

MS54XX

Miniature SMD Pressure Sensor

RoHS

FEATURES

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

APPLICATIONS

- High resolution altimeters, variometers
- Barometers
- Engine management
- Waterproof watches and diving computers

SPECIFICATIONS

- 1, 7, and 12 bar absolute pressure range
- Uncompensated
- Piezoresistive silicon micromachined sensor
- Miniature surface mount
- Ceramic carrier
- Low noise, high sensitivity, high linearity

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. The MS54XX can be delivered in a high sensitivity version giving a maximal output voltage or in a high linearity version. Both versions provide an output voltage directly proportional to the applied pressure.

Carrier	Full scale pressure	High Sensitivity Versions			High Linearity Versions		
		Product code	Full scale span	Linearity	Product code	Full scale span	Linearity
Ceramic	1 bar	MS5401-AM	240 mV	±0.20 % FS	MS5401-BM	150 mV	±0.05 % FS
	7 bar	MS5407-AM	392 mV	±0.20 % FS			
	12 bar				MS5412-BM	150 mV	±0.05 % FS

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PERFORMANCE SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Min	Max	Unit
Supply voltage	VS+	Ta = 25 °C	-	20	V
Storage temperature	T_S		-40	+125	°C
Overpressure MS5401-AM MS5401-BM (1) MS5407-AM (2) MS5412-BM	P	Ta = 25 °C	- - - - -	 5 10 21 30	bar

NOTES

1) The MS5401-BM is qualified referring to ISO Standard 22810 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 22810 and can withstand an absolute pressure of 21 bar in salt water or 200 m water specifically.

ELECTRICAL CHARACTERISTICS HIGH SENSITIVITY VERSION

(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	±0.40	% 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	±040	% 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
	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.

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PERFORMANCE SPECIFICATIONS (CONTINUED)

ELECTRICAL CHARACTERISTICS HIGH LINEARITY VERSIONS

(Vs+ = 5 V; Ta = 25 °C)

	Parameter	Min	Typ	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	±0.20	% FS	1, 6
MS5412-BM	Operating pressure range	0	-	12	bar	8
	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
8) This sensor family is optimized for the linearity; it is suitable for applications with higher pressure where the linearity requirement is less critical.

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APPLICATION INFORMATION

GENERAL

The MS54XX is a miniaturized absolute pressure sensor series which has been designed as a surface mount device (SMD). Its main advantages are the high performance of the semiconductor sensor and a design which makes it suitable for applications requiring small dimensions and cost efficiency.

The sensor element of the MS54XX consists of a micromachined silicon membrane with borosilicate glass wafer-bonded under vacuum to the back side for reference pressure. Implanted resistors make use of the piezo-resistive effect to sense pressure applied to the membrane. The sensor is mounted using a special process allowing best offset stability making the device suitable for direct PCB assembly.

Typical applications for this miniaturized 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-AX)	High Linearity Versions (MS54XX-BX)
1 bar	Variometer, Altimeter, Barometer	High End Altimeter, Medical Instrumentation
7 bar	Divers Watch, Tire Pressure, Electronic Scale	High End Electronic Scale
12 bar		Pneumatic Brake, Diving Computer

HUMIDITY, WATER PROTECTION

MS54XX-XM WITH METAL CAP

The MS54XX-AM / - BMXXBA has an anticorrosive and antimagnetic metallic 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 advisable to rinse with clean water afterwards. Special care has to be taken not to mechanically damage the gel. Damaged gel may 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 alloy in order to avoid any galvanic effects within the end product. The MS5401-BM is qualified referring to the ISO Standard 22810 and can withstand a pressure of 11 bar in salt water. The concentration of the sea water used for the qualification is 41 g of sea salt per 1 litre of DI water. The MS5407-BM satisfies salt-water testing with a pressure capability of 21 bar.
For underwater operations as specified in ISO Standard 22810 it is important to seal the sensor with a rubber O-ring around the metal cap. Any salt water reaching the contact side (ceramic and pads) of the sensor could lead to permanent damage. Especially for "water-resistant 100 m" watches and for diving computers, it is recommended to provide a stable mechanical pusher from the backside of the sensor; otherwise the overpressure may push the sensor backwards and even deform the electronic board on which the sensor is mounted.

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LIGHT SENSITIVITY

The MS54XX is sensitive to sunlight (visible and near-infrared spectrum). 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 as it effects the measurement. 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 enables 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

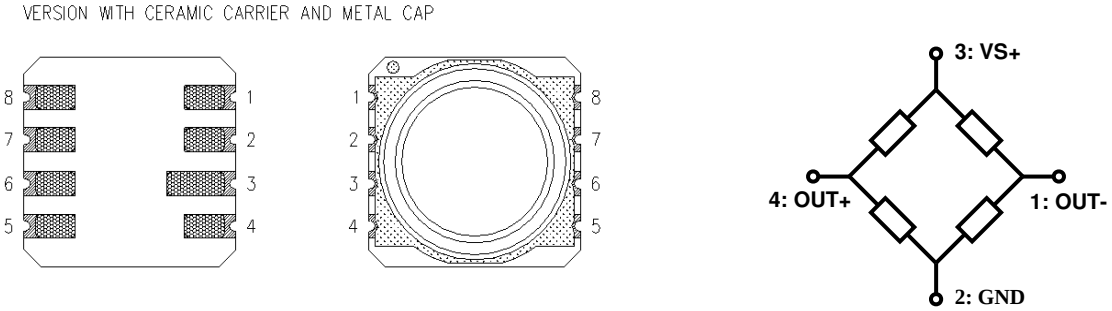
Please refer to the application note AN808 for all soldering issues.

