

# Data Sheet INS-333x

Version 1.9 - 28.07.2020

## PRODUCT FAMILY

Motion Detector / Switch

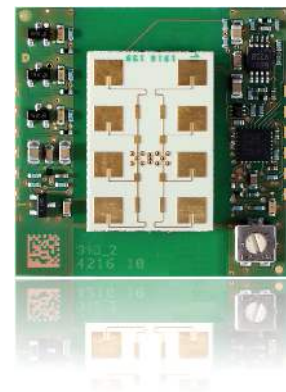


## APPLICATIONS

- Home Automation
- Security Applications

## FEATURES

- » can be hidden behind many materials
- » motion detector up to 10m for a human being
- » detection range adjustable via potentiometer (only for advanced version)
- » proximity switch for object detection for distances less than 10cm
- » movement recognition with direction, velocity and signal strength in distance of 2 to 10m
- » advanced version with open-collector outputs and UART interface
- » pure digital version only with UART interface
- » ECO-mode with reduced power consumption (saving up to 90%)
- » standby mode
- » flat SMD-design with 5mm height
- » both versions will be delivered on tape&reel



## DESCRIPTION

The INS-333X is a Doppler Motion Sensor combined with a radar based proximity switch. It offers three open collector outputs with indicator LEDs: Two for each direction of detected movement and one for the proximity switch function. The motion sensor has a range of 10m for detecting a human being, which can be reduced by adjusting an on-board potentiometer. A digital (UART) interface provides a continuous data stream of signal amplitude, velocity, direction of movement and the status of the proximity switch.

A stripped-off, digital only version is also available, omitting the LEDs, open collector outputs and potentiometer.

## ADDITIONAL INFORMATION

InnoSenT Standard Product. Changes will not be notified as long as there is no influence on form, fit and within this data sheet specified function of the product.

## CERTIFICATES

InnoSenT GmbH has established and applies a quality system for: development, production and sales of radar sensors for industrial and automotive sensors. More information on our quality standards:

<https://www.innosent.de/en/company/certifications/>

## RoHS-INFO

This product is compliant to the restriction of hazardous substances (RoHS - European Union directive 2011/65/EU).

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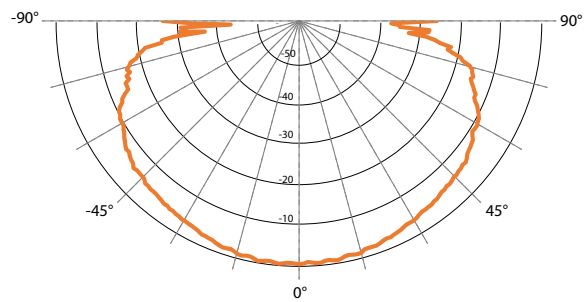
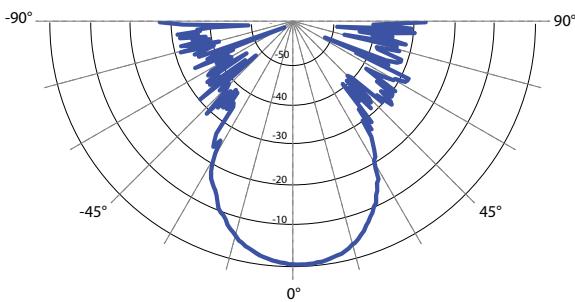
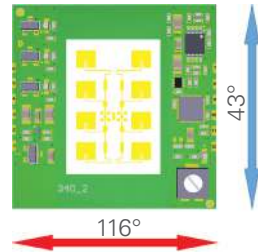
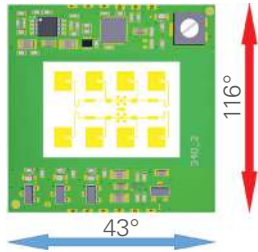
## ELECTRICAL CHARACTERISTICS

PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNITS
<b>Radar</b>						
transmit frequency	frequency band for EU and US	f	24.150		24.250	GHz
output power (EIRP)		P <sub>out</sub>			12.7	dBm
<b>Sensor</b>						
max adjustable detection range	motion detection for an RCS = 1m <sup>2</sup>	d <sub>r</sub>			10	m
	switch functionality E.g. Detection of a hand	d <sub>switch</sub>			0.1	m
range for direction of movement recognition	E.g. Detection of a person	d <sub>domr</sub>	2		10	m
activation time switch		t <sub>active_switch</sub>		400		ms
velocity range		v <sub>r</sub>	0.7		34	km/h
antenna pattern (10dB width)	compare plot on page 3	azimuth		43		°
		elevation		116		°
<b>Power supply</b>						
supply voltage		V <sub>CC</sub>	3.8		5.5	V
supply current	full operation	I <sub>CC</sub>		55	65	mA
	stand-by (ECO mode activated)	I <sub>stand-by</sub>		6		mA
	open collector output activated in "ADVANCED" version (7mA per output); full operation	I <sub>OC_active</sub>		80	95	mA
<b>Environment</b>						
operating temperature		T <sub>OP</sub>	-20		+60	°C
storage temperature		T <sub>STG</sub>	-40		+85	°C
<b>Mechanical Outlines</b>						
outline dimensions		height length width		4.7 33.5 33.5		mm
<b>Weight</b>						
		w		5.69		g

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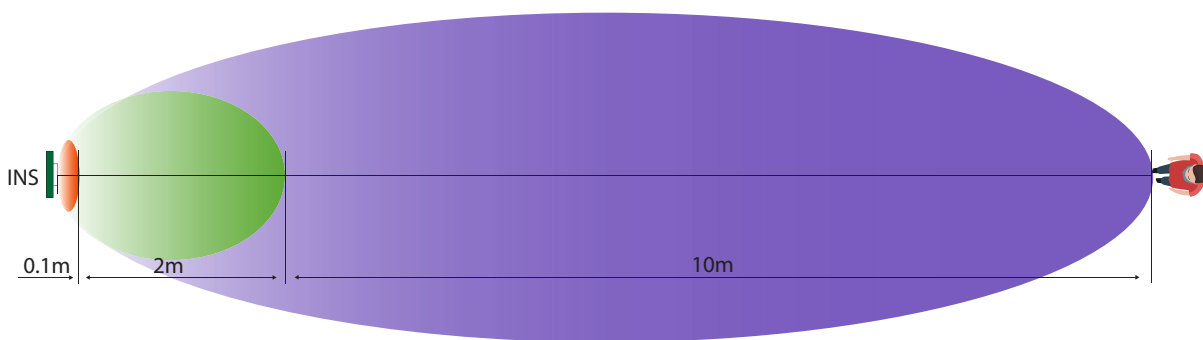
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ANTENNA PATTERN



system pattern (-10dB)	azimuth	system_az	43	°
	elevation	system_el	116	°

DETECTION ZONES



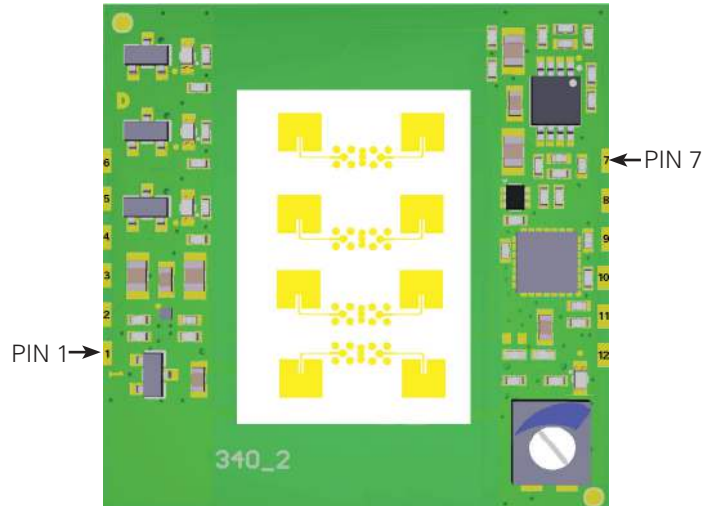
- blue zone: motion detection with direction of movement recognition
- green zone: motion detection only
- red zone: proximity detection for switch functionality

