Data Sheet

CTS3001

Features

- 20x15 pixels thermal sensor
- 45mK NETD @ 7.5 Hz
- 27mW power consumption (continuous operation)
- Operating temperature -40°C to 65°C
- Configurable frame rate from 1 to 60 Hz
- 146° x 110° (H x V) Field of View
- Factory calibrated
- MIPI CSI-2 output interface
- Full integration and technical support provided for fast time to market

Applications

- Presence detection/person localization
- Smart building lighting and HVAC control
- Non-contact temperature measurement
- Industrial monitoring
- Continuous asset temperature monitoring
- Intruder detection for security systems
- Hotel room occupancy and facility management
- Aged care wellbeing monitoring

About

The CTS3001 outputs an 8-bit raw uncorrected image via MIPI CSI-2 and contains on-board memory with calibration parameters. A downstream MIPI capable processor uses the stored calibration parameters to output a thermal image with true temperatures.

Calumino provides an application-layer sensor protocol with a Python host library and SPI transport specification for fast, low-effort integration.

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1. Key specifications

***Table 1:** CTS3001 general specifications*

Parameters	Min.	Typical	Max.	Units	Comments
Resolution X	-	20	-	Pixels	Fixed Resolution
Resolution Y	-	15	-	Pixels	Fixed Resolution
Frame rate	-	8	60	Hz	
Spectral detection range	8	-	12	µm	LWIR
Thermal sensitivity / NETD[1]	-	45	70	mK	Median of all pixels
Thermal accuracy[2]	-2	-	2	°C	
Power consumption	-	27	30	mW	
Power supply	3.0	3.3	4.0	V	
Operating temperature range	-40	-	65	˚C	
Dynamic temperature range	-20	-	70	˚C	
Weight	-	-	3	g	
Dimension - Length	-	30.0	-	mm	
Dimension - Width	-	14.0	-	mm	
Dimension - Height	-	8.6	-	mm	
Field of View - Horizontal	140	146	-	°	
Field of View - Vertical	100	110	-	°	

***Table 2:** CTS3001 general interface specifications*

Parameters	Values
Output and control interface	MIPI (data stream), I^2C (control, memory, and peripherals)
Output format	8-bit raw uncorrected image (640 x 480)
Physical interface	18-pin, 0.5mm pitch FFC connector

2. Order Information

***Table 3**: CTS3001 Order Information*

Ordering Code	Product Description
STSCTG30N140MP	CTS3001
STSEVG30E140UB	CTS3001 Evaluation Kit
STSDVG30N140MP	CTS3001 Development Kit
STSSTG30N140MP	CTS3001 Starter Kit

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[1] At flood illumination and at calibration

[2] At flood illumination and at $T_{ambient}$ = 25°C

3. Absolute maximum ratings

Do not exceed the maximum limits specified in Table 4 as this could cause permanent damage or reliability issues.

Table 4: *Absolute maximum ratings*

Parameter	Min.	Max.	Units	Conditions
Storage Temperature	-40	85	°C	
Storage Humidity (non-condensing)	5	85	%RH	
ESD Immunity – housing	-15	15	kV	IEC 61000-4-2, air
ESD Immunity – housing	-8	8	kV	IEC 61000-4-2, contact
ESD Immunity – connector pins	-1	1	kV	HBM, all pins
ESD Immunity – connector pins	-250	250	V	CDM, all pins

4. Product performance

4.1. Focal plane array

The focal plane array (FPA) has natively 20x15 infrared pixels (shown in Figure 1) and the FPA orientation related to sensor position (shown in Figure 2).

