

CALIBRATED INTRASENSE

1-FRENCH WIRE-CONNECTED PRESSURE SENSOR

Description

The IntraSense series are absolute pressure sensors designed to fit into a 1-French hypo tube. The sensor comes pre-attached to cabling, simplifying the connection for the end user. The fully encapsulated electronics allow the device to be easily integrated. This sensor compares pressure in vivo to an onboard vacuum cavity for reference to an absolute standard. It delivers accurate and stable pressure for acute procedures in the clinically useful range of -300 mmHg to +500 mmHg (460 mmHg to 1260 mmHg absolute) and from 10°C to 60°C. The output is stable in 37°C liquid, and every part is calibrated and tested in DI water.

These devices are delivered with an attached PCB with a 5-pin right angle header offering fully temperature-compensated output, with both digital and amplified analog noise-filtered outputs.

Features

- Miniature sized sensor: 750 μm \times 220 μm \times 75 μm .
- Fits within 1-French catheter tubes.
- Typical drift <2 mmHg over the lifetime
- PCB with a 5-pin connector on the proximal end
- Fully temperature-compensated digital and amplified analog outputs.
- RoHS and REACH Compliant.
- Biocompatible Materials

Applications

- Embolization.
- Thermodilution.
- Intracranial Pressure.
- Compartment Syndrome.
- Atrial Ablation.
- Microvascular Obstruction.
- Fractional Flow Reserve (FFR).
- Endourology.
- Atherectomy.
- Animal Testing.
- Reproductive Health.
- Glaucoma.
- Resuscitative Balloon Occlusion of the Aorta.
- Endoscopy.
- Aortic Control.
- Cochlear Implant.

NOTE: The device manufacturer is responsible for determining suitability for use in their specific equipment.

Absolute Maximum Ratings^{(a), (b)}

All parameters are specified for sensors in 37°C DI water, 3.3 V or 5.0 V supply and 20°C back-end electronics, unless otherwise noted. Clinical pressure is defined as having a zero point at 760 mmHg above absolute vacuum. Values are for devices without gel or other added encapsulant.

Characteristic	Symbol	Medium	Min	Max	Units
DC Excitation Voltage	V _{SUPPLY}	N/A	-0.3	6.0	V
Storage Temperature ^(c)	T _{STG}	Air	-25	70	°C
Processing Temperature ^(d)	T _{PROC}	Air	-	135	°C
ESD Rating: Standard Device ^(e)	V _{ESD}	Air	N/A	2	kV
Operating Pressure ^(f)	P _A	Water	-400	600	mmHg clinical
Proof Pressure ^(g)	P _{PROOF}	Air or Water	-400	4000	mmHg clinical
Brust Pressure ^(h)	P _{BRUST}	Air or Water	0	4000	mmHg clinical
Service Life	T _{LIFE}	41 °C Water	N/A	24	Hours
Bend Radius	R _{BEND}	Air	1.7	N/A	mm
Trifilar Tensile Strength ⁽ⁱ⁾ , Distal	TS	Air	55	N/A	grams
Trifilar Tensile Strength ⁽ⁱ⁾ , Proximal	TS	Air	60	N/A	grams

Notes:

- (a) Beyond these limits, the device may suffer permanent damage.
- (b) Limits established during PV testing; tested per BP22 and/or ISO 60601 whenever applicable.
- (c) The minimum temperature the device can withstand in liquid is just above the freezing temperature of the liquid or -25°C, whichever is higher.
- (d) At the distal end of the device, wire insulation, and epoxy are rated up to 135°C and can withstand 135°C in the air for short duration operations (<10 min). This does not include the shipping method (spool) and shipment packaging.
- (e) Human body model.
- (f) The minimum pressure the device can withstand in liquid is the vapor pressure (boiling point) of the liquid, which is a function of temperature.
- (g) Pressure excursions above this pressure could result in loss of performance upon returning to the operating pressure range.
- (h) The device could fail catastrophically above these pressures, generating fragments.
- (i) Force required to break wires from the sensor when pulled parallel to the long axis of the sensor.
- (j) Force required to break wires from the PCB when pulled parallel to the top surface of the PCB and in the direction of the wire length.

Recommended Operating Conditions

The recommended operating conditions must not be exceeded in order to ensure the proper functionality of the device. Operating ranges assume use in water unless otherwise specified.

