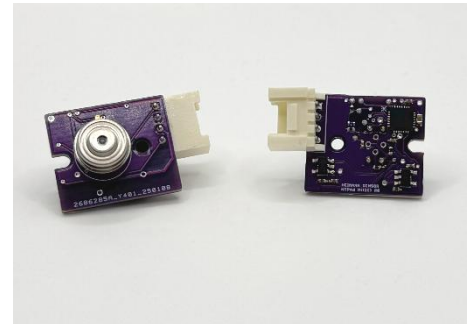


HTPAd HiM I²C

The HTPAd HiM I²C module is a device designed for easy access remote temperature measurements. Consisting of a Heimann Sensor HTPAd thermopile sensor and the required readout electronics, the module facilitates development as well as handling.

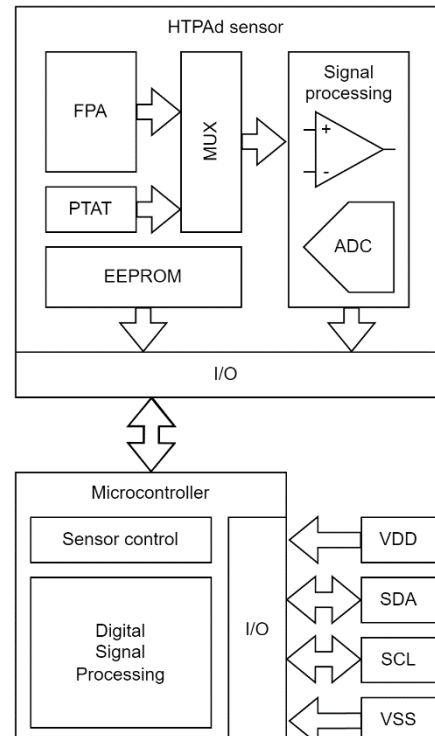
Due to smallest size, integration into limited space is feasible and provides maximum areas of application. Typical areas of application for the module are imager applications for human or fire/overheat detection or temperature measurements for process surveillance.

The module is configurable for different HTPAd sensors, matching different applications and Field of View.



The core features of the module are:

- Low power consumption of less than 70 mW operating
- Digital input voltage selectable between 3.3 V and 5 V
- High framerates of typical 16 Hz (depending on HTPAd sensor speed and calibration)
- Small size of 20 mm x 17 mm (excl. plug)
- Single connection plug for supply voltage and I²C interface
- different HTPAd sensors available (8x8 pixels or 16x16 pixels)
 - for different spatial resolutions (Field of View from 19° up to 90°)
- high temperature measurement accuracy
- Software-controlled pixel selection to achieve higher frame rates
- existing ESP32 demo code for easy access and development start

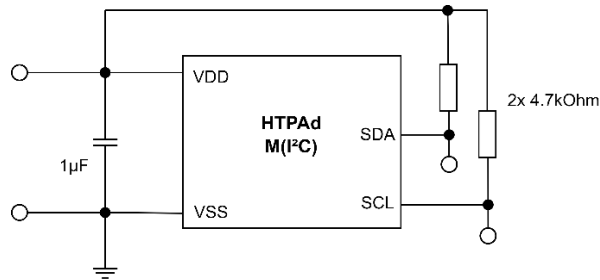


MODULE SPECIFICATIONS AND TRANSFER PROTOCOL

HTPA16x16d_HiM_I²C

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Typical Application Circuit



Order-Code

| | | | | | | |
|------------|----|-----------------|------|----|----------|-------------------------|
| HTPA16x16d | R2 | L1.0/0.8 | F5.0 | Hi | M | (I²C) |
| HTPA16x16d | R2 | L2.1/0.8 | F5.0 | Hi | M | (I²C) |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | Group | Description |
|---|-------------|-----------------------------------------------------------------------------------------------------|
| 1 | Sensor Type | TP Array with 16x16 Pixel For all available HTPA and module combinations contact our support |
| 2 | Revision | Silicon revision 2 |
| 3 | Optics | Focal length/F-Number Focal length: L1.0 = 1.0 mm F-Number: 0.8 |
| 4 | Filter | F: Filter characteristics |
| 5 | Sensitivity | Hi default sensitivity |
| 6 | Version | M: Modul: HTPA sensor soldered to PCB, calibrated stream |
| 7 | Interface | i ² C: 4 Pin Connector |

