TUOPUONE Hailo-8 AI M.2 Module

TUOPUONE Hailo-8 AI M.2 Module User Manual

Model: Hailo-8 AI M.2 Module

Brand: TUOPUONE

1. Introduction

The TUOPUONE Hailo-8 AI M.2 Accelerator Module is designed to provide high-performance artificial intelligence (AI) inferencing capabilities for edge devices, particularly compatible with Raspberry Pi 5. This module integrates the powerful 26 Tera-Operations Per Second (TOPS) Hailo-8 AI Processor, offering an efficient solution for various AI applications.

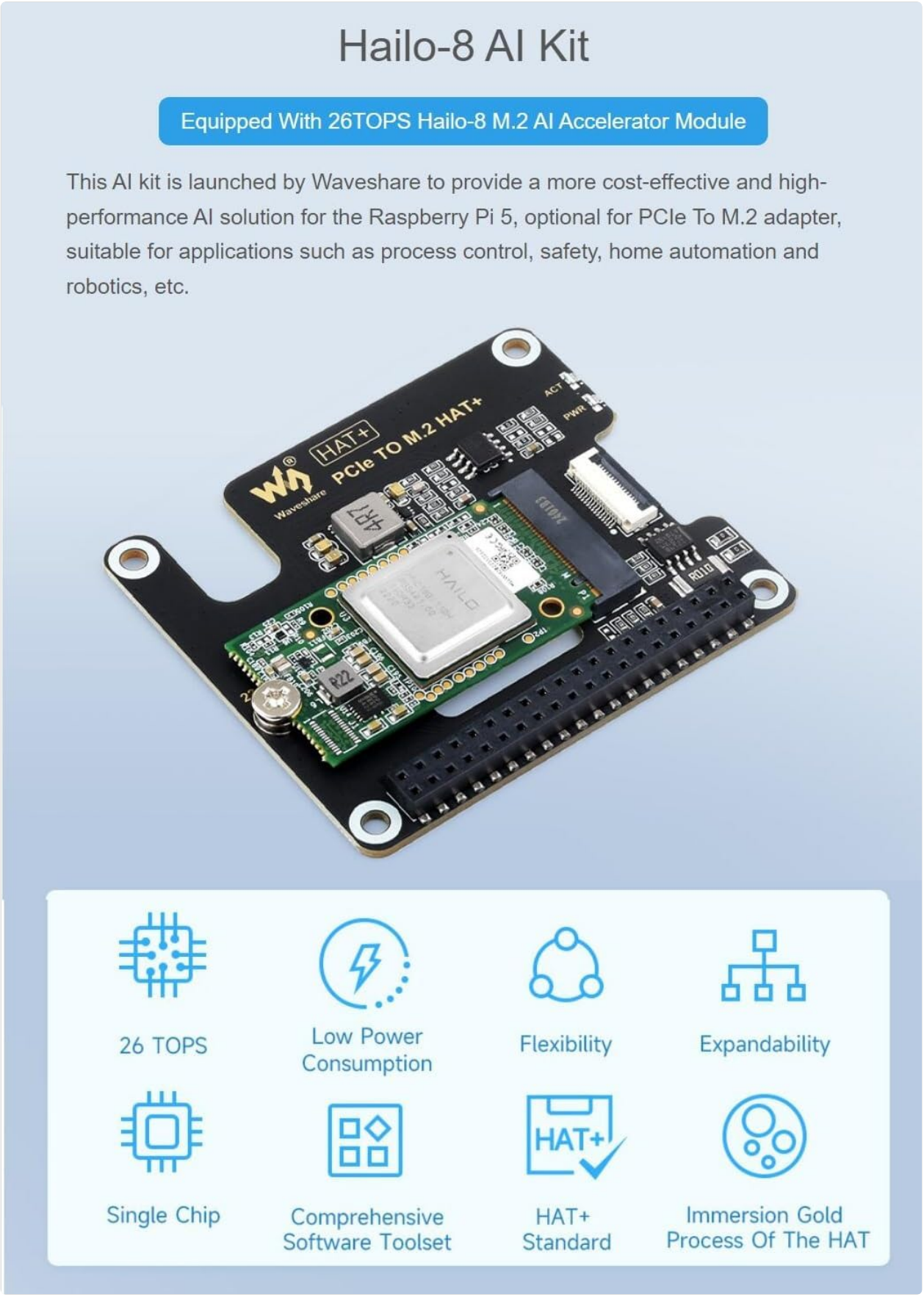

Figure 1: Overview of the Hailo-8 AI Kit, highlighting the M.2 AI Accelerator Module and its key features such as 26 TOPS, low power consumption, flexibility, and expandability.

