Technical Product Brief

CTS3001

Intelligent thermal sensor for
privacy-preserving people sensing

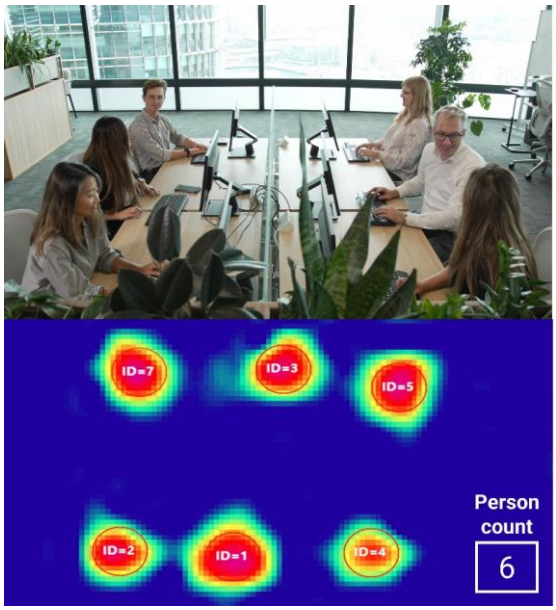
The CTS3001 brings high thermal sensitivity to mass-market applications with Calumino's invented and patented thermo-optical Micro-Opto-Mechanical System (MOMS) detector.

Unlike conventional thermal sensors that convert heat into an electrical signal at the pixel, the CTS3001 converts heat into the mechanical deflection of a micro-mirror array, which is then read optically by a CMOS image sensor. This signal chain delivers a structurally higher SNR, eliminates the need for a mechanical shutter, and removes the column-amplifier 1/f noise that limits microbolometer performance.

The result is a low-cost, low-power, privacy-preserving thermal sensor that captures heat signatures - not identifiable images - and enables intelligent occupancy, presence, and thermal-monitoring applications across consumer, building, and industrial markets.

Target applications

- Smart-building presence detection and people counting
- HVAC and lighting control driven by occupancy
- Smart-home appliances and AC airflow direction
- Smart doorbells and security cameras
- Industrial asset and switchgear monitoring
- Non-contact temperature measurement
- Hotel and facility-management occupancy
- Aged-care fall and wellbeing monitoring
- Data-center rack thermal mapping
- In-cabin automotive monitoring



Please contact info@calumino.com for more information

1. Calumino thermo-optic sensing technology

The CTS3001 sensing chain converts long-wave infrared (LWIR) radiation into a thermal image through four optical stages, replacing the resistive or thermoelectric pixel readout used by conventional sensors.

1.1. Operating principle

- LWIR radiation from the scene is focused onto a passive MOMS micro-mirror array.
- Each mirror deflects via the bi-metallic effect ($\Delta\alpha \cdot \Delta T$), with deflection proportional to absorbed IR energy.
- A low power LED illuminates the array; the reflected optical pattern is captured by a CMOS image sensor.
- Calumino's proprietary thermal rendering converts the optical pattern into a calibrated thermal image and optional computer-vision outputs.

Because the sensing signal is optical rather than electrical at the pixel, the dominant low-frequency noise sources that limit microbolometers (Johnson noise, 1/f noise, ROIC noise) are structurally eliminated. Mechanical damping further suppresses high-frequency noise before digitization, producing a high-SNR signal chain with low thermal drift - and removing the need for frequent flat-field correction or a mechanical shutter.

