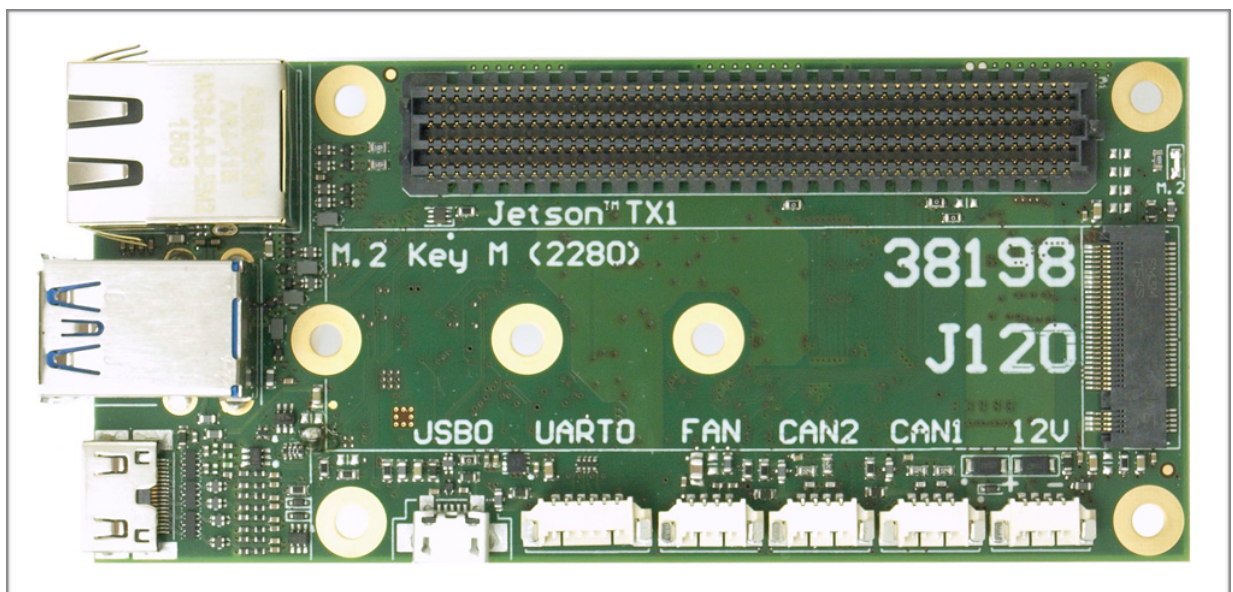


# J120

## technical reference manual

38198-X  
Version 1.3



# Preliminary

April 2016

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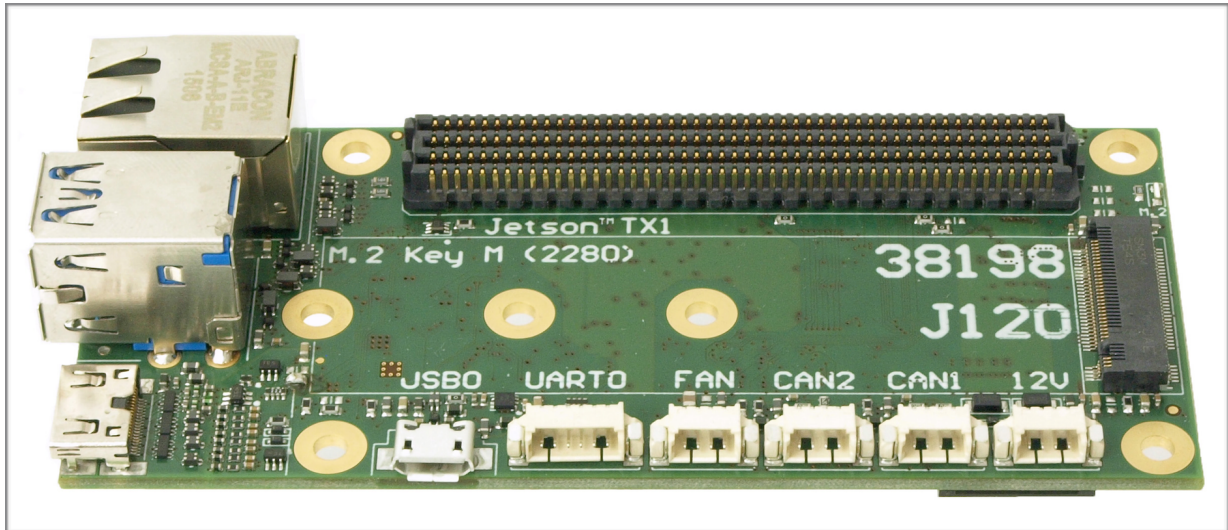
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# Features

## J120 carrier board for the NVIDIA® Jetson™ TX1

The J120 carrier board is slightly larger than the TX1 compute module. It has the same height but it extends out to the left side, to make room for the USB3 and RJ45 connectors. It is plugged in below the TX1 and brings out many interfaces on connectors.



