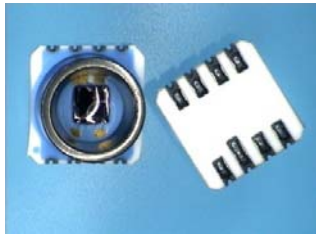


## MS54XX

## Miniature SMD PRESSURE SENSOR



- Piezoresistive Silicon Micromachined Sensor
- Pressure Range 1, 7, and 12 bar Absolute
- Uncompensated

### DESCRIPTION

The MS54XX SMD pressure sensor series is designed for pressure sensor systems with highest demands on resolution and accuracy. The device consists of a silicon micro-machined pressure sensor die mounted on a 6.2 x 6.4 mm ceramic carrier protected by a metal cap. The MS54XX can be delivered in the 'high sensitivity' option giving an output signal of up to 400mV Full Scale signal at 5V or a 'high linearity' option with an output signal of 150mV Full Scale and an excellent linearity of typical 0.05%.

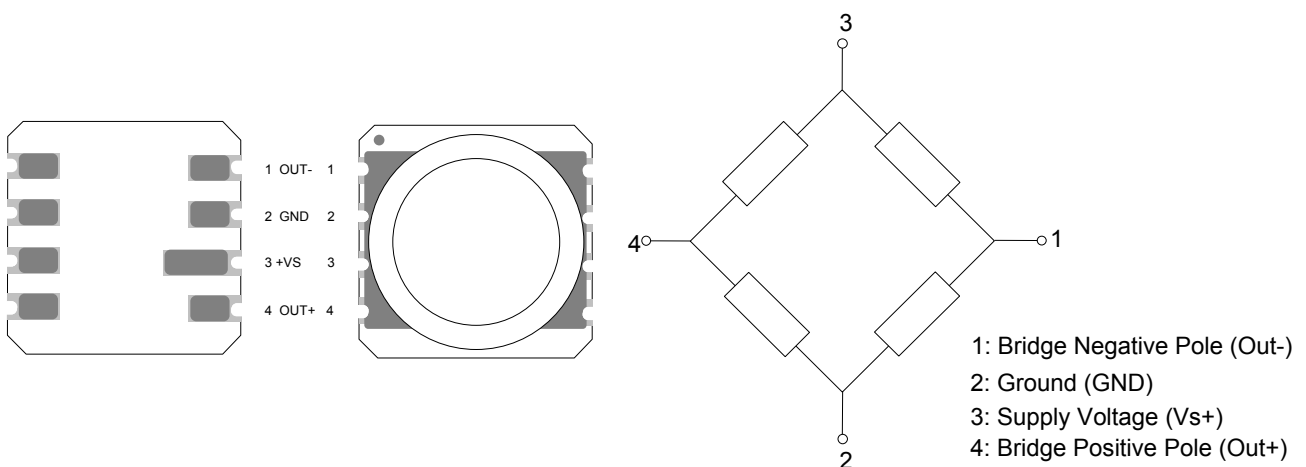
### FEATURES

- 1-12 bar Full Scale Range
- Low Cost SMD ceramic Package
- High sensitivity version (A) span 240mV @ 5V
- High linearity version (B) 0.05% typical
- 5 x Overpressure
- Uncompensated
- -40°C to +125 °C
- High reliability, low drift
- Gel protection
- B-version Water resist 100m (ISO 2281 Standard)

### APPLICATION

- Absolute pressure sensor systems
- High resolution Altimeters, Variometers
- Barometers
- Engine controls
- Water proof watches and Diver's computers
- Tire pressure Monitoring Systems (TPMS)

### ELECTRICAL CONNECTIONS



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## PIN DESCRIPTION

Pin Name	Pin No.	Function
OUT-	1	Bridge negative pole
GND	2	Ground
VS+	3	Supply voltage
OUT+	4	Bridge positive pole

## FULL SCALE PRESSURE

kPa	bar	mbar	PSI	atm	mm Hg	mm H <sub>2</sub> O	Inches H <sub>2</sub> O
100	1	1000	14.50	0.987	750	1019	401
200	2	2000	29.01	1.974	1500	2038	803
400	4	4000	58.02	3.948	3000	4077	1607
700	7	7000	101.53	6.909	5250	7135	2813
1200	12	12000	174.05	11.844	9000	12232	4822

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Min	Max	Unit
Supply voltage	VS+	T <sub>a</sub> = 25 °C		20	V
Storage temperature	T <sub>s</sub>		-40	+125	°C

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## ELECTRICAL CHARACTERISTICS

### ◆ MS54XX-AZ (High Sensitivity)

(Reference conditions: Supply Voltage VS+ = 5 Vdc; Ambient Temperature Ta = 25°C.)

