MOORE INDUSTRIES WORLDWIDE

FDY

PC-Programmable Frequency-to-DC Transmitter with Display

October 2018

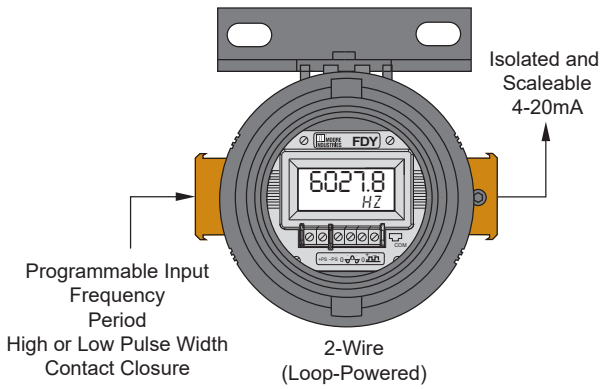
Description

The FDY PC-Programmable Frequency-to-DC Transmitter with Display monitors frequency, period, high or low pulse width, and contact closure signals. It converts the input signal to a proportional, input-to-output isolated 4-20mA output ready for direct interface with a readout instrument, recorder, PLC, DCS, SCADA system or other readout instrument.

The 2-wire (loop-powered) FDY is ideal for use in a wide range of process and factory automation monitoring applications:

- **Turbine Tachometer Generators**
- **Turbine Flow Meters**
- **Magnetic Pickups** • **Dry Contact Closures**
- **Variable Frequency Drives** • **Rotating Equipment**
- **Pulse and Frequency Output Transducers**
- **Motor and Conveyor Speed**

Figure 1. *The FDY configures with application-specific operating parameters in just minutes using our single-window Intelligent PC Configuration Software*



Certifications

FM APPROVED · CSA C US · Ex · CE · ANZEx

The FDY installs quickly and easily *in harsh conditions using our protective field-mount enclosures, or on a surface, DIN-rail or relay track.*

Features

- **Exceptional accuracy and long-term stability.** Typical accuracy is ±0.025% of span with up to 5 years between scheduled calibrations.
- **Sets up in minutes with PC software.** You can choose, and then view to confirm, all application-specific operating parameters.
- **Versatile input choices.** Measures frequency ranges between an amazingly low 0.005Hz up to 25kHz; periods from 40microseconds to 200sec; and pulse widths from 0.2msec to 200 seconds.
- **User-configurable display.** A 5-digit LCD shows the process variable in selectable engineering units.
- **Input-to-output isolated and RFI/EMI protected.** Resistant to unpredictable ground loops and the harmful effects of plant and equipment “noise”.
- **Programmable moving average filter.** Minimizes measurement instability caused by the effects of bent turbine blades and other frequency variations.

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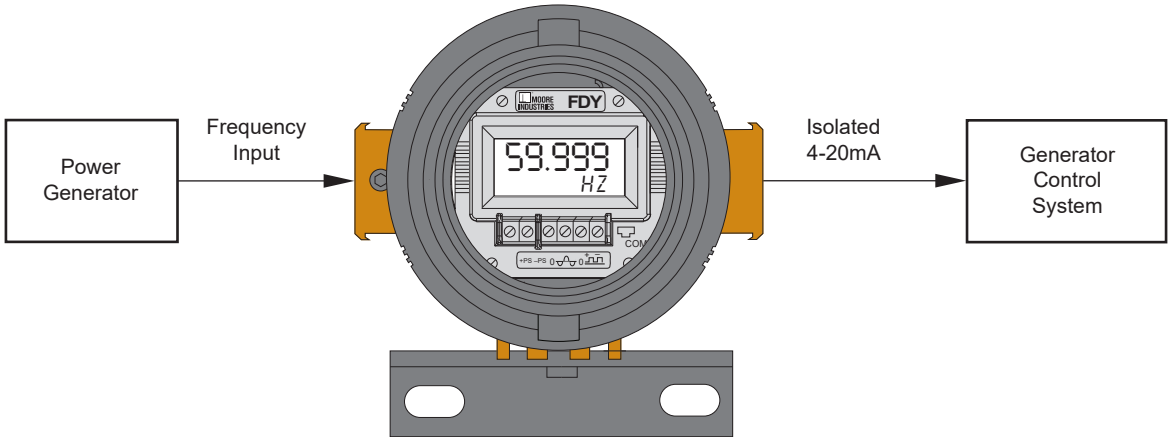
Accurate Frequency Monitoring

