



DAIRYLAND ELECTRICAL INDUSTRIES

ISOLATE. GROUND. PROTECT.

The Polarization Cell Replacement (PCRH) Technical Literature

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.

This product is available in two different versions to most economically accommodate the two different hazardous location listings which are available. In many applications, these products are used in a hazardous location; hence, the reason for hazardous location listings.

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.

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



COMMON APPLICATIONS

AC Voltage Mitigation

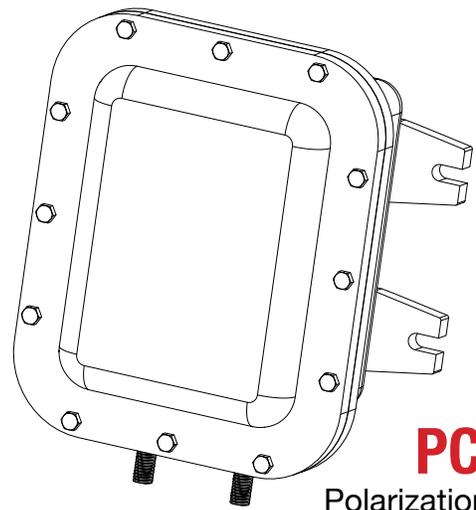
As an AC mitigation device, the PCRH can collapse the steady-state voltage between the connected points to a negligible level by providing continuous AC grounding for pipelines with induced AC while leaving cathodic protection unaffected.

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.

Insulated Joint Protection

Insulated 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 insulated 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

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)				
60 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
50 Hz Cycles	3.7kA	5kA	10kA	15kA
1	6500	8800	19000	33000
3	5000	6800	14000	25000
10	4200	5700	11000	20000
30	3700	5000	9000	14000

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.

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. Either model 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 insulated 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 $2.0 V_{DC}$ in either direction.

If one side of the insulated 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

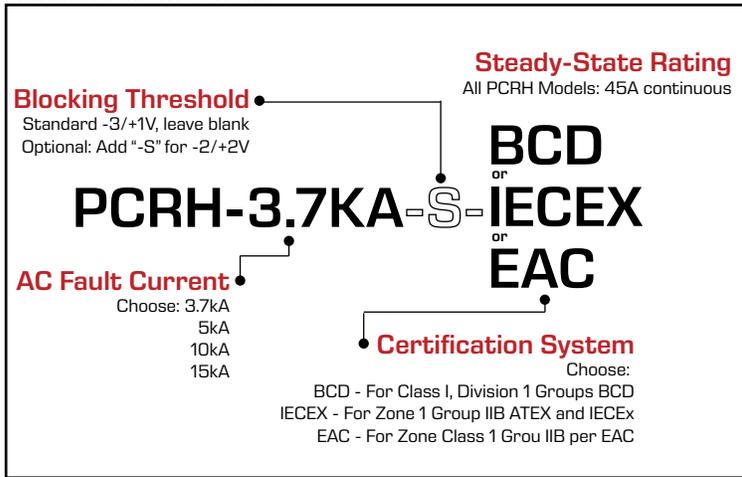
All models have the same lightning surge current rating which is shown in the following table.

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

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.

ORDERING INSTRUCTIONS



NOTE: The EAC version is a separate product from standard models, with a Cyrillic nameplate and instruction manual, and references GOST standards only. To purchase, order model with "EAC" suffix. See separate Russian/English EAC manual.

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 milliamperes 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.

FEATURES AND CERTIFICATIONS

Certifications - Class and Division System per UL/CSA

Applies to models with "BCD" suffix

Underwriters Laboratories (UL) has listed the PCRH as meeting the criteria for "an effective grounding path" as defined in Section 250.2 and 250.4(A)(5) of the U.S. National Electrical Code (NFPA 70), thereby enabling its use as an AC grounding device. The PCRH is also C-UL listed in Canada as meeting the criteria for "an effective grounding path" per CSA C22.1-12 Article 10-500 and bonding requirements per C22.2 No. 0.4-04 (R2009).