	Parameter	Min	Typ	Max	Unit	Notes	
MS5401-AZ	Operating pressure range	0	-	1	bar		
	Overpressure			5	bar		
	Full-scale span (FS)	190	240	290	mV		
	Sensitivity	190	240	290	mV/bar		
	Linearity	-	±0.15	±0.4	%FS	1,6	
MS5407-AZ	Operating pressure range	0	-	7	bar		
	Overpressure			35	bar		
	Full-scale span (FS)	322	392	462	mV		
	Sensitivity	46	56	66	mV/bar		
	Linearity	-	±0.15	±0.4	%FS		
All Ranges	Operating Temperature Range	-40		125	°C		
	Zero pressure offset	-40	0	40	mV		
	Hysteresis	-	-	±0.20	%FS	2, 6	
	Repeatability	-	-	±0.20	%FS	3, 6	
	Bridge resistance	3.0	3.4	3.8	kΩ		
	Temperature coefficient of resistance	Span	+2'400	2'900	+3'300	ppm/°C	4, 6
		Offset	-1'500	-1'900	-2'300	ppm/°C	4, 6
			-80	-	+80	μV/°C	4, 6
Temperature hysteresis	-	0.3	0.8	%FS	5, 6		

### NOTES

- 1) Deviation at one half full-scale pressure from least squares best line fit over pressure range
- 2) Maximum difference in output at any pressure within the operating pressure range
- 3) Same as 2) after 10 pressure cycles
- 4) Slope of the endpoint straight line from 25°C to 60°C
- 5) Maximum difference in offset after one thermal cycle from -40°C to +125°C
- 6) Not 100 % tested

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## ELECTRICAL CHARACTERISTICS (CONT.)

### ◆ MS54XX-BZ (High Linearity)

(Reference conditions: Supply Voltage VS+ = 5 Vdc; Ambient Temperature Ta = 25°C)

	Parameter	Min	Type	Max	Unit	Notes	
All Ranges	Full-scale span (FS)	120	150	180	mV		
MS5401-BZ	Operating pressure range	0	-	1	bar		
	Overpressure			10	bar	8	
	Sensitivity	120	150	180	mV/bar		
	Linearity		±0.05	±0.2	%FS	1,6	
MS5412-BZ	Operating pressure range	0	-	12	bar		
	Overpressure			35	bar		
	Sensitivity	10	12.5	15	mV/bar		
	Linearity		±0.05	±0.15	%FS	1,6	
All Ranges	Operating Temperature Range	-40		125	°C		
	Zero pressure offset	-40	0	40	mV		
	Hysteresis	-	-	±0.20	%FS	2, 6	
	Repeatability	-	-	±0.20	%FS	3, 6, 7	
	Bridge resistance	3.0	3.4	3.8	kΩ		
	Temperature coefficient of resistance	Span	+2'400	2'900	+3'300	ppm/°C	4, 6
		Offset	-1'500	-1'900	-2'300	ppm/°C	4, 6
		Offset	-80	-	+80	μV/°C	4, 6
Temperature hysteresis	-	0.3	0.8	%FS	5, 6		

### NOTES

- 1) Deviation at one half full-scale pressure from least squares best line fit over pressure range
- 2) Maximum difference in output at any pressure within the operating pressure range
- 3) Same as 2) after 10 pressure cycles
- 4) Slope of the endpoint straight line from 25°C to 60°C
- 5) Maximum difference in offset after one thermal cycle from -40°C to +125°C
- 6) Not 100 % tested
- 7) 12 bar: max. 0.3% FS
- 8) The MS5401-BM was qualified referring to the ISO 2281 standard and can withstand an absolute pressure of 11 bar in salt water

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## GENERAL DESCRIPTION

The MS54XX is a miniaturised absolute pressure sensor series which has been designed for surface mounting applications. Its main advantages are the high reliability of the semiconductor sensor and a design which makes it suitable for applications requiring small-scale and cost-efficient solutions.

