



Technical Details

**Documentation:
Edge Camera with
NVIDIA® Jetson™ SoMs**



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Documentation: Edge Camera with NVIDIA® Jetson™ SoM

1 Introduction

The edge camera features an integrated imaging system, which combines an image sensor with the computing power of NVIDIA® Jetson Nano™ or NVIDIA® Jetson Xavier™ NX in a compact package.

2 Camera Specifications

Physical dimensions: 115mm x 59mm x 63mm (LxWxH)

Temperature range: 0 – 70 °C (housing temperature)

Power Supply: PoE+ (25 watts, PoE class 4) or via

Hirose connector (12V - 24V ± 5%, max. 30 watts)

2.1 Supported NVIDIA SoMs

NVIDIA Jetson Nano (further referenced as "Nano SoM" in this document)

NVIDIA Jetson Xavier NX (further referenced as "NX SoM" in this document)

2.2 Interfaces

2.2.1 Standard Interfaces

- 1x Gigabit Ethernet (RJ45) with PoE+
- 1x USB 3.0 (Nano SOM) / USB 3.2 Gen 2 (NX SOM)
- 1x Micro HDMI 2.0a/b
- 1x SD card (microSD receptacle)

2.2.2 12-Pin Hirose Connector

Additional I/O signals are available on a 12-pin round Hirose connector:

- 1x CAN bus
- 1x I²C or UART (configurable)
- 1x Opto-isolated general-purpose input (camera trigger signal)
- 1x General-purpose output signal, can also be configured as 5V / 500mA power output

2.2.3 Internal Interfaces

The camera has an internal M.2 slot that can be equipped with an M.2 Wi-Fi card.

2.2.4 Visual Interfaces

The camera has an RGB LED that indicates various operating states. The meaning of the LED color is not part of this documentation, as it is dependant on the installed software.



3 Hirose Connector Pinout

The Hirose connector has the part number HR10A-10R-12PB. It has several I/O signals:

Pin	Signal Name	Function
1	CAN_L	CAN bus, negative wire
2	SIGNAL_GND	reference ground / shield for CAN bus, UART, I ² C and GP_OUT
3	POWER_IN	Power supply positive input. Connect a voltage source (12V to 24V) if no PoE+ Ethernet connection is used.
4		
5	TXD_SCL	UART or I ² C (3.3V level). The function of these pins is configurable via software.
6	RXD_SDA	
7	POWER_GND	Power supply negative input. WARNING! If power is supplied to the camera via pins 3 and 4, DO NOT USE these two pins as reference for UART/I ² C/CAN.
8		
9	CAN_H	CAN bus, positive wire
10	GP_OUT	General-purpose output, referenced to SIGNAL_GND. This pin can be configured as open-drain output (max. high-level voltage is 24V), digital output (0V/5V), or as power output (5V at max. 500mA).
11	GP_IN_P	General-purpose digital input, Vin 3.3V - 24V (max. 9 mA). These two pins are connected to the LED inside an opto-coupler. The current flowing through the LED is internally limited, thus no additional series resistor is required.
12	GP_IN_N	



Appendix

4 Sensor Interface

The sensor is connected with four MIPI lanes to the SoM input channels CSI0 and CSI1. Whether all four MIPI lanes can be used depends on the sensor and its configuration. The sensor has several control signals that are connected to a FPGA (field-programmable gate array) inside the camera.

Internally, the image sensor board is connected with a flexible flat cable to the camera main board. The table below lists the signals on the cable:

Pin	Name	Type	Description
1, 4, 7, 10, 13, 16	GND		Ground
2,3	MIPI CH3	Output	MIPI channel 3 (2=negative, 3=positive signal)
5,6	MIPI CH1	Output	MIPI channel 1 (5=negative, 6=positive signal)
8,9	MIPI DCK	Output	MIPI clock (8=negative, 9=positive signal)
11,12	MIPI CH2	Output	MIPI channel 2 (11=negative, 12=positive signal))
14,15	MIPI CH4	Output	MIPI channel 4 (14=negative, 15=positive signal))
17	CLK	Input	Sensor input clock (from Si5356A PLL chip)
18	CAM PWR	Input	Camera power enable. Must be high to power up the sensor.
19	I ² C_SCL	I/O	I ² C bus to the sensor, clock signal
20	I ² C_SDA	I/O	I ² C bus to the sensor, data signal
21	reserved1	I/O	Function depends on installed sensor
22	RESET	Input	Sensor hardware reset signal (low active)
23	reserved2	I/O	Function depends on installed sensor
24	STROBE	Output	Strobe output signal (not available on every sensor)
25	TRIGGER	Input	Trigger input signal (not available on every sensor)
26	+5V_VDD	Input	5V power supply