Electric Specifications

Table 1: Absolute Maximum Ratings

| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|-----------------------------------|------------------|-----------|------|------|----------------------|--------|
| Supply Voltage | V _{DD} | | -0.3 | | 5.8 | V |
| Voltage at all inputs and outputs | V _{IO} | | | | V _{DD} +0.3 | V |
| Storage Temperature | T _{STG} | | -40 | | 85 | Deg. C |

Table 2: Operating Conditions

| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|--------------------------------------------|------------------|------------------|---------------------------|-----------------------------|------------------------------|--------|
| Supply Voltage | V _{DD} | | 3.5 | 5.0 | 5.5 | V |
| Supply Current (module running) | I _{DD} | | | 13.8 | | mA |
| Standby Current (module in sleep state) | I _{SBY} | | | 2.9 | | mA |
| Sleep Current (module in deep sleep state) | I _{SBY} | | | 110 | | µA |
| Operation Temperature | T _A | | -20 | | 85 | Deg. C |
| ESD-Protection | | Human body model | 2000 | | | kV |
| | | 100pF + 1k50hm | | | | |
| Internal I ² C Pull up | RPU | | | - | | kOhm |
| Frame rate (Full Array) | FR1 | | 7 @50kHz I ² C | 11 @100kHz I ² C | 15 @>400kHz I ² C | Hz |

I²C Timings

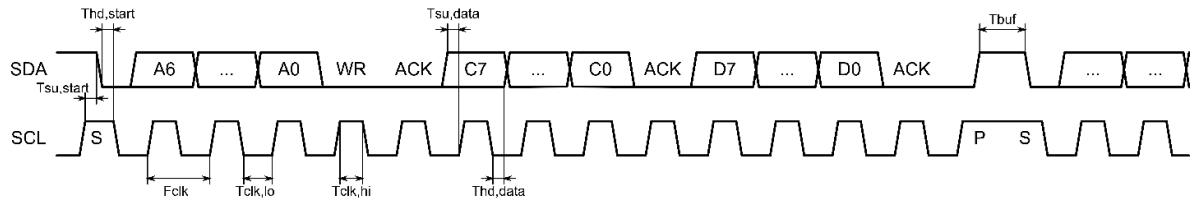
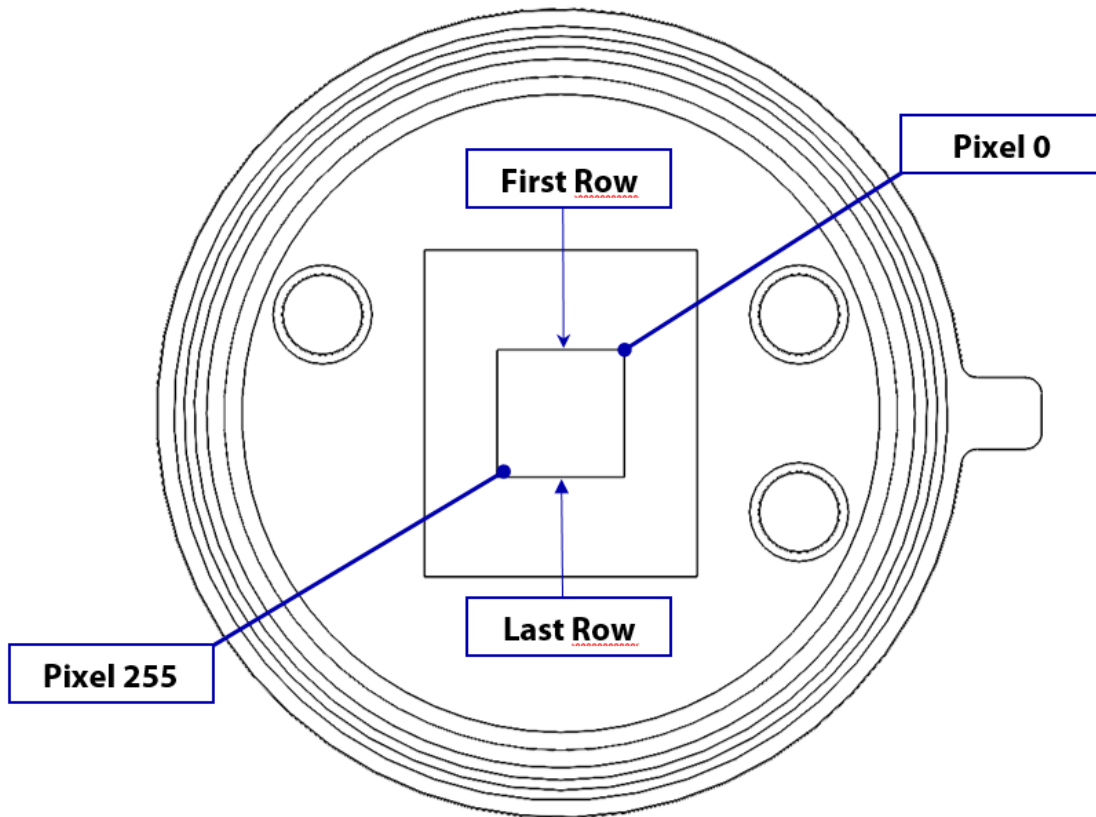


