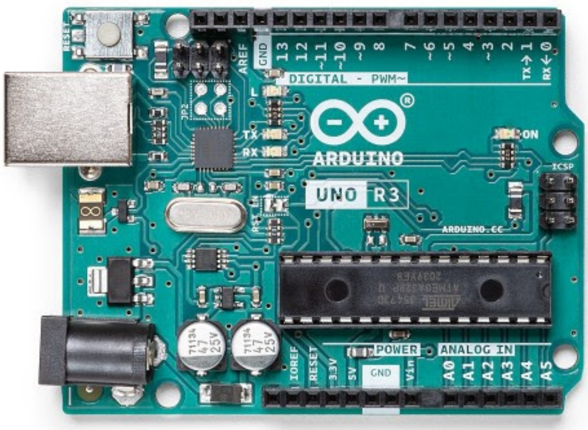
LAMPIRAN

Coding Arduino

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <HX711_ADC.h>

const int SensorProximty = 11;
const int LOADCELL_DOUT_PIN = 4;
const int LOADCELL_SCK_PIN = 5;
#define RELAY 10

HX711_ADC scale(LOADCELL_DOUT_PIN, LOADCELL_SCK_PIN);
LiquidCrystal_I2C lcd(0x27, 16, 2);

void setup() {
  Serial.begin(9600);
  lcd.init();
  lcd.backlight();
  scale.begin();
  scale.start(100);
  scale.setCalFactor(966.3636363636);
  pinMode(SensorProximty, INPUT);
  pinMode(RELAY, OUTPUT);
}

void loop() {
  scale.update();
  int i = scale.getData();
  if (i < 0) {
```

```
  i = 0;
 }
 Serial.print("Berat [Gram]: ");
 Serial.println(i);
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print("Berat:");
 lcd.setCursor(7, 0);
 lcd.print(i);
 lcd.setCursor(12, 0);
 lcd.print("Gram");
 delay(500);