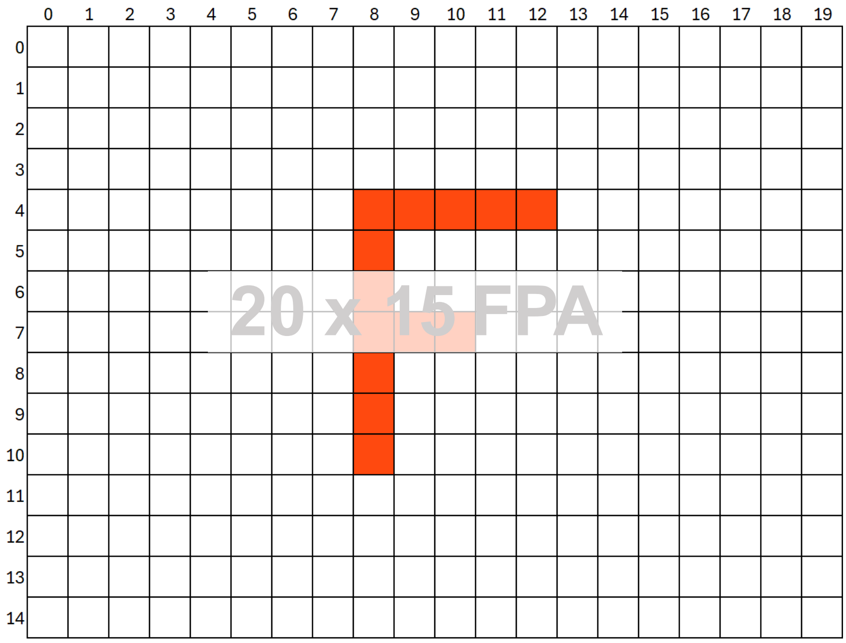

***Figure 1**: CTS3001 FPA Dimensions*

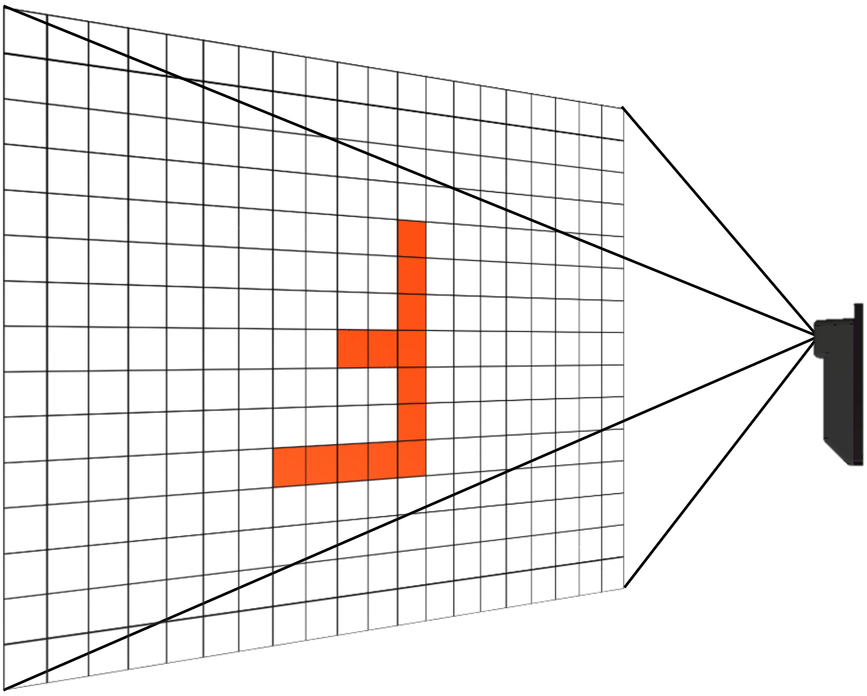

***Figure 2**: CTS3001 FPA Orientation*

4.2. Typical optical performance specifications

Table 5: *Typical lens specification*

Lens Type	HxV FOV (°)	F#	Rel. Illumination (XFOV)	Distortion (XFOV)	Focus
CTS3001	146x110	0.66	76 %	64 %	Fixed

4.3. FOV distortion map

The angular distortion map for the CTS3001 can be visualized below in Figure 3.