In addition, the PCRH is listed by UL as meeting:

- The requirements of a DC isolating/AC coupling device suitable for the isolation of objectionable DC current from cathodically protected systems to ground as defined in NFPA 70 Article 250.6(E) and CSA C22.1-12 Article 10-806 (1).
- An over-voltage protective device, having been tested to the applicable requirements of ANSI C62.11.

The PCRH is listed by Underwriters Laboratories (UL) for use in hazardous locations in accordance with NFPA 70 (U.S. National Electrical Code), Articles 500-505 for Class I, Division 1, Groups B, C, and D. The applicable standard to which the PCRH is listed is UL 1203 which deals with explosion proof products to meet Class I, Division 1 requirements. The listing is valid for ambient temperatures from -45°C to +65°C. The operating temperature code is T5 (100°C). The PCRH is also C-UL listed to the above classifications per Canadian code C22.2 No. 30-M1986 (R2012.)

Certifications - Zone System per ATEX and IECEX

Applies to models with "IECEX" suffix

The PCRH is certified to the ATEX Directive and IECEX for Zone 1, Gas Group IIB, Temp Code T6, under protection method "d".

The ambient temperature range is -20°C to +60°C. The standards used in this evaluation are: EN60079-0:2009; EN60079-1:2007; IEC 60079-0, 5th Edition; IEC60079-1, 6th Edition.

The EAC version of the PCRH, available by ordering a model number with a "-EAC" suffix, is certified to the EAC requirements of the Customs Union (Russia, Kazakhstan, etc) for use in Zone Class 1, Group IIB hazardous locations by NANIO-CCVE to: GOST R IEC 60079-1-2008, GOST R IEC 60079-0-2011.

Certifications - Zone System per EAC

Applies to models with "EAC" suffix

The EAC version of the PCRH is certified to the EAC requirements of the Customs Union (Russia, Kazakhstan, etc) for use in Zone Class 1, Group IIB hazardous locations by NANIO-CCVE to: GOST R IEC 60079-1-2008, GOST R IEC 60079-0-2011. Temperature code T6. Method of protection "d." Ambient temperature range is -20°C to +60°C.

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 and EAC Zone 1 devices.

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 article on [Conductor Information](#) for more information on conductor options.

Ambient Temperature

-45°C to +65°C for Div 1 devices
-20°C to +60°C for Zone 1 devices

Number of Operations

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

Energy Requirements

None. The devices are totally passive.

MOUNTING

All PCRH versions have a 3/16" (4.8 mm) thick aluminum backplate 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 the Dairyland website here: [Dairyland Accessories](#).

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 Applications](#).