 int hasil = digitalRead(SensorProximty);
 if (hasil == LOW) {
  lcd.clear();
  lcd.setCursor(0, 1);
  lcd.print("Umbi Terdeteksi");
  Serial.println("Umbi Terdeteksi");
  digitalWrite(RELAY, LOW);
  delay(1000);
 } else {
  lcd.clear();
  lcd.setCursor(0, 1);
  lcd.print("Tidak Terdeteksi");
  Serial.println("Umbi Tidak Terdeteksi");
  digitalWrite(RELAY, HIGH);
 }
 delay(1000);
}
```

Product Reference Manual
SKU: A000066



Description

The Arduino® UNO R3 is the perfect board to get familiar with electronics and coding. This versatile development board is equipped with the well-known ATmega328P and the ATMega 16U2 Processor.

This board will give you a great first experience within the world of Arduino.

Target areas:

Maker, introduction, industries

Features

- **ATMega328P** Processor
  - **Memory**
    - AVR CPU at up to 16 MHz
    - 32 kB Flash
    - 2 kB SRAM
    - 1 kB EEPROM
  - **Security**
    - Power On Reset (POR)
    - Brown Out Detection (BOD)
  - **Peripherals**
    - 2x 8-bit Timer/Counter with a dedicated period register and compare channels
    - 1x 16-bit Timer/Counter with a dedicated period register, input capture and compare channels
    - 1x USART with fractional baud rate generator and start-of-frame detection
    - 1x controller/peripheral Serial Peripheral Interface (SPI)
    - 1x Dual mode controller/peripheral I2C
    - 1x Analog Comparator (AC) with a scalable reference input
    - Watchdog Timer with separate on-chip oscillator
    - Six PWM channels
    - Interrupt and wake-up on pin change
  - **ATMega16U2 Processor**
    - 8-bit AVR® RISC-based microcontroller
  - **Memory**
    - 16 kB ISP Flash
    - 512B EEPROM
    - 512B SRAM
    - debugWIRE interface for on-chip debugging and programming
  - **Power**
    - 2.7-5.5 volts

CONTENTS

1 The Board

1.1 Application Examples

The UNO board is the flagship product of Arduino. Regardless if you are new to the world of electronics or will use the UNO R3 as a tool for education purposes or industry-related tasks, the UNO R3 is likely to meet your needs.

First entry to electronics: If this is your first project within coding and electronics, get started with our most used and documented board; UNO. It is equipped with the well-known ATmega328P processor, 14 digital input/output pins, 6 analog inputs, USB connections, ICSP header and reset button. This board includes everything you will need for a great first experience with Arduino.

Industry-standard development board: Using the UNO R3 board in industries, there are a range of companies using the UNO R3 board as the brain for their PLC's.

Education purposes: Although the UNO R3 board has been with us for about ten years, it is still widely used for various education purposes and scientific projects. The board's high standard and top quality performance makes it a great resource to capture real time from sensors and to trigger complex laboratory equipment to mention a few examples.

1.2 Related Products

- Arduino Starter Kit
- Arduino UNO R4 Minima
- Arduino UNO R4 WiFi
- Tinkerkit Braccio Robot

2 Ratings

2.1 Recommended Operating Conditions

Symbol	Description	Min	Max
	Conservative thermal limits for the whole board:	-40 °C (-40 °F)	85 °C (185 °F)

NOTE: In extreme temperatures, EEPROM, voltage regulator, and the crystal oscillator, might not work as expected.

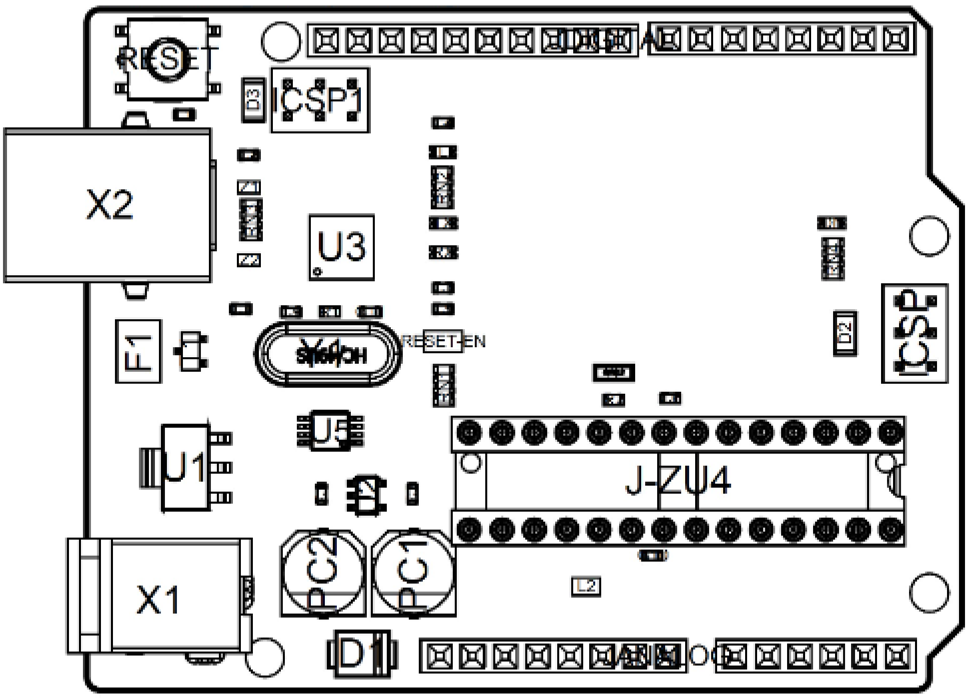
2.2 Power Consumption

Symbol	Description	Min	Typ	Max	Unit
VINMax	Maximum input voltage from VIN pad	6	-	20	V
VUSBMax	Maximum input voltage from USB connector		-	5.5	V
PMax	Maximum Power Consumption	-	-	xx	mA

3 Functional Overview

3.1 Board Topology

Top view



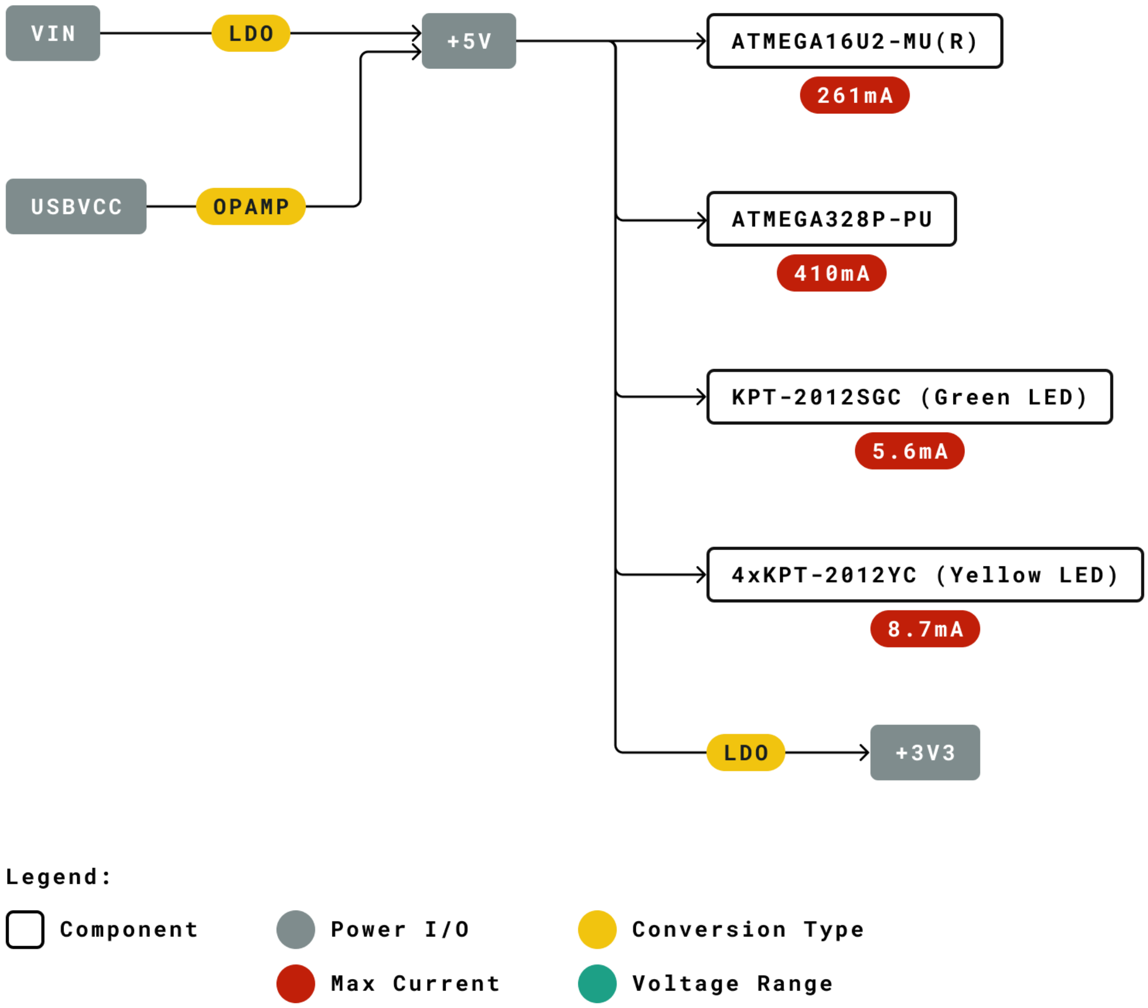
Board topology

Ref.	Description	Ref.	Description
X1	Power jack 2.1x5.5mm	U1	SPX1117M3-L-5 Regulator
X2	USB B Connector	U3	ATMEGA16U2 Module
PC1	EEE-1EA470WP 25V SMD Capacitor	U5	LMV358LIST-A.9 IC
PC2	EEE-1EA470WP 25V SMD Capacitor	F1	Chip Capacitor, High Density
D1	CGRA4007-G Rectifier	ICSP	Pin header connector (through hole 6)
J-ZU4	ATMEGA328P Module	ICSP1	Pin header connector (through hole 6)
Y1	ECS-160-20-4X-DU Oscillator		

3.2 Processor

The Main Processor is a ATmega328P running at up to 20 MHz. Most of its pins are connected to the external headers, however some are reserved for internal communication with the USB Bridge coprocessor.

3.3 Power Tree



Power tree

4 Board Operation

4.1 Getting Started - IDE

If you want to program your UNO R3 while offline you need to install the Arduino Desktop IDE [1] To connect the UNO R3 to your computer, you'll need a USB-B cable. This also provides power to the board, as indicated by the LED.

4.2 Getting Started - Arduino Cloud Editor

All Arduino boards, including this one, work out-of-the-box on the Arduino Cloud Editor [2], by just installing a simple plugin.

The Arduino Cloud Editor is hosted online, therefore it will always be up-to-date with the latest features and support for all boards. Follow **[3]** to start coding on the browser and upload your sketches onto your board.

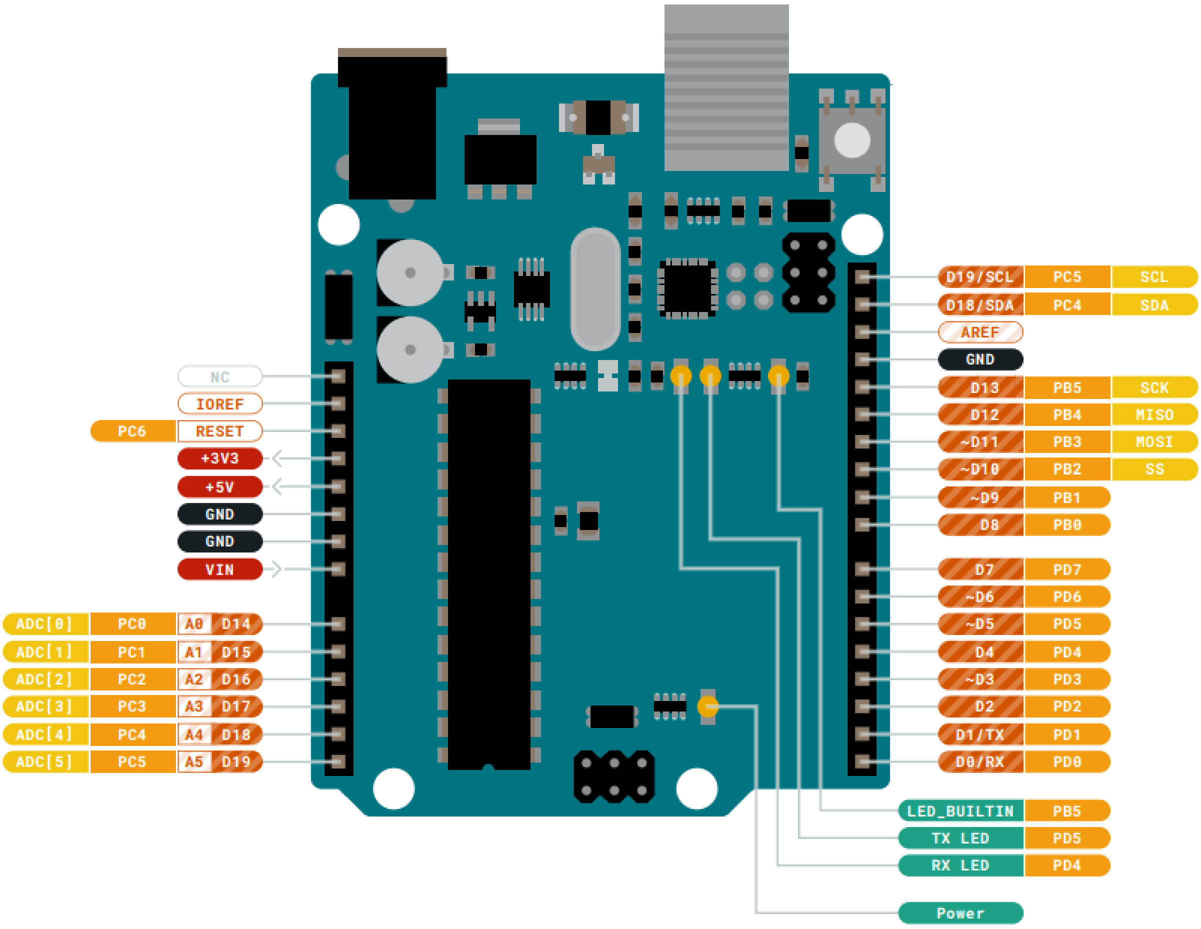
4.3 Sample Sketches

Sample sketches for the UNO R3 can be found either in the "Examples" menu in the Arduino IDE or in the "Documentation" section of the Arduino website [4].

4.4 Online Resources

Now that you have gone through the basics of what you can do with the board you can explore the endless possibilities it provides by checking exciting projects on Arduino Project Hub [5], the Arduino Library Reference [6] and the online Arduino store [7] where you will be able to complement your board with sensors, actuators and more.

5 Connector Pinouts



Pinout

5.1 JANALOG

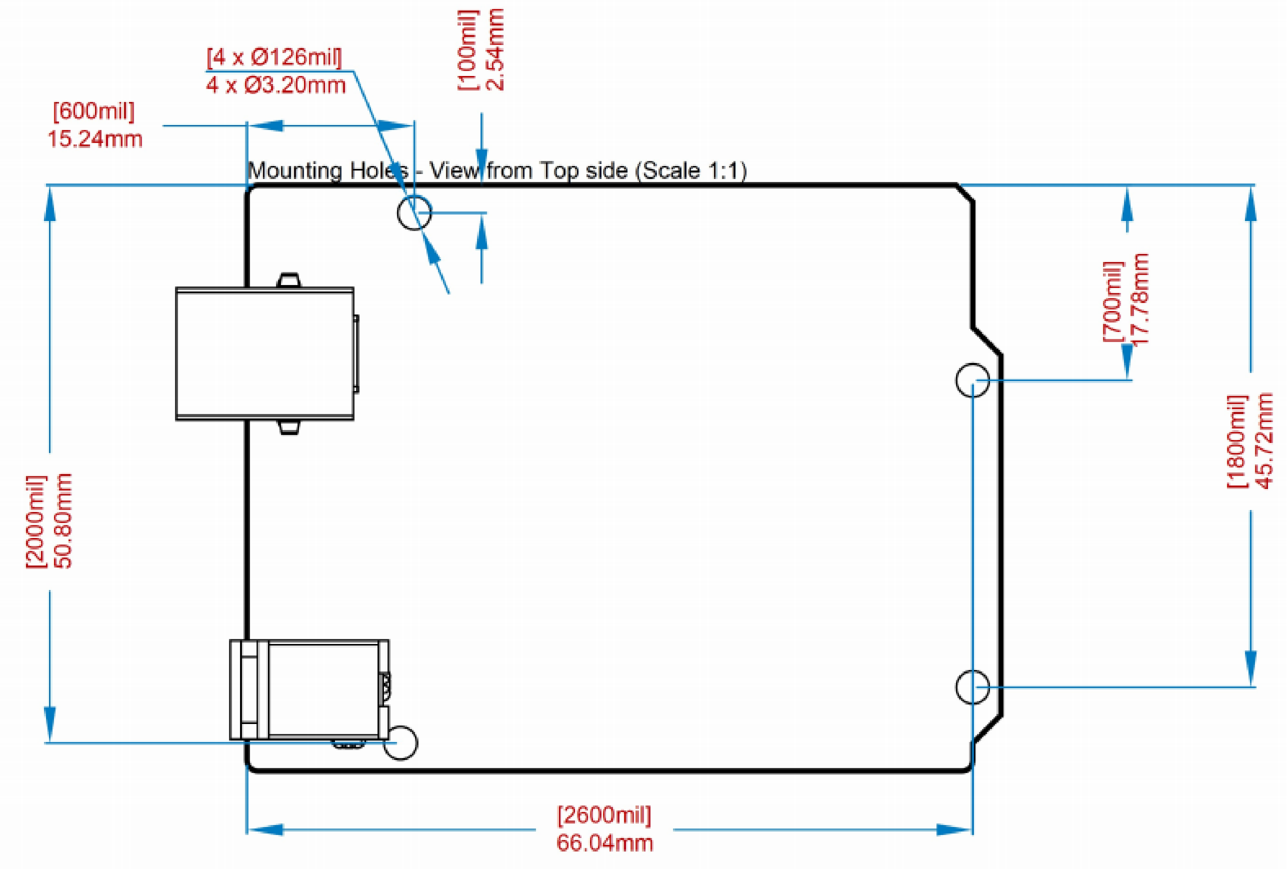
Pin	Function	Type	Description
1	NC	NC	Not connected
2	IOREF	IOREF	Reference for digital logic V - connected to 5V
3	Reset	Reset	Reset
4	+3V3	Power	+3V3 Power Rail
5	+5V	Power	+5V Power Rail
6	GND	Power	Ground
7	GND	Power	Ground
8	VIN	Power	Voltage Input
9	A0	Analog/GPIO	Analog input 0 /GPIO
10	A1	Analog/GPIO	Analog input 1 /GPIO
11	A2	Analog/GPIO	Analog input 2 /GPIO
12	A3	Analog/GPIO	Analog input 3 /GPIO
13	A4/SDA	Analog input/I2C	Analog input 4/I2C Data line
14	A5/SCL	Analog input/I2C	Analog input 5/I2C Clock line

5.2 JDIGITAL

Pin	Function	Type	Description
1	D0	Digital/GPIO	Digital pin 0/GPIO
2	D1	Digital/GPIO	Digital pin 1/GPIO
3	D2	Digital/GPIO	Digital pin 2/GPIO
4	D3	Digital/GPIO	Digital pin 3/GPIO
5	D4	Digital/GPIO	Digital pin 4/GPIO
6	D5	Digital/GPIO	Digital pin 5/GPIO
7	D6	Digital/GPIO	Digital pin 6/GPIO
8	D7	Digital/GPIO	Digital pin 7/GPIO
9	D8	Digital/GPIO	Digital pin 8/GPIO
10	D9	Digital/GPIO	Digital pin 9/GPIO
11	SS	Digital	SPI Chip Select
12	MOSI	Digital	SPI1 Main Out Secondary In
13	MISO	Digital	SPI Main In Secondary Out
14	SCK	Digital	SPI serial clock output
15	GND	Power	Ground
16	AREF	Digital	Analog reference voltage
17	A4/SD4	Digital	Analog input 4/I2C Data line (duplicated)
18	A5/SD5	Digital	Analog input 5/I2C Clock line (duplicated)

5.3 Mechanical Information

5.4 Board Outline & Mounting Holes



Board outline

6 Certifications

6.1 Declaration of Conformity CE DoC (EU)

We declare under our sole responsibility that the products above are in conformity with the essential requirements of the following EU Directives and therefore qualify for free movement within markets comprising the European Union (EU) and European Economic Area (EEA).

ROHS 2 Directive 2011/65/EU	
Conforms to:	EN50581:2012
Directive 2014/35/EU. (LVD)	
Conforms to:	EN 60950-1:2006/A11:2009/A1:2010/A12:2011/AC:2011
Directive 2004/40/EC & 2008/46/EC & 2013/35/EU, EMF	
Conforms to:	EN 62311:2008

6.2 Declaration of Conformity to EU RoHS & REACH 211 01/19/2021

Arduino boards are in compliance with RoHS 2 Directive 2011/65/EU of the European Parliament and RoHS 3 Directive 2015/863/EU of the Council of 4 June 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Substance	Maximum limit (ppm)
Lead (Pb)	1000
Cadmium (Cd)	100
Mercury (Hg)	1000
Hexavalent Chromium (Cr6+)	1000
Poly Brominated Biphenyls (PBB)	1000
Poly Brominated Diphenyl ethers (PBDE)	1000
Bis(2-Ethylhexyl} phthalate (DEHP)	1000
Benzyl butyl phthalate (BBP)	1000
Dibutyl phthalate (DBP)	1000
Diisobutyl phthalate (DIBP)	1000

Exemptions: No exemptions are claimed.

Arduino Boards are fully compliant with the related requirements of European Union Regulation (EC) 1907 /2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH). We declare none of the SVHCs (https://echa.europa.eu/web/guest/candidate-list-table), the Candidate List of Substances of Very High Concern for authorization currently released by ECHA, is present in all products (and also package) in quantities totaling in a concentration equal or above 0.1%. To the best of our knowledge, we also declare that our products do not contain any of the substances listed on the "Authorization List" (Annex XIV of the REACH regulations) and Substances of Very High Concern (SVHC) in any significant amounts as specified by the Annex XVII of Candidate list published by ECHA (European Chemical Agency) 1907 /2006/EC.

6.3 Conflict Minerals Declaration

As a global supplier of electronic and electrical components, Arduino is aware of our obligations with regards to laws and regulations regarding Conflict Minerals, specifically the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 1502. Arduino does not directly source or process conflict minerals such as Tin, Tantalum, Tungsten, or Gold. Conflict minerals are contained in our products in the form of solder, or as a component in metal alloys. As part of our reasonable due diligence Arduino has contacted component suppliers within our supply chain to verify their continued compliance with the regulations. Based on the information received thus far we declare that our products contain Conflict Minerals sourced from conflict-free areas.

7 FCC Caution

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference

(2) this device must accept any interference received, including interference that may cause undesired operation.

FCC RF Radiation Exposure Statement:

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2. This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.
3. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

English: User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both. This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause interference

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

French: Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l' appareil nedoit pas produire de brouillage

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IC SAR Warning:

English This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

French: Lors de l' installation et de l' exploitation de ce dispositif, la distance entre le radiateur et le corps est d 'au moins 20 cm.

