AUVIDEA

X221, -LC, -AI

TECHNICAL REFERENCE MANUAL

SCOPE OF WORK
Providing technical information and documentation for the X221, -LC, -AI carrier boards for the AGX Xavier

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1.8

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Contents

SECTION 1 Document revisions and changes

Document version	Changes
1.0	Initial document, internal verification process
1.1	Internal verification process
1.2	Restructuring of document, added Appendix B, C
1.3	Adding Socket Pins
1.4	Adding Appendix D & E and fixed missing table in Appendix B
1.5	Minor changes
1.6	Updated Appendix D, added pinout description header
1.7	Corrected the Extension port for CSI-2 from up to 8 cameras to up to 4 cameras

SECTION 2 Product revisions, changes and problems

Product version	Changes
38413-2	Crypto chip
38413-4	Safety MCU, Change of Ethernet controllers, MCU UART to LTE, CAN RX/TX

2.1 Bootproblem

Some of the X221 has got a boot problem:

Which carrier boards are affected:

- X221 – 38413 rev 5 and below
- X221-AI – 38413 rev 5 and below (MCU firmware fix available)

What is the boot problem:

The Jetson's boot process could randomly get interrupted due to falsely receiving a signal through the UART interface.

How is it caused:

The UART's receive pin (pin 3 = UART3_RX) is floating due to a missing pull down resistor, this can cause the signal to oscillate right around the threshold of the level shifter which then turns this false signal into a proper 3.3V signal that send a false "keystroke" to the Jetson. If the Jetson is in the bootloader part of the boot process and at that particular time happens to wait for an input during: "Hit any key to stop autoboot" then the Jetson enters the U-Boot/CBoot/UEFI and stops the boot process. This interrupt message accepts any signal and has a three second time window.

Observations of our limited testing (your mileage may vary):

- Nothing plugged into the UART connector

Most of the time the issue did not appear, however other surrounding signals could interfere and have an impact on this behavior, same with the aging of the carrier board and degradation of the components.

- UART is connected to another device

The problem should not appear since the signal is not floating anymore and the message interrupting the boot process would have to come from the other device instead.

- UART has wires plugged in which are not connected to anything

In this case, problems may arise. If the distance is too small to the carrier board, a person can trigger signals at the Jetson through electromagnetic waves.
This can be thought of as a kind of antenna, which then receives signals.

For example simply approaching a 15cm/~6in long "antenna" with your hand at a distance of ~20cm/~8in or less causes the Jetson so stop booting 100% of the time.
How to fix this issue:

The ideal solution is to add the missing resistor in the schematics but this requires a new hardware revision. On some of the above mentioned versions of the affected carrier boards this issue can be resolved by using a special MCU firmware which adds an internal pull down resistance to keep the signal from floating. For the other boards the temporary fix is to connect UART RX to ground, so the signal gets pulled down. The connector that shorts these two pins (pin 3 and pin 6) will be included.

SECTION 3 Overview

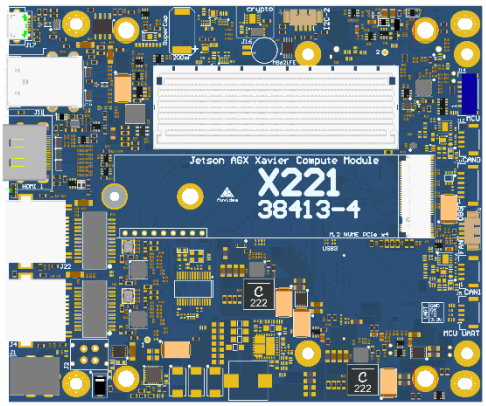
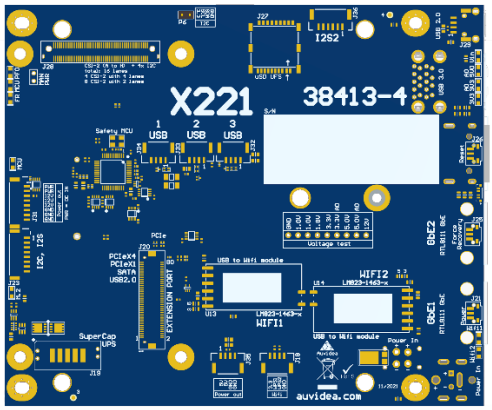
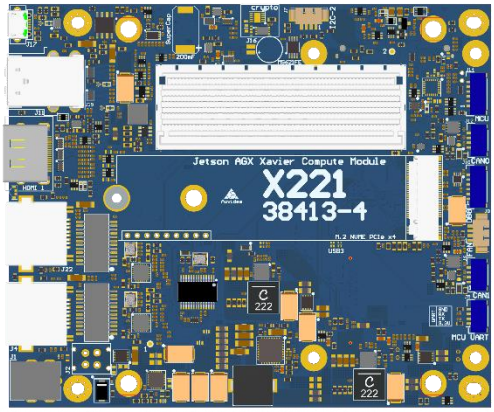
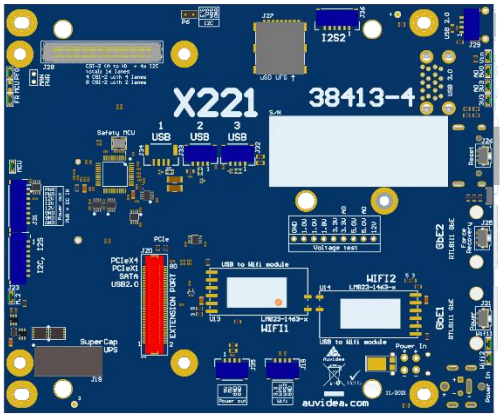
3.1 Model comparison

