

Installation Instructions for the Honeywell Zephyr™ Digital Aiflow Sensors HAF Series—High Accuracy, 10 SLPM, 15 SLPM, 20 SLPM, 50 SLPM, 100 SLPM, 200 SLPM or 300 SLPM

50080060
Rev. B

GENERAL INFORMATION

CAUTION

IMPROPER USE

Do not use these products to sense liquid flow.

Failure to comply with these instructions may result in product damage.

CAUTION

PRODUCT DAMAGE

Do not disassemble these products.

Failure to comply with these instructions may result in product damage.

CAUTION

IMPROPER CLEANING

- Avoid cleaning the sensor; however, if it must be cleaned, use isopropyl alcohol and dry the device thoroughly before use. Cap the ports or connect housing to the ports before cleaning the sensor with alcohol. Using alcohol may remove the text on the sensor label; however, the label ID is hard-coded inside the sensor.
- Do not use III Tri-chloroethane, methylene chloride, methyl pyrrolidone, or any oxidizing type acids such as formic acid.
- Do not use ultrasonic cleaning.

Failure to comply with these instructions may result in product damage.

Table 1. Compatible Gases

Gas	Calibration Type
Dry air	standard
Helium (He)	optimized calibration available
Argon (Ar)	
Nitrogen (N ₂)	
Nitrous oxide (N ₂ O)	
Carbon dioxide (CO ₂)	
Oxygen (O ₂)	See the Technical Note “Gas Media Compatibility and Correction Factors”.
80/20 He/O ₂ Mix	
Methane (CH ₄)	
Xenon (Xe)	

Table 2. Materials Specifications

Characteristic	Parameter
Wetted materials	glass reinforced (GR) thermoplastic polymer, gold, silicon, silicon dioxide, silicon nitride, epoxy, PCB epoxy composite
Housing	GR thermoplastic polymer
Substrate	PCB
Adhesives	epoxy
Electronic components	silicon, gold
Compliance	RoHS, WEEE

Table 3. Absolute Maximum Ratings¹

Characteristic	Parameter
Supply voltage	-0.3 Vdc to 11.0 Vdc
Voltage on digital I/O output pins	-0.3 Vdc to 3.0 Vdc ²
Storage temperature range	-40 °C to 100 °C [-40 °F to 212 °F]
Maximum flow change	10,000 SLPM/s
Maximum common mode pressure	60 psi at 25 °C [77 °F]
Maximum flow	350 SLPM

¹Absolute maximum ratings are the extreme limits that the device will withstand without damage to the device. However, the electrical and mechanical characteristics are not guaranteed as the maximum limits (above recommended operating conditions) are approached, nor will the device necessarily operate at absolute maximum ratings.

²Digital I/O pins are diode protected at this voltage up to 2 mA. Digital bus voltage may exceed this value if the maximum digital bus current is limited to 2 mA or less. The maximum bus current is generally determined by the bus pull-up resistors

Table 4. Environmental Specifications

Characteristic	Parameter
Humidity	0% to 95% RH, non-condensing
Shock	30 g, 6 ms
Vibration	1.33 g at 10 Hz to 500 Hz
ESD	ESD IEC6100-4-2 air discharge up to 8 kV, or direct contact discharge up to 4 kV
Radiated immunity: test conditions for ≥20 SLPM test conditions for ≤20 SLPM	Level 3 from 80 MHz to 1000 MHz per IEC61000-4-3 1 meter shielded cable with 3 cm exposed leads at connector 1 meter shielded cable with 3 cm exposed leads at connector and 280 Ohm at 1 MHz ferrite bead

Table 5. Recommended Mounting and Implementation

Characteristic	Parameter
Mounting screw size	10-32
Mounting screw torque	1,13 N m [20 in-lb]
Electrical connection	6 pin SIP connector
Pneumatic connection	manifold mount, 22 mm OD tapered male fitting, G 3/8 female threaded fitting

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Table 6. Operating Specifications