Important: The operating temperature of the EUT can't exceed 85℃ and shouldn't be lower than -40℃.

Hereby, Arduino S.r.l. declares that this product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU. This product is allowed to be used in all EU member states.

8 Company Information

Company name	Arduino S.r.l
Company Address	Via Andrea Appiani 25 20900 MONZA Italy

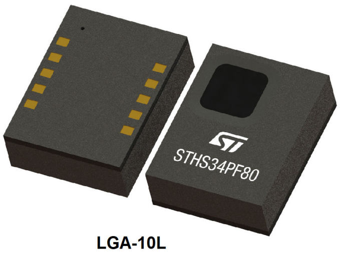
9 Reference Documentation

Reference	Link
Arduino IDE (Desktop)	https://www.arduino.cc/en/Main/Software
Arduino Cloud Editor	https://create.arduino.cc/editor
Arduino Cloud Editor - Getting Started	https://docs.arduino.cc/arduino-cloud/guides/editor/
Arduino Website	https://www.arduino.cc/
Arduino Project Hub	https://create.arduino.cc/projecthub?by=part&part_id=11332&sort=trending
Library Reference	https://www.arduino.cc/reference/en/
Arduino Store	https://store.arduino.cc/

10 Revision History

Date	Revision	Changes
25/04/2024	3	Updated link to new Cloud Editor
26/07/2023	2	General Update
06/2021	1	Datasheet release

Low-power, high-sensitivity infrared (IR) sensor for presence and motion detection



LGA-10L
3.2 x 4.2 x 1.455 (max)

Product status link
STHS34PF80

Product summary	
Order code	STHS34PF80TR
Temperature range [°C]	-40 to +85
Package	LGA-10L
Packing	Tape and reel

Product resources
AN5867 (device application note)
TN0018 (design and soldering)

Product label
SUSTAINABLE TECHNOLOGY

Features

Key features

- High-sensitivity infrared presence and motion detection sensor
- Reach up to 4 meters without lens for objects measuring 70 x 25 cm²
- Integrated silicon IR filter
- SMD friendly
- Capable of detecting stationary objects
- Capable of distinguishing between stationary and moving objects
- 80° field of view
- Factory calibrated
- Low power
- Embedded smart algorithm for presence / motion detection

Electrical specifications

- Supply voltage: 1.7 V to 3.6 V
- Supply current: 10 µA
- 2-wire I²C / 3-wire SPI serial interface
- Programmable ODRs from 0.25 Hz to 30 Hz
- One-shot mode

Sensing specifications

- IR sensitivity: 2000 LSB/°C
- RMS noise: 25 LSB_{rms}
- Operating wavelength: 5 µm to 20 µm
- Local temperature sensor accuracy: ±0.3 °C

Package specifications

- LGA 10-lead, 3.2 x 4.2 x 1.455 (max) mm
- ECOPACK and RoHS compliant

Applications

- Presence and proximity sensing
- Alarm / security systems
- Home automation
- Smart lighting
- IoT
- Smart lockers
- Smart wall pads

Description

The STHS34PF80 is an uncooled, factory-calibrated, infrared motion and presence detection sensor with operating wavelength between 5 μm and 20 μm.

The STHS34PF80 sensor has been designed to measure the amount of IR radiation emitted from an object within its field of view. The information is digitally processed by the ASIC, which can be programmed to monitor motion, presence, or an overtemperature condition.

Thanks to its exceptional sensitivity, the STHS34PF80 can detect the presence of a human being at a distance up to 4 meters without the need of an optical lens.

The STHS34PF80 is housed in a small 3.2 x 4.2 x 1.455 (max) mm 10-lead LGA package.

1 Overview

The STHS34PF80 is an infrared sensor that can be used to detect the presence of stationary and moving objects as well as overtemperature conditions. It measures the object's IR radiation with unique TMOS technology to detect its presence or motion when the object is inside the field of view.

An optical band-pass filter is deposited over the sensor limiting its operating range within the wavelengths of 5 µm to 20 µm, making it insensitive to visible light and other bands.

The sensor is based on a matrix of floating vacuum thermal transistors MOS (TMOS) connected together and acting as a single sensing element. A state-of-the-art thermal isolation is achieved thanks to ST's unique MEMS manufacturing technologies, allowing the sensor to translate the smallest temperature changes into electrical signals that, in turn, are fed to the ASIC.

The sensor is split into two parts, one exposed to IR radiation and the other one shielded. Differential reading between the two parts is implemented to remove the effect of sensor self-heating.

The STHS34PF80 embeds a high-accuracy temperature sensor to measure the ambient temperature and to enable measuring the precise IR radiation of an object.

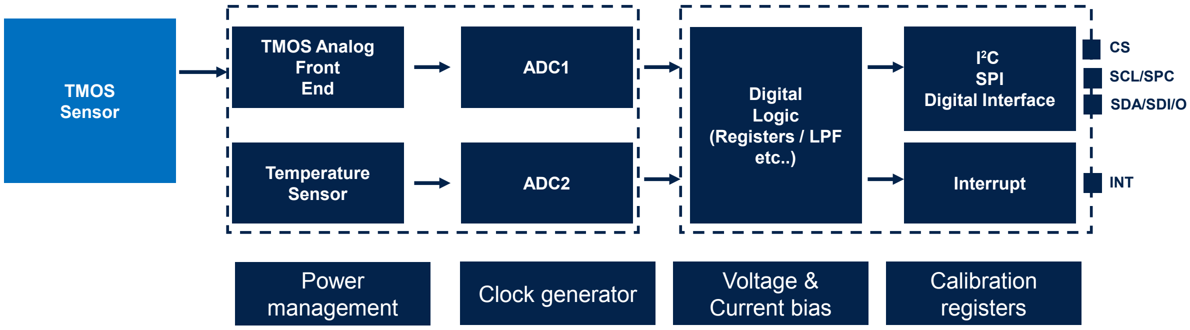
The ASIC also implements dedicated smart processing to detect / discriminate between stationary and moving objects and which can assert dedicated interrupts.

Different ODRs from 0.25 Hz to 30 Hz and a one-shot mode are available.

The STHS34PF80 is equipped with an I²C / 3-wire SPI interface and is housed in an OLGA 3.2 x 4.2 x 1.455 mm 10L package compatible with SMD mounting.

The field of view guaranteed by the package is 80°.

Figure 1. Block diagram



2 Pin description

Figure 2. Pin configuration (package bottom view)

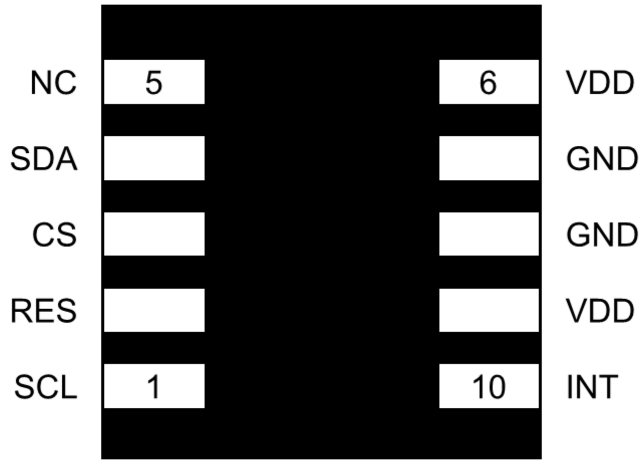


Table 1. Pin description

Pin number	Name	Function
1	SCL / SPC	I²C / SPI serial interface clock
2	RES	Reserved (connect to GND)
3	CS	I²C / SPI interface selection (1: I²C enabled; 0: SPI enabled)
4	SDA / SDI/O	I²C / SPI serial data line
5	NC	Leave floating (do not connect)
6	VDD	Power supply
7	GND	0 V supply
8	GND	0 V supply
9	VDD	Power supply
10	INT	Interrupt signal

3 Sensor and electrical specifications

Conditions at V_{DD} = 1.8 V, T = 25 °C.

Table 2. Sensor specifications

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
T_{bit}	Temperature output data (object and ambient)		–	16	–	Bit
T_{amb_s}	Ambient temperature sensitivity		–	100	–	LSB/°C
T_{obj_s}	Object temperature sensitivity(2)	15 °C to 35 °C		2000		LSB/°C
T_{amb_a}	Ambient temperature sensor accuracy	-10 °C to 60 °C		±0.3		°C
		-40 °C to 85 °C		±0.6		
ODR	Object and ambient temperature output data rate	ODR [3:0] = 0001		0.25		Hz
		ODR [3:0] = 0010		0.5		
		ODR [3:0] = 0011		1.0		
		ODR [3:0] = 0100		2.0		
		ODR [3:0] = 0101		4.0		
		ODR [3:0] = 0110		8.0		
		ODR [3:0] = 0111		15.0		
		ODR [3:0] = 1xxx		30.0		
RMS noise	AVG_TMOS = 32(3)			25		LSB_{rms}
FFOV	Full field of view(4)			80		Degree

1. *Typical specifications are not guaranteed.*
2. *The object temperature sensitivity is specified for full field-of-view coverage by a blackbody with more than 99% emissivity and default gain mode configuration (CTRL0 (17h)). The accuracy specifications apply under settled isothermal conditions only.*
3. *T_{obj} RMS noise can be different based on the AVG_TMOS value. Further detailed information can be found in Table 19.*
4. *Angle to have 50% IR intensity.*

Table 3. Electrical specifications

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
V_{DD}	Supply voltage		1.7	–	3.6	V
I_{DD}	Supply current	128 average @ 1 Hz ODR		10		µA
		32 average @ 1 Hz ODR		5		
Idd_{PDN}	Power-down supply current			1.5		µA
T_{OP}	Operating temperature range (refer to Table 5)		-40	–	85	°C

1. *Typical specifications are not guaranteed.*

Table 4. DC characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
DC input characteristics						
V_{IL}	Low-level input voltage (Schmitt buffer)	-	-	-	0.3 * VDD	V
V_{IH}	High-level input voltage (Schmitt buffer)	-	0.7 * VDD	-	-	V
DC output characteristics						
V_{OL}	Low-level output voltage		-	-	0.2	V
V_{OH}	High-level output voltage		VDD - 0.2	-	-	V

Table 5. Operating temperature range

CTRL0 (17h)	Operating temperature range	∆Temp = Tamb_room – Tamb_sensor
Default gain mode	-40 ~ 85 °C	± 2 °C
	10 ~ 40 °C	± 10 °C
Wide mode	-40 ~ 85 °C	-90 ~ 50 °C

Considering IR radiation measurement methodology, the output signal of TMOS is sensitive to temperature differences between the ambient temperature of the sensor itself and the ambient temperature of the room where the sensor takes the measurement. This delta of temperature could impact the operating temperature of the sensor. Depending on the target application, the user can select different gain modes to cover the proper range of the operating temperature and the delta of the temperature between the ambient temperature of the room and the ambient temperature of the sensor as described in Table 5.

The gain mode can be selected in the gain mode register (CTRL0 (17h)) when the device is in power-down mode. Note that this register restores its default value whenever the boot/reboot procedure is performed, so the user needs to set wide mode whenever the device is turned on in case the application needs to cover a broad operating temperature range and the delta between the temperature of the room in which the object is located and the temperature of the environment in thermal coupling with the sensor (in other words, the temperature inside the application).

3.1 Communication interface characteristics

3.1.1 SPI - serial peripheral interface

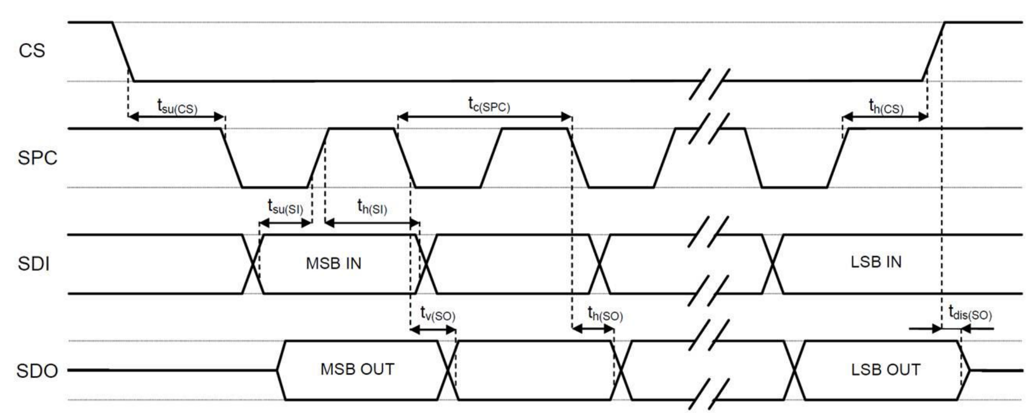
Subject to general operating conditions for V_{DD} and T_{OP}.

Table 6. **SPI slave timing values**

Symbol	Parameter	Value(1)			Unit
		Min	Typ	Max	
$f_{c(SPC)}$	SPI clock frequency			10	MHz
$t_{c(SPC)}$	SPI clock period	100			ns
$t_{high(SPC)}$	SPI clock high	45			ns
$t_{low(SPC)}$	SPI clock low	45			ns
$t_{su(CS)}$	CS setup time (mode 3)	5			ns
	CS setup time (mode 0)	20			ns
$t_{h(CS)}$	CS hold time (mode 3)	40			ns
	CS hold time (mode 0)	20			ns
$t_{su(SI)}$	SDI input setup time	15			ns
$t_{h(SI)}$	SDI input hold time	15			ns
$t_{v(SO)}$	SDO valid output time			50	ns
$t_{dis(SO)}$	SDO output disable time			50	ns
C_{load}	Bus capacitance			100	pF

1. *Values are evaluated at 10 MHz clock frequency for SPI with 3 wires, based on characterization results, not tested in production.*

Figure 3. **SPI slave timing diagram**



Note: Measurement points are done at 0.3·VDD and 0.7·VDD for both ports.

3.1.2 I²C - inter-IC control interface

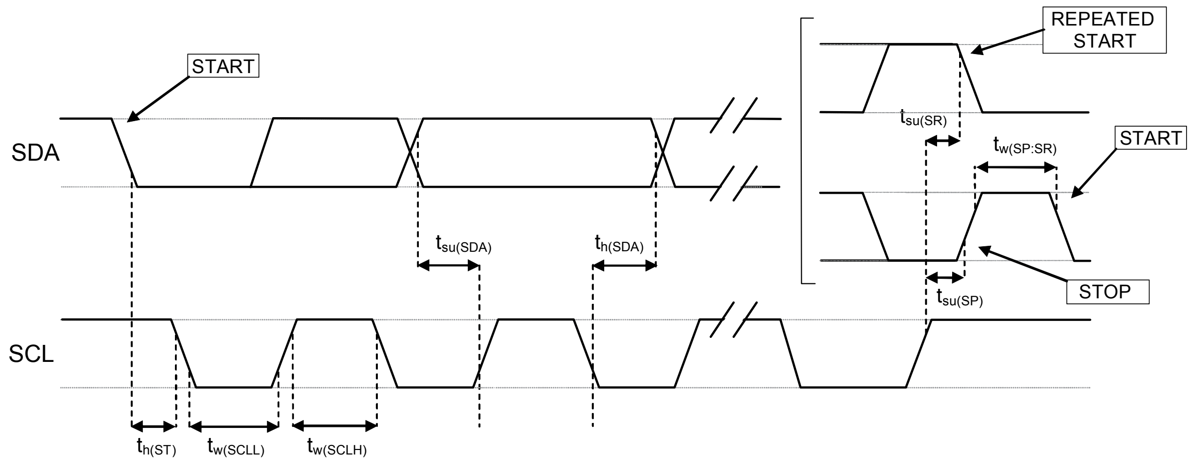
Subject to general operating conditions for V_{DD} and T_{OP}.

Table 7. I²C slave timing values

Symbol	Parameter	I²C fast mode(1)(2)		I²C fast mode plus(1)(2)		Unit
		Min	Max	Min	Max	
$f_{(SCL)}$	SCL clock frequency	0	400	0	1000	kHz
$t_{w(SCLL)}$	SCL clock low time	1.3		0.5		µs
$t_{w(SCLH)}$	SCL clock high time	0.6		0.26		
$t_{su(SDA)}$	SDA setup time	100		50		ns
$t_{h(SDA)}$	SDA data hold time	0	0.9	0		µs
$t_{h(ST)}$	START/REPEATED START condition hold time	0.6		0.26		
$t_{su(SR)}$	REPEATED START condition setup time	0.6		0.26		
$t_{su(SP)}$	STOP condition setup time	0.6		0.26		
$t_{w(SP:SR)}$	Bus free time between STOP and START condition	1.3		0.5		
	Data valid time		0.9		0.45	
	Data valid acknowledge time		0.9		0.45	
C_B	Capacitive load for each bus line		400		550	pF

1. *Data based on standard I²C protocol requirement, not tested in production.*
2. *Data for I²C fast mode and I²C fast mode plus have been evaluated by characterization, not tested in production*

Figure 4. I²C slave timing diagram