In power generating stations, stand-by power systems, and cogeneration plants, the frequency of the generated power must be tightly controlled.
The FDY provides extraordinary precision for this measurement, providing a 4-20mA signal for a narrow span centered on the set point (for example, 55-65Hz for a 60Hz system).

Figure 2. *Precision frequency measurement for power generators*



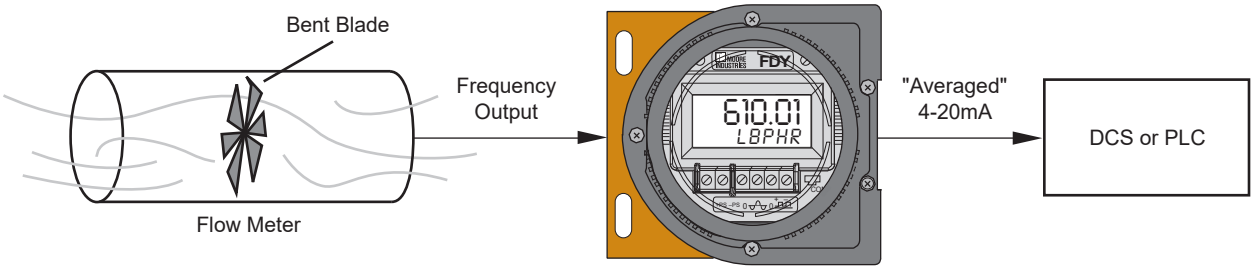
Make Consistent Flow Measurements

Flow measurements are often made with turbine flow meters. One common source of measurement inconsistencies is frequency variation due to bent blades.

Programmable Averaging Filter—To compensate for bent blades, the FDY incorporates a programmable moving average filter.
The user-selectable moving average is set to match the number of turbine blades. Taking a reading from each turbine blade, the FDY averages the readings to produce a “smoothed out” 4-20mA value proportional to the continuous averaged measurement. This advantage stretches the time between maintenance cycles needed to replace the rotor in the turbine meter by delivering accurate measurements even if the turbine blade(s) are damaged.

Custom Linearization Curves—Another potential for error is the effect of viscosity, which varies according to published curves. For liquids, the change is temperature related, while for gas, it is flow related. In some cases, the onboard linearization capability of the FDY can compensate for the viscosity effect using calibration data supplied by the meter manufacturer.

Figure 3. *Programmable “filtering” features minimize the effects of bent turbine blades*



Increasing Pump Efficiency

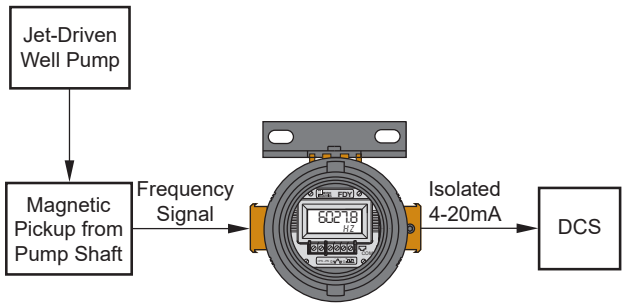
Natural gas typically must be processed both to remove unwanted contaminants, and to separate it into different types of gas before it is usable. These gas processing plants require the raw gas to be pumped from low pressure to high pressure to produce usable products. Maintaining consistent pump speed is essential to this process to maintain efficiency and decrease wasted product.

Most pumps use jet engines to create the required pressure; however, a change in engine speed of just ±0.1% can vary the volume of the pump drastically. To ensure the pump is operating at the required level, it must be continuously monitored.