Characteristic	Parameter
Supply voltage	3 Vdc to 10 Vdc
Supply current	20 mA max.
Power: 3 Vdc 10 Vdc	60 mW max. 200 mW max.
Calibrated temperature range ¹	0 °C to 50 °C [32 °F to 122 °F]
Operating temperature range	-20 °C to 70 °C [-4 °F to 158 °F]
Full scale (FS) flow ²	10 SLPM, 15 SLPM, 20 SLPM, 50 SLPM, 100 SLPM, 200 SLPM, 300 SLPM
Calibrated flow range	0 to 10 SLPM, 0 to 15 SLPM, 0 to 20 SLPM, 0 to 50 SLPM, 0 to 100 SLPM, 0 to 200 SLPM, 0 to 300 SLPM
Calibration gas ³	clean, dry air
Accuracy ⁴ 0 SLPM, 15 SLPM, 20 SLPM, 50 SLPM, 100 SLPM, 200 SLPM: 0 %FS to 14.3 %FS 14.3 %FS to 100 %FS 300 SLPM only: 0 %FS to 14.3 %FS (0 SLPM to 43 SLPM) 14.6 %FS to 100 %FS (44 SLPM to 300 SLPM)	0.5% FS 3.5% reading 0.5% FS 3.5% reading
Total Error Band: ⁵ 0 SLPM, 15 SLPM, 20 SLPM, 50 SLPM, 100 SLPM, 200 SLPM: 0 %FS to 12.5 %FS 12.5 %FS to 100 %FS 300 SLPM only: 0 %FS to 14.3 %FS (0 SLPM to 43 SLPM) 14.6 %FS to 66.3 %FS (44 SLPM to 199 SLPM) 66.6 %FS to 100 %FS (200 SLPM to 300 SLPM)	0.5% FS 4.0% reading 0.5% FS 4.0% reading 7.0% reading
Null accuracy ⁶	±0.5 %FS
Flow response time ⁷	1 ms
Warm up time ⁸	35 ms
Resolution: 10 SLPM 15 SLPM 20 SLPM 50 SLPM 100 SLPM 200 SLPM 300 SLPM	0.002 SLPM 0.003 SLPM 0.003 SLPM 0.008 SLPM 0.015 SLPM 0.020 SLPM 0.030 SLPM
Bus standards ⁹	I ² C fast mode (up to 400 kHz)
Proof pressure	150 psig
Reverse polarity protection	no

¹Custom and extended temperature compensated ranges are possible. Contact Honeywell for details.

²Honeywell standard for mass flow rate units is SLPM, which has reference conditions of 0 °C and 1 atm. Custom units are given as LPM with listed reference conditions at the first mention.

³Contact Honeywell for requirements with other custom gases for calibration. See the Technical Note “Gas Media Compatibility and Correction Factors”.

⁴Accuracy is the maximum deviation in output from nominal over the entire calibrated flow range at 25 °C. Errors include Offset, Full Scale Span, Linearity, Flow Hysteresis, and Repeatability. (See Figures 1 and 5.)

⁵Total Error Band (TEB) is the maximum deviation in output from nominal over the entire calibrated flow range and temperature range. Total Error Band includes all Accuracy errors, as well as all temperature effects over the compensated temperature range, including Temperature Offset, Temperature Span and Thermal Hysteresis. (See Figures 1 and 5.)

⁶Null Accuracy is the maximum deviation in output from nominal at null flow over the entire calibrated temperature range.

⁷Response time: time to electrically respond to any mass flow change at the microbridge airflow transducer (response time of the transducer may be affected by the pneumatic interface).

⁸Warm-up time: time to the first valid flow measurement after power is applied.

⁹Refer to the Technical Note “I²C Communications with Honeywell Digital Airflow Sensors” for I²C protocol information.