Note: Measurement points are done at 0.3·VDD and 0.7·VDD for both ports.

3.2 Absolute maximum ratings

Stress above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 8. Absolute maximum ratings

Symbol	Ratings	Maximum value	Unit
VDD	Supply voltage	-0.3 to 4.8	V
Vin	Input voltage on any control pin	-0.3 to VDD+0.3	V
T_{STG}	Storage temperature range	-40 to +125	°C
ESD	Electrostatic discharge protection	2 (HBM)	kV

Note: Supply voltage on any pin should never exceed 4.8 V.

This device is sensitive to mechanical shock, improper handling can cause permanent damage to the part.

This device is sensitive to electrostatic discharge (ESD), improper handling can cause permanent damage to the part.

4 Optical specifications

Table 9. Optical specification

Symbol	Parameter	Test condition	Min.	Typ. (1)	Max.	Unit
FFOV	Full field of view	At 50% intensity		80		Degree

1. *Typical specifications are not guaranteed.*

Figure 5. Typical field of view measurements

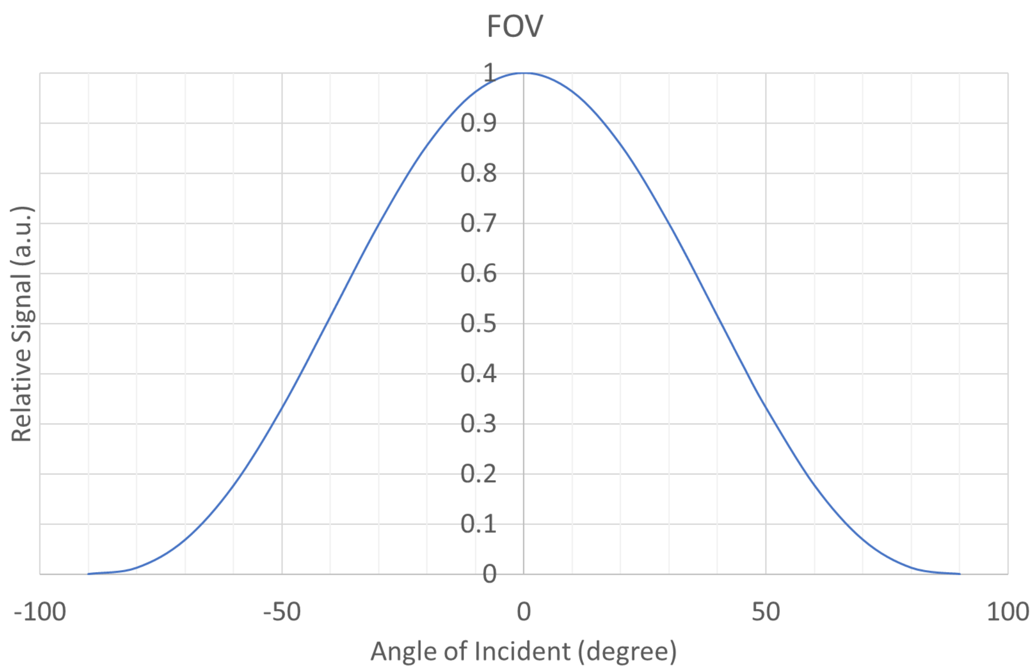
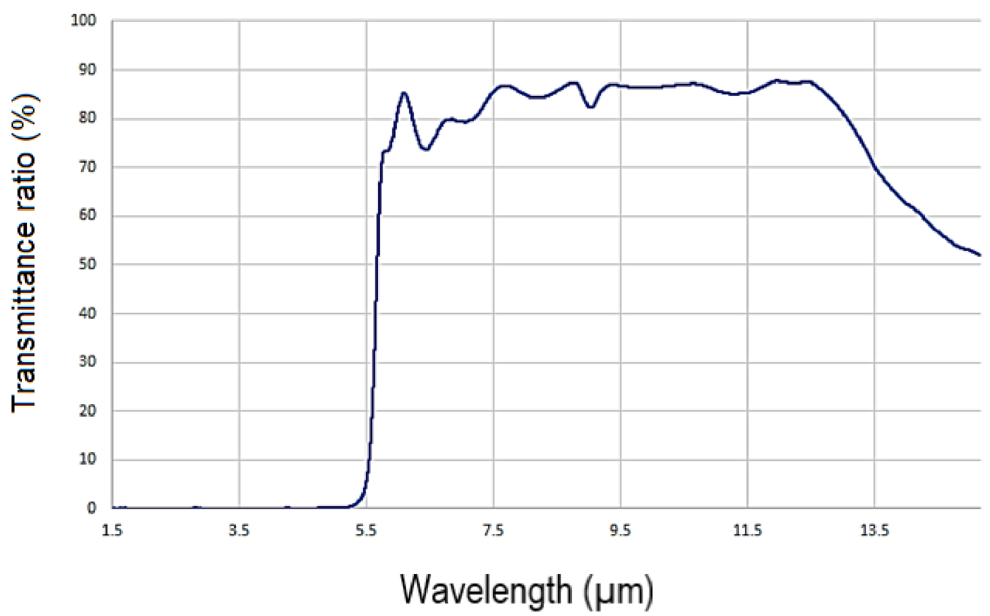


Figure 6. Filter transmittance typical curve



5 Digital interfaces

The registers embedded inside the STHS34PF80 can be accessed through both an I²C and a 3-wire SPI slave interface.

The serial interfaces are mapped to the same pins. The selection between the two interfaces is made through the CS pin, refer to Table 1. Pin description.

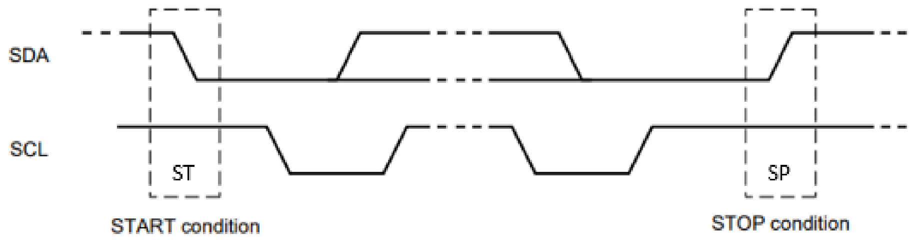
5.1 I²C interface

Following the correct protocols, the device behaves as an I²C slave. The registers embedded inside the ASIC device may be accessed through the I²C serial interfaces.

There are two signals associated with the I²C bus: the serial clock line (SCL) and the serial data line (SDA). The latter is a bidirectional line used for sending and receiving the data to/from the interface. Both the lines must be connected to VDD through an external pull-up resistor. When the bus is free, both the lines are high.

All transactions begin with a start (ST) and are terminated by a stop (SP) (see Figure 7). A high to low transition on the SDA line while SCL is high defines a start condition (ST). A low to high transition on the SDA line while SCL is high defines a stop condition.

Figure 7. Start and stop conditions



After the ST signal has been transmitted by the master, the bus is considered busy. The next byte of data transmitted after the ST condition contains the address of the slave in the first 7 bits (SAD) and the eighth bit is W = 0 which indicates that the master is transmitting data to the slave (SAD+W). When a slave address (SAD) is sent, each device in the system compares the first seven bits after a start condition (ST) with its slave address. If they match, the device considers itself addressed by the master.

The slave address of the STHS34PF80 is SAD=1011010.

Data transfer with acknowledge is mandatory. The transmitter must release the SDA line during the acknowledge pulse. The receiver must then pull the data line low so that it remains stable low during the high period of the acknowledge clock pulse (SAK). A receiver which has been addressed must generate an acknowledge after each byte of data has been received.

After the SAK from slave (STHS34PF80) the master sends an 8-bit subaddress (SUB): the 7 LSB represent the actual register address while the MSB has no meaning. For this I²C the auto increment is always active. Since auto increment is enabled by default, the SUB (register address) is automatically incremented to allow multiple data read/write at increasing addresses. When the slave receives the subaddress it responds with an ACK.

After this SAK from the slave, the master can do a write (single or multiple) or a read (single or multiple).

When the master wants to write, it sends a DATA (8-bit) and the slave responds with SAK. At this point if the master wants to close the communication, it sends a stop condition (SP) otherwise, it sends a new DATA.

When the master wants to read, it sends a repeated start condition (SR) and resends the slave address (SAD) with a read bit (R = 1) (SAD+R). The slave responds with a SAK and sends the DATA (8-bit) to the master to read. The master responds with a MAK (master acknowledge) if it wants to read from the next SUB address, otherwise it responds with a NMAK (no master acknowledge) and closes the communication, sending a stop condition (SP).

5.1.1 I²C read and write sequences

The previous sequences are used to perform actual write and read sequences described in the following tables.

Table 10. Transfer when the master is writing one byte to slave

Master	ST	SAD+W		SUB		DATA		SP
Slave			SAK		SAK		SAK	

Table 11. Transfer when master is writing multiple bytes to slave

Master	ST	SAD+W		SUB		DATA		DATA		SP
Slave			SAK		SAK		SAK		SAK	

Table 12. Transfer when master is receiving (reading) one byte of data from slave

Master	ST	SAD+W		SUB		SR	SAD+R			NMAK	SP
Slave			SAK		SAK			SAK	DATA		

Table 13. Transfer when master is receiving (reading) multiple bytes of data from slave

Master	ST	SAD+W		SUB		SR	SAD+R			MAK		MAK		NMAK	SP
Slave			SAK		SAK			SAK	DATA		DATA		DATA		

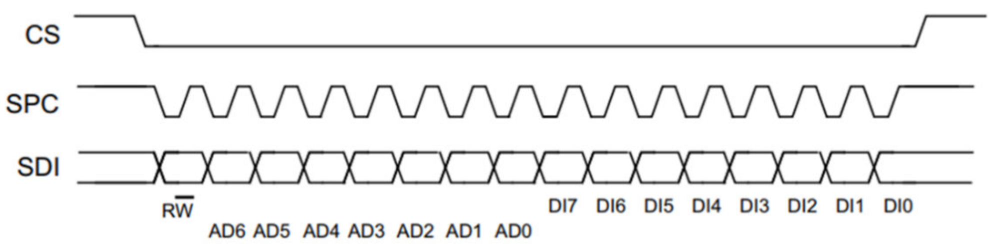
5.2 SPI interface

The ASIC SPI is a bus slave. The SPI allows writing and read the registers of the device.

The serial interface interacts with the application using 3 wires: CS, SPC, SDI/O.

5.2.1 SPI write

Figure 8. **SPI write protocol**



The SPI write command is performed with 16 clock pulses. A multiple byte write command is performed by adding blocks of 8 clock pulses to the previous one.

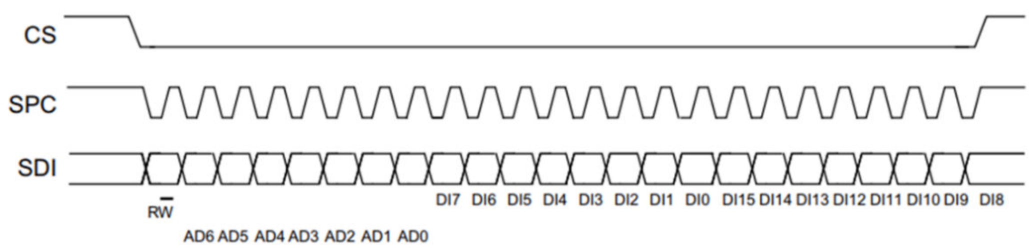
bit 0: WRITE bit. The value is 0.

bit 1 -7: address AD(6:0). This is the address field of the indexed register.

bit 8-15: data DI(7:0) (write mode). This is the data that is written inside the device (MSb first).

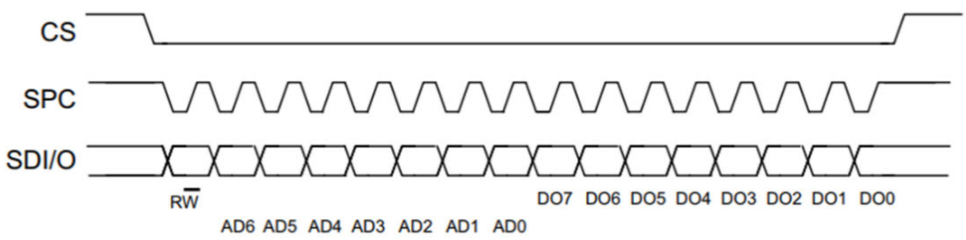
bit 16-... : data DI(...-8). Additional data in multiple byte writes.

Figure 9. **Multiple byte SPI write protocol (2-byte example)**



5.2.2 SPI read

Figure 10. **SPI read protocol in 3-wire mode**



The SPI read command is performed with 16 clocks pulses:

bit 0: READ bit. The value is 1.

bit 1-7: address AD(6:0). This is the address field of the indexed register.

bit 8-15: data DO(7:0) (read mode). This is the data that will be read from the device (MSB first).

The multiple write command is also available in 3-wire mode.

6 Smart digital algorithms

The STHS34PF80 embeds smart digital algorithms to support the following three detection modes. These embedded smart digital features are supported with default gain mode (CTRL0 (17h) = F1h), but they are not available when wide mode (CTRL0 (17h) = 81h) is configured.

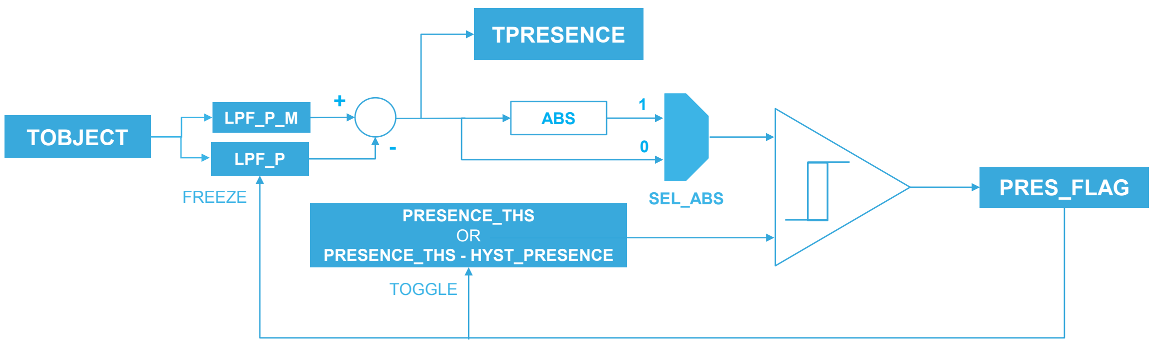
- **Presence detection**
- **Motion detection**
- **Ambient temperature shock detection**

6.1 Presence detection

Presence detection is performed by observing the difference between the two output signals of each low-pass filter (LPF_P_M & LPF_P) from the TMOS raw data of TOBJECT.

Then, the difference of the two signals is compared with the two thresholds of PRESENCE_THS and HYST_PRES which can be configured for the target application. Finally, the presence detection flag signal (PRES_FLAG) is set when the difference of the two filtered signals exceeds the threshold value as described in the figure below. When the PRES_FLAG is asserted, the LPF_P output remains at its last value. The LPF_P starts processing again the input data, providing filtered output when the PRES_FLAG is de-asserted

Figure 11. Block diagram of presence detection algorithm

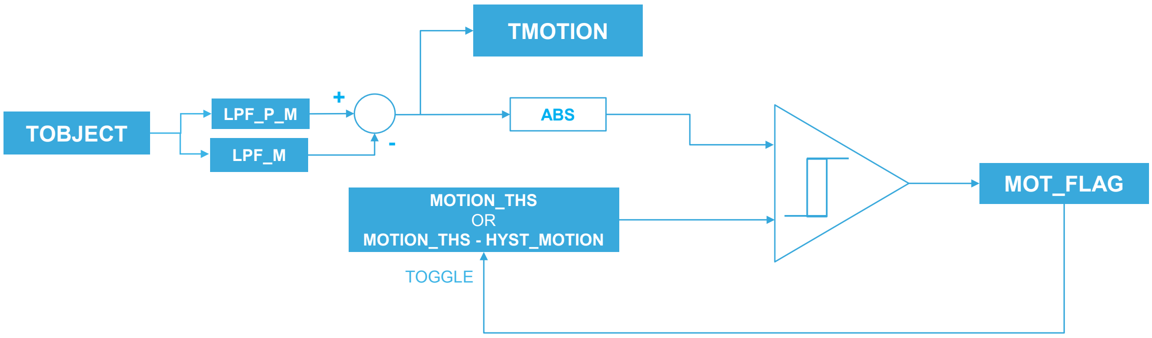


6.2 Motion detection

Motion detection is performed by observing the difference between the two output signals of each low-pass filter (LPF_P_M & LPF_M) from the TMOS raw data of TOBJECT.

Then, the difference of the two signals is compared with the two thresholds of MOTION_THS and HYST_MOT which can be configured for the target application. Finally, the motion detection flag signal (MOT_FLAG) is set when the difference of the two filtered signals exceeds the threshold value as described in the figure below.

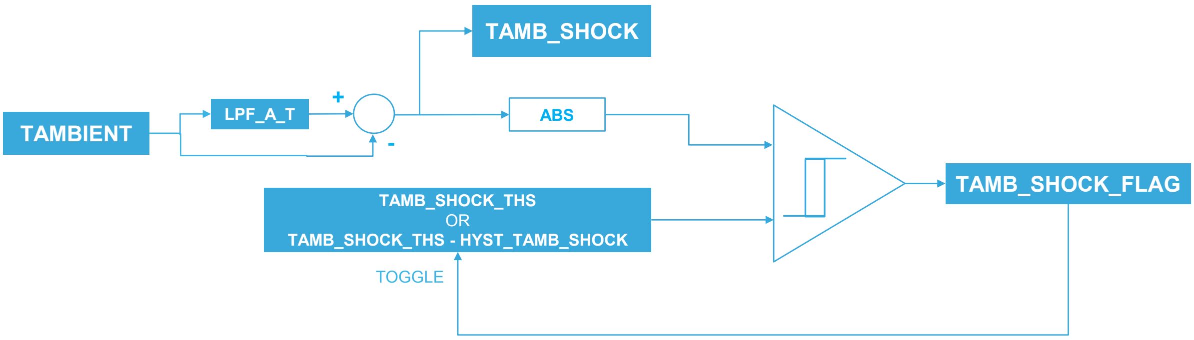
Figure 12. **Block diagram of motion detection algorithm**



6.3 Ambient temperature shock detection

Ambient temperature shock detection is supported with the output signal of LPF_A_T and the signal of TAMBIENT. The difference of the two signals is compared with the hysteresis of TAMB_SHOCK_THS and HYST_TAMBS. The detection of the ambient shock flag (TAMB_SHOCK_FLAG) is set when the difference of the two signals (LPF_A_T & TAMBIENT) exceeds the threshold values to indicate a sudden change of ambient temperature.

Figure 13. **Block diagram of ambient temperature shock detection algorithm**



7 Application schematics

The device power supply must be provided through the VDD line, a power supply decoupling capacitor (100 nF) must be placed as near as possible to the supply pins of device (VDD). Depending on the application, an additional capacitor of 1 μF could be placed on the VDD line to avoid power noise on VDD.

The functionality of the device and the measured data outputs are selectable and accessible through the I²C and SPI digital interface as shown in the following figures.

Figure 14. Application schematic with I²C connection

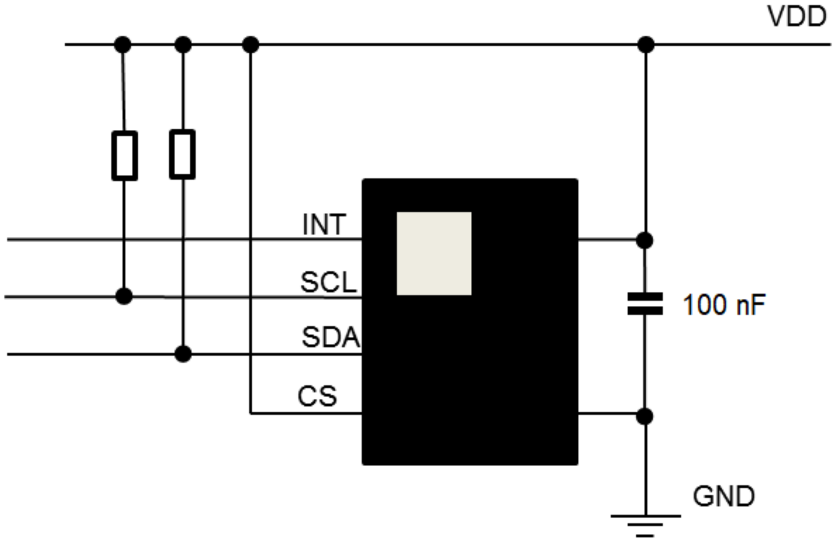


Figure 15. Application schematic with SPI connection

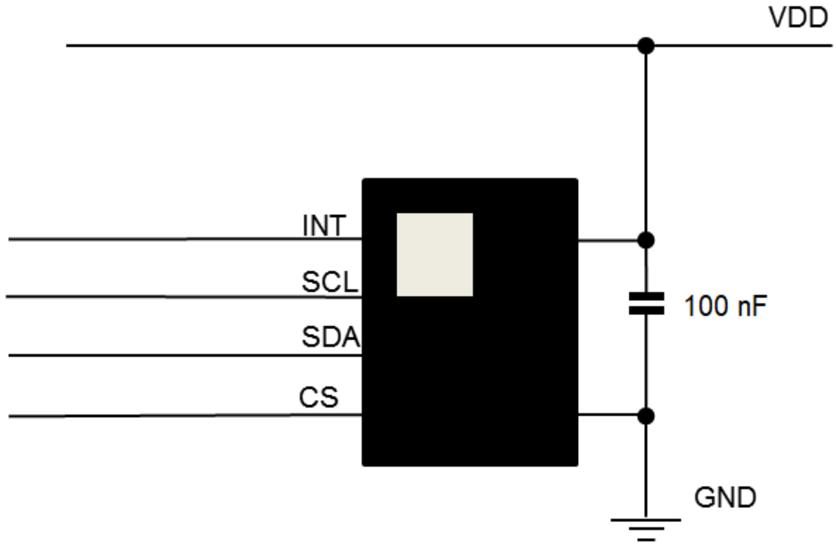


Table 14. Internal pin status

Pin number	Name	Default pin status
1	SCL / SPC	Default: input without pull-up
2	RES	
3	CS	Default: input with pull-up
4	SDA / SDI/O	Default: input without pull-up
5	NC	
6	VDD	
7	GND	
8	GND	
9	VDD	
10	INT	Default: input without pull-up

8 Soldering guidelines

The soldering profile depends on the number, size and placement of components on the application board. For this reason, it is not possible to define a unique soldering profile for the sensor only. The customer should use a time and temperature reflow profile based on PCB design and manufacturing expertise. In any case, the soldering profile should not exceed profiles as specified in Jedec J-STD-020.

LGA packages show metal traces on the side of the package so solder material must be avoided on the side of package during reflow.

The product package is not sealed as there is a 0.1 mm hole on the bottom of the package as illustrated in Figure 17. OLGA-10L (3.2 x 4.2 x 1.455 mm) package outline and mechanical data. A dry reflow process such as convection reflow is recommended. Vapor phase reflow is not suitable for this type of optical component.

A "no-wash" assembly process has to be used. “Self-cleaning” / “no flux” solder paste are to be used.

The product top surface can be eventually protected by suitable tape during reflow and other manufacturing steps to avoid contamination or scratches on the optical filter section of the component.