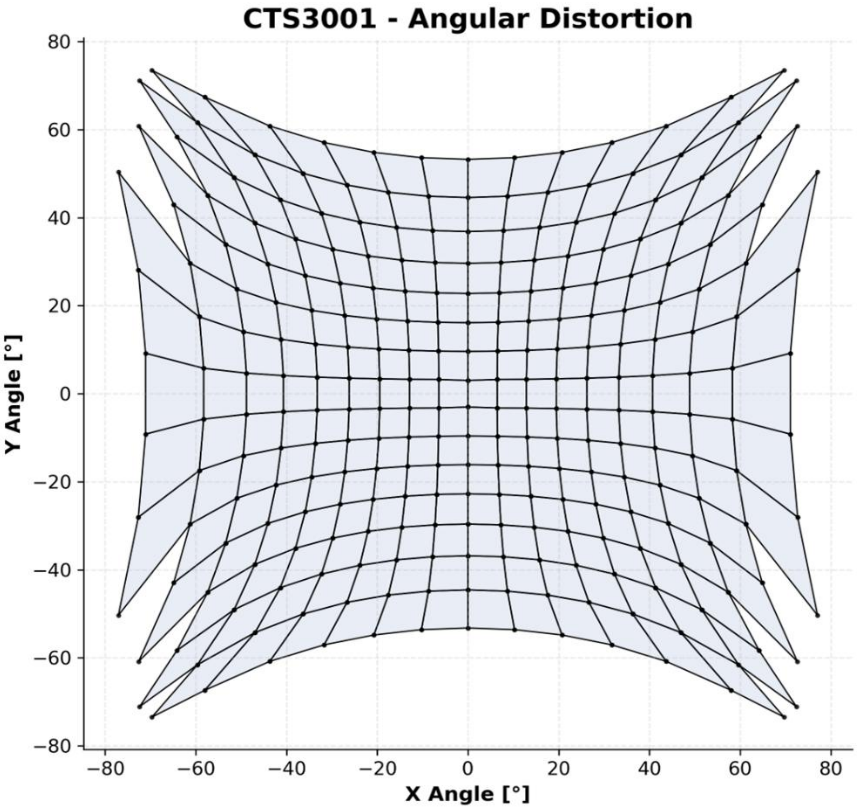

Figure 3: *CTS3001 Angular Distortion*

4.4. Defective pixel limitations

This section describes the number and location/grouping of defective pixels allowable on each sensor.

Defective pixels are defined as any pixel within the active area that do not respond to incident IR radiation or that do not meet the specified dynamic range.

The image circle is defined by a 9.5-pixel radius drawn around the optical center. The optical center varies from device to device by up to 1 pixel from the geometric center of the array, and the per-device value is stored in EEPROM. An example depiction of the image circle can be seen in Figure 4.

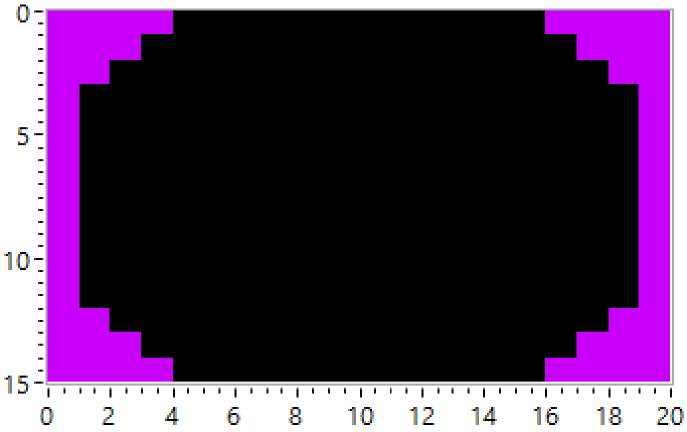

Figure 4: *Pixels within the image circle (marked as black) in the CTS3001 FPA*

Defective pixels and clusters of defective pixels are defined in the active area of the FPA only.

Table 6: *Defective pixel limitations*

Defect Specifications	Value	Comments
Total defective interpolated pixels (maximum)	9	The total count of defective interpolated pixels within the image circle at factory calibration.[3]
2x2 defective pixel clusters or larger	0	Cluster refers to any grouping of defective pixels in which a defective pixel is adjacent to another defective pixel.

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[3] By factory default, in the output thermal image, every defective pixel is replaced with interpolated values from neighboring non-defective pixels.

5. Electrical integration

5.1. General

CTS3001 outputs raw data in real time via a MIPI CSI-2 interface, as well as via I^{2}C for reading configuration parameters, unit identification details, optical parameters, and the on-board temperature sensor.

Raw MIPI data must be converted into a thermal image using Calumino's provided algorithms which are available as an IP block for several microcontrollers.

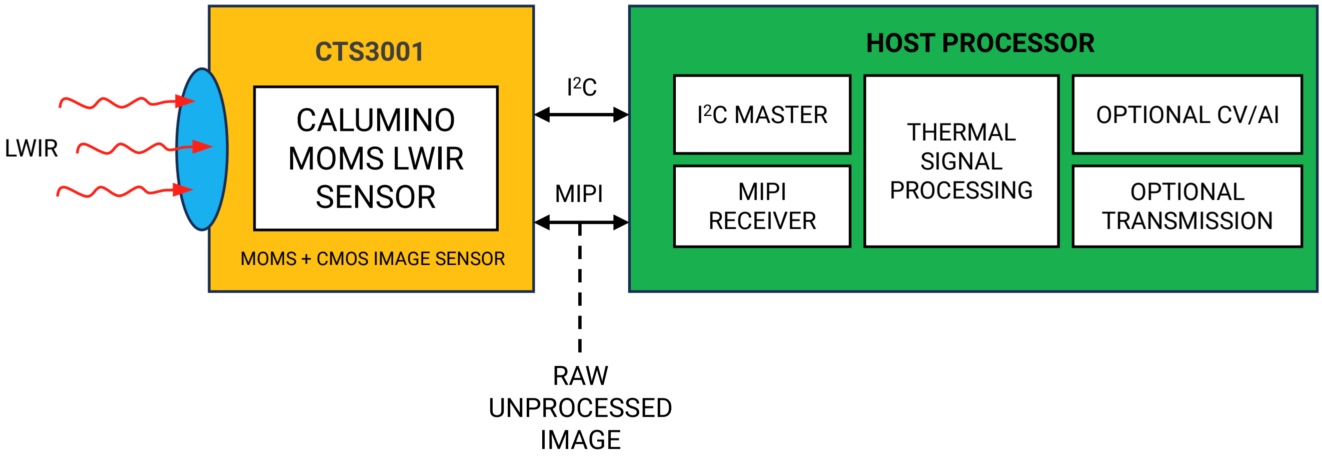

Figure 5: *High level system diagram of CTS3001 and downstream host processor communication*

