KNOW?

The PCRH has been certified by independent laboratories for compliance to U.S., Canadian, European, and international standards and codes. The PCRH is certified for use in hazardous locations (Class I, Div 1 and Zone 1). For more information on certifications and listings, visit www.dairyland.com.



PRODUCT OVERVIEW

AC Fault Current Ratings

Some applications may have conditions where an over-voltage device such as the PCRH is subject to fault current. For this reason, the PCRH was designed to have AC fault current carrying capability. The PCRH will limit the voltage between its connection points to less than 10 volts AC under the maximum fault current ratings listed below.

Four different fault current ratings are offered at 60Hz and 50Hz with the following current-time relationship:

AC Fault Current Ratings (Amps AC-RMS Symmetrical 50/60 Hz)				
Hz Cycles	3.7kA	5kA	10kA	15kA
1	6500	8800	20000	35000
3	5000	6800	15000	27000
10	4200	5700	12000	21000
30	3700	5000	10000	15000

Select a PCRH fault current rating that encompasses the fault current available. For more information on sizing for available fault current, view our web article: [Determining AC Fault Current](#).

Steady-State AC Current Ratings

This rating represents the maximum steady-state AC current that is allowed to flow through the device while still blocking the flow of DC current.

The table represents maximum values. As the DC voltage approaches the maximum blocking voltage rating selected, the allowable steady-state AC current is reduced as shown in Figure 1.

Steady-State Current Ratings (Amps AC-RMS Symmetrical) 50/60 Hz Ratings	
Ambient Temp	Standard 45A Rating
20°C	50A
65°C	40A

There are a number of applications where a PCRH may be required to block DC while simultaneously carrying steady-state AC current. For example, when a pipeline is in the same corridor as an electrical transmission line, steady-state AC voltage is often induced on the pipeline. The PCRH can mitigate this voltage by providing a low AC impedance path to ground while simultaneously preventing the flow of DC current.

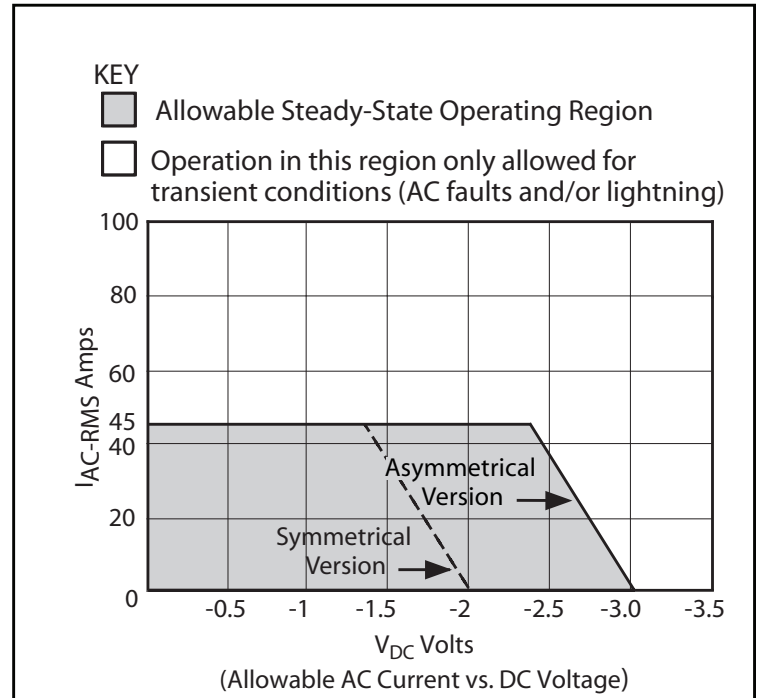


Figure 1: PCRH Operating Characteristics @ 43°C (Standard 45A @ 50/60 Hz)

The steady-state AC impedance of the PCRH at 60 Hz is 9.8 milliohms. At 50 Hz, the comparable impedance is 11.9 milliohms. Under an AC fault or lightning current condition, these impedances momentarily become virtually zero. For more information on steady-state current view our web article: [Measuring Steady-State AC Current](#)

DC Blocking Voltage Rating

The standard, and most commonly specified, PCRH model has an asymmetrical voltage blocking rating of -3.0 volts to +1.0 volt. The PCRH can also be furnished with a symmetrical voltage blocking rating of +/- 2.0 volts. Other voltage blocking ratings will be considered upon request.