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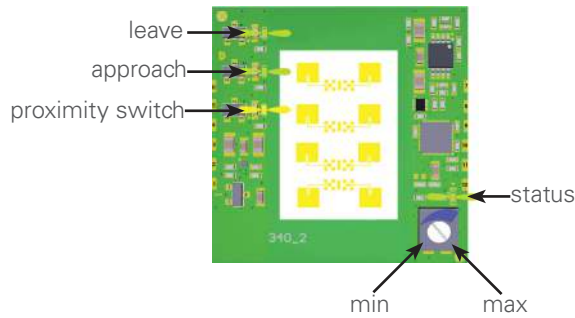
## INTERFACE

The sensor provides solder pads for SMT mounting



PIN #	DESCRIPTION	IN/OUT	COMMENT
1	enable	IN	active high
2	Vcc	IN	3.8 - 5.5V
3	open collector proximity	OUT	$U_{max} = 36V / I_{max} = 100mA @25^{\circ}C$ (available only in ADVANCED version)
4	open collector approach	OUT	$U_{max} = 36V / I_{max} = 100mA @25^{\circ}C$ (available only in ADVANCED version)
5	open collector leave	OUT	$U_{max} = 36V / I_{max} = 100mA @25^{\circ}C$ (available only in ADVANCED version)
6	GND	IN	
7	GND	IN	
8	UART Rx	IN	3.3V (low <sub>max</sub> 0.9V high <sub>min</sub> 2.4V) (38400 baud)
9	UART Tx	OUT	3.3V (low <sub>max</sub> 0.9V high <sub>min</sub> 2.4V) (38400 baud)
10	enable ECO	IN	active low
11	d.n.c.	IN	
12	GND	IN	

FUNCTION DESCRIPTION



Potentiometer

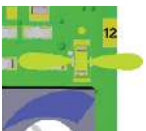


The taper of the potentiometer is approximately linear with range.

Position min: approx. 2 m detection range of the movement detector

Position max: at least 10 m detection range of the movement detector

Status LED



The LED signalizes Power-On (continuous) and Eco-mode (blinking).

Detection LEDs



If the „approach“ and „leave“ LEDs are switched on at the same time, this means that the object moves at a distance of less than 2m from the sensor.

The INS can be switched from continuous operation to a power reduced ECO-mode by pulling down pin #10 and in Standby-mode by pulling down pin #1.

In ECO-mode the sensor wakes up once a second, which is signalized by flashing the status LED.

In case of a detection the sensor stays active for 5 sec.

The proximity-switch is activated by detections in less than 10cm distance.

Following parameters can be modified by customer via UART-interface (default values in brackets):

