

# デジタル大気圧センサーモジュール(I<sup>2</sup>C)

## Miniature I<sup>2</sup>C Digital Barometer

The MPL115A2 is an absolute pressure sensor with a digital I<sup>2</sup>C output targeting low cost applications. A miniature 5 x 3 x 1.2 mm LGA package is ideally suited for the space constrained requirements of portable electronic devices. Low current consumptions of 5 μA during Active mode and 1 μA during Shutdown (Sleep) mode are essential when focusing on low-power applications. The wide operating temperature range spans from -40°C to +105°C to fit demanding environmental conditions.

The MPL115A2 employs a MEMS pressure sensor with a conditioning IC to provide accurate pressure measurements from 50 to 115 kPa. An integrated ADC converts pressure and temperature sensor readings to digitized outputs via a I<sup>2</sup>C port. Factory calibration data is stored internally in an on-board ROM. Utilizing the raw sensor output and calibration data, the host microcontroller executes a compensation algorithm to render *Compensated Absolute Pressure* with ±1 kPa accuracy.

The MPL115A2 pressure sensor's small form factor, low power capability, precision, and digital output optimize it for barometric measurement applications.

### Features

- Digitized pressure and temperature information together with programmed calibration coefficients for host micro use.
- Factory calibrated
- 50 kPa to 115 kPa absolute pressure
- ±1 kPa accuracy
- 2.375V to 5.5V supply
- Integrated ADC
- I<sup>2</sup>C Interface (operates up to 400 kHz)
- 7-bit I<sup>2</sup>C address = 0x60
- Monotonic pressure and temperature data outputs
- Surface mount RoHS compliant package

### Application Examples

- Barometry (portable and desktop)
- Altimeters
- Weather stations
- Hard-disk drives (HDD)
- Industrial equipment
- Health monitoring
- Air control systems

**MPL115A2**

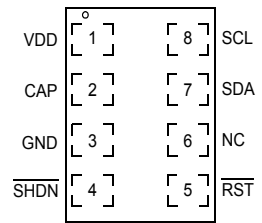
50 to 115 kPa



**MPL115A2**

5.0 mm x 3.0 mm x 1.2 mm

Top View

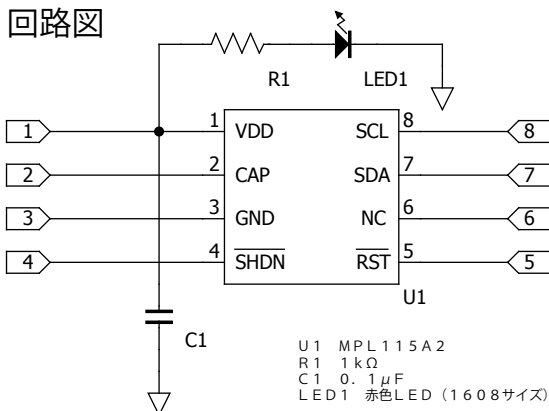


Pin Connections

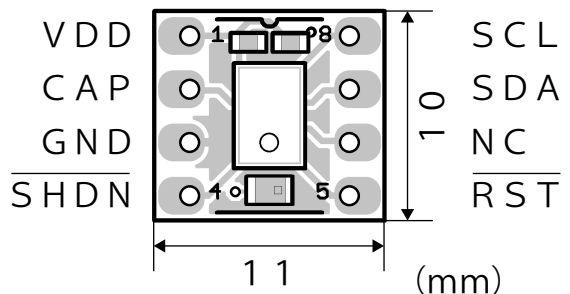
Pin	Name	Function
1	VDD	VDD Power Supply Connection: VDD range is 2.375V to 5.5V.
2	CAP	1 μF connected to ground.
3	GND	Ground
4	SHDN	Shutdown: Connect to GND to disable the device. When in shutdown, the part draws no more than 1 μA supply current and all communications pins (RST, SCL, SDA) are high impedance. Connect to VDD for normal operation.
5	RST	Reset: Connect to ground to disable I <sup>2</sup> C communications.
6	NC	NC: No connection
7	SDA <sup>(1)</sup>	SDA: Serial data I/O line
8	SCL <sup>(1)</sup>	I <sup>2</sup> C Serial Clock Input.