## Technical details

- carrier board for one NVIDIA® Jetson™ TX1 compute module
- standalone operation
- one 4 lane CSI-2 (22 pin FPC 0.5mm pitch) - B102
- micro SD card
- two USB3 type A
- RJ45 connector for 10/100/1000BT Ethernet
- UART 0 (3.3V TTL) (6 pin) - console access
- one I2S digital audio (6 pins each)
- fan connector (4 pin)
- mini HDMI out
- M.2 type M 2280 (not operational on J120 rev 1)
- size: 50 x 119 mm (size of the PCB)
- height: 16 mm (incl. TX1 without heatsink without height of bottom side components of J100)
- height: 21 mm (incl. TX1 without heatsink including height of bottom side components of J100)
- weight: 42 grams (just the J120)
- TX1 weight: 144 grams (TX1 with heatsink), 75 grams (TX1 w/o heatsink)
- mounting: 4 M3 holes with 3.2mm each (42 x 79 mm spacing - 4 mm from each edge)
- model: 38198 (J120 rev 1)

## Power

- power: 12V typical (4 pin) - 2 power pins for redundant powering
- range: 7V to 17V
- do not use the 19V power supply of the Jetson TX1 dev kit - it will damage the J120 carrier board

## How do the various models differ?

Feature	J100	J100 + 38194	J120
Jetson TX1 compatible	✓	✓	✓
mini HDMI out	✓	✓	✓
USB 3.0 type A	-	-	2
micro USB 3.0	2	2	-
micro USB 2.0 OTG	-	✓	✓
Wifi (2 antennas) on TX1 module	✓	✓	✓
10/100/1000 Ethernet (RJ45)	-	✓	✓
IMU MPU-9250 (optional 9 axis sensor)	✓	✓	✓
CAN controllers	-	2 + (2)	2
M.2 type B (SATA - 2242)	-	✓	-
M.2 type M (4x PCIe - 2280)	-	-	✓
micro SD card	✓	✓	✓
SPI/I2C	-	-	1/1
UART	1	2	1
CSI-2 (4 lanes)	2	2	1
CSI-2 (2 lanes)	2	2	-
I2S (digital audio)	2	2	1
fan connector	✓	✓	✓
switches: power, reset, force recovery	-	✓	✓
size	50x87mm	98x87mm	50x11mm
power in	dual 7 .. 17V	dual 7..42V	dual 7 .. 17V

**J100 + 38194**

The J100 is plugged into the 38194 modular motherboard. Three motherboard connectors carry signals for CAN, Ethernet, UART, power, PCIe, SATA, SPI, I2C and more.

