

	Technical Specification	TS	1115
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For this revision		
Function	Date	Signature
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Revision (Rev) History

Rev	Problem Report	Released Date/ Approved By	Description
00	Archive 855/14	2014-08-27/ SST	Initial version.
01	EM1705-15	2015-04-22/ SST	Added variant
02	EM1719-15	2015-08-19/ PTN	Added variant P/N 32127, added relaxed spec -50°C to -55°C
03	EM1790-16	2016-02-04/ AE	Added variant P/N 32147. Changed pressure range for P/N32073 to 2495mbar.
04	EM1946-17	2017-09-11/ AE	Added variant P/N 32163, P/N 32254 and P/N 32255. Added operating temperature range for all products.
05	EM1988-18	2018-06-12/ AE	Added variant 32180 550 to 1150mbar absolute pressure 0.1 bar. Added P/N32075 35-2800mb, P/N32076 35-1200. Clean P/N listing in the tables 3-3 and 3-4, Added P/N32254 35 to 1200 , P/N32255 -10 – 1500 and P/N32163 -500 to 500mbar
06	EM2087/19	2019-06-27/ SST	Updated PN32076 pressure range: 35mbar - 1400mbar. Added variant PN32620: 35mbar to 1200mbar, -40°C to +85°C
07	PRR-377	2022-05-10/ SST	Updated PN32163 pressure range to ±750 mbar, total pressure error to ±0.25 / ±0.6 mbar and long-term stability to ±0.6 mbar / 5 years.
08	589	2023-09-11/ RG	Added PN33023. Added a new table for absolute sensors. Updated Figure 1.
09	660	2024-04-02 / AV	Added PN32742 pressure range 34mbar – 3600mbar, maximum overpressure 4.0 bar.
10	659	2024-07-04 / AV	Added PN33118 TP1200 001A 09 with pressure range 90 to 1355 mbar and temperature range -10 to +60°C. Changed table formatting
11	682, 737	2024-12-05 / AV	Added PN 33173 and 32741. Updated storage temperature to 105°C for all products. Changed name of 32742 and 33173
12	762	2024-12-19 / AV	Removed PN 33173 and 32741.

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1 Introduction

1.1 Purpose and Scope

The MEMSCAP TP1200 series digital-output pressure transducer is a fully calibrated, high precision device.

The TP1200 contains a MEMSCAP pressure sensor, Analog to Digital Converter (ADC) and Electrically Erasable Programmable Read-Only Memory (EEPROM) with compensation data.

Temperature and non-linearity effects need to be externally compensated by using data stored in the EEPROM. More than 400 sets of measurements, covering a wide range of temperature and pressure combinations are used as the input to the compensation data.

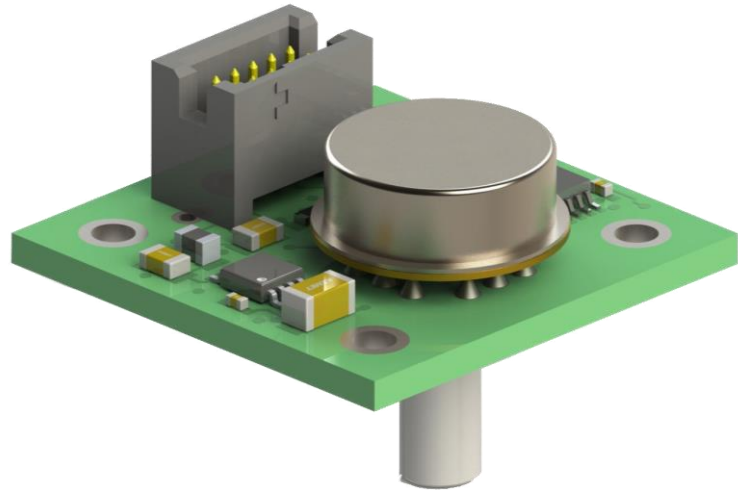


Figure 1 TP1200 – Absolute Pressure


This ‘board to board’ solution creates an opportunity to use a pre-calibrated sensor that easily can be integrated into a final product. The capability of changing transducers without the need for recalibration, makes the TP1200 an ideal choice in maintenance, repair and overhaul (MRO) situations.

