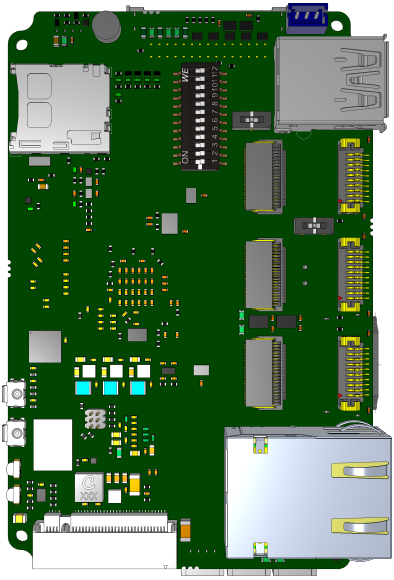

Technical Description

xEC-NX-3P-X2G3

September 6, 2023

Version 0.2 (draft)

Introduction

Dear Customer,

thank you for choosing XIMEA and the XEC-NX-3P-X2G3, our embedded carrier board designed to connect your xiX or xiX-Xtreme cameras to the NVIDIA® Jetson Xavier NX™ module. Equipped with three Firefly PCIe connectors, a high-speed 10 Gbit/s Ethernet port, and an M.2 slot for NVMe SSDs, this device is tailored to the special requirements of an embedded imaging system.

We've designed this guide to be your comprehensive resource, covering everything from setup to in-depth descriptions of complex features.

Thank you for entrusting us with your sophisticated needs. Together, we will unlock unparalleled performance embodying our commitment to imaging beyond the standard.

Your XIMEA Team

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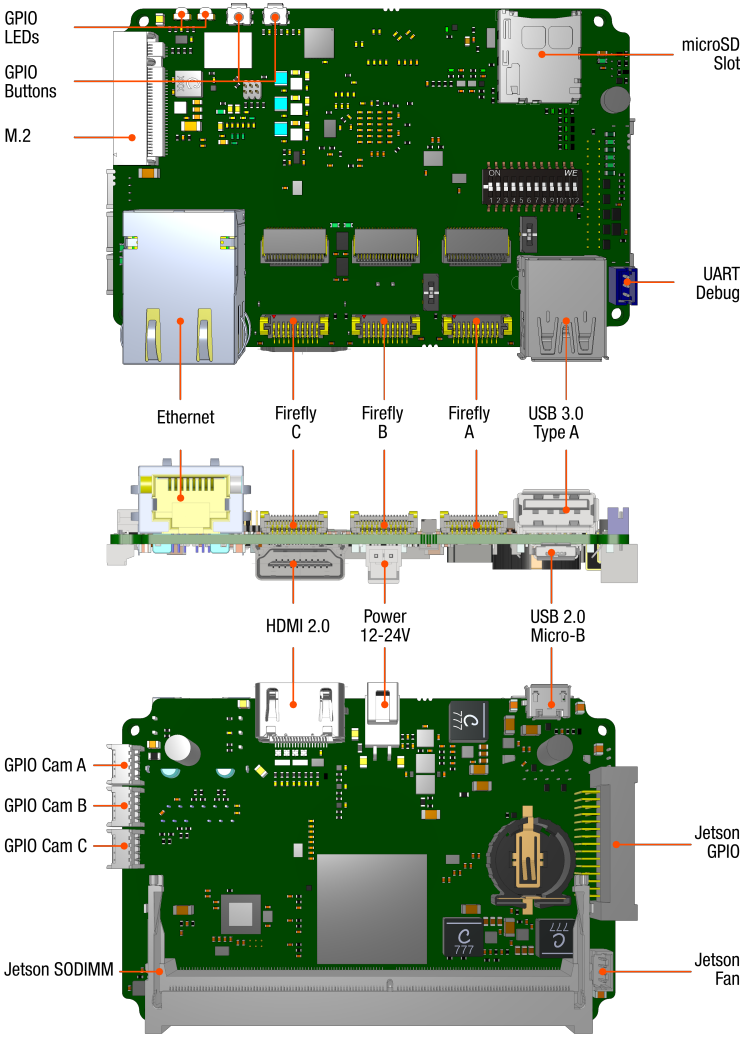
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2 Getting Started

2.1 Requirements

To begin the setup of your XEC-NX-3P-X2G3, ensure you have the following essentials:

You'll need an **NVIDIA Jetson module** with an appropriate cooler as the central component of your system. A **24V power supply unit** that can supply at least 2.5A is also required, though actual power consumption may vary with use. If expanded storage is needed, an **NVMe SSD** tailored to your use case will be suitable.

