

Camcuda super mini 640

Camcuda super mini 640T

Uncooled Infrared Core Module

Product Manual

English edition · V1.0.0

640 × 512 resolution | 8 μm pixel pitch

640: Imaging only · 50 Hz

640T: Thermographic · 30 Hz

Hardware interfaces · Video protocols · Mechanical dimensions

Revision History

Version	Date	Description
V1.0.0	January 2026	Initial release

English translation of the supplied V1.0.0 product manual. Commercial model names distinguish the imaging-only model from the thermographic model. Accessory part numbers, signal names and protocol identifiers are retained.

Commercial model	Function	Frame rate
Camcuda super mini 640	Imaging only; no temperature measurement	50 Hz
Camcuda super mini 640T	Imaging and temperature measurement	30 Hz

The suffix T identifies the thermographic model. Temperature ranges, accuracy specifications, temperature data output and conversion formulas apply only to Camcuda super mini 640T.

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1. Product Description

The Camcuda super mini 640 / 640T series comprises ultra-miniature uncooled infrared core modules with a compact 13 × 13 mm footprint and a weight of less than 3.5 g. It is designed for low size, weight and power (SWaP). The module uses a 640 × 512 long-wave infrared detector with an 8 μm pixel pitch to capture fine image detail. Its 0.5 W low-power operation and multiple SDK solutions support integration and iterative development for compact systems such as drones, micro-gimbals and FPV platforms. A selection of lightweight infrared lenses is available.

Table 2.1 Lens Specifications

Array	Focal length / F#	Lens type	Field of view (H × V)	IFOV
640 × 512	3.7 mm / F1.0	Athermal	90.0° × 68.2°	2.16 mrad
640 × 512	6.1 mm / F1.0	Athermal	46.6° × 37.6°	1.31 mrad
640 × 512	8.7 mm / F1.0	Athermal	40.0° × 32.2°	0.92 mrad
640 × 512	11 mm / F1.0	Athermal	24.9° × 20.0°	0.73 mrad

2. Performance Specifications

Table 3.1 Product Performance Specifications

Parameter	Imaging variant	Thermographic variant
Product name	Camcuda super mini 640	Camcuda super mini 640T
Detector type	VOx uncooled infrared focal plane detector	VOx uncooled infrared focal plane detector
Resolution	640 × 512	640 × 512
Pixel pitch	8 μm	8 μm
Frame rate	50 Hz	30 Hz
Spectral range	8–14 μm	8–14 μm
NETD	≤40 mK @ 25°C, F#1.0	≤40 mK @ 25°C, F#1.0
Startup time	Not specified	Not specified
Brightness / contrast	Manual / automatic	Manual / automatic
Polarity	Black hot / white hot	Black hot / white hot
Pseudocolor	Supported [1]	Supported [1]

2. Performance Specifications (continued)

Parameter	Specification
Image processing	Grayscale stretching; local contrast enhancement; temporal and spatial noise reduction; detail and edge enhancement
Image mirroring	Vertical / horizontal / diagonal
Supply voltage [2]	Core MAIN_POWER: 3.8–5.2 V (typ. 5 V) +1.8 V rail: 1.78–1.82 V (typ. 1.8 V) +3.3 V rail: 3.28–3.32 V (typ. 3.3 V) 4P USB expansion board: USB 2.0; USB_VBUS 5.0 V 5P analog video user board: POWER_IN 5–20 V
Typical core power [3]	≤0.5 W for both variants, excluding expansion board
Digital video [4]	8-bit LVCMOS; 2-lane MIPI 640 (imaging only): BT656 640T (thermographic): CDS3
Control interface	UART (1.8 V)
Temperature range	640: not applicable 640T: –20°C to +150°C; 100°C to +650°C
Temperature accuracy	640: not applicable 640T: ±2°C or ±2% of reading, at ambient –20°C to +60°C
Weight [5]	<3.5 g
Dimensions [5]	13 × 13 × 13.4 mm
Operating temperature	–40°C to +70°C (–20°C to +60°C for thermography)
Storage temperature	–45°C to +80°C
Humidity	5–95%, non-condensing
Vibration	2 g, random vibration, 3 axes / 6 directions
Shock	6 g, 2 ms, terminal-peak sawtooth, 3 axes / 6 directions
Environmental compliance	RoHS 2.0: compliant

Notes

[1] LVCMOS does not support pseudocolor.