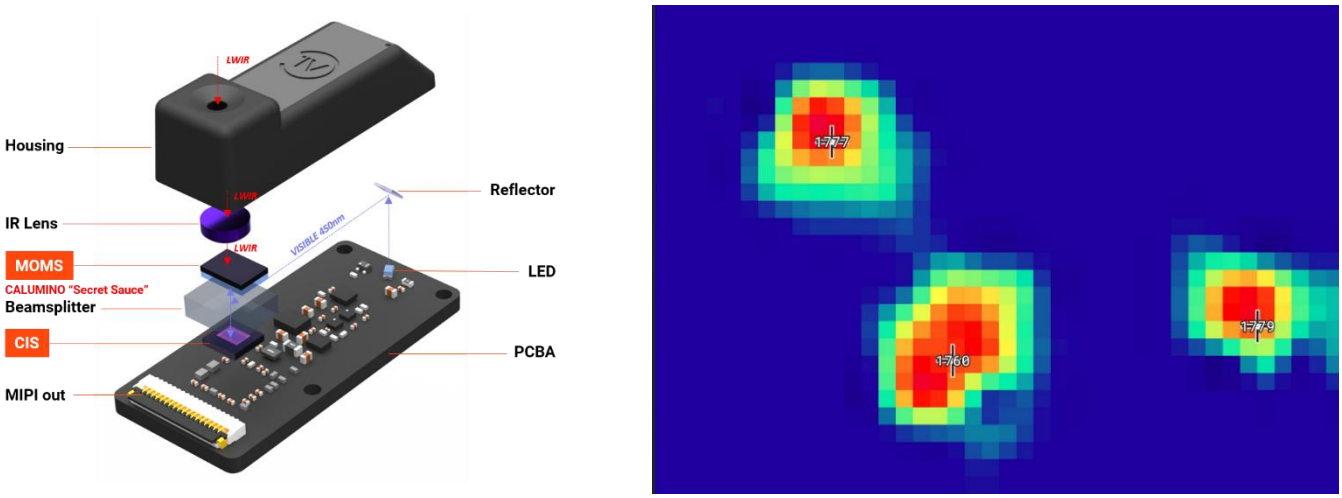


Figure 1: *CTS3001 exploded view and thermal image visualization*

2. Competitive positioning

The CTS3001 occupies a unique position in the LWIR sensing landscape: it matches microbolometer-class NETD at thermopile-class cost and power, with no shutter and strong static-object detection. The table below summarizes the key differences against the two dominant thermal sensor families.

Table 1: *CTS3001 vs. conventional thermal sensor technologies*

	Microbolometer	Thermopile	CTS3001
Operating principle	ΔR from absorbed IR	μV via Seebeck effect	Mirror deflection, read optically
Typical resolution	160×120 to VGA+	Single pixel to ~80×80	20×15
NETD	Good - excellent	Moderate (~300–600 mK)	~45 mK
Shutter / NUC required	Yes (periodic FFC)	No	No
Thermal drift	High	High	Low
Static object detection	Drift-limited	Poor	Strong
Power consumption	Medium	Low - medium	Low (27 mW typ.)

2.1. Compared to PIR motion sensors

PIR sensors are single pixel sensing devices and output a single binary signal triggered by movement. This means they cannot provide sufficient information to detect static people or count occupants. The CTS3001 provides pixelated thermal data, counts both moving and stationary people, covers a larger area, and produces far fewer false alarms - while remaining a viable always-on, low-power solution suitable for battery operation.

2.2. Compared to mmWave radar

Radar shares the night-capable, non-intrusive properties of thermal sensing, but mmWave radar is an active RF device: it is typically limited to roughly three to five people per scene, is sensitive to vibration and reflections, can be subject to RF interference, and as an active emitter, requires additional spectrum certification. The CTS3001 counts up to six people reliably, adds thermal-temperature data (e.g., fire and hotspot detection), is fully passive (no irradiation), and offers plug-and-play setup without that spectrum-certification burden or interference risk.

3. Key Specifications and Performance

The CTS3001 pairs high thermal sensitivity with low power consumption and a wide field of view, making always-on, low-power people sensing practical for mainstream applications. Detection range is set by NETD, not pixel count - the 20 × 15 array at 45 mK reliably outperforms higher-resolution thermopile sensors at several-hundred mK on the same target, and a single CTS3001 covers 6 × 4 m of floor area from a 2.5 m mounting height.