The sensor element of the MS54XX consists of a silicon micro-machined membrane with a Pyrex glass mounted under vacuum. Implanted resistors make use of the piezo-resistive effect. The sensor is mounted in a special process allowing best-offset stability making the part suitable for direct PCB assembly.

The sensor cell is mounted on a ceramic substrate. SnPb connection pads ensure the soldering of the substrate and automatic assembly. Standard surface mount techniques (IR reflow soldering technique at 220° C for 30 sec) can be used. A dot on the ceramic substrate marks pad 1. A metal cap protects the silicon measurement cell and the bonding wires. The MS54XX-BZ is factory protected against humidity by a silicone gel. The MS54XX is normally packed in an antistatic plastic tube.

Two options are available to allow the user to choose for either **high sensitivity (MS54XX-AZ)** or **high linearity (MS54XX-BZ)**.

Full Scale Pressure	High Linearity		High Sensitivity	
	Product Code	Signal	Product Code	Signal
1 bar	MS5401-BZ	150mV/0.05%	MS5401-AZ	240mV/0.2%
2 bar				
4 bar				
7 bar			MS5407-AZ	392mV/0.2%
12 bar	MS5412-BZ			

Typical applications for this miniaturised pressure sensor MS54XX are altitude measurements and the measurement of atmospheric reference pressure in medical and industrial equipment as well as in automotive and household applications, consumer electronics and pneumatics.

Full Scale Pressure	High Linearity	High Sensitivity
1 bar	High End Altimeter, Medical Instrumentation	Variometer, Altimeter, Barometer
2 bar	Divers Watch	
4 bar	Tire Pressure	
7 bar	High End Electronic Scale	Electronic Scale
12 bar	Pneumatic Brake, Diving Computer	

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## APPLICATION INFORMATION

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The MS54xx Sensor is protected by a soft transparent silicone gel. The properties of this gel ensure function of the sensor even when in direct water contact. This feature can be useful for waterproof watches or other applications, where direct water contact cannot be avoided. Nevertheless the user should avoid drying of hard materials like for example salt particles on the silicone gel surface. In this case it is better to rinse with clean water afterwards. Special care has to be taken to not mechanically damage the gel. Damaged gel could lead to air entrapment and consequently to unstable sensor signal, especially if the damage is close to the sensor surface.

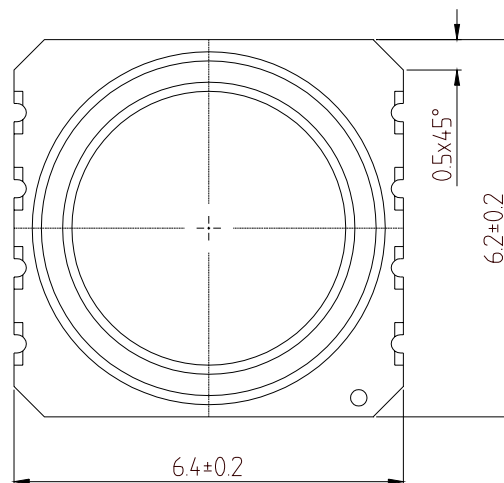
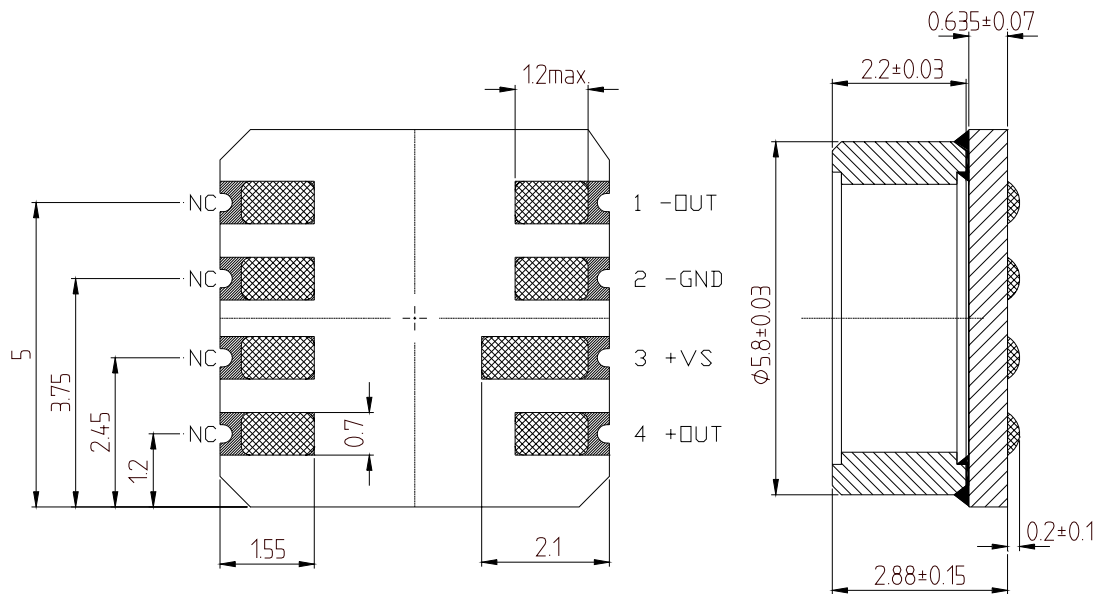
The metal cap is fabricated of special anticorrosive stainless steel in order to avoid any corrosive battery effects inside the final product. The MS5401-BM was qualified referring to the ISO 2281 standard and can withstand an absolute pressure of 11 bar in salt water. The concentration of the sea water used for the qualification is 41 g of sea salt for 1 litre of DI water.

