LAMPIRAN

Lampiran 1. Listing Coding

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 4);
#include <Wire.h>
#include <ESP8266WiFi.h>
#include <ESP8266WiFiMulti.h>
#include <ESP8266HTTPClient.h>
#define D6F_ADDR 0x6C
ESP8266WiFiMulti WiFiMulti;
String url; // string untuk menampung url
String api = "V6UIQYEKIE8PHSM0"; // kode API ThingSpeak Kalian (PERLU
DISESUAIKAN)
unsigned long oldTime = 0;
//============================================
#include <Wire.h>  //libraries untuk pengaksesan i2c
#include <Adafruit_BME280.h> //libraries yang baru saja diinstall seperti cara
diatas
#include <Adafruit_Sensor.h>
#define SEALEVELPRESSURE_HPA (1013.25) //nilai awal untuk pressure
Adafruit_BME280 bme; //penggunaan I2C
//============================================
const int pinGP2Y = A0;
int pinLED = D2; // LED diset pada pin D3
int samplingTime = 280; // Lama pengukuran/ sampling
int deltaTime = 40;
int sleepTime = 9680;
//float flow_rate;
//============================================
uint8_t conv16_u8_h(int16_t a) {
   return (uint8_t)(a >> 8);
}
uint8_t conv16_u8_l(int16_t a) {
   return (uint8_t)(a & 0xFF);
}
uint16_t conv8us_u16_be(uint8_t* buf) {
   return (uint16_t)(((uint32_t)buf[0] << 8) | (uint32_t)buf[1]);
/** <!-- i2c_write_reg16 {{{1 --> I2C write bytes with a 16bit register.
 bool i2c_write_reg16(uint8_t slave_addr, uint16_t register_addr,
                 uint8_t *write_buff, uint8_t len) {
   Wire.beginTransmission(slave_addr);
   Wire.write(conv16_u8_h(register_addr));
   Wire.write(conv16_u8_l(register_addr));
   if (len != 0) {
      for (uint8_t i = 0; i < len; i++) {
         Wire.write(write_buff[i]);
         Wire.endTransmission();
   return false;
```

```
}
/** <!-- i2c_read_reg8 {{{1 --> I2C read bytes with a 8bit register.
 */
bool i2c_read_reg8(uint8_t slave_addr, uint8_t register_addr,
               uint8_t *read_buff, uint8_t len) {
   Wire.beginTransmission(slave_addr);
   Wire.write(register_addr);
   Wire.endTransmission();
   Wire.requestFrom(slave_addr, len);
   if (Wire.available() != len) {
      return true;
   }
   for (uint16_t i = 0; i < len; i++) {
      read_buff[i] = Wire.read();
   }
   return false;
}
//====================================================
void setup() {
 Serial.begin(9600);
 lcd.begin();
 Wire.begin();
 i2c_write_reg16(D6F_ADDR, 0x0B00, NULL, 0);
  lcd.clear();
 WiFi.mode(WIFI_STA);
   WiFiMulti.addAP("mutohar", "affanbagus"); // nama SSID dan Passwordnya
(PERLU DISESUAIKAN)
  pinMode(pinLED,OUTPUT); // Set LED sebagai OUTPUT
  lcd.setCursor(0,0);
  lcd.print(" Selamat Datang ");
  lcd.setCursor(0,1);
  lcd.print("Smart System  RO");
  lcd.setCursor(-4,2);
  lcd.print("Akhmad  Mutohar");
  lcd.setCursor(-4,3);
  lcd.print("    UNISSULA    ");
  delay(4000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Kalibrasi Sensor");
  lcd.setCursor(-4,2);
  lcd.print("  Suhu BME280:  ");
  delay(2000);
   //cek sensor
  if (!bme.begin(0x76)) {
   Serial.println("tidak ada sensor BME280, Coba cek rangkaianmu!");
   lcd.clear();
   lcd.setCursor(-4,3);
   lcd.print("Tidak Terdeteksi");
   while (1);
```

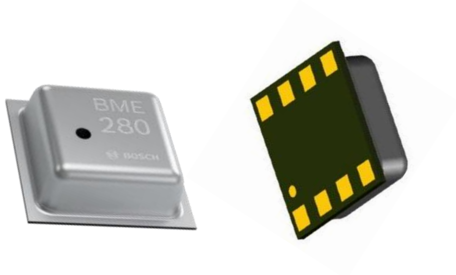
```
 }
   lcd.setCursor(-4,3);
   lcd.print("      OK      ");
   delay(2000);
   lcd.clear();
   lcd.setCursor(0,0);
   lcd.print("Kalibrasi Sensor");
   lcd.setCursor(-4,2);
   lcd.print("  Sensor Debu:  ");
   delay(2000);
   lcd.setCursor(-4,3);
   lcd.print("      OK      ");
   delay(2000);
}
void omronsensor(){
}
void bme280(){
Serial.print("Suhu =");
Serial.print(bme.readTemperature());
Serial.print(" *C    ");
 //pembacaan data Kelembaban
Serial.print("Kelembaban = ");
Serial.print(bme.readHumidity());
Serial.print(" %   ");
 //pembacaan data tekanan atmosfer
//Serial.print("Pressure = ");
//Serial.print(flow_rate);
//Serial.print(" Pa     ");
 //pembacaan data ketinggian berdasarkan permukaan laut
Serial.print("Approx. Altitude = ");
Serial.print(bme.readAltitude(SEALEVELPRESSURE_HPA));
Serial.print(" m");
}
void loop() {
 //lcd.clear();
  while (WiFiMulti.run() != WL_CONNECTED)
        Serial.println("Connecting to Wi-Fi . .");
        lcd.clear();
        lcd.setCursor(0,0);
        lcd.print("Connect Wirelles");
        delay(500);
 digitalWrite(pinLED,LOW); // Nyalakan LED
 delayMicroseconds(samplingTime);
  float voMeasured = analogRead(pinGP2Y); // membaca nilai ADC
 delayMicroseconds(deltaTime);
 digitalWrite(pinLED,HIGH); // Matikan LED, karena proses pengukuran telah
selesai, karena menggunakan metode cuplik
 delayMicroseconds(sleepTime);
 float calcVoltage = voMeasured * (3.3/1024); // konversi nilai ADC ke tegangan
 float dustDensity = (0.17 * calcVoltage - 0.1)*1000; // dalam ug/m3
```

```
if (dustDensity < 0){ // antisipasi nilai negative
dustDensity = 0;
}
lcd.setCursor(0,0);
lcd.print("D: ");
lcd.print(dustDensity);
lcd.print(" gr/m3    ");
//============================================
delay(900);
 uint8_t send0[] = {0x40, 0x18, 0x06};
   i2c_write_reg16(D6F_ADDR, 0x00D0, send0, 3);
   delay(50);  // wait 50ms
   uint8_t send1[] = {0x51, 0x2C};
   i2c_write_reg16(D6F_ADDR, 0x00D0, send1, 2);
   uint8_t rbuf[2];
   if (i2c_read_reg8(D6F_ADDR, 0x07, rbuf, 2)) {  // read from [07h]
   }
   uint16_t rd_flow = conv8us_u16_be(rbuf);
   float flow_rate;
   // calculation for +/-50[Pa] range
   flow_rate = ((float)rd_flow - 1024.0) * 100.0 / 60000.0 - 50.0;
   Serial.print("      sensor output:");
   Serial.print(flow_rate, 2);  // print converted flow rate
   Serial.println("[Pa]");
//=======  Baca BME280
bme280();
//omronsensor();
 //======= Baca Sensor LCD =========
lcd.setCursor(0,1);
lcd.print("T: ");
lcd.print(bme.readTemperature());
lcd.print(" *C      ");
lcd.setCursor(-4,2);
lcd.print("H: ");
lcd.print(bme.readHumidity());
lcd.print(" %        ");
lcd.setCursor(-4,3);
lcd.print("P: ");
lcd.print(flow_rate);
lcd.print(" Pa       ");
delay(1000);
  if((WiFiMulti.run() == WL_CONNECTED))
      {
       if ((millis() - oldTime) > 10000) {
       HTTPClient http;
        Serial.println("[HTTP] Memulai Koneksi...");
        url = "http://api.thingspeak.com/update?api_key=";
        url += api;
```

```
        url += "&field1=" + String(dustDensity) + "&field2=" +
String(bme.readTemperature()) + "&field3=" + String(bme.readHumidity()) +
"&field4=" + String(flow_rate);
         Serial.println(url);
        http.begin(url); //HTTP Request ke URL
          int httpCode = http.GET(); // mengakses jawaban server
          if(httpCode > 0) {