Description	Symbol	Min	Typ	Max	Units
Supply Voltage	V _{DD}	4.75	5.0	5.25	V
		3.0	3.3	3.6	
Operating Pressure Range	P _{RANGE}	-300	-	500	mmHg clinical
Distal End Operating Temperature	T _{OP}	10	-	60	°C
Proximal End (PCBA) Operating Temperature	T _{OP_PROX}	15	-	40	°C
Compatible Media	Suitability for use in vivo must be confirmed by the end user				
Compatible Sterilization Method	Ethylene Oxide gas				

Operating Characteristics – Specification.

All parameters are specified for sensors in 37°C DI water, 3.3 V or 5.0 V supply and 20°C back-end electronics. All values assume 100 cm trifilar length. Clinical pressure is defined as 0 = 760 mmHg above absolute vacuum. Values were established for SMI-1B variant, without gel or other added encapsulant.

Characteristic	Symbol	Min	Typ	Max	Units	
Low Level Output Voltage at Digital I/O, 3.3 V supply	V _{IN,I2C,LO}	-	-	0.3	V	
Low Level Output Voltage at Digital I/O, 5.0 V supply		-	-	0.5		
High Level Output Voltage at Digital I/O, 3.3 V supply	V _{IN,I2C,HI}	2.7	-	-		
High Level Output Voltage at Digital I/O, 5.0 V supply		4.25	-	-		
Current Consumption	I _{VDD(AO)}	-	7.5	-	mA	
Digital Pressure Output @ -300 mmHg	D _{OUT_MIN}	-	-26214	-	Counts	
Digital Pressure Output @ 500 mmHg	D _{OUT_MAX}	-	26214	-	Counts	
Digital Full-Scale Span	DFS	-	52428	-	Counts	
Digital Pressure Resolution ^(a)	-	-	-	16	Bit	
Digital Output Accuracy ^(b)	DACC	-8	±2	8	mmHg	
Analog Pressure Output @ -300 mmHg	A _{OUT_MIN}	-	10	-	%V _{DD}	
Analog Pressure Output @ 500 mmHg	A _{OUT_MAX}	-	90	-	%V _{DD}	
Analog Full-Scale Span	AFS	-	80	-	%V _{DD}	
Analog Output Accuracy ^(b)	AACC	-12	-	12	mmHg	
Light Sensitivity ^(c)	Standard (SMI-1A)	S _{LIGHT}	-	25	-	mmHg
	Light Shielded (SMI-1B)		-	10	-	mmHg

Notes:

- (a) Analog output is converted from 16-bit digital output.
- (b) This specification includes the combination of offset, sensitivity, linearity, and hysteresis errors over full ranges of pressure, temperature, and supply voltage.
- (c) Determined per ANSI/AAMI BP22 testing.

Digital Output

This section is a reference for a possible coding method to achieve pressure and status for IntraSense part readings using I²C. For more general information on how to interface using the I²C protocol please refer to Application Note 40AN7000. IntraSense devices have been calibrated with a 3.3 V or 5.0 V supply voltage, which should also be used during readout.

- The default I²C slave address is 0x6C HEX.
- The default ADC sample rate is 2 kHz.

For additional questions, please consult [TE Connectivity](#).

Sensor Transfer Function

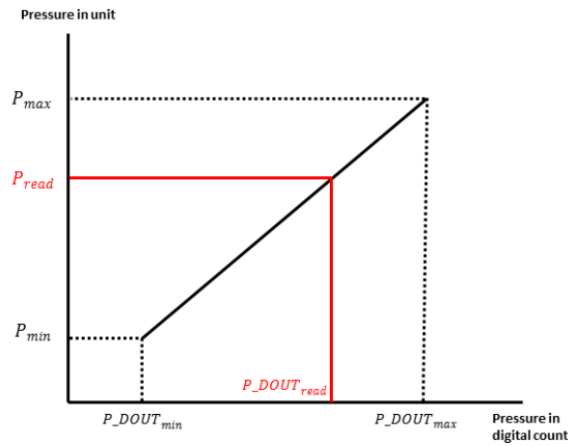
$$P_{read} = P_{min} + \frac{P_{DOUT_{read}} - P_{DOUT_{min}}}{P_{DOUT_{max}} - P_{DOUT_{min}}} (P_{max} - P_{min})$$

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P_{min} and P_{max} are **460 mmHg** and **1260 mmHg** absolute, respectively (-300 mmHg and +500 mmHg, clinical respectively).

