DVK90642 People Detection

Evaluation Kit
Detailed specification

Features and Benefits

- Evaluation kit for testing the performance of the people detection, counting and visualization software library
- Allows parameter configuration for specific environments
- Contains MLX90642BCA (wide FOV)
- Based on STM32F446ME MCU:
  - Arm® 32-bit Cortex®-M4 CPU
  - 512 Kbytes of Flash memory
  - 128 + 4 Kbytes of SRAM
  - 8 MHz crystal, up to 180 MHz CPU frequency
- Onboard USB Type-C® plug connector
- Ambient temperature range: from 0°C to 40°C

Applications examples

- Confined indoor environments
- Ideal for elevator management and safety
- Smart building and office management
- Energy optimization

Available support & tools

- The latest firmware can be found on the evaluation kit webpage: melexis.com/DVK90642
- For more about the library please visit: melexis.com/library-people-detection
- Compiled library can be downloaded through the MyMelexis platform: www.melexis.com/mymelexis
  To gain access, please contact your local sales representative.

General Description

The purpose of this kit is to evaluate the performance of the people detection, localization and counting library, developed by Melexis. The library uses raw data from MLX90642 thermal array sensor and algorithm-based image processing logic to obtain information about human presence in the indoor environment.

The evaluation kit contains the following items:

1. Demonstration board packaged in a plastic case
2. A standard USB cable for communication with the board
3. 1 pc. MLX90642ESF-BCA-000-TU
4. Female USB-C Adapter

The evaluation kit allows to test the performance of the library by configuring a few basic parameters to match the desired environment.

Figure 1. DVK90642_PeopleDet_rev1.0A

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Ordering information

Table 1. Melexis.IO ordering Information

Product code	Description
DVK90642_PeopleDet_rev1.0A	People Detection Evaluation Kit, revision 1.

1 Block diagram

The DVK90642_PeopleDet_rev1.0A consists of the following blocks:

- Melexis.IO_rev1.2x board
- The USB Type-C® plug (male) connector (X1)
- MLX90642ESF-BCA-000-TU (wide FOV)
- Tripod Attachment ¼-20 UNC
- Plastic case

Figure 2. Evaluation kit content

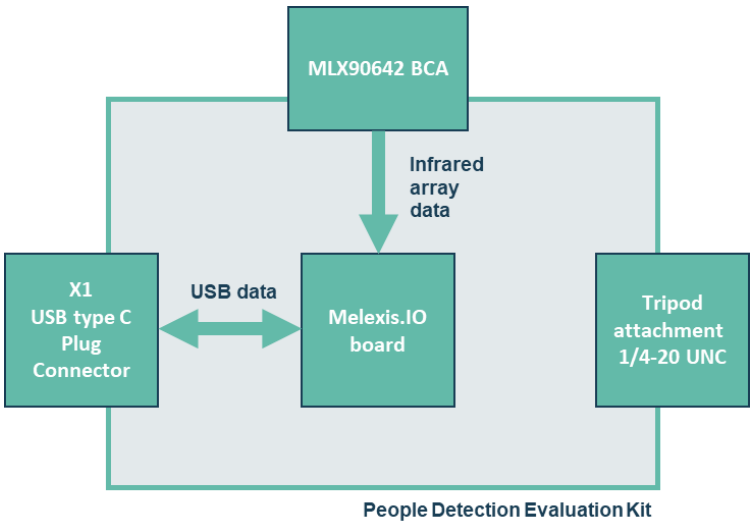

Figure 3. DVK90642_PeopleDet_rev1.0A Block Diagram

2 Evaluation kit content

2.1 Evaluation kit

2.1.1 Melexis.IO_rev1.2x board

The board serves as the core interface for the evaluation kit. It integrates a microcontroller (STM32F446ME) that runs a dedicated firmware incorporating the people-detection library, thereby enabling real-time tracking and localization of humans when used with the infrared sensor. The board manages sensor communication, USB data transfer and power regulation.

