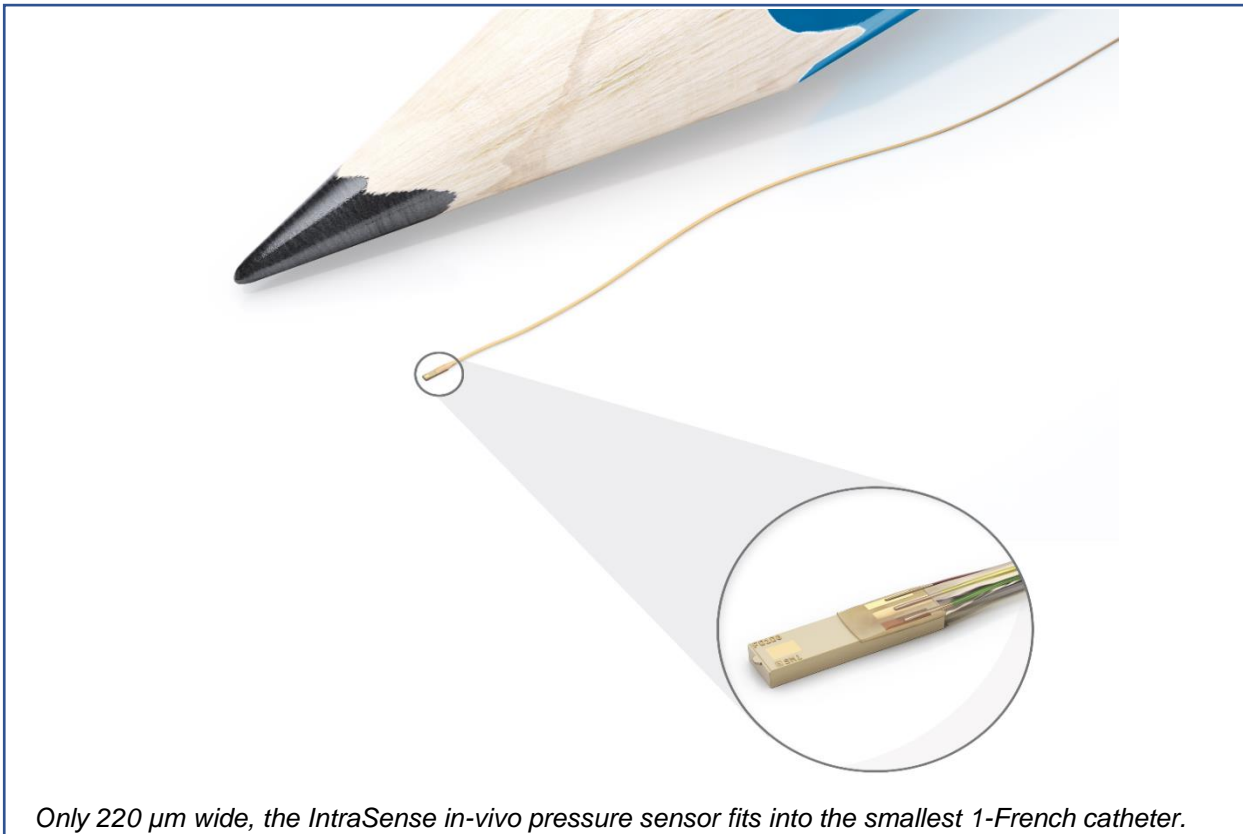




Ten things you need to know about the IntraSense catheter sensor



Only 220 μm wide, the IntraSense in-vivo pressure sensor fits into the smallest 1-French catheter.

The IntraSense is a tiny absolute pressure sensor developed by SMI Inc. that was acquired in 2019 by TE Connectivity. This in-vivo sensor is intended for use in catheters for medical examination or during surgery and designed to stay in the body for a limited period of time. Here are ten tips and tricks you will not find in the datasheet.

AMSYS GmbH & Co KG from Mainz, Germany, is a pressure sensor specialist and has worked with the manufacturer of the IntraSense for many decades. Knowing how difficult the handling of this sensor can be, AMSYS would like to give you some advice on the initial application of the IntraSense, a true masterpiece of technology – but one that is also very fragile.

Our FAQs are merely intended to supplement the information contained in the IntraSense datasheets. Please therefore always first read the datasheets for both the calibrated and uncalibrated IntraSense pressure sensors in full before referring to our additional tips and tricks. The datasheets can be found here:

<https://www.amsys-sensor.com/products/pressure-sensor/intrasense-in-vivo-pressure-sensor-for-medical-catheters/>

AMSYS does not assume any responsibility for any errors in this document.