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Figure 1. Accuracy and Total Error Band

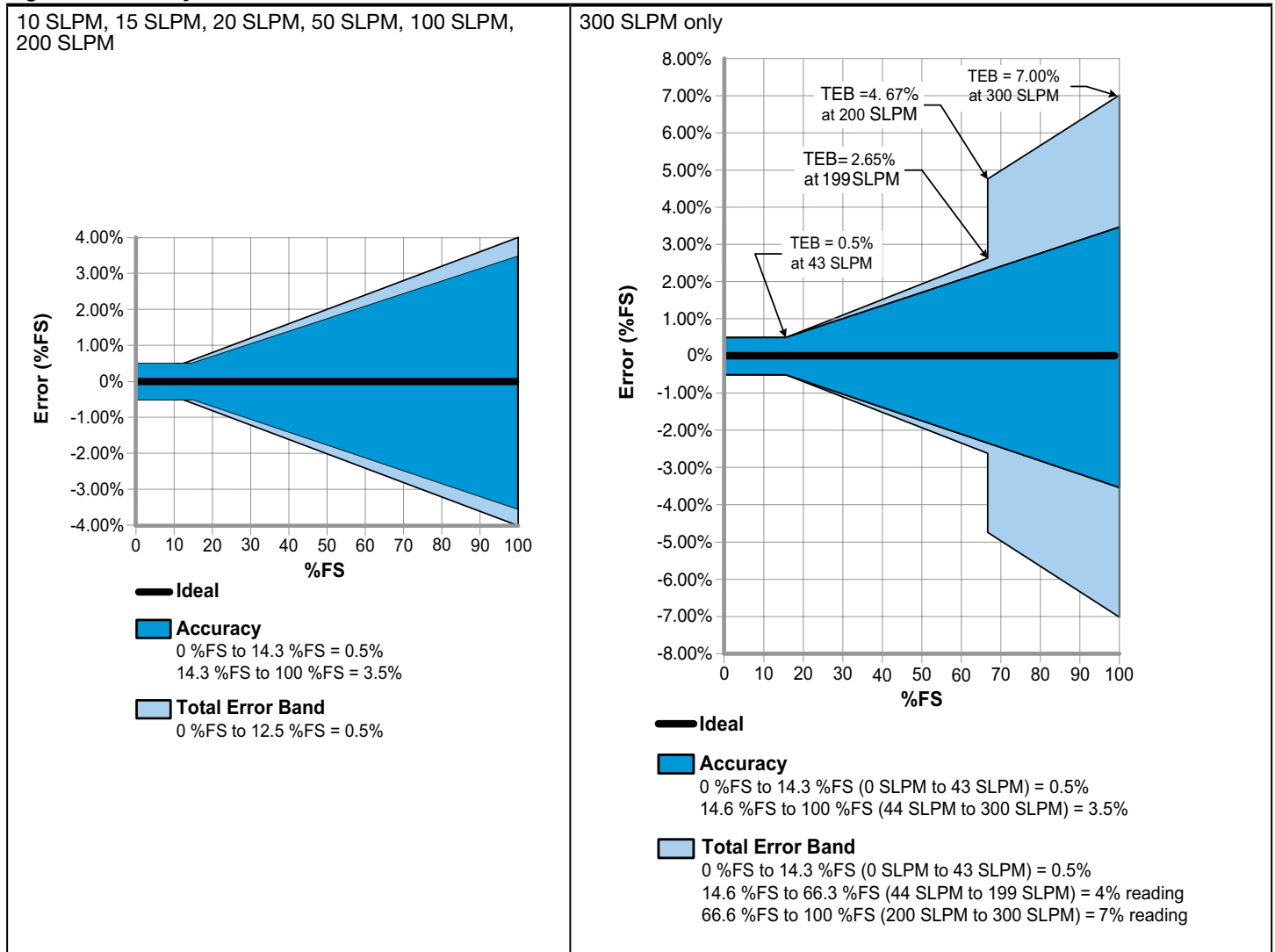


Table 7. Ideal Transfer Function

Item	Equation
Digital Output Code	$16384 * [0.1 + 0.8 * (\text{Flow Applied}/\text{Full Scale Flow})]$
Flow Applied	$\text{Full Scale Flow} * [(\text{Digital Output Code}/16384) - 0.1]/0.8$

Digital Interface

For additional details on the use of Zephyr with digital output see the Technical Note “I2C Communications with Honeywell Digital Airflow Sensors”.