The reasons for symmetrical and asymmetrical choices are best described with an example. If the PCRH is used to provide over-voltage protection for an isolated joint and both sides of the joint are cathodically protected, the DC voltage across the joint will be the difference in voltage between the two cathodic protection systems, normally near zero volts. For this application it is desirable to select the symmetrical +/- 2.0 volt blocking rating. In the event that the cathodic protection system is OFF on one side of the joint, the device can block 2.0 VDC in either direction.

If one side of the isolated joint is cathodically protected and the other side is grounded, then it is preferable to select the asymmetrical version which blocks from -3.0 volts to +1.0 volt since one side has been shifted to a more negative voltage. Whenever one side is referenced to ground, the asymmetrical version is suggested because the CP voltage is situated in the center of the threshold voltage range.



Lightning Surge Current Rating

All models have the same lightning surge current rating which is shown in the following table.

Lightning Surge Current Rating All PCRH Models
Peak Amperes: 100,000
Note: 8x20 microsecond waveform

The peak voltage directly across the voltage-clamping elements within the device is less than 250 volts at rated lightning surge current; however, the voltage developed between the conductor connection points will be greater due to the effect of conductor inductance. Conductors can develop from 1 to 3 kV per foot (approx. 3 to 10 kV/meter) when subject to lightning current. This is the reason that conductors should be kept as short as possible. For more information on keeping conductor lengths short, please visit the conductor length article on our website.

DC Leakage Current

The DC leakage current of any model is well under 1.0 milliampere under typical operating conditions where the DC voltage is in the 0.85 to 1.25 V range, even when the temperature is up to 65°C. See Figure 2.

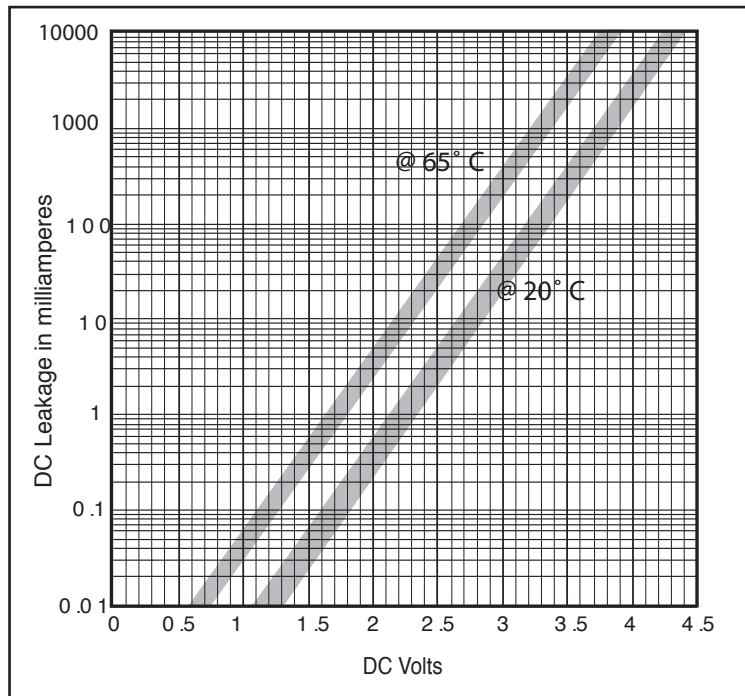
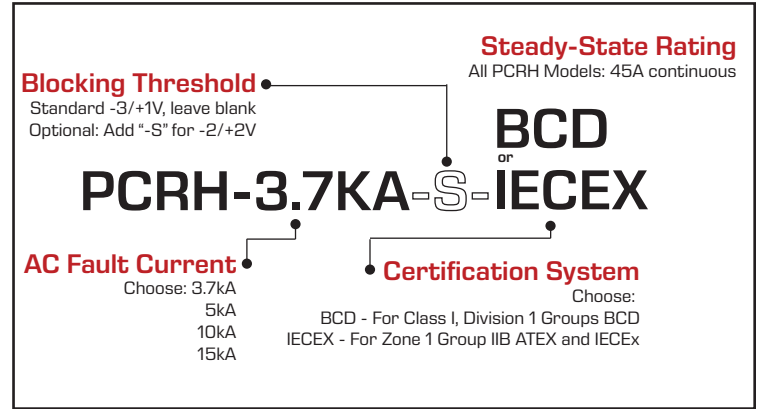