For flashing the operating system onto the Jetson module, a separately procured **USB micro-B cable** will be necessary. Your host system should be running **Ubuntu 18.04 or 20.04**, with internet access to download required software packages.

With these prerequisites in place, you're ready to explore the unique capabilities of your XEC-NX-3P-X2G3, taking your imaging beyond the standard.

2.2 Connecting the Hardware

As you embark on setting up your XEC-NX-3P-X2G3, begin by installing the NVIDIA Jetson Xavier NX module into the SO-DIMM slot on the carrier board. Slide the module in and push down until it clicks into place, securing it with the provided screw. Connect the fan of the Jetson Xavier NX module to the fan connector on the carrier board.

Next, if using an NVMe SSD, place it in the M.2 slot and secure it with the supplied screw.

To connect a camera, slide the Firefly connector into one of the ports on the board. If you want to use a camera that utilizes four PCIe lanes, please use port A. Please refer to section 3.1 for more information on these ports.

With these connections in place, you can connect the included power cable to the board as shown in Figure 2, but refrain from connecting the power supply to the power cable through the barrel connector just yet. Proceed through the following sections of this guide for continued setup and configuration.

2.3 Flashing the System

To flash the Jetson Xavier NX Module, please download and install the NVIDIA SDK Manager on your host system.

Figure 1: XEC-NX-3P-X2G3 with Jetson module

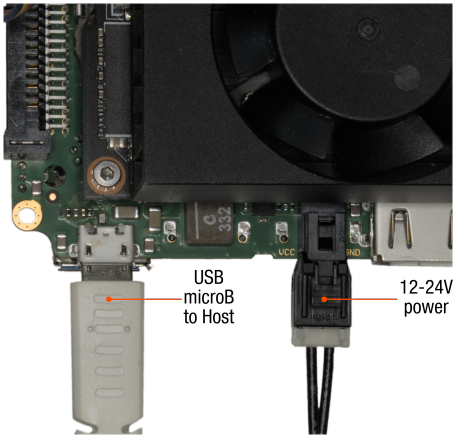

Figure 2: System with power and USB for flashing connected

Enable the force recovery mode on your Jetson Module by setting switch 11 on SW-DIP-12POS to ON as shown in Figure 3. Then connect the module to your host system using a micro USB cable. Afterwards you can connect power to the system which will cause it to boot into force recovery mode.

You may now launch the NVIDIA SDK manager. It will detect your module and you will be able to choose a Jetpack version to install. Please note that Jetpack version 5.0 or later will be required to be able to boot from the NVMe drive.

If you plan to flash the system image to an NVMe drive, it is recommended to also set the DIP switch for "dual x4" mode to get the best performance during installation. You may later switch to "quad x2" mode if required. Please refer to section 3.1 for more information on those configuration options.

In case you want to use the Jetson Orin NX module, please follow the instructions in section 2.3.1 now. For the Jetson Xavier NX you can proceed with the unmodified default image for the development kit provided by NVIDIA. Please follow the instructions in the installer to complete the installation.[1]

2.3.1 Modifications for Jetson Orin NX

To prepare the image for flashing the Jetson Orin NX on the XEC-NX-3P-X2G3, the device tree must be slightly modified.

Follow the instructions in the SDK manager to download and prepare the image on your host system, but skip the flashing step for now. The image can be found in the **Target HW image folder** after it has been prepared.