3. Core Module User Interfaces

Specification notes (continued)

[2] All supply voltages are specified at the core module connector.

[3] Power consumption is measured at 25°C and excludes the interface board.

[4] BT656 and MIPI digital video are available only through the core module's Hirose 30-pin interface. BT656 and MIPI cannot be used simultaneously.

[5] Weight and dimensions refer to the core module only, excluding optical assemblies and expansion boards.

The user interface uses a Hirose DF40C-30DP-0.4V(51) 30-pin connector. It includes power inputs, UART communication, BT656 digital video, 2-lane MIPI digital video and USB 2.0 connections.

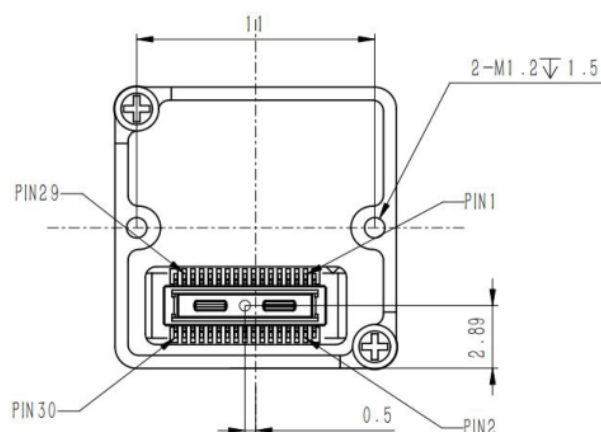


Figure 3.1 Core Module User Interface

3.1 Hirose 30-Pin Connector Pin Definitions

Table 3.1 Hirose 30-Pin Connector Pin Definitions

Pin	Signal	Type	Description
1	MAIN_POWER	Power input	3.8–5.2 V; typ. 5 V [2]
2	MAIN_POWER	Power input	3.8–5.2 V; typ. 5 V [2]
3	GND	Ground	GND
4	GND	Ground	GND
5	+3.3V	Power input	3.28–3.32 V; typ. 3.3 V [2]
6	+3.3V	Power input	3.28–3.32 V; typ. 3.3 V [2]

3.1 Pin Definitions (continued)

Pin	Signal	Type	Description
7	+1.8V	Power input	1.78–1.82 V; typ. 1.8 V [2]
8	+1.8V	Power input	1.78–1.82 V; typ. 1.8 V [2]
9	GND	Ground	GND
10	MIPI_CLK_N	Output	MIPI clock (1.2 V)
11	MIPI_D1_P/DV3	Output	MIPI data (1.2 V) / BT656 DV3 (1.8 V)
12	MIPI_CLK_P/DV_FRAME	Output	MIPI clock (1.2 V) / BT656 frame sync (1.8 V)
13	MIPI_D1_N/DV4	Output	MIPI data (1.2 V) / BT656 DV4 (1.8 V)
14	GND	Ground	GND
15	DV5	Output	BT656 DV5 (1.8 V)
16	MIPI_D0_P/DV1	Output	MIPI data (1.2 V) / BT656 DV1 (1.8 V)
17	DV6	Output	BT656 DV6 (1.8 V)
18	MIPI_D0_N/DV2	Output	MIPI data (1.2 V) / BT656 DV2 (1.8 V)
19	DV7	Output	BT656 DV7 (1.8 V)
20	DV0	Output	BT656 DV0 (1.8 V)
21	DV_LINE	Output	BT656 line sync (1.8 V)
22	DV_CLK	Output	BT656 clock (1.8 V)
23	IR_SYNC	Input	External trigger (1.8 V)
24	GND	Ground	GND
25	UART_RX	Input	1.8 V logic level
26	USB_DM	Input/output	USB 2.0 data
27	UART_TX	Output	1.8 V logic level
28	USB_DP	Input/output	USB 2.0 data
29	CVBS	Output	Analog video requires an external video buffer IC
30	GND	Ground	GND

Notes

[1] These pin definitions apply only to the factory configuration without an expansion board.