Description	X221-LC (Rev 2)	X221-AI (Rev 2)	X221 (Rev 4)	X221-AI (Rev 4)
2x GbE (RJ45)	1x native, 1x i210 PCIe to GbE	1x native, 1x i210 PCIe to GbE	2x RTL8111 PCIe to GbE	2x RTL8111 PCIe to GbE
HDMI out	1x	1x	1x	1x
USB 2.0	1x micro	4x	1x micro	4x
USB 3.0	2x	2x	2x	2x
LM823 Wifi	-	2x (optional)	-	2x (optional)
Safety MCU (for JAXi)	-	-	-	yes
Basic MCU	yes	yes	yes	-
Remote power control & debug via LTE	-	-	-	yes
MicroSD/UFS card slot	-	1x	-	1x
UART	1x	2x	1x	3x
I2S	-	2x	-	2x
I2C	1x	2x	1x	2x
Extension port for PCIe x4/x1/USB/UART/I2C/GPIO	-	yes	-	yes
Extension port for CSI-2	-	3x4X or 4x4X (with addon board M222 (38548) or M220 (38451))	-	3x4X or 4x4X (with addon board M222 (38548) or M220 (38451))
Operating Voltage	12V	12-48V	12V	12-48V
Jetson power modes	30W + MAXN	30W	30W + MAXN	30W
Super Cap UPS	-	(optional)	-	(optional)
Power out (5V, 12V)	-	yes	-	yes
Power/Reset/Force-Recovery Buttons	-	yes	-	yes
RTC super cap	200mF	200mF	200mF	200mF
Auto flashing	yes	yes	yes	yes
CAN (RX/TX only)	1x	1x	1x	1x
CAN	-	1x	-	1x
Debug port	-	-	yes	yes
Fan connector (5V, PWM)	1x	1x	1x	1x
RGB LED (GPIO controlled)	-	1x	-	1x
Revers voltage protection (low voltage drop MOSFET)	yes	yes	yes	yes
Overvoltage protection	yes	yes	yes	yes
Rechargeable lithium cell (MS621FE)	(optional)	(optional)	(optional)	(optional)
Crypto authentication chip	-	-	yes	Yes

3.2 Technical specification

Description		Note
HDMI	2.0, 4k60p	
USB 3.1	10Gb/s	
Physical size	125mm x 104.6mm	3D STP model available
Mounting holes	4x M3	
Temperature range	-25°C to +80°C	Cold temperature monitoring with MCU optional
Humidity	Noncondensing humidity	
Longevity	No temperature sensitive electrolytic capacitors	

3.3 Model pictures

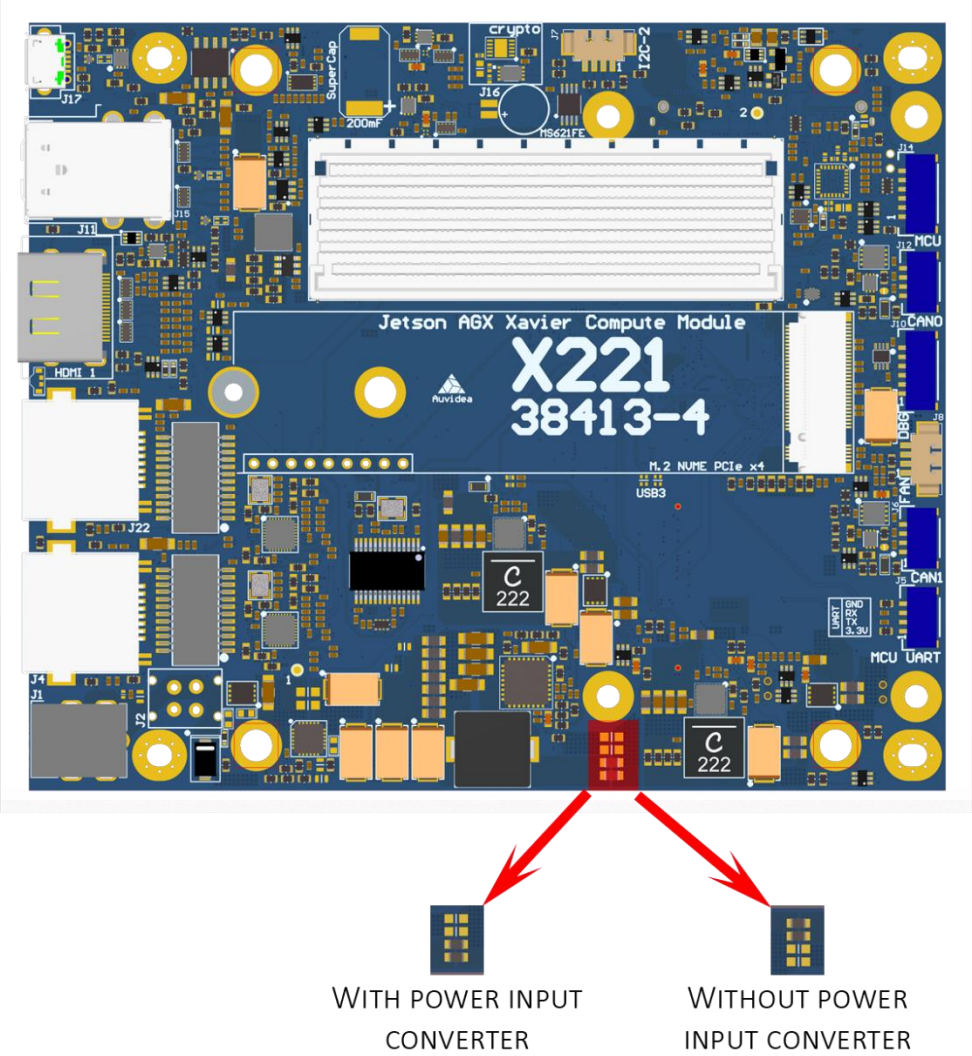
	Top side	Bottom side
X221 (Rev 4)		
X221-AI (Rev 4)		
		