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FAQs for IntraSense in-vivo pressure sensor by AMSYS

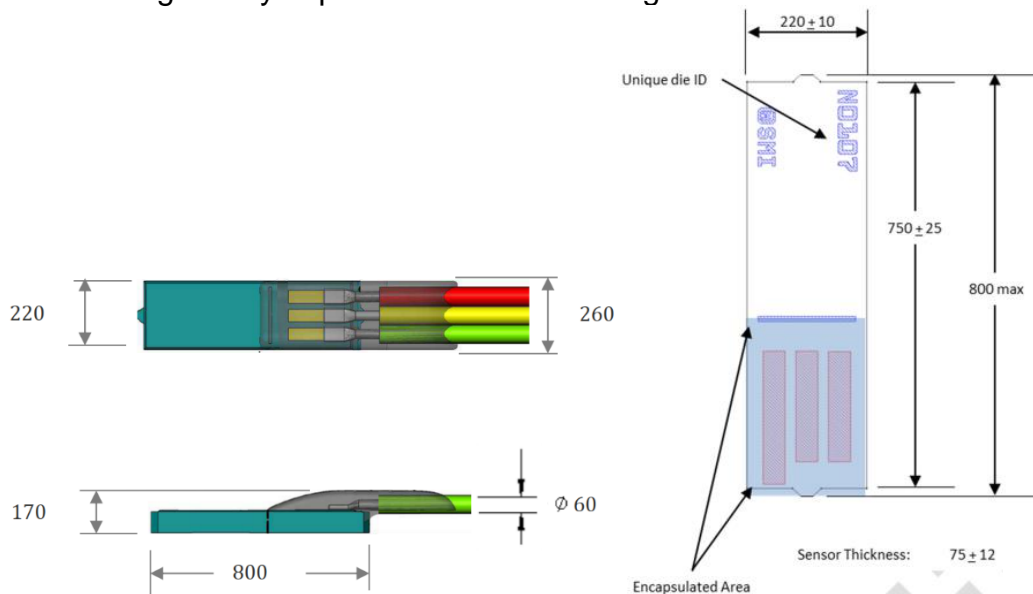
General questions about the IntraSense datasheet

1) When should a light-shielded version be used?

The doped silicon of the piezo resistors used for the pressure sensing membrane on the IntraSense is light sensitive. If you intend to use the sensor in an endoscope using a light source for illumination, the light-shielded version is recommended. As this light shielding reduces sensitivity by approximately 10%, the use of this particular version is otherwise not recommended.

2) How can the fine cables be protected during use, especially in critical areas such as the edge of the PCB?

Additional epoxy or adhesive can be applied to the cable to increase strength. Heat shrink tubing is very expensive in this size range and is not recommended.



3) What's the best way to insert the IntraSense into a catheter tube?

During insertion the sensor often gets wedged and breaks off. Furthermore, if the sensor scratches against the tube, particles become loose that are then deposited on the sensor.

AMSYS recommends sucking the sensor through the tube. It can also be helpful to work in pairs so that the cable can be fed evenly. A slight vacuum such as that of a vacuum cleaner should be sufficient here.



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Calibrated IntraSense

4) What's the difference between the supply voltages (3.3 V and 5.0 V)? Does this affect the sensitivity of the catheter sensor?

The sensor itself is specified for up to 3V only. 2.4V are usually applied (see the specification sheet for uncalibrated probes). 3.3V (-BMAP) or optionally 5.0V (-BMAR) are used only for calibrated probes that have an additional ASIC with voltage control mounted on the PCB. This therefore doesn't affect the performance of the calibrated sensor. As 3.3V are more common, we recommend using the 3.3V calibrated sensors (...-BMAP) for new designs.

5) Does this pressure catheter sensor need any other ancillary equipment to measure pressure?

The calibrated IntraSense sensor comes with both an amplified analog output (10%–90% of the supply voltage) and an I²C digital interface. Any measurement device capable of measuring analog or I²C signals can be used. The easiest solution is to use the IntraSense evaluation kit, including an Arduino with a special shield for connection and software for quick pressure and temperature measurements. The IntraSense evaluation kit is available with both light-shielded and unshielded calibrated sensors for different cable lengths.

6) I want to cut away the PCB on my IntraSense as I wish to mount it in a catheter tube. What do I have to be aware of?