             Serial.printf("[HTTP] GET... code: %d\n", httpCode);
              if(httpCode == HTTP_CODE_OK) {
                String payload = http.getString();
                Serial.println(payload); // print balasan / file html dari server
                Serial.println("\n\n");
            }
        } else {
            Serial.println("[HTTP] GET... failed");
        }
          http.end(); // mengakhiri Request
                 oldTime = millis()
}
```

Lampiran 2. Data Sheet Sensor BME280GY

BME280



BME280 BOSCH

Digital humidity, pressure and temperature sensor

Key features

Package	2.5 mm x 2.5 mm x 0.93 mm metal lid LGA
Digital interface	I^2C (up to 3.4 MHz) and SPI (3 and 4 wire, up to 10 MHz)
Supply voltage	V_{DD} main supply voltage range: 1.71 V to 3.6 V V_{DDIO} interface voltage range: 1.2 V to 3.6 V
Current consumption	1.8 µA @ 1 Hz humidity and temperature 2.8 µA @ 1 Hz pressure and temperature 3.6 µA @ 1 Hz humidity, pressure and temperature 0.1 µA in sleep mode
Operating range	-40…+85 °C, 0…100 % rel. humidity, 300…1100 hPa

- Humidity sensor and pressure sensor can be independently enabled / disabled
- Register and performance compatible to Bosch Sensortec BMP280 digital pressure sensor RoHS compliant, halogen-free, MSL1

Key parameters for humidity sensor

- Response time ($\tau_{63\%}$) 1 s
- Accuracy tolerance ±3 % relative humidity
- Hysteresis ±1% relative humidity

Key parameters for pressure sensor

- RMS Noise 0.2 Pa, equiv. to 1.7 cm
- Offset temperature coefficient ±1.5 Pa/K, equiv. to ±12.6 cm at 1 °C temperature change

Typical application

- Context awareness, e.g. skin detection, room change detection
- Fitness monitoring / well-being
- Warning regarding dryness or high temperatures
- Measurement of volume and air flow
- Home automation control

- control heating, venting, air conditioning (HVAC)
- Internet of things
- GPS enhancement (e.g. time-to-first-fix improvement, dead reckoning, slope detection)
- Indoor navigation (change of floor detection, elevator detection)
- Outdoor navigation, leisure and sports applications
- Weather forecast
- Vertical velocity indication (rise/sink speed)

Target devices

- Handsets such as mobile phones, tablet PCs, GPS devices
- Navigation systems
- Gaming, e.g flying toys
- Camera (DSC, video)
- Home weather stations
- Flying toys
- Watches

General Description

The BME280 is as combined digital humidity, pressure and temperature sensor based on proven sensing principles. The sensor module is housed in an extremely compact metal-lid LGA package with a footprint of only 2.5 × 2.5 mm² with a height of 0.93 mm. Its small dimensions and its low power consumption allow the implementation in battery driven devices such as handsets, GPS modules or watches. The BME280 is register and performance compatible to the Bosch Sensortec BMP280 digital pressure sensor (see chapter 5.2 for details). The BME280 achieves high performance in all applications requiring humidity and pressure measurement. These emerging applications of home automation control, in-door navigation, fitness as well as GPS refinement require a high accuracy and a low TCO at the same time.

The humidity sensor provides an extremely fast response time for fast context awareness applications and high overall accuracy over a wide temperature range. The pressure sensor is an absolute barometric pressure sensor with extremely high accuracy and resolution and drastically lower noise than the Bosch Sensortec BMP180. The integrated temperature sensor has been optimized for lowest noise and highest resolution. Its output is used for temperature compensation of the pressure and humidity sensors and can also be used for estimation of the ambient temperature. The sensor provides both SPI and I²C interfaces and can be supplied using 1.71 to 3.6 V for the sensor supply V_{DD} and 1.2 to 3.6 V for the interface supply V_{DDIO}. Measurements can be triggered by the host or performed in regular intervals. When the sensor is disabled, current consumption drops to 0.1 µA.

BME280 can be operated in three power modes (see chapter 3.3):

- sleep mode
- normal mode
- forced mode

In order to tailor data rate, noise, response time and current consumption to the needs of the user, a variety of oversampling modes, filter modes and data rates can be selected.

Specification

If not stated otherwise,

- All values are valid over the full voltage range
- All minimum/maximum values are given for the full accuracy temperature range
- Minimum/maximum values of drifts, offsets and temperature coefficients are ±3□ values over lifetime
- Typical values of currents and state machine timings are determined at 25 °C
- Minimum/maximum values of currents are determined using corner lots over complete temperature range
- Minimum/maximum values of state machine timings are determined using corner lots over 0…+65 °C temperature range

The specification tables are split into humidity, pressure, and temperature part of BME280.

General electrical specification

Table 1: Electrical parameter specification

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage Internal Domains	V_{DD}	ripple max. 50 mVpp	1.71	1.8	3.6	V
Supply Voltage I/O Domain	V_{DDIO}		1.2	1.8	3.6	V
Sleep current	I_{DDSL}			0.1	0.3	µA
Standby current (inactive period of normal mode)	I_{DDSB}			0.2	0.5	µA
Current during humidity measurement	I_{DDH}	Max value at 85 °C		340		µA

Current during pressure measurement	I_{DDP}	Max value at -40 °C		714		µA
Current during temperature measurement	I_{DDT}	Max value at 85 °C		350		µA
Start-up time	$t_{startup}$	Time to first communication after both V_{DD} > 1.58 V and V_{DDIO} > 0.65 V			2	ms
Power supply rejection ratio (DC)	PSRR	full V_{DD} range			±0.01 ±5	%RH/V Pa/V
Standby time accuracy	$\Delta t_{standby}$			±5	±25	%

Humidity parameter specification

Table 2: Humidity parameter specification

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating range[1]	R_H	For temperatures < 0 °C and > 60 °C see Figure 1	-40	25	85	°C
			0		100	%RH
Supply current	$I_{DD,H}$	1 Hz forced mode, humidity and temperature		1.8	2.8	µA
Absolute accuracy tolerance	A_H	20...80 %RH, 25 °C, including hysteresis		±3		%RH
Hysteresis[2]	H_H	10→90→10 %RH, 25 °C		±1		%RH

[1] When exceeding the operating range (e.g. for soldering), humidity sensing performance is temporarily degraded and reconditioning is recommended as described in section 7.8. Operating range only for non-condensing environment.