The picture shows a prototype custom heatsink, designed for the AGX Xavier. It is designed to mount a standard 80x80mm fan.

3.4 Power consumption

Description	X221-LC (Rev 2)	X221-AI (Rev 2)	X221 (Rev 4)	X221-AI (Rev 4)
Carrier board logic	1-2W	1-2W	1-2W	1-2W
1.8/3.3/5V power converter efficiency	>90%	>90%	>90%	>90%
Power in converter efficiency	-	>90%	-	>90%

If you intend to use MAXN mode, the LC version is better suited because it does not have a power limiting input converter. The full version features high voltage power in converter with an output of 12V 5A, so that a maximum power setting of 30W is recommended.
It is possible to bypass the power input converter by moving two 0805 beads as seen in the picture below. With this patch the input voltage is limited to 12V as the power input converter is bypassed.



SECTION 4 Features

4.1 Crypto authentication chip

Pin	Description
Model	ATSHA204A-MAHCZ-T
Datasheet	https://ww1.microchip.com/downloads/en/DeviceDoc/ATSHA204A-Data-Sheet-40002025A.pdf

The crypto chip can used for authentication, software licensing and copy protection.

4.2 Safety MCU

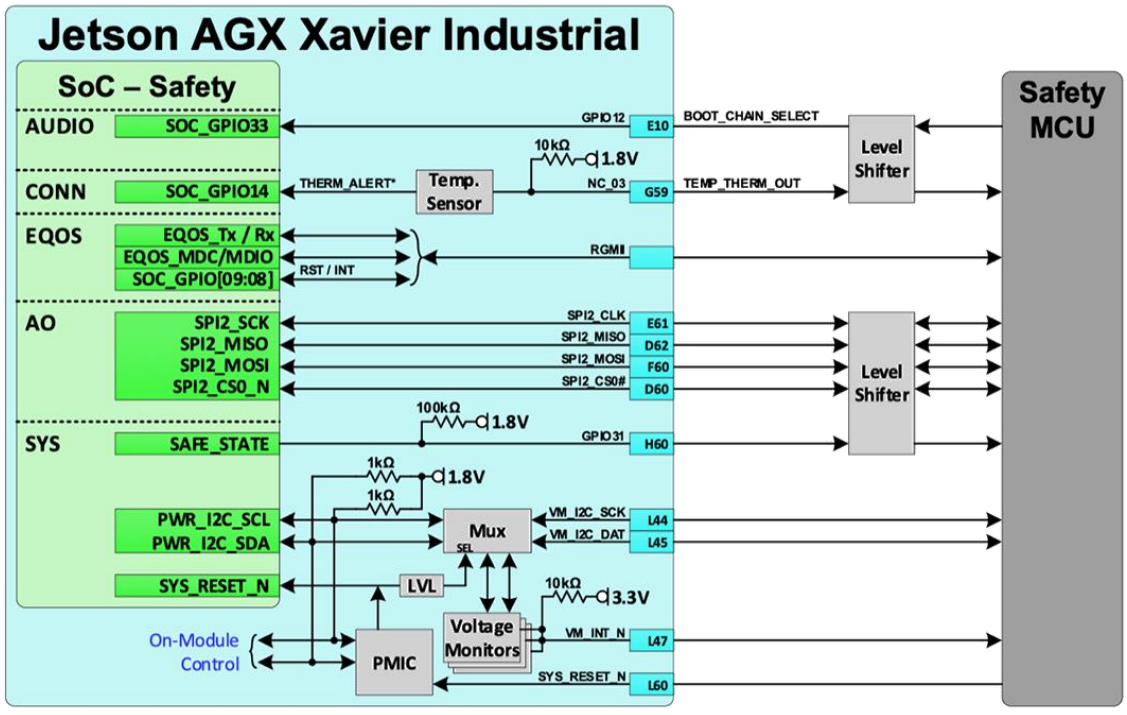
4.2.1 Features

- Ability to control power management of carrier board and AGX Xavier
- Select boot chain (GPIO)
- Retrieve internal status (SPI)
- Monitor internal power rails (I2C)

