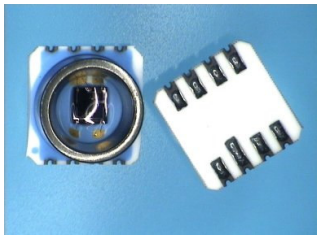
MS54XX (RoHS*) MINIATURE SMD PRESSURE SENSOR



- **1, 7, and 12 bar absolute pressure range**
- **Uncompensated**
- **Piezoresistive silicon micromachined sensor**
- **Miniature surface mount 6.2 x 6.4 mm**
- **Low noise, high sensitivity, high linearity**
- **RoHS-compatible & Pb-free***

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 micromachined 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 a highly sensitive version giving a maximal output voltage or in a highly linear version giving a linear output voltage directly proportional to the applied pressure.

Full Scale Pressure	High Sensitivity Versions		High Linearity Versions	
	Product Code	Full Scale Span / Linearity	Product Code	Full Scale Span / Linearity
1 bar	MS5401-AM	240 mV / ±0.2% FS	MS5401-BM	150 mV / ±0.05% FS
7 bar	MS5407-AM	392 mV / ±0.2% FS		
12 bar			MS5412-BM	150 mV / ±0.05% FS

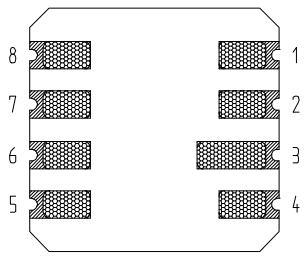
FEATURES

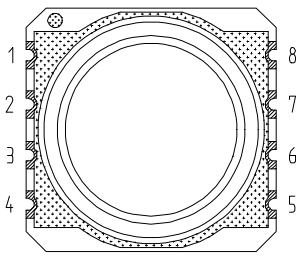
- Low cost SMD ceramic package
- Small size
- High reliability, low drift
- -40°C to +125 °C operation range
- Gel protection against humidity and water

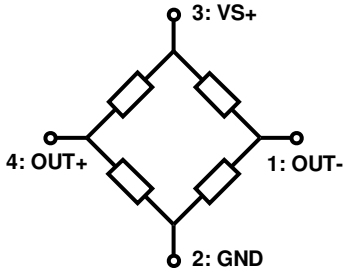
APPLICATIONS

- Absolute pressure sensor systems
- High resolution altimeters, variometers
- Barometers
- Engine controls
- Water proof watches and diver's computers
- Tire pressure monitoring systems (TPMS)

PIN CONFIGURATION







* The European RoHS directive 2002/95/EC (Restriction of the use of certain Hazardous Substances in electrical and electronic equipment) bans the use of lead, mercury, cadmium, hexavalent chromium and polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

PIN DESCRIPTION

Pin Name	Pin No.	Function
OUT-	1	Negative output voltage of Wheatstone bridge
GND	2	Ground
VS+	3	Supply voltage of Wheatstone bridge
OUT+	4	Positive output voltage of Wheatstone bridge

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Min	Max	Unit	Notes
Supply voltage	VS+	Ta = 25 °C	-	20	V	
Storage temperature	T_S		-40	+125	°C	
Overpressure MS5401-AM MS5401-BM MS5407-AM MS5412-BM	P	Ta = 25 °C	- - - -	5 10 20 30	bar	- (1) (2) -

NOTES

1) The MS5401-BM is qualified referring to ISO Standard 2281 and can withstand an absolute pressure of 11 bar in salt water or 100 m water respectively.
2) The MS5407-AM is qualified referring to ISO Standard 2281 and can withstand an absolute pressure of 21 bar in salt water or 200 m water respectively.

ELECTRICAL CHARACTERISTICS

HIGH SENSITIVITY VERSIONS

(VS+ = 5 V; Ta = 25°C)

	Parameter	Min	Typ	Max	Unit	Notes
MS5401-AM	Operating pressure range	0	-	1	bar	
	Full-scale span (FS)	190	240	290	mV	
	Sensitivity	190	240	290	mV/bar	
	Linearity	-	±0.15	±0.4	% FS	1, 6
MS5407-AM	Operating pressure range	0	-	7	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	
	Pressure hysteresis	-	-	±0.20	% FS	2, 6
	Temperature hysteresis	-	0.3	0.8	% FS	3, 6
	Repeatability	-	-	±0.20	% FS	4, 6
	Bridge resistance	3.0	3.4	3.8	kΩ	
	Temperature coefficient of resistance Temperature coefficient of span Temperature coefficient of offset	+2'400 -1'500 -80	2'900 -1'900 -	+3'300 -2'300 +80	ppm/°C ppm/°C µV/°C	5, 6 5, 6 5, 6

NOTES

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

ELECTRICAL CHARACTERISTICS (CONT.)

