MCP-H11 I2C Series

Features

- Supply voltage: 1.8V to 5.5V
- Pressure range: -100Kpa to 1000Kpa
- Standby current: <0.2μA
- Operation temperature: -40 to +85℃
- High-speed I²C digital output interface
- Fully data compensated



Applications

- Blocked Filter Detection
- Altitude and Airspeed Measurements
- Medical Instruments
- Fire Suppression System
- Panel Meter
- Air Movement/Environmental Controls
- Pneumatic Controls

Descriptions

The sensor pressure and temperature outputs are digitized by a high resolution 24-bit ADC. Data compensation is integrated internally to save the effort of the external host MCU system. Easy command-based data acquisition interface and programmable interrupt control is available. Combining the pressure sensor with a signal-conditioning ASIC in a single package simplifies the use of advanced silicon micro-machined pressure sensors. Pressure signal can be acquired from the digital interface. High performance digital output pressure (24bit) and temperature (16bit) transducer designed to meet the strictest requirements from OEM customers.

1. Block Diagram…….. 3

2. Mechanical and Electrical Specifications..... 3

2.1 Pressure and Temperature Characteristics..... 3

2.2 Electrical Characteristics..... 4

2.3 Absolute Maximum Rating..... 4

3. I2C Interface..... 5

3.1 I²C Device and Register Address..... 5

3.2 I²C Specification..... 5

3.3 Register Map..... 6

4. Work mode..... 9

4.1 Single-shot Pressure Signal Conversion..... 9

4.2 Single-shot Temperature Signal Conversion..... 9

4.3 Combined Conversion..... 9

4.4 Sleep Conversion..... 9

5. Get Pressure and Temperature Data..... 10

5.1 Temperature Calculate..... 10

5.2 Pressure Calculate..... 10

6. Ordering Guide 10

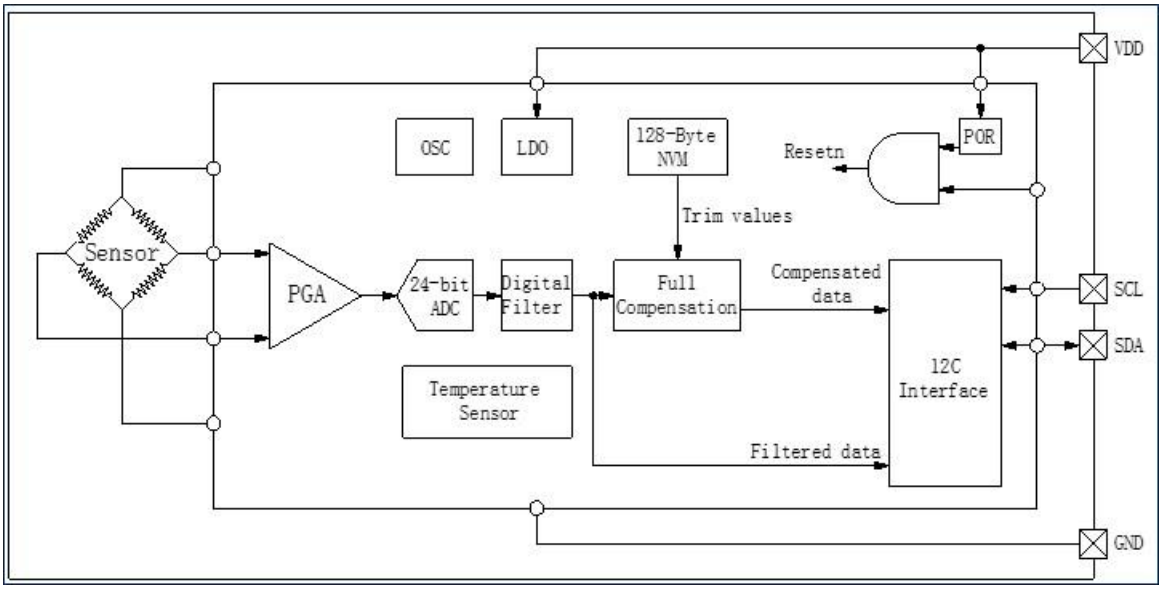
7. Typical Application Circuit..... 11

8. Pin Configuration..... 11

9. Recommended PAD Layout..... 11

10. Package Information..... 12

1. Block Diagram



Figrue1: Functional block diagram

2. Mechanical and Electrical Specifications

2.1 Pressure and Temperature Characteristics

Table1: Pressure Output Characteristics @ VDD = 5.0V, T = 25℃ unless otherwise noted