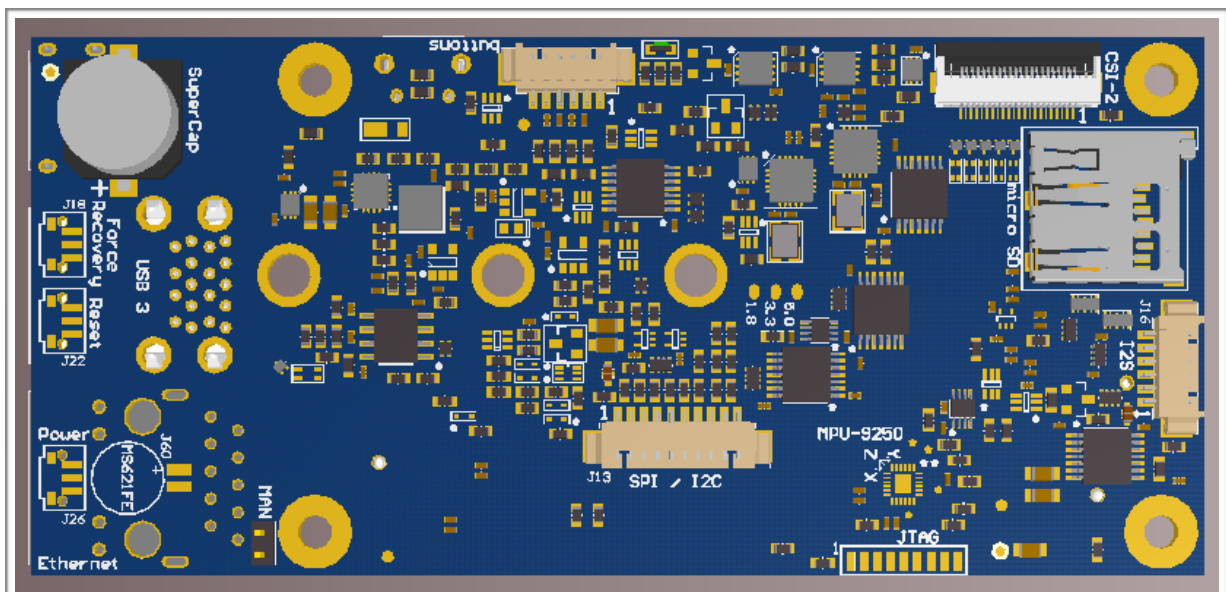
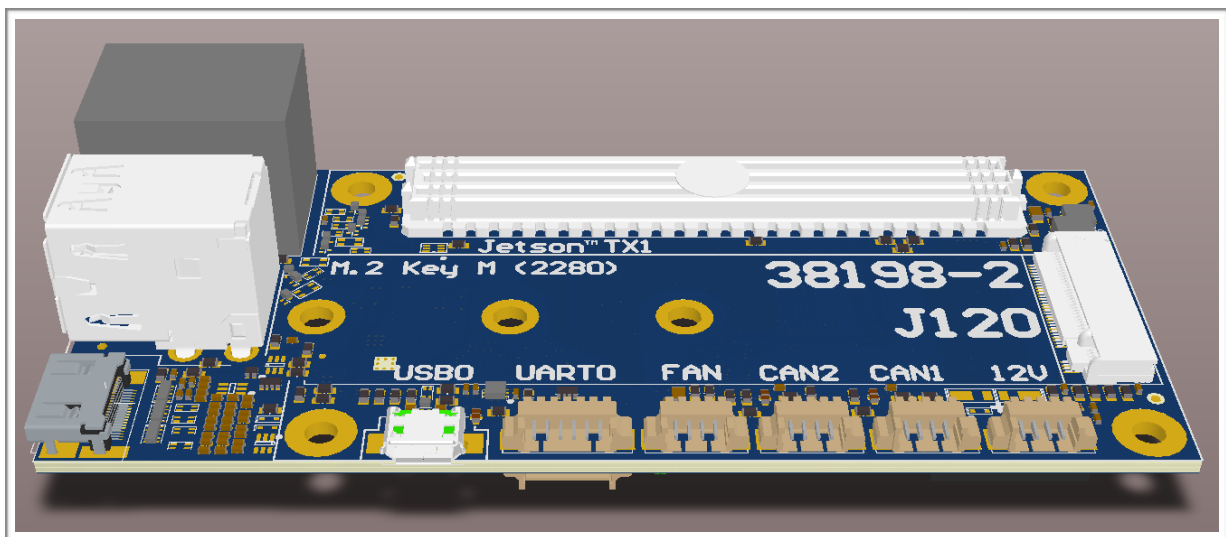
**J120 Rev 1 (38198)**

First revision of the J100. Limited distribution.

**J120 Rev 2 (38198-2)**

Second revision of the J120. It will become available in late April 2016. Modifications:

- all 3 connectors on the left are aligned (Ethernet, USB3 and mini HDMI)
- PCB size: 50 x 109.5 mm, total size: 50 x 110 mm
- M.2 type M fixed
- auto start recovery time shortened
- optional super cap for RTC
- firmware upgrade (back powering fix)
- INT lines of CAN controllers connect to individual pins of the TX1 (interrupts not shared)



The optional super cap is the tallest component on the bottom side (5.5mm high). The capacity of the super cap is 47mF or 100mF. Optionally the RTC (realtime clock of the Jetson TX1) may be powered by a Lithium cell (MS621FE-FL11E). It is located next to the power button. If the super cap and the Lithium cell are not populated, RTC power may be provided on the buttons connector (J12 pin 1).

### Testing of the J120

For the first shipments of the J120 to beta customers only selected functions will be tested. The testing of functions like CAN, IMU, CSI-2 and I2S require drivers and test programs to be developed first.

Initially the following functions are tested:

- HDMI out
- 1000BT Ethernet
- USB 3.0 on USB1
- USB 2.0 on USB2
- micro SD card
- power consumption with 12 V power supply (Ubuntu booted and system idle)

Please have a look at the test report which is included with the shipment.