Key Features:

- **High Performance:** Powered by a 26 TOPS Hailo-8 AI Processor.
- **Low Power Consumption:** Typical power consumption of 2.5W.

- **Scalability:** Enables simultaneous processing of multiple streams and models for real-time, low-latency AI inferencing.
- **Broad Framework Support:** Compatible with TensorFlow, TensorFlow Lite, ONNX, Keras, and PyTorch.
- **Operating System Compatibility:** Supports Linux and Windows systems.
- **Wide Temperature Range:** Operates reliably from -40°C to 85°C.

2. Specifications

This section details the technical specifications and performance parameters of the Hailo-8 AI M.2 Module.

Features At A Glance

- Hailo-8 AI M.2 module
  - Powered by 26 Tera-Operations Per Second (TOPS) Hailo-8 AI Processor
  - 2.5W typical power consumption
  - Scalable, enabling simultaneous processing of multi-streams & multi-models
  - Enabling real-time, low latency and high-efficiency AI inferencing on the edge devices
  - Supports TensorFlow, TensorFlow Lite, ONNX, Keras, Pytorch frameworks
  - Supports Linux and Windows
  - Supports the temperature range of -40°C to 85°C
- PCIe To M.2 adapter
  - Onboard power monitoring chip and EEPROM, supports real-time monitoring of device power status for more stable operation
  - Raspberry Pi HAT+ compliant
  - Reserved airflow vent, supports installing cooling fan for better heat dissipation of the AI module to improve performance
  - Immersion gold process design, anti-oxidation and more durable

Hailo-8 AI M.2 Module Parameters

AI PERFORMANCE	26 TOPS
FORM FACTOR	M.2 Key M
POWER SUPPLY	3.3V ± 5%
POWER CONSUMPTION	2.5W (Typ.) 8.65W (Max.)
INTERFACE	PCIe Gen3, 4-lane
CERTIFICATE	CE, FCC Class A
STORAGE TEMPERATURE	-40 ~ 85°C
OPERATING TEMPERATURE	-40 ~ 85°C
OPERATING HUMIDITY	5% ~ 90%RH (no frosting)
DIMENSIONS	22×80mm with breakable extensions to 22×42mm and 22×60mm

Figure 2: Detailed parameters for the Hailo-8 AI M.2 Module, including AI performance, form factor, power supply, power consumption, interface, and operating conditions.

Hailo-8 AI M.2 Module Parameters:

Parameter	Value
AI Performance	26 TOPS
Form Factor	M.2 Key M
Power Supply	3.3V ±5%
Power Consumption	2.5W (Typical), 8.65W (Max)
Interface	PCIe Gen3, 4-lane
Certificates	CE, FCC Class A
Storage Temperature	-40°C to 85°C
Operating Temperature	-40°C to 85°C
Operating Humidity	5% - 90% RH (no frosting)
Dimensions	22×80mm with breakable extensions to 22×42mm and 22×60mm

Hailo-8 Performance Parameters

NN MODEL	INPUT RESOLUTION	MAP	HAILO-8L FPS (BATCH8)
yolov4_tiny	yolov4_tiny	18.98	610
yolov6n	yolov6n	34.3	345
yolov7	yolov7	49.8	45
yolox_s_wide	yolox_s_wide	42.4	75
yolov3	yolov3	38	26
yolov8n	yolov8n	37.23	270
yolov8s	yolov8s	44.75	128
yolov8m	yolov8m	50.08	55

TYPE	NN MODEL	INPUT RESOLUTION	FPS	POWER(W)	FPS/W
CLASSIFICATION	ResNet-50 v1	224x224	1332	3.45	386
	MobileNet_v2_1.0	224x224	2444	2.152	1135
	EfficientNet_M	240x240	889	3.5	254
OBJECT DETECTION	SSD_MobileNet_v1	300x300	1055	2.2	479
	YOLOv5m	640x640	218	4.6	47.3
SEGMENTATION	stdc1	1024x1920	54	2.9	18.6
MULTI STREAM OBJECT DETECTION (8 STREAMS)	YOLOv3	608x608	69	4.9	14

Figure 3: Performance parameters of the Hailo-8 for different Neural Network (NN) models, including input resolution, mAP, and FPS.