To accomplish this, a magnetic pickup is attached to the pump shaft (Figure 4). The pickup provides a frequency output. The FDY takes the pickup signal, converts it to a 4-20mA output proportional to the pump shaft speed, and transmits it to the DCS. Should there be an unwanted change in speed, it can be detected at the DCS.

Because of the FDY's superior accuracy, it is able to detect even slight changes in shaft speed to help ensure the pump is running at optimum efficiency.

Figure 4. *Monitor pump speed to ensure optimum efficiency*

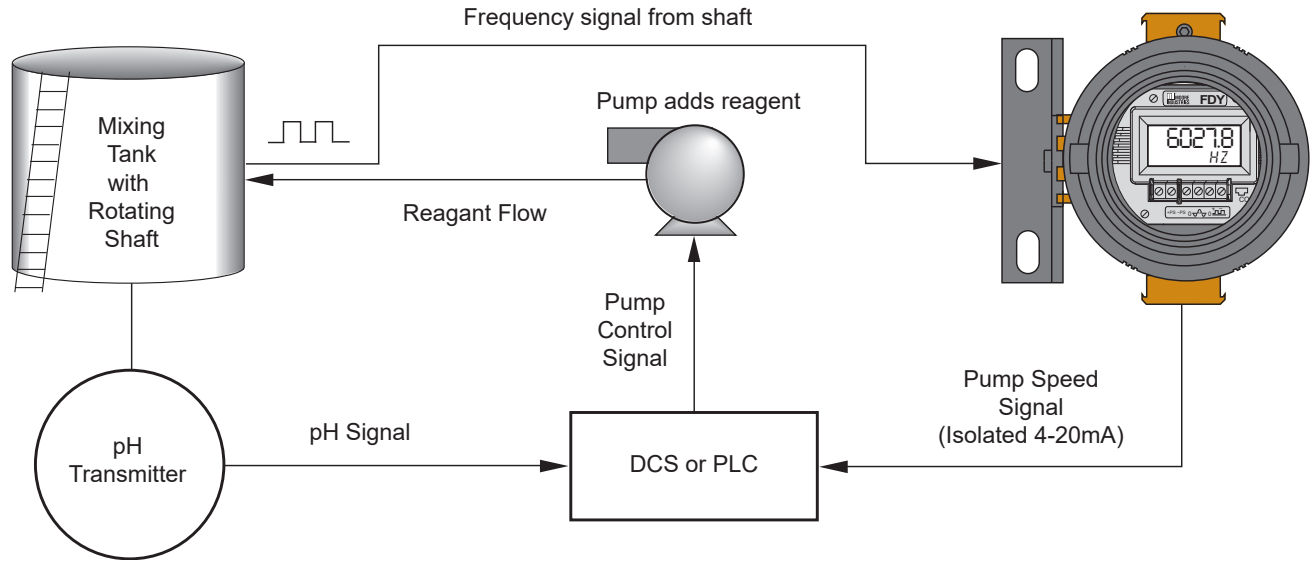


Measuring Volumetric Flow Based On Shaft Rotational Speed

Many processes require the periodic addition of precise amounts of a regeant or similar additives using a pump. Because there is a direct correlation between shaft rotation speed and the volume of product pumped, this strategy delivers a precise volume of additive for each revolution of the shaft.

In this application, the FDY is used to accurately measure the RPM of the shaft, and provide a 4-20mA signal directly proportional to volumetric flow (Figure 5). The flow information is used by the control system to provide on/off pump control.

Figure 5. *Precision feedback of pump shaft revolutions per minute (RPM) for monitoring additive volume*



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Measuring Weight per Minute of Product Transported on Conveyer Belts

The FDY accepts the input from a magnetic pickup sensor, turbine tachometer generator, dry contact closure, or other frequency sensor. It converts the input to a user scaleable 4-20mA signal proportional to belt speed. This is useful for measuring and transmitting information from conveyer belts.