$P_{DOUT_{min}}$ and $P_{DOUT_{max}}$ are **-26214** and **+26214**, respectively.

$P_{DOUT_{read}}$ is the digital reading from the output and P_{read} is the converted pressure output based on $P_{DOUT_{read}}$.



For example, the P_{min} and P_{max} for the sensor are specified as -300 and +500 clinical mmHg. The D_{OUT_MIN} and D_{OUT_MAX} are -26214 and +26214.

Interface Timing Parameters – I²C Interface

Description	Symbol	Min	Typ	Max	Units
I ² C Clock Frequency ¹⁾	f _{CLK}			400	KHz
I ² C Clock low time ¹⁾	t _{LO}	1300			ns
I ² C Clock high Time ¹⁾	t _{HI}	800			ns
I ² C Setup time for repeated start condition hold time	t _{SH}	600			ns
I ² C Data setup time	t _{SU}	100			ns
I ² C Data hold time	t _H	0			ns
I ² C repeated START setup time	t _{RSU}	600			ns
I ² C stop condition setup time ¹⁾	t _{PSU}	600			ns
I ² C rise time ¹⁾	t _R			300	ns
I ² C fall time	t _F			300	ns
I ² C bus free time between STOP and START conditions	t _{BUF}	600			ns
Low output voltage SDA pin	V _{LO}			10	%VDD
High output voltage SDA pin	V _{HI}	85			%VDD

Notes:

¹⁾ This specification includes the combination of offset, sensitivity, linearity, and hysteresis errors over full ranges of pressure, I²C.

Amplified Analog Output

For more general information on how to interface using the I²C protocol please refer to Application Note 40AN7000. IntraSense devices have been calibrated with a 3.3 V or 5.0 V supply voltage, which should also be used during readout. EXAMPLE 1:

If the supply voltage is 3.3 V and the readout is 1.75V, then the clinical pressure is calculated as follows:

$$\text{Output at } P_{MIN} = (3.3 V \times 0.1)P_{MIN}; P_{MIN} = -300 \text{ mmHg}$$

$$\text{Output at } P_{MAX} = (3.3 V \times 0.9)P_{MIN}; P_{MIN} = 500 \text{ mmHg}$$

$$\text{Slope pf this line is } \frac{(500 - (-300))}{((0.9 \times 3.3) - (0.1 \times 3.3))} = 303.03 \text{ mmHg/V. Intercept of this line is } -400.$$

$$\text{Pressure at } 1.75 V = (1.75 \times 303.03) - 400 = 130 \text{ mmHg}$$

EXAMPLE 2:

If the supply voltage is 5.0 V and the readout is 0.8 V, then the clinical pressure is calculated as follows:

$$\text{Output at } P_{MIN} = (5.0 V \times 0.1)P_{MIN}; P_{MIN} = -300 \text{ mmHg}$$

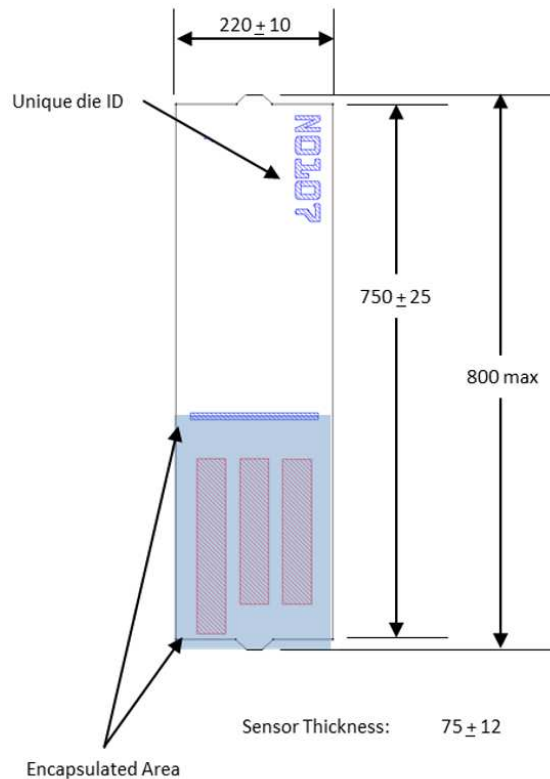
$$\text{Output at } P_{MAX} = (5.0 V \times 0.9)P_{MIN}; P_{MIN} = 500 \text{ mmHg}$$

$$\text{Slope pf this line is } \frac{(500 - (-300))}{((0.9 \times 5.0) - (0.1 \times 5.0))} = 200 \text{ mmHg/V. Intercept of this line is } -400.$$