1. Use 4.7k pullup resistors for I<sup>2</sup>C communication.

回路図



基板寸法とピン配置



## 2 Mechanical and Electrical Specifications

### 2.1 Maximum Ratings

Voltage (with respect to GND unless otherwise noted)

V <sub>DD</sub> .....	-0.3 V to +5.5 V
SHDN, RST, SDA, SCL .....	-0.3 V to V <sub>DD</sub> +0.3 V
Operating Temperature Range .....	-40°C to +105°C
Storage Temperature Range .....	-40°C to +125°C
Overpressure.....	1000 kPa

### Example of Pressure Compensated Calculation in Floating-point Notation

a0 coefficient	=	2009.75
b1 coefficient	=	-2.37585
b2 coefficient	=	-0.92047
c12 coefficient	=	0.000790
Pressure	=	410 ADC counts
Temperature	=	507 ADC counts

#### Pressure Compensation:

$$P_{comp} = a0 + (b1 + c12 \cdot T_{adc}) \cdot P_{adc} + b(c)$$

## 2.2 Operating Characteristics

V<sub>DD</sub> = 2.375 V to 5.5 V, T<sub>A</sub> = -40°C to +105°C, unless otherwise noted. Typical values are at V<sub>DD</sub> = 3.3 V, T<sub>A</sub> = +25°C.

Ref	Parameters	Symbol	Conditions	Min	Typ	Max	Units	
1	Operating Supply Voltage	V <sub>DD</sub>		2.375	3.3	5.5	V	
2	Supply Current	I <sub>DD</sub>	Shutdown (SHDN = GND)	—	—	1	µA	
			Standby	—	—	3.5	10	µA
Average – at one measurement per second				—	—	5	6	µA

#### Pressure Sensor

3	Range			50	—	115	kPa
4	Resolution			—	0.15	—	kPa
5	Accuracy		-20°C to 85°C	—	—	±1	kPa
6	Power Supply Rejection		Typical operating circuit at DC	—	0.1	—	kPa/V
			100 mV p-p 217 Hz square wave plus 100 mV pseudo random noise with 10 MHz bandwidth	—	0.1	—	kPa
7	Conversion Time (Start Pressure and Temperature Conversion)	t <sub>c</sub>	Time between start convert command and data available in the Pressure and Temperature registers	—	1.6	3	ms
8	Wakeup Time	t <sub>w</sub>	Time between leaving Shutdown mode (SHDN goes high) and communicating with the device to issue a command or read data.	—	3	5	ms

#### I<sup>2</sup>C I/O Stages: SCL, SDA

9	SCL Clock Frequency	f <sub>SCL</sub>		—	—	400	kHz
10	Low Level Input Voltage	V <sub>IL</sub>		—	—	0.3V <sub>DD</sub>	V
11	High Level Input Voltage	V <sub>IH</sub>		0.7V <sub>DD</sub>	—	—	V

#### I<sup>2</sup>C Outputs: SDA

12	Data Setup Time	t <sub>SU</sub>	Setup time from command receipt to ready to transmit	0	—	0.4	s
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#### I<sup>2</sup>C Addressing

MPL 115A2 uses 7-bit addressing, does not acknowledge the general call address 0000000. Slave address has been set to 0x60 or 11000000.

Using the evaluation sequence shown in Section 3.3:

$$\begin{aligned}
 c12x2 &= c12 \cdot T_{adc} = 0.000790 \cdot 507 &= 0.40053 \\
 a1 &= b1 + c12x2 = -2.37585 + 0.40053 &= -1.97532 \\
 a1x1 &= a1 \cdot P_{adc} = -1.97532 \cdot 410 &= -809.8812 \\
 y1 &= a0 + a1x1 = 2009.75 + (-809.8812) &= 1199.8688 \\
 a2x2 &= b2 \cdot T_{adc} = -0.92047 \cdot 507 &= -466.67829 \\
 P_{Comp} &= y1 + a2x2 = 1199.8688 + (-466.67829) &= 733.19051
 \end{aligned}$$

$$\begin{aligned}
 \text{Pressure (kPa)} &= P_{comp} \cdot \left[ \frac{115 - 50}{1023} \right] + 50 \\
 &= 96.59 \text{ kPa}
 \end{aligned}$$

$$= 733.19 \cdot \left[ \frac{115 - 50}{1023} \right] + 50$$

### I<sup>2</sup>C Write Commands

Command	Binary	HEX <sup>(1)</sup>
Devices Address + Write bit	1100 0000	0xC0
Start Conversions	X001 0010	0x12

X = Don't care  
1 = The command byte needs to be paired with a 0x00 as part of the I<sup>2</sup>C exchange to complete the passing of Start Conversions.

#### I<sup>2</sup>C Write Command Description

Command	Action Taken
Start Conversions	Wake main circuits. Start clock. Allow supply stabilization time. Select pressure sensor input. Apply positive sensor excitation and perform A to D conversion. Select temperature input. Perform A to D conversion. Load the Pressure and Temperature registers with the result. Shut down main circuits and clock.

#### I<sup>2</sup>C Read Command Description

Device Address + Read bit	Command	Binary	HEX <sup>(1)</sup>
Read Pressure MSB		X000 0000	0x00
Read Pressure LSB		X000 0001	0x01
Read Temperature MSB		X000 0010	0x02
Read Temperature LSB		X000 0011	0x03
Read Coefficient data byte 1		X000 0100	0x04

X = don't care

參考資料