Any residual material (such as water, dust, or any contamination on top of the optical window) causes lower sensitivity of the IR measurment.

For land pattern and soldering recommendations, consult technical note TN0018 available on www.st.com.

9 Register mapping

Table 15. **Register map**

Name	Type	Register address	Default	Function and comment
Reserved		00h - 0Bh		Reserved
LPF1	RW	0Ch	04h	
LPF2	RW	0Dh	22h	
Reserved		0Eh		Reserved
WHO_AM_I	R	0Fh	D3h	Who am I
AVG_TRIM	RW	10h	03h	
Reserved		11h - 16h		Reserved
CTRL0	RW	17h	F1h	
Reserved		18h - 1Ch		Reserved
SENS_DATA	RW	1Dh		
Reserved		1Eh - 1Fh		Reserved
CTRL1	RW	20h	00h	
CTRL2	RW	21h	00h	
CTRL3	RW	22h	00h	Interrupt control
STATUS	R	23h		
Reserved		24h		Reserved
FUNC_STATUS	R	25h		
TOBJECT_L	R	26h		
TOBJECT_H	R	27h		
TAMBIENT_L	R	28h		
TAMBIENT_H	R	29h		
TOBJ_COMP_L	R	38h		
TOBJ_COMP_H	R	39h		
TPRESENCE_L	R	3Ah		
TPRESENCE_H	R	3Bh		
TMOTION_L	R	3Ch		
TMOTION_H	R	3Dh		
TAMB_SHOCK_L	R	3Eh		
TAMB_SHOCK_H	R	3Fh		

Reserved registers must not be changed. Writing to those registers may cause permanent damage to the device.

9.1 Embedded functions page register mapping

Table 16. Embedded functions page register map

Name	Type	Register address	Default	Function and comment
PRESENCE_THS	RW	20h - 21h	C8h	
MOTION_THS	RW	22h - 23h	C8h	
TAMB_SHOCK_THS	RW	24h - 25h	0Ah	
HYST_MOTION	RW	26h	32h	
HYST_PRESENCE	RW	27h	32h	
ALGO_CONFIG	RW	28h	00h	
HYST_TAMB_SHOCK	RW	29h	02h	
RESET_ALGO	RW	2Ah	00h	

10 Registers description

10.1 LPF1 (0Ch)

RW – default = 04h

7	6	5	4	3	2	1	0
-	-	LPF_P_M2	LPF_P_M1	LPF_P_M0	LPF_M2	LPF_M1	LPF_M0

LPF_P_M[2:0]	Low-pass filter configuration for motion and presence detection, see Table 17.
LPF_M[2:0]	Low-pass filter configuration for motion detection, see Table 17.

Table 17. Low-pass filter configuration

LPF_P_M[2:0] / LPF_M[2:0] / LPF_P[2:0] / LPF_A_T[2:0]	Low-pass filter configuration
000	ODR/9
001	ODR/20
010	ODR/50
011	ODR/100
100	ODR/200
101	ODR/400
110	ODR/800

10.2 LPF2 (0Dh)

RW – default = 22h

7	6	5	4	3	2	1	0
-	-	LPF_P2	LPF_P1	LPF_P0	LPF_A_T2	LPF_A_T1	LPF_A_T0

LPF_P[2:0]	Low-pass filter configuration for presence detection, see Table 17.
LPF_A_T[2:0]	Low-pass filter configuration for ambient temperature shock detection, see Table 17.

10.3 WHO_AM_I (0Fh)

Read only – default = D3h

7	6	5	4	3	2	1	0
1	1	0	1	0	0	1	1

WHO_AM_I	Device identification – Who am I

10.4 AVG_TRIM (10h)

RW – default = 03h

7	6	5	4	3	2	1	0
0	0	AVG_T1	AVG_T0	0	AVG_TMOS2	AVG_TMOS1	AVG_TMOS0

AVG_T[1:0]	Select the number of averaged samples for ambient temperature, see Table 18.
AVG_TMOS[2:0]	Select the number of averaged samples for object temperature, see Table 19.

Table 18. Averaging selection for ambient temperature

AVG_T[1:0]	Number of averaged samples for ambient temperature
00	8 (default)
01	4
10	2
11	1

Table 19. Averaging selection for object temperature and noise

AVG_TMOS [2:0]	Number of averaged samples for object temperature	RMS noise (LSB_{rms})
000	2	90
001	8	50
010	32	25
011	128 (default)	20
100	256	15
101	512	12
110	1024	11
111	2048	10

10.5 CTRL0 (17h)

RW – default = F1h

7	6	5	4	3	2	1	0
1	GAIN2	GAIN1	GAIN0	0	0	0	1

GAIN[2:0]	Enables the device to cover a wide operating temperature range for applications that might be thermally heated inside of the application. (000: wide mode; 111: default gain mode)

Refer to the ranges in Table 5. Operating temperature range for the wide mode and default gain modes.

10.6 SENS_DATA (1Dh)

RW – default = 00h

7	6	5	4	3	2	1	0
SENS7	SENS6	SENS5	SENS4	SENS3	SENS2	SENS1	SENS0

SENS[7:0]	Provides the sensitivity value in the embedded linear algorithm for compensating ambient temperature variations in the object temperature.

This register is written during factory calibration to indicate the sensitivity of the device and this value is used in the embedded linear algorithm for compensating ambient temperature variations in the object temperature.

If the sensitivity is changed by the optical material (that is, cover material) and the embedded compensation algorithm is required, the sensitivity data need to be revised accordingly.

Sensitivity can be calculated with the following formula by reading the SENS_DATA (1Dh) register.

Sensitivity = value of 1Dh (signed two's complement) x 16 + 2048

10.7 CTRL1 (20h)

RW – default = 00h

7	6	5	4	3	2	1	0
0	-	-	BDU	ODR3	ODR2	ODR1	ODR0

BDU	Enables the block data update feature for output registers TOBJECT (26h and 27h) and TAMBIENT (28h and 29h).
ODR[3:0]	Output data rate, refer to Table 20 for ODR configuration

Table 20. ODR configuration

ODR [3:0]	ODR frequency [Hz]	Time [ms]
0000	Power-down mode	-
0001	0.25	4000
0010	0.5	2000
0011	1	1000
0100	2	500
0101	4	250
0110	8	126
0111	15	66.67
1xxx	30	33.33

Refer to AN5867 (Section 3.3 Continuous mode) on www.st.com for the details of entering power-down mode and changing the ODR in continuous mode.

Device power consumption depends on the AVG_TMOS configuration and continuous mode at different ODRs as described in the following table.

Table 21. Current consumption at different ODRs and AVG_TMOS setting

AVG_TMOS [2:0]	One-shot mode	Continuous mode – current consumption (μA) vs ODR							
	Current consumption (μA) @ 1Hz	0.25 Hz	0.5 Hz	1 Hz	2 Hz	4 Hz	8 Hz	15 Hz	30 Hz
000 (2)	3.23	3.2	3.52	4.39	6.58	10.54	18.32	33.45	64.50
001 (8)	3.74	3.27	3.82	4.9	7.23	11.4	20.62	38.3	74.94
010 (32)	5	3.6	4.48	6.26	9.58	17.05	30.75	59	115.65
011 (128)	10	4.89	7.07	11.44	19.65	37.25	71.85		
100 (256)	16.89	6.55	10.55	18.02	33.1	65.5			
101 (512)	31.16	10.05	17.45	32.25	59.50				
110 (1024)	56.34	16.97	31.3	57.60					
111 (2048)	113	30.86	58.97						

10.8 CTRL2 (21h)

RW (bit 4: write only) – default = 00h

7	6	5	4	3	2	1	0
BOOT	-	-	FUNC_CFG_ACCESS	-	0	0	ONE_SHOT

BOOT	Reboot OTP memory content. Self-clearing upon completion. Default value : 0 (0: normal mode; 1: reboot memory content)
FUNC_CFG_ACCESS	Enable access to the registers[(1)] for embedded functions. Default value : 0 (0 : disable access to the embedded function page; 1: enable access to the embedded function page)
ONE_SHOT	Trigger one-shot acquisition. Self-clearing upon completion. Default value: 0 (0 : idle mode; 1 : new data set is acquired)

1. *It is not possible to write or read registers in the main page if this bit is set to 1. In order to go back to the main page, this bit should be written to 0.*

10.9 CTRL3 (22h)

RW – default = 00h

7	6	5	4	3	2	1	0
INT_H_L	PP_OD	INT_MSK2	INT_MSK1	INT_MSK0	INT_LATCHED	IEN1	IEN0

INT_H_L	Interrupt active-high & active-low. Default value: 0 (0: active high; 1: active low)
PP_OD	Push-pull / open-drain selection on the INT pin. Default value: 0 (0: push-pull; 1: open drain)
INT_MSK[2:0]	Interrupt masks for flag of FUNC_STATUS (25h), see Figure 16.
INT_LATCHED	Sets latched mode of DRDY on the INT pin. (0: pulsed mode on the INT pin; 1: latched mode on the INT pin)
IEN[1:0]	Configures the signal routed to the INT pin, see Table 22.

The DRDY signal on the INT pin is set to either pulsed or latched mode using the INT_LATCHED bit. If IEN[1:0] = 10 (INT_OR routed to the INT pin), INT_LATCHED must be set to 0.

Figure 16. INT_OR

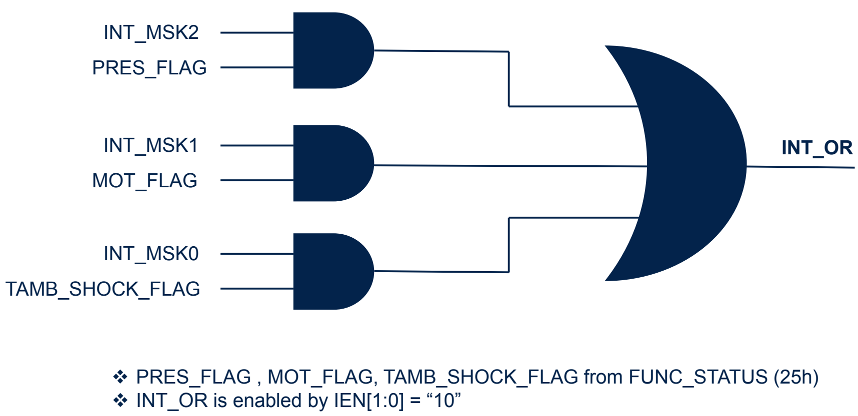


Table 22. IEN[1:0] configuration

IEN[1:0]	INT pin
00	high-Z
01	Data ready (DRDY)
10	INT_OR

10.10 STATUS (23h)

Read only – default = 00h

7	6	5	4	3	2	1	0
-	-	-	-	-	DRDY	-	-

DRDY	Data ready for TAMBIENT, TOBJECT, TAMB_SHOCK, TPRESENCE, TMOTION. This bit is reset to 0 when reading the FUNC_STATUS (25h) register. (0: no set of output data is available; 1: new set of output data is available)

10.11 FUNC_STATUS (25h)

Read only – default = 00h

7	6	5	4	3	2	1	0
-	-	-	-	-	PRES_FLAG	MOT_FLAG	TAMB_ SHOCK_FLAG

PRES_FLAG	Presence detection flag. This bit goes to 1 when there is presence detection. It returns back to 0 when there is no presence detection. Default value: 0 (0: no presence is detected; 1: presence is detected)
MOT_FLAG	Motion detection flag. This bit goes to 1 when there is motion detection. It returns back to 0 when there is no motion detection. Default value: 0 (0: no motion is detected; 1: motion is detected)
TAMB_SHOCK_FLAG	Ambient temperature shock detection flag. This bit goes to 1 when there is ambient temperature shock detection. It returns back to 0 when there is no ambient temperature shock detection. Default : 0 (0: no ambient temperature shock is detected; 1: ambient temperature shock is detected)

10.12 TOBJECT_L (26h)

Read only – default = 00h

7	6	5	4	3	2	1	0
TOBJECT7	TOBJECT6	TOBJECT5	TOBJECT4	TOBJECT3	TOBJECT2	TOBJECT1	TOBJECT0

TOBJECT[7:0]	TOBJECT LSB data

10.13 TOBJECT_H (27h)

Read only – default = 00h

7	6	5	4	3	2	1	0
TOBJECT15	TOBJECT14	TOBJECT13	TOBJECT12	TOBJECT11	TOBJECT10	TOBJECT9	TOBJECT8

TOBJECT[15:8]	TOBJECT MSB data

The TOBJECT (object temperature) output value is 16-bit data that represents the amount of infrared radiation emitted from the objects inside the field of view. It is composed of TOBJECT_H (27h) and TOBJECT_L (28h). The value is expressed as two's complement.

10.14 TAMBIENT_L (28h)

Read only – default = 00h

7	6	5	4	3	2	1	0
TAMBIENT7	TAMBIENT6	TAMBIENT5	TAMBIENT4	TAMBIENT3	TAMBIENT2	TAMBIENT1	TAMBIENT0

TAMBIENT[7:0]	Ambient temperature LSB data

10.15 TAMBIENT_H (29h)

Read only – default = 00h

7	6	5	4	3	2	1	0
TAMBIENT15	TAMBIENT14	TAMBIENT13	TAMBIENT12	TAMBIENT11	TAMBIENT10	TAMBIENT9	TAMBIENT8

TAMBIENT[15:8]	Ambient temperature MSB data

The TAMBIENT (ambient temperature) output value is 16-bit data that represents the temperature of the environment in thermal coupling with the sensor. It is composed of TAMBIENT_H (28h) and TAMBIENT_L (29h). The value is expressed as two's complement and its sensitivity is 100 LSB/°C.

10.16 TOBJ_COMP_L (38h)

Read only – default = 00h

7	6	5	4	3	2	1	0
TOBJ_COMP7	TOBJ_COMP6	TOBJ_COMP5	TOBJ_COMP4	TOBJ_COMP3	TOBJ_COMP2	TOBJ_COMP1	TOBJ_COMP0

TOBJ_COMP[7:0]	Compensated LSB data for object temperature output

10.17 TOBJ_COMP_H (39h)

Read only – default = 00h

7	6	5	4	3	2	1	0
TOBJ_COMP15	TOBJ_COMP14	TOBJ_COMP13	TOBJ_COMP12	TOBJ_COMP11	TOBJ_COMP10	TOBJ_COMP9	TOBJ_COMP8

TOBJ_COMP[15:8]	Compensated MSB data for object temperature output

The TOBJ_COMP output value is 16-bit data that represents the amount of infrared radiation emitted from the objects inside the field of view compensated through the embedded algorithm for compensating ambient temperature variations (refer to application note AN5867 on www.st.com for the details of the compensation algorithm). The output data is composed of TOBJ_COMP_H (39h) and TOBJ_COMP_L (38h). The value is expressed as two's complement.

10.18 TPRESENCE_L (3Ah)

Read only – default = 00h

7	6	5	4	3	2	1	0
TPRESENCE7	TPRESENCE6	TPRESENCE5	TPRESENCE4	TPRESENCE3	TPRESENCE2	TPRESENCE1	TPRESENCE0

TPRESENCE[7:0]	Presence detection output using embedded algorithms, LSB data

