

MTCS 2300 - Pressure

Thermal Conductivity Sensor for miniature Pirani gauge

Applications

Miniature Pirani devices and sensors have applications including:

- Leak detection
- Propulsion
- Semiconductor manufacturing (e.g., sputtering chambers)
- Freeze dryers
- Vacuum meat packing machines
- Vacuum coating
- Load locks

In general, pressure measurement following Pirani principle in rough environments with power and size constraints, such as in analytical portable instruments or small mechanical pumping systems

Silicon Pirani gauge MTCS characteristics

The packaged sensor is available with different possible packaging options:

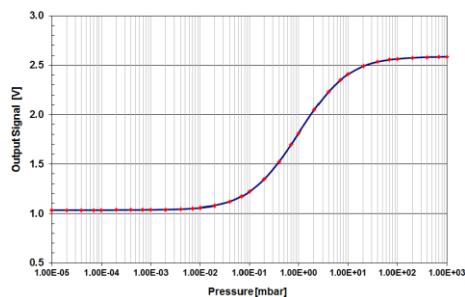
- Only the sensing die, realizing a miniature hot wire in air
- The sensing die with a silicon lid, creating a gap between the hot and cold part of 10 μm or 20 μm . These small gaps enhance the sensitivity of the Pirani principle at pressures between 100-1000 mbar

General description

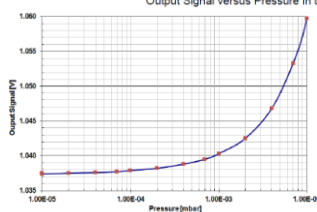
The **MTCS2300** pressure gauge, using thermal conductance measurement according to Pirani principle, is a dedicated MEMS device mounted in a small TO8 or TO39 package. The sensor incorporates one large micro-machined low stress silicon nitride membrane with two thin film resistors for heating and two reference resistors for compensation on silicon bulk using Ni-Pt resistors MEMS technologies in a miniature package. This MEMS structure, combined with simple CMOS standard integrated circuits for current source and temperature analysis, is a suitable choice for size-critical vacuum OEM sensing solution requiring ultra-low power consumption with an excellent signal-to-noise ratio and resistance to corrosive gas.

Features

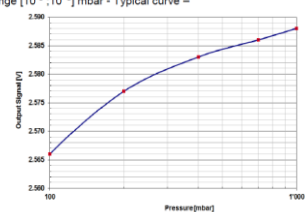
- Extended measuring range from 10^{-4} to 1000 mbar
- MEMS Micro machined silicon sensor with perfect matching of the sensor geometry and sensor resistors
- Ultra small sensor gas volume such as $< 0.1 \text{ cm}^3$
- Pirani microwire-to-wall distance adjusted by silicon micromachining, down to 10 μm or 20 μm with excellent sensor reproducibility
- Ultra-low power consumption in operation ($< 6 \text{ mW}$) due to the use of MEMS based silicon sensor with large integrated resistors such as 250 Ohms and small heated mass
- Ultra-fast response time $< 50 \text{ ms}$
- Easy temperature compensation due to similar heating and reference resistors, realized in micro structured platinum-nickel thin film process
- Insensitive to mounting position
- High shock survivability ($>1000 \text{ G}$) due to small size
- Resistance to corrosive gas as Hydrogen, using gold contact



Output Signal versus Pressure in the range $[10^{-5}; 10^3]$ mbar - Typical curve -



Response detail in the range $[10^{-5}; 10^{-2}]$ mbar



Response detail in the range $[100; 1'000]$ mbar

MTCS2301/MTCS2302 sensor electrical characteristics

	Symbol	Min	Typical	Max	Units
Measuring resistor (R_{m1} and R_{m2})	R_{m1} and R_{m2}	110	120	135	Ω
Reference resistor	R_{t1} and R_{t2}	240	270	300	Ω
Absolute ($R_{m1}-R_{m2}$)			< 1.5		Ω
Absolute ($R_{t1}-R_{t2}$)			< 5.5		Ω
$R_{tx}/(R_{m1} + R_{m2})$			1.0 to 1.2		
Thermal coefficient	α	0.0045	0.0050	0.0055	/°K
Defined gas gap between hot and cold part		10	20	200	μm

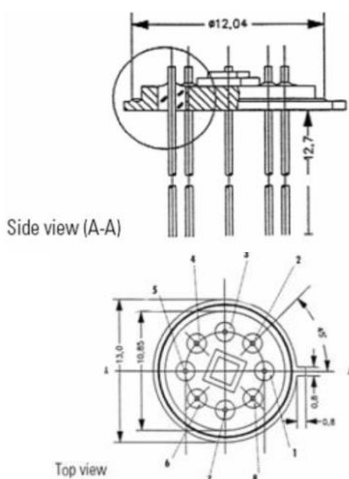
Sensor package information

MTCS sensor in TO8 metallic header, with 8 isolated leads (TO8 size)