Mining and Cement Industries

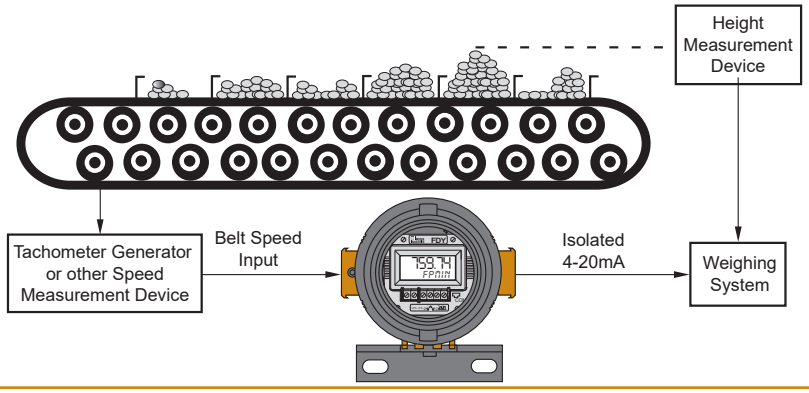
The mining and cement industries often use conveyer belts to transport bulk solids. The amount of the product being moved is related to its cross sectional area, (determined by measuring the average height on the belt across a known width), the weight of the material, and the speed of the belt. (Typically, a non-contact device is used to measure the average height and provide a 4-20mA signal.)

A weighing system accepts the analog inputs for height and speed and makes the calculations for weight per minute. Moore Industries' MDS I/O Equation Station may be used to provide this calculation functionality and then report the information to a monitoring system via 4-20mA signal, discrete status and/or MODBUS RTU data.

Paper Industry

In most paper production facilities, precision control of roller speeds is critical. Use the FDY to make a speed measurement using a frequency pickup on the roller shaft. Installed in Moore Industries' NEMA 4X (IP66) D-BOX enclosure or an explosion-proof BH enclosure, the FDY can be field-mounted in rugged and hazardous field environments.

Figure 6. *Used in conjunction with a weighing system, the FDY can be used for conveyer belt weight calculations*



Certifications: **FDY-HP**
(Approved for **PRG** Input Only; Not **10-250V** Input)

Factory Mutual Approvals (FM Global Group):
Intrinsically-Safe
Class I, II & III, Division 1,
Groups A, B, C, D, E, F & G
Class I, Zone 0, AEx ia IIC T4
Non-Incendive
Class I, Division 2, Groups A, B, C & D
Temperature Class T4 @ 60°C Ambient

Canadian Standards Association (CSA Group):
Intrinsically-Safe & Non-Incendive
Class I, Divisions 1 & 2, Groups A, B, C & D
Class II, Divisions 1 & 2, Groups E, F & G
Class III, Divisions 1 & 2

ATEX Directive 2014/34/EU (LCIE):
Intrinsically-Safe
Ex II 1 G EEx ia IIC T4

CE Conformant:
EMC Directive 2014/34/EU - EN 61326

Tamb = -40°C to +60°C

Certifications: **FDY-HP in BH/SB2 Housing**
(Approved for **PRG** Input Only; Not **10-250V** Input)

Factory Mutual Approvals (FM Global Group):
Explosion-Proof & Dust/Ignition-Proof
Class I, Division 1, Groups A*, B, C & D
Class II & III, Division 1, Groups E, F & G
Environmental Protection: NEMA 4X & IP66
T6 @ 60°C Maximum Operating Ambient
**For Group A applications, seal all conduits within 18"*

Canadian Standards Association (CSA Group):
Explosion-Proof
Class I, Division 1, Groups A*, B, C & D
Class II, III, Groups E, F & G
Type 4X, IP66
Ambient Temperature Range: -20°C to +60°C; T6
**For U.S. Group A applications, seal all conduits within 18"*

ATEX Directive 2014/30/EU (ISSeP):
Explosion-Proof/Flameproof
Ex II G Ex d IIC T6 Gb
Ex II D Ex tb IIIC Db T85°C IP66

ANZEx (TestSafe):
Explosion-Proof/Flameproof
Ex d IIC T6 (Tamb 60°C)

