Calibrated IntraSense™
1-French Wire-Connected Pressure Sensor
SMI-1A, SMI-1B Families

FEATURES

- Miniature sized sensor: 750µm × 220µm × 75µm
- Fits within 1-French catheter tubes
- Typical drift <2 mmHg/hour drift in 37°C saline
- Encapsulated copper trifilar connection for ease of integration
- PCB with 5-pin connector on the proximal end
- Fully compensated, digital and amplified analog outputs
- RoHS and REACH Compliant
- Biocompatible materials
- Option for reduced sensitivity to light

DESCRIPTION

The IntraSense™ series are absolute pressure sensors designed to fit into a 1-French hypo tube. The attached wire simplifies the connection for the end user. The fully encapsulated electronics allow the device to be used without additional gel or encapsulent. This absolute die delivers accurate and stable pressure for acute procedures in the clinically useful range of -300mmHg to +500mmHg (460mmHg to 1260mmHg absolute) and from 10°C to 70°C. The output is stable in 37°C saline, and calibration is done in water.

These devices are delivered with an attached PCB with a 5-pin connector offering fully temperature-compensated output. Length of wire is per customer requirements.

This device is intended for single use.

Typical Medical Applications			
ENDOVASCULAR	NEPHROLOGY	INTRACRANIAL	OTHER
Invasive blood pressure	Endourology	Intracranial Pressure Monitors	Labor and childbirth
Central arterial line	Urinalysis	Spinal Pressure	Guided biopsies
Cardiac surgery			Animal monitoring
Peripheral artery disease			Trauma response
Coronary artery disease			Laparoscopic surgery

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Absolute Maximum Ratings[a]

No.	Characteristic	Symbol	Medium	Minimum	Maximum	Units
1	Excitation Voltage[(a)]	V_{DD}	Water	3.0	6.0	V
2	Operating Temperature[(b,c)]	T_{OP}	Water	1	70	°C
3	Storage Temperature	T_{STG}	Air	-40	+105	°C
4	ESD Rating	V_{ESD}	Air	-	TBD	kV
5	Operating Pressure[(d)]	P_A	Water	-600	640	mmHg clinical
				160	1400	mmHg absolute
6	Proof Pressure	P_{BURST}	Air	-	TBD, >4000	mmHg absolute
7	Burst Pressure[(e)]	P_{BURST}	Air	-	TBD, >4000	mmHg absolute

Notes:

a. The device can be safely exposed within these levels with no loss in performance
b. The minimum temperature the device can withstand in liquid is just above the freezing temperature of the liquid or -40C, whichever is higher.
c. Operating lifetimes for temperatures above 70°C in liquid have not been established
d. The minimum pressure the device can withstand in liquid is the vapor pressure (boiling point) of the liquid, which is a function of temperature
e. The device could fail catastrophically above these pressures, generating fragments

Operating Characteristics - Specifications

All parameters are specified at 37°C, unless otherwise noted. Calibration is performed in liquid, but the device may be used either in liquid or in air.