[2] Voltages are specified at the core module connector.

[3] UART TX and RX refer to transmission and reception by the core module.

3.2 Hirose 30-Pin Connector Power Requirements

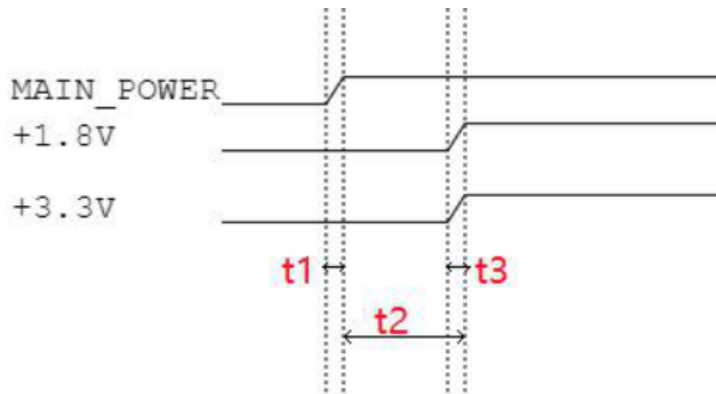
Both Camcuda super mini 640 and 640T use multiple power rails. The allowable supply noise and power-on sequence are specified below.

Table 3.2 Power Supply Requirements

Rail	Voltage range	Typical	Max. noise	Peak current	Steady current [1]
MAIN_POWER	3.8-5.2 V	5 V	10 mV p-p	200 mA	80 mA
+3.3V	3.28-3.32 V	3.3 V	10 mV p-p	100 mA	20 mA
+1.8V	1.78-1.82 V	1.8 V	1 mV RMS (1 Hz-50 kHz)	100 mA	35 mA

Table 3.3 30-Pin Power-On Timing

Interval	Requirement
t1	t1 > 200 μs
t2	t2 > 200 μs
t3	t3 > 200 μs



[1] Steady-state currents are typical values measured under normal ambient conditions at 25°C, for reference only.

3.3 Digital Video

Table 3.4 Parallel Digital Video

Item	LVCMOS	CDS3
Supported model	640 / 640T	640T only
I/O signals (bits)	Clock (1); line sync (1); frame sync (1); data (8)	Clock (1); line sync (1); frame sync (1); data (8)

3.3 Digital Video (continued)

Item	LVC MOS	CDS3
Scanning	Progressive	Progressive
Clock frequency	45 MHz	45 MHz
External sync signals	Yes	Yes
Embedded reference codes	No	No
Data format	RAW image	YUV422 + TEMP; 2 clocks/pixel; UY then VY; temperature low byte first
Pseudocolor / polarity	Pseudocolor not supported	Supported
Image data source selection	DRC	DRC
Array size (columns × rows)	640 × 512	1280 × 512