Specifications

Performance

Input Accuracy: See Tables 2-7
Output Accuracy: ±0.015% of span
Overall Accuracy: The overall accuracy of the unit is the combined input and output accuracies. It includes the combined effects of linearity, hysteresis, repeatability, and adjustment resolution. Does not include ambient temperature effect.
Input Hysteresis: See Tables 5-7
Input Threshold: See Tables 5-7
Stability: See Table 1
Minimum Frequency: Twice the lower range
Digital Input Filter: 3dB point is at 10kHz
Step Response Time: 300msec maximum, 200msec typical from the time an input is applied to the output reaching 90% of its final value + actual input
Rise Time: 100msec maximum for the output to change from 10% to 90% of its scale of an input step change of 0% to 100% + actual input
Isolation: 500Vrms between input, output, and case continuous, and will withstand a 500Vac dielectric strength test for one minute with no breakdown
Ripple: 10mV p-p measured across a 250 ohm resistor
Overcurrent Limiting: 25mA maximum
Maximum Voltages: 48Vdc output, maximum; DC input, 48Vdc, maximum; AC input, 30Vac maximum for 0.02-30AC model, 250Vac maximum for 10-250AC model
Input Impedance: >30kohms for DC and contact closure inputs; 2kohms for input >6V, 4kohms typical@50Hz and 56kohms typical@1kHz for input <6V for 0.02-30AC model; >125kohms for 10-250AC model
Load Capability: 508 ohms@24V

$$\frac{\text{Supply Voltage} - 12\text{V}}{0.0236\text{A}} = \text{Ohms}$$

Output Current Limiting: 3.8mA and 21.4mA for input under range and over range; 3.6mA and 23.6mA for input failure
Load Effect (current outputs): Negligible within specified power limits
Power Supply Effect: ±0.002% of span per 1V change
Startup Time: Performance within specification less than 1sec after power is applied for frequency higher than 100Hz and average of 8 samples
Damping: Adjustable from 0 to 30 seconds with PC software
Linearization: Configurable up to 128 points with PC software
Moving Average: Configurable up to 16 segments with PC software
Low Pass Filter: On/Off is software configurable

Display

Type: LCD; Top Row, 10.16mm (0.4 in) high black digits on a reflective background; Bottom Row, 5.72mm (0.225 in) high black digits on a reflective background
Display Update Rate: 100msec
Format: Top row is five alphanumeric characters, plus sign and decimal point; bottom is five alphanumeric characters
Range: -99999 to 99999
Minimum Display Span: 1.00

Ambient Conditions

Operating & Storage Range: -40°C to +85°C (-40°F to +185°F)
I.S. Operating Range: -40°C to +65°C (-40°F to +149°F)
Relative Humidity: 0-95%, non-condensing
Ambient Temperature Effect: Input to output, ±0.007% of span/°C maximum; Digital Accuracy, ±0.003% of span/°C maximum
RFI/EMI Immunity: 30V/m when tested according to SAMA 33.1 abc with 0.5% of span or less error; 20V/m@ 80-1000MHz, 1kHz AM, when tested according to IEC1000-4-3-1995
Noise Rejection: Common mode, 120dB typical@100mVp-p input

Weight

FDY HP: 227 grams (5.3 ounces)
FDY in BH housing with glass cover: 1451 grams (3 pounds, 12.4 ounces)
FDY in D-BOX housing: 811 grams (1 pound, 6.3 ounces)

Accesories

Each FDY order comes with one copy of our Intelligent PC Configuration Software (Windows® compatible) on CD.

To order additional software or cables:

Part Number	Part
750-75E05-01	Intelligent PC Configuration Software
804-030-26	Fuse Protected, Non-Isolated USB Communication Cable (required by ATEX for products installed in Intrinsically-Safe areas)
803-039-26	Isolated Configuration Cable (9-pin Serial Port)
803-040-26	Non-Isolated Configuration Cable (9-pin Serial Port)

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Table 1. *Stability for All Models**

		Input-to-Display (% of Reading)			Display-to-Output (% of Output Span**)		
		1 year	3 years	5 years	1 year	3 years	5 years
Frequency/Period		0.001	0.0017	0.0022	0.08	0.139	0.179
Pulse Width	1 Sec	0.001	0.0017	0.0022			
	0.1 Sec	0.0015	0.0026	0.0034			

*Combine Input-to-Display and Display-to-Output values to determine overall stability.
**Consult factory for improved long-term drift specifications.