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Pressure Measurement Range	P_{FS}		-100		1000	Kpa
Pressure Resolution		Pressure		0.05		%FS
Pressure Accuracy[1]		At 25℃	-0.1		0.1	%FS
Total Error Band[2]	TEB	From 25℃ to 60℃	-0.3		+0.3	%FS
		From -40℃ to 85℃	-1.0		+1.0	%FS
Long Term Drift		After a period of 1 year		±0.15		%FS
Reflow soldering impact		IPC/JEDEC J-STD-020C		±0.2		%FS

1. *The maximum deviation from a best fit straight line (BFSL) fitted to the output measured over the pressure range at 25C. Includes all errors due to pressure non linearity, hysteresis, and non-repeatability.*
2. *Total pressure error band includes all accuracy errors, thermal errors over the compensated temperature range and span and offset calibration tolerances. For ideal sensor output with respect to input pressure and temperature, TEB values are valid only at the calibrated supply voltage.*

Table2: Temperature Output Characteristics @ VDD = 5.0V, T = 25°C unless otherwise note

Parameter	Symbol	Conditions	Min	Typ.。	Max	Unit
Operation Temperature	T_{OP}		-40		85	℃
Temperature Absolute Accuracy		-10℃ to +50℃		±1.0		℃
Max Error with Power		Power supply from 1.8V to 5.5V			±0.1	℃
Temperature Resolution of Output Data				0.01		℃

2.2 Electrical Characteristics

Table3: DC Characteristics @VDD=5.0 V, T=25℃ unless otherwise note

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Average Operation Current	I_{DDAVP}	One Conversion per Second		4.5	6.4	μA
Peak Current	I_{PEAK}	Pressure conversion		1.5		mA
		Temperature conversion		0.95		mA
Standby Supply Current	I_{DDSTB}	At 25℃			0.2	μA
Serial Data Clock Frequency	f_{SCLK}	I^2C protocol, pull-up resistor of 4.7k		100	400	kHz
Digital Input High Voltage	VIH		0.8			V
Digital Input Low Voltage	VIL				0.2	V
Digital Output High Voltage	V_{OH}	IO = 0.5 mA	0.9			V
Digital Output Low Voltage	V_{OL}	IO = 0.5 mA			0.1	V
Input Capacitance	C_{IN}				10	pF
I2C Pull-Up Resistors	R_{PU}		3.3	4.7	10	KΩ

2.3 Absolute Maximum Rating

Table 4: Absolute Maximum Rating

Parameter	Symbol	Conditions	Min	Max	Unit
Overpressure	P_{MAX}			3X	
Supply Voltage	V_{DD}		-0.3	6.5	V
Interface Voltage	V_{IF}		-0.3	VDD+0.3	V
Storage Temperature Range	T_{STG}		-40	150	℃

Maximum Soldering Temperature	T_{MS}	10 second maximum		250	℃
ESD Rating		Human body model	-2	+2	kV

Exposure to maximum rating conditions for extended periods may affect device reliability.

3. I2C Interface

I²C bus uses SCL and SDA as signal lines. Both lines are connected to VDD externally via pull-up resistors so that they are pulled high when the bus is free.

3.1 I²C Device and Register Address

The I²C device address is shown below. The LSB of the device address is corresponding to address 0xDA (write) and 0xDB (read).