3.3.1 8-Bit LVC MOS Digital Video

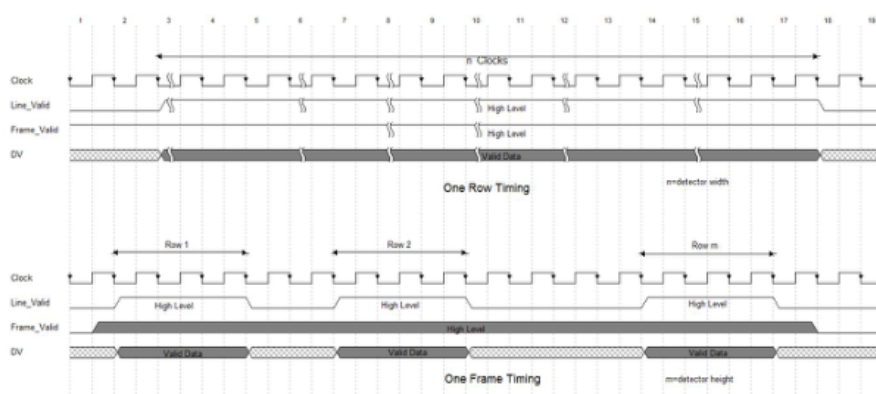


Figure 3.2 8-Bit LVC MOS Digital Video Timing

3.3.2 BT.656 Timing

The core module outputs one video frame in the following format.

Table 3.5 Video Frame Format

EAV reference code	Blanking	SAV reference code	Data
Invalid-line EAV	0x10 0x80	Invalid-line SAV	Invalid: 0x10 0x80
Valid-line EAV	0x10 0x80	Valid-line SAV	Image: 640 × 512 pixels / 640 × 512 × 2 clocks
Invalid-line EAV	0x10 0x80	Invalid-line SAV	Invalid: 0x10 0x80

3.3.2 BT.656 Timing (continued)

In the frame table, the upper-left corner is the start of the frame and the lower-right corner is the end. The timing of one line is shown below.

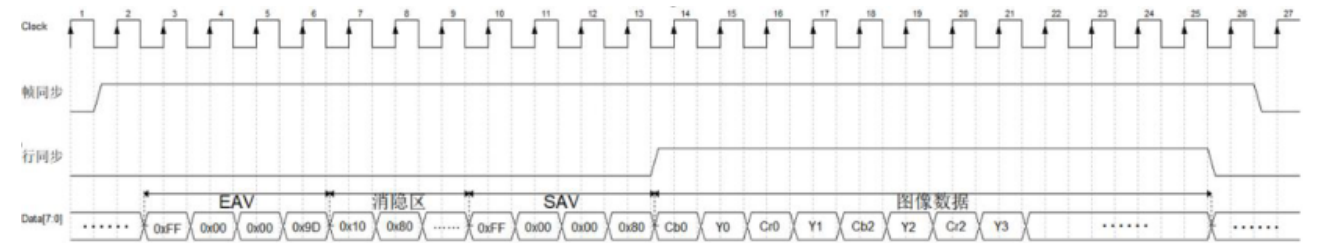


Figure 3.3 BT.656 Digital Video Timing

Table 3.6 Fourth Byte of the Reference Code

Reference code position	Code
Invalid-line EAV	0xB6
Invalid-line SAV	0xAB
Valid-line EAV	0x9D
Valid-line SAV	0x80

3.3.3 CDS3 Timing — 640T

CDS3 video supports pseudocolor images. It does not require frame-sync or line-sync signals; only one clock signal and eight data lines are required. Data are arranged progressively, line by line. Each line contains reference codes (EAV/SAV), a blanking interval and a data region.

Table 3.7 Video Frame Format

EAV code	Blanking	SAV code	Image / invalid data	Temperature data
Invalid-line	0x80 0x10	Invalid-line	Invalid: 0x80 0x10	Invalid: 0x80 0x10
Valid-line	0x80 0x10	Valid-line	640 × 512 pixels / 640 × 512 × 2 clocks	640 × 512 pixels / 640 × 512 × 2 clocks
Invalid-line	0x80 0x10	Invalid-line	Invalid: 0x80 0x10	Invalid: 0x80 0x10

The upper-left corner is the frame start and the lower-right corner is the frame end. CDS3 uses SAV/EAV reference codes instead of separate line/frame sync signals to indicate the start or end of line or frame data. EAV marks the end of the previous line’s data and the start of the next line; SAV marks the start of the line’s data region. Each reference code occupies four clock cycles (four bytes).

3.3.3 CDS3 Timing (continued)

The first three bytes of each reference code are fixed: 0xFF, 0x00 and 0x00. The fourth byte depends on the reference code position, as shown below.

