

# Hailo-8

## mPCIe AI Acceleration Module

(PCI Express Mini Card Full-Mini F1)



Data Sheet  
HMP1RB1C2GA

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# Documentation Control

## Revision History

Version	Date	Description
0.1	August 2020	First draft
0.2	September 2020	Minor updates and corrections
0.3	December 2020	Minor updates and corrections
0.4	February 2021	Added information on power consumption
0.5	March 2021	Changes to formatting and phrasing

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# 1. Overview

## 1.1. Introduction

The Hailo mPCIe AI Acceleration Module (part number HMP1RB1C2GA), compatible with the PCI Express Mini (mPCIe) form factor, is targeted at artificial intelligence (AI) applications. It is a member of Hailo's comprehensive family of PCI Express (PCIe) based acceleration modules that meet industry standards for a range of form factors and performance objectives.

The module is based on the Hailo-8 processor and features a PCIe Gen 3, 1-lane interface (x1) which enables high throughput of input and output data.

As a PCIe device, the module can be used to perform real-time, low latency neural network inference, using PCIe for streaming input data and for streaming inference results.

## 1.2. System Requirements

### **Hardware:**

- CPU Architecture
  - x86 based ; or
  - ARM aarch-64 based
- At least 1 available mPCIe Full-Mini socket

### • **Software:**

- Linux Ubuntu or other distributions
- Supported kernel versions: multiple, tested on Linux kernel versions 4.15.0-39-generic and 5.0.16-050016-generic.

### 1.3. System Level Block Diagram

The following block diagram illustrates the mPCIe AI Acceleration Module (HMP1RB1C2GA):

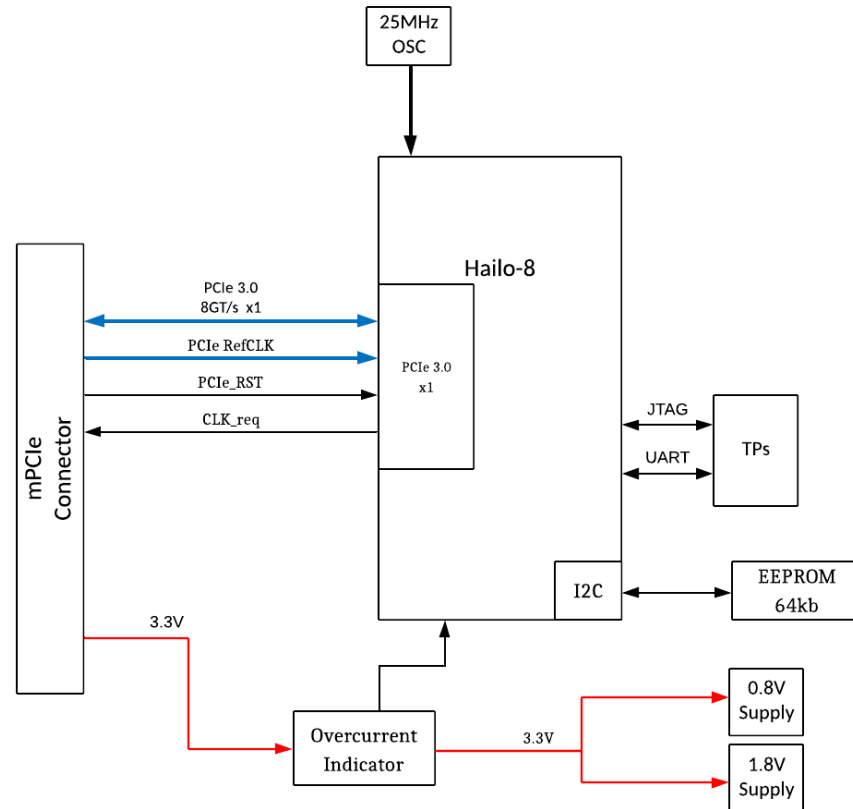


Figure 1: HMP1RB1C2GA Functional Block Diagram

## 2. Specifications

### 2.1. Key Properties

Compliance	
Certification	CE; FCC Class A
Environmental	
Storage Temperature	0°-70° C
Operating Temperature	0°-70° C ( <i>refer to section 3.2 for further details</i> )
Physical	
Form Factor	PCI Express Mini Card Full-Mini F1
Dimensions	30 x 50.95 mm
Electrical	
Power supply	3.14V-3.59V
Thermal design power (TDP)	2.3W <sup>1</sup>
Interface	PCIe Gen 3, 1-lane (x1)

<sup>1</sup> As per PCI Express® Mini Card Electromechanical Specification Revision 2.1.  
For AI acceleration application which are compute intensive, Hailo recommends using a higher TDP of 3.6W.