For further details refer to NVIDIA documentation:
Jetson Xavier OEM product design guide (NVIDIA Jetson download center: 15.5 Safety MCU)

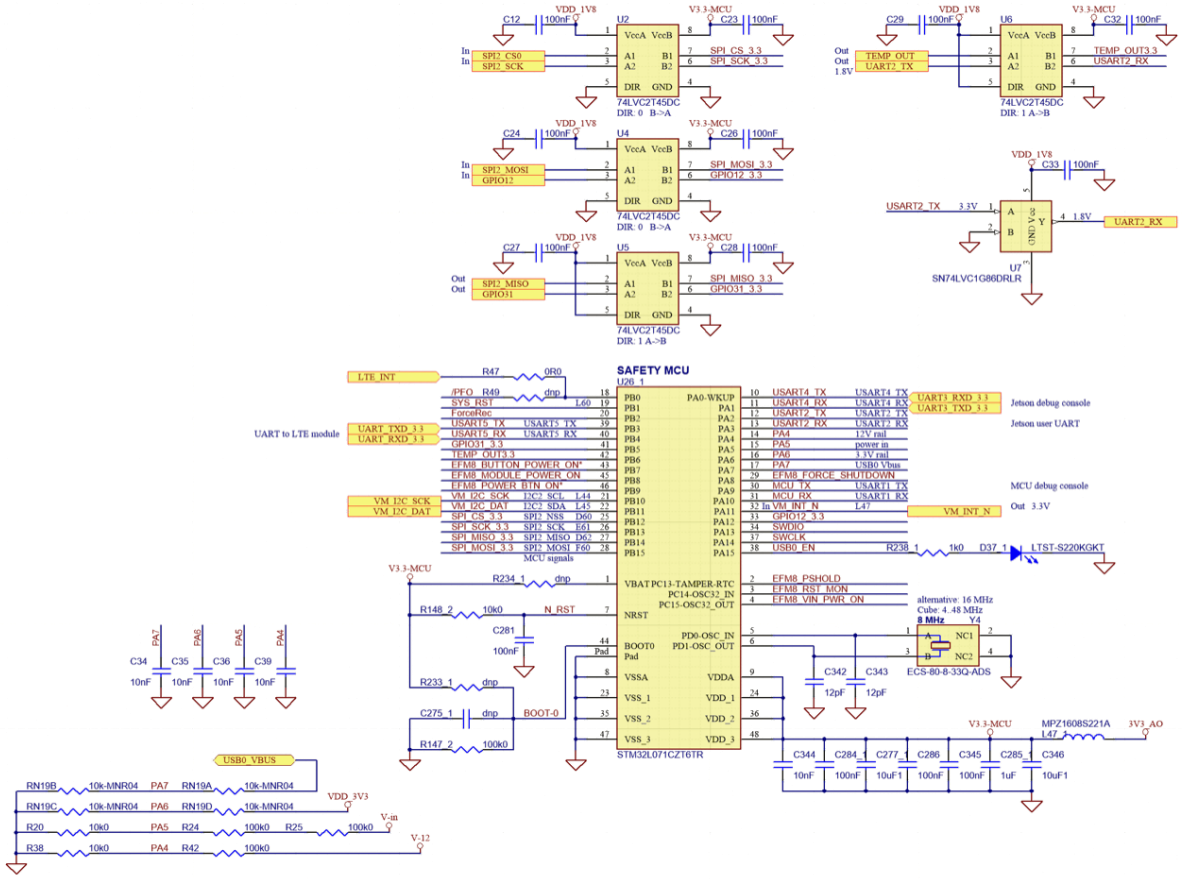
4.2.2 Block diagram of Safety MCU

Figure 15-5. Safety MCU Connections



4.2.3 Schematic of Safety MCU section

Pleas check that your model has a Safety MCU. If your models does not have a safety MCU you will have the basic MCU.



4.2.4 Pinout basic MCU

STM32L031G6U6TR

Pin	Description	Socket pin	Note
1	3V3_AO		3.3V
2	MCU_LED		5V tolerant
3	ForceRec		
4	MCU_RESET		With 3.3V pullup
5	3V3_AO		3.3V
6	EFM8_BUTTON_POWER_ON*		
7	EFM8B10_D_ONKEY_N		
8	PA6		
9	EFM8_ACOK		
10	EFM8_PSHOLD		
11	EFM8_FORCE_SHUTDOWN		
12	EFM8_RST_MON		
13	PA7		USB0_VBUS/2
14	/PFO		
15	SYS_RST		
16	GND		
17	3V3_AO		3.3V
18	3V3_AO		3.3V
19	MCU_TX		Connected to J14 pin 2
20	MCU_RX		Connected to J14 pin 3
21	SWDIO		Connected to J14 pin 5
22	SWCLK		Connected to J14 pin 4
23	USB0_EN		
24	EFM8_VIN_PWER_ON		
25	EFM8_MODULE_POWER_ON		
26	EFM8_POWER_BTN_ON*		
27	BOOT0		
28	GND		

SECTION 5 Pinout description

Below is a list of all connectors featured on the carrier board.
Pleas reference the socket pin number to *10.2 Pin to GPIO reference sheet for Xavier-NX/Nano/TX2-NX*. With the socket pin number, you can find out the corresponding GPIO number for your module.