Figure 2 DC Voltage vs. DC Leakage Current (Standard Asymmetrical PCRH with -3V / +1V Blocking Voltage)

Ordering Instructions



FEATURES AND CERTIFICATIONS

Certifications

The PCRH has been tested by Nationally Recognized Testing Laboratories (NRTLs) for compliance to independent standards in its operation, ratings, and construction. This includes compliance to standards for:

Class I, Div. 1, Groups B, C, D and Zone 1, Group IIB

Class & Division System:

UL (United States) and C-UL (Canada)

- Effective Ground Fault Current Path per:
 - NFPA 70 (US National Electric Code – NEC): Article 250.4(A)(5)
 - CSA C22.1 (Canadian Electric Code, Part I): 10-100 & 10-500
- Isolation of Objectionable DC Ground Currents per:
 - NFPA 70: Article 250.6(E)
 - CSA C22.1: 10-100 & 10-500
- Hazardous Location Use:
 - Class 1, Division 1 & 2, Groups B,C,D by UL & C-UL per:
 - UL 1203, 5th Ed. & CSA C22.2 No.30, 3rd Ed.
- Safety Requirements for Electrical Equipment per:
 - UL 61010-1, 3rd Ed. & CSA C22.2 No. 61010-1, 3rd Ed.
 - Overvoltage Protection from Impulse (Lightning) Current: 100kA (8 x 20µs)
 - Enclosure Rating: NEMA 4X
 - Temperature Range: -45°C to +65°C (-49°F to +149°F)



Zone System: ATEX / IECEx / UKEx (Europe / International / UK). ATEX per directive 2014/34/EU (Equipment for use in Potentially Explosive Atmospheres):

- Zone 1, Gas Group IIB, Flameproof “db”
- EN IEC 60079-0: 2018
- EN 60079-1: 2014
- IEC 60079-0: 2017
- IEC 60079-1: 2014-06
- Overvoltage Protection from Impulse (Lightning) Current: 100kA (8 x 20µs)
- Temperature Range: -20°C to +60°C
- Enclosure Rating: IP66

Solid-State Design

Both the PCRH and its counterpart, the PCR use proven solid-state components which have an instantaneous response with respect to voltage, thereby initiating voltage clamping immediately when the voltage attempts to exceed the blocking level selected

Fail-Safe

An important safety feature is that if subject to AC fault current or lightning surge current in excess of rating such that failure occurs, failure will occur in the shorted mode. In the shorted mode, the unit can carry greater than rated fault current or lightning surge current and still provide an effective grounding (or conducting) path.

Enclosures

All PCRH enclosures are explosion proof and are made of cast aluminum. Enclosures are rated NEMA 4X for Div 1 devices and rated IP66 for ATEX/IECEx.

Polarity / Electrical Connections

Polarity marks (+) and (-) are provided near the terminals to aid in proper installation. Connect the (-) to the structure with CP and the (+) to the grounded, or more positive, system.

Note: The positive terminal is bonded internally to the metallic enclosure.