### STEP (3D) models

J120 rev 1: <http://www.auvidea.eu/download/step/38198.step.zip>

J120 rev 2: <http://www.auvidea.eu/download/step/38198-2.step.zip>

# Getting started

## Applying power

The J120 is powered by the on-board power connector (J11). Each of the 2 separate power pins features a Schottky diode. These 2 diodes OR the 2 power inputs together. So 2 independent power inputs are provided to achieve redundant powering.

## Auto start

The J120 automatically powers up the TX1 with a digital one shot which pulls the POWER-BTN input of the TX1 low for approximately 1 second after power is applied. When the TX1 raises the CARRIER\_PWR (A48) line, the power supplies on the J120 are powered up. This is indicated by lighting up the green power LED below the fan connector.

The auto start logic is powered by Vdd\_RTC (A50). Rev 1: for auto start to work, please power down the TX1 for at least 10 seconds. This allows time for the Vdd\_RTC supply to drain and the enable auto start, when power is applied again. Rev 2 of the J120 will shorten this time, by actively draining Vdd\_RTC when the main power is removed. Alternatively power up the J120 by pressing the power button.

## Console access

The console port of the TX1 is UART 0. The J120 converts this UART port to standard 3.3V TTL levels. So a standard USB to TTL serial converter may be used to connect to the console. Just connect TXD, RXD and GND to the USB converter. Make sure that you connect TXD to the RXD input of the USB TTL converter. Standard baud rate is 115200. Settings: 8/1/N.

## Firmware upgrade of the TX1

The J120 does support a direct firmware upgrade of the TX1. However, there is one issue on rev 1. Once the USB cable to USB0 is connected the J120 will be back powered through USB. In this mode the J120 will not boot. Please put the TX1 into the upgrade mode with the recovery button before connecting the USB cable to USB0. Alternatively please perform the firmware upgrade on the TX1 development board.

# Devices

## IMU (MPU-9250)

A 9 axis sensor is connected to the SPI0 bus of the TX1. Pin 8 (VddIO) of the IMU is connected to 1.8V. Please set the INT output of the IMU by software to „totem pole“ mode as there is no pull-up on the INT output.

This IMU is optional. Only some J120 models are equipped with this function.

Pin	Function	Jetson TX1	Description
9	AD0/SDO	E4	SPI0_MISO (1.8V)
24	SDA/SDI	F4	SPI0_MOSI (1.8V)
23	SCL/SCLK	E3	SPI0_CLK (1.8V)
22	/CS	F3	SPI0_CS0 (1.8V)
12	INT	G14	INT is inverted and connected to GPIO9_MOTION_INT (1.8V)

## SPI busses with the Jetson TX1

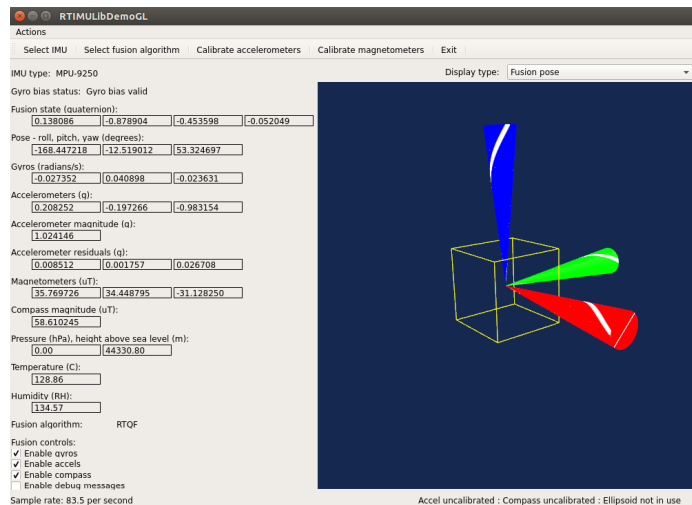
The Jetson TX1 features 3 SPI busses: SPI0 to SPI2. The table below lists how these SPI devices are mounted. Please note how the 5 physical SPI devices relate to the 5 spidevs.

Bus	CS	Tegra X1	SPI device	Use
SPI0	0	SPI4	spidev3.0	IMU MPU-9250
SPI1	0	SPI1	spidev0.0	CAN controller 1 (MCP2515)
SPI1	1	SPI1	spidev0.1	CAN Controller 2 (MCP2515)
SPI2	0	SPI2	spidev1.0	I2C/SPI connector J13
SPI2	1	SPI2	spidev1.1	I2C/SPI connector J14

## Test of the IMU with the RTIMULibDemo

This demo may be downloaded from Github. Please install qtcreator first. Next please make sure that the spidev3.0 device in /dev is loaded. Edit the RTIMULibDemo.ini file with the SPI settings for the IMU (bus 3, select 0). Start the demo as root so it gets access to the SPI bus.