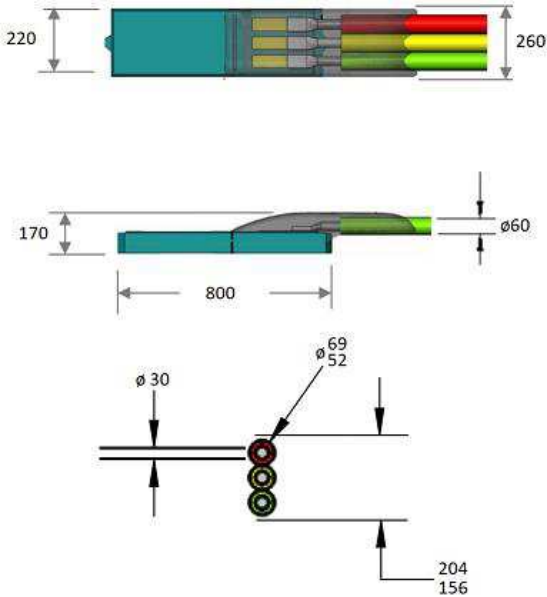
$$\text{Pressure at } 0.8 V = (0.8 \times 200) - 400 = -240 \text{ mmHg}$$

Diagram and Dimensions

Sensor Die (microns)



Assembled Sensor Die (microns)

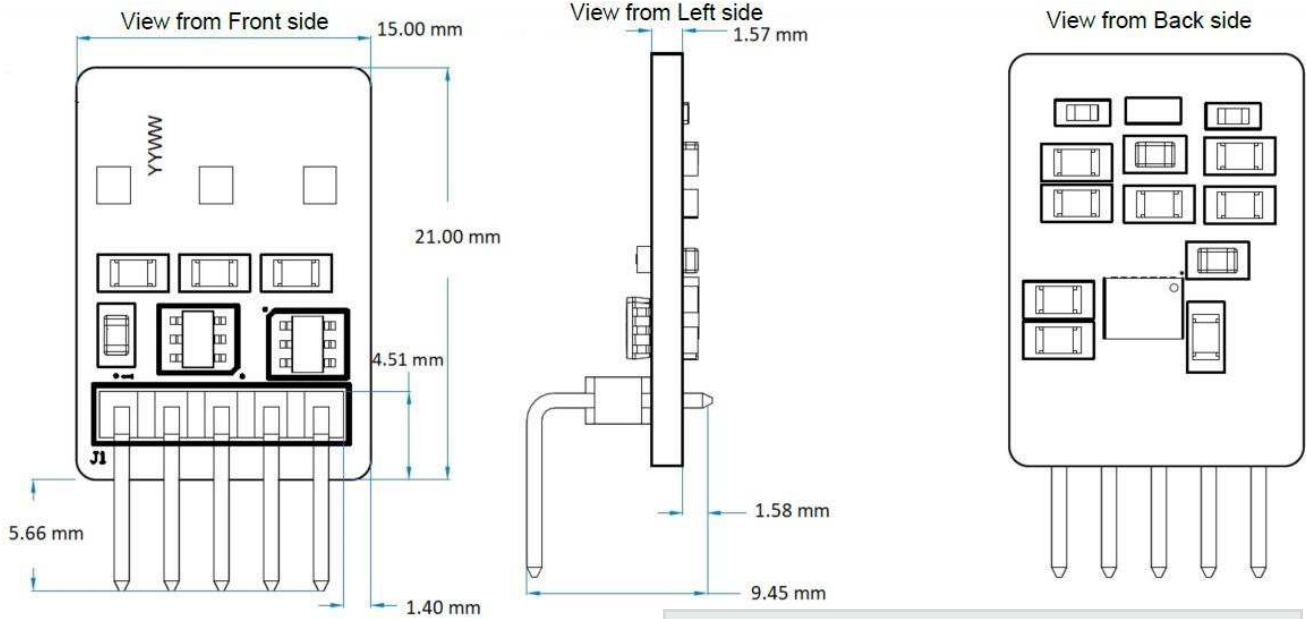


Wire Description		
Wire Color	Soldered Pin	Signal
Green	BP1	V _{SUPPLY}
Yellow	BP2	V _{SIG+}
Red	BP3	V _{SIG-}

Typical wire length tolerance:

- ±1 cm typical up to 100 cm.
- ±1% typical of wire length cm for 100 cm or longer.