General Melexis.IO_rev1.2x board features:

- Arm® 32-bit Cortex®-M4 CPU
- 512 Kbytes of Flash memory
- 128 + 4 Kbytes of SRAM
- 8 MHz crystal, up to 180 MHz CPU frequency

For full technical details and ordering information, refer to the product webpage: melexis.com/DVK90642

The associated software library is documented and available at: melexis.com/library-people-detection

2.1.2 Plastic case

The 3D-printed plastic enclosure protects the electronics from mechanical damage and provides alignment for the infrared sensor. The case includes openings for the USB connector and the sensor aperture.

Figure 4. Plastic enclosure

Attention. Avoid dropping the kit, as the plastic may crack.

2.1.3 Tripod Attachment

The bottom of the enclosure includes a screw insert compatible with standard camera tripods. This allows stable and repeatable positioning during measurements.

2.2 MLX90642ESF-BCA-000-TU

The MLX90642 is a fully calibrated far-infrared thermal sensor array, featuring a 32 × 24 pixel matrix housed in an industry-standard TO39 package with a digital I²C interface. It provides excellent signal-to-noise performance (NETD ≈ 0.065 K at 2 Hz) and supports selectable refresh rates up to 16 Hz. Two field-of-view (FOV) options are available: 45°×35° (narrow, MLX90642ESF-BCB-000) and 110°×75° (wide, MLX90642ESF-BCA-000) to suit different application scenarios. However the evaluation kit and people detection library are tailored for the wide FoV option. The device supports operation from –40 °C to +85 °C ambient, and object temperatures from –40 °C to +260 °C. Supply voltage is 3.3 V typical (3.0 V to 3.6 V). For complete specification details, see the product page: MLX90642

Table 2. MLX90642ESF-BCA_000_TU characteristics

Parameter	Value
Array size	32 × 24 pixels
Field of View (FOV)	110°×75°
Supply voltage	3.0 – 3.6 V
Interface	I²C

Figure 5. MLX90642ESF-BCA-000

2.3 USB cable

The kit includes a long USB cable used to power the evaluation board and transfer data to a computer.
Note. Note to avoid tension or bending at connectors, and ensure a stable 5 V supply.

Table 3. USB cable characteristics

Parameter	Specification
Connector type	Type C to Type A
Length	3.0 m
Supply voltage	5 V ±5%
Function	Power and data transfer

Figure 6. USB cable

2.4 Female USB-C Adapter

The USB-C to USB-C female adapter can be used to connect the long USB cable to the Evaluation board.

Figure 7. USB-C Female Adapter

3 Evaluation kit placement

First, connect the evaluation kit to a laptop using the USB-C adapter and the USB cable (included in the box). After establishing the connection, the kit should be installed on the ceiling of an indoor, enclosed environment. The recommended installation height ranges from 2 meters to 5 meters, with optimal placement at 2.5 meters.

When positioning the kit, it is important to ensure that the heads of the people passing underneath or staying within the monitored area remain inside the sensor's Field of View (FOV).

What is the FOV?

The Field of View (FOV) describes the angular area that the sensor can "see." In other words, it defines the width and height of the scene captured by the sensor. The MLX90642 sensor has a FOV of 110° horizontally and 75° vertically. Any object or person that falls outside these angles will not be detected or measured accurately. Ensuring that people's heads remain within this angular range is essential for reliable detection and performance.

For optimal performance, the evaluation kit should ideally be mounted at a 90-degree angle relative to the floor (pointing straight downward). This orientation provides the most accurate coverage and detection results.

However, the system is flexible and can also operate effectively when the kit is angled. It may be installed at any angle between 90° and 45° depending on the constraints or requirements of the specific installation site.

To assist with positioning, the back side of the enclosure is designed with built-in 90-degree and 45-degree reference surfaces, allowing installers to easily align the device at these common angles.