The IMU chip is located on the bottom side next to the JTAG connector. The IMU is optional on the J120. Please make sure that your J120 has the IMU installed.





# Connectors

Auvideo supplies cable kits for the connectors with 1.25 mm pitch. Please check the website for details. Figure 1 and 2 show the J120 rev 2 but the connector placement and pin numbering also applies to the J120 rev 1.

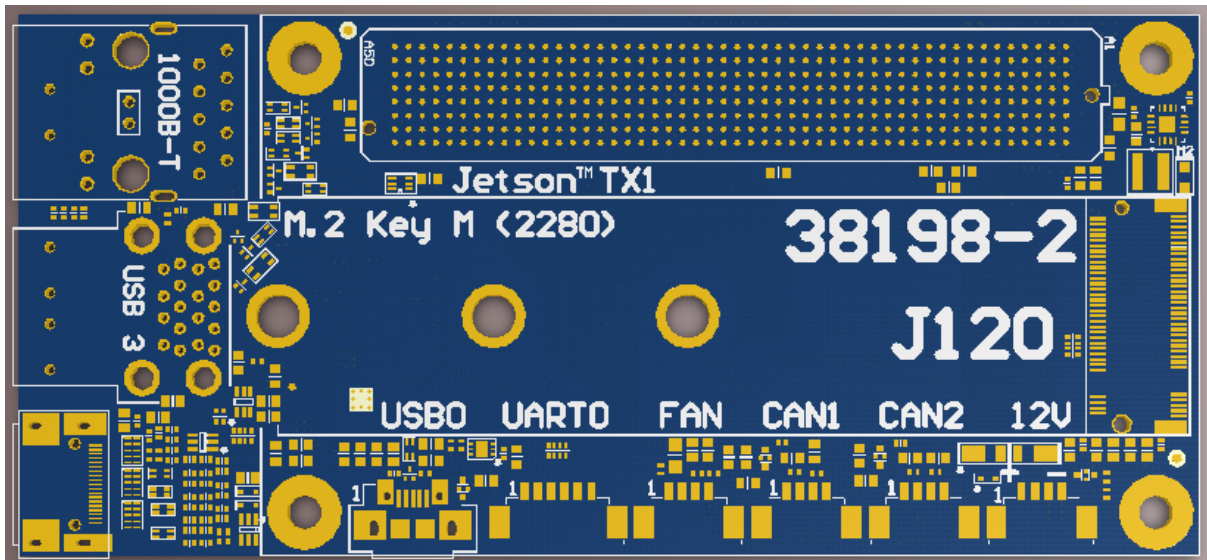


Figure 1: connectors on the top side

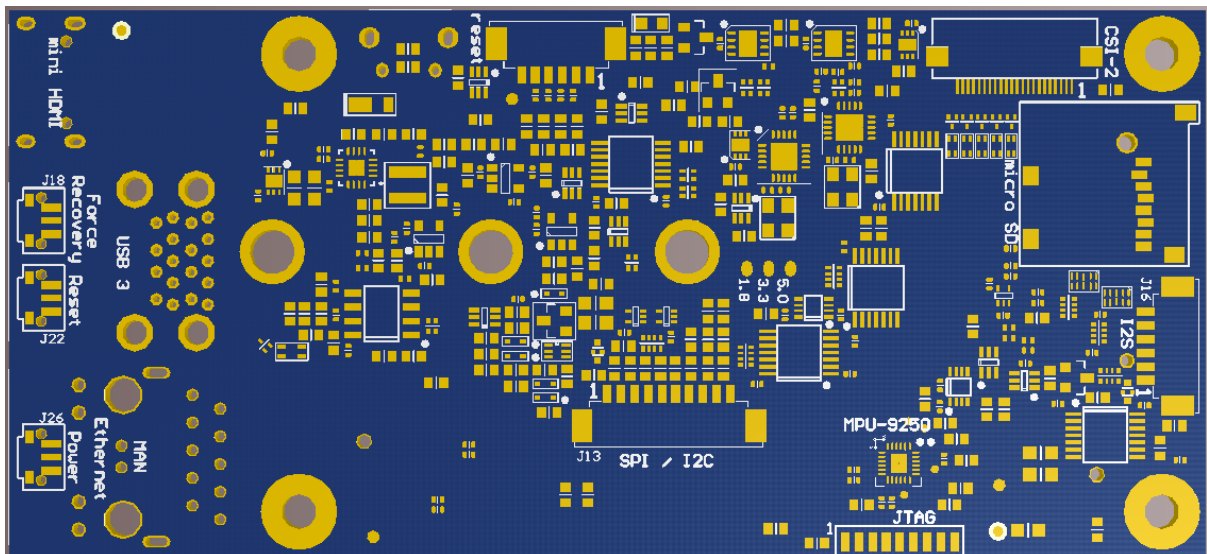


Figure 2: connectors on the bottom side

**USB 3.0 (J2)**

This is dual USB 3.0 type a connector. Pin 1-9 is the bottom connector and pin 10-18 is the top connector.