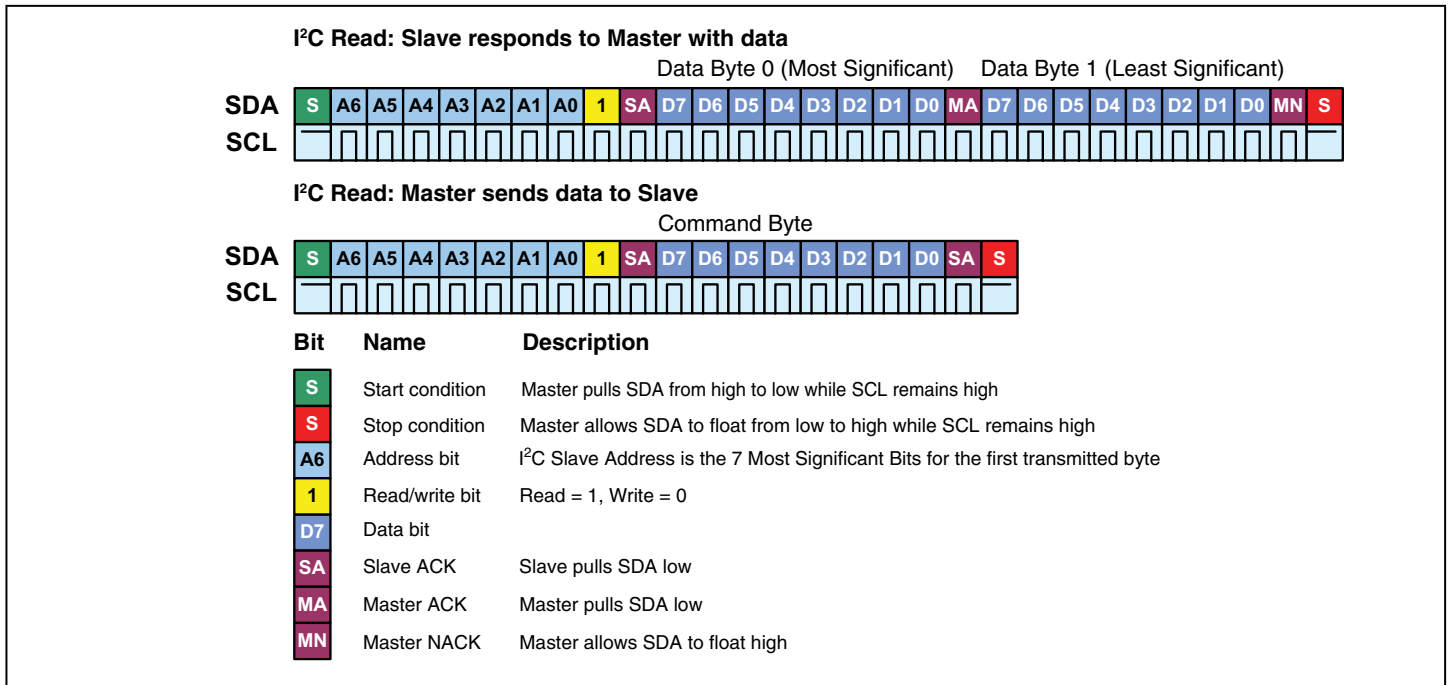
The sensor uses the I²C standard for digital communication with a slave address specified in the Nomenclature and Order Guide in Figure 2. Following sensor power-up, each of the first two read sequences shown in Figure 7 will respond with 2 bytes of the unique 4-byte Serial Number. The first read after power-up will respond with the two most significant bytes of the Serial Number, while the second read will respond with the two least significant bytes of the Serial Number. For reliable performance, allow sensor to be powered for the sensor startup time before performing the first read, then allow a 10 ms command response time before performing the second read.