Go to the following folder in your Target HW image folder:

```
<version>/Linux\_for\_Tegra/bootloader/t186ref/BCT/
```

Now open the following file in your preferred text editor with root privileges:

```
tegra234-mb2-bct-misc-p3767-0000.dts
```

Search for `cvb_eeprom_read_size` and change that line to:

```
cvb_eeprm_read_size = <0x0>;
```

Afterwards you can continue with the regular flashing procedure using SDK Manager or the `flash.sh` script.

[1] For additional guidance see: https://docs.nvidia.com/sdk-manager/install-with-sdkm-jetson/index.html

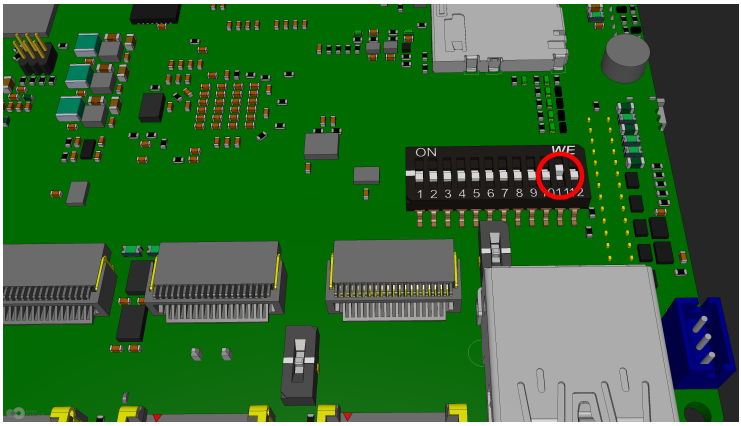

Figure 3: Configuration of SW-DIP-12POS for force recovery mode

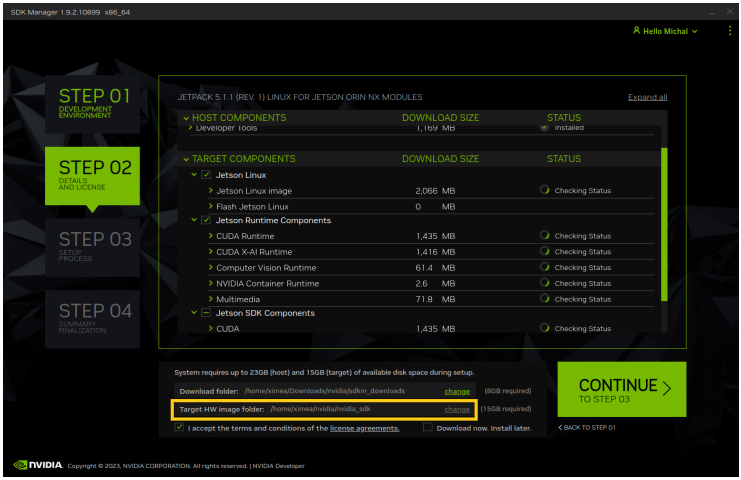

Figure 4: SDK manager: Step 02, Target HW image folder

2.4 Installing the XIMEA Software Package

Once the installation is finished, you will be able to login to the Jetson system. You can do so either with a directly attached keyboard and monitor or via ssh.

To install the XIMEA Software package on the Jetson, follow the installation instructions provided on the XIMEA website.

3 Reference

3.1 PCIe System Overview

The XEC-NX-3P-X2G3's PCIe ports offer two configurations: "Dual x4" mode activates the m.2 and Firefly port A with PCIe x4 bandwidth, disabling Firefly ports B and C. In "Quad x2" mode, all ports are enabled with PCIe x2 bandwidth.