5.2. Initialization flowchart

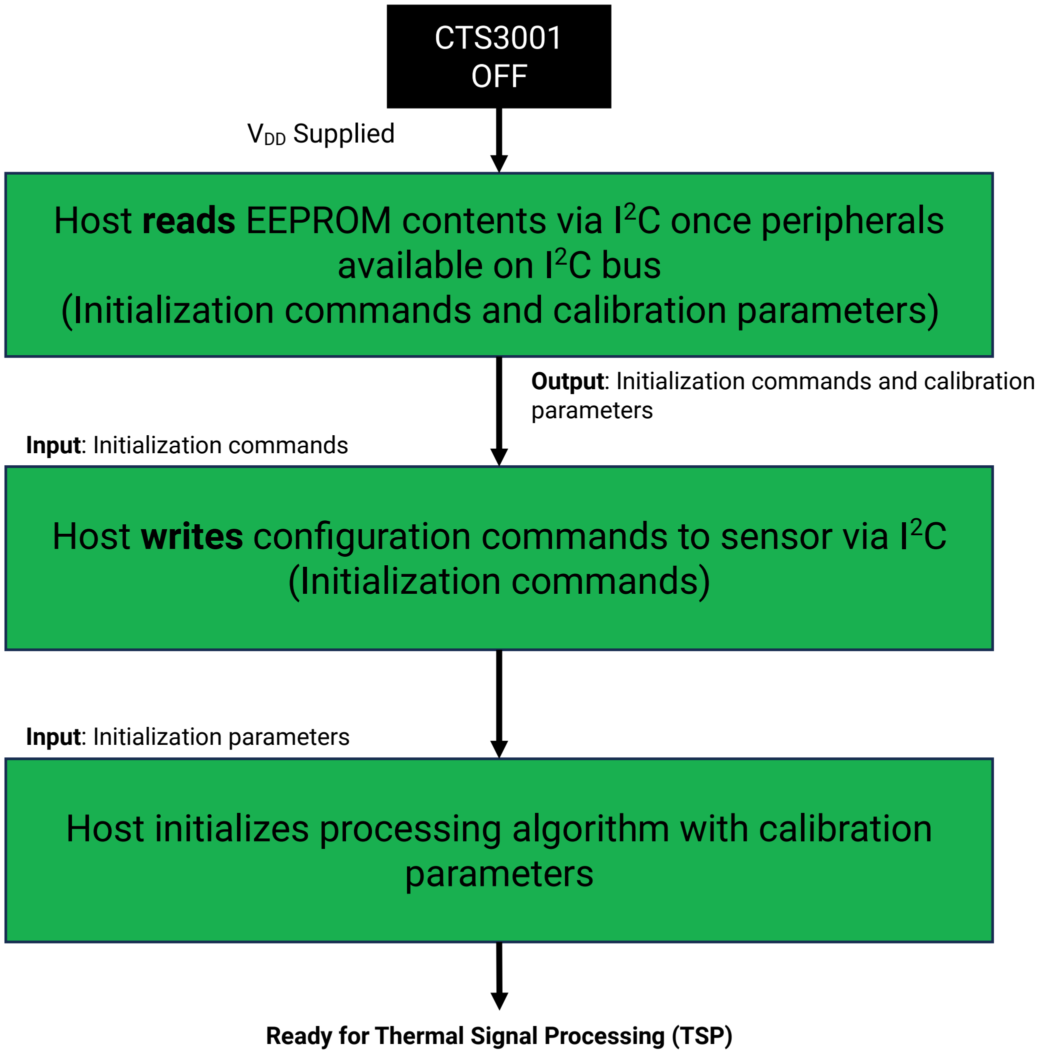

Figure 6: *Required initialization flowchart*

5.3. Electrical specifications

Table 7: *Electrical specifications*

Parameter	Symbol	Min.	Typ.	Max.	Units
Supply voltage	V_{DD}	3.0	3.3	4.0	V
I/O Voltage	V_{IO}	1.7	1.8	1.9	V
Supply current	I_{DD}	-	8	35	mA
Input logic low voltage[4]	V_{IL}	0	0	0.3	V
Input logic high voltage[5]	V_{IH}	1.5	1.8	1.9	V

CTS3001 functionality may be affected by alternating current (AC) induced power rail voltage oscillations, or if electrostatic charges are brought close to the CTS3001 module. It is necessary to ensure that adequate grounding is established in the circuitry powering the CTS3001 and that the CTS3001 is shielded from electrostatic interference during operation.