5.1 J2 - POWER PORT

Molex Micro Fit 3.0 (alternative power input)

5.2 J4 - Ethernet

RJ45
Standard pinout.

5.3 J5 - MCU UART

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	3.3V		
2	UART_TX	Safety MCU pin 39	3.3V, MCU user UART to connect to LTE module
3	UART_RX	Safety MCU pin 40	3.3V, MCU user UART to connect to LTE module
4	GND		

5.4 J6 - CAN1

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	5V		max 500mA (with current limiting switch)
2	CAN_H	B61	2.5V center voltage, with CAN transceiver
3	CAN_L	H61	2.5V center voltage, with CAN transceiver
4	GND		

5.5 J7 - I2C

Pico blade 1.25mm

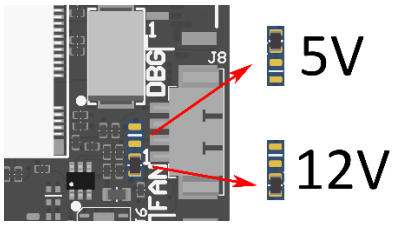
Pin	Description	Socket pin	Note
1	3.3V		
2	SCL	J61	3.3V, open drain
3	SDA	K61	3.3V, open drain
4	GND		

5.6 J8 - FAN

Pico blade 1.25mm

Pin	Description	Socket pin	Note
1	GND		
2	12V		1A
3	TACH	E54	1.8V input 100K pull up to 1.8V, fan speed tacho
4	PWM	K62	open drain output with 10k pullup to 12V

For the use of a 5V fan there is an option to resolder a component appropriately.



5.7 J10 - Debug

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	3.3V		
2	UART3_TX	H62	3.3V, AGX Xavier debug console transmit
3	UART3_RX	K60	3.3V, AGX Xavier debug console receive
4	GPIO13_OUT	G7	3.3V, G7 (AGX Xavier ball), output from Jetson
5	GPIO4_IN	B59	3.3V, B59 (AGX Xavier ball), input to Jetson
6	GND		

5.8 J11 - HDMI

Standard pinout, connected to DP-2

5.9 J12 - CAN0

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	5V		max 500mA (with current limiting switch)
2	CAN0_H	F58	2.5V center voltage, with CAN transceiver
3	CAN0_L	D59	2.5V center voltage, with CAN transceiver
4	GND		

5.10 J14 - MCU

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	3.3V		
2	MCU_TX		3.3V, MCU console debug port, transmit, 115200 baud, 8N1
3	MCU_RX		3.3V, MCU console debug port, receive, 115200 baud, 8N1
4	SWCLK		ST-Link programming interface of MCU
5	SWDIO		ST-Link programming interface of MCU
6	GND		

With the AI model of the X221 you have access to the safety MCU features. Pleas contact Auvidea for more information.
The basic MCU of the non AI models only handle power up functionality.

5.11 J15 - 2x USB 3.1

Standard pinout (type A).
10Gb/s.
Power can be Enabled/Disabled with GPIO22

Nexus-3815RFY

Pin	Description	Socket pin	Note
1	Vin		1A, 5V
2	USB3_D_N	G10	
3	USB3_D_P	G11	
4	GND		
5	UPHY_RX11_N	D13	
6	UPHY_RX11_P	D12	
7	GND		
8	UPHY_TX11_N	H13	
9	UPHY_TX11_P	H12	
10	Vin		1A, 5V
11	USB1_D_N	C10	
12	USB1_D_P	C11	
13	GND		
14	UPHY_RX6_N	B17	
15	UPHY_RX6_P	B16	
16	GND		
17	UPHY_TX6_N	K16	
18	UPHY_TX6_P	K17	
19	GND		
20	GND		
21	GND		
22	GND		

5.12 J17 - MICRO USB

Standard pinout.
Host and device mode supported.
Powered by power limiting switch with 500mA.

5.13 J18 – Wi-Fi

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	3.3V		
2	WPS1		Connects to pin 6 of LM823-Module 1
3	WPS2		Connects to pin 6 of LM823-Module 2
4	GND		

Prepared for LM823 3.3V modules.
Wi-Fi options can be found in the Wi-Fi Appendix.
Wi-Fi bays for modules are only supported on the AI version and will not work with the standard configuration as the necessary components are not present.
For options including LM823 modules solder on please contact Auvidea.