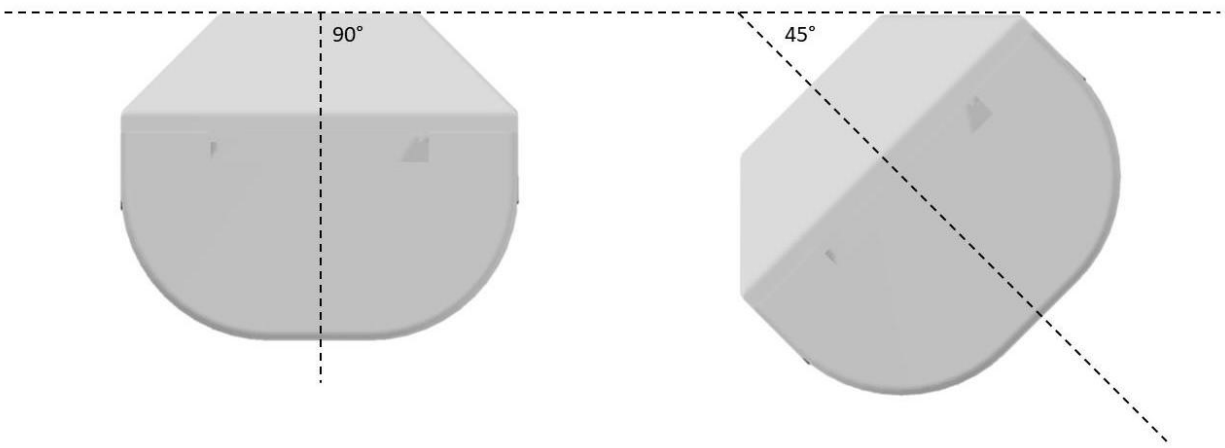

Figure 8. Evaluation kit placement

4 Software and data acquisition

4.1 MLX90642 Thermal Viewer. GUI Overview

The MLX90642 Thermal Viewer is a web-based graphical user interface designed to visualize thermal data from the MLX90642 infrared array and to demonstrate the output of the Melexis People Detection Library in real time.

The interface provides a convenient way to observe raw thermal imagery, algorithm results, and performance indicators while adjusting key configuration parameters.