Table 3: I²C Timings

| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|-------------------------------------|-----------------------|---------------------------|------|------|------|------|
| I ² C clock frequency | F _{CLK} | | | 400 | 700 | kHz |
| low pulse duration | T _{CLK,lo} | F _{CLK} = 400kHz | 1.3 | | | µs |
| high pulse duration | T _{CLK,hi} | F _{CLK} = 400kHz | 0.6 | | | µs |
| data set up time | T _{SU,data} | F _{CLK} = 400kHz | 0.1 | | | µs |
| data hold time | T _{hd,data} | F _{CLK} = 400kHz | | | 0.9 | µs |
| start setup time | T _{SU,start} | F _{CLK} = 400kHz | 0.6 | | | µs |
| start hold time | T _{hd,start} | F _{CLK} = 400kHz | 0.6 | | | µs |
| stop setup time | T _{SU,stop} | F _{CLK} = 400kHz | 0.6 | | | µs |
| stop hold time | T _{hd,stop} | F _{CLK} = 400kHz | 0.6 | | | µs |
| time between STOP / START | T _{buf} | F _{CLK} = 400kHz | 1.3 | | | µs |
| Time startup (after Power on Reset) | T _{startup} | | | 350 | | ms |
| Time wakeup (after sending WAKEUP) | T _{wakeup} | | | 1 | | ms |

Optical Orientation of Pixels



Characteristics

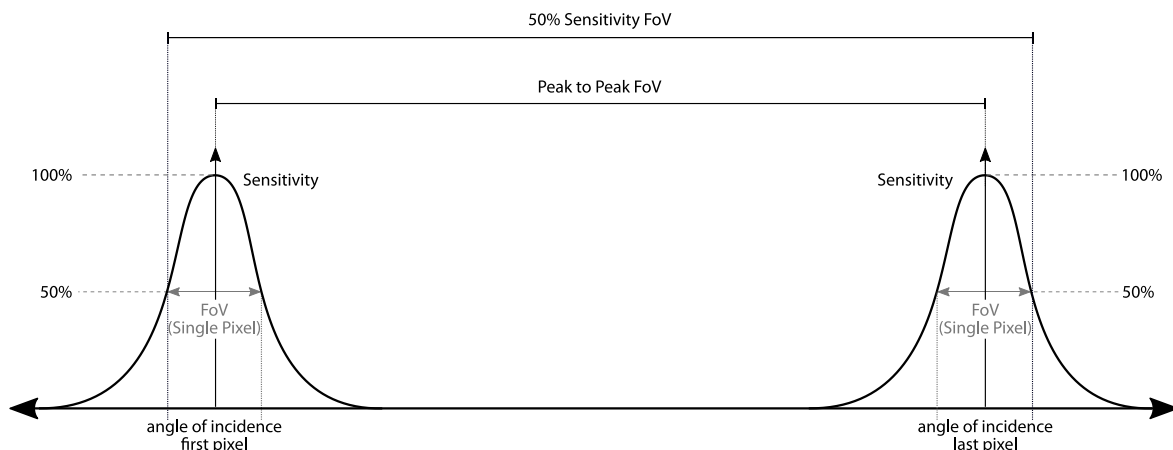
Common Specification

| | |
|-----------------------------|-------------------|
| Technology | n-poly/p-poly Si |
| Element Resistance | approx. 300 kOhms |
| Thermal pixel time constant | <6 ms |
| Digital Interface | I ² C |
| Pitch | 90 µm |
| Absorber size | 44 µm |
| 256 sensitive elements | |