HIGH LINEARITY VERSIONS

(VS+ = 5 V; Ta = 25°C)

	Parameter	Min	Type	Max	Unit	Notes
MS5401-BM	Operating pressure range	0	-	1	bar	8
	Full-scale span (FS)	120	150	180	mV	
	Sensitivity	120	150	180	mV/bar	
	Linearity	-	±0.05	±0.2	% FS	1, 6
MS5412-BM	Operating pressure range	0	-	12	bar	
	Full-scale span (FS)	120	150	180	mV	
	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	
	Pressure hysteresis	-	-	±0.20	% FS	2, 6
	Temperature hysteresis	-	0.3	0.8	% FS	3, 6
	Repeatability	-	-	±0.20	% FS	4, 6, 7
	Bridge resistance	3.0	3.4	3.8	kΩ	
	Temperature coefficient of resistance Temperature coefficient of span Temperature coefficient of offset	+2'400 -1'500 -80	2'900 -1'900 -	+3'300 -2'300 +80	ppm/°C ppm/°C µV/°C	5, 6 5, 6 5, 6

NOTES

1) Deviation at one half full-scale pressure from the least squares best line fit over pressure range.
2) Maximum difference of output voltage after 1 pressure cycle at any pressure within the operating pressure range.
3) Maximum difference in offset after one thermal cycle from -40°C to +125°C.
4) Same as 2) after 10 pressure cycles.
5) Slope of the end-point straight line from 25°C to 60°C.
6) Not 100% tested.
7) MS5412-BM: Max. 0.3% FS

APPLICATION INFORMATION

GENERAL

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 micromachined silicone membrane with Pyrex glass wafer-bonded under vacuum to the backside for reference pressure. Implanted resistors make use of the piezo-resistive effect to sense pressure applied to the membrane. The sensor is mounted in a special process allowing best-offset stability making the part suitable for direct PCB assembly.

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 Sensitivity Versions (MS54XX-AM)	High Linearity Versions (MS54XX-BM)
1 bar	Variometer, Altimeter, Barometer	High End Altimeter, Medical Instrumentation
7 bar	Electronic Scale	Divers Watch, Tire Pressure, High End Electronic Scale
12 bar		Pneumatic Brake, Diving Computer

HUMIDITY, WATER PROTECTION

The MS54XX carries a anticorrosive and antimagnetic stainless steel protection cap filled with silicone gel for enhanced protection against humidity. 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 and MS5407-AM are qualified referring to the ISO Standard 2281 and can withstand a pressure of 11 bar in salt water. The concentration of the see water used for the qualification is 41 g of see salt for 1 litre of DI water.
For underwater operations as specified in ISO Standard 2281 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.

LIGHT SENSITIVITY

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.

CONNECTION TO PCB

The package outline of the module allows the use of a flexible PCB to connect it. This can be important for applications in watches and other special devices, and will also reduce mechanical stress on the device.
For applications subjected to mechanical shock, it is recommended to enhance the mechanical reliability of the solder junctions by covering the rim or the corners of MS54XX ceramic substrate with glue or Globtop-like material.

SOLDERING

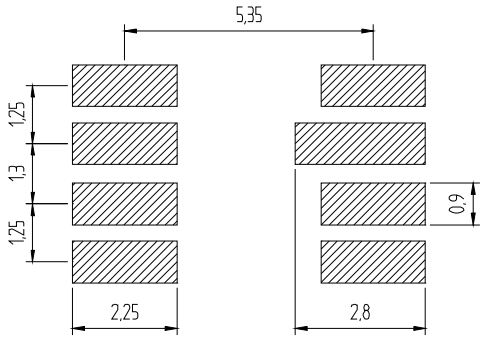
Please refer to the application note AN808 for all soldering issues.