[2] For hysteresis measurement the sequence 10→30→50→70→90→70→50→30→10 %RH is used. The hysteresis is defined as the difference between measurements of the humidity up / down branch and the averaged curve of both branches

Nonlinearity[3]	NL_H	10→90 %RH, 25 °C		1		%RH
Response time to complete 63% of step[4]	$\tau_{63\%}$	90→0 or 0→90 %RH, 25°C		1		s
Resolution	R_H			0.008		%RH
Noise in humidity (RMS)	N_H	Highest oversampling, see chapter 3.6		0.02		%RH
Long term stability	□H_{stab}	10…90 %RH, 25 °C		0.5		%RH/ year

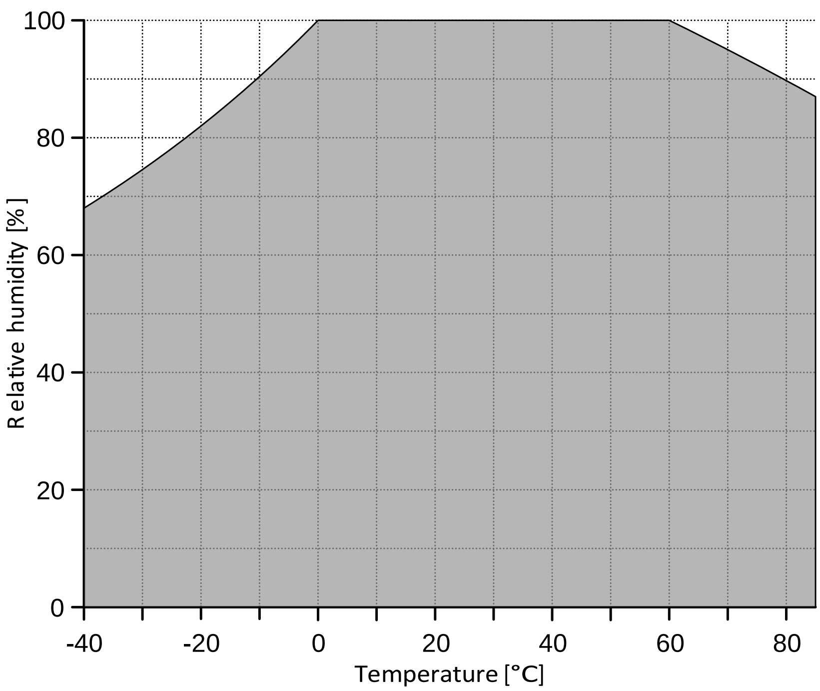


Figure 1: humidity sensor operating range

Pressure sensor specification

Table 3: Pressure parameter specification

[3] Non-linear contributions to the sensor data are corrected during the calculation of the relative humidity by the compensation formulas described in section 4.2.3.

[4] The air-flow in direction to the vent-hole of the device has to be dimensioned in a way that a sufficient air exchange inside to outside will be possible. To observe effects on the response time-scale of the device an air-flow velocity of approx. 1 m/s is needed.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating temperature range	T_A	operational	-40	25	+85	°C
		full accuracy	0		+65	
Operating pressure range	P	full accuracy	300		1100	hPa
Supply current	$I_{DD,LP}$	1 Hz forced mode, pressure and temperature, lowest power		2.8	4.2	µA

Temperature coefficient of offset[5]	TCO_P	25...65 °C, 900 hPa		±1.5		Pa/K
				±12.6		cm/K
Absolute accuracy pressure	A_{Pext}	300. . 1100 hPa -20 . . . 0 °C		±1.7		hPa
	$A_{P,full}$	300 . . . 1100 hPa 0 . . . 65 °C		±1.0		hPa
	A^P	1100 . . . 1250 hPa 25 . . . 40 °C		±1.5		hPa
Relative accuracy pressure V_{DD} = 3.3V	A_{rel}	700 … 900hPa 25 . . . 40 °C		±0.12		hPa
Resolution of pressure output data	R_P	Highest oversampling		0.18		Pa
Noise in pressure	$N_{P,fullBW}$	Full bandwidth, highest oversampling See chapter 3.6		1.3		Pa
				11		cm

[5] When changing temperature by e.g. 10 °C at constant pressure / altitude, the measured pressure / altitude will change by (10 × TCO_P).

	$N_{P,filtered}$	Reduced bandwidth, highest oversampling See chapter 3.6		0.2		Pa
				1.7		cm
Solder drift		Minimum solder height 50µm	-0.5		+2.0	hPa
Long term stability[6]	□P_{stab}	per year		±1.0		hPa
Possible sampling rate	f_{sample_P}□	Lowest oversampling, see chapter 9.2	157	182		Hz

Temperature sensor specification

Table 4: Temperature parameter specification

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating range	T	Operational	-40	25	85	°C
		Full accuracy	0		65	°C
Supply current	$I_{DD,T}$	1 Hz forced mode, temperature measurement only		1.0		µA
	$A_{T,25}$	25 °C		±0.5		°C
Absolute accuracy temperature[7]	$A_{T,full}$	0…65 °C		±1.0		°C
	$A_{T,ext}$[8]	-20 …. 0 °C		±1.25		°C

[6] Long term stability is specified in the full accuracy operating pressure range 0 … 65 °C
[7] Temperature measured by the internal temperature sensor. This temperature value depends on the PCB temperature, sensor element self-heating and ambient temperature and is typically above ambient temperature.
[8] Target values & not guaranteed

	$A_{T,ext}$[9]	-40 … -20 °C		±1.5		°C
Output resolution	R_T	API output resolution		0.01		°C
RMS noise	N_T	Lowest oversampling		0.005		°C

Absolute maximum ratings

The absolute maximum ratings are determined over complete temperature range using corner lots.

The values are provided in Table 5.

Table 5: Absolute maximum ratings

Parameter	Condition	Min	Max	Unit
Voltage at any supply pin	V_{DD} and V_{DDIO} pin	-0.3	4.25	V
Voltage at any interface pin		-0.3	V_{DDIO} + 0.3	V
Storage temperature	≤ 65% RH	-45	+85	°C
Pressure		0	20 000	hPa
ESD	HBM, at any pin		±2	kV
	CDM		±500	V
	Machine model		±200	V
Condensation	No power supplied	Allowed		

[9] Target values & not guaranteed

Functional description

Block diagram

Figure 2 shows a simplified block diagram of the BME280:

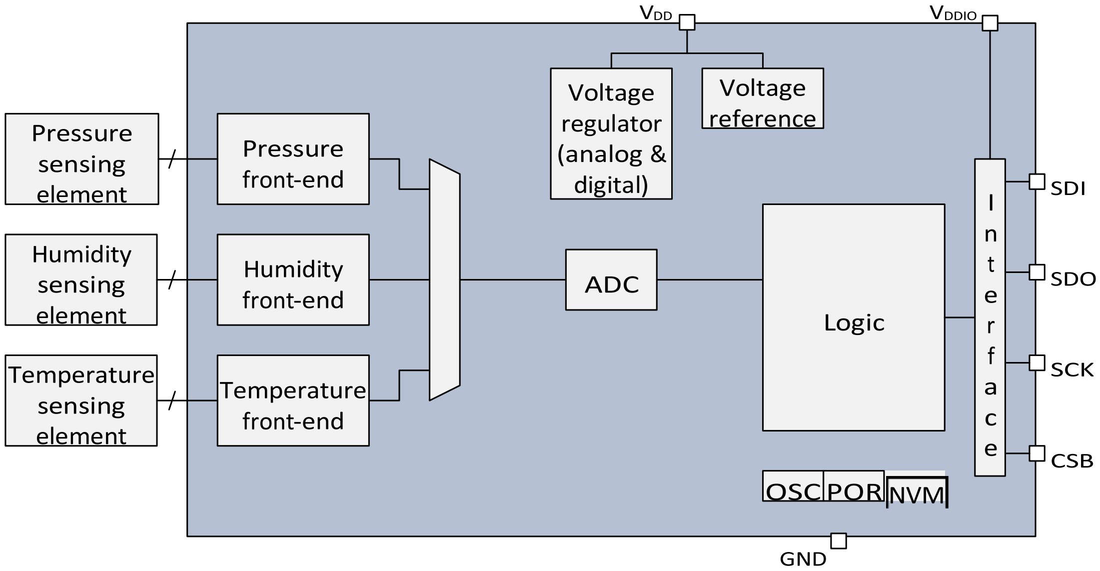


Figure 2: Block diagram of BME280

Power management

The BME280 has two distinct power supply pins

- V_{DD} is the main power supply for all internal analog and digital functional blocks
- V_{DDIO} is a separate power supply pin used for the supply of the digital interface

A power-on reset (POR) generator is built in; it resets the logic part and the register values after both V_{DD} and V_{DDIO} reach their minimum levels. There are no limitations on slope and sequence of raising the V_{DD} and V_{DDIO} levels. After powering up, the sensor settles in sleep mode (described in chapter 3.3.2).