Optical Characteristics

| | | |
|----------------|-------------|-------------|
| | L1.0 | L2.1 |
| Focal length: | 1.0 mm | 2.1 mm |
| F-Number: | 0.8 | 0.8 |
| Field of view: | ≥90 x 90°* | 44 x 44°* |

*Field of view is specified as 50 % sensitivity (see diagram below).



Lens coating: LWP-coating 5.0
Cut On (Tr. 5 %): 5.0 µm ±0.3 µm

Accuracy: ±3 % or ±3 K (whatever is larger) in the working ambient temperature range of 5 °C to 50 °C and object temperatures ≤300 °C.

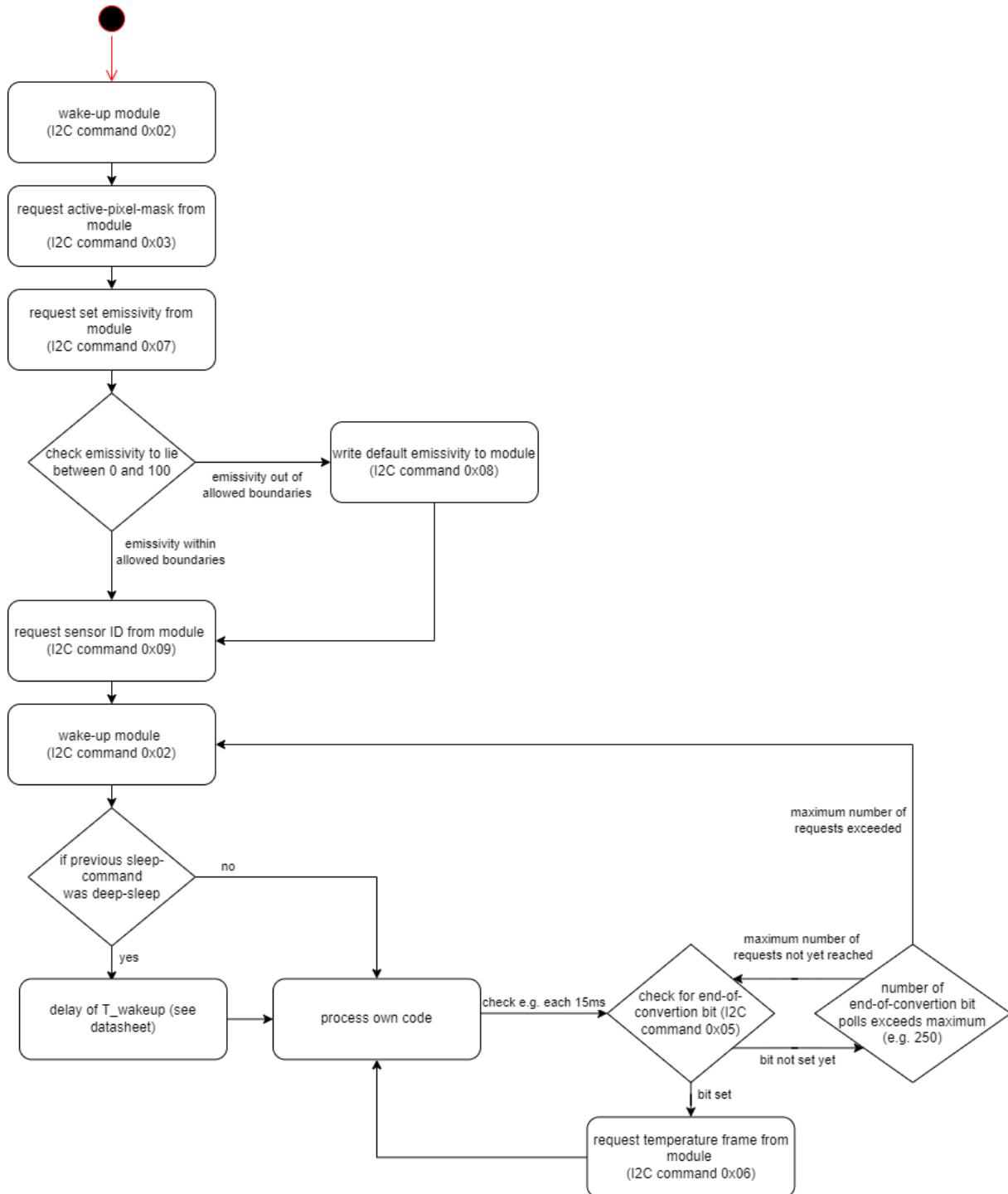
Radiometric Radius L1.0

The radiometric radius is specified for pixels listed below with a "1". All pixels outside this area can have a higher tolerance and less accuracy.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

Communication and Timings

Proposed flow chart of communication.



Serial order of data in stream

| HTPA16x16d Temperature Mode | |
|-----------------------------|---------------------------------|
| Dataset | Value |
| 0 | Temperature of Pixel(0) in K*10 |
| 1 | Temperature of Pixel(1) in K*10 |
| 2 | Temperature of Pixel(2) in K*10 |
| 3 | Temperature of Pixel(3) in K*10 |
| ... | ... |
| n* | Temperature of Pixel(n) in K*10 |
| n+1 | TAmb in K*10 |

Each dataset consists of a 16-bit value, first the Low-Byte is send, then the High-Byte.

*n=255

Control Messages

The module is accessed via the I²C protocol. Therefore, the device address is set as 0x1C.