5.14 J19 - SUPER CAP UPS

For optional super cap addon board.
This will support a graceful power down in case of a power outage.

5.15 J20 - PCIEx4/x1/USB/UART/I2C/GPIO

DF17(3.0)-80DS-0.5V (57)
Extension connector for variety of extension boards.

Pin	Description	Socket pin	Note
1	5V		
2	5V		
3	5V		
4	5V		
5	3.3V		
6	VCC_SRC		12V
7	3.3V		
8	VCC_SRC		12V
9	1.8V		
10	VCC_SRC		12V
11	TRX-0_P	A56	SPI1_MISO
12	CAN1_STBY	B62	
13	TRX-0_N	D55	SPI1_MOSI
14	NC		
15	TRX-1_P	J57	SPI1_SCK
16	NC		

17	TRX-1_N	E55	SPI1_CS0
18	UART5_RTS	K58	3.3V
19	NC		
20	UART5_RX	H58	3.3V
21	NC		
22	UART5_TX	J58	3.3V
23	NC		
24	PEX_L0_RST_N	D10	
25	NC		
26			
27	PEX_WAKE_N	A8	
28	GND		
29	PEX_L1_RST_N	B9	
30	PEX_CLK0_N	E14	
31	I2C_SCL_GP5_3.3		
32	PEX_CLK0_P	E15	
33	I2C_SDA_GP5_3.3		
34	GND		
35	GND		
36	PEX_CLK1_N	F17	
37			
38	PEX_CLK1_P	F16	
39	LTE_INT		Connected to Safety MCU
40	GND		
41	GND		
42	UPHY_TX2_N	K20	
43	UART_RXD		3.3V, UART to LTE module (from Safety MCU)
44	UPHY_TX2 P	K21	
45	UART_TXD		3.3V, UART to LTE module (from Safety MCU)
46	GND		
47	GND		
48	UPHY_TX3_N	H21	
49	UPHY_RX2_N	B20	
50	UPHY_TX3_P	H20	
51	UPHY_RX2_P	B21	
52	GND		
53	GND		
54	UPHY_TX4_N	N19	
55	UPHY_RX3_N	D21	
56	UPHY_TX4_P	N18	
57	UPHY_RX3_P	D20	
58	GND		
59	GND		
60	UPHY_TX5_N	G18	
61	UPHY_RX0_N	A23	Standard is PCIEx1, optional USB3.0, contact Auvidea
62	UPHY_TX5_P	G19	
63	UPHY_RX0_P	A22	Standard is PCIEx1, optional USB3.0, contact Auvidea
64	GND		

65	GND		
66	UPHY_RX5_N	C18	
67	UPHY_TX0_N	J23	Standard is PCIEx1, optional USB3.0, contact Auvidea
68	UPHY_RX_P	C19	
69	UPHY_TX0_P	J22	Standard is PCIEx1, optional USB3.0, contact Auvidea
70	GND		
71	GND		
72	D2_N		
73	UPHY RX4_N	A19	
74	D2_P		
75	UPHY_RX4_P	A18	
76	NC		
77	GND		
78	NC		
79	GPIO_EXP0_INT		connected to J28 pin 74
80	NC		

5.16 J21 - POWER BUTTON

5.17 J22 - ETHERNET

Standard pinout.

5.18 J23 - I2S/I2C

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	3.3V		
2	I2S3_DIN	J59	1.8V
3	I2S3_DOUT	K59	1.8V
4	I2S3_FS	C60	1.8V
5	I2S3_SCLK	C59	1.8V
6	I2C_SCL_GP5_3.3	A53	3.3V, also connected to J28 (93)
7	I2C_SDA_GP5_3.3	C53	3.3V, also connected to J28 (95)
8	GND		GND

5.19 J25 - FORCE RECOVERY BUTTON

5.20 J26 - RESET BUTTON

5.21 J27 - MICRO SD-CARD/UFS SLOT

Standard pinout

5.22 J28 - CSI-2

LSHM-150-02.5-L-DV-A-S-K-TR

Pin	Description	Socket pin	Note
1	GND		
2	VCC SRC		12V
3	CSI_3_CLK_N	F45	
4	VCC SRC		12V
5	CSI_3_CLK_P	F46	
6	VCC SRC		12V
7	GND		
8	VCC SRC		12V
9	CSI_3_D1_N	G45	
10	VCC SRC		12V
11	CSI_3_D1_P	G44	
12	VDD_5V		
13	GND		
14	VDD_5V		
15	CSI_3_D0_N	E44	
16	VDD_5V		
17	CSI_3_D0_P	E45	
18	VDD_3.3V		
19	GND		
20	VDD_3.3V		
21	CSI_2_CLK_N	B42	
22	VDD_3.3V		
23	CSI_2_CLK_P	B43	
24	I2C_GP4_CLK	J61	1.8V
25	GND		
26	I2C_GP4_DAT	K61	1.8V
27	CSI_2_D1_N	C41	
28	UART1_TX	K53	
29	CSI_2_D1_N	C41	
30	UART1_RX	K54	
31	GND		
32	GND		
33	CSI_2_D0_N	A42	
34	CSI_5_D1_P	D46	
35	CSI_2_D0_P	A41	
36	CSI_5_D1_N	D45	
37	GND		
38	GND		
39	CSI_1_CLK_N	H42	