Link: https://www.melexis.io/isp/

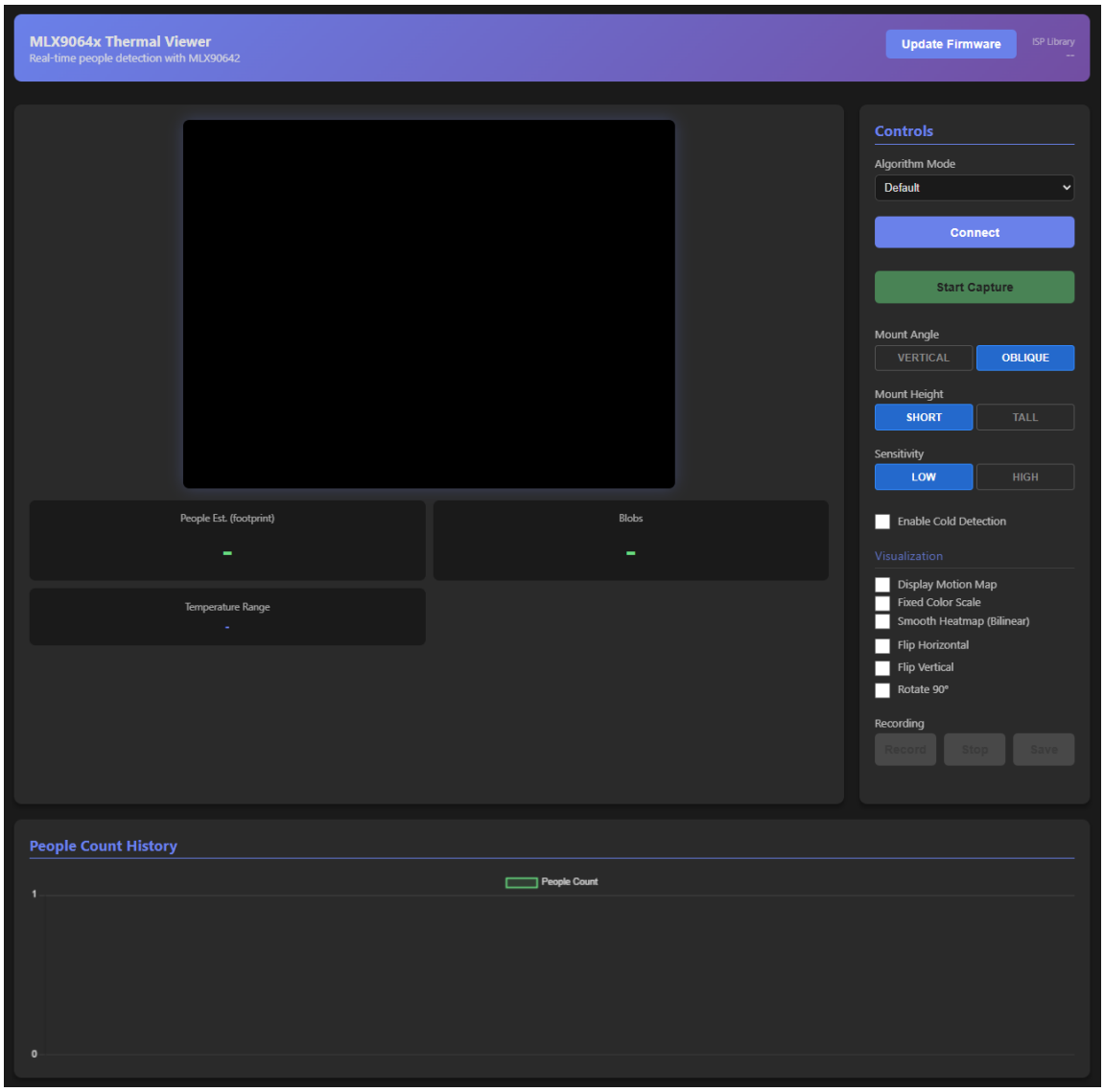

Figure 9. MLX90642 Thermal Viewer

4.1.1 Thermal Display Area

The central black area of the GUI displays the live thermal image streamed from the MLX90642.

When the sensor is connected and the capture is started, this window shows:

- The 24×32 thermal pixel array rendered as a heatmap
- Detected blobs or subjects, depending on the active algorithm mode

- Optional overlays such as bounding marks, color mapping, or rotation

This view updates continuously according to the selected frame rate.

4.1.2 Connection Controls

Connect / Disconnect Button

Table 4. Connect / Disconnect Button

State	Button Text	Action
Disconnected	**Connect**	Opens device selector popup
Connected	**Disconnect**	Closes connection to device

How to connect:

1. Click **Connect**
2. Browser shows available serial ports
3. Select your Melexis IO device
4. Wait for connection confirmation

Connection indicators:

- Library version appears in header when connected
- Capture button becomes enabled

4.1.3 Capture Controls

Start / Stop Capture

Table 5. Start / Stop Capture

State	Button Text	Action
Stopped	Start Capture	Begins receiving thermal frames
Running	Stop Capture	Pauses thermal display

While capturing:

- Thermal heatmap updates continuously
- People count refreshes each frame
- Statistics update in real-time

4.1.4 Algorithm Mode

Mode Selection Dropdown

Choose how people are detected:

Table 6. Mode Selection Dropdown

Mode	Best For	Description
Default	Most scenarios	Advanced detection with tracking and presets
Simple	Low-resource, experimental	Lightweight threshold-based detection

Switching modes requires the algorithm to reinitialize. Detection may pause briefly.

What Changes Per Mode

Table 7. What Changes Per Mode

Feature	Default Mode	Simple Mode
Configuration	Preset options (angle, height, sensitivity)	Hot Threshold slider + Motion Validation
Detection Method	Scene analysis finds warm bodies automatically	Direct temperature threshold you control
Best For	Accurate counting with minimal setup	Fine-tuned control, experimental scenes

Default mode analyzes the thermal scene to build a background model and detect people as warm regions that stand out. Configure it using the Preset options below.
Simple mode uses a direct temperature difference from background. Configure it using the Simple Mode options below.