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Figure 2. Sensor I²C Read and Write Sequences



After the power-up read sequence described above, the sensor will respond to each I²C read request with a 16-bit (2 byte) digital flow reading. Read requests taken faster than the Response Time (1 ms) are not guaranteed to return fresh data. The first two bits of each flow reading will be '00', while non-flow responses (such as error and status codes) will begin with '11'. There are several user commands available as shown in Table 9. Following an I²C write sequence of a user command, the sensor will respond to the next I²C read request with a 16-bit response. Possible responses to user commands can be seen in Table 10.

Table 9. User Command Descriptions

Command Byte (Hexadecimal)	Command Name	Command Description	Command Response Time (Max.)
0x01	GetSerialNumber	Next two read requests will each return two bytes of the sensor's unique 4-byte Serial Number.	10 ms
0x02	PowerOnReset	Force Power-On reset of sensor microcontroller.	20 ms
0x03	Checksum	Calculates EEPROM Checksum and compares to production Checksum value. If the values match, the next read request will respond with 0xCCA5. Otherwise, the next read will respond with 0xCC90.	1 s

Table 10. Sensor Response Descriptions

Sensor Response (Hexadecimal)	Response Name	Response Description
0xCCA5	POSACK	non-response command was executed successfully
0xCC99	BadCommand	command byte was not recognized
0xCC9A	BadParam	command sent with incorrect parameter bytes
0xCC9B	Failure	command failed during execution
0xCC90	BadChecksum	checksum did not match stored value
0xCCBB	Busy	sensor is busy calculating the checksum value

The maximum sink current on SCL or SDA is 2 mA. Therefore, if the pull-up resistors are biased by VDD, and if VDD reaches the maximum supply voltage of 6 V, then the pull-up resistors for SCL and SDA must be greater than 3.0 kΩ to limit the sink current to 2 mA. The typical value for SCL and SDA pull-up resistors is 4.7 kΩ (this value depends on the bus capacitance and the bus speed).

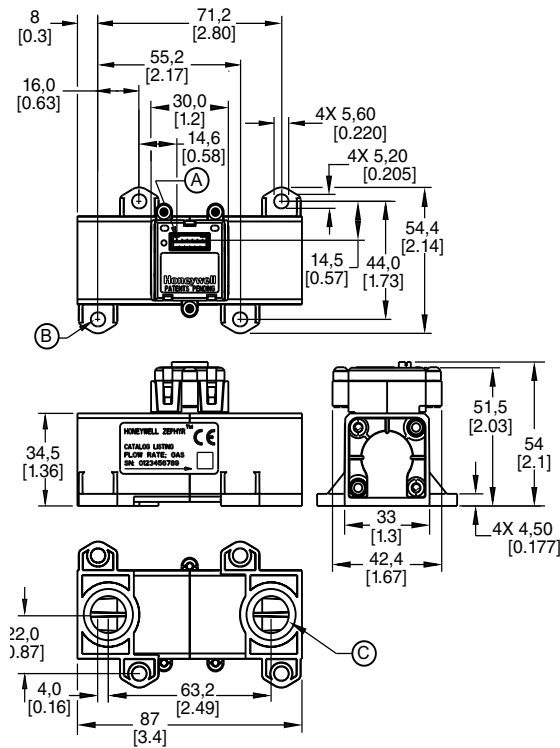
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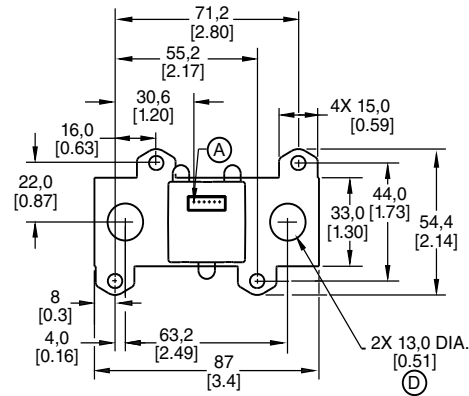
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Figure 3. Mounting Dimensions (For reference only: mm [in.])