Appendix *continued*

5 I²C Buses and Devices

The Jetson SoM modules provide a couple of I²C buses. The table below lists the additional I²C devices on the Edge Camera with the hardware I²C bus and the logical software device name:

I ² C Bus	Device Name on Nano SoM	Device Name on NX SoM	I ² C Device Address	Description
CAM_I2C	i2c-6	i2c-2	TBD	Image sensor (address depends on installed sensor)
CAM_I2C	i2c-6	i2c-2	0x44	FPGA (register control interface)
I2C0	i2c-0	i2c-1	0x20	TCA6408A I/O-port expander
I2C0	i2c-0	i2c-1	0x40, 0x43	FPGA (configuration interface)
I2C0	i2c-0	i2c-1	0x48	Temperature sensor TMP100
I2C0	i2c-0	i2c-1	0x68	BMI160 IMU. This part may not be available in all edge cameras.
I2C1	i2c-1	i2c-8	user defined	External I ² C bus (via Hirose connector)
I2C2	i2c-2	i2c-0	0x57	EEPROM AT24C07



Appendix *continued*

6 FPGA

A small FPGA in the camera implements a control interface for the several image sensor control signals, for camera I/O signals and for the RGB LED. The FPGA is controlled via an I²C interface.

The FPGA has the 7-bit I²C-address 0x44 and is connected to the camera I²C bus on the SOM (CAM_I2C). The register interface is very simple: To write to a register in the FPGA, send the 8-bit register address followed by the 8-bit data to be written to the register. To read a register, first send the 8-bit register address and then initiate a new I²C read transfer to read the 8-bit data from the register.

List of implemented registers:

Register	Read / Write	Description
0x00	R/W	Sensor Power Control Register (reset value: 0x04) Bit 0-1 : 0 = power off, 1 = power on, 2 = power controlled by SOM CAM0_PWDN pin, 3 = power off Bit 2 : sensor reset (1 = reset, 0 = operational state)
0x01	R/W	RGB LED Control Register (reset value: 0x04) Bit 0 : red LED Bit 1 : green LED Bit 2 : blue LED
0x02	R/W	GPOUT function on external Hirose connector (reset value: 0x00) Bit 0 : 0 = strobe output from sensor, 1 = GPOUT (value of bit1 in this register) Bit 1 : GPOUT value (only applicable when Bit 0 = 1) Bit 2 : 1 = invert strobe input from sensor, 0 = do not invert strobe input
0x03	R/W	Trigger Configuration Register (reset value: 0x00) Bit 0 : 0 = use GPIO07 from SoM as trigger source for sensor, 1 = use FPGA internal trigger generator as source Bit 1 : 0 = the trigger pulse is output to the sensor trigger pin, 1 = the trigger pulse is output to sensor reserved2 pin Bit 2 : (only applies when Bit 0 = 1): 1 = invert trigger input signal from external Hirose connector Bit 3 : (only applies when Bit 0 = 1): 0 = pass through the external trigger signal, 1 = start internal counter with the ext.trigger-signal (edge), and use the counter to trigger the sensor Bit 4 : level of the sensors reserved1 input pin
0x04	R/W	Trigger counter value, bits 0 - 7 Notes: - the counter is clocked with 1 MHz - the sensor trigger signal is high while the counter is running - for a trigger pulse width of 10ms load this counter with the value 9999



Appendix *continued*

Register	Read / Write	Description
0x05	R/W	Trigger counter value, bits 8 - 15
0x06	R/W	Trigger counter value, bits 16 - 23
0x0F	R	FPGA version number

Note: The FPGA is subject to change, it can be extended in the future without notice in order to support new sensors.

7 I/O Port Expander TCA6408A

There is a I²C bus I/O port expander in the camera that controls the behavior of the I/O signals on the external Hirose connector. The function of the eight I/O pins of the port expander are described in the table below:

I/O Pin	Direction	Function
P0	output	When the Hirose GPOUT pin is configured as digital output, this bit controls if the digital output is open-drain or push-pull. 0 : push-pull TTL output. The voltage on GPOUT can be 0V or 5V. 1 : open drain (also known as “open collector”)
P1	output	CAN bus driver enable 0 : CAN bus active 1 : CAN bus in standby mode
P2		(not connected)
P3	input	Status of the external power connection. 0 : The camera is powered over the Hirose connector 1 : The camera is powered over POE
P4		(not connected)
P5		(not connected)
P6	output	Choose between UART and I ² C on Hirose connector 0 : UART 1 : I ² C
P7	output	Enable power output on the universal GPOUT pin 0 : disable power output, GPOUT behaves like a data output pin 1 : enable power output. GPOUT sources 5V at 500mA max.