4.1.5 Simple Mode Configuration

Only available in Simple mode
When you select Simple mode, these controls appear instead of Preset Configuration:

Hot Threshold

Table 8. Hot Threshold

Range	Default	Unit
0 - 10.0	2.0	°C

What it does: Sets how much warmer than the background a region must be to detect as a person.
How it works: The algorithm learns what the "empty" scene looks like (the background). When something warmer appears, it's detected if the temperature difference exceeds this threshold. A person typically appears 2-5°C warmer than the background.
When to adjust:

- **Missing people?** → Decrease (try 1.5°C or lower)
- **False detections from warm objects?** → Increase (try 2.5-3.0°C)

Motion Validation

Table 9. Motion Validation

State	Behavior
Off (default)	Detects all warm regions above threshold
On	Only detects warm regions that have recently moved

How it works: When enabled, a warm region must show temperature changes (motion) to be counted as a person. Static warm objects like radiators, monitors, or sunlit areas are ignored.
When to enable:

- Scene has static heat sources causing false detections
- You only need to count people who are moving

When to keep off:

- You need to detect standing/stationary people
- Scene has no problematic static heat sources

4.1.6 Preset Configuration

Only available in Default mode

Presets automatically configure detection parameters based on your installation:

Mount Angle

Table 10. Mount Angle

Option	Use When
Vertical	Sensor mounted on ceiling, looking straight down
Oblique	Sensor mounted on wall, looking at an angle

How it works: When looking straight down (Vertical), people appear as round shapes. When looking at an angle (Oblique), people appear elongated. This setting helps the algorithm correctly identify person shapes for your installation.

Mount Height

Table 11. Mount Height

Option	Use When
Short	Sensor is less than 2.5 meters from floor
Tall	Sensor is 2.5 meters or higher

How it works: The further the sensor is from people, the smaller they appear in the thermal image. This setting tells the algorithm how large a person should look, so it can count them correctly.

Sensitivity

Table 12. Sensitivity

Option	Effect
Low	Fewer false detections, may miss some people
High	Detects more people, may have false positives

Recommendation: Start with **Low**, increase if people are missed.

Cold Detection

Table 13. Cold Detection

State	Behavior
Off (default)	Only detects warm objects (people, heat sources)
On	Also detects cold regions (useful in some special scenarios)

How it works: Normally, people are warmer than the background and show up as "hot spots". In some environments (e.g., strong air conditioning), cold air can create distinct cold regions. Enable this only if instructed for specific use cases. Most installations should leave this **Off**.

Applying Presets

Presets are applied automatically when you change any toggle. The system may briefly reinitialize.

4.1.7 Display Statistics

Stats Panel

Table 14. Stats Panel

Stat	Meaning
People	Number of people currently detected
Blobs	Number of distinct heat regions (may differ from people count)
Temp Range	Lowest to highest temperature in current frame (e.g., "22.5 - 32.1°C")

Understanding the Numbers

- **People ≤ Blobs**: Multiple heat sources may be detected, but only some are classified as people
- **People > 1 per blob**: Large blobs may contain multiple people standing together
- **Temp Range**: Useful for monitoring scene conditions

4.1.8 Visualization Options

Display Motion Map

Table 15. Display Motion Map

State	Effect
Off	Shows only temperature data
On	Highlights areas with recent movement, dims static areas

How it works: The system tracks which areas have had temperature changes (motion). When enabled, areas with recent motion appear at full brightness, while static (non-moving) areas appear slightly muted/faded. This helps you see which regions the algorithm considers "active" - useful for understanding why certain areas trigger detections.