1.2 Configuration Management

This document is categorized as a CC1 document and shall therefore follow the CC1 workflow defined in DOC5049 Configuration Management Plan.

1.3 Acronyms and Abbreviations

ADC	Analogue to Digital Converter
CC1	Control Category 1
EEPROM	Electrically Erasable Programmable Read Only Memory
FS	Full Scale
FSO	Full Scale Output
LUT	Look-Up Table.
MRO	Maintenance, Repair and Overhaul
SPI	Serial Peripheral Interface

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1.4 Reference Documents

DOC5049 Configuration Management Plan

2 Specifications

2.1 Performance and electrical parameters

The electrical parameters of the transducer are listed in Table 2-1. General performance parameters are listed in Table 2-2. Variants of the product with specific specifications are listed in Table 2-3, Table 2-4 and Table 2-5 .

Parameter	Min	Typical	Max	Unit
Power-supply	6.5		20	V
Current consumption ¹⁾		0.8	2 ²⁾	mA
V _{IH} - High-level input voltage	2.0		5.5	V
V _{IL} - Low-level input voltage	0		0.8	V
V _{OH} - High-level output voltage		5.0		V
V _{OL} - Low-level output voltage		0		V
SPI clock rate (SCLK) ³⁾		0.5		MHz


Table 2-1 Electrical parameters

¹⁾ All measurements is specified without write protect connected, and after power-up time (steady-state).

²⁾ Typical in-rush current peak value is 1,5A for a short time (< 50μs) when transducer is first turned on at max input voltage.

Typical in-rush current peak value is 700mA for a short time (< 40μs) when transducer is first turned on at min input voltage.

³⁾ For more details on the SPI Timing Characteristics, refer to the Analog Devices AD7793 Data Sheet.

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Parameter	Min	Typical	Max	Unit
Pressure ranges (absolute, relative or differential)	See Table 2-3, Table 2-4 and Table 2-5			mbar
Overpressure			150 Exception for PN32742: 4.0 bar = 111%FSO	% FSO
Total pressure error (absolute)	See Table 2-3 and Table 2-4			mbar
Total pressure error (differential and relative)	See Table 2-5			mbar
Long term stability at ambient temperature) ⁴⁾	See Table 2-3, Table 2-4 and Table 2-5			mbar/5 years
Repeatability and mechanical hysteresis			±0.005	% FSO
Pressure resolution		<0.0005		% FSO
Output noise		±0.005		% FSO
Conversion time ^{5), 6)}		15		ms
Total temperature error			±2	°C
Temperature resolution		<0.01		°C
Calibration temperature range	See Table 2-3, Table 2-4 and Table 2-5			°C
Weight			10	g


Table 2-2 General performance

The PCB is designed according to IPC-2221A and produced according to IPC-6012B.

⁴ Most of long term stability drift is in the beginning of the product lifetime.

⁵ Specified for typical SPI clock rate

⁶ PN33118 has typical conversion time of 23 ms


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	MEMSCAP Part Number					
Parameter	32074	32147	32076	32254	32180	32620
Part name	TP1200 001A 00	TP1200 001A 01	TP1200 001A 02	TP1200 001A 03	TP1200 001A 04	TP1200 001A 06
Pressure range [mbar]	35 to 1200	35 to 1400	35 to 1400	35 to 1200	550 to 1150 at -23 to 85 °C	35 to 1200
					Extended range: 162 to 2000 within - 40 to 85 °C	
Total pressure error [mbar]	±0.3	±0.3	±0.33	±0.25	±2.0	±0.25
					Extended range: ±4.0	
Total pressure error [mbar] for temperature range -50°C to - 55°C ⁷⁾	±0.4	±0.5	N/A	±0.4	N/A	N/A
Long term stability (at ambient temperature) [mbar/5years]	±0.5	±0.5	±0.25	±0.25	±0.5 ⁸⁾	±0.25
Calibration temperature range [°C]	-55 to +85	-55 to +85	-40 to +85	-55 to +85	-40 to +85	-40 to +85
Operating temperature range [°C]	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85
Storage temperature [°C]	-55 to +105	-55 to +105	-55 to +105	-55 to +105	-55 to +105	-55 to +105
Electrical interface	Samtec TFM-105-11-S-D					

Table 2-3 Product Variants, Absolute Pressure

⁷ Are only verified to be within this specification before shipment, outside operating temperature range.