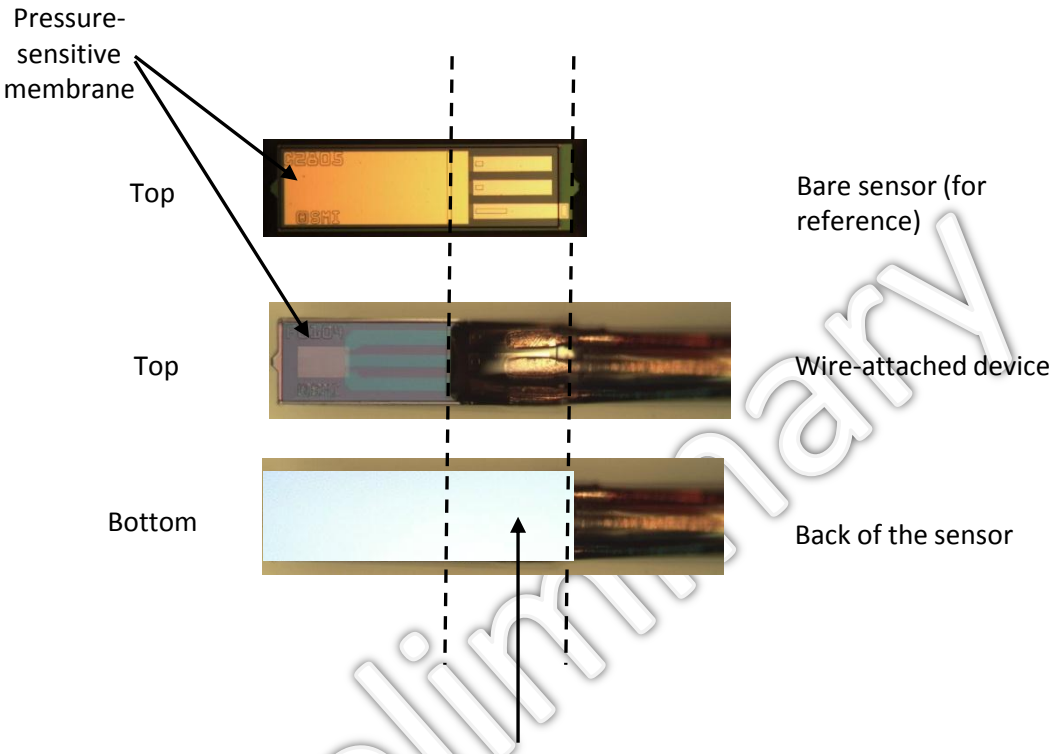
No.	Characteristic	Symbol	Minimum	Typical	Maximum	Units
9	Supply Voltage	V_{DD}	4.75	5.0	5.25	V
			3.0	3.3	3.6	
10	Compensated Pressure Range(f)	P_{COMP}	-300		+500	mmHg clinical
			460		1260	mmHg absolute
11	Compensated Temperature Range	T_{COMP}	10		70	°C
12	Low Level Output Voltage at Digital I/O, 3.3V supply	$V_{IN,I2C,lo}$	-	-	0.3	V
13	Low Level Output Voltage at Digital I/O, 5.0V supply		-		0.5	
14	High Level Output Voltage at Digital I/O, 3.3V supply	$V_{IN,I2C,hi}$	2.8	-	-	V
15	High Level Output Voltage at Digital I/O, 5.0V supply		4.25	-	-	
16	Current Consumption	$I_{VDD(AO)}$	-	TBD	-	mA
17	Digital Pressure Output @ 460mmHg absolute (-300mmHg clinical)	$DOUT_{MIN}$	-	-26214	-	Counts
18	Digital Pressure Output @ 1260mmHg absolute (+500mmHg clinical)	$DOUT_{MAX}$	-	26214	-	Counts
19	Digital Full Scale Span	DFS	-	52428	-	Counts
21	Pressure Resolution	-	-	16	-	Bits
				800/52428		mmHg/bit
22	Digital Output Accuracy(g)	DACC	-8	± 2	+8	mmHg
23	Analog Pressure Output @ P_{MIN}	$AOUT_{MIN}$	-	10	-	%VDD
24	Analog Pressure Output @ P_{MAX}	$AOUT_{MAX}$	-	90	-	%VDD
25	Analog Full Scale Span	AFS	-	80	-	%VDD
26	Analog Output Accuracy (g)	AACC	TBD	-	TBD	mmHg

Notes:

f. Clinical pressure range has a zero point at 760mmHg absolute

g. The accuracy specification applies across the compensated temp range. This specification includes the combination of linearity, repeatability, and hysteresis errors over pressure, temperature, and voltage.

Guide to Die Mounting



Apply die attach / adhesive on the backside of the die in this region to avoid unwanted stress on membrane. Silastic Medical Adhesive Type A from Dow Corning or Dymax 1128 A-M Gel are both low-stress, biocompatible die-attach materials.

Digital Output: I²C Communication

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

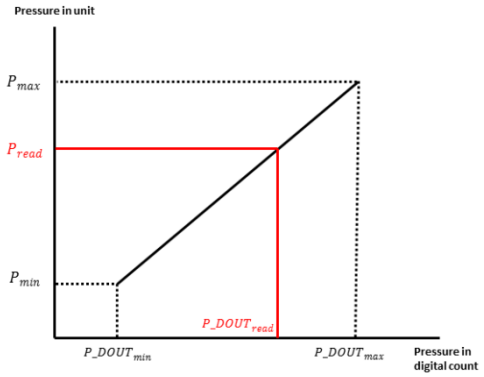
For additional questions, please consult sales@si-micro.com.

Sensor Transfer Function

Digital Pressure Transfer Function

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

P_{min} and P_{max} are 460mmHg and 1260mmHg absolute, respectively (-300mmHg and +500mmHg, respectively)
P_DOUT_{min} and P_DOUT_{max} are -26214 and +26214, respectively.
P_DOUT_{read} is 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 +500mmHg. The $DOUT_{min}$ and $DOUT_{max}$ are -26214 and +26214.

$$P_{read} = -300 + \frac{DOUT_{read} + 26214}{52428} \times 800mmHg$$

Amplified Analog Output

These devices should be powered at 3.3V or 5.0V. The devices must be powered at the same voltage used for calibration. The transfer function for interpreting readout is linear. The equations below show how to calculate pressure from the voltage readout assuming a stable voltage supply as indicated. The output will scale with the actual voltage applied (i.e. the output signal is ratiometric with the input voltage.)