Table 3.8 Fourth Byte of the Reference Code

Reference code position	Code
Invalid-line EAV	0xB6
Invalid-line SAV	0xAB
Valid-line EAV	0x9D
Valid-line SAV	0x80

Blanking and data bytes are ordered Cb Y Cr Y. Each Cb, Cr and Y value is 8 bits wide and occupies one clock cycle. One Cb Y Cr Y group represents two pixels and occupies four clock cycles.

In blanking and invalid data, Cb and Cr are fixed at 0x80 and Y is fixed at 0x10. In the valid image region, Cb and Cr are 8-bit chroma values and Y is an 8-bit grayscale value. In the temperature region, Cb and Cr carry the low eight bits, TEMP[7:0], and Y carries the high eight bits, TEMP[15:8].

Table 3.9 Format of One Video Line

Region	Length	Invalid line	Valid line
EAV	4 bytes	FF 00 00 B6	FF 00 00 9D
Blanking	—	80 10 80 10	80 10 80 10
SAV	4 bytes	FF 00 00 AB	FF 00 00 80
Image	640 × 2 bytes	80 10 80 10 ...	Cb Y Cr Y ...
Temperature	640 × 2 bytes	80 10 80 10 ...	TEMP[7:0], TEMP[15:8], TEMP[7:0], TEMP[15:8] ...

3.4 MIPI Protocol

3.4.1 MIPI Protocol Overview

The product uses 2-lane MIPI: one source-synchronous differential clock pair (MIPI_CLK+, MIPI_CLK-) and two differential data pairs (MIPI_DATA0+, MIPI_DATA0-, MIPI_DATA1+, MIPI_DATA1-).

The clock signal is in Low Power mode at the frame header, frame footer and inter-line blanking intervals. Data packets are sent in High Speed mode. The specified high logic level for both data and clock lines is 1.2 V. The transfer rate is 216 Mbps per lane, corresponding to a clock-lane frequency of 108 MHz.

3.4 MIPI Protocol (continued)

At the beginning of each frame, the data lanes send a frame-start packet; at the end, they send a frame-end packet. Between them are as many long data packets as the array has rows: a 640×512 core produces 512 long packets. Each long packet contains one line of valid data.

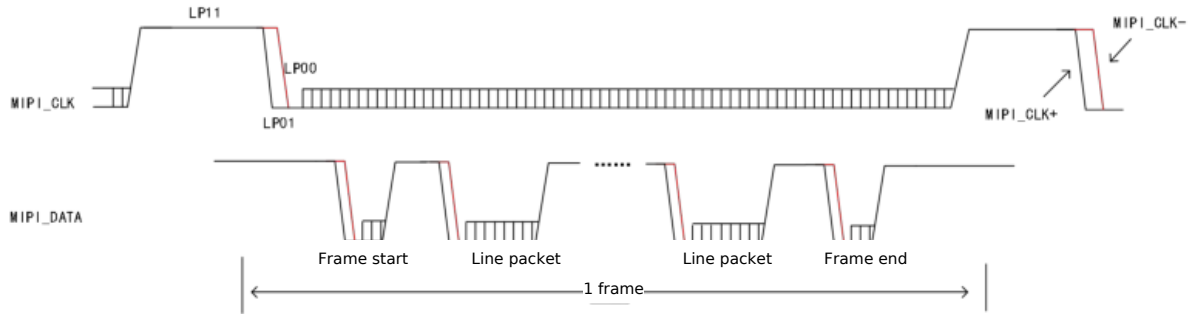


Figure 4.4 Data Structure of One Frame

3.4.2 Core Module Output

After power-on, the core begins outputting MIPI digital video. For Camcuda super mini 640T (640×512 thermographic model), the output format is RAW8 under the standard MIPI CSI-2 protocol. Configure the receiving array as $(1280 \times 2) \times 512$. The host must combine the bytes into $1280 \times 512 \times 16$ -bit data, low byte first. The first 640×16 bits of each valid line contain image data (UV before Y when pseudocolor is used); the remaining 640×16 bits contain temperature data.