It is prohibited to keep any interface pin (SDI, SDO, SCK or CSB) at a logical high level when V_{DDIO} is switched off. Such a configuration can permanently damage the device due an excessive current flow through the ESD protection diodes.

If V_{DDIO} is supplied, but V_{DD} is not, the interface pins are kept at a high-Z level. The bus can therefore already be used freely before the BME280 V_{DD} supply is established.

Resetting the sensor is possible by cycling V_{DD} level or by writing a soft reset command. Cycling the V_{DDIO} level will not cause a reset.

Sensor modes

The BME280 offers three sensor modes: sleep mode, forced mode and normal mode. These can be selected using the *mode*[1:0] setting (see chapter 5.4.5). The available modes are:

- Sleep mode: no operation, all registers accessible, lowest power, selected after startup
- Forced mode: perform one measurement, store results and return to sleep mode
- Normal mode: perpetual cycling of measurements and inactive periods.

The modes will be explained in detail in chapters 3.3.2 (sleep mode), 3.3.3 (forced mode) and 3.3.4 (normal mode).

Sensor mode transitions

The supported mode transitions are shown in Figure 3. If the device is currently performing a measurement, execution of mode switching commands is delayed until the end of the currently running measurement period. Further mode change commands or other write commands to the register *ctrl_hum* are ignored until the mode change command has been executed. Mode transitions other than the ones shown below are tested for stability but do not represent recommended use of the device.

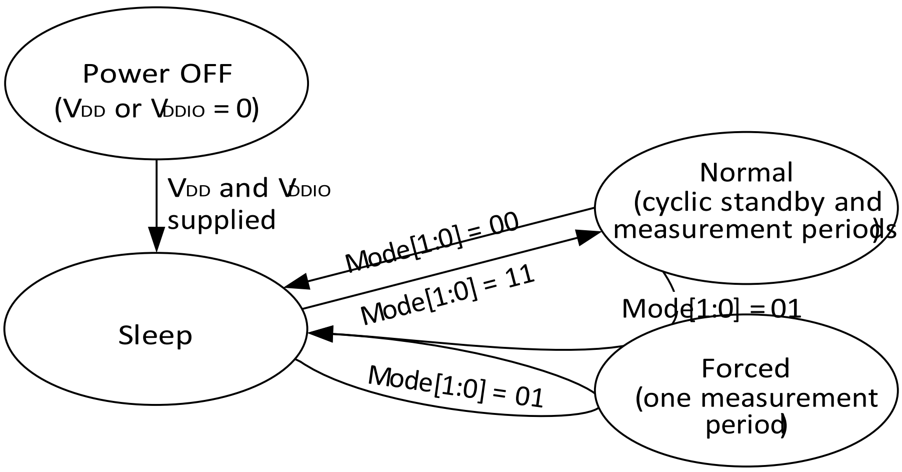


Figure 3: Sensor mode transition diagram

Sleep mode

Sleep mode is entered by default after power on reset. In sleep mode, no measurements are performed and power consumption (I_{DDSM}) is at a minimum. All registers are accessible; Chip-ID and compensation coefficients can be read. There are no special restrictions on interface timings.

Forced mode

In forced mode, a single measurement is performed in accordance to the selected measurement and filter options. When the measurement is finished, the sensor returns to sleep mode and the measurement results can be obtained from the data registers. For anext measurement, forced mode needs to be selected again. This is similar to BMP180 operation. Using forced mode is recommended for applications which require low sampling rate or host-based synchronization. The timing diagram is shown below.

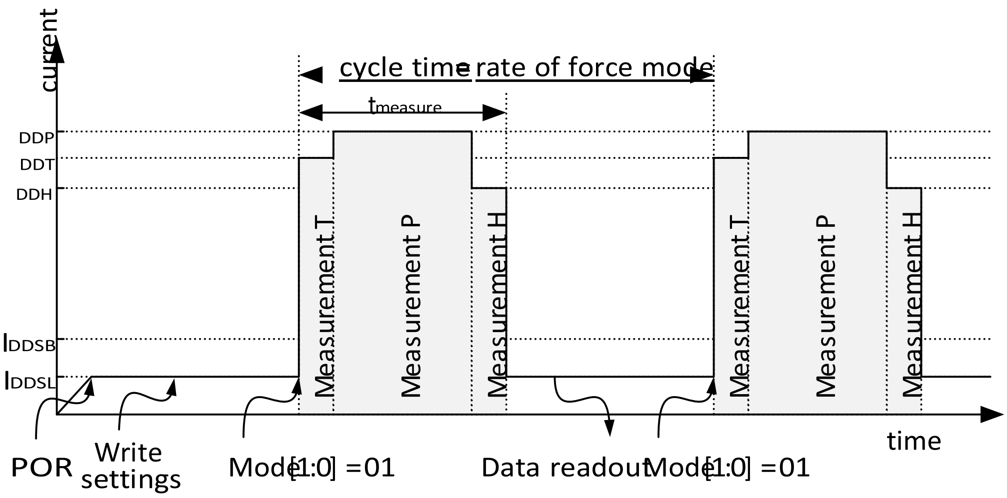


Figure 4: Forced mode timing diagram

Normal mode

Normal mode comprises an automated perpetual cycling between an (active) measurement period and an (inactive) standby period.

The measurements are performed in accordance to the selected measurement and filter options. The standby time is determined by the setting *t_sb*[2:0] and can be set to between 0.5 and 1000 ms according to Table 27.

The total cycle time depends on the sum of the active time (see chapter 9) and standby time $t_{standby}$. The current in the standby period (I_{DDSB}) is slightly higher than in sleep mode. After setting the measurement and filter options and enabling normal mode, the last measurement results can always be obtained at the data registers without the need of further write accesses.

Using normal mode is recommended when using the IIR filter. This is useful for applications in which short-term disturbances (e.g. blowing into the sensor) should be filtered. The timing diagram is shown below:

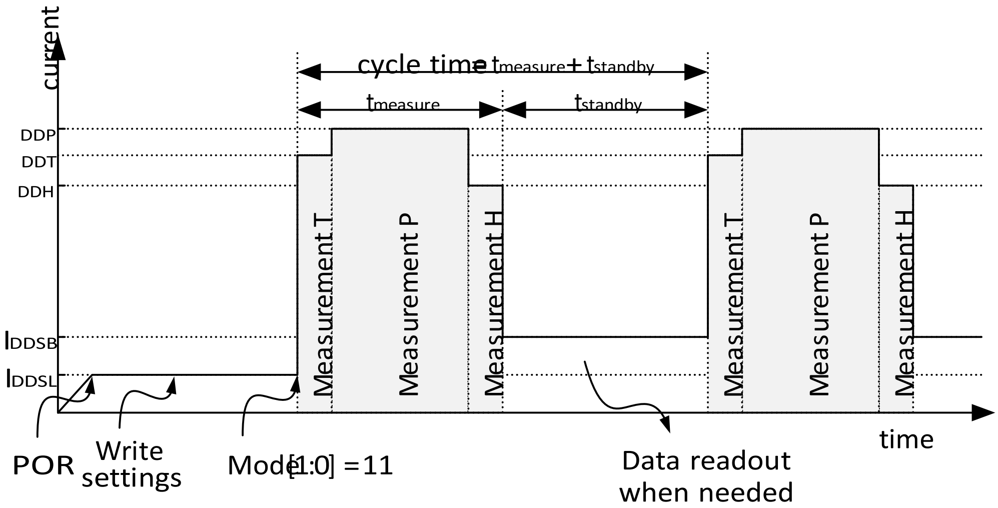


Figure 5: Normal mode timing diagram

Measurement flow

The BME280 measurement period consists of a temperature, pressure and humidity measurement with selectable oversampling. After the measurement period, the pressure and temperature data can be passed through an optional IIR filter, which removes short-term fluctuations in pressure (e.g. caused by slamming a door). For humidity, such a filter is not needed and has not been implemented.