Package size:

External diameter: 13.00 mm

Internal diameter: 10.85 mm



Bonding:

Gold or aluminum wires, 30 μm diameter

Pins list:

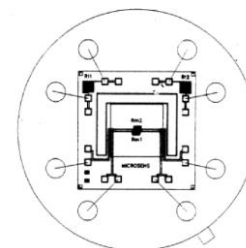
1 - 8: R_{m1}

2 - 7: R_{m2}

3 - 4: R_t

5 - 6: R_T (temp. resistor)

○ : Pins connected to case

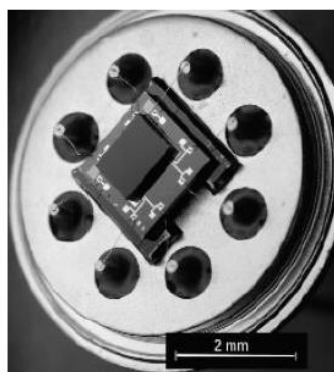
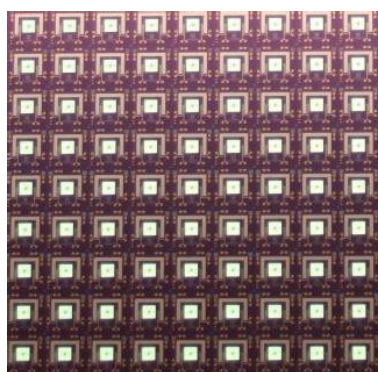


Mounting principle and parts exposed to vacuum:

- Dies glued with epoxy glue (120°C, 80 minute curing, ultra-low degassing)
- Material exposed to vacuum: gold or aluminum, bulk silicon, silicon dioxide, silicon nitride, fused quartz

Sensor package remarks:

MTCS sensor can also be directly PCB or COB mounted.



Ordering Information

MTCS230X	X = 1 : MTCS2301 = Al contact	X = 2 : MTCS2302 = Au contact
<u>Part number</u>	<u>Description</u>	
MTCS230X-0	Only one sensing die, no silicon cap or silicon lid, in TO8	
MTCS230X-10	Sensing die with a cap lid of 10 μm air gap, in TO8	
MTCS230X-20	Sensing die with a cap lid of 20 μm air gap, in TO8	

MTCS2303/MTCS2304 sensor electrical characteristics

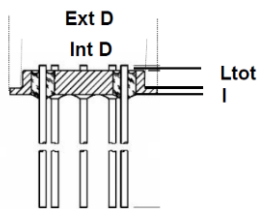
	Symbol	Min	Typical	Max	Units
Measuring resistor (R_{m1} and R_{m2})	R_{m1} and R_{m2}	110	120	135	Ω
Reference resistor	R_t	240	270	300	Ω
Absolute ($R_{m1}-R_{m2}$)			< 1.5		Ω
Absolute ($R_{t1}-R_{t2}$)			< 5.5		Ω
$R_{tx}/(R_{m1} + R_{m2})$			1.0 to 1.2		
Thermal coefficient	α	0.0045	0.0050	0.0055	$^{\circ}\text{K}$
Defined gas gap between hot and cold part		10	20	200	μm

Sensor package information

MTCS sensor in TO5-6 metallic header, with 6 isolated leads and 2 ground leads (TO39 size)

Package size:

External diameter Ext D: 9.00 mm
 Internal diameter Int D: 8.65 mm
 Total Thickness Ltot: 1.55 mm
 Border thickness l: 0.55 mm



Mounting principle and parts exposed to vacuum:

- Dies glued with epoxy glue (120°C, 80 minute curing, ultra-low degassing)
- Material exposed to vacuum: gold or aluminum, bulk silicon, silicon dioxide, silicon nitride, fused quartz

Sensor package remarks:

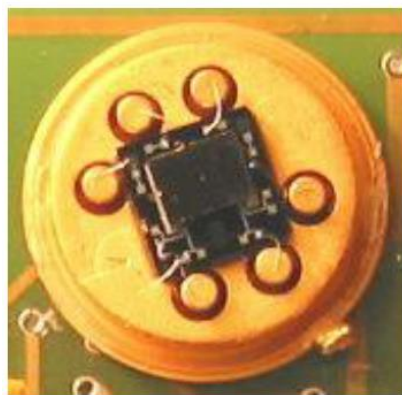
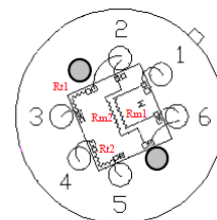
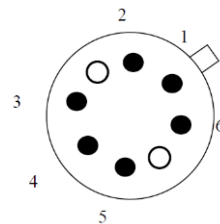
MTCS sensor can also be directly PCB or COB mounted.