Port Style: Manifold Mount

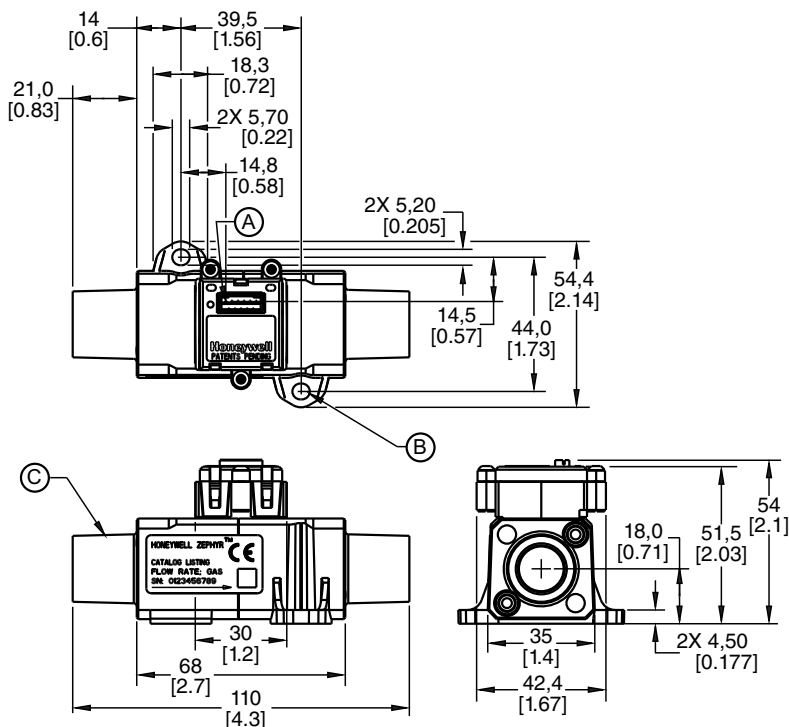


Mounting Footprint

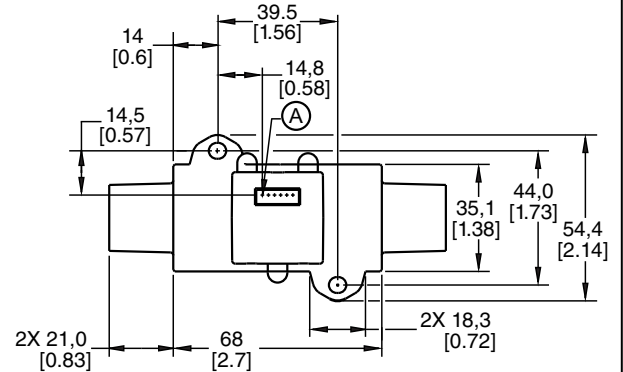


- (A) Pin 1.
- (B) 4X 10-32 pan head screws 1,13 N m [20 in-lb] torque.
- (C) 2X Gland for O-Ring AS568-113, 13,94 mm ID x 2,62 mm [0.549 in ID x 0.103 in W. Two O-rings, AS568A-113 Durometer A65 to A80 Silicon or Viton, are required to seal sensor to manifold. O-rings are not included.
- (D) Flow channel.

Port Style: 22 mm OD Tapered Male Fitting per ISO 5356



Mounting Footprint



- (A) Pin 1.
- (B) 2X 10-32 pan head screws 1,13 N m [20 in-lb] torque.
- (C) 15 mm ID/22 mm OD tapered fitting per ISO 5356.

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Figure 3. Mounting Dimensions (For reference only: mm [in], continued.)