Table 2: *CTS3001 typical detection performance (140° silicon lens module)*

Parameter	Value
Resolution	20 x 15 Pixels
Frame Rate	8 Hz (configurable up to 60Hz)
Thermal Sensitivity (NETD)	45 mK typical
Power Consumption	<30mW
Field of View (H x V)	146° x 110°
Operating temperature (ambient)	−40 °C to 65 °C
Dynamic temperature range	−20 °C to 70 °C

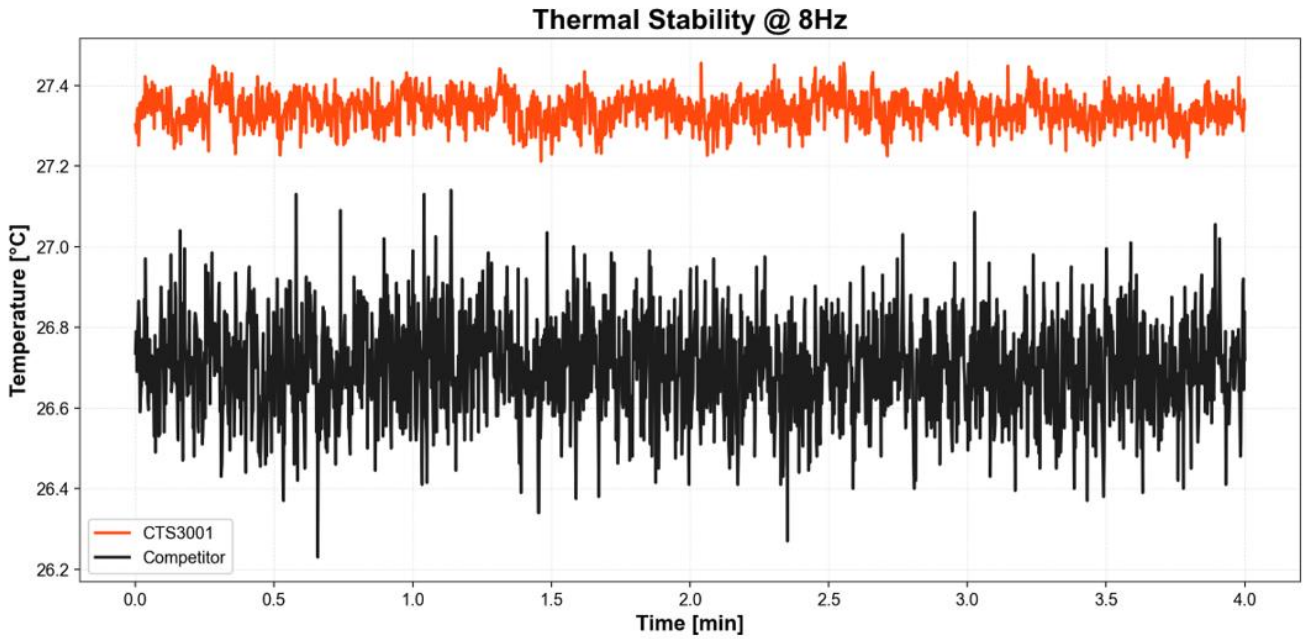


Figure 2: *CTS3001 vs. Competitor single pixel measurement stability comparison*

Table 3: *Detection Performance*

Parameter	Value
Coverage area at 2.5 m mounting height	6 m × 4 m
Indoor human detection range	Up to 20 m