10.19 TPRESENCE_H (3Bh)

Read only – default = 00h

7	6	5	4	3	2	1	0
TPRESENCE15	TPRESENCE14	TPRESENCE13	TPRESENCE12	TPRESENCE11	TPRESENCE10	TPRESENCE9	TPRESENCE8

TPRESENCE[15:8]	Presence detection output using embedded algorithms, MSB data

The TPRESENCE (presence) output value is 16-bit data that contains the presence data. It is composed of TPRESENCE_H (3Bh) and TPRESENCE_L (3Ah). The value is expressed as two's complement.

10.20 TMOTION_L (3Ch)

Read only – default =00h

7	6	5	4	3	2	1	0
TMOTION 7	TMOTION 6	TMOTION 5	TMOTION 4	TMOTION 3	TMOTION 2	TMOTION 1	TMOTION 0

TMOTION[7:0]	Motion detection output using embedded algorithms, LSB data

10.21 TMOTION_H (3Dh)

Read only – default = 00h

7	6	5	4	3	2	1	0
TMOTION 15	TMOTION 14	TMOTION 13	TMOTION 12	TMOTION 11	TMOTION 10	TMOTION 9	TMOTION 8

TMOTION[15:8]	Motion detection output using embedded algorithms, MSB data

The TMOTION (motion) output value is 16-bit data that contains the motion data. It is composed of TMOTION_H (3Dh) and TMOTION_L (3Ch). The value is expressed as two's complement.

10.22 TAMB_SHOCK_L (3Eh)

Read only – default = 00h

7	6	5	4	3	2	1	0
TAMB_SHOCK7	TAMB_SHOCK6	TAMB_SHOCK5	TAMB_SHOCK4	TAMB_SHOCK3	TAMB_SHOCK2	TAMB_SHOCK1	TAMB_SHOCK0

TAMB_SHOCK[7:0]	Ambient shock detection output using embedded algorithms, LSB data

10.23 TAMB_SHOCK_H (3Fh)

Read only – default = 00h

7	6	5	4	3	2	1	0
TAMB_SHOCK15	TAMB_SHOCK14	TAMB_SHOCK13	TAMB_SHOCK12	TAMB_SHOCK11	TAMB_SHOCK10	TAMB_SHOCK9	TAMB_SHOCK8

TAMB_SHOCK[15:8]	Ambient shock detection output using embedded algorithms, MSB data

The TAMB_SHOCK (ambient temperature shock) output value is 16-bit data that contains the ambient temperature shock data. It is composed of TAMB_SHOCK_H (3Fh) and TAMB_SHOCK_L (3Eh). The value is expressed as two's complement.

11 Embedded functions description

The following registers are used to configure the embedded functions page. These registers are accessible when the FUNC_CFG_ACCESS bit in CTRL2 (21h) is set to 1.

11.1 FUNC_CFG_ADDR (08h)

RW – default = 00h

7	6	5	4	3	2	1	0
FUNC_CFG_ADDR[7:0]							

FUNC_CFG_ADDR[7:0]	Address of embedded feature that has to be read or written according to the configuration bits in the PAGE_RW (11h) register.

11.2 FUNC_CFG_DATA (09h)

RW – default = 00h

7	6	5	4	3	2	1	0
FUNC_CFG_DATA[7:0]							

FUNC_CFG_DATA[7:0]	Data byte that is read or written to the address of the page indicated by FUNC_CFG_ADDR (08h) according to the configuration bit in PAGE_RW (11h).

11.3 PAGE_RW (11h)

RW default = 00h

7	6	5	4	3	2	1	0
0	FUNC_CFG _WRITE	FUNC_CFG _READ	0	-	-	-	-

FUNC_CFG_WRITE	When set to 1, enables the write procedure for the embedded functions.
FUNC_CFG_READ	When set to 1, enables the read procedure for the embedded functions.

12 Embedded functions registers description

Detailed write and read procedures for the embedded functions registers are explained in application note AN5867 (refer to sections 2.1.1 and 2.1.2, respectively) on www.st.com.

12.1 PRESENCE_THS (20h - 21h)

Presence threshold for presence detection algorithm. This value is 15-bit unsigned. The default value is 200 (00C8h).

7	6	5	4	3	2	1	0
PRESENCE_THS7	PRESENCE_THS6	PRESENCE_THS5	PRESENCE_THS4	PRESENCE_THS3	PRESENCE_THS2	PRESENCE_THS1	PRESENCE_THS0
15	14	13	12	11	10	9	8
-	PRESENCE_THS14	PRESENCE_THS13	PRESENCE_THS12	PRESENCE_THS11	PRESENCE_THS10	PRESENCE_THS9	PRESENCE_THS8

12.2 MOTION_THS (22h - 23h)

Motion threshold for motion detection algorithm. This value is 15-bit unsigned. The default value is 200 (00C8h).

7	6	5	4	3	2	1	0
MOTION_THS7	MOTION_THS6	MOTION_THS5	MOTION_THS4	MOTION_THS3	MOTION_THS2	MOTION_THS1	MOTION_THS0
15	14	13	12	11	10	9	8
-	MOTION_THS14	MOTION_THS13	MOTION_THS12	MOTION_THS11	MOTION_THS10	MOTION_THS9	MOTION_THS8

12.3 TAMB_SHOCK_THS (24h - 25h)

Ambient temperature shock threshold for Tambient shock detection algorithm. This value is 15-bit unsigned. The default value is 10 (000Ah).

7	6	5	4	3	2	1	0
TAMB_SHOCK7	TAMB_SHOCK6	TAMB_SHOCK5	TAMB_SHOCK4	TAMB_SHOCK3	TAMB_SHOCK2	TAMB_SHOCK1	TAMB_SHOCK0
15	14	13	12	11	10	9	8
-	TAMB_SHOCK14	TAMB_SHOCK13	TAMB_SHOCK12	TAMB_SHOCK11	TAMB_SHOCK10	TAMB_SHOCK9	TAMB_SHOCK8

12.4 HYST_MOTION (26h)

Hysteresis configuration value for motion detection algorithm. It is an 8-bit unsigned value in the registers. The default value is 32h.

7	6	5	4	3	2	1	0
HYST_MOTION7	HYST_MOTION6	HYST_MOTION5	HYST_MOTION4	HYST_MOTION3	HYST_MOTION2	HYST_MOTION1	HYST_MOTION0

12.5 HYST_PRESENCE (27h)

Hysteresis configuration value for presence detection algorithm. It is an 8-bit unsigned value in the registers. The default value is 32h.

7	6	5	4	3	2	1	0
HYST_ PRESENCE7	HYST_ PRESENCE6	HYST_ PRESENCE5	HYST_ PRESENCE4	HYST_ PRESENCE3	HYST_ PRESENCE2	HYST_ PRESENCE1	HYST_ PRESENCE0

12.6 ALGO_CONFIG (28h)

Algorithm configuration with 00h default value

7	6	5	4	3	2	1	0
-	-	-	0	INT_PULSED	COMP_TYPE	SEL_ABS	0

INT_PULSED	When 1, the flags as a result of the algorithms are pulsed (high for ODR defined) on the INT pin. Default value: 0 (0: latched mode; 1: pulsed mode)
COMP_TYPE	Enables the embedded linear algorithm for compensating ambient temperature variations in the object temperature. Default value: 0 (0: disabled; 1: enabled)
SEL_ABS	Selects the absolute value in the presence detection algorithm. Default value: 0 (0: ABS is not applied; 1: ABS is applied)

The COMP_TYPE bit can be set to enable the embedded algorithm for compensating ambient temperature variations in the object temperature under the condition of CTRL0 (17h) GAIN[2:0] = 111. If CTRL0 (17h) GAIN[2:0] is set as 000, the embedded compensation algorithm is not supported. Note that enabling the embedded compensation algorithm may cause the signal to have higher RMS noise. For further configuration guidelines, refer to the application note.

12.7 HYST_TAMB_SHOCK (29h)

Hysteresis configuration value for ambient temperature shock detection algorithm. It is an 8-bit unsigned value in the registers. The default value is 02h.

7	6	5	4	3	2	1	0
HYST_TAMB_ SHOCK7	HYST_TAMB_ SHOCK6	HYST_TAMB_ SHOCK5	HYST_TAMB_ SHOCK4	HYST_TAMB_ SHOCK3	HYST_TAMB_ SHOCK2	HYST_TAMB_ SHOCK1	HYST_TAMB_ SHOCK0

12.8 RESET_ALGO (2Ah)

RW – default = 00h

7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	ALGO_ENABLE _RESET

ALGO_ENABLE_RESET	When this bit is set to 1, it executes a reset of the algorithms. Default value: 0 (0 : no reset of algorithms; 1: reset of algorithms)

The ALGO_ENABLE_RESET bit must be set to 1 in power-down mode in order to reset the algorithm properly.

This register allows a reset of the algorithm when relevant parameters (threshold, hysteresis, SEL_ABS, or low-pass filter configuration) are modified.

When the user changes one or more of these parameters, it is necessary to execute a reset operation of the algorithms before restarting a new measurement.

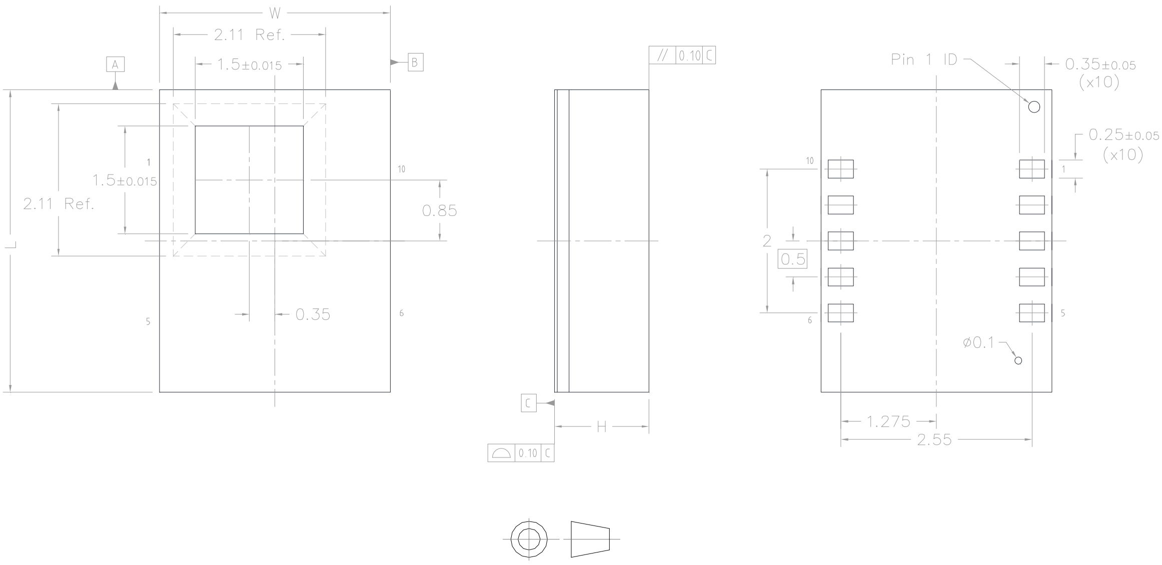
Refer to AN5867 (Section 7.4 Resetting the algorithm) on www.st.com for the details of the reset procedure.

13 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

13.1 OLGA-10L 3.2 x 4.2 x 1.455 mm package information

Figure 17. **OLGA-10L (3.2 x 4.2 x 1.455 mm) package outline and mechanical data**



Dimensions are in millimeter unless otherwise specified.
General Tolerance is +/-0.1mm unless otherwise specified.

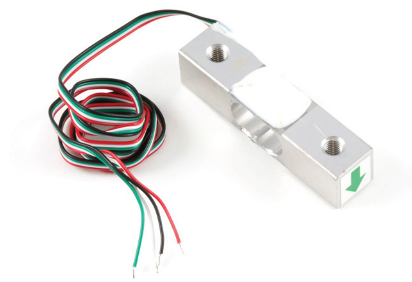
OUTER DIMENSIONS

ITEM	DIMENSION [mm]	TOLERANCE [mm]
Width [W]	3.2	±0.1
Length [L]	4.2	±0.1
Height [H]	1.455	MAX

DM00488758_6

Datasheet

3134 - Micro Load Cell (0-20kg) - CZL635



Contents

What do you have to know?

A load cell is a force sensing module - a carefully designed metal structure, with small elements called strain gauges mounted in precise locations on the structure. Load cells are designed to measure a specific force, and ignore other forces being applied. The electrical signal output by the load cell is very small and requires specialized amplification. Fortunately, **the 1046 PhidgetBridge will perform all the amplification and measurement of the electrical output.**

Load cells are designed to measure force in one direction. They will often measure force in other directions, but the sensor sensitivity will be different, since parts of the load cell operating under compression are now in tension, and vice versa.

How does it work - For curious people

Strain-gauge load cells convert the load acting on them into electrical signals. The measuring is done with very small resistor patterns called strain gauges - effectively small, flexible circuit boards. The gauges are bonded onto a beam or structural member that deforms when weight is applied, in turn deforming the strain-gauge. As the strain gauge is deformed, it's electrical resistance changes in proportion to the load.

The changes to the circuit caused by force is much smaller than the changes caused by variation in temperature. Higher quality load cells cancel out the effects of temperature using two techniques. By matching the expansion rate of the strain gauge to the expansion rate of the metal it's mounted on, undue strain on the gauges can be avoided as the load cell warms up and cools down. The most important method of temperature compensation involves using multiple strain gauges, which all respond to the change in temperature with the same change in resistance. Some load cell designs use gauges which are never subjected to any force, but only serve to counterbalance the temperature effects on the gauges that measuring force. Most designs use 4 strain gauges, some in compression, some under tension, which maximizes the sensitivity of the load cell, and automatically cancels the effect of temperature.

Installation

This Single Point Load Cell is used in small jewelry scales and kitchen scales. It's mounted by bolting down the end of the load cell where the wires are attached, and applying force on the other end **in the direction of the arrow.** Where the force is applied is not critical, as this load cell measures a shearing effect on the beam, not the bending of the beam. If you mount a small platform on the load cell, as would be done in a small scale, this load cell provides accurate readings regardless of the position of the load on the platform.

Calibration

A simple formula is usually used to convert the measured mv/V output from the load cell to the measured force:

$$Measured\ Force = A * Measured\ mV/V + B \text{ (offset)}$$

It's important to decide what unit your measured force is - grams, kilograms, pounds, etc.

This load cell has a rated output of 1.0±0.15mv/v which corresponds to the sensor's capacity of 20kg.

To find A we use

$$Capacity = A * Rated\ Output$$

$$A = Capacity / Rated\ Output$$

$$A = 20 / 1.0$$

$$A = 20$$

Since the Offset is quite variable between individual load cells, it's necessary to calculate the offset for each sensor. Measure the output of the load cell with no force on it and note the mv/V output measured by the PhidgetBridge.