5.4. MIPI interface

CTS3001 contains a MIPI slave interface which outputs a raw uncorrected image with a CRC error detecting code at up to 60 frames per second (FPS).

The MIPI channel utilizes 2 differential data lanes (4 channels total) as shown in Figure 7. The function pinout for the CTS3001 SPI connector is listed in Table 8:

- Data Lane 0 Negative
- Data Lane 0 Positive
- Clock Lane Negative
- Clock Lane Positive

For more information on interfacing with the MIPI we recommend referring to the Himax HM0360 datasheet.

Important note: It is imperative that the host PCB requires 100 Ω differential traces for the MIPI lines. Alternatively, Calumino can support with fast integration through a packaged MIPI to SPI module that performs all required thermal conversion and SPI interface.

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[4] Excluding MIPI

[5] Excluding MIPI

CTS3001 also contains an I²C interface providing access to internal memory for accessing configuration parameters (1 time read) as well as real time on-board temperature readings (continuous reading).

- I2C SCL – Clock signal provided by host
- I2C SDA – Bidirectional data line

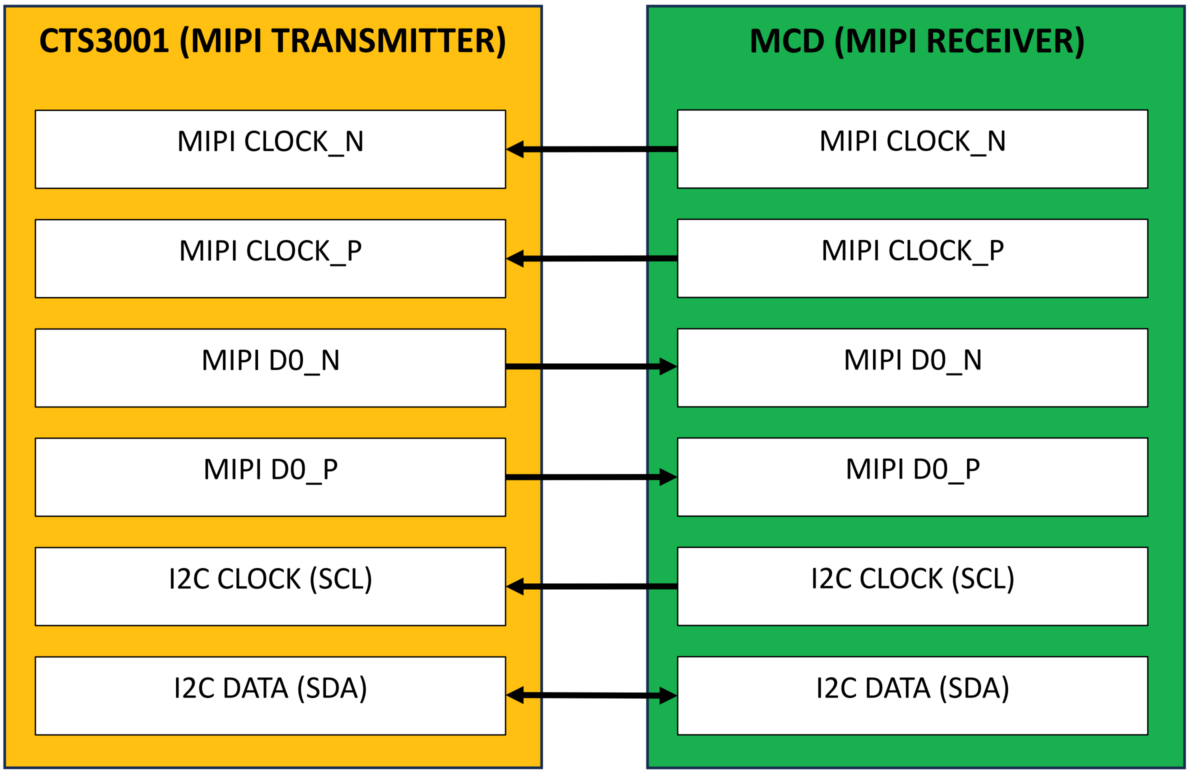

Figure 7: MIPI and I2C channels (I/O) schematic diagram

5.5. MIPI connector pinout

The mating connector type is Molex 505110-1892 (female), and the mating cable type is Molex 015020018x. Host must have the same or similar connector for integration, and it is recommended that **cable length does not exceed 200mm.**

Note that it is not recommended to plug in and out the connector repeatedly.