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

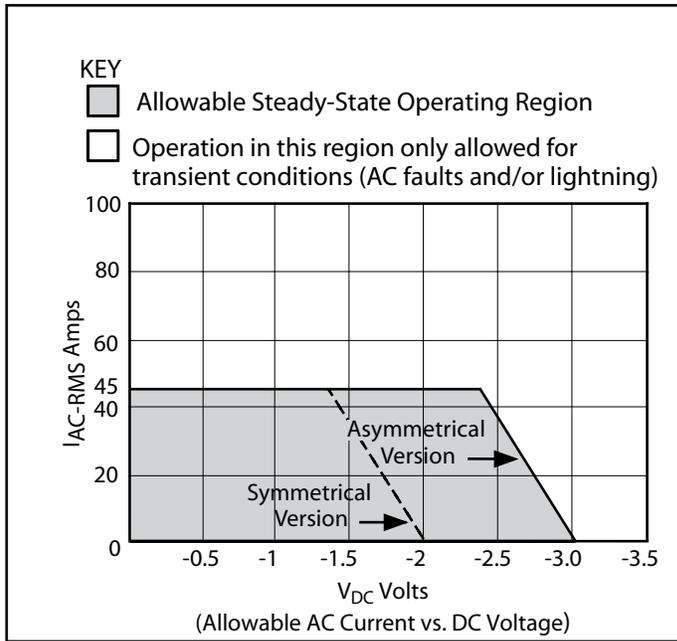