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Appendix *continued*

8 Recovery Mode Over USB3 Socket

The “Recovery Mode” of the NVIDIA Jetson SoM is accessible via the USB3 connector on the back of the camera. To access it, you will need a USB2.0 cable with Type-A plugs on both ends of the cable.

WARNING! Please be careful when handling the cable. Improper use may lead to equipment damage. The camera is protected against faulty power flows, but other components may not be.

Follow these steps to put the camera into recovery mode:

1. Make sure computer is turned on (this is important to avoid computer damage).
2. Turn off the camera.
3. Connect the camera to the computer (which has already been turned on) with this cable.
4. Turn on the camera; the camera will enter recovery mode.

Now the recovery mode can be used to load new firmware on the camera. To exit the recovery mode, proceed as follows:

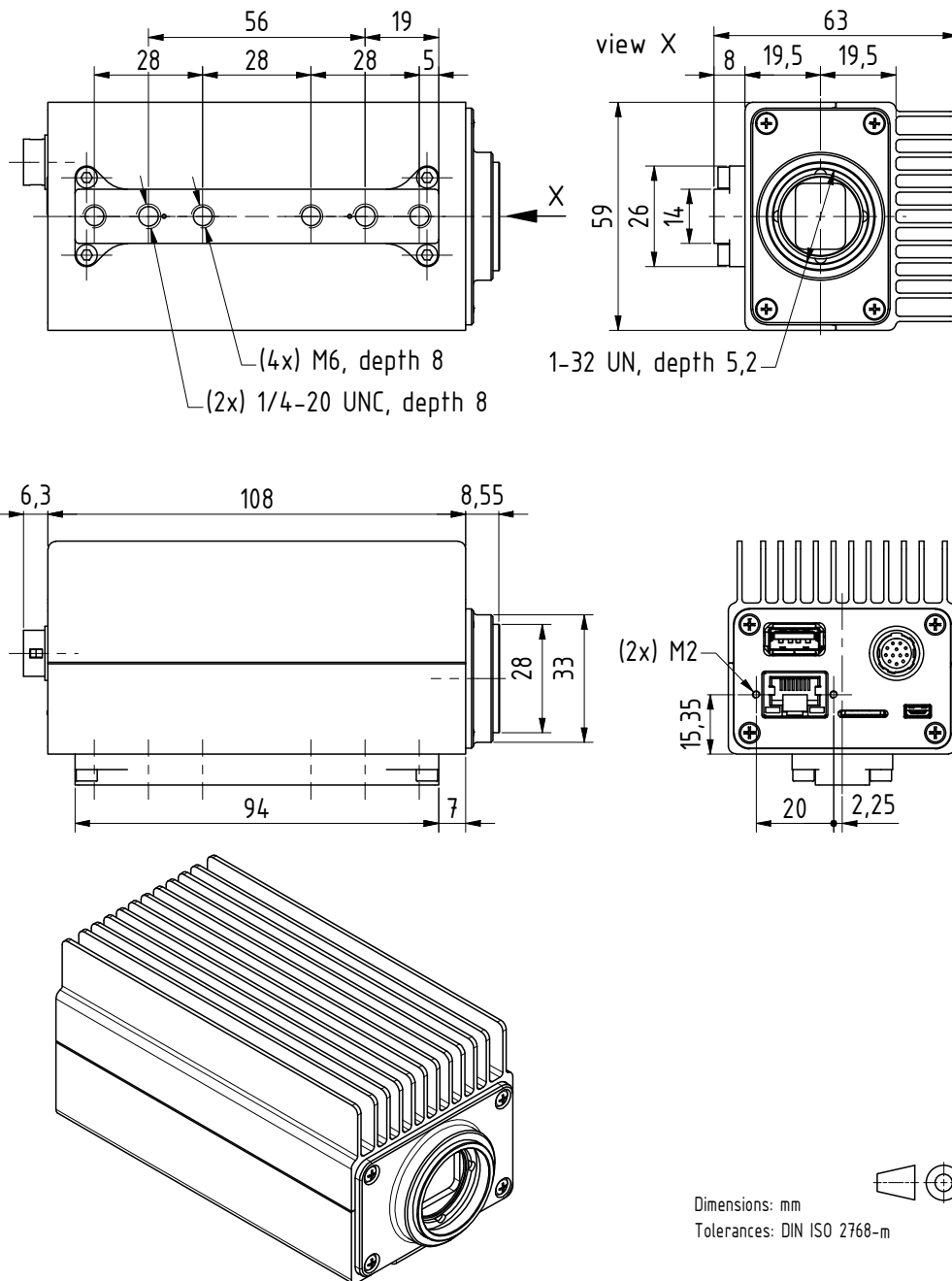
1. Unplug the USB cable.
2. Turn off the camera.
3. Turn on the camera. The camera should now work normally.



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Appendix *continued*

9 Technical Drawings





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