Pin	Function	Jetson TX1	Description
1	5V	-	5V power controlled by USB2_EN_OC (A19) - max. 900 mA
2	USB2-D-	B43	USB 2.0 data
3	USB2-D+	B42	USB 2.0 data
4	GND	-	Ground
5	USB3_RX2-	H42	USB 3.0 receive data
6	USB3_RX2+	H41	USB 3.0 receive data
7	GND	-	Ground
8	USB3_TX2-	E42	USB 3.0 transmit data
9	USB3_TX2+	E41	USB 3.0 transmit data
10	5V	-	5V power controlled by USB1_EN_OC (A18) - max. 900 mA
11	USB1-D-	A39	USB 2.0 data
12	USB1-D+	A38	USB 2.0 data
13	GND	-	Ground
14	USB3_RX1-	F44	USB 3.0 receive data
15	USB3_RX1+	F43	USB 3.0 receive data
16	GND	-	Ground
17	USB3_TX1-	C44	USB 3.0 transmit data
18	USB3_TX1+	C43	USB 3.0 transmit data

**USB 2.0 (J6)**

USB 2.0 port for firmware upgrades. J120 rev 1: no back powering protection. Please use with care when using it for firmware upgrades. Please connect USB cable after the Jetson TX1 has booted up.

Pin	Function	Jetson TX1	Description
1	5V	-	5V power controlled by USB0_EN_OC* (A17) - max. 500 mA
2	USB0-D-	B40	USB 2.0 data
3	USB0-D+	B39	USB 2.0 data
4	GND	-	Ground
-	USB0_ID	A36	connected to 3.3V with 10k pullup
-	USB0_VBUS	B37	connected to pin 1 of this connector

## CAN controller (MCP2515T-I/ML)

The two SPI to CAN controllers add two CAN bus interfaces to the TX1, as there is no internal CAN controller in the TX1. The SPI bus, RESET and INT are shared between the 2 CAN controllers (J120 rev 1). The J120 rev 2 will use separate SPI interrupts. Just SPI1\_CS0 and SPI1\_CS1 select one of the two controllers. The two CAN busses are available on J9 (CAN1) and J10 (CAN2).

Interrupt: the interrupt outputs of the 2 CAN controllers are tied together and have a common 10k pull-up resistor (rev 1).

J120 rev 1: on the silkscreen „CAN1“ and „CAN2“ are swapped. CAN1 is next to the FAN connector.

CAN controller 1:

Pin	Function	Jetson TX1	Description
15	SO	F14	SPI1_MISO (level shifted to 3.3V)
14	SI	F13	SPI1_MOSI (level shifted to 3.3V)
12	SCK	G13	SPI1_CLK (level shifted to 3.3V)
22	/CS	E14	SPI1_CS0 (level shifted to 3.3V)
12	/INT	H3	GPIO20_AUD_INT (low active with 10k pull-up to 3.3V)
17	/RESET	D7	GPIO5_CAM_FLASH_EN is inverted and connected to the RESET inputs

CAN controller 2:

Pin	Function	Jetson TX1	Description
15	SO	F14	SPI1_MISO (level shifted to 3.3V)
14	SI	F13	SPI1_MOSI (level shifted to 3.3V)
12	SCK	G13	SPI1_CLK (level shifted to 3.3V)
22	/CS	E13	SPI1_CS1 (level shifted to 3.3V)
12	/INT	H3	GPIO20_AUD_INT (low active with 10k pull-up to 3.3V)
17	/RESET	D7	GPIO5_CAM_FLASH_EN is inverted and connected to the RESET inputs

CAN1 (J9):

Pin	Function	Jetson TX1	Description
1	5V	-	5V power for the CAN bus (500 mA)
2	CAN2_H	-	CAN data high
3	CAN2_L	-	CAN data low
4	GND	-	Ground (0V)

CAN2 (J10):

Pin	Function	Jetson TX1	Description
1	5V	-	5V power for the CAN bus (500 mA)
2	CAN1_H	-	CAN data high

Pin	Function	Jetson TX1	Description
3	CAN1_L	-	CAN data low
4	GND	-	Ground (0V)

**CSI-EF (J14)**

This is a 22 pin 4 lane CSI-2 connector with 0.5mm pitch (Wuerth 687122149022). To open the connector and to release the cable just lift the brown lid upwards. This connector has the same pinout as the CSI-2 connector on the Raspberry Pi compute module carrier board. The contacts are on the bottom.