40	CSI_5_D0_P	D42	
41	CSI_1_CLK_P	H43	
42	CSI_5_D0_N	D43	
43	GND		
44	GND		
45	CSI_1_D1_N	J42	
46	CSI_5_CLK_P	C44	
47	CSI_1_D1_P	J41	
48	CSI_5_CLK_N	C45	
49	GND		
50	GND		
51	CSI_1_D0_N	G42	
52	CSI_4_D0_P	G48	
53	CSI_1_D0_P	G41	
54	CSI_4_D0_N	G47	
55	GND		
56	VDD_1V8		VDD_1V8
57	CSI_0_CLK_N	F42	
58	CSI_4_D1_P	E47	
59	CSI_0_CLK_P	F43	
60	CSI_4_D1_N	E48	
61	GND		
62	GND		
63	CSI_0_D1_N	E38	
64	CSI_4_CLK_P	F48	
65	CSI_0_D1_P	E39	
66	CSI_4_CLK_N	F49	
67	GND		
68	GND		
69	CSI_0_D0_N	E41	
70	NC		
71	CSI_0_D0_P	E42	
72	NC		
73	GND		
74	GPIO_EXP0_INT		Connected to J20 pin 79
75	CSI_7_CLK_N	B46	
76	GND		
77	CSI_7_CLK_P	B45	
78	I2C_GP3_CLK_PEX_LVS	F53	3.3V
79	GND		
80	I2C_GP3_DAT_PEX_LVS	E53	3.3V
81	CSI_7_D1_N	C48	
82	GND		
83	CSI_7_D1_P	C47	
84	CSI_6_CLK_N	J45	
85	GND		
86	CSI_6_CLK_P	J44	
87	CSI_7_D0_N	A45	

88	GND		
89	CSI_7_D0_P	A44	
90	CSI_6_D1_N	H45	
91	GND		
92	CSI_6_D1_P	H46	
93	I2C_SCL_GP5_3.3	A53	3.3V, also connected to J23 (6)
94	GND		
95	I2C_SDA_GP5_3.3	C53	3.3V, also connected to J23 (7)
96	CSI_6_D0_N	K43	
97	I2C_GP2_CLK_LVS	J61	3.3V
98	CSI_6_D0_P	K44	
99	I2C_GP2_DAT_LVS	K61	3.3V
100	GND		

5.23 J29 - USB 2.0

Pin	Description	Socket pin	Note
1	5V		
2	D-		Parallel to J17
3	D+		Parallel to J17
4	GND		

5.24 J31 - POWER OUT

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	PWR		DC IN
2	PWR		DC IN
3	12V		
4	12V		
5	12V		
6	GND		
7	GND		
8	GND		

5.25 J32 – USB(3)

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	5V		
2	D-		connected to USB 2.0 hub using USB2_D_N Socket pin A11
3	D+		connected to USB 2.0 hub using USB2_D_P Socket pin A10
4	GND		

5.26 J33 – USB(2)

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	5V		
2	D-		connected to USB 2.0 hub using USB2_D_N Socket pin A11
3	D+		connected to USB 2.0 hub using USB2_D_P Socket pin A10
4	GND		

5.27 J34 – USB(1)

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	5V		
2	D-		connected to USB 2.0 hub using USB2_D_N Socket pin A11
3	D+		connected to USB 2.0 hub using USB2_D_P Socket pin A10
4	GND		

5.28 J35 - POWER OUT

Pin	Description	Socket pin	Note
1	5V		
2	5V		
3	GND		
4	GND		

5.29 J36 - I2S2

JST-GH 1.25mm

Pin	Description	Socket pin	Note
1	1.8V		
2	SDIN	F6	
3	SDOUT	C7	
4	FS	E4	
5	CLK	G4	
6	GND		

5.1 RGB LED

Pin	Description	Socket pin	Note
LED-R	GPIO15_CAM1_PWDN	B8	
LED-G	GPIO16_CAM1_RST	F10	
LED-B	GPIO11_CODEC_INT	F9	

SECTION 6 FAQ

- My X221 is not going in to force recovery
  - If your system is not going in to force recovery, please contact our support as you may got a system with a mismatched firmware.