Offset = 0 - 20 * Measured Output

Product Specifications

Mechanical	
Housing Material	Aluminum Alloy
Load Cell Type	Strain Gauge
Capacity	20kg
Dimensions	55.25x12.7x12.7mm
Mounting Holes	M5 (Screw Size)
Cable Length	550mm
Cable Size	30 AWG (0.2mm)
Cable - no. of leads	4
Electrical	
Precision	0.05%
Rated Output	1.0±0.15 mv/V
Non-Linearity	0.05% FS
Hysteresis	0.05% FS
Non-Repeatability	0.05% FS
Creep (per 30 minutes)	0.1% FS
Temperature Effect on Zero (per 10°C)	0.05% FS
Temperature Effect on Span (per 10°C)	0.05% FS
Zero Balance	±1.5% FS
Input Impedance	1130±10 Ohm
Output Impedance	1000±10 Ohm
Insulation Resistance (Under 50VDC)	≥5000 MOhm
Excitation Voltage	5 VDC
Compensated Temperature Range	-10 to ~+40°C
Operating Temperature Range	-20 to ~+55°C
Safe Overload	120% Capacity
Ultimate Overload	150% Capacity

Glossary

Capacity
The maximum load the load cell is designed to measure within its specifications.

Creep
The change in sensor output occurring over 30 minutes, while under load at or near capacity and with all environmental conditions and other variables remaining constant.

FULL SCALE or FS
Used to qualify error - FULL SCALE is the change in output when the sensor is fully loaded. If a particular error (for example, Non-Linearity) is expressed as 0.1% F.S., and the output is 1.0mV/V, the maximum non-linearity that will be seen over the operating range of the sensor will be 0.001 mV/V. An important distinction is that this error doesn't have to only occur at the maximum load. If you are operating the sensor at a maximum of 10% of capacity, for this example, the non-linearity would still be 0.001mV/V, or 1% of the operating range that you are actually using.

Hysteresis
If a force equal to 50% of capacity is applied to a load cell which has been at no load, a given output will be measured. The same load cell is at full capacity, and some of the force is removed, resulting in the load cell operating at 50% capacity. The difference in output between the two test scenarios is called hysteresis.

Excitation Voltage
Specifies the voltage that can be applied to the power/ground terminals on the load cell. In practice, if you are using the load cell with the PhidgetBridge, you don't have to worry about this spec.

Input Impedance
Determines the power that will be consumed by the load cell. The lower this number is, the more current will be required, and the more heating will occur when the load cell is powered. In very noisy environments, a lower input impedance will reduce the effect of Electromagnetic interference on long wires between the load cell and PhidgetBridge.

Insulation Resistance
The electrical resistance measured between the metal structure of the load cell, and the wiring. The practical result of this is the metal structure of the load cells should not be energized with a voltage, particularly higher voltages, as it can arc into the PhidgetBridge. Commonly the load cell and the metal framework it is part of will be grounded to earth or to your system ground.

Maximum Overload
The maximum load which can be applied without producing a structural failure.

Non-Linearity
Ideally, the output of the sensor will be perfectly linear, and a simple 2-point calibration will exactly describe the behaviour of the sensor at other loads. In practice, the sensor is not perfect, and Non-linearity describes the maximum deviation from the linear curve. Theoretically, if a more complex calibration is used, some of the non-linearity can be calibrated out, but this will require a very high accuracy calibration with multiple points.

Non-Repeatability
The maximum difference the sensor will report when exactly the same weight is applied, at the same temperature, over multiple test runs.

Operating Temperature
The extremes of ambient temperature within which the load cell will operate without permanent adverse change to any of its performance characteristics.

Output Impedance
Roughly corresponds to the input impedance. If the Output Impedance is very high, measuring the bridge will distort the results. The PhidgetBridge carefully buffers the signals coming from the load cell, so in practice this is not a concern.

Rated Output
Is the difference in the output of the sensor between when it is fully loaded to its rated capacity, and when it's unloaded. Effectively, it's how sensitive the sensor is, and corresponds to the gain calculated when calibrating the sensor. More expensive sensors have an exact rated output based on an individual calibration done at the factory.

Safe Overload
The maximum axial load which can be applied without producing a permanent shift in performance characteristics beyond those specified.

Compensated Temperature
The range of temperature over which the load cell is compensated to maintain output and zero balance within specified limits.

Temperature Effect on Span
Span is also called rated output. This value is the change in output due to a change in ambient temperature. It is measured over 10 degree C temperature interval.

Temperature Effect on Zero
The change in zero balance due to a change in ambient temperature. This value is measured over 10 degree C temperature interval.

Zero Balance
Zero Balance defines the maximum difference between the +/- output wires when no load is applied. Realistically, each sensor will be individually calibrated, at least for the output when no load is applied. Zero Balance is more of a concern if the load cell is being interfaced to an amplification circuit - the PhidgetBridge can easily handle enormous differences between +/-. If the difference is very large, the PhidgetBridge will not be able to use the higher Gain settings.

1 Channel 5V Optical Isolated Relay Module

This is a LOW Level 5V 1-channel relay interface board, needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller. This module is optically isolated from high voltage side for safety requirement and also prevent ground loop when interface to microcontroller.

SKU: MDU1091

Brief Data:

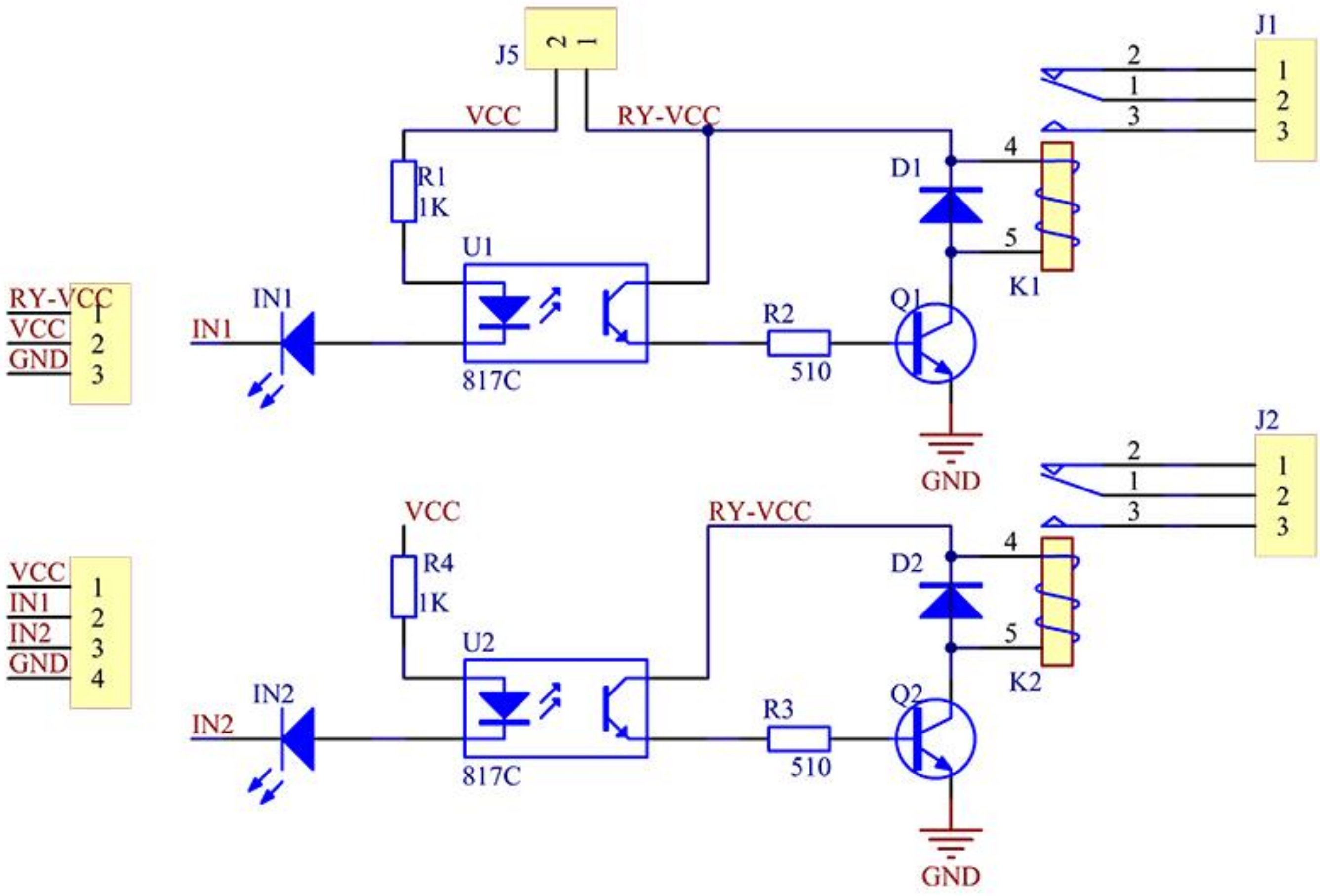
- Operating Voltage: 5Vdc.
- Relay Maximum output: DC 30V/10A, AC 250V/10A.
- 1 Channel Relay Module with Opto-coupler. LOW Level Trigger expansion board, which is compatible with Arduino control board.
- Standard interface that can be controlled directly by microcontroller (8051, AVR, *PIC, DSP, ARM, ARM, MSP430, TTL logic).
- Relay of high quality low noise relays SPDT. A common terminal, a normally open, one normally closed terminal.
- Opto-Coupler isolation, for high voltage safety and prevent ground loop with microcontroller.

Schematic:

VCC and RY-VCC are also the power supply of the relay module. When you need to drive a large power load, you can take the jumper cap off and connect an extra power to RY-VCC to supply the relay; connect VCC to 5V of the MCU board to supply input signals.

NOTES: If you want complete optical isolation, connect "Vcc" to Arduino +5 volts but do NOT connect Arduino Ground. Remove the Vcc to JD-Vcc jumper. Connect a separate +5 supply to "JD-Vcc" and board Gnd. This will supply power to the transistor drivers and relay coils.

If relay isolation is enough for your application, connect Arduino +5 and Gnd, and leave Vcc to JD-Vcc jumper in place.

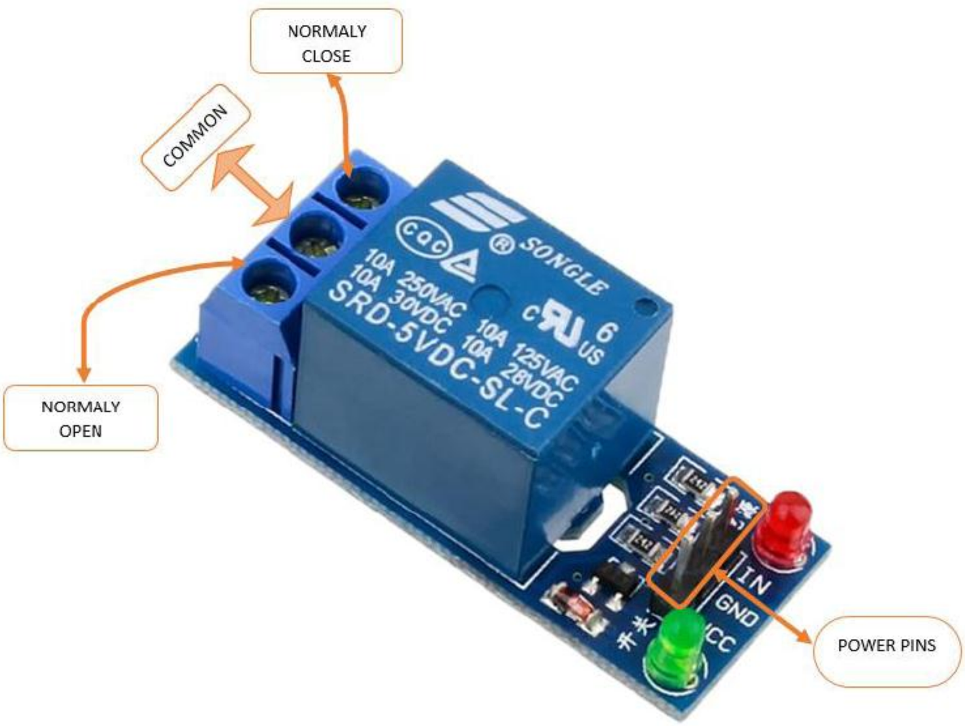


It is sometimes possible to use this relay boards with 3.3V signals, if the JD-VCC (Relay Power) is provided from a +5V supply and the VCC to JD-VCC jumper is removed. That 5V relay supply could be totally isolated from the 3.3V device, or have a common ground if opto-isolation is not needed. If used with isolated 3.3V signals, VCC (To the input of the opto-isolator, next to the IN pins) should be connected to the 3.3V device's +3.3V supply.

NOTE: Some Raspberry-Pi users have found that some relays are reliable and others do not actuate sometimes. It may be necessary to change the value of R1 from 1000 ohms to something like 220 ohms, or supply +5V to the VCC connection.

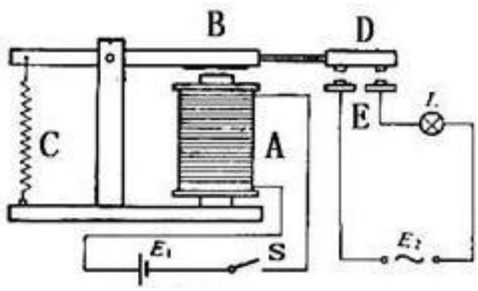
NOTE: The digital inputs from Arduino are Active LOW: The relay actuates and LED lights when the input pin is LOW, and turns off on HIGH.

Module Layout:



Operating Principle:

See the picture below: A is an electromagnet, B armature, C spring, D moving contact, and E fixed contacts. There are two fixed contacts, a normally closed one and a normally open one. When the coil is not energized, the normally open contact is the one that is off, while the normally closed one is the other that is on.



Supply voltage to the coil and some currents will pass through the coil thus generating the electromagnetic effect. So the armature overcomes the tension of the spring and is attracted to the core, thus closing the moving contact of the armature and the normally open (NO) contact or you may say releasing the former and the normally closed (NC) contact. After the coil is de-energized, the electromagnetic force disappears and the armature moves back to the original position, releasing the moving contact and normally closed contact. The closing and releasing of the contacts results in power on and off of the circuit.

Input:

VCC : Connected to positive supply voltage (supply power according to relay voltage)

GND : Connected to supply ground.

IN1: Signal triggering terminal 1 of relay module

Output:

Each module of the relay has one NC (normally close), one NO (normally open) and one COM (Common) terminal. So there are 2 NC, 2 NO and 2 COM of the channel relay in total. NC stands for the normal close port contact and the state without power. NO stands for the normal open port contact and the state with power. COM means the common port. You can choose NC port or NO port according to whether power or not.

Testing Setup:

When a low level is supplied to signal terminal of the 2-channel relay, the LED at the output terminal will light up. Otherwise, it will turn off. If a periodic high and low level is supplied to the signal terminal, you can see the LED will cycle between on and off.

For Arduino：

Step 1：

Connect the signal terminal IN1、IN2 of 2-channel relay to digital pin 4 & 5 of the Arduino Uno or ATMega2560 board, and connect an LED at the output terminal.

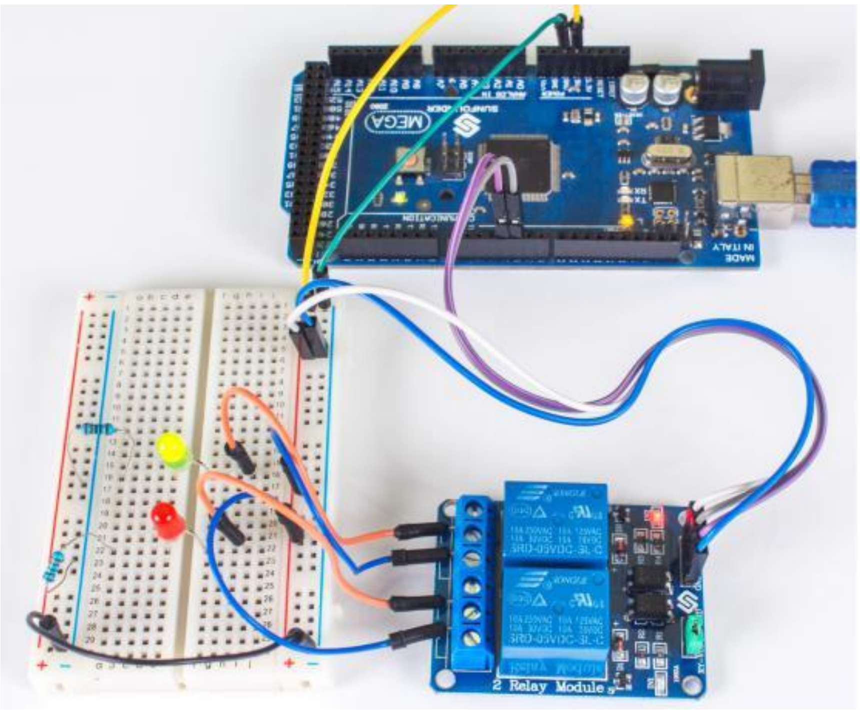
IN1> 4

IN2> 5

Step 2:

Upload the sketch "text_code" to the Arduino Uno or ATMega2560 board. Then you can see the LED cycle between on and off.

The actual figure is shown below:



For raspberry Pi:

Step1:

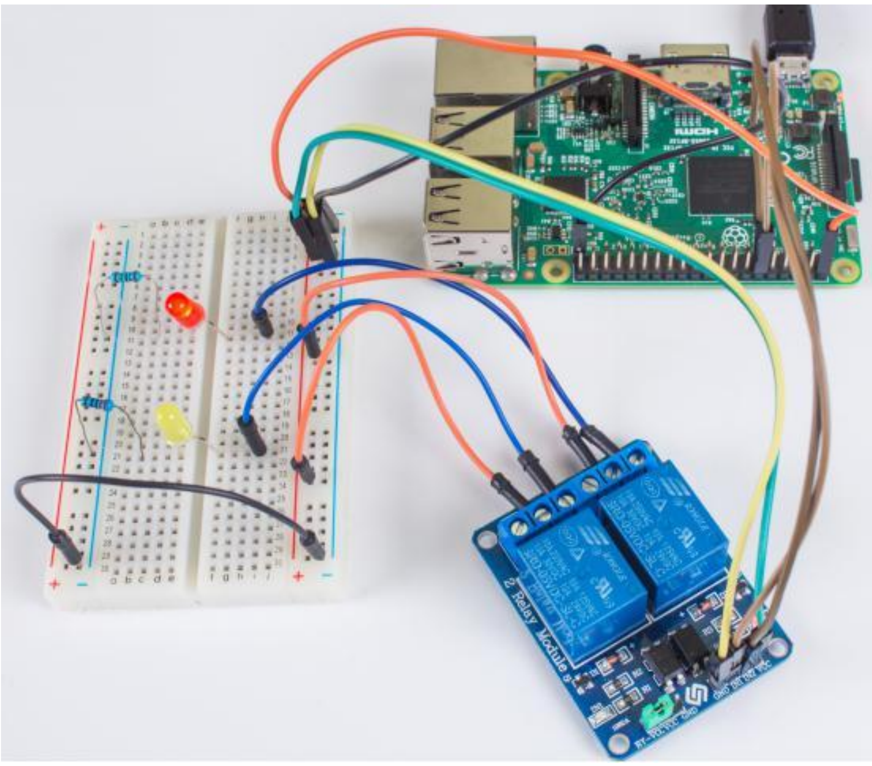
Connect the signal terminal IN2、IN1 of 2-channel relay to port 17、18 of the Raspberry Pi, and connect an LED at the output terminal.

IN2 > 17

IN1 > 18

Step 2:

Run the "test_code". Then you can see the LED cycle between on and off.



Sketch for Arduino:

```
/************************************************
   Name: _2_channel_relay
   Description: control the 2 channel relay module to ON or OFF
   Website: www.handsontec.com
   Email: techsupport@handsontec.com
*****************************************************/

//the relays connect to
int IN1 = 4;
int IN2 = 5;

#define ON   0
#define OFF  1

void setup()
{
  relay_init();//initialize the relay
}

void loop() {
  relay_SetStatus(ON, OFF);//turn on RELAY_1
  delay(2000);//delay 2s
  relay_SetStatus(OFF, ON);//turn on RELAY_2
```

```
  delay(2000);//delay 2s
}
void relay_init(void)//initialize the relay
{
  //set all the relays OUTPUT
  pinMode(IN1, OUTPUT);
  pinMode(IN2, OUTPUT);
  relay_SetStatus(OFF, OFF); //turn off all the relay
}
//set the status of relays
void relay_SetStatus( unsigned char status_1,  unsigned char status_2)
{
  digitalWrite(IN1, status_1);
  digitalWrite(IN2, status_2);
}
```

Code for Raspberry Pi:

```
#!/usr/bin/env python
'''
**********************************************************************
* Filename      : 2_channel_relay.py
* Description   : a sample script for 2-Channel High trigger Relay
* E-mail        : techsupport@handsontec.com
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* Detail        : New file
**********************************************************************
'''
import RPi.GPIO as GPIO
from time import sleep

Relay_channel = [17, 18]

def setup():
    GPIO.setmode(GPIO.BOARD)
    GPIO.setup(Relay_channel, GPIO.OUT, initial=GPIO.LOW)
    print "|=====================================================|"
    print "|         2-Channel High trigger Relay Sample         |"
    print "|-----------------------------------------------------|"
    print "|                                                     |"
    print "|          Turn 2 channels on off in orders           |"
    print "|                                                     |"
    print "|                    17 ===> IN2                      |"
    print "|                    18 ===> IN1                      |"
    print "|                                                     |"
    print "|                                                     |"
    print "|=====================================================|"

def main():
    while True:
        for i in range(0, len(Relay_channel)):
            print '...Relay channel %d on' % i+1
            GPIO.output(Relay_channel[i], GPIO.HIGH)
            sleep(0.5)
            print '...Relay channel %d off' % i+1
            GPIO.output(Relay_channel[i], GPIO.LOW)
            sleep(0.5)

def destroy():
    GPIO.output(Relay_channel, GPIO.LOW)
    GPIO.cleanup()

if __name__ == '__main__':
    setup()
```

```
    try:
        main()
    except KeyboardInterrupt:
        destroy()
```

Related Information:

- 2-Channel Solid State Relay (SSR) Module 2A-240VAC
- 30A High Power Optical Isolated Relay Module
- 4-Channel 5V Optical Isolated Relay Module
- 8 Channel 5V Optical Isolated Relay Module
- Photosensitive Light Activate Relay Module