Pin	Function	Jetson TX1	Description
1	3.3V	-	3.3V power supply
2	I2C_PM_DAT	B6	3.3V level (converted from 1.8V of the Jetson TX1)
3	I2C_PM_CLK	A6	3.3V level (converted from 1.8V of the Jetson TX1)
4	GND	-	Ground
5	CAM2_MCLK	E7	CAM2_MCLK
6	CAM3_GPIO	H7	GPIO3_CAM1_RST*
7	GND	-	Ground
8	CSI-F_D1+	E21	CSI-2 bus F lane 0
9	CSI-F_D1-	E20	CSI-2 bus F lane 1
10	GND	-	Ground
11	CSI-F-D0-	C23	CSI-2 bus F lane 0
12	CSI-F-D0-	C22	CSI-2 bus F lane 0
13	GND	-	Ground
14	CSI-E_CLK+	G22	CSI-2 bus E clock
15	CSI-E_CLK-	G21	CSI-2 bus E clock
16	GND	-	Ground
17	CSI-E-D1+	H21	CSI-2 bus E lane 1
18	CSI-E-D1-	H20	CSI-2 bus E lane 1
19	GND	-	Ground
20	CSI-E-D0+	F23	CSI-2 bus E lane 0
21	CSI-E-D0-	F22	CSI-2 bus E lane 0
22	GND	-	Ground

**Ethernet (J1)**

The J120 features an on-board RJ45 connector for 10/100/1000BT Ethernet with 2 LEDs.

LED	Function	Jetson TX1	Description
GBE0	GBE_LINK_ACT*	E47	left LED
GBE1	GBE_LINK_100	F50	right LED

## HDMI (J3)

This is a 19 pin mini HDMI connector. Please note that the HDMI and mini HDMI connector have different pin outs.

Pin	Function	Jetson TX1	Description
1	GND	-	Ground
2	DP1_TXD0+	E39	HDMI data lane 2
3	DP1_TXD0-	E38	HDMI data lane 2
4	GND	-	Ground
5	DP1_TXD1+	C38	HDMI data lane 1
6	DP1_TXD1-	C37	HDMI data lane 1
7	GND	-	Ground
8	DP1_TXD2+	D37	HDMI data lane 0
9	DP1_TXD2-	D36	HDMI data lane 0
10	GND	-	Ground
11	DP1_TXD3+	E36	HDMI clock
12	DP1_TXD3-	E35	HDMI clock
13	GND	-	Ground
14	CEC	B33	HDMI_CEC
15	HDMI_DDC_SCL	A35	DP1_AUX_CH
16	HDMI_DDC_SDA	A34	DP1_AUX_CH*
17	reserved	-	not connected
18	PWR	-	5V power (max. 500 mA)
19	HPD	A33	inverted and connected to DP1_HPD

## UART 0 (J7)

This is a 6 pin connector with 1.25 mm pitch. Please connect to USB TTL serial converter (3.3V TTL level). Normally just connect TXD, RXD, and GND. Swap data lines. Default speed: 115200 bps.

Pin	Function	Jetson TX1	Description
1	5V	-	5V power output
2	UART0_TXD	H12	UART 0 console port (3.3V TTL level): transmit data output
3	UART0_RXD	G12	UART 0 console port (3.3V TTL level): receive data input
4	UART0_CTS	H11	UART 0 console port (3.3V TTL level): clear to send
5	UART0_RTS	G11	UART 0 console port (3.3V TTL level): ready to send
6	GND	-	Ground

## FAN (J8)

This is a 4 pin connector with 1.25 mm pitch. This is the same pinout as the fan connector on the Jetson TX1 development kit. With the J100 the fan is on by default. Use the „fan disable“ feature to turn off the fan.

Please note, that the „fan disable“ requires a software change when compared to the dev kit. On the dev kit „fan disable“ is controlled by an I2C port expander line. On the J100 „fan disable“ is connected to GPIO19\_AUD\_RST (through an inverting MOSFET). Pull the GPIO19 (F2) high to disable the fan (pin 4 becomes low). A low or floating signal on GPIO19 will not disable the fan.