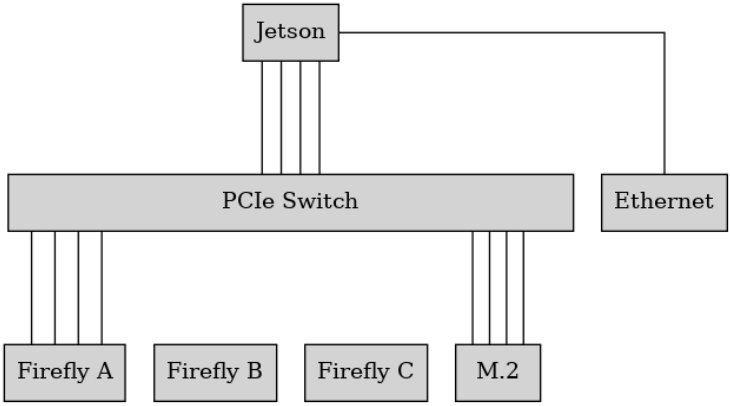

Figure 5: Configuration of the PCIe system in **Dual x4** mode

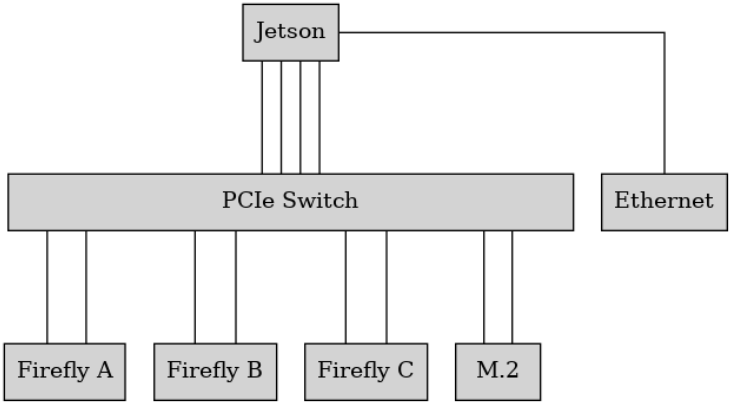

Figure 6: Configuration of the PCIe system in **Quad x2** mode

3.2 PCIe / FireFly connectors

The XEC-NX-3P-X2G3 provides three FireFly connectors to connect cameras. They are used for data transmission, camera control, power and IO.

These connectors can be used with Samtec ECUE copper cables or PCUO optical transceivers.

When the configuration is switched to **Dual x4** mode, only FireFly connector A is active with four lanes of PCIe Gen3.

When the configuration is switched to **Quad x2** mode, all three connectors are active with two lanes of PCIe Gen3.