Conductor connections are made to bushings which have a 1/2"-13 diameter threaded stud that is 0.875" long. It is suggested that the PCRH be purchased with factory furnished conductors and connectors to simplify field installation. See the dairyland website at dairyland.com for more information on conductor options.

Number of Operations

Virtually unlimited under maximum ratings, provided the operations are not immediately repetitive.

WARNING

Keep the Conductors Short!

The PCRH is designed to keep the voltage between the device terminals to a limited value. During lightning conditions, a more important factor than the PCRH voltage clamping capability is the voltage developed in the conductors or bus used to attach the device. Use low inductance bus bars or conductors ideally less than 6 inches (150 mm) long for best results. More information on conductor length is available at www.dairyland.com.

Energy Requirements

None. The devices are totally passive.

Mounting

All PCRH versions have a 3/16" (4.8 mm) thick aluminum back-plate which can be mounted to a flat surface with two 1/2" (12 mm) bolts, user furnished. All models are also furnished with appropriate holes in the back plate, suitable for U-bolt mounting to a 2" pipe (2.375" or 60.3 mm outer diameter).

It is always recommended that the product be mounted so that the total lead length to the connection points is kept as short as possible so as to minimize the voltage developed due to lead inductance. (Refer to section on lightning current ratings.)

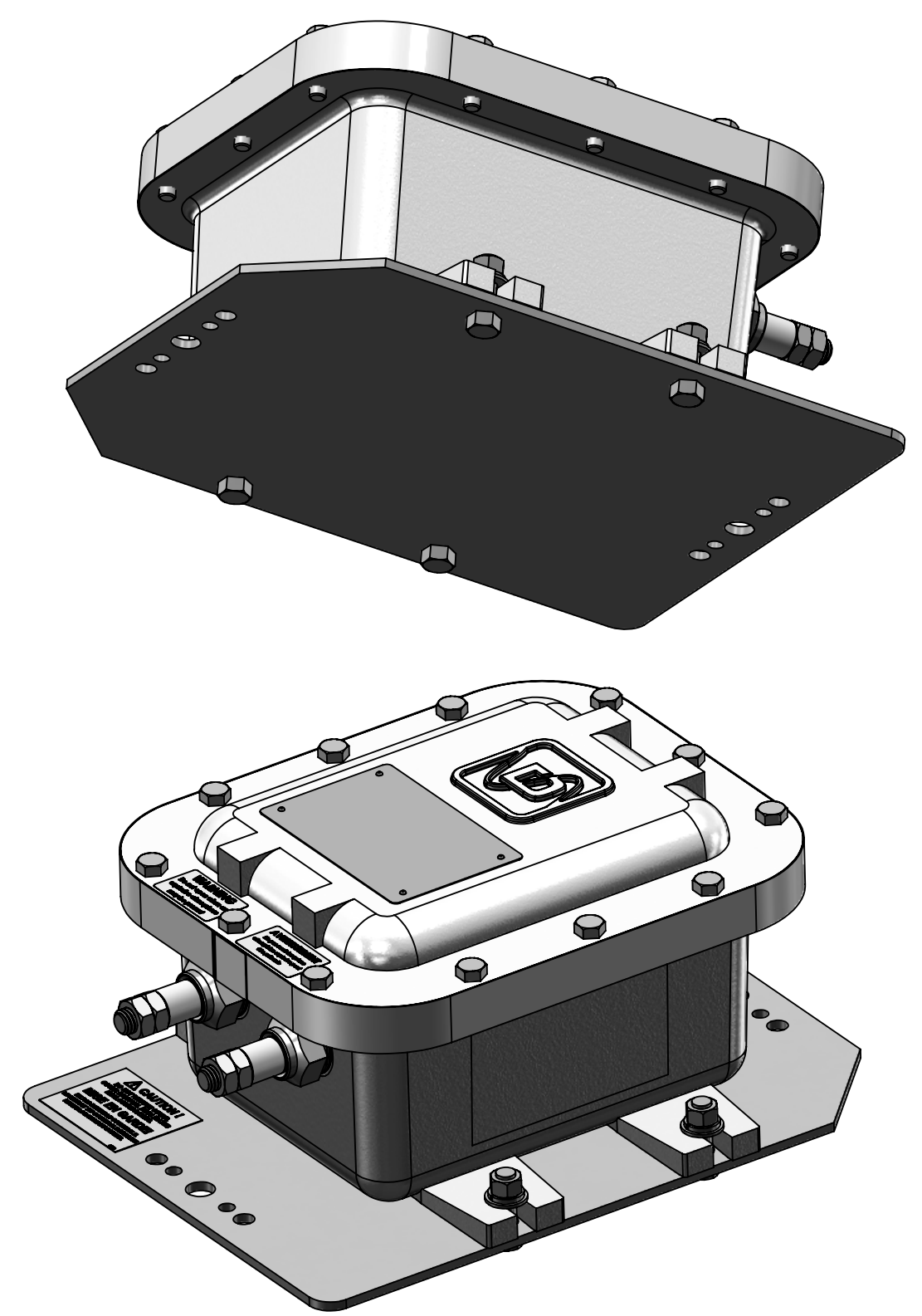
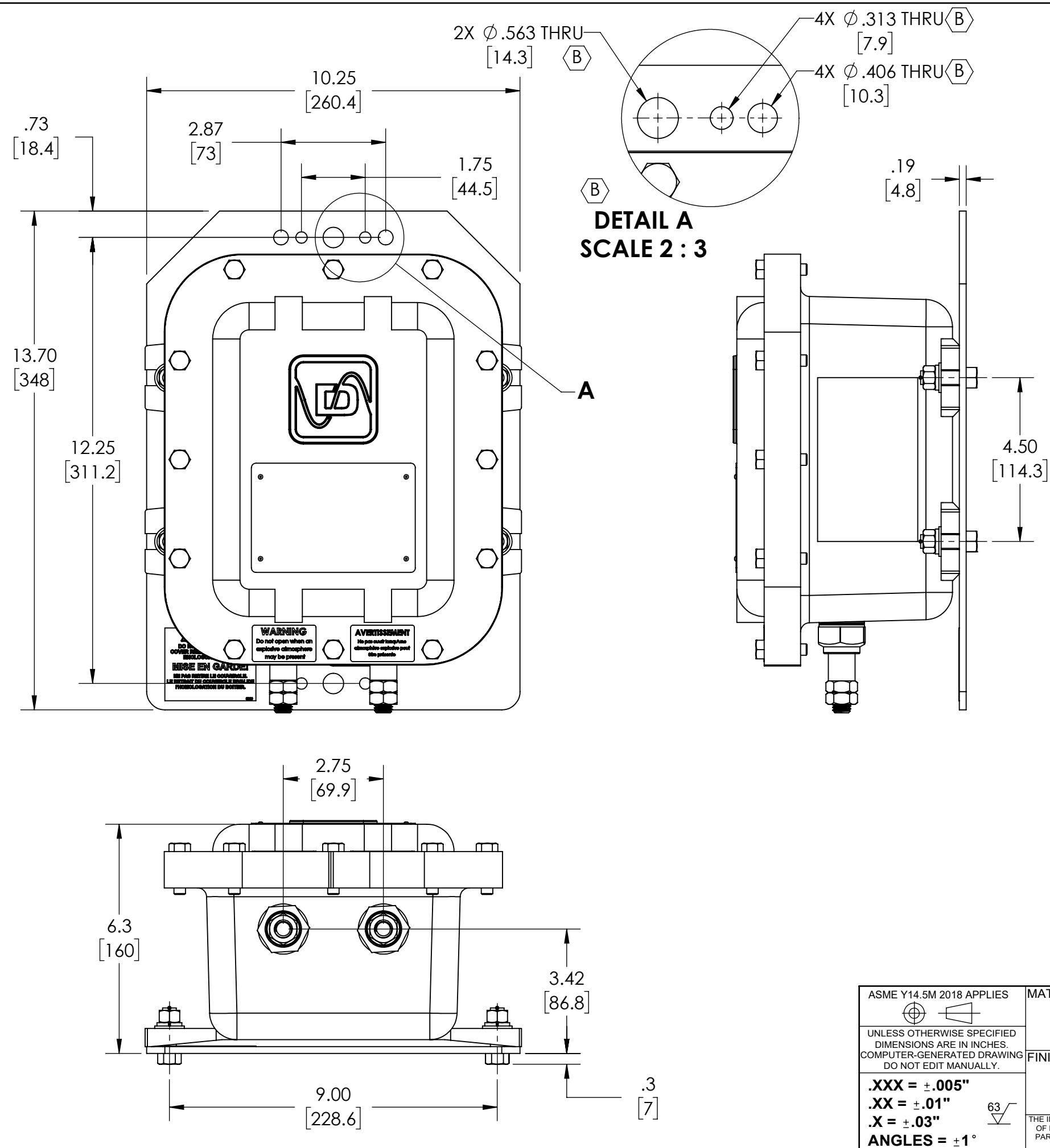
Note: Because of the internal bond between the enclosure and positive terminal, mount the PCRH on a structure not in contact with the cathodically protected structure.