Table 5. I2C Address

A7	A6	A5	A4	A3	A2	A1	W/R
1	1	0	1	1	0	1	0/1

3.2 I²C Specification

Table 6. I²C Slave Timing Values

Parameter	Symbol	I²C				Unit
		Condition	Min	Typ.	Max	
SCL Clock Frequency	S_{CL}	Pull-up = 4.7 kΩ	0		400	KHz
Bus free time between STOP and START condition	t_{BUF}		1.5			μs
Repeated START Hold Time	$t_{HD.STA}$		0.6			μs
Repeated START Setup Time	$t_{SU.STA}$		0.6			μs
STOP Condition Setup Time	$t_{SU.STO}$		0.6			μs
SDA Data Hold Time	$t_{HD.DAT}$		100			ns
SDA Setup Time	$t_{SU.DAT}$		100			ns
SCL Clock Low Time	t_{LOW}		1.5			μs
SCL Clock High Time	t_{HIGH}		0.6			μs
SDA and SCL Rise Time	t_R		30		500	ns
SDA and SCL Fall Time	t_F		30		500	ns

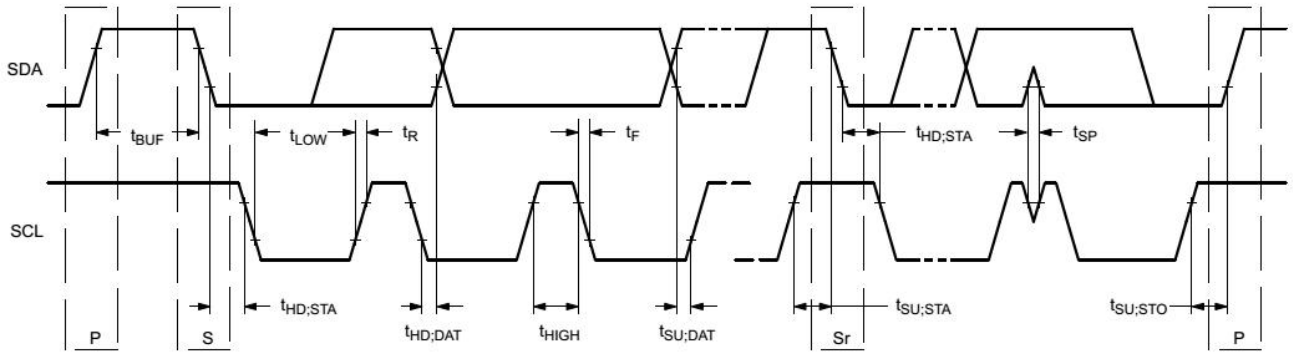
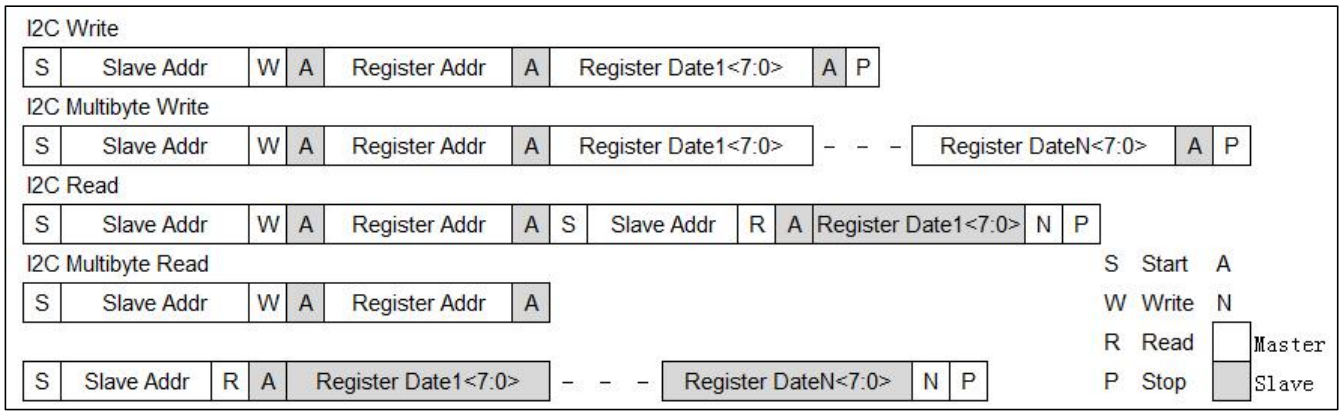