The following I²C commands are available.

| Command | | Remarks |
|-----------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sleep | 0x01 | Device is in sleep after power on reset |
| WakeUp | 0x02 | Also starts data conversion stream of sensor |
| ReadMask | 0x03 | Device goes into sleep after transmission of mask |
| WriteMask | 0x04 | Device goes into sleep after receiving and writing mask. Delay of 120ms required after sent of mask. TAKE CARE: This stores the mask to the FLASH of the controller. FLASH endurance is about 10k write cycles. Therefore, don't do that on every power up, only if necessary. |
| ReadEoC | 0x05 | Slave transmits End of Conversion bit. |
| ReadData | 0x06 | |
| ReadEmissivity | 0x07 | Device goes into sleep after tranmission of emissivity |
| WriteEmissivity | 0x08 | Device goes into sleep after write of emissivity. Delay of 250ms required after new emissivity sent. |
| ReadSensorID | 0x09 | Device goes into sleep after tranmission of SensorID |
| DeepSleep | 0x0A | Power supply of sensor will be disabled. Requires delay (Time wakeup) after WakeUp for voltage stabilization of the sensor VDD. |

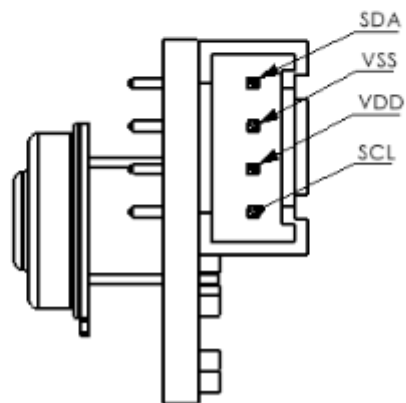
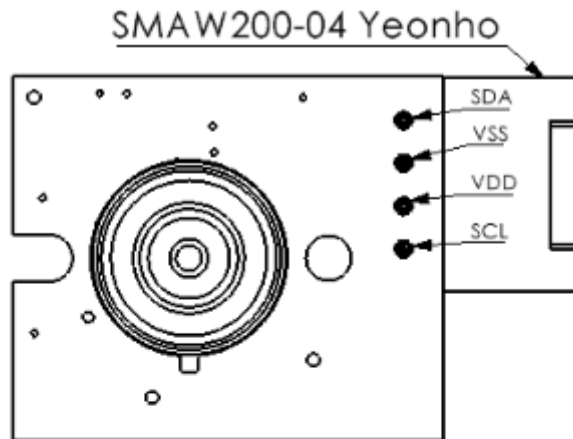
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Pinout

For powering the module V_{DD} is +5 V (see drawings below).



There are no pull-ups in the I2C lines realized.

Module Dimensions