⁸ With each year from acceptance test onwards the transducer accuracy band may increase by +/-0.4 mbar. However over service life, the accuracy band shall be maximum +/-2.6 mbar over 30 years.


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Parameter	MEMSCAP Part Number				
	33023	33118 ⁹⁾	32073	32075	32742
Part name	TP1200 001A 08	TP1200 001A 09	TP1200 002A 00	TP1200 002A 01	TP1200 002A 03
Pressure range [mbar]	27 to 1500	90 to 1355	35 to 2495	35 to 2800	34 to 3600
Total pressure error [mbar]	±0.25	±0.10 (±0.15 from 1090 to 1355 mbar)	±0.6	±0.6	±0.55 (0.015%FSO)
Total pressure error [mbar] for temperature range -50°C to -55°C ¹⁰⁾	N/A	N/A	±0.7	N/A	N/A
Long term stability (at ambient temperature) [mbar/5years]	±0.25	±0.25	±1.0	±0.25	±0.55 (0.015%FSO)
Calibration temperature range [°C]	-40 to +85	-10 to +60	-55 to +85	-40 to +85	-40 to +85
Operating temperature range [°C]	-40 to +85	-10 to +60	-40 to +85	-40 to +85	-40 to +85
Storage temperature [°C]	-55 to +105	-55 to +105	-55 to +105	-55 to +105	-55 to +105
Electrical interface	Samtec TFM-105-11-S-D				

Table 2-4 Product Variants, Absolute Pressure

⁹ PN33118 has typical conversion time of 23 ms

¹⁰ Are only verified to be within this specification before shipment, outside operating temperature range.

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Parameter	MEMSCAP Part Number				
	32072	32071	32163	32127	32255
Part name	TP1200 00D5 00	TP1200 001D 00	TP1200 001D 01	TP1200 002D 00	TP1200 002D 01
Pressure range [mbar]	0 to 500	0 to 1000	-750 to 750	-10 to 1500	-10 to 1500
Total pressure error [mbar]	±0.3	±0.6	±0.25	±0.37	±0.25
Total pressure error [mbar] for temperature range -50°C to -55°C ¹¹⁾	±0.4	±0.7	±0.6	±0.5	±0.6
Long term stability (at ambient temperature) [mbar/5years]	±0.5	±1.0	±0.6	±2.0	±0.6
Calibration temperature range [°C]	-55 to +85	-55 to +85	-55 to +85	-55 to +85	-55 to +85
Operating temperature range [°C]	-40 to +85	-40 to +85	-40 to +85	-40 to +85	-40 to +85
Storage temperature [°C]	-55 to +105	-55 to +105	-55 to +105	-55 to +105	-55 to +105
Electrical interface	Samtec TFM-105-11-S-D				

Table 2-5 Product Variants, Differential Pressure

The connector Samtec TFM-105-11-S-D mates with Samtec SFM-105-01-S-D.

2.2 Mechanical Dimensions

The mechanical dimensions of the TP1200 transducer are outlined in Figure 2, Figure 3 and Figure 4. Note that these figures are for reference only. Mounting holes is 2,20 mm in diameter.