For underwater operations like specified in ISO 2281 standard it is important to seal the sensor with a rubber O-Ring around the metal cap. Any salt water coming to the contact side (ceramic and Pads) of the sensor could lead to permanent damage. Especially for "water-resistant 100 m" watches it is recommended to provide a stable mechanical pusher from the backside of the sensor. Otherwise the overpressure might push the sensor backwards and even bend the electronic board on which the sensor is mounted.

The MS54xx is sensitive to sunlight, especially to infrared light sources. This is due to the strong photo effect of silicon. As the effect is reversible there will be no damage, but the user has to take care that in the final product the sensor cannot be exposed to direct light during operation. This can be achieved for instance by placing mechanical parts with holes in such that light cannot pass.

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## PACKAGE OUTLINES



Notes:

1) General tolerances  $\pm 0.1$

2) Cap centering tol. of  $\pm 0.15$  from the center of the ceramic.

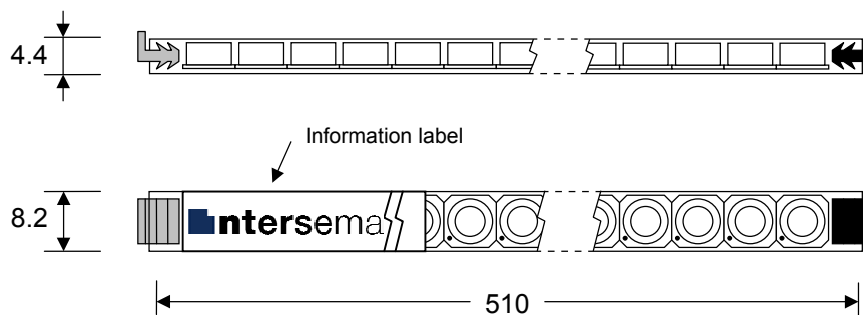
**MS54XX-YM**  
(stainless steel cap)

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## PACKING

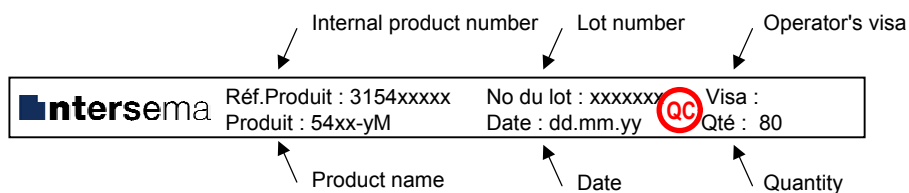
The MS54XX is packed in a 51cm (20-inch) antistatic plastic tube with rubber end-plugs of two different colors: One green and one black. The dot on the ceramic (pin 1) is facing the green end-plug. Each tube contains 80 sensors. The tubes are marked "ANTISTATIC" and have an information label. See the drawings below for more details.