3. Setup and Installation

This section provides instructions for installing the Hailo-8 AI M.2 Module, particularly with the Raspberry Pi 5.

Figure 4: Illustration of the Hailo-8 M.2 module connected to a Raspberry Pi 5, detailing the 16PIN cable connection and power monitoring chip.

Connecting to Raspberry Pi 5:

1. Ensure your Raspberry Pi 5 is powered off and disconnected from any power source.
2. Locate the PCIe interface on your Raspberry Pi 5.
3. Connect the 16PIN cable to the designated port on the Hailo-8 M.2 HAT+ adapter. Ensure the triangles on the cable and connector align correctly to prevent damage.
4. Connect the other end of the 16PIN cable to the Raspberry Pi 5's PCIe interface.
5. Carefully insert the Hailo-8 AI M.2 Module into the M.2 slot on the HAT+ adapter. Secure it with the provided screw.
6. Mount the HAT+ adapter onto the Raspberry Pi 5's GPIO pins.
7. If using an optional cooling fan, install it according to its instructions, ensuring proper airflow for the AI module.

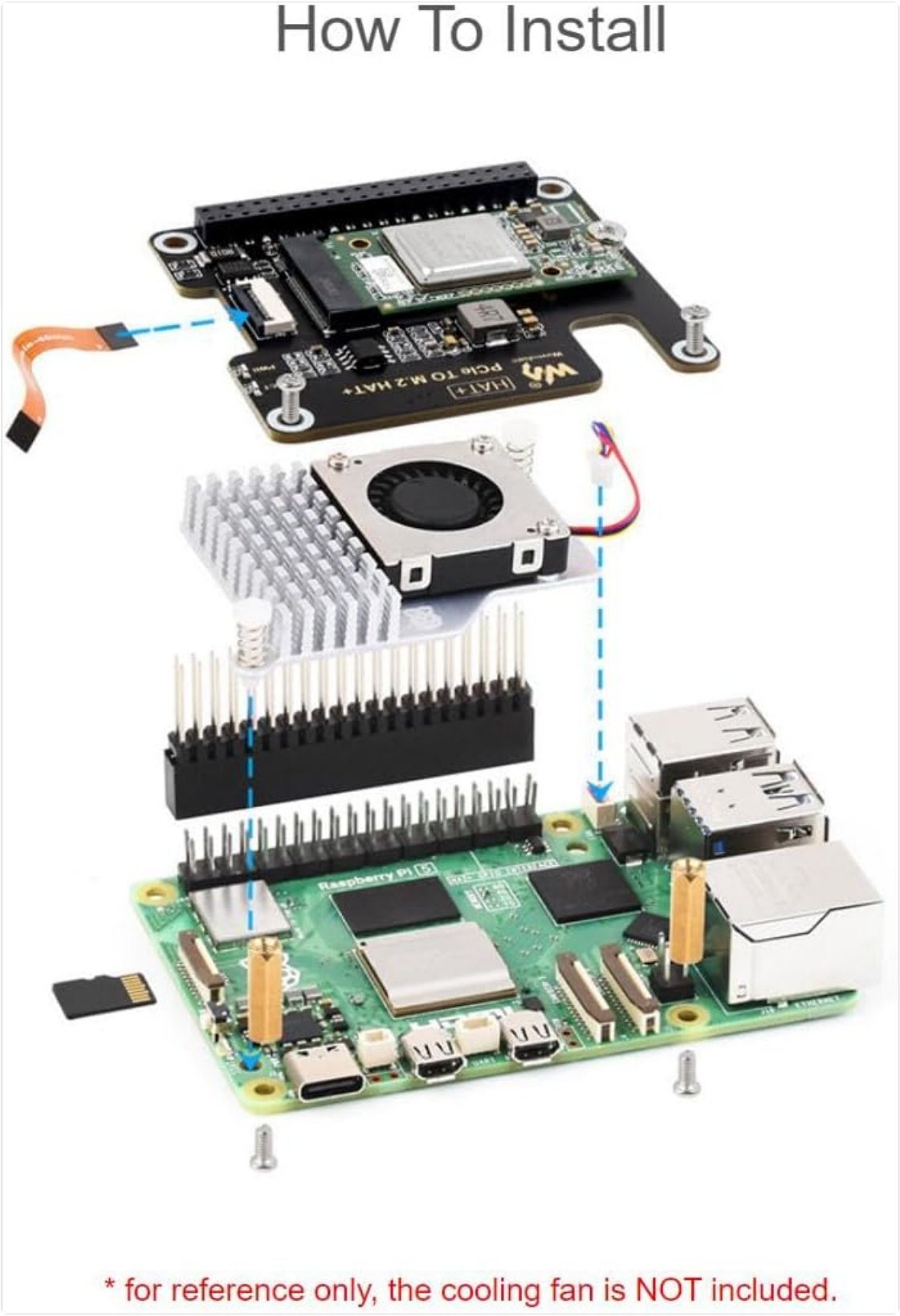

Figure 5: Exploded view illustrating the assembly process of the Hailo-8 AI M.2 module with a Raspberry Pi 5 and an optional cooling solution. Note: The cooling fan is not included.

4. Operating Instructions

The Hailo-8 AI M.2 Module is designed for seamless integration into various AI development environments.

Software and Frameworks:

- The module supports popular AI frameworks including TensorFlow, TensorFlow Lite, ONNX, Keras, and

PyTorch.

- It is compatible with both Linux and Windows operating systems, allowing for flexible development and deployment.
- Utilize Hailo's comprehensive Dataflow Compiler and software toolset to port Neural Network models efficiently to the Hailo-8.

Power Monitoring and Cooling:

- The onboard power monitoring chip and EEPROM provide real-time device power status, contributing to stable operation.
- For optimal performance and longevity, especially under heavy AI workloads, consider utilizing the reserved airflow vent for a cooling fan. This helps dissipate heat and maintain module performance.

5. Maintenance