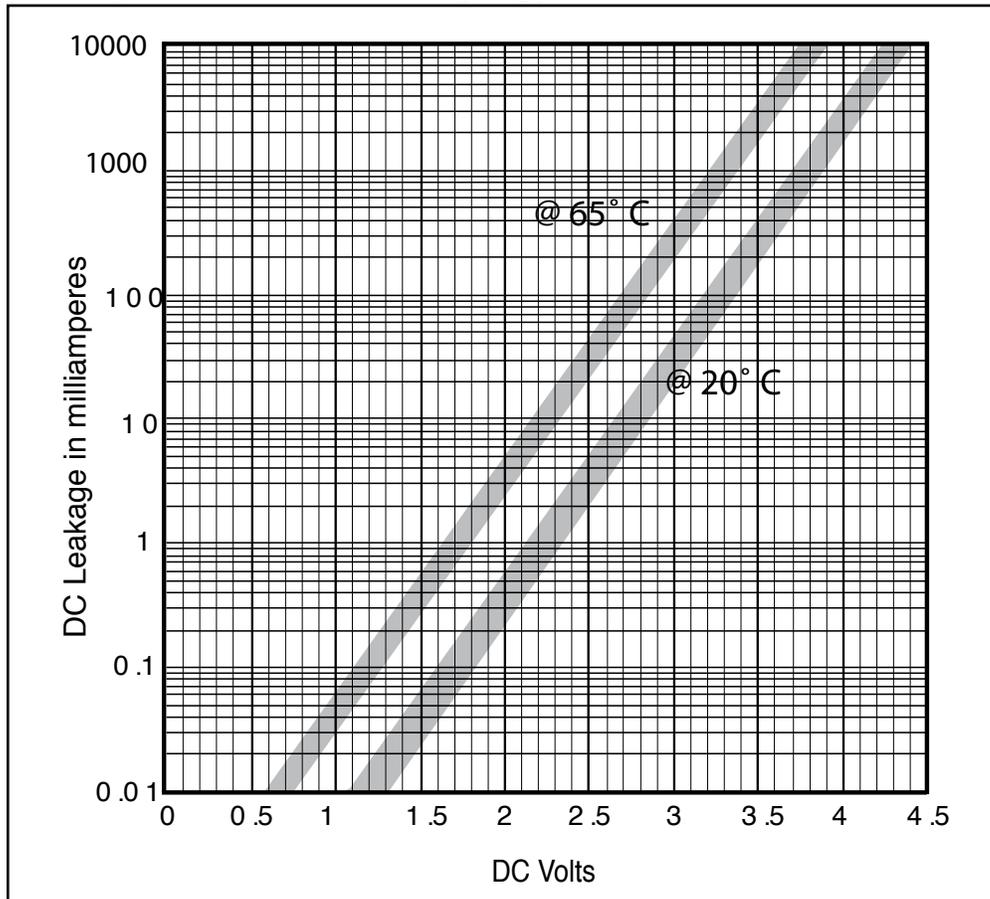