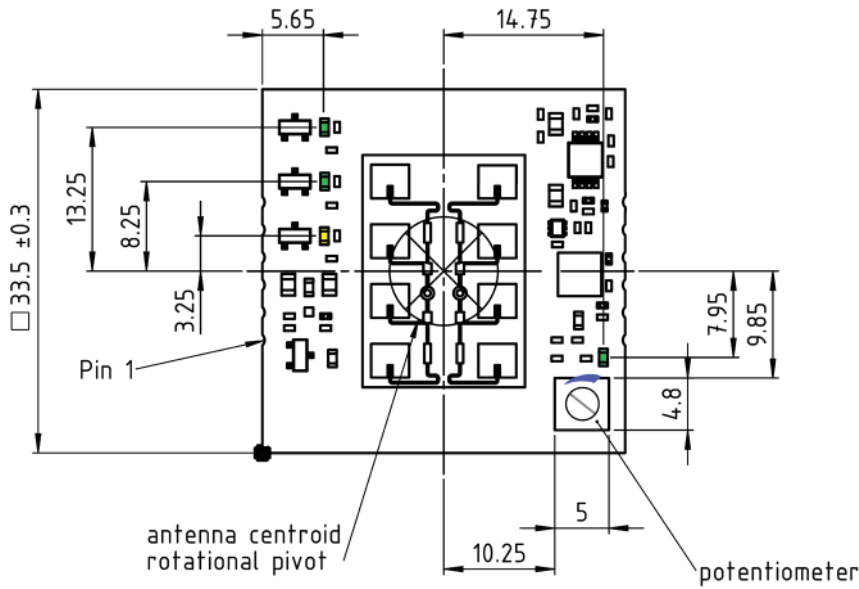
- Time after motion detection to activate output (0.5sec)
- Dwell time of outputs after motion detection (1sec)
- Outputs of motion detections can be separately deactivated
- Time after presence detection to activate proximity-switch (0.3sec)
- Minimum time between two proximity-switch activation (0.6sec)

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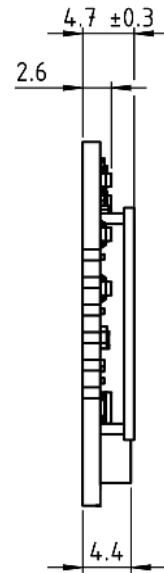
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OUTLINE DIMENSIONS

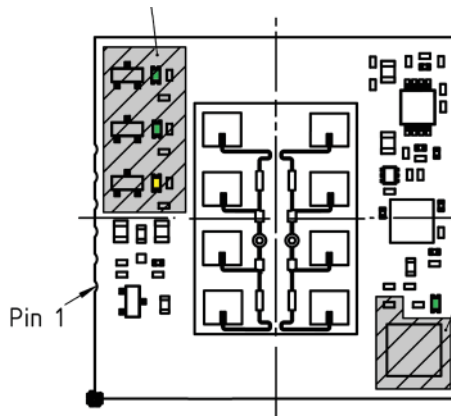
top view



side view



PARTS UN PLACED IN DIGITAL ONLY VERSION



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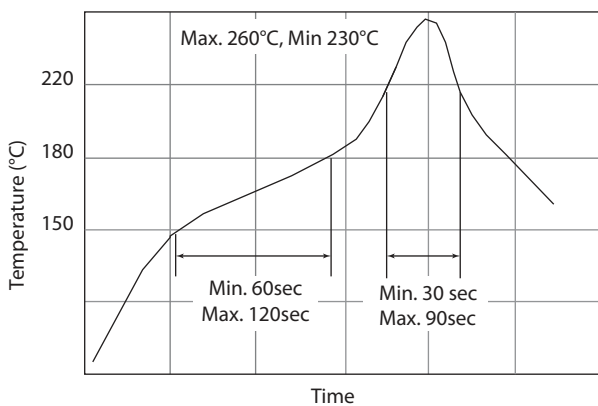
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### SMT GUIDELINES

The IMS is 100% Pb-free. Therefore, Pb-free solder paste with a reflow profile is as shown below recommended. Do not use solder paste with active or acid-based flux. To avoid submerging the device in the solder paste, the placement height (Z) of the device on the pick-and-place equipment should be controlled carefully. Optimally, the Z height should be set at one-half the printed solder paste height. Maintaining board flatness (coplanarity) is important for keeping the Z height under control.