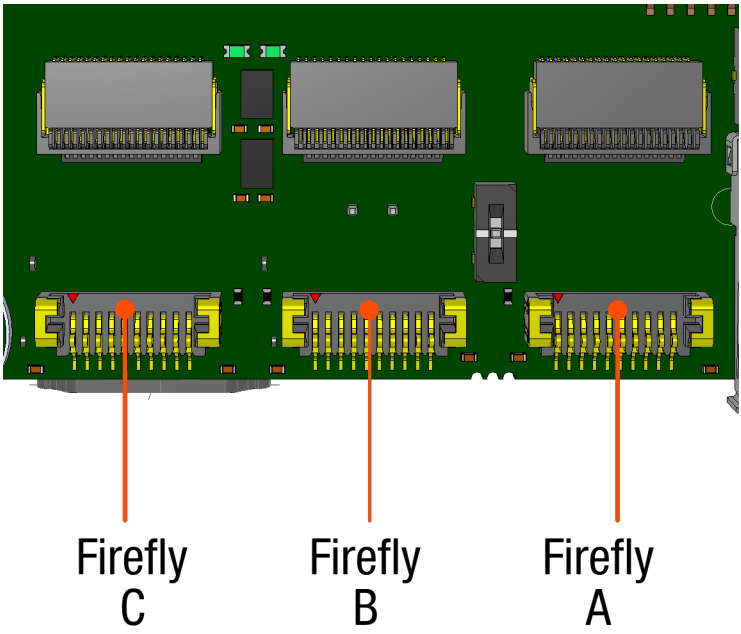

Figure 7: FireFly Connectors

3.3 DIP Switches

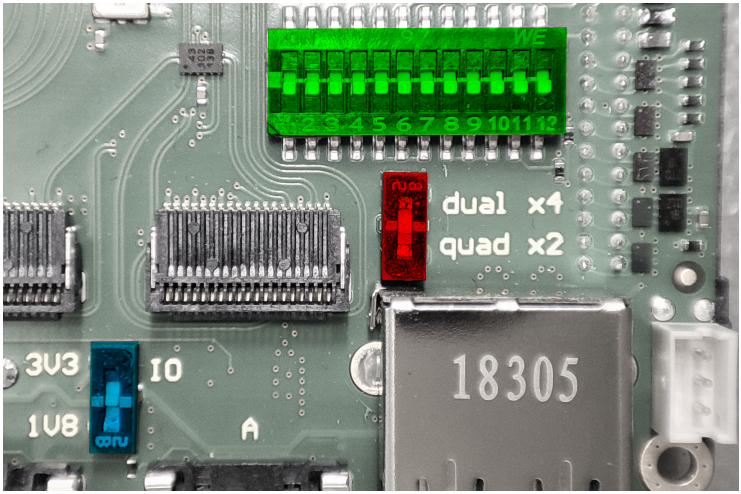

Figure 8: Location of SW-DIP-12POS (green), the PCIe Port Configuration Switch (red) and the SPI Voltage Switch (blue)

3.3.1 Port Configuration

The Port Configuration Switch can be used to configure the PCIe ports. There are two possible settings:

- Dual x4 – only Firefly port A and M.2 are enabled with four lanes each
- Quad x2 – all ports enabled with two lanes each

3.3.2 SPI Voltage

The SPI voltage switch determines the voltage for the SPI interface of the Jetson module. There are two possible settings:

- 1V8 – 1.8V
- 3V3 – 3.3V

3.3.3 SW-DIP-12POS

SW-DIP-12POS consists of 12 individual switches:

Function		Position
Connect camera IO ground to system ground [2]		1
Enable GPO 5V for	Camera A	2
	Camera B	3
	Camera C	4
Connect the 5V output of Camera A to the input of	Camera A	5
	Camera B	6
	Camera C	7
Connect GPIO07 of the Jetson module to the input of	Camera A	8
	Camera B	9
	Camera C	10
Enable the Force Recovery mode on the Jetson module		11
Connect GPIO13 to ground [3]		12

3.4 Buttons and LEDs

The two buttons and LEDs on the edge of the PCB near the M.2 connector are connected to GPIO pins on the Jetson module as shown in Figure 9

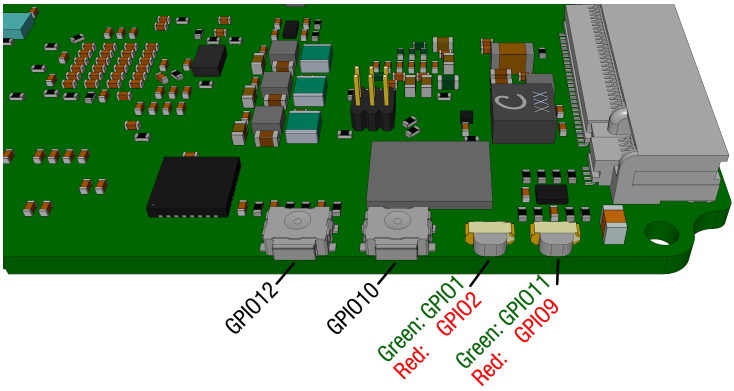

Figure 9: Buttons and LEDs

[2] Required for 5V IOs
[3] GPIO13 is high (1.8V) in OFF position

3.5 GPIOs

3.5.1 Jetson GPIOs

The GPIO connector is a Samtec TigerEye TFM Header (TFM-115-01-S-D-RE1-W) with 30 positions. It gives users access to the GPIOs of the Jetson module and the supply voltages on the board. Figure 10 shows the orientation of the connector.