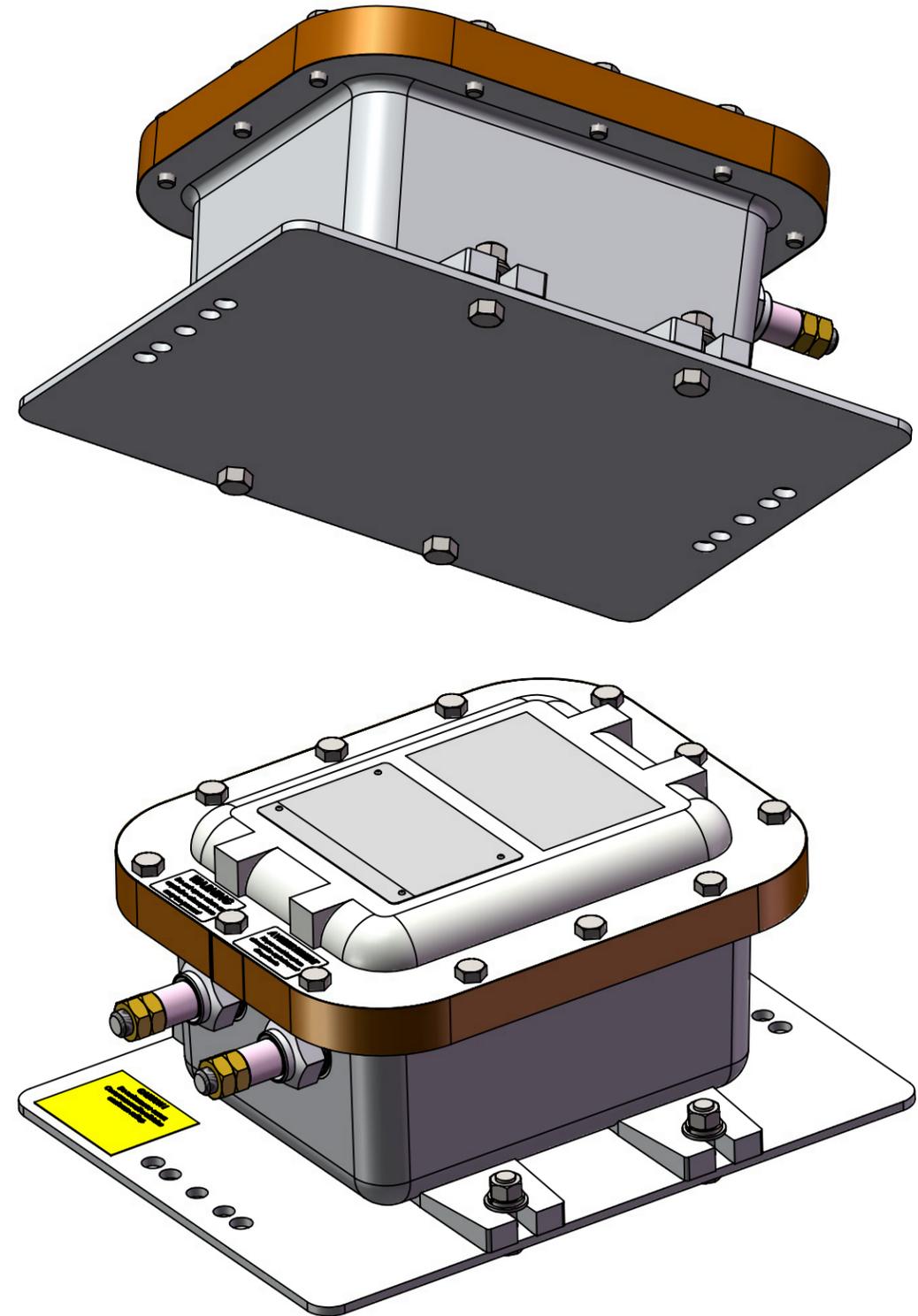
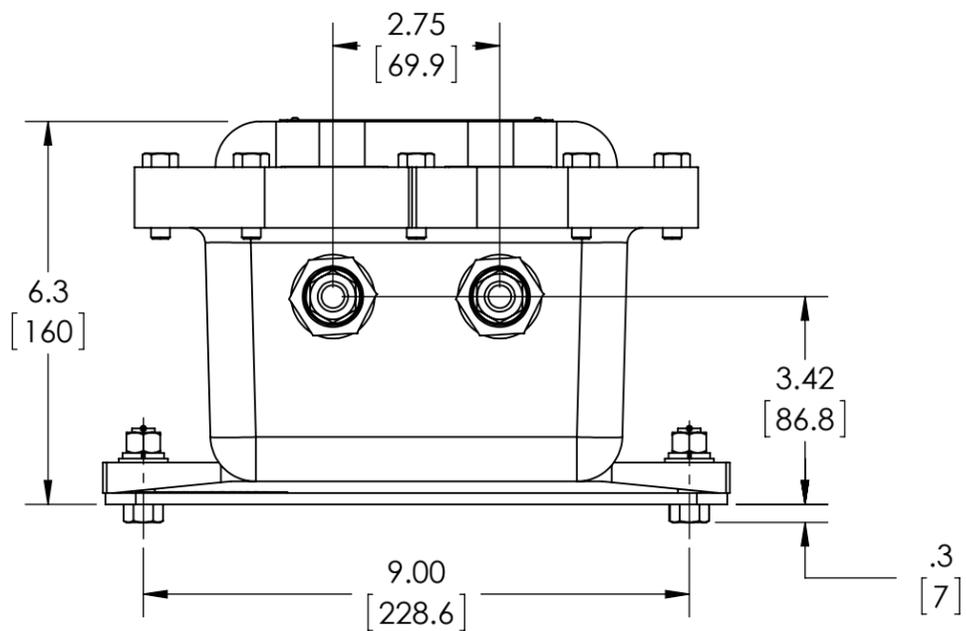