The analog output at -300mmHg clinical will be 10% of the supply voltage, and the analog output at +500mmHg clinical will be 90% of the supply voltage.

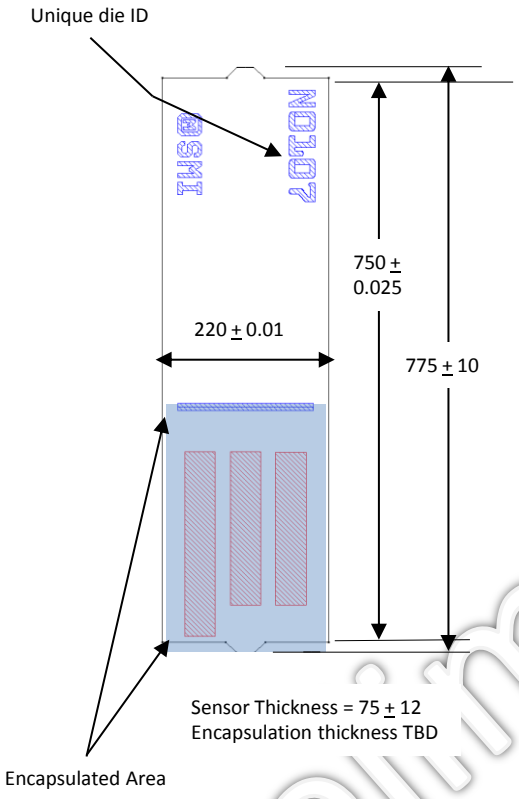
The default I2C slave address is 0x6C hex. The default ADC sample rate is 2Khz.

EXAMPLE 1:
If the supply voltage is 3.3V and the readout is 1.75V, then the clinical pressure is calculated as follows:
Output at Pmin = (3.3V * 0.1); Pmin = -300mmHg
Output at Pmax = (3.3V * 0.9); Pmax = +500mmHg
Slope of this line is (500 - -300)/((0.9*3.3) – (0.1*3.3)) = 303.03mmHg/V
Intercept of this line is -400
Pressure at 1.75V = (1.75*303.03) – 400 = 130mmHg clinical

EXAMPLE 2:
If the supply voltage is 5.0V and the readout is 0.8V, then the clinical pressure is calculated as follows:
Output at Pmin = (5.0V * 0.1); Pmin = -300mmHg
Output at Pmax = (5.0V * 0.9); Pmax = +500mmHg
Slope of this line is (500 - -300)/((0.9*5.0) – (0.1*5.0)) = 200mmHg/V
Intercept of this line is -400
Pressure at 0.8V = (0.8*200) – 400 = -240mmHg clinical

SM1A, SMI 1B Diagrams and Dimensions – Distal Side

All dimensions are in microns.



SMI-1A
Standard

SMI-1B
Light-Shielded

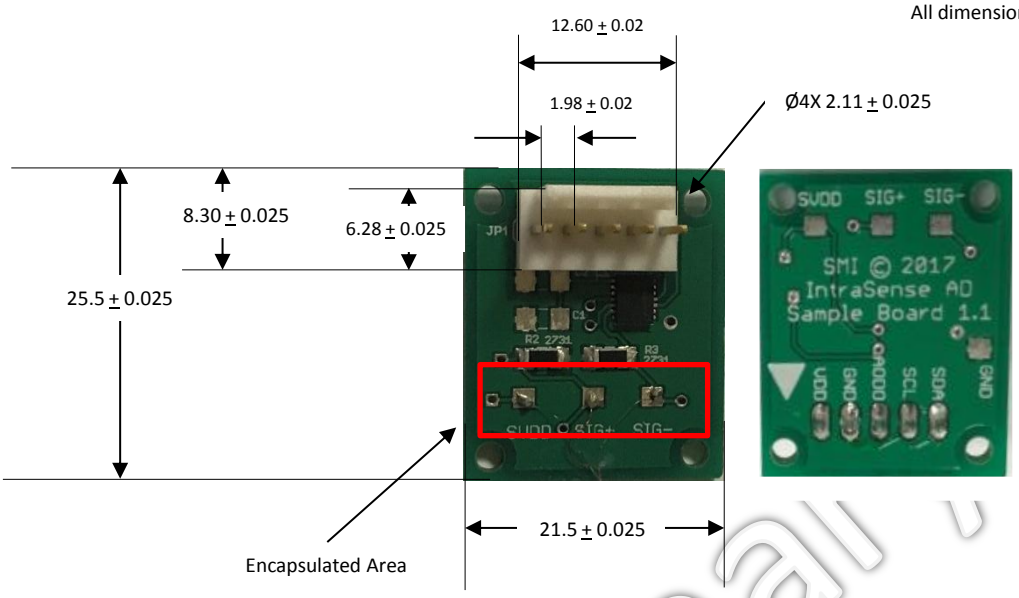
Thickness of sensor + epoxy:
95um – 175um