Table 8: *Required user connector pinout for the on board 18-pin connector*

Connector Pin Number	Pin Description	State
1	GND – Ground	GND
2	MIPI_D0_N	O
3	MIPI_D0_P	O
4	GND – Ground	GND
5	MIPI_CLK_N	I
6	MIPI_CLK_P	I
7	GND – Ground	GND
8	MIPI_D1_N	O
9	MIPI_D1_P	O
10	GND – Ground	GND
11	IS_INT	O
12	XSHUTDN	I
13	GND – Ground	GND
14	Power Enable	I
15	CMOS Trig	I
16	I2C_SCL	I
17	I2C_SDA	I/O
18	3V3	PWR

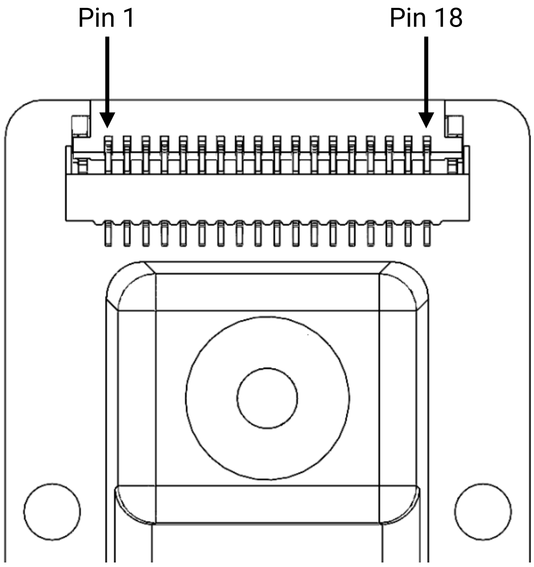

Figure 8: *Top view of CTS3001 showing user connector Pin 1 & Pin 18*

6. Mechanical integration

6.1. Mechanical drawing

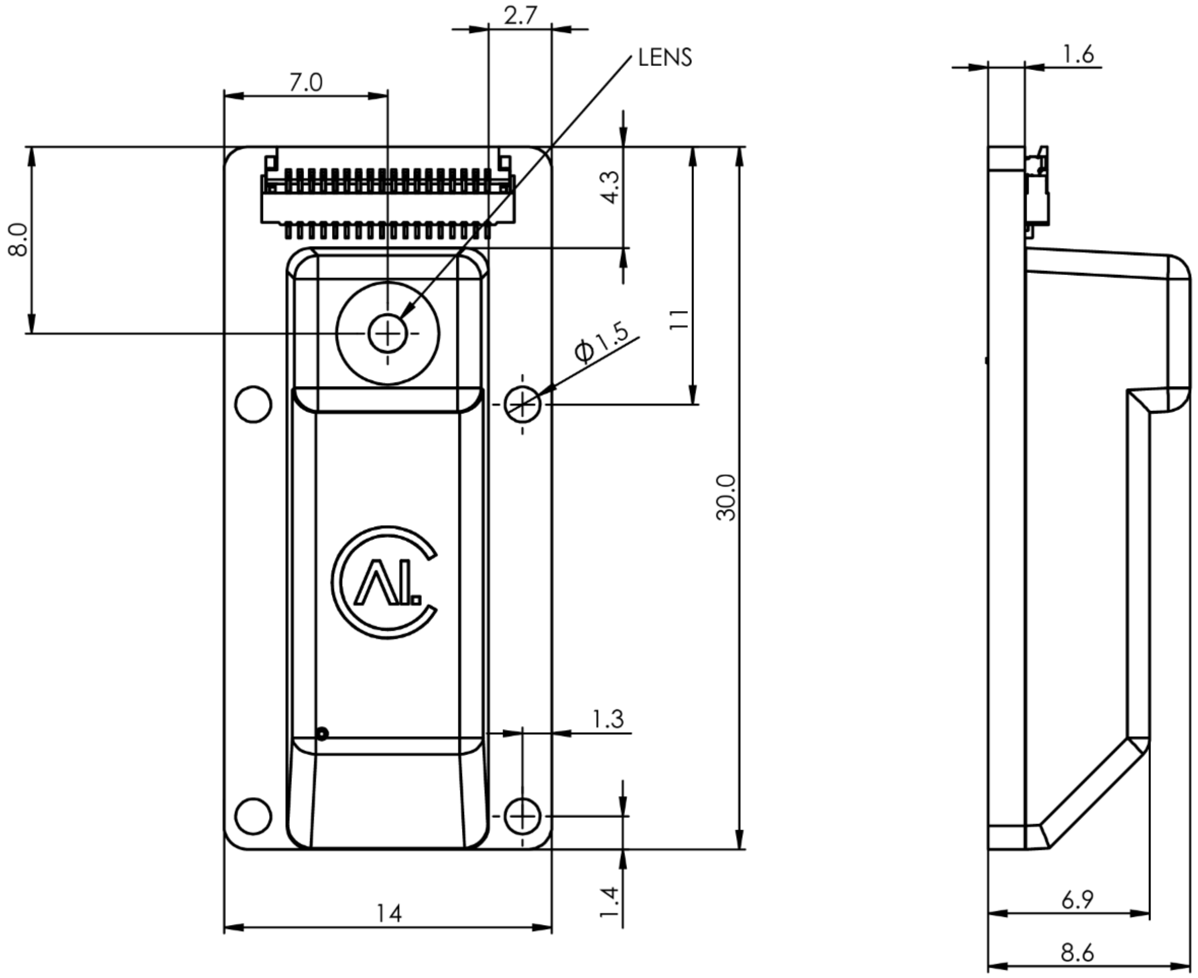

Figure 9: *CTS3001 Mechanical Drawing*

6.2. Design guidelines

Please ensure that the following design guidelines are met when integrating the CTS3001into the final product or as a solution in its final installation location:

- CTS3001 lens must be clear and free from contamination. Please ensure that no dust, particles, or grime obstructs the optical path.
- CTS3001 should not be exposed to strong UV radiation, as it may degrade the infrared anti-reflective coating.
- CTS3001 should be integrated within an enclosure that ensures a dust-and dirt-free environment for optimal operation (IP5X recommended).
- CTS3001 must always be operated in a non-condensing environment, as condensation on the lens or within the optical path will degrade the CTS3001 performance.
- Product integration should consider thermal management, and CTS3001 should be placed as far as possible from heat generating sources such as power regulators, high-current components, and processors.