The flow is depicted in the diagram below.

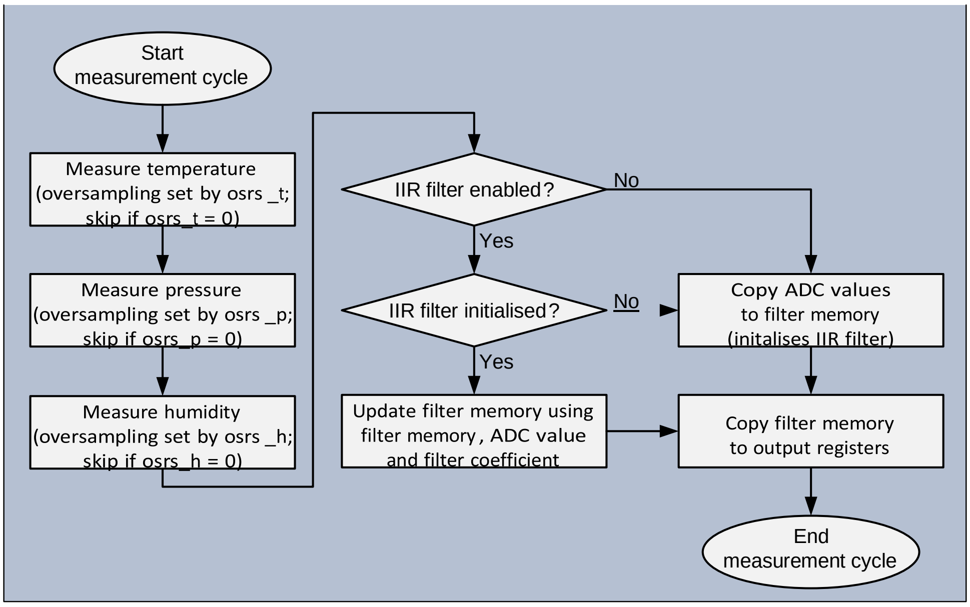


Figure 6: BME280 measurement cycle

Lampiran 3. Data Sheet Sensor D6F-PH0505AD3

MEMS Differential Pressure Sensor D6F-PH

A Compact, High-accuracy Differential Pressure Sensor with Superior Resistance to Environments.

- High accuracy of ±3% R.D.
- Linearized and temperature compensated
- Digital output (I^2C communication)
- High flow impedance to reduce the influence of bypassconfiguration
- RoHS Compliant

Ordering Information

Measurement Range	Applicable Fluid	Model
0 to 250 Pa (0 to 1 in. H_2O)	Air	**D6F-PH0025AD1**
-50 to +50 Pa (± 0.2 in. H_2O)		**D6F-PH0505AD3**
-500 to +500 Pa (± 2 in. H_2O)		**D6F-PH5050AD3**

Note: The Sensor can be calibrated for different gas types. Consult Omron.

Characteristics

Model	D6F-PH0025AD1	D6F-PH0505AD3	D6F-PH5050AD3
Measurement Range (See Note 1)	0 to 250 Pa	± 50 Pa	± 500 Pa
Calibration Gas (See Note 2)	Air		
PortType	Barb joint, Maximum outside diameter: 4.9mm		
Power Supply	2.3 to 3.6 VDC		
Current Consumption	6 mA max. with no load and V_{CC} of 3.3 V, GND=0 VDC, 25°C		
Resolution	12 bit		
Zero PointTolerance (See Note 4)	± 0.2 Pa		
SpanTolerance (See Note 4)	± 3% R.D.		
Temperature Compensation	Yes		
Span shift due toTemperature Variation	± 0.5% R.D. per 10°C		
ResponseTime	25 ms typical at 12 bit resolution (50 ms max). The processing time is 6 ms typical at 12 bit resolution.		
Gas Flow through Sensor (See Note 3)	≤ 63 mL/min	≤ 23 mL/min	≤ 100 mL/min
Interface	I^2C		
Case Material	PPS		
Degree of Protection	IEC IP40		

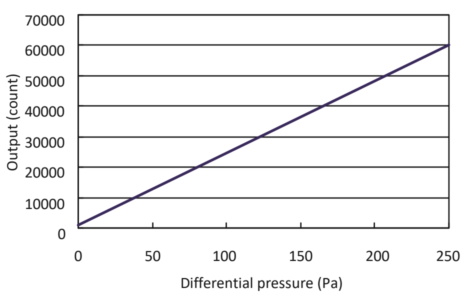
Withstand Pressure	10 kPa
OperatingTemperature	-20 to 80°C (with no condensation or icing)
Operating Humidity	35 to 85% RH (with no condensation or icing)
StorageTemperature	-40 to 80°C (with no condensation or icing)
Storage Humidity	35 to 85% RH (with no condensation or icing)
Insulation Resistance	Between Sensor outer cover and lead terminals: 20 MΩ min. (at 500 VDC)
Dielectric Strength	Between Sensor outer cover and lead terminals: 500 VAC, 50/60 Hz min. for 1 min (leakage current: 1 mA max.)
Weight	5.2 g

Note: 1. At standard atmospheric pressure (1013.25 hPa).

2. Dry gas must not contain large particles, e.g., dust, oil or mist.
3. Type D6F-PH is based on thermal flow principle. Air flow is needed to measure the differential pressure. Typical characteristic of air flow by differential pressure is shown in the "Engineering Data" section.
4. The zero point tolerance and span tolerance are independent uncertainties and add according to the principles of error propagation.