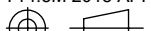


Mounting Accessories

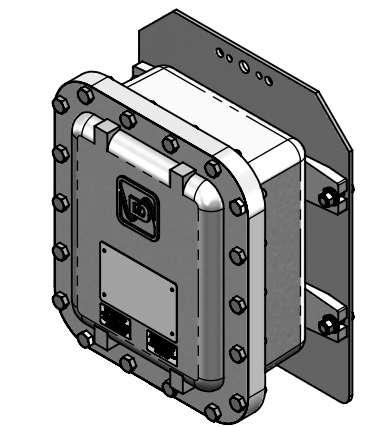
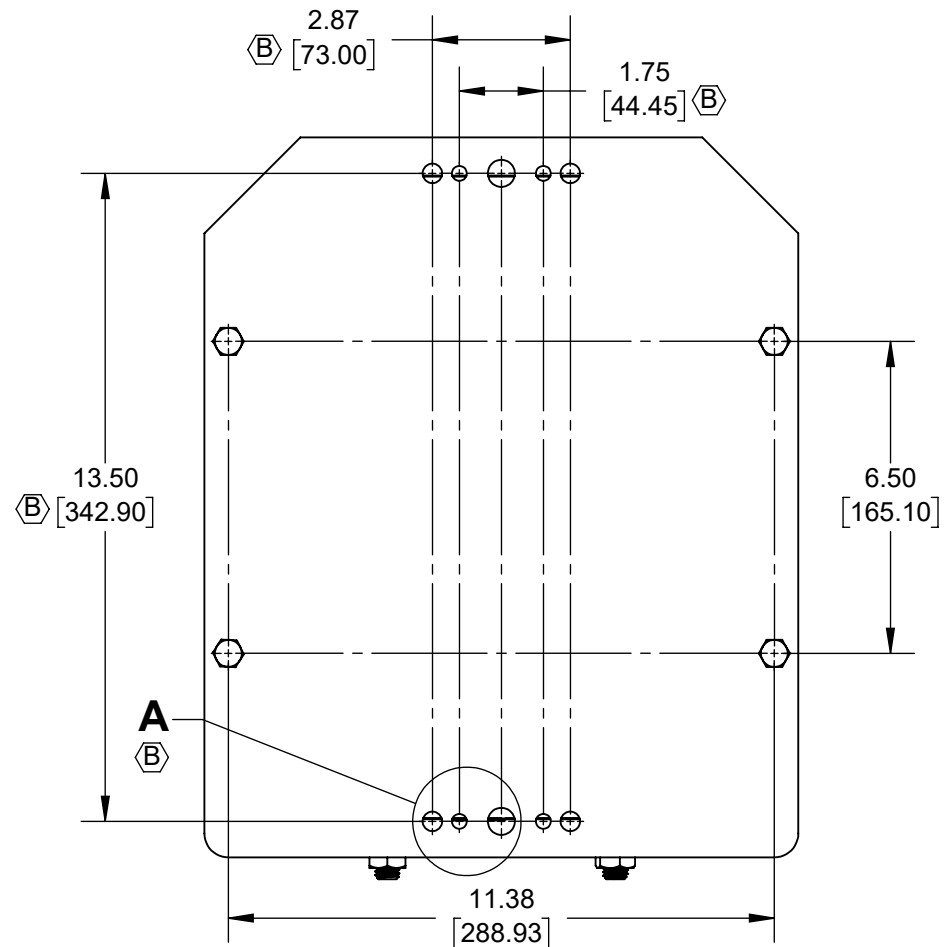
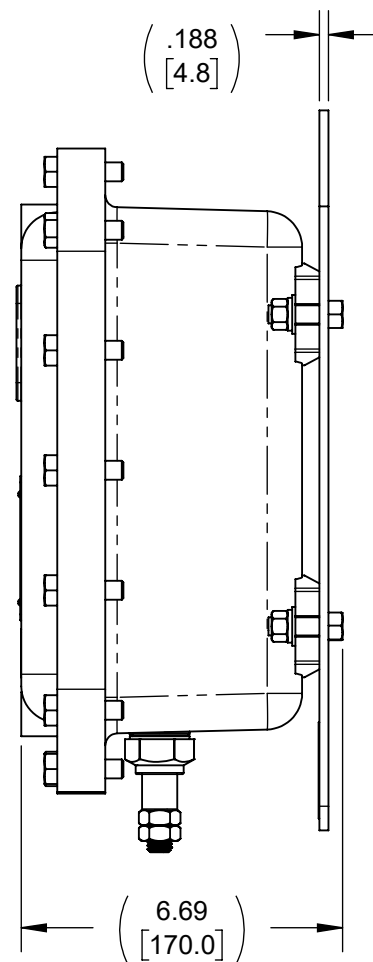
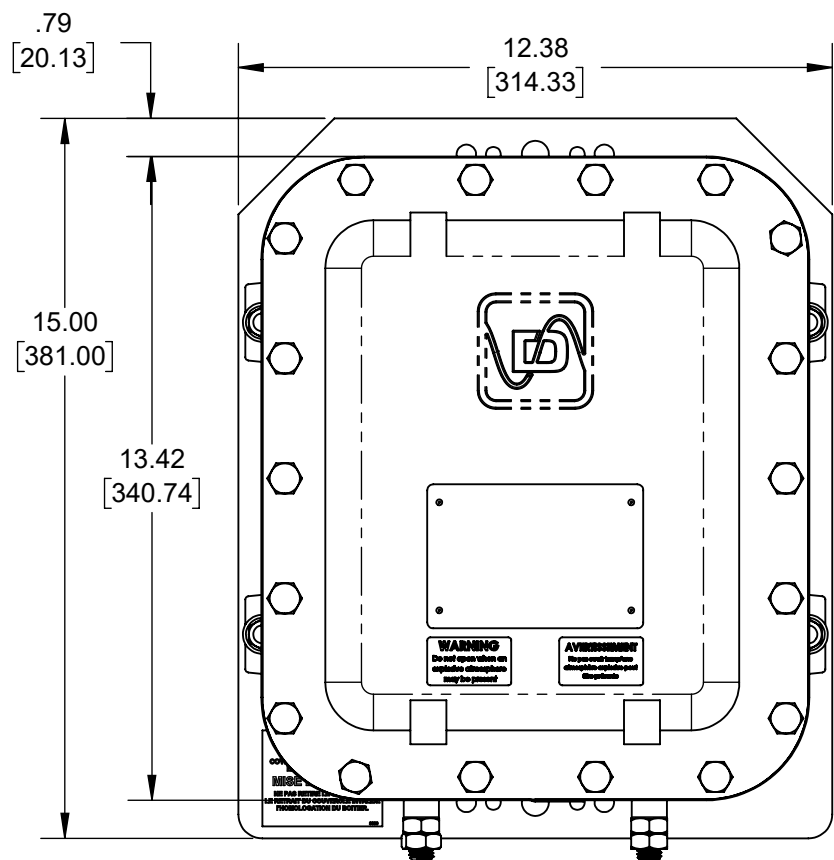
Numerous mounting accessories are available from Dairyland to aid in the proper installation of the PCRH. Detailed accessory information, including complete installation instructions are available on Dairyland.com.