- Do not use the CTS3001 in environments prone to frequent vibrations as oscillation could lead to functionality and performance degradations of the sensor.
- The four Ø1.5 mm plated through holes may be used for mechanical mounting using M1.4 fasteners with a recommended tightening torque ≤0.1 Nm.

6.3. Handling instructions

The CTS3001 must be handled with care, so the module enclosure (housing) is mechanically isolated from its counter-mounting surface. As the module enclosure has a functional purpose (part of the optical light path inside the module), do not handle or touch the exposed optical components, and only handle the sensor housing with powder-free latex or nitrile gloves. If any mechanical pressure or shock is applied to the exposed optical components, as shown below in Figure 10, the sensor performance may degrade.

For integration the CTS3001 shall be adhered onto a supporting structure along the entire backside of the sensor. Handling pressure shall only be applied around areas of the green arrows. **Pressure along the direction of the red arrows must be avoided.**

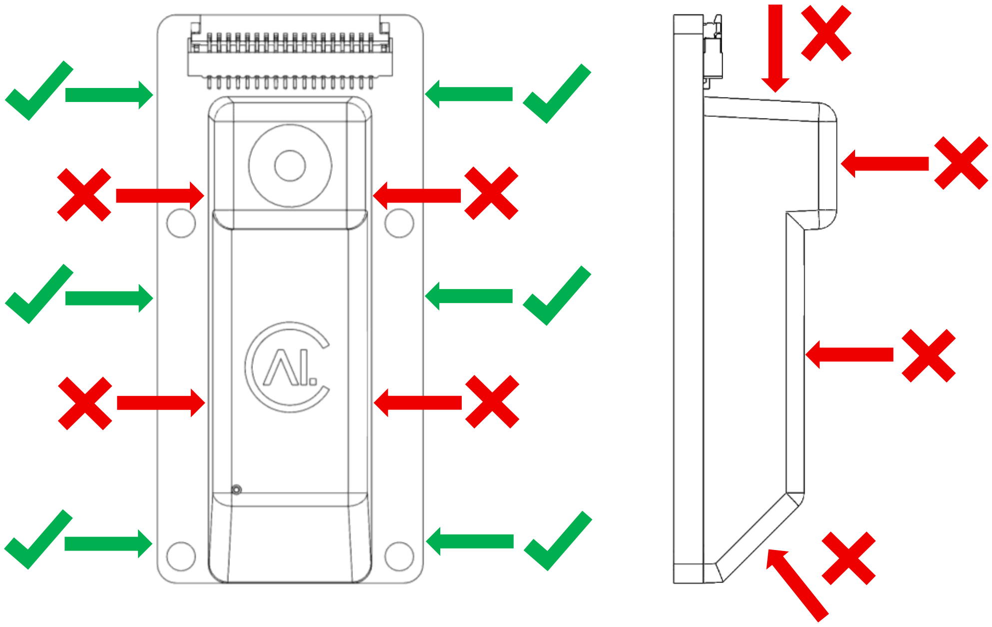

Figure 10: *Mechanical drawing of* ***CTS3001*** *showing green arrow indicators on locations where force can be applied for handling purposes (<1N) on the CTS3001 module, and red arrow indicators on where force (>0.1N) must not be applied on the CTS3001 module enclosure.*