NOTE:
AC indicates zero-crossing signal.
DC indicates non-zero crossing signal.

Table 2. *DC Input Accuracy and Minimum Amplitude*

Input Type	Input	Accuracy	Minimum Amplitude
Frequency	< 5kHz	0.01% ± 1 LSD	100 mV
	5kHz - 20kHz	0.05% ± 1 LSD	200 mV
	> 20kHz	0.10% ± 1 LSD	200 mV
Period	< 50µs	0.10% ± 1 LSD	200 mV
	50µs - 200µs	0.05% ± 1 LSD	200 mV
	> 200µs	0.01% ± 1 LSD	100 mV
Pulse Width	entire range	0.05% ± 1 LSD ± 2 µs	1 V
Contact Closure	entire range	0.01% ± 1 LSD	

Table 3. *AC Input Accuracy and Minimum Amplitude*

Input Type	Input	Accuracy	Minimum Amplitude
Frequency	< 10Hz	0.01% ± 1 LSD	20 mV
	10Hz - 5kHz	0.01% ± 1 LSD	200 mV
	5kHz - 20kHz	0.05% ± 1 LSD	200 mV
	> 20kHz	0.10% ± 1 LSD	1 V
Period	< 50µs	0.10% ± 1 LSD	1 V
	50µs - 200µs	0.05% ± 1 LSD	200 mV
	200µs - 100ms	0.01% ± 1 LSD	200 mV
	> 100ms	0.01% ± 1 LSD	20 mV

Table 4. *AC Input Accuracy and Minimum Amplitude For 10-250V Input Type*

Input Type	Input	Accuracy	Minimum Amplitude
Frequency	< 5kHz	0.01% ± 1 LSD	10V
	5kHz - 20kHz	0.05% ± 1 LSD	10V
	> 20kHz	0.10% ± 1 LSD	10V
Period	< 50µs	0.10% ± 1 LSD	10V
	50µs - 200µs	0.05% ± 1 LSD	10V
	> 200µs	0.01% ± 1 LSD	10V

Table 5. *Maximum Configurable Input Range And Minimum Span*

Input Type	Max Configurable Range	Min Span
Frequency	0 - 25kHz	See Table 9
Period	0 - 70s	500µsec
Pulse Width	0 - 70s	500µsec
Contact Closure	0 - 20Hz	0.1Hz

Table 6. *Frequency Input Parameters*

Input Range	Threshold Resolution	Threshold Range	Hysteresis Resolution	Hysteresis Range	Filter (3db Point)	Measured Frequency
100mV-30V (DC)	1mV	0.01-2.5V	1mV	0.01-1.5V	10kHz	0.02Hz to 25kHz
20mV-30V (AC)			1mV	0.002-0.15V	10kHz	0.5Hz to 25kHz
10V-250V(AC)			1mV	0.002-0.15V	10kHz	0.5Hz to 25kHz

Table 7. *Period Input Parameters*

Input Range	Threshold Resolution	Threshold Range	Hysteresis Resolution	Hysteresis Range	Filter (3db Point)	Measured Period
100mV-30V (DC)	1mV	0.01-2.5V	1mV	0.01-1.5V	10kHz	40µsec to 50sec
20mV-30V (AC)			1mV	0.002-0.15V	10kHz	40µsec to 2sec
10V-250V (AC)			1mV	0.002-0.15V	10kHz	40µsec to 2sec

Table 8. *Pulse Width Input Parameters*

Input Range	Threshold Resolution	Threshold Range	Hysteresis Resolution	Hysteresis Range	Filter (3db Point)	Measured Pulse Width
100mV-30V (DC)	1mV	0.01-2.5V	1mV	0.01-1.5V	10kHz	0.2msec to 50sec