Figure2: I²C Timing Diagram

In one access, without stop, incremental read (address is auto increment) and auto-incremental write is supported. The read and write access is described below:



3.3 Register Map

Table 7. Register Map

Register Name	Addr.	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Reset State
Part_ID	0X01	Chip ID[23:16]								
	0xA8	Chip ID[15:8]								
	0xAD	Chip ID[7:0]								
Status	0x02	-							DRDY	
PSR_B2	0x06	PSR[23:16] (R)								0x00
PSR_B1	0x07	PSR[15:8] (R)								0x00
PSR_B0	0x08	PSR[7:0] (R)								0x00
TMP_B1	0x09	TMP[15:8] (R)								0x00
TMP_B0	0x0A	TMP[7:0] (R)								0x00

CMD	0x30	Sleep_time<3:0>				Sco	Measurement_ctrl<2:0>	0x00
P_config	0xA6	0	0	1	0	0	OSR_P<2:0>	0x00

Status

DRDY=1, indicates once conversion complete, and the output data is ready for reading.

Pressure data

The Pressure Data registers contains the 24 bit (3 bytes) 2's complement pressure measurement value.

PSR_B2: The highest b of the three bytes measured pressure value

PSR_B1: The middle byte of the three bytes measured pressure value

PSR_B0: The lowest byte of the three bytes measured pressure value

Temperature data

The Temperature Data registers contain the 16 bit (2 bytes) 2's complement temperature measurement value.

TMP_B1: The highest byte of the three bytes measured temperature value

TMP_B0: The lowest part of the three bytes measured temperature value.

CMD

Sleep time<3:0>:0000:62.5ms, 0001:125ms, 0010:187.5ms... 1111: 1s (**See Table8**), only active during sleep mode conversion.

Table 8. Sleep time list

Sleep_Time<3:0>	Time(ms)
0000	62.5
0001	125
0010	187.5
0011	250
0100	312.5
0101	375
0110	437.5
0111	500
1000	562.5
1001	625
1010	687.5
1011	750
1100	812.5
1101	875
1110	937.5
1111	1000

Sco=1, Start of conversion, automatically come back to 0 after conversion ends (except sleep mode conversion). **Measurement control<1:0>:** 000b, indicate a single shot temperature signal conversion. 001b, indicate a single shot pressure signal conversion.010b: indicate a combined conversion (once temperature conversion immediately followed by once pressure signal conversion).011b: indicate a sleep mode conversion (periodically perform once combined conversion with an interval time of 'sleep time'), 100b: OTP programming mode, enter this mode to when programming OTP banks.

P_config

OSR_P: set the over sampling ratio of the sensor signal conversion channel. 000:1024X(Default), 001:2048X, 010:4096X, 011:8192X, 100:256X, 101:512X, 110:16384X, 111:32768X.

Table 9. Conversion Time VS OSR

OSR	OSR_P<2:0> Binary	Conversion Time (ms)
256X	100	1.54
512X	101	1.86
1024X	000	2.5
2048X	001	3.78
4096X	010	6.34
8192X	011	11.46
16384X	110	21.7
32768X	111	42.18

4. Work Mode

4.1 Single-shot Pressure Signal Conversion

Setting ‘measurement_control’ = 01 and ‘sco’ = 1 to initiate once single-shot sensor signal conversion, the chip powers up, performs once sensor signal conversion, and returns back to standby mode with automatically changing ‘sco’ to 0. INT goes high when data is ready and returns low after the data value (0x06-0x08) has been read out from the ‘data_out’ registers. The ‘data_out’ registers can be read several times if required, even when the INT pin is low, but care must be taken not to read data when the ‘data_out’ registers are just in refreshing

4.2 Single-shot Temperature Signal Conversion

Setting ‘measurement_control’ = 00 and ‘sco’ = 1 to initiate once single-shot temperature conversion, the chip powers up, performs once temperature conversion, and returns back to standby mode with automatically changing ‘sco’ to 0.