Figure 4.5 Data Structure of One Valid Line

Packet header	Image data: 640×16 bits	Temperature data: 640×16 bits	Packet footer
Header	P1[7:0], P1[15:8], P2[7:0], P2[15:8], ... P640[7:0], P640[15:8]	TEMP1[7:0], TEMP1[15:8], ... TEMP640[7:0], TEMP640[15:8]	Footer

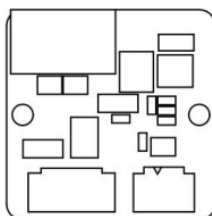
3.5 Optional User Expansion Board

An optional user expansion board provides signal-interface conversion and additional functionality for both Camcuda super mini 640 and 640T.

Table 4.10 User Expansion Board (see following page)

3.5 Optional User Expansion Board (continued)

Part number	Main interface	Compatible variants
TMS6102V100F022	4-pin USB	Camcuda super mini 640 (imaging) Camcuda super mini 640T (thermographic)



4. Mechanical Dimensions

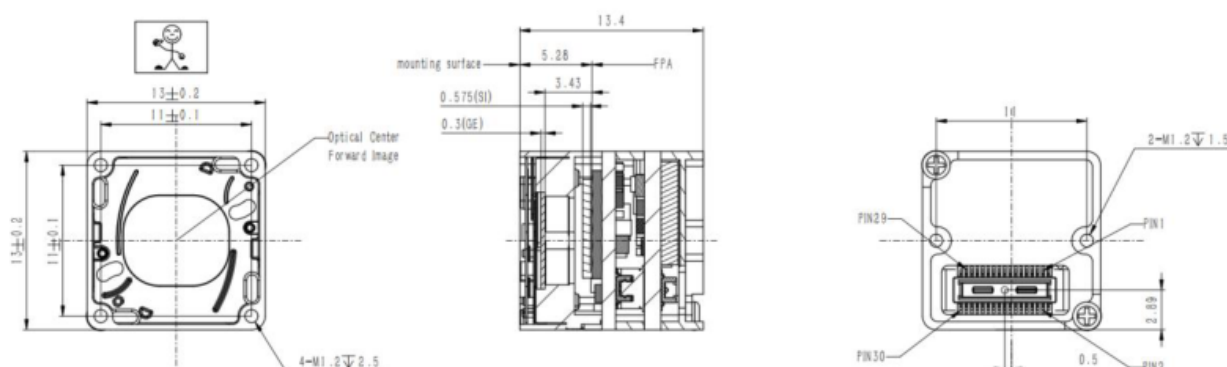


Figure 4.1 Core Dimensions Without Lens or Expansion Board

5. Precautions

Read all of the following information before using the device to help prevent personal injury and equipment damage.