Proximal End Dimensions



Pin Description		
Number	Name	Description
1	V _{DD}	Supply Voltage
2	GND	Ground
3	AODO	V _{OUT}
4	SCL	I ² C Clock Input
5	SDA	I ² C Serial Data In/Out

Recommended External Components

External I ² C Pull-Up Resistors		
Characteristic	Value	Unit
Resistor x2	4.7	kΩ

One Resistor is used for SCL and a second one for SDA external buses.

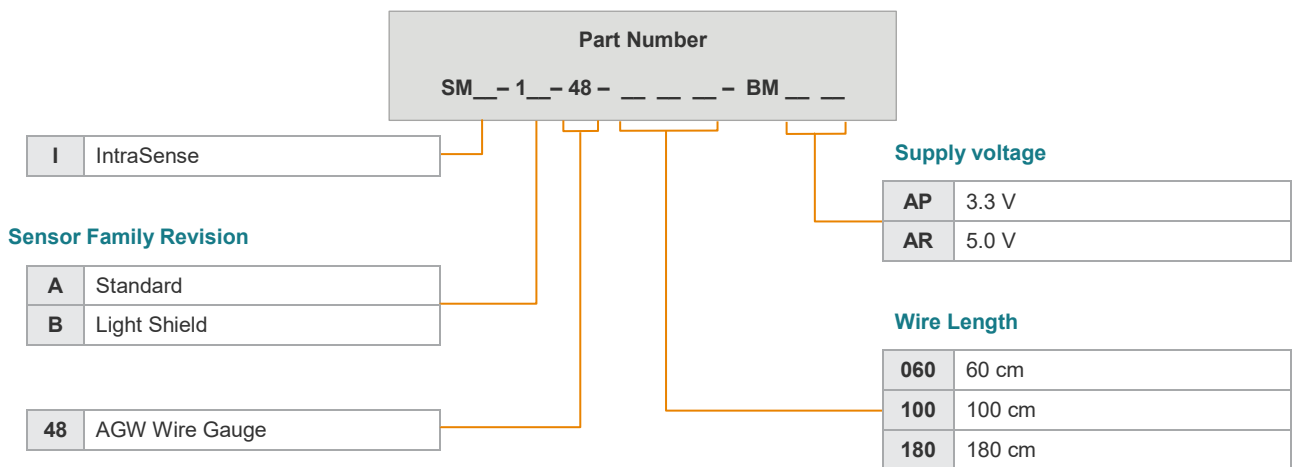
Ordering Information (Standard Configurations).

Part Number	Pressure Range (mmHg)	Compensated Temperature Range (°C)	Supply Voltage (V)	Design Feature
SMI-1A-48-060-BMAP	-300 to +500	10 to 60	3.3	60 cm Cable, standard sensor
SMI-1A-48-100-BMAP				100 cm Cable, standard sensor
SMI-1A-48-180-BMAP				180 cm Cable, standard sensor
SMI-1B-48-060-BMAP				60 cm Cable, light shielded sensor
SMI-1B-48-100-BMAP				100 cm Cable, light shielded sensor
SMI-1B-48-180-BMAP				180 cm Cable, light shielded sensor
SMI-1A-48-060-BMAR			5.0	60 cm Cable, standard sensor
SMI-1A-48-100-BMAR				100 cm Cable, standard sensor
SMI-1A-48-180-BMAR				180 cm Cable, standard sensor
SMI-1B-48-060-BMAR				60 cm Cable, light shielded sensor
SMI-1B-48-100-BMAR				100 cm Cable, light shielded sensor
SMI-1B-48-180-BMAR				180 cm Cable, light shielded sensor

Parts are shipped on individual spools sealed in ESD bags.

For other calibration ranges, wire lengths, or custom features, contact [TE Sensor Sales](#).

Part number Key.



Warnings

- This Pressure transducer is not protected against defibrillation discharges. It must be used only with monitors labeled as having an isolated defibrillator-protected patient connection.
- Devices must be sterilized before use.
- Not for use in oxygen-rich environments.
- IntraSense has not been qualified as an implantable or reusable device. It is designed for single use of a duration <24 hours.

Qualification Standards

ISO 9001

ISO 14001

ISO/TS 16949

RoHS Compliant

REACH Compliant

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