Bonding:

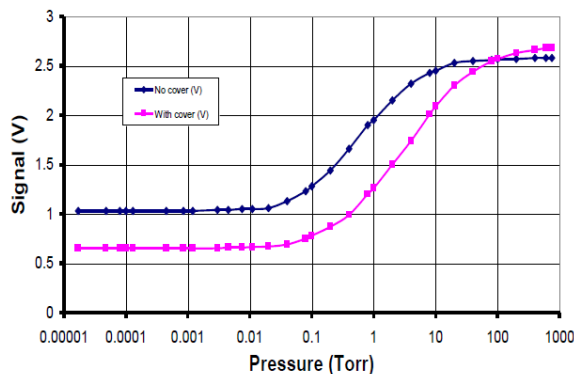
Gold or aluminum wires, 30 μm diameter

Pins list:

- 1 - 6 : R_{m1}
- 6 - 2 : R_{m2}
- 1 - 2 : $R_m = R_{m1} + R_{m2}$
- 2 - 3 : R_t
- 4 - 5 : R_T (temp. resistor)
- : Pins connected to case



Pressure signal of miniature Pirani sensor MTCS2303 using a constant temperature interface



Ordering Information

Part number	Description
MTCS230X	X = 3 : MTCS2303 = Al contact X = 4 : MTCS2304 = Au contact
MTCS230X-0	Only one sensing die, no silicon cap or silicon lid, in TO5-6
MTCS230X-10	Sensing die with a cap lid of 10 μm air gap, in TO5-6
MTCS230X-20	Sensing die with a cap lid of 20 μm air gap, in TO5-6

MTCS2305/MTCS2306 sensor electrical characteristics

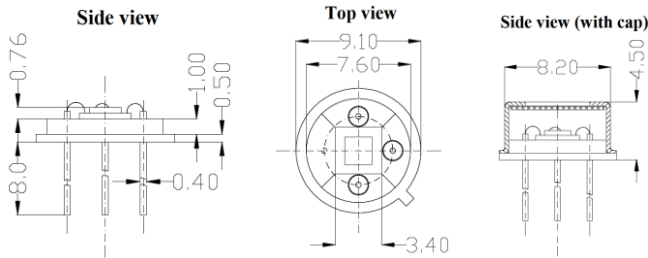
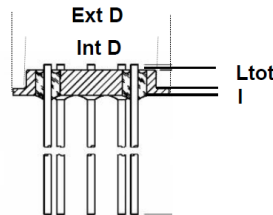
	Symbol	Min	Typical	Max	Units
Measuring resistor Rm	Rm	220	240	270	Ω
Reference resistor Rt	Rt	480	540	600	Ω
Rt/Rm			2.1 to 2.4		Ω
Thermal coefficient	α	0.0045	0.0050	0.0055	/°K
Defined gas gap between hot and cold part		10	20	200	μm

Sensor package information

MTCS sensor in TO5-4 metallic header, with 3 isolated leads and 1 ground leads (TO39 type)

Package size:

(deliver with or without metallic cap)
 External diameter Ext D: 9.10 mm
 Internal diameter Int D: 7.60 mm
 Total Thickness Ltot: 1.76 mm
 Border thickness l: 0.50 mm

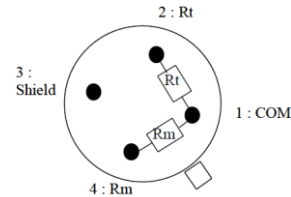


Bonding:

Aluminum wires, 30 μm diameter

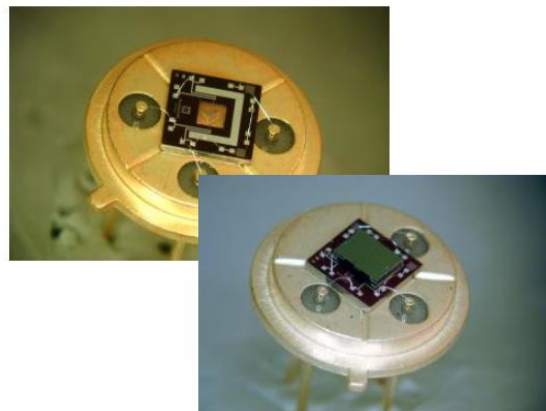
Pins list:

- 1 : COM
- 2 : Rt
- 3 : Shield
- 4 : Rm



Mounting principle and parts exposed to vacuum:

- Dies glued with epoxy glue (120°C, 80 minute curing, ultra-low degassing)
- Material exposed to vacuum: gold or aluminum, bulk silicon, silicon dioxide, silicon nitride, fused quartz



Ordering Information

Part number	Description
MTCS230X	X = 5 : MTCS2305 = Al contact X = 6 : MTCS2306 = Au contact
MTCS230X-0	Only one sensing die, no silicon cap or silicon lid, in TO5-4
MTCS230X-10	Sensing die with a cap lid of 10 μm air gap, in TO5-4
MTCS230X-20	Sensing die with a cap lid of 20 μm air gap, in TO5-4

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