Pin	Name	Description
1	VCC_CONN	Voltage from the input power connector (12-24V)
2	VCC_CONN	Voltage from the input power connector (12-24V)
3	VCC5V0	5V
4	GND	Ground
5	VCC3V3	3.3V
6	GND	Ground
7	VCC1V8	1.8V
8	TX_RTC_BAT	Positive voltage from coin battery
9	NC	Reserved for future use
10	GPIO7_5V0	Jetson GPIO07 driven to 5V
11	GPIO3	Jetson GPIO03
12	GPIO4	Jetson GPIO04
13	GPIO5	Jetson GPIO05
14	GPIO6	Jetson GPIO06
15	GPIO7	Jetson GPIO07
16	UART0_1V8_RTS	Jetson UART0 RTS
17	UART0_1V8_CTS	Jetson UART0 CTS
18	UART0_1V8_RX	Jetson UART0 RX
19	UART0_1V8_TX	Jeston UART0 TX
20	UART1_1V8_RX	Jetson UART1 TX
21	UART1_1V8_TX	Jeston UART1 RX
22	SPI_MISO	Jetson SPI0 MISO
23	SPI_CLK	Jetson SPI0 CLK
24	SPI_MOSI	Jetson SPI0 MOSI
25	SPI_CS0#	Jetson SPI0 CS0
26	SPI_CS1#	Jetson SPI0 CS1
27	I2C1_3V3_SCL	Jetson I^2C1 SCL
28	I2C1_3V3_SDA	Jetson I^2C1 SDA
29	I2C2_1V8_SCL	Jetson I^2C2 SCL
30	I2C2_1V8_SDA	Jetson I^2C2 SDA

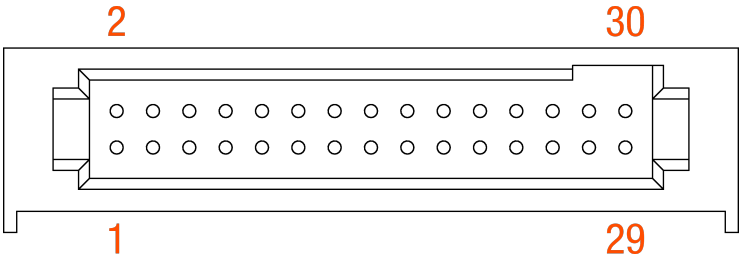

Figure 10: Jetson GPIO Connector

3.5.2 Camera GPIO

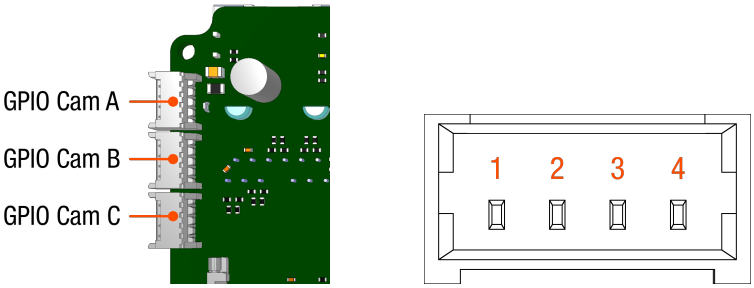

Figure 11: Camera GPIO Connector

Pin	Name	Description
1	CAM_GPO_ISO	Opto-isolated output
2	ISO_GND	Ground for Opto-isolated signals
3	CAM_GPI_ISO	Opto-isolated input
4	CAM_GPO_5V0	Output driven to 5V

4 Accessories

TBD

5 Example: Hardware Trigger

6 Known Issues

6.1 Related to 10GigE

- The ACQ113 Ethernet controller is not reliably detected when the Jetson boots.
- In hardware rev. 1, the ACQ113 is never detected on the Jetson Orin NX without modifications to the board.
- When connected to the Jetson Xavier NX, it is not possible to achieve full 10Gbit/s ethernet bandwidth.

6.2 Related to NVMe SSDs

- Most NVMe SSDs will heat up quickly and throttle down when used without additional cooling.
- Some SSDs are not properly detected when the board is configured to Quad x2 mode.
- In Jetpack 5.x there is a known issue which causes PCIe devices behind PCIe switches to have lower than expected bandwidth. This affects the write speed on SSDs.

6.3 Other

- The xEC-NX-3P-X2G3 has a socket for a non-rechargeable coin battery to keep its real time clock running when powered down. Unfortunately, the battery charging logic on the Jetson Xavier NX is enabled by default and may try to charge this non-rechargeable battery.