4.3 Combined Conversion

Setting ‘measurement_control’ = 10 and ‘sco’ = 1 to initiate once combined conversion, the chip powers up, Successively performs once temperature conversion and once sensor signal conversion, then returns back to standby mode with automatically changing ‘sco’ to 0. The ‘raw_data_on’ bit should be set 0 during combined conversion and the calibrated temperature data and sensor signal data are separately stored in ‘temp_out’ and ‘data_out’ registers. INT pin will go high when the sensor signal conversion ends and will return low after a reading of the “data_out” registers.

4.4 Sleep Conversion

Setting ‘measurement_control’ = 11 and ‘sco’ = 1 to get into sleep conversion mode, the chip powers up and periodically performs once temperature conversion, once sensor signal conversion and a period of sleep phase. The duration of the sleep phase is configured by the ’sleep_time’ bits from 64ms to 1s. The chip will not get back to standby mode until manually setting ‘sco’ bit to ‘0’. The ‘raw_data_on’ bit will be forced to 0 during sleep conversion and the calibrated temperature data and sensor signal are separately stored in ‘temp_out’ and ‘data_out’ registers. INT pin will go high when the sensor signal conversion ends and will automatically return low before next temperature conversion starting or after a reading of the “data_out” registers.

5. Pressure and Temperature

5.1 Temperature Calculate

Read the Temperature result from the registers 0x09~0x0A are 16 bit 2´s complement numbers.
Traw = (TMP [15:8] * 256 + TMP [7:0]);
if (Traw > 32767)
{
Traw - =65536;
}
Temperature (°C) =Traw / 2^8;

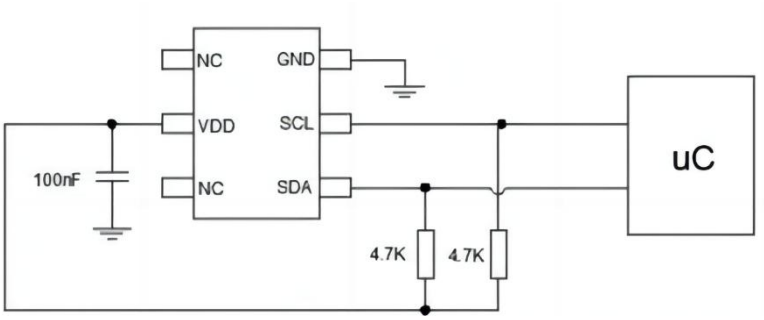
5.2 Pressure Calculate

Read the pressure result from the registers 0x06~0x08 are 24 bit 2´s complement numbers.
Pressure (unit: pa) = (PSR [23:16] * 65536+ PSR [15:8] * 256 + PSR [7:0]) / Scale Factor

6. Ordering Guide

Model	Operation pressure(kPa)	Scale Factor
MCP-H11-I10KPP	0~10	512
MCP-H11-I40KPP	0~40	128
MCP-H11-I40KPN	0~ -40	128
MCP-H11-I40KPPN	-40~40	128
MCP-H11-I100KPP	0~100	64
MCP-H11-I100KPN	0~-100	64
MCP-H11-I100KPPN	-100~100	64
MCP-H11-I200KPP	0~200	32
MCP-H11-I200KPPN	-100~200	32
MCP-H11-I500KPP	0~500	16
MCP-H11-I1000KPP	0~1000	8