Indoor Wall Mount

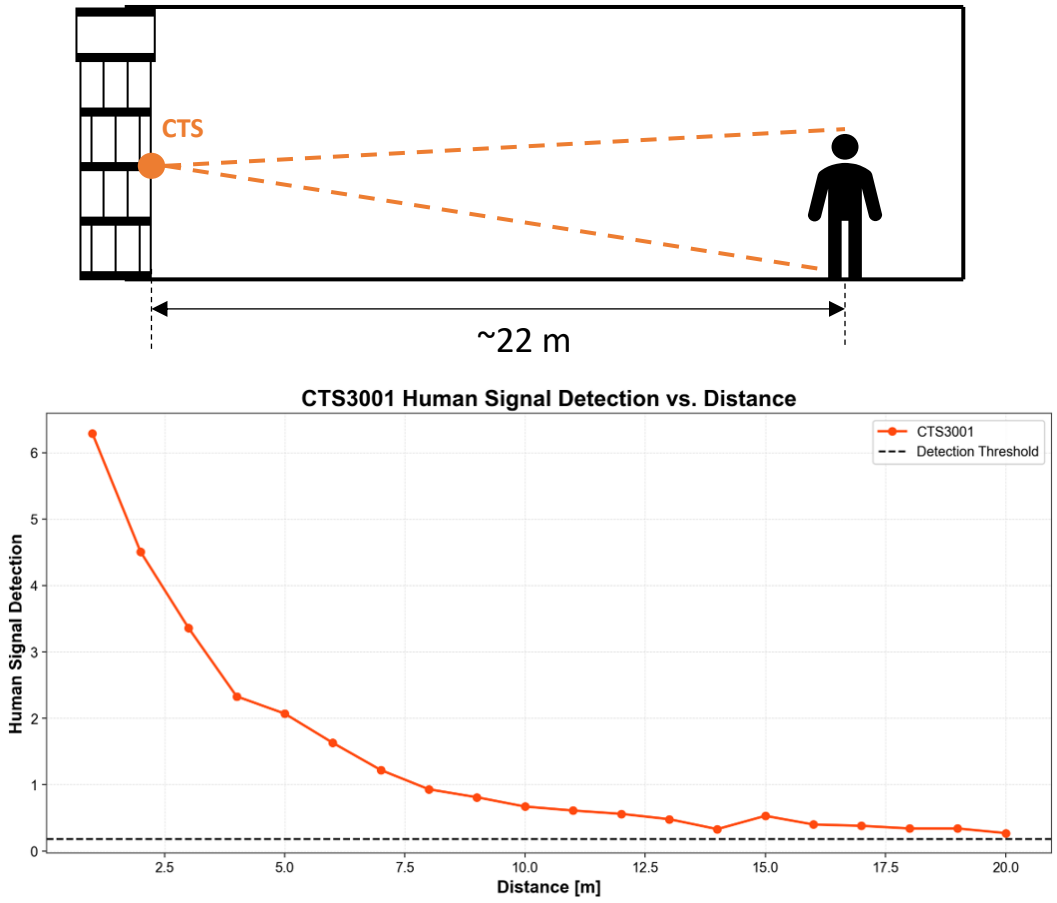


Figure 3: *Diagram of wall and detection range falloff*

The threshold for human recognition is set using Calumino's human detection algorithm. Performance was validated on a 180 cm subject in standard clothing under typical indoor (21 °C, 50% RH) and outdoor (mixed shadow and sun) conditions. Narrower-FOV lens variants extend detection range further when required.

4. System integration

The CTS3001 outputs an 8-bit raw image over MIPI CSI-2 in real time, with on-board EEPROM storing factory-calibration parameters. A downstream MIPI-capable processor reads the calibration parameters once at boot via I²C, then runs Calumino-provided Thermal Signal Processing (TSP) to produce a calibrated thermal image.

4.1. Reference integration architecture

- CTS3001 sensor module connects to the host PCB via an 18-pin FFC.
- On the host, an on-edge AI processor (such as the HX6538) runs Calumino-compiled TSP and people-counting firmware.
- The processed thermal images and computer-vision outputs (headcount, X/Y positions, point temperatures) can then be delivered to the application MCU via host's choice of communication protocol.
- For hosts without native MIPI, Calumino-supplied MIPI-to-SPI converter module simplifies integration.

4.2. Software ecosystem

- Application-layer sensor protocol with Python host library and SPI transport specification.
- Calumino-compiled firmware images for HX6538, including a thermal output stream and top-down people-counting mode.
- Application notes for top-down occupancy, door counting, smart-home and industrial-monitoring deployments.