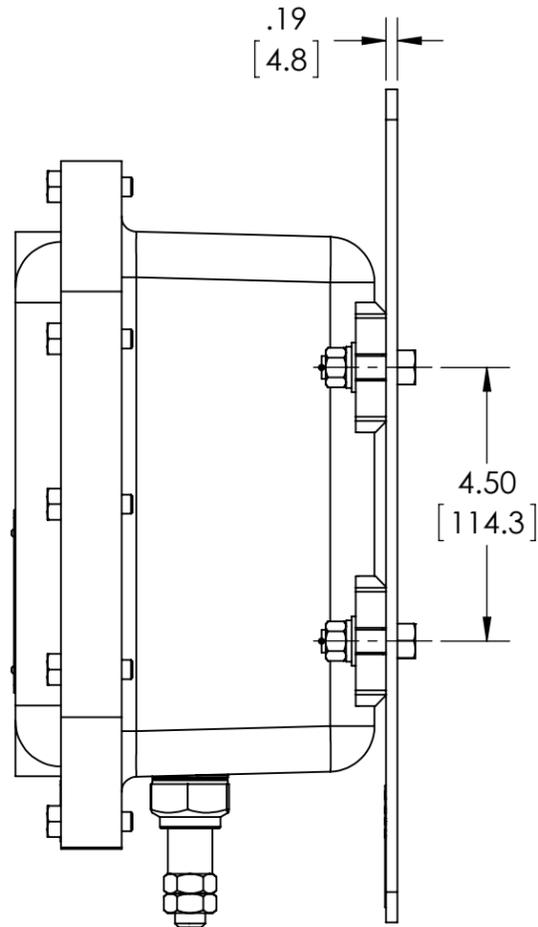
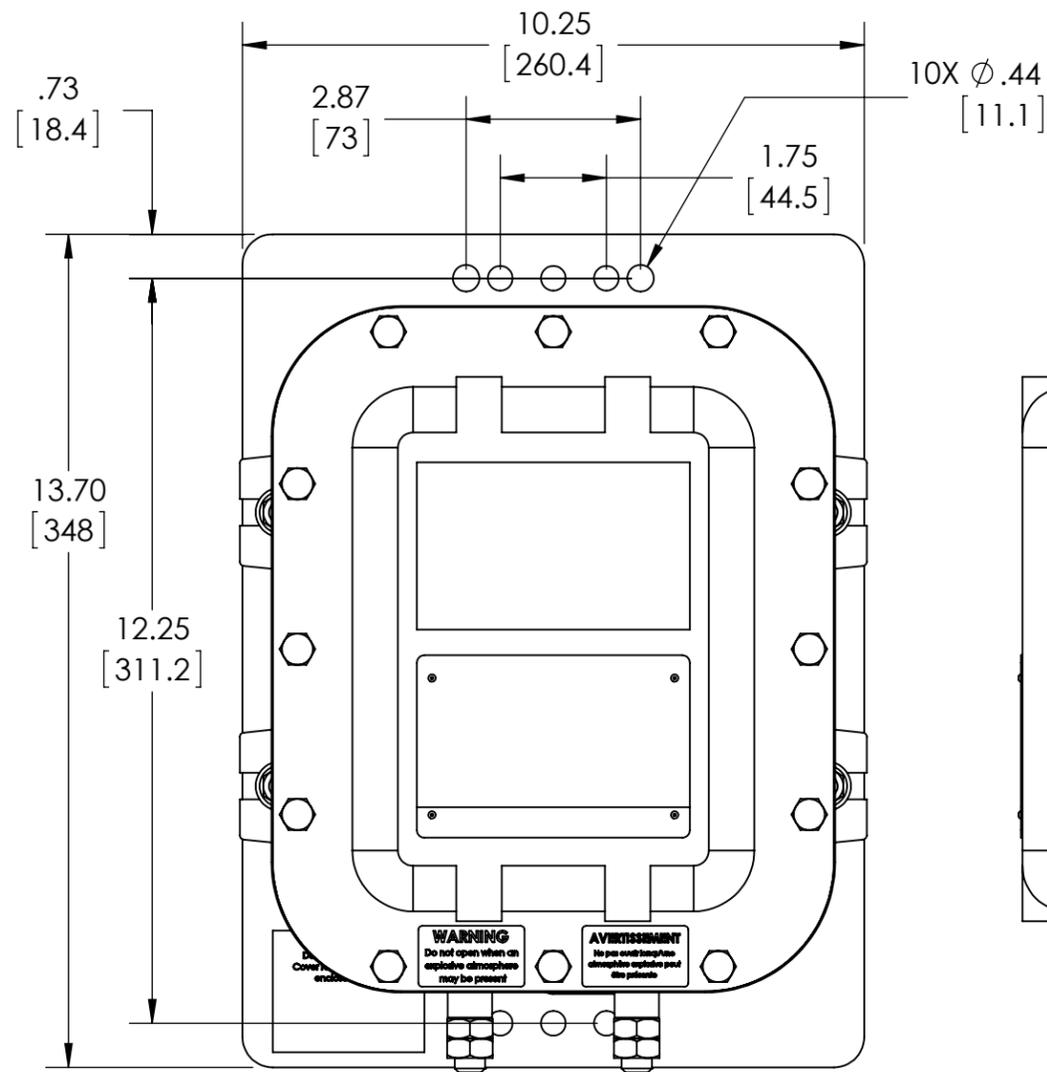