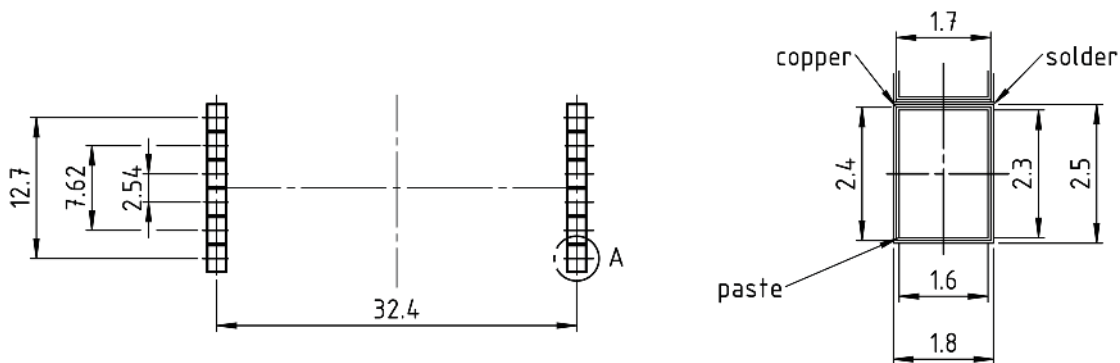
If possible use a pick-and-place machine with a visions-alignment system for proper centering on the PCB.

For the soldering process we recommend the following profile:



### PACKAGE FOOTPRINT

Recommended Footprint and Stencil Layout



Recommended stencil thickness 250µm

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### APPLICATION INFORMATION

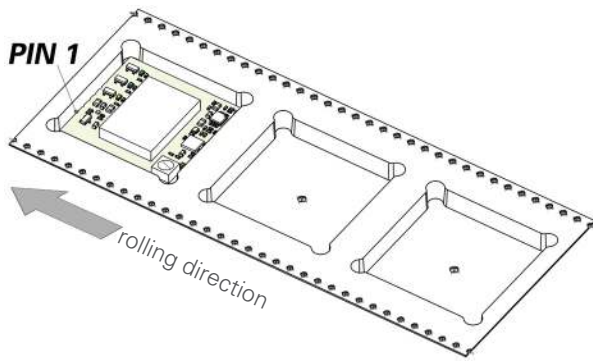
Radome materials and proposed dimensions

The INS sensor may be covered by any non-conductive material. However, direct contact with the antenna structures must be avoided.

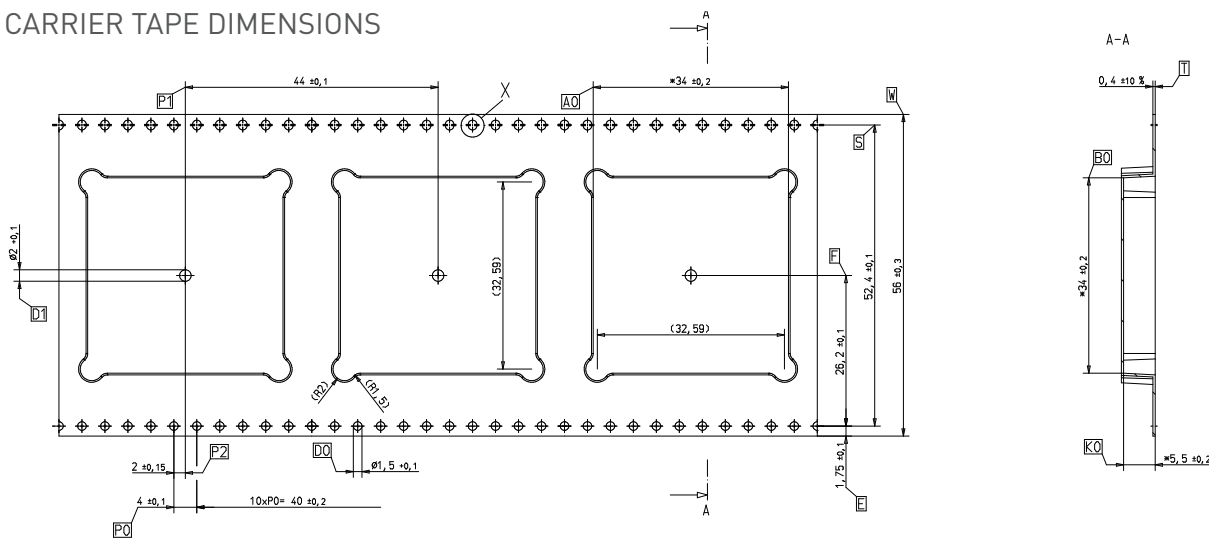
Using plastic materials (ABS, PVC etc.) the best performance can be achieved by choosing the material thickness to 3-4mm and the distance to the antenna surface to 6mm.