To ensure the longevity and optimal performance of your Hailo-8 AI M.2 Module, follow these general maintenance guidelines:

- **Environmental Conditions:** Operate the module within the specified temperature range of -40°C to 85°C and humidity range of 5% - 90% RH (non-condensing).
- **Cleanliness:** Keep the module free from dust and debris. Use compressed air or a soft brush for cleaning if necessary. Avoid using liquids or harsh chemicals.
- **Physical Handling:** Handle the module by its edges to avoid touching sensitive components. Static electricity can damage electronic components, so use anti-static precautions when handling.
- **Firmware Updates:** Regularly check the TUOPUONE or Hailo Technologies website for any available firmware or software updates to ensure the best performance and compatibility.

6. Troubleshooting

If you encounter issues with your Hailo-8 AI M.2 Module, consider the following troubleshooting steps:

- **No Detection:** Ensure the module is correctly seated in the M.2 slot and the 16PIN cable is securely connected to both the HAT+ adapter and the Raspberry Pi 5. Verify the cable orientation is correct (aligning triangles).
- **Power Issues:** Confirm that your Raspberry Pi 5 has an adequate power supply. The Hailo-8 module requires 3.3V ±5%.
- **Software Compatibility:** Verify that your operating system (Linux/Windows) and AI frameworks (TensorFlow, etc.) are correctly installed and configured according to Hailo's documentation.
- **Overheating:** If the module experiences performance degradation or unexpected shutdowns, check for proper cooling. Ensure any optional cooling fans are functioning and not obstructed.
- **Performance Issues:** Ensure your AI models are optimized for the Hailo-8 processor using the provided Dataflow Compiler. Check for any resource conflicts with other components.

For persistent issues, refer to the official documentation from Hailo Technologies or contact TUOPUONE support.

7. Applications

The Hailo-8 AI M.2 Module is suitable for a wide range of edge AI applications due to its high performance and low power consumption.