Pin	Function	Jetson TX1	Description
1	GND	-	Ground
2	5V	-	5V power supply to the fan
3	FAN_TACH	B17	tachometer from the fan (open drain input with 100k pull-up to 1.8V)
4	FAN_PWM	C16	PWM control to the fan (open drain output: controlled by FAN_PWM and „disable fan“ with GPIO19 - F2)

## Power (J11)

This is a 4 pin connector with 1.25 mm pitch. Power in 1 and power in 2 are or'ed with 2 Schottky diodes. They may be tied together or they may be connected to 2 redundant power supplies.

Pin	Function	Jetson TX1	Description
1	power in 1	-	power input: typical 12V (range: 7V to 17V)
2	power in 2	-	power input: typical 12V (range: 7V to 17V)
3	GND	-	power ground
4	GND	-	power ground

## I2S (J16)

This is a 6 pin connector with 1.25 mm pitch.

Pin	Function	Jetson TX1	Description
1	3.3V	-	3.3V power supply
2	I2S_MCLK	F1	digital audio interface: master clock (3.3V)
3	I2S0_SIN	G1	digital audio interface 0: audio input (3.3V)
4	I2S0_CLK	G2	digital audio interface 0: bit clock (3.3V)
5	I2S0_LRCLK	H1	digital audio interface 0: word clock (3.3V)
6	GND	-	Ground

**SPI/I2C (J13)**

This is a 10 pin connector with 1.25 mm pitch.

Pin	Function	Jetson TX1	Description
1	5.0V	-	5.0V power supply
2	SPI2_CLK	H14	SPI2_CLK (level shifted to 3.3V)
3	SPI2_MISO	H15	SPI2_CLK (level shifted to 3.3V)
4	SPI2_MOSI	G15	SPI2_CLK (level shifted to 3.3V)
5	SPI2_CS0	G16	SPI2_CLK (level shifted to 3.3V)
6	SPI2_CS1	F16	SPI2_CLK (level shifted to 3.3V)
7	INT_SPI2	H13	GPIO8_ALS_PROX_INT
8	I2C0_CLK	E15	I2C0_CLK (level shifted to 3.3V with 1k pullup)
9	I2C0_DAT	F15	I2C0_DAT (level shifted to 3.3V with 1k pullup)
10	GND	-	Ground

**Micro SD card (J15)**

Micro SD card reader (Amphenol 101-00660-68-6). SDCARD\_WP (F20) = 0 (inactive).

Pin	Function	Jetson TX1	Description
1	SD_DAT2	F19	SD card interface data 2
2	SD_DAT3	F18	SD card interface data 3
3	SD_CMD	G19	SD card interface command
4	3.3V	-	enabled by SDCARD_PWR_EN = 1 (H16)
5	SD_CLK	G18	SD card interface clock
6	GND	-	Ground
7	SD_DAT0	H18	SD card interface data 0
8	SD_DAT1	H17	SD card interface data 1
9	SD_CD	F17	GND



## Buttons (J12)

6 pin connector with 1.25 mm pitch (on the bottom side next to the green LED).

Pin	Function	Jetson TX1	Description
1	Vdd_RTC	A50	Realtime clock power input from backup battery or super cap Do not connect if super cap or Lithium cell (J60) is populated on the J120. (rev 1: connected to GND)
2	power	B50	power button (connect to GND)
3	sleep	E2	sleep button (connect to GND)
4	force recv.	E1	force recovery button (connect to GND)
5	reset	A47	reset in button (connect to GND)
6	GND	-	Ground

## M.2 type M 2280 (J15)

J120 rev 1: this slot is non functional due to power limitations of the integrated 3.3V power supply.

J120 rev 2: this will be fixed by adding a 3.3V 3A power supply.

Form factor: 2242, 2260 or 2280 (22 x 80 mm)

Interface: four PCIe lanes for top performance (no SATA support)

## JTAG header (P1)

This is a 9 pin connector with 1.25 mm pitch with surface mount pads on the edge of the board.

Pin	Function	Jetson TX1	Description
1	1.8V	-	1.8V power output
2	JTAG_AP_TRST_L	B13	JTAG port of Jetson TX1
3	JTAG_AP_TCK	B11	JTAG port of Jetson TX2
4	JTAG_AP_RTCK	A14	JTAG port of Jetson TX3
5	JTAG_AP_TDO	A13	JTAG port of Jetson TX4
6	JTAG_AP_TMS	A12	JTAG port of Jetson TX5
7	NVJTAG_SEL	A11	JTAG port of Jetson TX6
8	JTAG_AP_TDI	B12	JTAG port of Jetson TX7
9	GND	-	Ground

# FAQ

1. to be added

# Disclaimer

Thank you for reading this manual. If you have found any typos or errors in this document, please let us know.

This is the preliminary version of this data sheet. Please treat all specifications with caution as there may be any typos or errors.

The Auvideo Team