Engineering Data

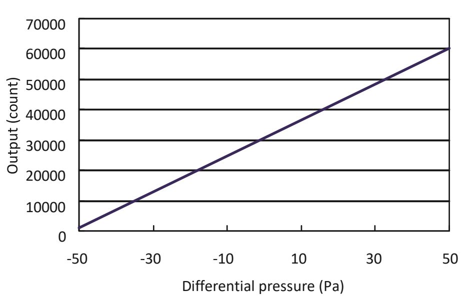
■Output Characteristics



D6F-PH0025AD1

Differential pressure (Pa)	0	50	100	150	200	250
Output (Hex)	1024 (0x0400)	13024 (0x32E0)	25024 (0x61C0)	37024 (0x90A0)	49024 (0xBF80)	61024 (0xEE60)

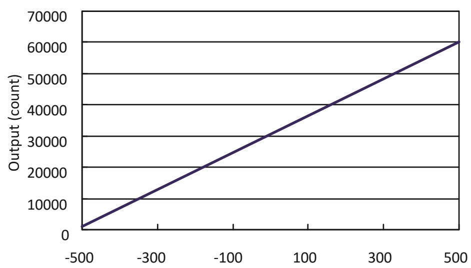
Differential pressure conversion formula:
DP = (Op - 1024) / 60000 x 250
DP = Differential pressure, OP = Output



D6F-PH0505AD3

Differential pressure (Pa)	-50	-30	-10	0	10	30	50
Output (Hex)	1024 (0x0400)	13024 (0x32E0)	25024 (0x61C0)	31024 (0x7930)	37024 (0x90A0)	49024 (0xBF80)	61024 (0xEE60)

Differential pressure conversion formula:
DP = (Op - 1024) / 60000 x 100 - 50
DP = Differential pressure, OP = Output



Differential pressure (Pa)	-500	-300	-100	0	100	300	500
Output (Hex)	1024 (0x0400)	11024 (0x2B10)	13024 (0x32E0)	16024 (0x3E98)	21024 (0x5220)	31024 (0x7930)	61024 (0xEE60)

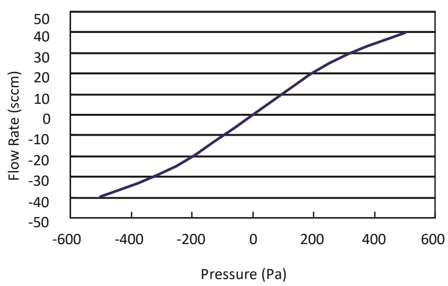
Differ

ential pressure conversion formula:
DP = (Op - 1024) / 60000 x 1000 - 500
DP = Differential pressure, OP = Output

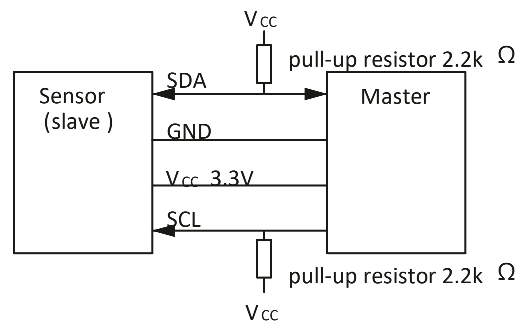
Note: Measurement conditions: Power supply voltage of 3.3 ± 0.1 VDC, ambient tem-

Differential pressure (Pa) perature of 25 ± 5°C, and ambient humidity of 25% to 75%.

Relation Between Pressure and Flow Rate



Electrical Connection



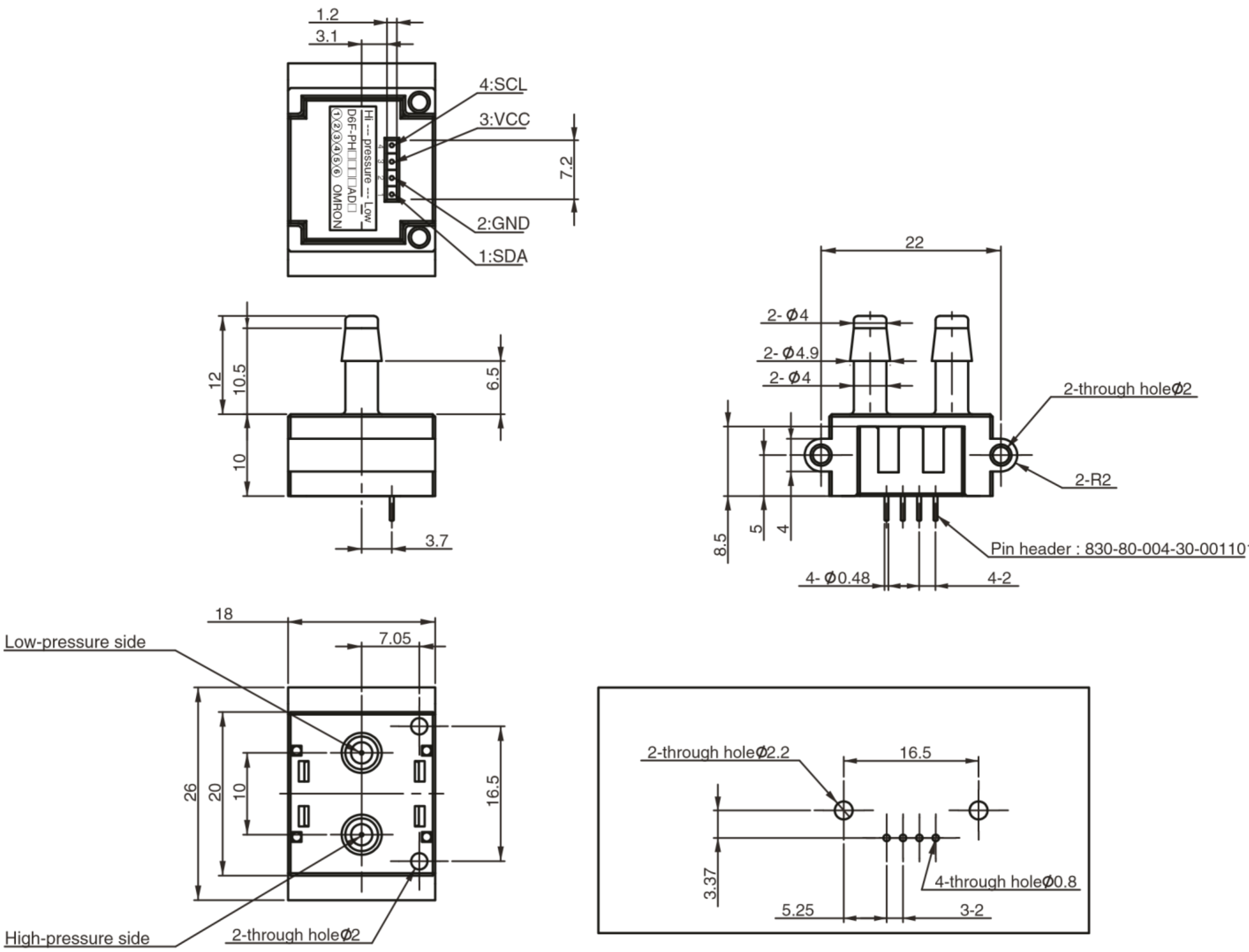
Communication

Method		I^2C
Master/Slave		Slave / Address: HEX: 0x6C BIN: 110_1100 (7bit)
Speed mode		Fast Mode 400kHz
Signals		
	SCL	Serial Clock
	SDA	Data Signal

2

Dimensions

(unit: mm)



Recommendation size for pin header installation (tolerances : ±0.1)

Precautions

!ΩAPNINΓ

The D6F is built for use with general-purpose devices. In cases such as those described below, where safety is required, implement measures to ensure the safety of the system and all devices, such as fail-safe designs, redundancy designs, and regular maintenance.

- Safety devices for ensuring safety for persons
- Transportation equipment control and Automotive control (suchas applications to stop operation)
- Aviation and space equipment
- Nuclear power equipment

D

o not use the D6F for applications in which D6F operation would directly affect human life.

!XAYTION

Make sure that the power to all equipment is turned OFF before you install the Sensor. Installing the Sensor while the power supply is ON may result in electrical shock or abnormal operation.

■Correct Use

Fluids,Tubes, and Sensor Installation

All Models

(1) Use clean fluids. Dust and mist can affect the

characteristics of the Sensor or damage the Sensor. Install a filter and mist separator on the upstream tube.

(Not required for the D6F-W≅A1, D6F-P and D6F-PH.)

(2) Do not use combustible gases (e.g., hydrogen), corrosive gases (e.g., chlorine, sulfur, acidic, or alkali gas), or other non-approved fluids. They may damage the Sensor.

(3) The performance specifications that are given for the D6F do not apply if any fluids other than the specified applicable fluid are used.

(4) Foreign matter in the tubes that are connected to the Sensor may damage the Sensor. Prevent any foreign matter from entering the tubes after the Sensor is removed from its packaging.