## 2.2. PCIe Connector Pinout

Pin Number(s)	Signal	Type
4,9,15,18,21,26,27,29,34,35,37,40,43,50	GND	Power
2,24,39,41,52	3.3V	Power
22	PERST#	I
7	CLKREQ#	I/O
1	PEWAKE#	I/O
13	REFCLK+	I
11	REFCLK-	I
31,33	PER[n/p]0	I
23,25	PET[n/p]0	O

Table 1: HMP1RB1C2GA Pin Description

For more information, see the *PCI Express® Mini Card Electromechanical Specification Revision 2.1* on the [PCISIG website](#).

## 2.3. Mechanical Properties

Below is a mechanical outline for the HMP1RB1C2GA module.



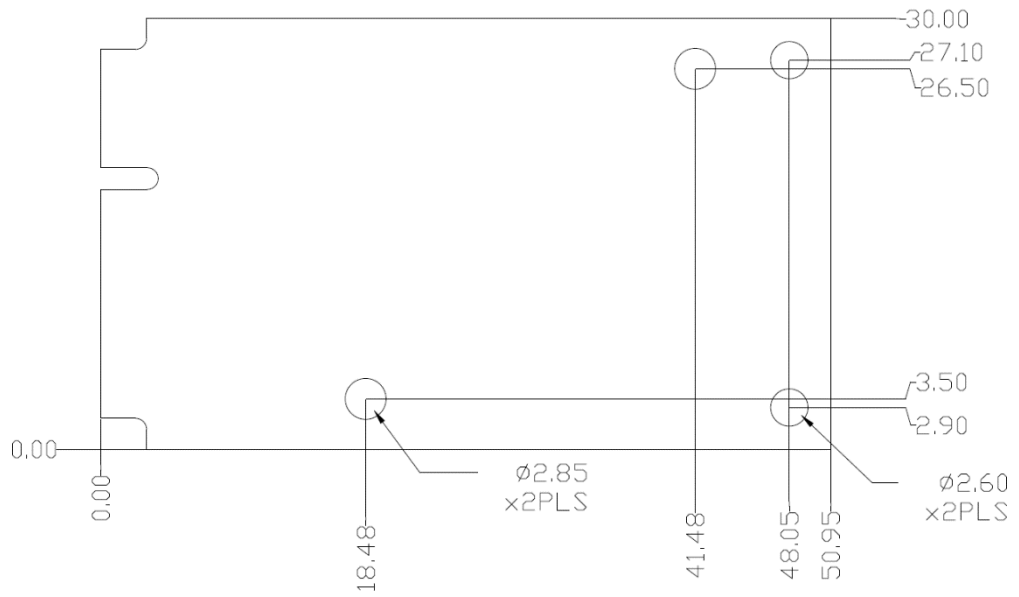


Figure 2: HMP1RB1C2GA Mechanical Outline – Top View (dimensions in millimeters)

For more information, see the *PCI Express® Mini Card Electromechanical Specification Revision 2.1* on the [PCISIG website](https://www.pcisig.com/).

### 3. Power Consumption and Thermal Management

#### 3.1. Module Power Consumption

The module requires a 3.3V supply (power pins are as detailed in Table 1). The module’s power consumption is dependent on the resources utilized for inference. Maximum power consumption is 3.63W (or 1.1A total current draw from 3.3V pins) at full utilization.

The module’s power consumption (typical at 25° C) is listed below for typical configurations:

<b>Configuration</b>	<b>Power [W]</b>
Resnet-50 224x224 @ 915 FPS	3.3
MobileNet-SSD 300x300 @ 996 FPS	2.4

*Table 2 - Power Consumption for Typical Configurations*

For up-to-date benchmark performance please visit the benchmarks page on Hailo’s website.