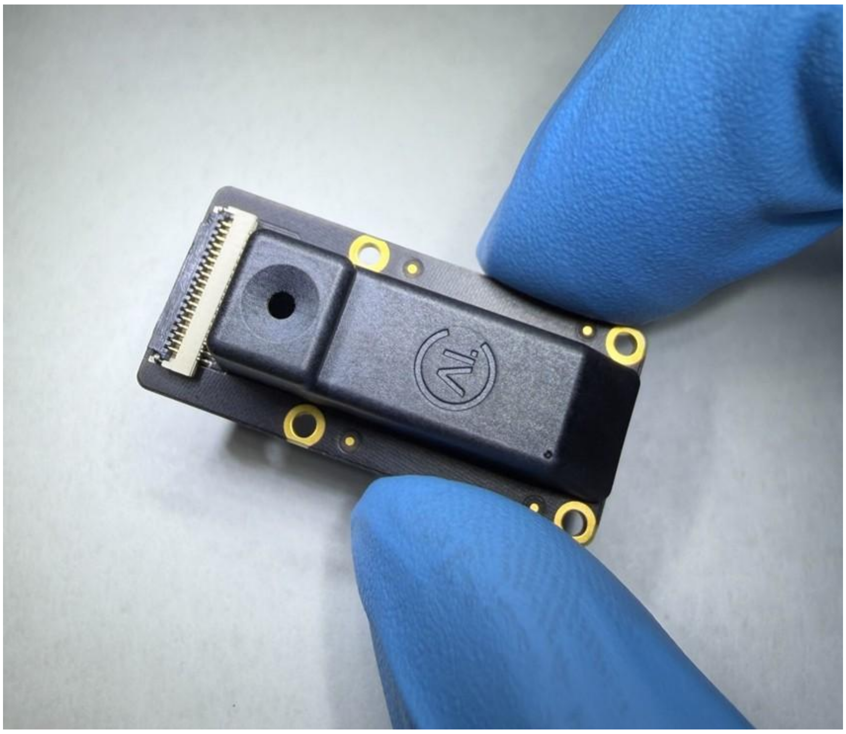

Figure 11: *Recommended handling touch points of the CTS3001 module. Gloves should always be worn when handling the sensor*

7. Environmental and reliability testing

For CTS3001 qualification, a set of samples goes through environmental and reliability testing according to international standards.

Table 9: *Environmental and reliability tests*

Test	Conditions	Standard
High Temperature Storage	85°C, 500h	IEC-60068-2-2:2007 (Test Be)
Drop Test (In Enclosure)	200mm (6 surfaces, 4 edges)	IEC 60068-2-31:2008 (Test Ec)
Humidity Cycling /Thermal Shock	-10°C to 65°C, 93%RH 10 cycles/days	IEC-60068-2-38:2009 (Test Z/AD)
Electro-Static Discharge Immunity Test	10x ESD pulses of ±8kV (air, direct, plates)	IEC 61000-4-2:2008

All sample units selected meet the datasheet requirements as well as the reliability requirements. The units are tested to Calumino standards and qualified based on performance measured.

8. Nomenclature

Table 10: *Nomenclature*

Abbreviation	Definition
2D	Two Dimension
CDM	Charge Device Model
CMOS	Complementary Metal Oxide Semiconductor
CRC	Cyclic Redundancy Check
CTS	CALUMINO Thermal Sensor
EOL	End Of Life
FOV	Field Of View
FPA	Focal Plane Array
FPS	Frames Per Second
HBM	Human Body Model
HFOV	Horizontal Field of View
IR	Infrared
LED	Light Emitting Diode
LWIR	Long Wave Infrared
MOMS	Micro Opto Mechanical System
NC	Not Connected
NETD	Noise Equivalent Temperature Difference
OEM	Original Equipment Manufacturer
RH	Relative Humidity
SCL	Serial Clock
SDA	Serial Data
SPI	Serial Peripheral Interface
VFOV	Vertical Field of View

9. Revision history

Table 11: *Revision history details*

Revision	Date	Change
0	30 April 2026	Product release