(5) Attach the tubes so that fluid flows only in the direction designated by the "Hi/Low" pressure markings on the Sensor. Correct measurements cannot be obtained if the fluid flows in the wrong direction.

(6) We recommend that you install the tubes horizontally. If the tubes are not installed horizontally, an error of ±1% FS or higher may result. (This does not apply to the D6F-03A3.)

(7) Install the Sensor on a flat surface. Incorrect installation may damage the Sensor and make it impossible to obtain correct measurements.

(8) After the Sensor is installed, check to confirm that it operates correctly.

(9) Do not drop the Sensor, remove the cover, or attempt to disassemble the Sensor in any way.

D6F-PH0025AD1, D6F-PH0505AD3, and D6F-PH5050AD3

(1) Depending on the ambient environment and installation location, dust, dirt, and other foreign matter may come inside the Sensor and block a part or all of the flow path or accumulate on internal components. This may result in the Sensor not being able to perform to the specifications given above. Always perform a pre-evaluation on your actual equipment and be aware of the possible problems that may occur before you use the Sensor with the actual equipment.

(2) Attach all tubes so that the fluid flows only in the direction from the positive side (+) to the negative side (-).

(3) For PCB-mounting, perform terminal soldering only after the Sensor is secured into place on the PCB.

(4) Use M1.8 panhead screws or equivalent tapping screws to mount the Sensor, and tighten the screws to a maximum torque of 0.36 N·m.

(5) The sensor output is minimally affected with the length of a tube.

The error is less than 1% with a tube (ID:4mm) length up to 800mm.

(6) Soldering

- Please solder properly
- Do not use flow soldering
- Please solder after fixed on the circuit board by screw
- Please use a soldering iron

Soldering conditionPressure: Max.100gf

Temperature:350 °C

Time: Max.5s

(7) About handling

- The sensor is a precision device, and if large shock and load is applied, it may cause a failure or characteristic change. Please do not use the sensor which has experienced excessive shock to the terminals, a damaged cover, or has fallen.
- The sensor shall only be handled in electrostatic discharge protected areas (EPA) under protected and controlled conditions.

4

Operating Environment

Do not use the Sensor in the following locations:

- Locations directly subject to heat radiated from heating equipment
- Locations subject to water or oil
- Locations subject to direct sunlight
- Locations subject to intense temperature changes
- Locations subject to icing or condensation
- Locations subject to excessive vibration or shock

Countermeasures against Noise

Noise may make it impossible to obtain correct measurements.

Consider the following countermeasures.

- Allow as much space as possible between the Sensor and devices that generate high frequencies (such as high-frequency welders and high-frequency sewing machines) or surges.
- Attach surge absorbers or noise filters to noise-generating devices that are near the Sensor (in particular, equipment with inductance, such as motors, transformers, solenoids, and magnetic coils).

  (It also helps to separate pipes and ducts, and to use shielded cables.)

Power Supply

- Do not directly solder power supply leads to the connector terminals. Use only the appropriate connectors.
- Wire with the correct terminal names and polarities. Incorrect wiring will cause failure of internal components.
- When using a commercially available switching regulator, ground the FG (frame ground) and G (ground) terminals.

RoHS Directive

The RoHS mark is displayed on the packing of products for which the six substances banned by the RoHS Directive have been abolished (both in processing and in the electronic components mounted to the PCBs).

*RoHS marking may be terminated if it is later determined that parts that were previously treated as RoHS compliant are not compliant due to circumstances at the supplier of the parts.

RoHS Compliance Criteria

The following standards are used to determine RoHS compliance for the six banned substances. (Items to which the RoHS Directive is not applicable are not given.)

- Lead: 1,000 ppm max.
- Hexavalent chromium: 1,000 ppm max.
- Mercury: 1,000 ppm max.
- PBB: 1,000 ppm max.
- Cadmium: 100 ppm max.
- PBDE: 1,000 ppm max.

Gas Density and Atmospheric Pressure

Change of gas density affects the sensor output.

Change of atmospheric pressure is compensated by the following formula:

Dpeff = Dp x (Pstd / Pamb)

Dpeff: Effective differential pressure
Dp: Differential pressure of the sensor output
Pstd: Standard atmospheric pressure (1,013.25 hPa)
Pamb: Actual ambient atmospheric pressure (hPa)

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

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Lampiran 4. Data Sheet Sensor GP2Y1010AUOF

Application note of Sharp dust sensor P2Y1010AU0F

Contents Page

Outline of this document :

This application note of Sharp dust sensor “GP2Y1010AU0F” is a document consists from Explanation how to use, cautions when using it, characteristics data, etc. for the customer’s reference when applying this device. When designing the device, please refer to this document and also evaluate it under actual usage conditions.

Features of GP2Y1010AU0F :

・Compact & thin package (46 × 30 × 17.6mm)

・With application of pulse output system, the device can detect even single house dust.

・House dust and cigarette smoke can be distinguished.

Objects to detect :

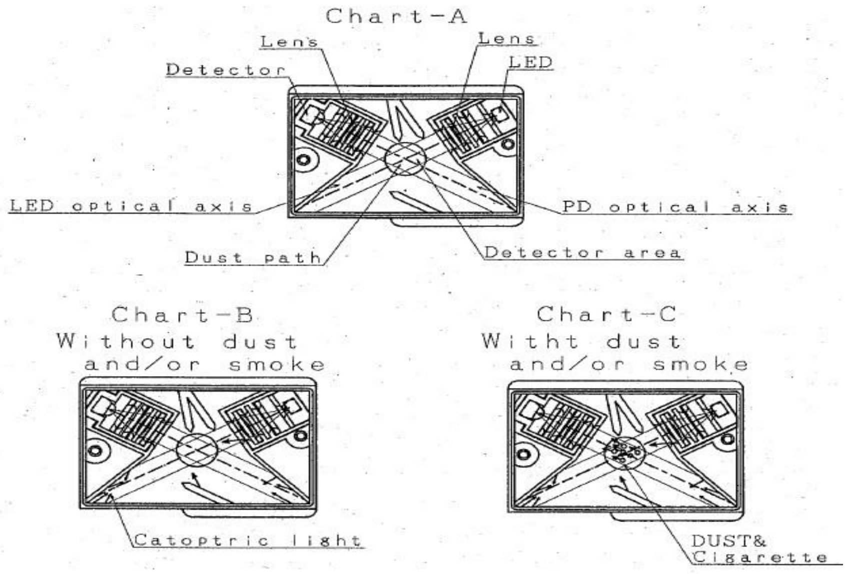
・House dust

・Cigarette smoke

Application ・Air conditioner ・Air purifier.

Principles of dust detection

This dust sensor “GP2Y1010AU0F” is the device to detect house dust, cigarette smoke, etc. and designed as a sensor for automatic running of application like air purifier and air conditioner with air purifier function.



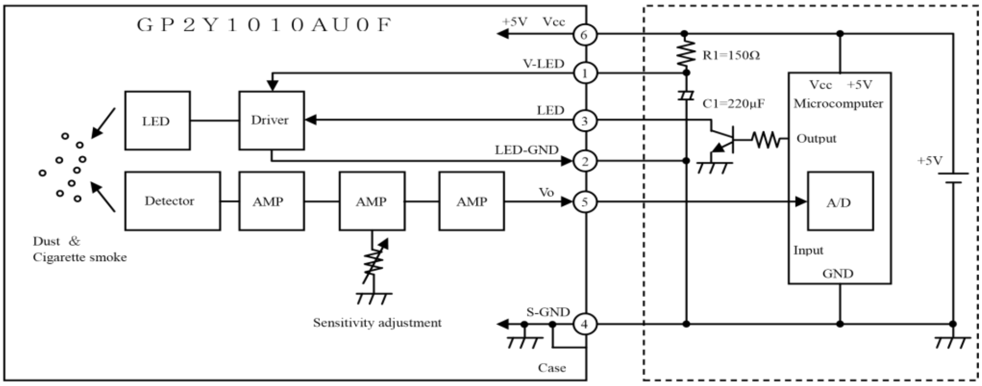
Light from the light emitter (Light Emitting Diode) is spotted with a lens and a slit as shown on the chart-A. Also for the light detector (Photodiode), a lens and a slit is positioned in front of it to cut disturbance light and to detect light reflection (when detecting dust) efficiently. Area where those two optical axis cross is detection area of the device.