CLEANING

The MS54XX has been manufactured under clean-room conditions. Each device is inspected for homogeneity and 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” must be used. **Cleaning might damage the sensor.**

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PIN CONFIGURATION

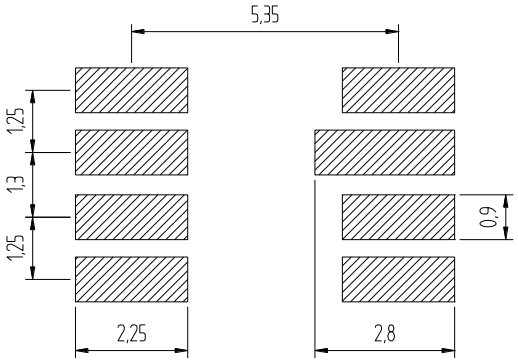


PIN DESCRIPTION

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

RECOMMENDED PAD LAYOUT

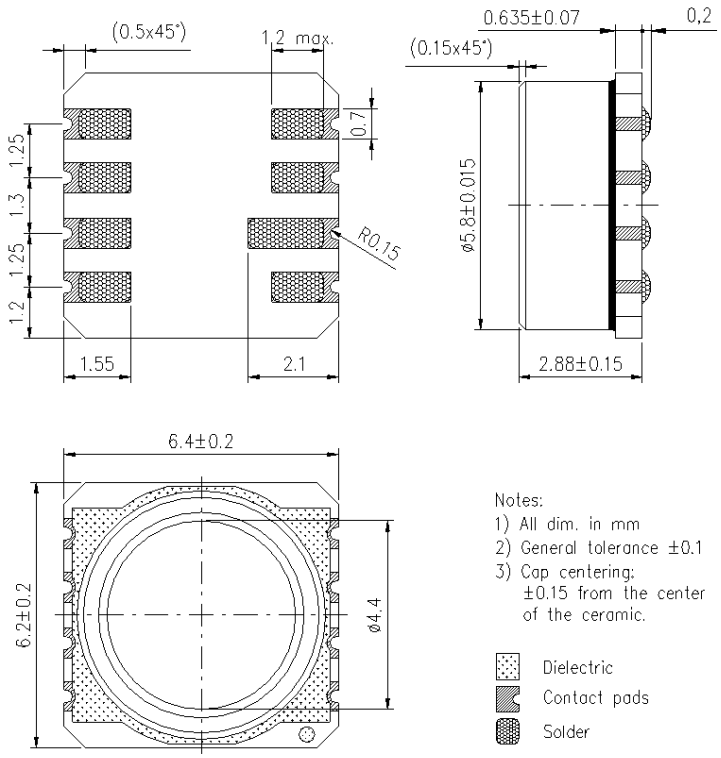
Recommended pad layout for soldering of the MS54XX on a printed circuit board



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PACKAGE OUTLINES

CERAMIC CARRIER AND METAL CAP

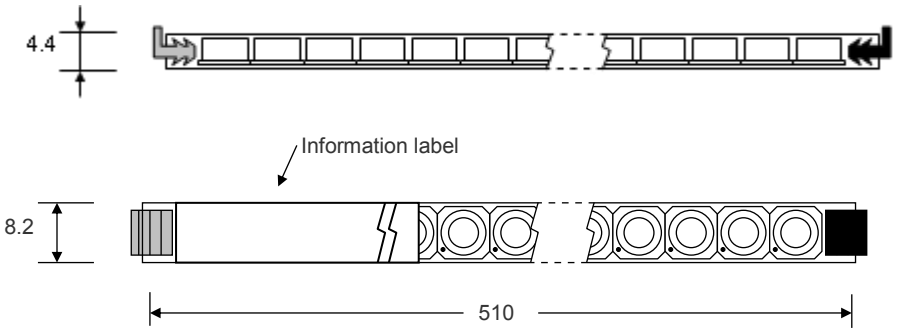


Device package outlines of **MS54XX-AM and MS54XX-BM**
(M = anticorrosive and antimagnetic stainless steel cap)

PACKAGING

The MS54XX is packed in 51 cm (20-inch) antistatic plastic tubes with rubber end-plugs of different colors: one green and one black. The dot on the carrier 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

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ORDERING INFORMATION

Product code	Product	Art. No	Package	Delivery Form
MS5401-AM	Miniature pressure sensor 1 bar, High sensitivity	325401001-00	Ceramic carrier	Tube
		325401001-50	Ceramic carrier	Tape and Reel
		325401006-00	Ceramic carrier, without transparent gel	Tube
MS5401-BM	Pressure sensor 1 bar, High linearity	325401000-00	Ceramic carrier	Tube
		325401000-50	Ceramic carrier	Tape and Reel
		325401002-00	Ceramic carrier, without transparent gel	Tube
MS5407-AM	Miniature pressure sensor 7 bar, High sensitivity	325407000-00	Ceramic carrier	Tube
		325407000-50	Ceramic carrier	Tape and Reel
		325407001-00	Ceramic carrier, without transparent gel	Tube
MS5412-BM	Pressure sensor 12 bar, High linearity	325412000-00	Ceramic carrier	Tube
		325412000-50	Ceramic carrier	Tape and Reel

AX = high sensitivity
BX = high linearity
XM = anticorrosive and antimagnetic metallic cap

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