## PACKING TUBE OUTLINES



All measures in mm

## INFORMATION LABEL

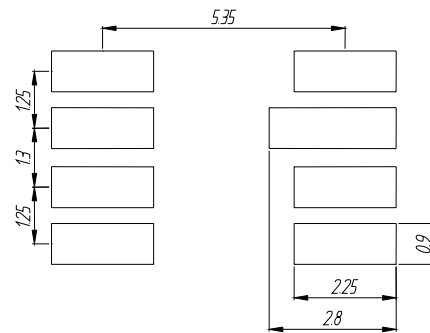


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## RECOMMENDED PAD LAYOUT

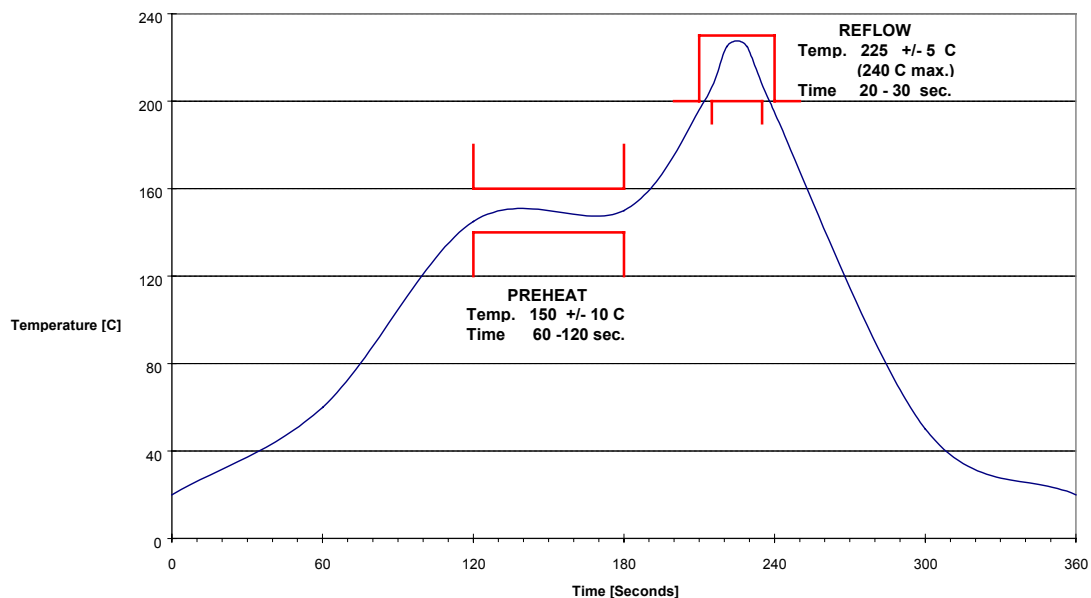
- Recommended Pad Layout for soldering of the MS54xx on a printed circuit board



## MOUNTING INFORMATION

When direct mounting on PCB, it is recommended to pass some tests with a temperature probe attached to the sensor to achieve the profile shown below which is valid for most of the RMA or No-Clean solder pastes. PCBs with components already mounted or PCBs with reflective areas might heat up much slower than the sensor itself. A most flat preheating zone of 150°C with combined IR and convection heating is therefore preferable.

- After soldering avoid mechanical stress (e.g. bending of the PCB) on the solder joints.
- The sensor shall be soldered only one time. If a sensor has to be desoldered, please do not solder again.
- Due to the photo effect, the sensor is sensitive to light. Light protection is therefore required during operation in the final product.



Recommended Soldering Profile

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## DEVICE MARKING

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54XXYY = Product number	XX = 01, 07 or 12 (pressure range in bar)
***** = Lot identification, for internal use at the manufacturer's, only	YY = A (high sensitivity) B (high linearity)

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## ORDERING INFORMATION

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MS54XX-YZ = Miniature SMD Pressure Sensors	XX = 01, 07 or 12 (pressure range in bar)
	Y = A (high sensitivity) B (high linearity)
	Z = M (ARCAP cap, gel filling)

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