### TAPE OF INS-333X

The INS will be delivered on tape



### CARRIER TAPE DIMENSIONS



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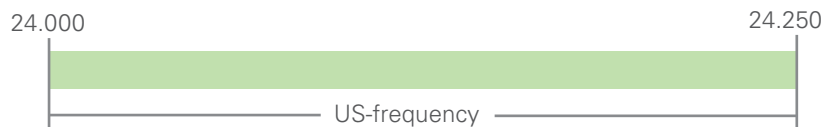


## Annex A

The information that will be given below is only a rough overview; for details please contact the local approval agencies. An overview over the frequency bands in Europe can also be found in the REC 70-03 (Annex 6) which is available under [www.ero.dk](http://www.ero.dk)

This device contains a short range device (SRD) called SMR-333

### Frequency Bands in US FCC 15.249



#### FCC approval

The SMR-333 complies with Part 15 of the FCC Rules and with RSS-310 of Industry Canada. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Manufacturers of mobile or fixed devices incorporating SMR-333 Modules are authorized to use the FCC Grants for their own final products according to the conditions referenced in these documents. In this case, the FCC label of the SMR-333 shall be visible from the outside, or the host device shall bear a second label stating „Contains FCC ID: UXS-SMR3X3“

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

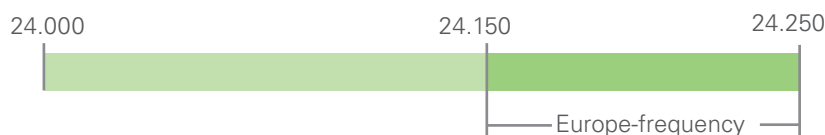
- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### NOTICE:

Changes or modifications made to this equipment not expressly approved by InnoSenT GmbH may void the FCC authorization to operate this equipment.

### Frequency Bands in Europe

The SMR-333 module compliant to RED. Generally the SMR-333 can be used also for all countries in Europe.



#### NOTICE:

Changes or modifications made to this equipment not expressly approved by InnoSenT GmbH may void the RED authorization to operate this equipment.

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## ORDER INFORMATION

INS - 3 3 3 X

0 = advanced  
1 = digital

## HANDLING PRECAUTIONS

To avoid damage to the devices, care should be exercised during handling. Proper Electrostatic Discharge (ESD) precautions should be observed at all stages of storage, handling, assembly, and testing.

## ESD INTEGRITY



This InnoSenT sensor is sensitive to damage from ESD. Normal precautions as usually applied to CMOS devices are sufficient when handling the device. Touching the signal output pins has to be avoided at any time before soldering or plugging the device into a motherboard.

## APPROVAL

This Product Description contains the technical specifications of the described product. Changes of the specification must be in written form.

VERSION	DATE	COMMENT
1.0	10.02.2017	initial release
1.1	08.03.2017	small changes in function description
1.2	22.06.2017	adding Uart information
1.3	21.09.2017	changing frequency band information
1.4	19.10.2017	changing frequency band information
1.5	21.12.2017	changing recommended footprint
1.6	12.06.2018	changing frequency band
1.7	18.07.2018	adding approval information
1.8	11.06.2019	changing recommended stencil thickness
1.9	28.07.2020	new layout

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