#### 3.2. Thermal Management Requirements

The HMP1RB1C2GA is tested and validated for commercial temperature grade (0°C – 70°C) when mounted in a test fixture.

Proper heat dissipation must be employed to ensure that the Hailo-8 chip does not overheat. The Hailo-8 is designed to dissipate most of the heat to

the top surface of the package.

For more information on typical use configurations and design guidelines, see Hailo's *Hailo-8 AI Acceleration Module Thermal Design Considerations Application Note*.

### 3.3. Overheat and Overcurrent Protection

The module features monitoring and protection from overheat conditions and excessive power consumption. The following features are supported:

TBD

For additional information on thermal design, see sec. 3.2.

For more information on power consumption limits, see the *PCI Express® Mini Card Electromechanical Specification Revision 2.1* on the [PCISIG website](#).

## 4. Installation and Troubleshooting

### 4.1. Hardware Installation

1. Make sure that the host computer is turned off.
2. Firmly attach the mPCIe module into a proper mPCIe socket (make sure it is a socket suitable for Full-Mini cards).
3. Power up the computer and log on to Linux.
4. Verify that the Hailo-8 is detected on the PCIe bus. From a Linux terminal, type:

```

>> lspci | grep "Co-processor: Hailo Technologies Ltd. Hailo-8 AI
Processor (rev 01)"
    
```

### 4.2. Software Installation<sup>2</sup>

1. Power up the computer and log on to Linux.
2. Locate the device driver installation package and extract the folder *Hailo-8 PCIe driver* from the .tar file.
3. Install driver. From a Linux terminal, type:

```

>> chmod u+x install.sh
>> ./install.sh
    
```

4. Verify the device is identified properly using the Hailo-RT API.
  - a. Start the Hailo-RT virtual environment. From a Linux terminal type, at the location where the Hailo-RT package was installed:

<sup>2</sup> All software related guidelines are based on pre-released software and may change upon product release. Any such changes will be included in future versions of this document.

```
>> source hailo_virtualenv/bin/activate
>> hailo fw-control scan
```

- b. Run python<sup>3</sup> and type the following in the python interpreter to identify the device:

```
>> from hailo_platform.drivers.hw_object import HailoPcieObject
>> p = HailoPcieObject()
>> p.control.identify()
```

For further information and instructions, see *Running HailoRT installation* in the HailoRT User Guide.

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<sup>3</sup> The method proposed is based on the Python API. Usage of python is optional and provided here as an example.

### 4.3. Troubleshooting

<b>A. Improper PCIe device enumeration</b>	
How to verify:	<p>From a Linux terminal type:</p> <pre>&gt;&gt; lspci   grep "Co-processor: Hailo Technologies Ltd. Hailo-8 AI Processor (rev 01)"</pre> <p>The device should be listed in the terminal output</p>
Possible root cause:	Improper mechanical installation
Solution:	Verify that the module is properly attached and secured into the mPCIe slot.
Possible root cause:	Slot is not functional
Solution:	<p>Verify the slot in use is a valid mPCIe socket suitable for Full-Mini cards.</p> <p>Check to see if the slot is disabled in platform BIOS.</p>

<b>B. Device driver not properly installed</b>	
How to verify:	<p>From a Linux terminal type:</p> <pre>&gt;&gt; lsmod   grep &lt;TBD&gt;</pre>

	The device should be listed in the terminal output
Possible root cause:	Driver not installed
Solution:	Obtain the driver installation package provided by Hailo and follows SW installation instructions (section 4.2)

<b>C. Module not identified by Hailo-RT</b>	
How to verify:	<p>From a python shell type:</p> <pre>&gt;&gt; from hailo_platform.drivers.hw_object import HailoPcieObject  &gt;&gt; p = HailoPcieObject()  &gt;&gt; p.control.identify()</pre> <p>The device should be listed in the interpreter output</p>
Possible root cause:	Improper installation of the Hailo-RT package
Solution:	Re-install the Hailo-RT package by following the installation instructions