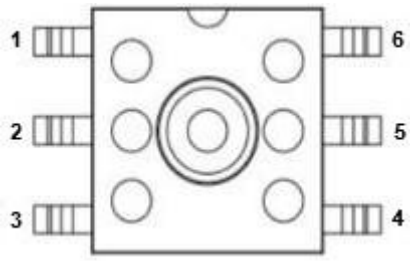
7. Typical Application Circuit



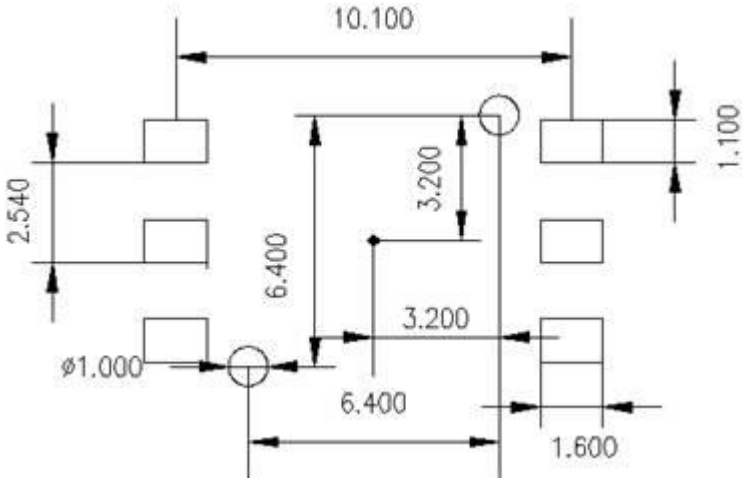
8. Pin Configuration

Table 10. Pin Descriptions

Pin	Name	I/O	Function
1	NC	-	NO Connect
2	VDD	I	Power Supply
3	SCL	I	I²C serial clock input pin
4	SDA	IO	I²C serial bi-directional data pin
5	GND	I	Ground
6	NC	-	NO Connect



9. Recommended PAD Layout



Unit: mm

10. Package Information

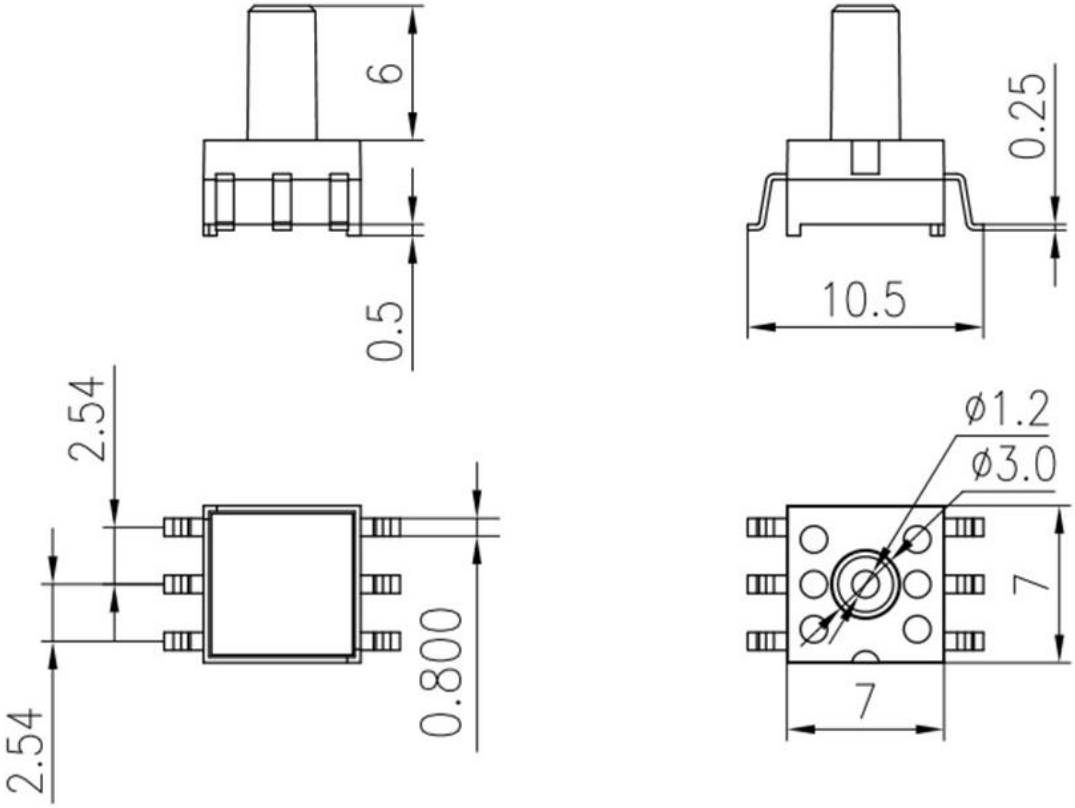


Figure4: Package outline

Notes:

Mechanical dimension is mm
General tolerance ±0.15

Contact us

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