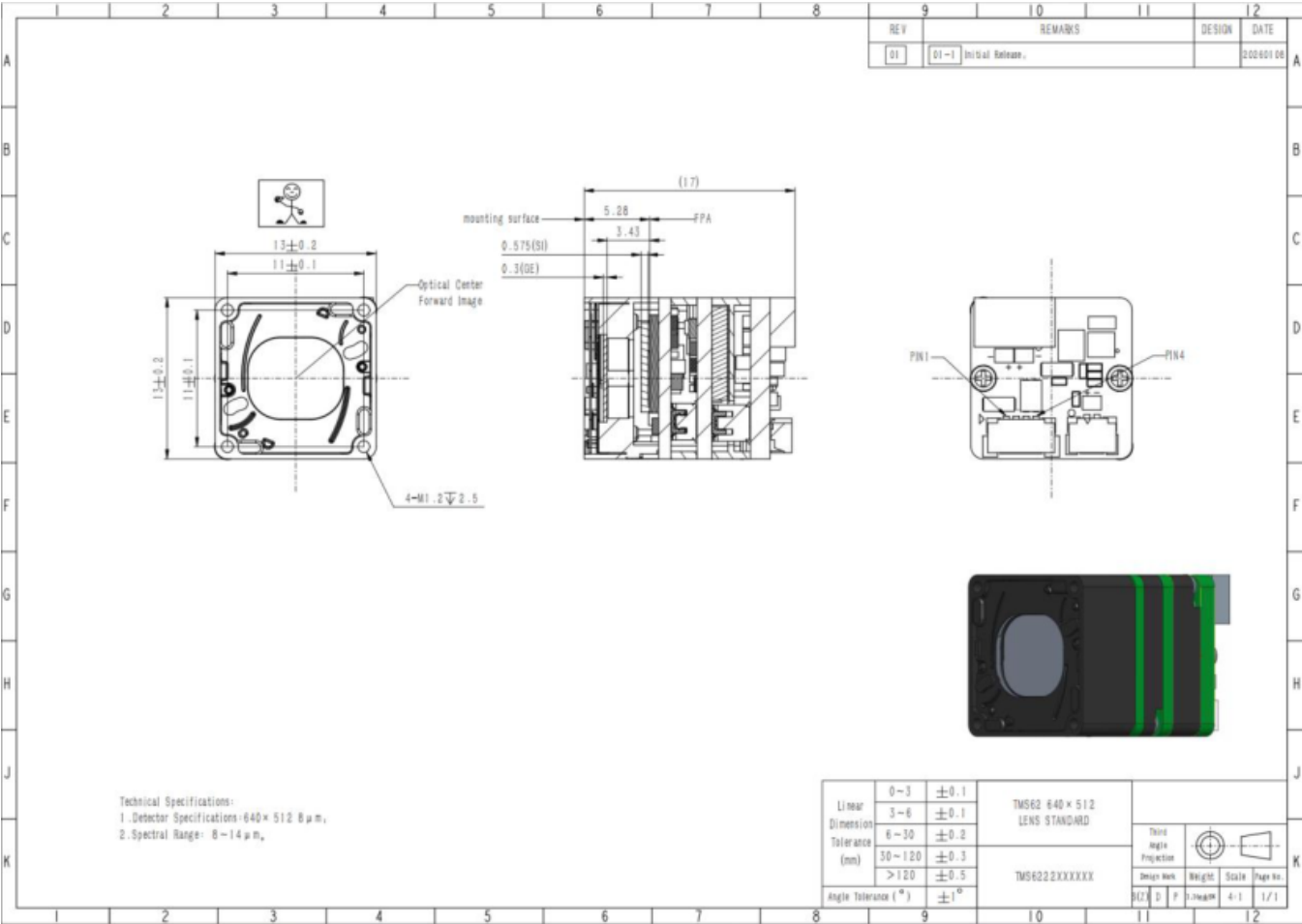
1. Do not point the core module directly at high-intensity radiation sources such as the sun.
2. The ideal ambient operating temperature is -20°C to $+50^{\circ}\text{C}$.
3. Do not touch the detector window or strike it with other objects.
4. Do not touch the equipment or cables with wet hands.
5. Do not bend or damage connecting cables.
6. Do not clean the device with thinner.
7. Disconnect power before connecting or disconnecting cables.

5. Precautions (continued)

8. Connect the supplied cables correctly to avoid damaging the equipment.
9. Take precautions against electrostatic discharge.
10. Do not disassemble the device. If a fault occurs, contact Camcuda and have the device serviced by qualified personnel.
11. After switching the core off, wait more than 5 seconds before switching it on again.

Appendix 1. Mechanical Drawing

Overall dimensions vary with the selected lens and expansion board. Refer to the corresponding mechanical drawing for detailed dimensions.



Mechanical dimensions, tolerances and drawing identifiers are retained from the supplied drawing.

Appendix 2. Temperature Conversion Formulas

Applicable model: Camcuda super mini 640T. These formulas do not apply to the imaging-only Camcuda super mini 640.

For Camcuda super mini 640T only, convert the TEMP value using the formulas below. Mode labels are retained as ND and HD.

ND

$$T = (\text{TEMP} + 7000) / 30 - 273.2$$

HD

$$T = (\text{TEMP} - 4600) / 10 - 273.2$$