CLEANING

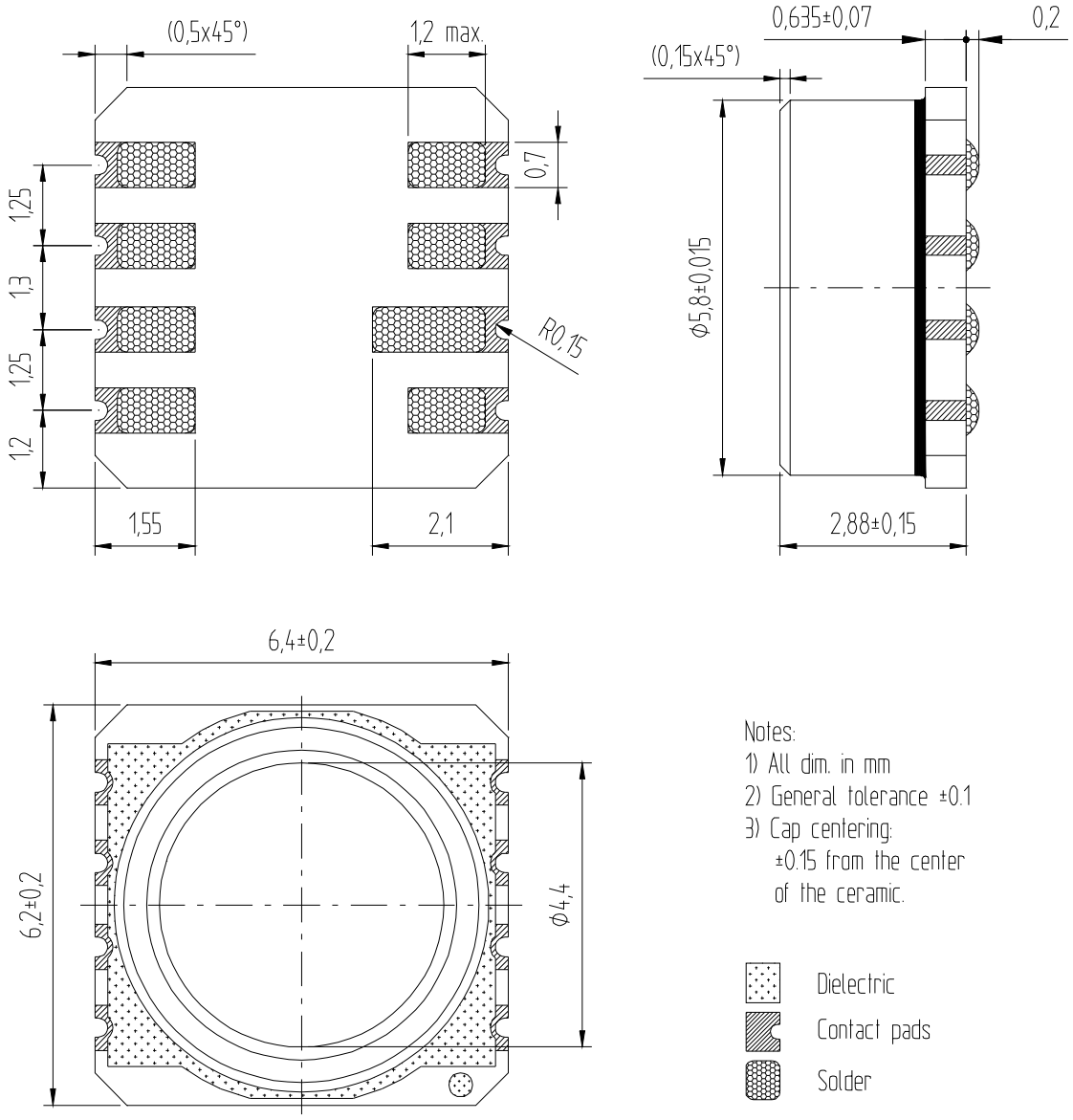
The MS54XX has been manufactured under cleanroom conditions. Each device has been inspected for the homogeneity and the cleanness of the silicone gel. It is therefore recommended to assemble the sensor under class 10'000 or better conditions. Should this not be possible, it is recommended to protect the sensor opening during assembly from entering particles and dust. To avoid cleaning of the PCB, solder paste of type "no-clean" shall be used. **Cleaning might damage the sensor.**

RECOMMENDED PAD LAYOUT

Recommended pad layout for soldering of the MS54xx on a printed circuit board



PACKAGE OUTLINES

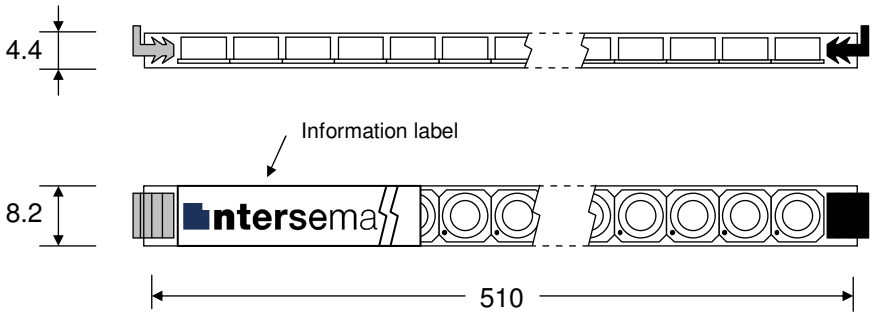


Device package outlines of **MS54XX-YM** (M = anticorrosive and antimagnetic stainless steel cap)

PACKING

The MS54XX is packed in a 51 cm (20-inch) antistatic plastic tube with rubber end-plugs of two different colours: One green and one black. The dot on the ceramic next to 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

ORDERING INFORMATION

MS5401-AM Miniature Pressure Sensor 1 bar, high sensitivity	Art.-Nr. 325401001
MS5401-BM Miniature Pressure Sensor 1 bar, high linearity	Art.-Nr. 325401000
MS5407-AM Miniature Pressure Sensor 7 bar, high sensitivity	Art.-Nr. 325407000
MS5412-BM Miniature Pressure Sensor 12 bar, high linearity	Art.-Nr. 325412000

A = high sensitivity
B = high linearity
M = anticorrosive and antimagnetic stainless steel cap

FACTORY CONTACTS

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