If you cut the PCB of the uncalibrated sensor off (...BBUU), you end up with an uncalibrated sensor with open-ended wires (...BAUU).

If you cut away the PCB of the calibrated sensor (...BMxx), you will also end up with an uncalibrated sensor, as amplification and calibration are performed on this PCB. Resoldering it to exactly the same PCB is also not recommended as resistance of the solder joints will influence the values, creating an offset. Resoldering it to another PCB will cause it to work with the wrong calibration data.

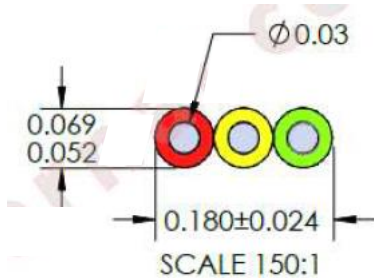
7) We have an IntraSense sensor with a PCB. The sensor or sensor cable is damaged and now we would like to replace it. What's the best way to repair or replace it? How do we loosen the epoxy without damaging the board? Do you have any tips as to how to distinguish the fine cables?

AMSYS does not recommend repairing damaged cables. Calibration is based on the resistance of the entire system of sensor, cable and PCB. Reattaching the wires may cause the sensor to be out of calibration. If you accept this risk, the epoxy resin can be softened in boiling water. The three wires are green, yellow and red. The green cable leads to the bond pad labeled SVDD, the yellow one goes to Sig+ and the red wire is connected to Sig-.



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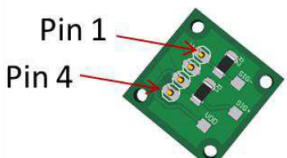
Wire Description		
Wire Color	Wire Name	Pad Function
Green	V _{DD}	V _{SUPPLY}
Yellow	R _{Center}	Sig+
Red	R _{Edge}	Sig-

Uncalibrated IntraSense

8) What's the difference between the uncalibrated types –BAUU and –BBUU?

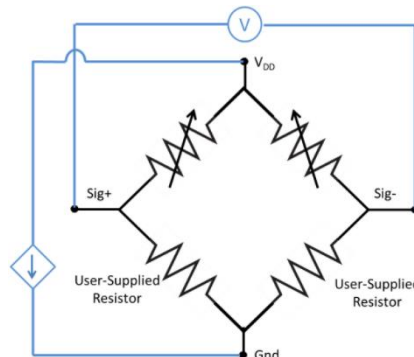
The BBUU comes with a small PCB with two resistors closing the half-bridge of the sensor. A 4-pin header facilitates connection to the readout electronics.

Pin	Connection	Purpose
1	Sig-	Signal Low
2	Power	Ground
3	Power	Supply Voltage
4	Sig+	Signal High



The BAUU has just the three bare wires which are stripped at the ends. You will probably need to add two resistors to complete the Wheatstone bridge.

Wire Description		
Wire Color	Wire Name	Pad Function
Green	V _{DD}	V _{SUPPLY}
Yellow	R _{Center}	Sig+
Red	R _{Edge}	Sig-



Unless you want to solder your own plug, we recommend the BBUU or even the calibrated and amplified BMAP/BMAR sensor. For serial production of a ready-to-use catheter, the uncalibrated BAUU version and individual pressure calibration in a water bath is recommended. Resoldering any connections will invalidate the calibration data stored.



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9) What ASIC do you recommend for use with the IntraSense? Do you have a reference schematic we can adopt?

Standard signal conditioners for piezoresistive pressure sensors like the ZSC31050 are not designed for the low signal levels of the IntraSense (as it only works as a half-bridge) or the low supply voltage of just 2.4V (max. 2.7V). You will need a pre-amplifier of some kind. TE recommends the OPA2388IDGKT operational amplifier from Texas Instruments for this task. To minimize the amount of noise, averaging is recommended. The ASIC used by TE in the calibrated versions of the IntraSense (-BMAP/-BMAR) is not publicly available as it is a customized design. It is also not available for sale from AMSYS or TE as it is only sold together with a calibrated sensor.

We would be pleased to hear about any different ways of interfacing the IntraSense!

10) Will there be different versions of the IntraSense available anytime soon? We would like a pressure sensor already mounted inside a catheter tube.

At the moment AMSYS is not aware of any development of a ready-to-use medical pressure sensor in a catheter. A version inside a stainless-steel tube is planned but no release date has yet been announced. We'll keep you posted! Follow AMSYS on LinkedIn for the latest news: <https://www.linkedin.com/company/amsys-gmbh-co-kg/>

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