Fixed Color Scale

Table 16. Fixed Color Scale

State	Effect
Off	Colors auto-adjust to current min/max temperature
On	Colors stay consistent across frames

When **On**, you can set:

Table 17. Color scale range

Control	Range	Description
Min Temp	0-50°C	Temperature mapped to blue
Max Temp	0-50°C	Temperature mapped to red

Recommendation:

- Use **Off** for exploring new scenes
- Use **On** for consistent monitoring

Smooth Heatmap

Table 18. Smooth Heatmap

State	Effect
Off	Shows raw 32×24 pixels (blocky)
On	Applies bilinear interpolation (smooth gradients)

Use case: Smooth looks better, but raw shows actual sensor resolution.

Orientation Controls

Adjust the display to match your installation:

Table 19. Orientation Controls

Control	Effect
Flip Horizontal	Mirror image left-to-right
Flip Vertical	Mirror image top-to-bottom
Rotate 90°	Rotate display 90 degrees clockwise

Use case: Match the thermal view to your physical camera orientation.

4.1.9 Recording

Capture thermal sessions for later review.

Recording Controls

Table 20. Recording Controls

Button	Action
Record	Start recording frames (disabled until capturing)
Stop	Stop recording
Save	Export recorded frames to JSON file

Recording Workflow

1. Start capture (thermal must be running)
2. Click **Record**
3. Frame counter shows recorded frame count
4. Click **Stop** when done
5. Click **Save** to download JSON file

Recorded Data

The JSON file contains:

- Raw thermal frame data
- Detection results (blobs, people count)
- Timestamps

Use case: Analyze detection performance, share scenarios for debugging.

4.1.10 Tips for Best Results

Optimal Setup

- Position sensor to view full area of interest
- Avoid pointing directly at heat sources (radiators, sunlight)
- Ensure people walk through the field of view

Improving Detection (Default Mode)

- **Missing people?** Try increasing Sensitivity to **High**
- **False detections?** Lower Sensitivity to **Low**, or check if a heat source (radiator, sunlight) is in view
- **Inconsistent counts?** Verify Mount Height and Mount Angle match your actual installation

Improving Detection (Simple Mode)

- **Missing people?** Lower the Hot Threshold (try 1.5°C or below)
- **False detections from static objects?** Enable **Motion Validation** to ignore non-moving heat sources
- **False detections from warm objects?** Increase Hot Threshold (try 2.5-3.0°C)

Performance

- Close other browser tabs for best frame rate
- Use wired USB connection (avoid hubs if possible)

Preset configurations allow users to quickly apply predefined algorithm settings optimized for different installation geometries, expected operating distances, and desired detection sensitivity. These presets simplify setup and ensure reliable performance across a wide range of environments.

4.2 Firmware Update

4.2.1 Overview

The thermal viewer includes browser-based firmware updates using WebUSB and DFU (Device Firmware Update) protocol. No external tools required!

Features

- Automatic update checking on device connect
- One-click firmware download and flash
- Progress tracking with real-time status
- Manual fallback for offline updates
- SHA-256 verification

Requirements

Table 21. Firmware Update Requirements

Browser	Support
Chrome 89+	Supported
Edge 89+	Supported
Firefox	Not supported (no WebUSB)
Safari	Not supported (no WebUSB)

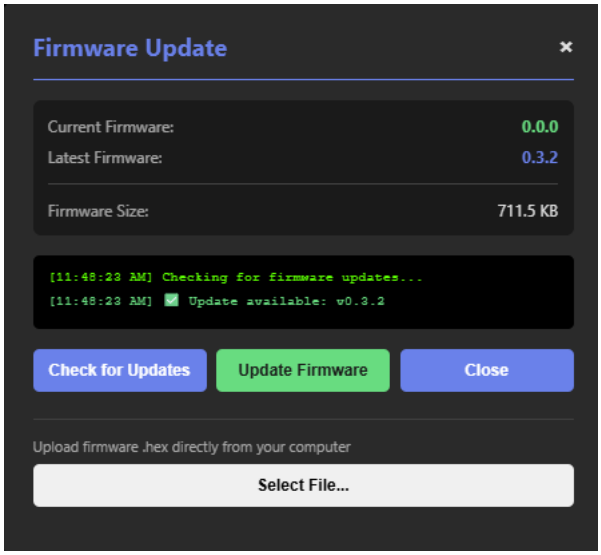

Figure 10. Firmware Update

4.2.2 Quick Update (Automatic)

Step 1: Connect Device

1. Click **Connect** button
2. Select your device's serial port
3. App automatically checks for updates

Step 2: Check for Updates

If an update is available:

- **Update Firmware** button appears in header with badge
- Click to open update dialog

Step 3: Update Firmware

1. Review version information in dialog
2. Click **Update Firmware**
3. Confirm the warning dialog
4. Wait ~90 seconds for update to complete

Step 4: Reconnect

1. Device automatically reboots to new firmware
2. Click **Reconnect** when prompted

4.2.3 Manual Update (Local File)

Use this when:

- No network access
- Installing custom firmware

Step 1: Get Firmware File

Download .hex file from:

- GitLab Releases page
- Local build output

Step 2: Open Update Dialog
Click **Update Firmware** button in header.
Step 3: Select File

1. Scroll to "Manual Firmware Upload" section
2. Click **Choose Firmware File...**
3. Select your .hex file
4. File size is validated

Step 4: Flash

1. Click **Update Firmware**
2. Confirm warning dialog
3. Wait ~90 seconds for update

4.2.4 Platform Setup

macOS
Works out of box - no driver installation needed.

Windows
Requires Zadig driver (one-time setup):

1. Download Zadig
2. Put device in DFU mode:
    - Disconnect USB
    - Press and **HOLD** BOOT button on board
    - Connect USB while holding BOOT
    - Release BOOT button
3. Run Zadig:
    - Options → List All Devices
    - Select "STM32 BOOTLOADER"
    - Driver: WinUSB (v6.x.x)
    - Click "Replace Driver"
4. Device is ready for WebUSB updates

Linux
Requires udev rules:
Create `/etc/udev/rules.d/50-stm32-dfu.rules`:

```
# STM32 DFU Bootloader
SUBSYSTEM=="usb", ATTR{idVendor}=="0483", ATTR{idProduct}=="df11",
MODE="0666"
```

Reload rules:

```
sudo udevadm control --reload-rules
sudo udevadm trigger
```

4.2.5 Recovery

Device Won't Boot After Update
Don't panic! STM32 has an unbrickable ROM bootloader.

Recovery Steps

1. **Enter manual DFU mode:**
   - Disconnect USB
   - Press and HOLD BOOT button
   - Connect USB while holding BOOT
   - Release BOOT button
2. **Retry from web interface:**
   - Open thermal viewer
   - Click Update Firmware
   - Select working firmware file
   - Flash
3. **If web update fails, use command-line:**

   STM32CubeProgrammer (Recommended):
   - Supports .hex files natively
   - Download from ST website

   dfu-util (Advanced):
   Warning: dfu-util treats files as raw binary. Do NOT flash .hex files directly - they must be converted first.

```
# Only for .bin files:
dfu-util -a 0 -s 0x08000000:leave -D melexis_io_fw.bin
```

4.2.6 Update Flow (Technical)

For reference, the complete update flow:

```
1. Check Version      → Query :PeopleDetection:VERSION? via Serial
2. Fetch Latest       → GitLab API: GET /releases
3. Download HEX       → Download melexis_io_fw.hex
4. Verify Checksum    → Validate download integrity
5. Enter DFU Mode     → Send :SYSTem:DFU 42 command
6. Connect USB        → WebUSB: 0483:df11 (STM32 BOOTLOADER)
7. Erase + Flash      → DfuSe protocol: 2KB blocks @ 0x08000000
8. Verify             → Readback verification
9. Reboot             → Device exits DFU, starts application
```

4.2.7 File Formats

Table 22. File Formats

Format	Description	Usage
.hex	Intel HEX (text)	Web tool, preserves memory layout
.bin	Raw binary	Command-line tools only
.dfu	DfuSe container	STM32-specific metadata

Recommendation: Always use .hex files with the web tool.