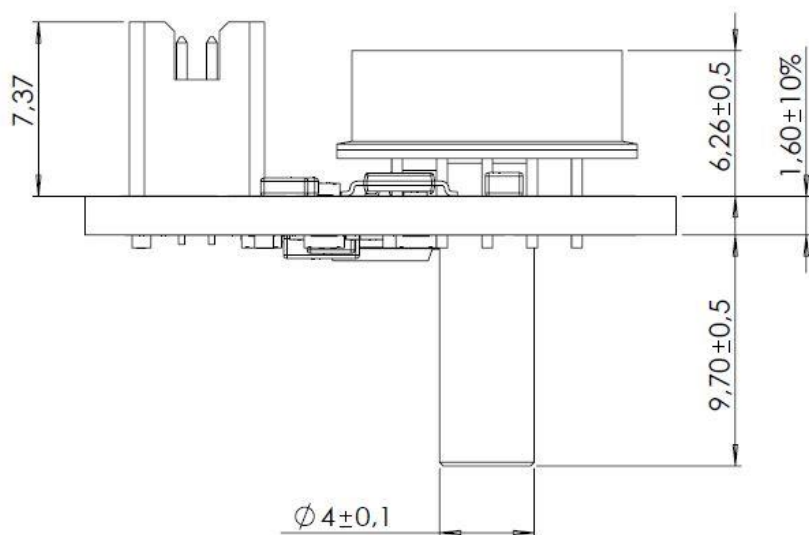


Figure 2 Mechanical dimensions TP1200 absolute transducer in side view (mm)

¹¹ Are only verified to be within this specification before shipment, outside operating temperature range.

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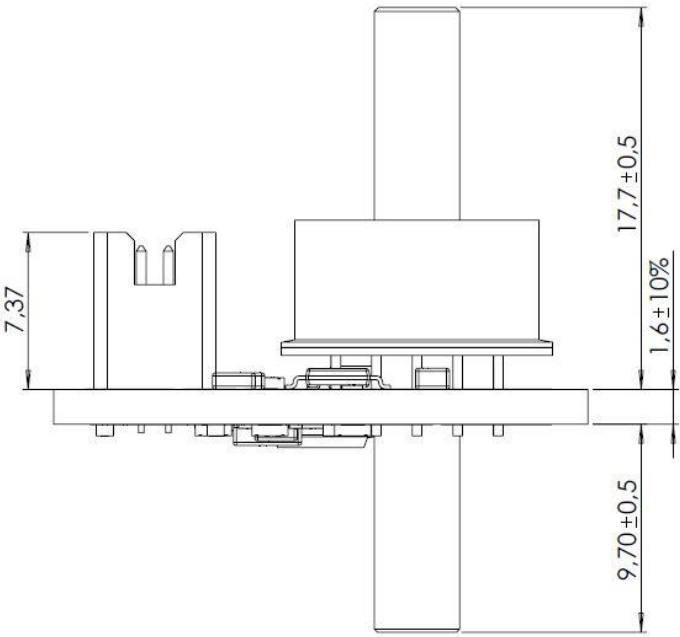


Figure 3 Mechanical dimensions TP1200 differential transducer in side view (mm)

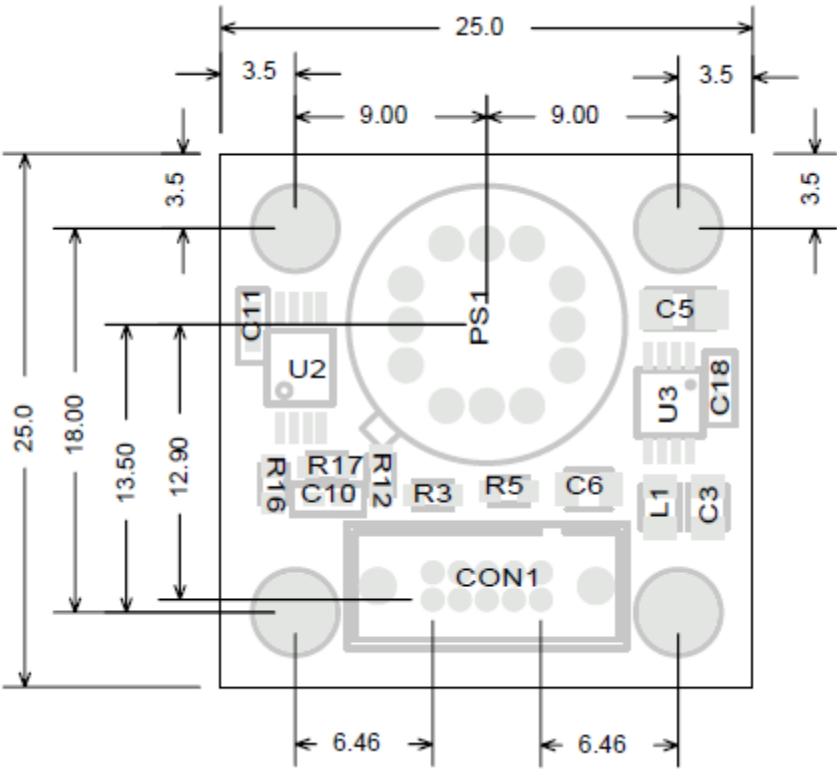



Figure 4 Mechanical dimensions top view (mm)