Specific Installation Guidance

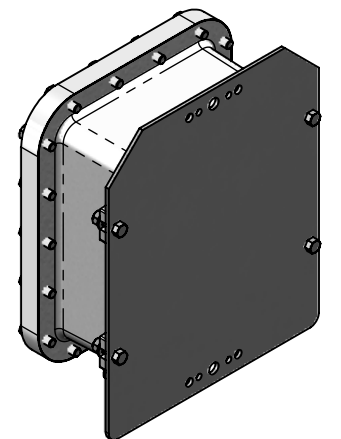
The Dairyland website contains detailed information on the installation methods specific to a given application. For wiring diagrams and/or application guidance, see Dairyland.com.



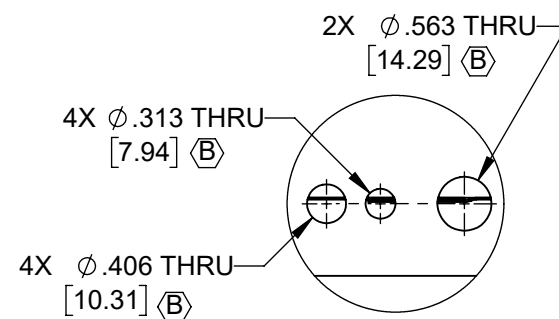
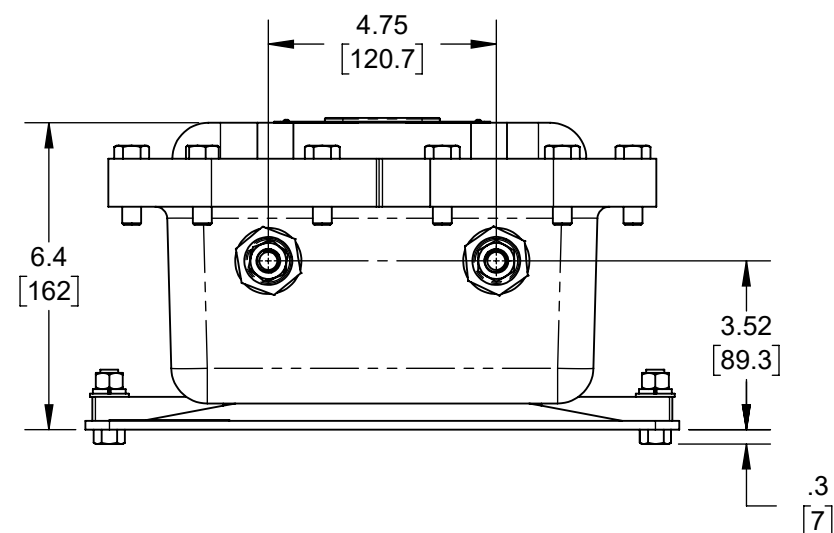
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.XXX = ±.005" .XX = ±.01" .X = ±.03" ANGLES = ±1° 	FINISH: NA	TITLE: PCRH - 3.5KA THRU 10KA OUTLINE DRAWING		
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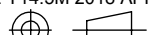


FRONT
ISOMETRIC VIEW
SCALE 1:8



REAR
ISOMETRIC VIEW
SCALE 1:8



DETAIL A (B)
SCALE 1 : 2

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