4.3 Recorded data format

4.2.8 JSON datatype structure

```
version                                    = string
```

```
timestamp                                 = string
frameCount                                      = int
frames [#]
      frameNum                            = int
      timestamp                           = int
      data
            thermalFrame                        = double [24x32]
            foregroundMask                = 1&0 [24x32]
            peopleCount                         = int
            activityCount                       = int
            blobCount                     = int
            blobs [#]
                  id                      = int
                  area                    = int
                  cx                      = int
                  cy                      = int
                  box                     = []
                  act                     = int
                  bord                    = int
                  mask                    = string
            tempMin                       = double
            tempMax                       = double
            processingTime                      = double
            scaleInfo
                  minTemp                 = double
                  maxTemp                 = double
                  mindigit                = int
                  maxDigit                = int
```

4.2.9 Matlab example sequence

- Read JSON data from a file

```
jsonFileName = 'thermal.json';
jsonStr = fileread(jsonFileName);
```

- Convert JSON string to MATLAB variables

```
jsonData = jsondecode(jsonStr);
```

- Access JSON data using MATLAB variables

```
thermalFrame = jsonData;
```

5 Safety and handling

5.1 ESD precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). Always observe Electro Static Discharge control procedures whenever handling semiconductor products

5.2 Operating temperature and voltage limits

The evaluation kit is designed to operate reliably within the same environmental and electrical limits as its core components: the MLX90642 infrared sensor and the STM32F446 microcontroller. The recommended ambient operating temperature range is 0 °C to +40 °C. Operating the kit outside of this range may lead to inaccurate measurements or reduced component lifetime. Prolonged exposure to high temperatures should

be avoided, especially when the kit is enclosed or used near heat sources, to prevent heat accumulation inside the 3D-printed housing.

The kit operates from a regulated 3.3 V supply, with an acceptable range between 3.0 V and 3.6 V. Both the MCU and the MLX90642 sensor are optimized for this voltage level. Supplying voltages below 3.0 V can cause unstable communication or sensor malfunction, while voltages above 3.6 V may permanently damage the components. When the kit is powered via USB, the onboard voltage regulator converts the 5 V USB input to the required 3.3 V rail. Users should ensure that the USB source provides a stable 5 V and that the USB cable is not excessively long or of poor quality, as voltage drops may affect performance.

To ensure optimal accuracy and reliability, avoid exposing the kit to rapid temperature changes or mechanical stress while powered. For measurement stability, it is recommended to allow the device to thermally settle to ambient conditions before taking readings.

Table 23. Operating temperature and voltage limits

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Operating ambient temperature	TA	0	—	+45	°C	Based on MLX90642 and STM32F446 ratings
Supply voltage (regulated rail)	VDD	3.0	3.3	3.6	V	Shared supply for MCU and sensor
USB input voltage	VUSB	4.75	5.0	5.25	V	Converted internally to 3.3 V
Storage temperature	Tstg	–40	—	+85	°C	Avoid condensation or mechanical stress

5.3 Mechanical handling advice

The evaluation kit contains sensitive electronic components housed in a 3D-printed plastic enclosure. Handle the kit with care to avoid mechanical damage. Do not drop, bend, or apply excessive force to the enclosure, as the plastic may crack or deform.

The MLX90642 infrared sensor is mounted inside the case and should not be exposed to strong mechanical or thermal shocks. Avoid pressing on the lens or allowing debris to accumulate on it.

The kit includes a long USB cable for connection to a computer. To prevent strain on the connectors, ensure that the cable is routed without tension or sharp bends. Avoid pulling on the cable to unplug it, always remove it by holding the connector.

For stable positioning during measurements, the case features a mounting screw compatible with standard camera tripods. When attaching the kit, make sure the screw is properly aligned and tightened gently to avoid damaging the plastic threads or enclosure.

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7 List of Tables

8 Revision history

Table 24. Revision History

Revision	Date	Change history
001	04-November-25	Initial creation

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