Table 9. *Frequency Range Minimum Span*

Maximum Frequency Range	Minimum Span
10Hz	0.1Hz
5kHz	1Hz
25kHz	25Hz

Ordering Information

Unit	Input	Output	Power	Options	Housings
FDY PC-Programmable Frequency-to-DC Transmitter with Display	**PRG** Input Amplitudes Supported: 0.02-30Vac* 0.1-30Vdc* (Programmable with supplied configuration software, see Tables on Page 6 for details) **10-250V** (This Input Type Has No Hazardous Area Approvals) Input Amplitudes Supported: 10-250Vac* 0.1-30Vdc* (Programmable with supplied configuration software, see Tables on Page 6 for details) *AC indicates zero-crossing signal; DC indicates non-zero crossing signal	**4-20MA** User scaleable with supplied software	**12-42DC** Loop-Powered **12-30DC** for **-ISC, -ISF, -ISE**	**-FMEDA** Unit comes with Failure, Modes, Effects and Diagnostic Analysis (FMEDA) data for evaluating the instrument for suitability of use in a safety-related applicatrion **-ISC** CSA approved IS (PRG Input Only) **-ISF** FM approved IS (PRG Input Only) **-ISE** ATEX IS approved (PRG Input Only)	**BH2NG** (*) or (‡) Aluminum Explosion-Proof enclosure with two, ½-inch NPT entry ports and a glass cover **BH2TG** (*) or (‡) Aluminum Explosion-Proof enclosure with two, ¾-inch NPT entry ports and a glass cover **BH2MG** (*) or (‡) Aluminum Explosion-Proof enclosure with two, M20 x 1.5 entry ports and a glass cover **BH3NG** (*) or (‡) Aluminum Explosion-Proof enclosure with three, ½-inch NPT entry ports and a glass cover **BH3TG** (*) or (‡) Aluminum Explosion-Proof enclosure with two, ¾-inch NPT side-entry ports, one ½-inch NPT bottom-entry port, and a glass cover **BH3MG** (*) or (‡) Aluminum Explosion-Proof enclosure with two, M20 x 1.5 side-entry ports, one ½-inch NPT bottom-entry port, and a glass cover **SB2NG** (*) or (‡) 316 Stainless Steel 2-Hub, Explosion-Proof enclosure with two, ½-inch NPT entry ports and a glass cover **SB2MG** (*) or (‡) 316 Stainless Steel 2-Hub Explosion-Proof enclosure with two, M20 x 1.5 entry ports and a glass cover) **D1LC** 1-Hub, D-BOX housing with low base, clear cover, NEMA 4X (IP66) enclosure **D2LC** 2-Hub, D-BOX housing with low base, clear cover, NEMA 4X (IP66) enclosure **HP** Hockey-puck housing with spring clips for mounting in standard field enclosures **DN** Snap-in mounting for HP case on TS-32 DIN-rail **FL** Mounting flanges on HP suitable for relay track or surface-mounting **FLD** Mounting flanges on HP suitable for 3½" relay track mounting * Either **A** or **E** suffix (comes supplied with 2" pipe mount hardware) **A** suffix indicates ANZEx/TestSafe (Ex d) Flameproof approvals (i.e. BH2MG**A**) **E** suffix indicates ATEX (Ex d and tb) Flameproof approvals (i.e. BH2MG**E**) ‡ **P** suffix indicates enclosure comes equipped with base plate and U-bolts for mounting on a 2-inch pipe (i.e. BH2NG**P**) See BH, SB and D-BOX Datasheets for additional information.

When ordering, specify: Unit / Input / Output / Power / Options [Housing]
Model number example: FDY / PRG / 4-20MA / 12-42DC [BH2NGP]
Note: Only **PRG** Input Type Has Hazardous Area Approvals; No Approvals for **10-250V** Input.