Chart-B shows what is ongoing inside of the device when no dust exists and Chart-C shows that when dust exists. The device makes voltage output even when dust is not being detected. This output voltage at no dust condition is specified as Voc on the specification. This is because light emitted from the LED reflects at case of the device & some part of it gets to the detector. Chart-C shows how the device works when dust and/or cigarette smoke exists inside of it. in this case, the detector detects the light reflected from the dust and/or a particle of the cigarette smoke. Current in proportion to amount of the detected light comes out from the detector and the device makes analog voltage output (Pulse output) after the amplifier circuit amplifies the current from the detector.

Application guidance

6-1 Example of system connection

<Example>



・Resister, R1=150Ω and capacitor, C1=220uF mentioned above is required for pulse drive of the LED of GP2Y1010AU0F. Please use the ones with the above mentioned constants. Without these cmponents, the device does not work. As input conditions of the LED terminal, please apply LED drive conditions mentioned in Electro-optical characteristics chart of the specification. When it is impossible to apply those conditions, please make it within the recommended input conditions mentioned in the specification. When the LED is driven under the condition beyond the specification, characteristics of the

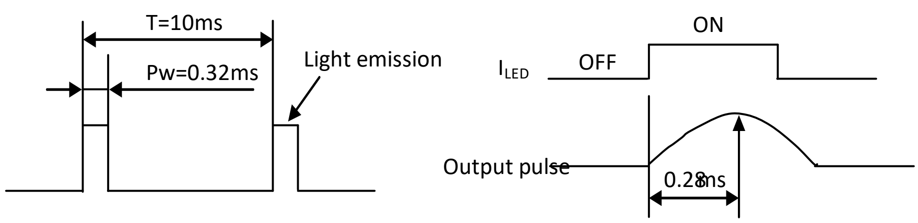
Parameter	Symbol	Specified condition	Recommended condition	Unit
Pulse cycle	T	10	10±1	ms
Pulse width	Pw	0.32	0.32±0.02	ms

device will be affected.

・The LED emits pulse light. Detected signal is amplified by the amplifier circuit and goes out as the output synchronized to the pulse mission of the LED.

・The specified output value is the one that is measured 0.28ms after the LED is turned on. Therefore, it is recommended that microcomputer to read the output 0.28ms after the LED emission also.

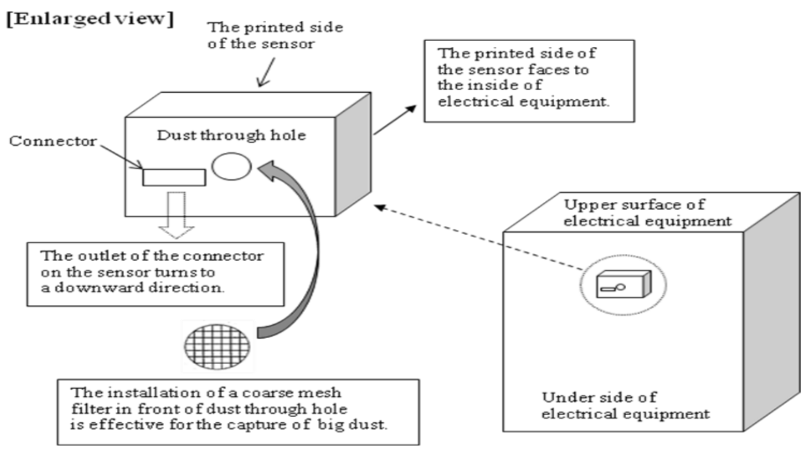
Sampling timing of output pulse



Sampling

- Time required for the device to be ready to detect dust from when the system is turned on is less than 1 sec.
- 6-2 Mounting method

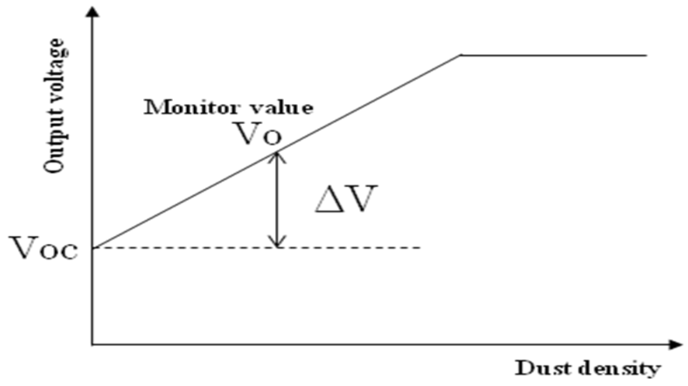
- There is a case that the sensor output may be affected when outer-light comes through dust through hole on the printed side.
- In order to avoid any influence from outer-light, please locate the printed side of the sensor facing to inside of the application.
- In order to avoid any influence from the attachment of dust to the inside of the sensor, please mount the sensor to the application so that the outlet of the connector on the sensor turns to a downward direction.
- Please consider the structure and the mechanism of the equipment so that big dust
- (string dust, etc.) should not enter the inside of the sensor. The installation of a coarse mesh filter in front of dust through hole is effective for the capture of big dust .
- Please consider the maintenance by vacuum cleaner in preparation for the false sensor output by the attachment of dust to the inside of the sensor.



6-3 Basic output handling

- The output voltage Vo of this sensor is the sum of output voltage at no dust Voc and output proportional to dust density ΔV.
  - Output proportional to dust density ΔV is shown as follows.
  - ΔV = Vo - Voc (Vo : monitor value)
- Output voltage at no dust Voc is caused by the stray light ocuurring in this sensor.
  - This sensor makes Voc voltage even at dust density 0mg/m^3.
  - If dust attached within this sensor increases, Voc becomes bigger. On the other hand, if dust attached within this sensor decreases, Voc becomes smaller.
- To store Voc in the memory of application is necessary to calculate ΔV from monitor value Vo. If monitor value Vo lower than the memorized Voc appears, this monitor value Vo should be stored in the memory of application as a new Voc.
- If monitor value Vo maintains a bigger value than the memorized Voc for

a certain period of time, this monitor value Vo should be stored in the memory of application as a new Voc.



6-4 Other cautions

- Please do not clean the device since cleaning may affect characteristics of the devive and it may result in operation failure of the device.
- VR for sensivity adjustment is adjusted in accordance to the specification at the time of shipment from Sharp. Therefore, please do not change value of it, or the value may become out of the specifications.
- Please do not disassemble the device. Once disassembled, the device may not have the same characteristics that it has had before the disassembly even if it is assembled again.
- Vibration may affect the characteristics of the device. Therefore, please make sure that the device works properly under actual usage conditions.
- The device does not work properly if bedewing occurs inside of it. Please design products so that the bedewing does not occur inside of the device.
- If the device is placed close to a noise generator (Electric dust collector, etc.), the sensor output may fluctuate due to inductive noise from the noise generator. Please consider the effect of the noise generator to the device when designing products.

Dust density characteristics (Example)

Test condition : According to "Electro-optical characteristics" of the specification of GP2Y1010AU0F.