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2.3 Electrical Interface

The connector with pin configuration in Figure 5 is used to power up and communicate with the transducer. Table 2-6 shows the pin functions. A Samtec type: TFM-105-11-S-D connector is mounted on the TP1200. This board to board connector has 0.76µm gold on contacts and mates with Samtec type: SFM-105-01-S-D.

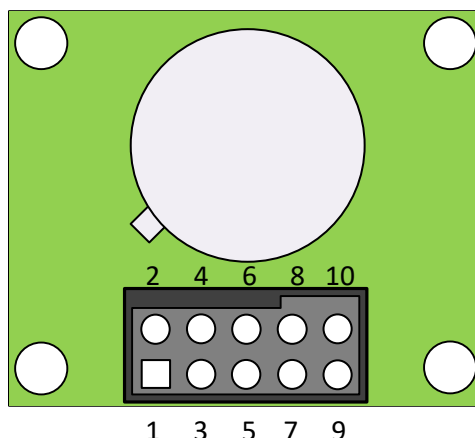


Figure 5 Pin configuration


Pin number	Function	I/O	Description
1	Supply voltage	I	
2	EE_CS	I	EEPROM chip select input pin (active low).
3	EE_WP	I	EEPROM write protect input pin (active low).
4	SCLK	I	SPI clock input to EEPROM and ADC.
5	MISO	O	SPI data output from EEPROM and ADC.
6	VCC_ERR	O	Low signal indicates too low voltage on internal voltage regulator.
7	ADC_CS	I	ADC chip select input pin (active low).
8	NC	-	No connection. May be internally connected in the transducer
9	GND	I	Common ground for supply voltage and communications
10	MOSI	I	SPI input pin to EEPROM and ADC.

Table 2-6 Pin functions

3 Safety features

These features ensure safe operation of the TP1200:

- Error detection (CRC) on data structure in EEPROM.
- Hardware write protection of contents in EEPROM.
- Low voltage error detection from the regulator.

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3.1 CRC

The EEPROM contents shall be protected with a 32-bit CRC.

3.2 EEPROM write protection

The contents of the EEPROM are protected by a hardware lock. If this hardware lock is active, it is not possible to modify the contents of the EEPROM by an external system, unless there is a hardware error present. The hardware lock is implemented as an active low write protect input signal to the EEPROM. This input signal is a pin on the connector, which when connected to 0V will enable the hardware lock. A pull-down resistor is implemented on this feature to increase the security of hardware lock. It is recommended to enable the hardware lock when the TP1200 is used in critical systems.

In addition to the hardware lock the EEPROM has a software write protection. The protection is enabled as default and must be turned off via software in addition before the EEPROM becomes writable.

3.3 Low voltage detection

The VCC ERROR is an open collector output from a voltage regulator with the series 470R resistor.

The error detection comparator output produces a logic low output whenever the voltage regulator falls out of regulation by more than approximately 5%.

The VCC ERROR output pin can be monitored to detect a state where the TP1200 may be out of specified accuracy. This VCC ERROR is an output from the regulator, available as a pin on the connector. The output is logical low when an error is present. This output can be used to detect if the power-supply is out of specification.

3.3.1 The importance of monitoring the VCC ERROR output line

Monitoring this output for failure detection is highly recommended and important because the TP1200 functionality is still maintained even if a lack of input voltage occurs.

The TP1200 low current consumption of 800µA allows the data communication lines to maintain the TP1200's operation and functionality. A noticeable pressure drop of typical ~0,4mbar and ~0,5°C temperature drop will occur if the input voltage is absent, or the input voltage drops below +5,5 V.