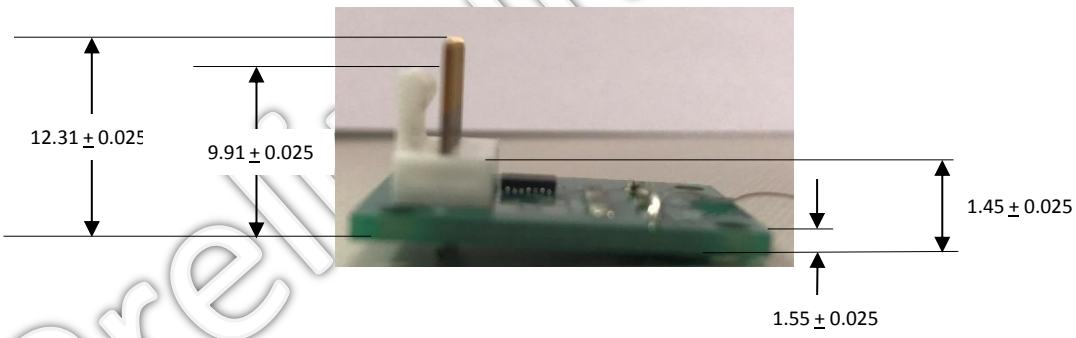
Wire Bond Pad Description	
Wire Color	**Pad Label**
Green	V_{SUPPLY}
Yellow	Sig+
Red	Sig-

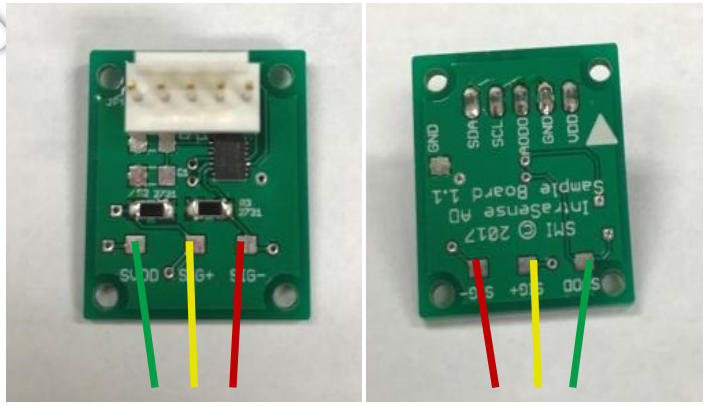
*SMI can provide separated test boards upon specific customer demands.
For additional questions, please consult sales@si-micro.com.

Test Board Diagrams and Dimensions – Proximal Side

All dimensions are in millimeters







Green - SVDD, Yellow - Sig+, Red- Sig-

Ordering Information: SMI-1A are Standard, SMI-1B are Light-Shielded

Order Code	Clinical Pressure Range (mmHg)	Compensated Temperature Range (°C)	Supply Voltage (V)	Design Feature
SMI-1A-48-XXX-BMAP	-300 to +500	10 - 70	3.3	XXX is the wire length in cm
SMI-1B-48-XXX-BMAP				
SMI-1A-48-XXX-BMAR			5.0	
SMI-1B-48-XXX-BMAR				

For other calibration ranges, wire lengths or custom features, contact SMI Sales at (408) 577-0100 or sales@si-micro.com

Part Number Legend

SMI - 1A - 48 - 180 - BMAR

- SMI: Silicon Microstructures IntraSense™
- 1A: Sensor Family; Revision A Standard; Revision B Light-Shielded
- 48: A.W.G. Wire Gauge
- 180: Trifilar Length (cm)
- B: Epoxy Type
- M: Proximal End Configuration
- AR: Calibration Code; 3.3V = AP; 5.0V = AR

Parts are shipped on individual spools sealed in ESD bags.

CAUTION: 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.

IntraSense™ has not been qualified as an implantable device. It is designed for single use

Qualification Standards

REACH Compliant
RoHS Compliant
PFOS/PFOA Compliant
For qualification specifications, please contact Sales at sales@si-micro.com

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