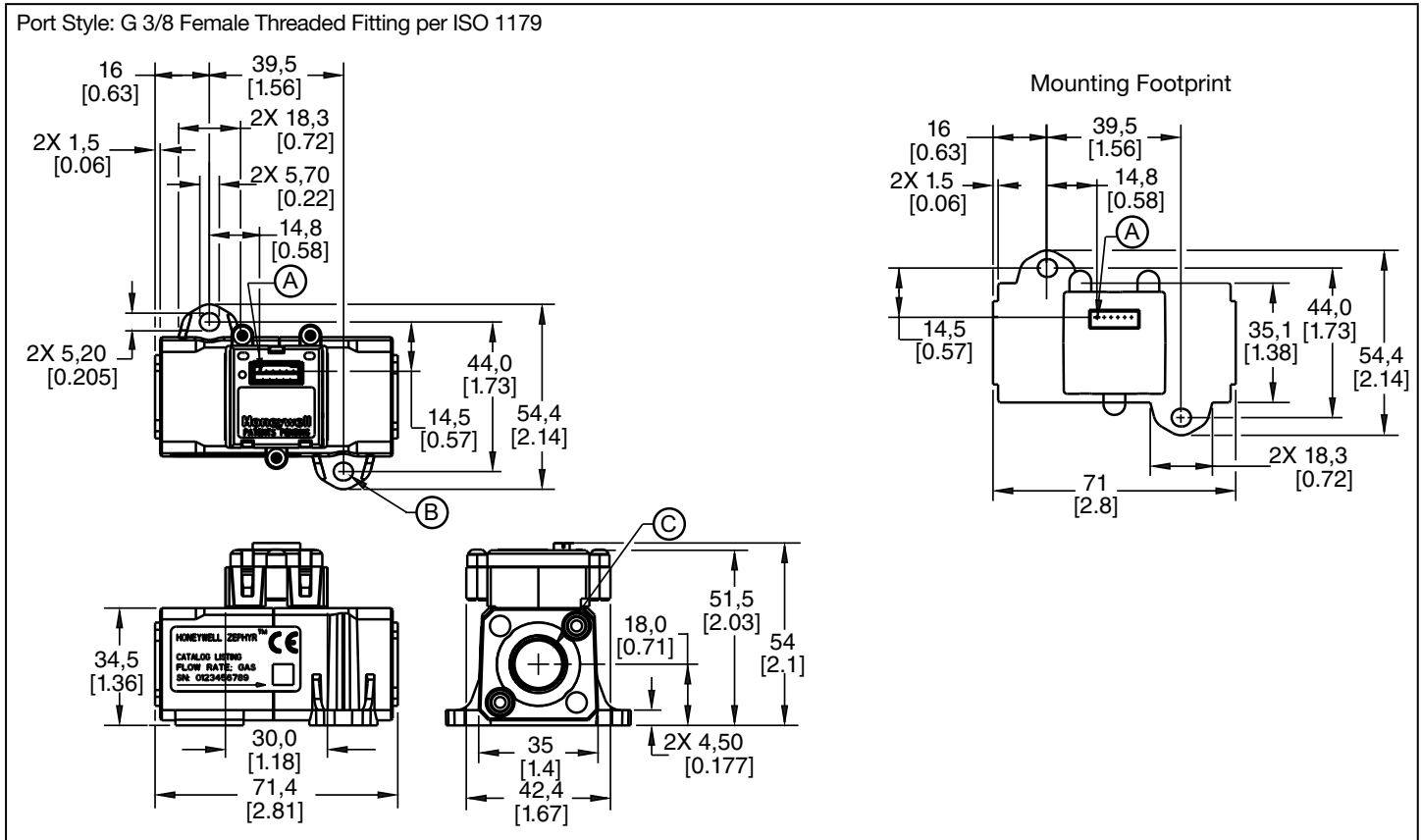


Table 11. Pinout (Digital Function)

Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
NC	SCL	VDD	ground	SDA	NC

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WARNING

PERSONAL INJURY

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

WARRANTY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

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