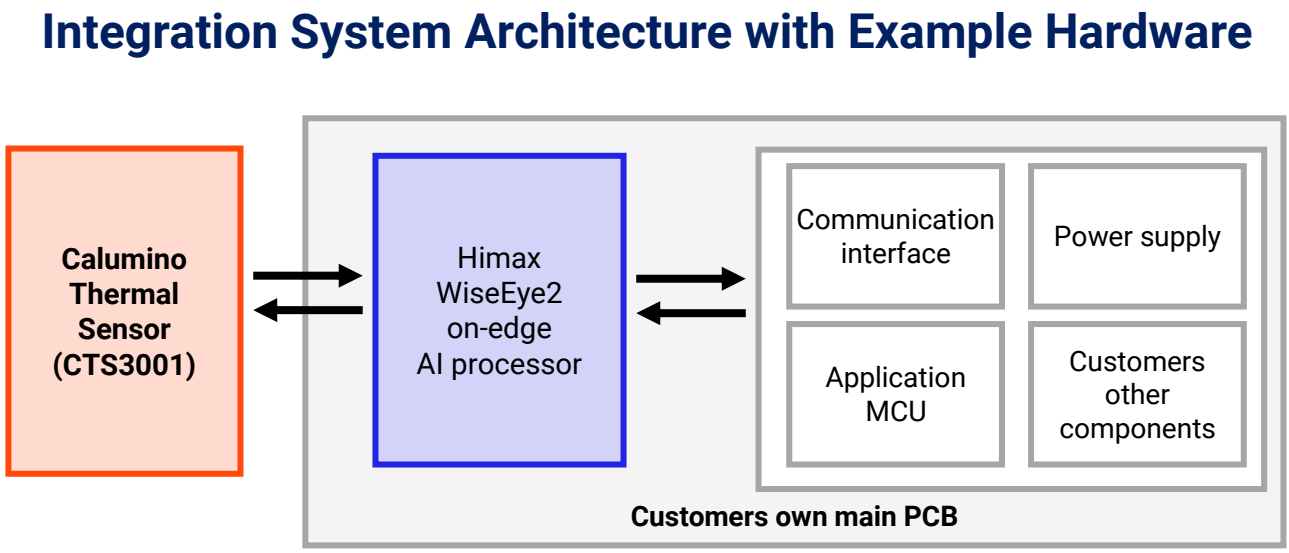
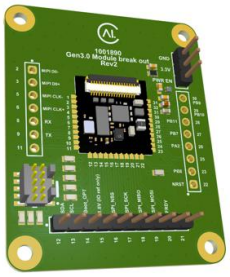


Figure 4: *CTS3001 integrated system architecture example*

5. Ordering information & support

CTS3001
Available for sale

CTS3001 - EVK
Available for sale



CTS3001 - DVK
Available for sale

CTS3001 - WE2
Available for sale

Table 4: *CTS3001 ordering codes*

Product Name	Ordering Code	Product Description
CTS3001	STSCTG30N140MP	Production sensor module
CTS3001 EVK	STSEVG30E140UB	Provides out of the box visualization of thermal and on-edge CV using the WE2 module. Kit includes dual-purpose stand, USB-A to USB-C cable and CTS Player visualization software
CTS3001 DVK	STSDVG30N140MP	A development module kit for architecting your system with the CTS3001 and WE2 module. Includes module + WiseEye2 breakout board + cables + firmware flashing tools
CTS3001 Starter Kit	STSSTG30N140MP	A starter kit that includes 1 x EVK and 3 x DVK's to accelerate your system development around the CTS3001

5.1. Customer design-in journey

Calumino provides end-to-end integration support from proof-of-concept through to mass production, including:

- Evaluation phase - EVK plus CTS Player software for real-time visualization, people counting, and region-of-interest analysis.
- Product design - Development Kit, reference PCB design, mechanical integration guidelines, firmware integration guidelines.
- Design-in review - optional engineering review with Calumino in-house engineers.
- Production support - end-of-line test guidelines, launch support, and after-sales engineering.

For pricing, availability, lead times, and integration support please contact your Calumino representative or write to info@calumino.com.