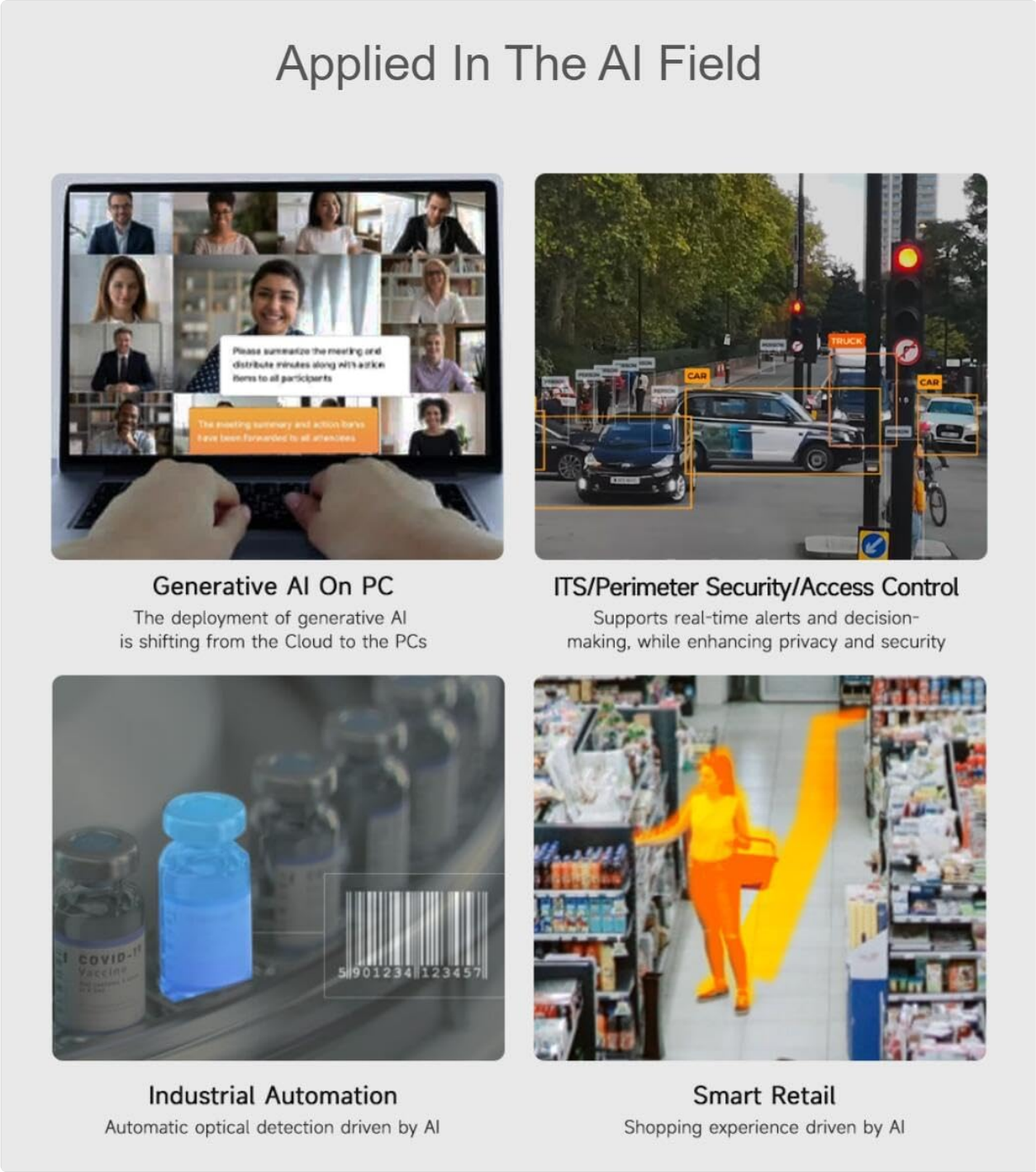

Figure 6: Examples of diverse applications where the Hailo-8 AI M.2 Module can be deployed, including generative AI on PCs, intelligent transportation systems, industrial automation, and smart retail solutions.

Typical Use Cases:

- **Generative AI on PC:** Accelerating generative AI workloads directly on personal computers.
- **ITS/Perimeter Security/Access Control:** Enabling real-time alerts and decision-making for security systems.
- **Industrial Automation:** Powering automatic optical detection and other AI-driven processes in industrial settings.
- **Smart Retail:** Enhancing shopping experiences through AI-driven analytics and automation.

8. Dimensions

The physical dimensions of the Hailo-8 AI M.2 Module are provided below.