FIGURE 2 DC Voltage vs. DC Leakage Current
(Standard Asymmetrical PCRH with -3V / +1V Blocking Voltage)



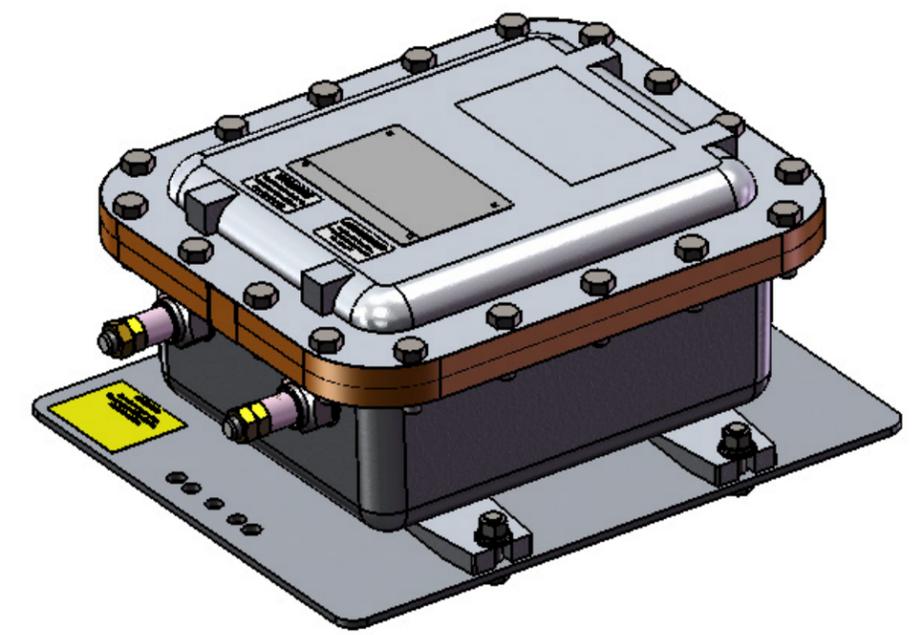
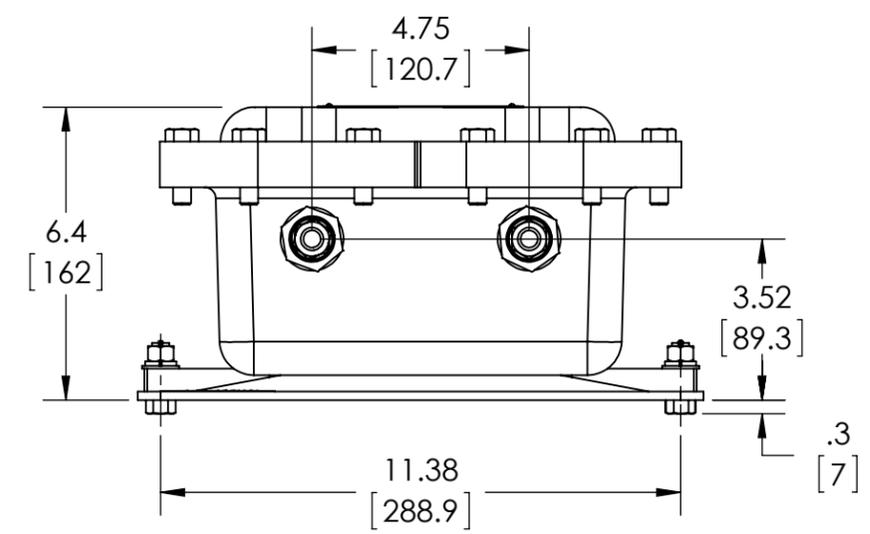
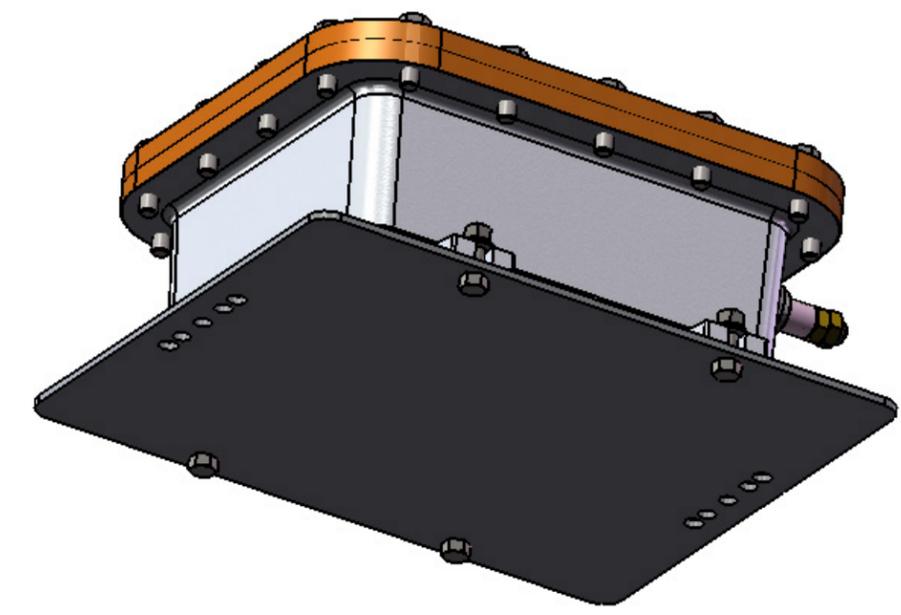
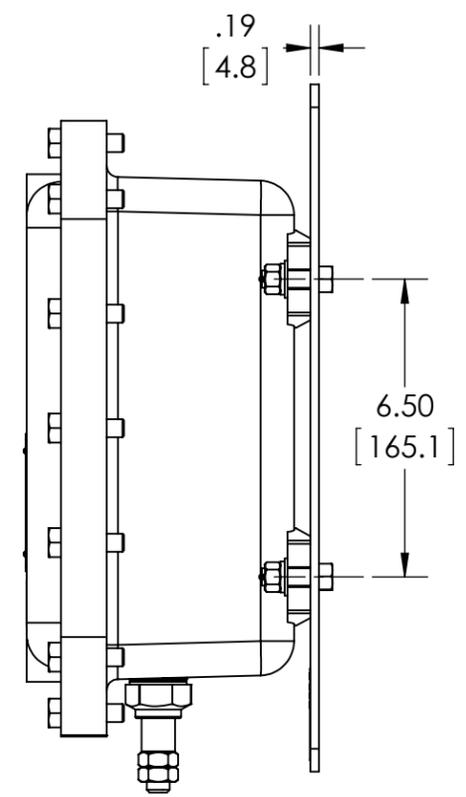
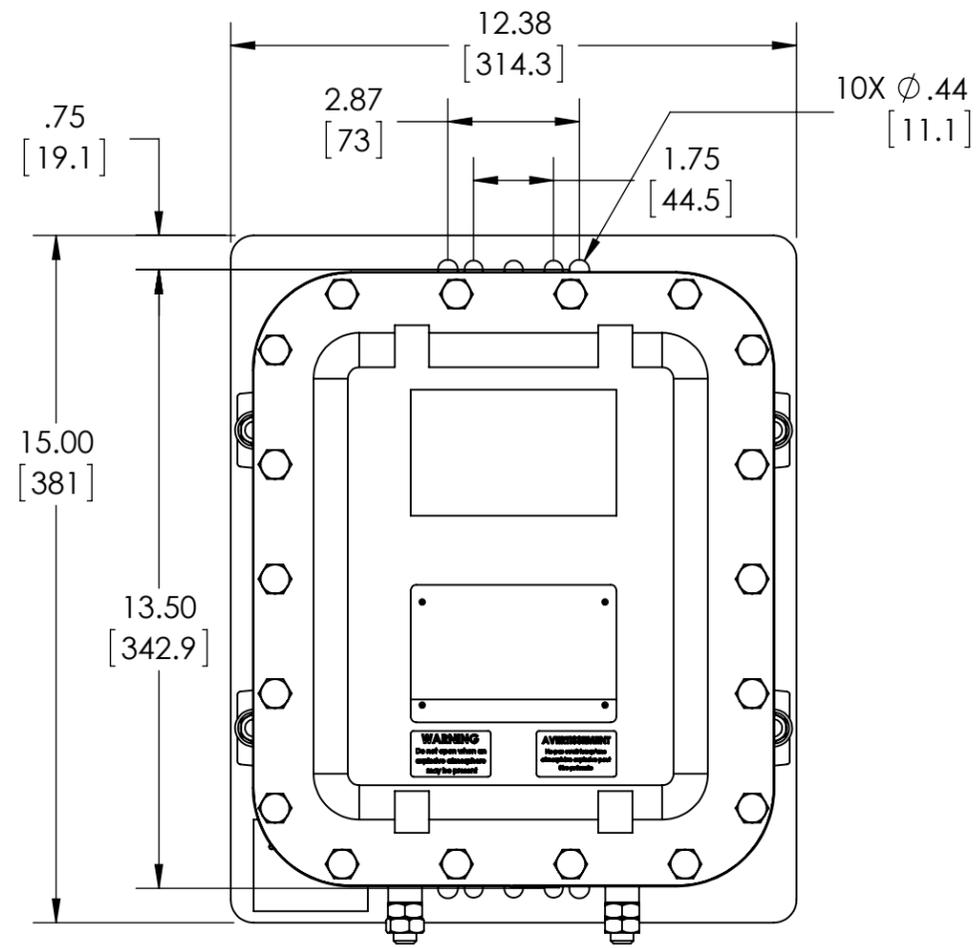


ANSI Y14.5M 1994 APPLIES
 UNLESS NOTED
 UNITS: INCHES
 3-PLACE: ±.005
 2-PLACE: ±.015
 1-PLACE / FRAC: ±.03
 ANGULAR: ±1



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DESCRIPTION PCRH - 3.7KA THRU 10KA OUTLINE DRAWING				
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SCALE 1:3	DRAWN: JPW	SHEET: 1 OF 1	DWG APPROVAL: TC	



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DESCRIPTION PCRH - 15KA OUTLINE DRAWING				
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