Figure 7. *FDY Dimensions (Unit with FL Mounting Flanges Shown)*

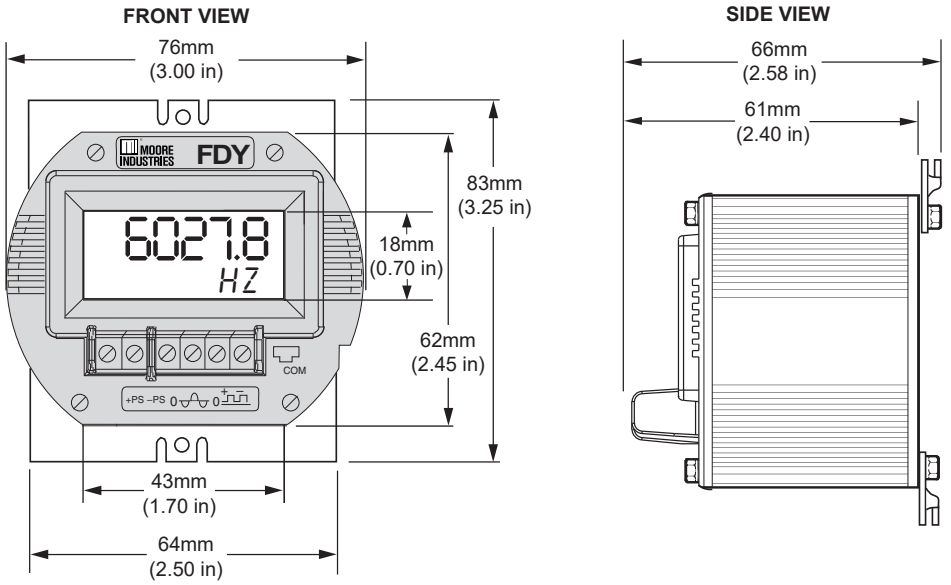

Figure 8. *BH Enclosure Dimensions*

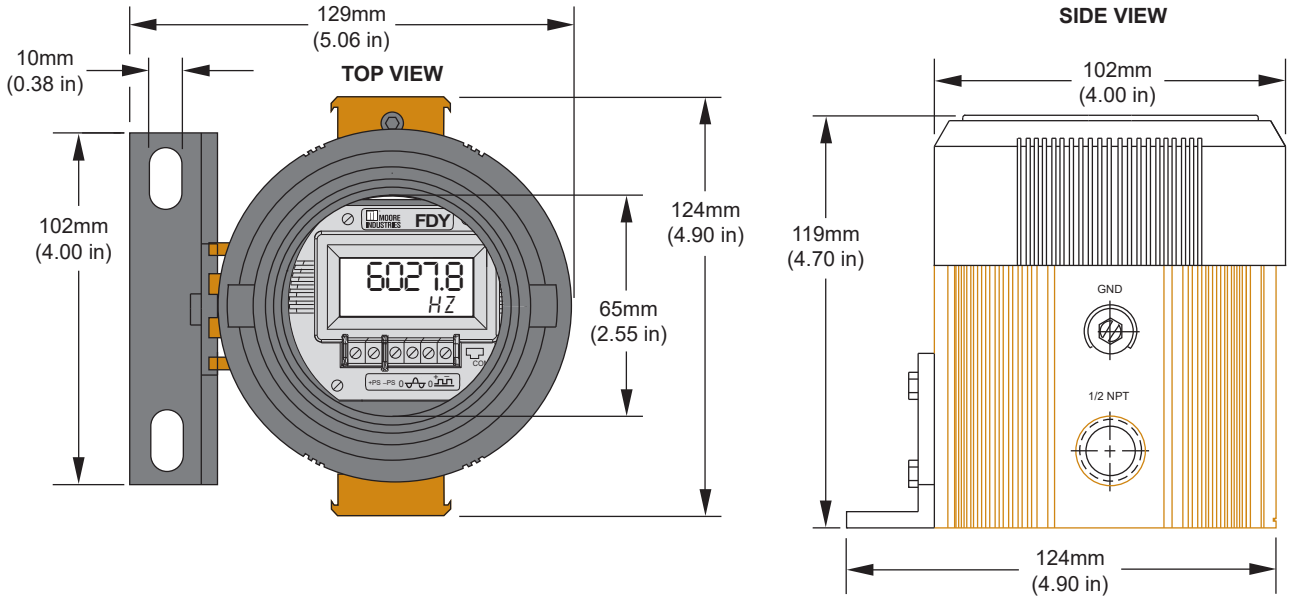

Figure 9. *D-BOX Enclosure Dimensions*