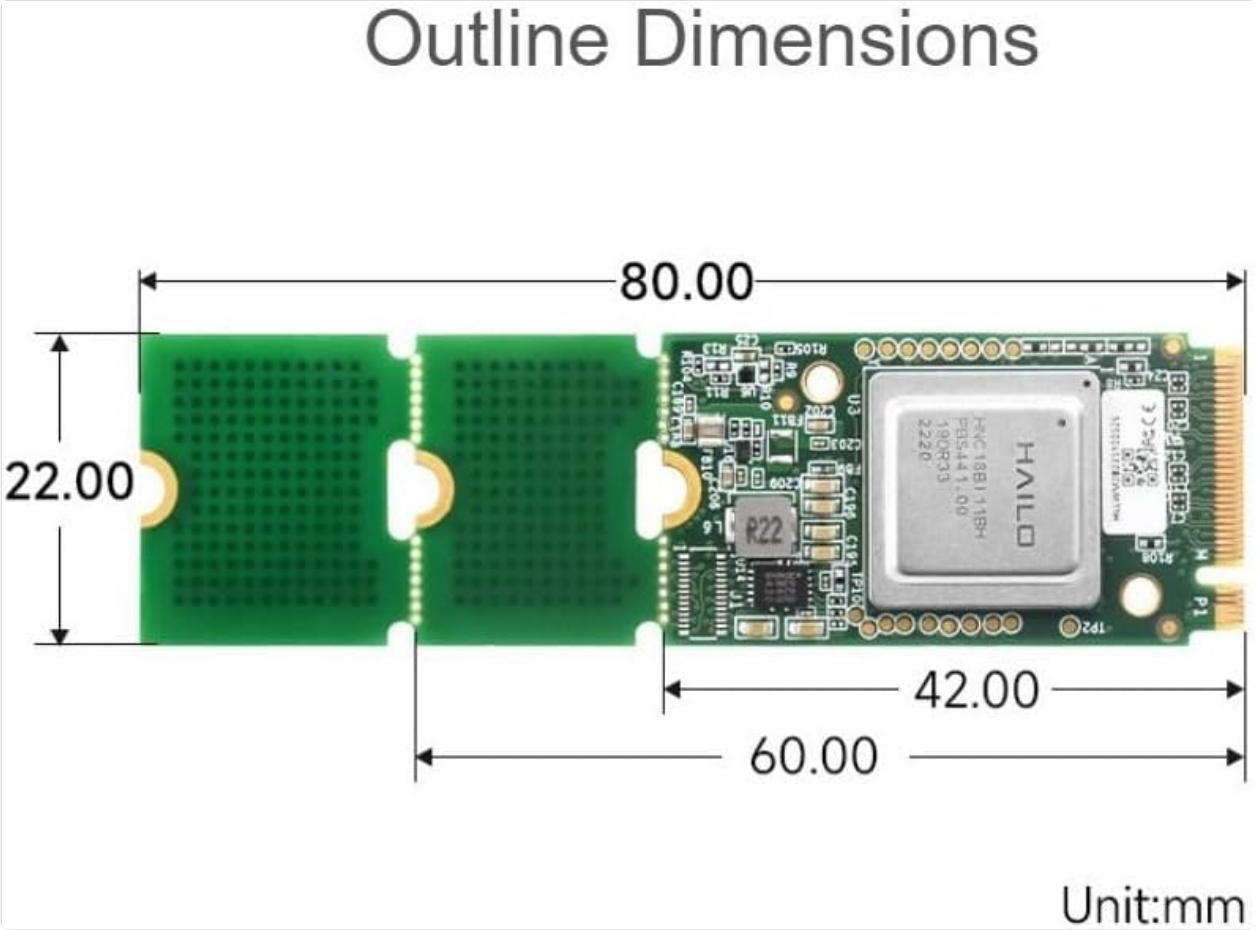

Figure 7: Outline dimensions of the Hailo-8 AI M.2 Module, showing a width of 22mm and a length of 80mm, with breakable sections for 42mm and 60mm lengths. All units are in millimeters.

9. Warranty and Support

For product support, technical assistance, or warranty inquiries, please contact TUOPUONE directly.
Information regarding protection plans may also be available at the point of purchase.
Always refer to the official TUOPUONE website or product page for the most up-to-date support information and resources.