SECTION 7 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 Auvidea Team

SECTION 8 Copyright notice

Trademarks
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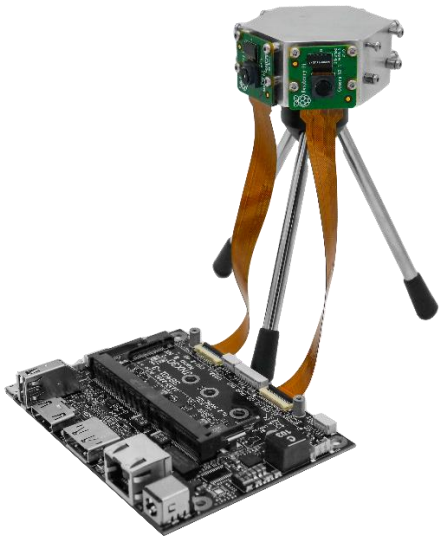
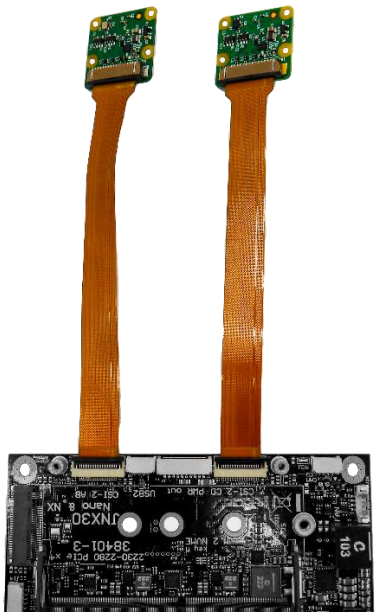
SECTION 9 Appendix A [CSI-Cameras]

This Appendix shows different CSI camera connection options and how to test your camera

9.1 Camera connection example

CSI cameras can connect to J5-CSI-2-CD and J19–CSI-2-AB connector as shown below.

	22 pin 0.5mm to 15 pin 1.0mm FPC cable	Using 38237 adapter + cable
		
		

9.2 Test CSI-Camera functionality

The CSI-Cameras should show up under /dev/video0 and /dev/video1
You can test the CSI-Cameras with the Gstreamer.
This framework should be already included in your Jetpack and can be used as follows:

```
//CSI-Camera0:
gst-launch-1.0 nvarguscamerasrc sensor-id=0 ! 'video/x-raw(memory:NVMM),width=3820, height=2464,
framerate=21/1, format=NV12' ! nvvidconv flip-method=0 ! 'video/x-raw,width=960, height=616' !
nvvidconv ! nvegltransform ! nveglglessink -e

//CSI-Camera1:
gst-launch-1.0 nvarguscamerasrc sensor-id=1 ! 'video/x-raw(memory:NVMM),width=3820, height=2464,
framerate=21/1, format=NV12' ! nvvidconv flip-method=0 ! 'video/x-raw,width=960, height=616' !
nvvidconv ! nvegltransform ! nveglglessink -e
```

*tested with raspberry pi camera module v2

A window with the camera stream is going to pop up if everything worked out correctly.

SECTION 10 Appendix B [GPIO]

This Appendix covers the basics of GPIO usage and provides a reference sheet for the socket pin – GPIOnumber correlation.

10.1 GPIO control

This example shows how to set and readout GPIO 414.
For different GPIO numbers replace 414 accordingly.

10.1.1 Export GPIO

```
nvidia@nvidia-desktop:~$ echo 414 > /sys/class/gpio/export
nvidia@nvidia-desktop:~$
```

10.1.2 Change direction to in

```
nvidia@nvidia-desktop:~$ echo in > /sys/class/gpio/gpio414/direction
nvidia@nvidia-desktop:~$
```

10.1.3 Change direction to out

```
nvidia@nvidia-desktop:~$ echo out > /sys/class/gpio/gpio414/direction
nvidia@nvidia-desktop:~$
```

10.1.4 Set GPIO low

```
nvidia@nvidia-desktop:~$ echo 0 > /sys/class/gpio/gpio414/value
nvidia@nvidia-desktop:~$
```

10.1.5 Set GPIO high

```
nvidia@nvidia-desktop:~$ echo 1 > /sys/class/gpio/gpio414/value
nvidia@nvidia-desktop:~$
```

10.1.6 Readout GPIO value

```
nvidia@nvidia-desktop:~$ cat /sys/class/gpio/gpio414/value
0
nvidia@nvidia-desktop:~$ cat /sys/class/gpio/gpio414/value
1
```

10.2 Pin to GPIO reference sheet for Xavier-NX/Nano/TX2-NX

Pin number (Socket number)	Xavier NX GPIOname	Xavier NX GPIOnumber	Xavier NX Pin direction	Nano GPIOname	Nano GPIOnumber	Nano Pin direction	TX2 NX GPIOname	TX2 NX GPIOnumber	TX2 NX Pin direction
1									
87	GPIO3_PZ.01	489	Bidirectional	GPIO3_PCC.04	228	Bidirectional	GPIO3_PL.04	412	Bidirectional
88	GPIO3_PM.00	384	Input	GPIO3_PCC.06	230	Input	GPIO3_PP.00	440	Input
89	GPIO3_PZ.05	493	Not Assigned	GPIO3_PC.00	16	Input	GPIO3_PH.02	378	Input
91	GPIO3_PZ.03	491	Not Assigned	GPIO3_PC.02	18	Input	GPIO3_PH.00	376	Input
93	GPIO3_PZ.04	492	Not Assigned	GPIO3_PC.01	17	Input	GPIO3_PH.01	377	Input
94	GPIO3_PM.04	388	Bidirectional	GPIO3_PCC.00	224	Bidirectional	GPIO3_PP.02	442	Bidirectional
95	GPIO3_PZ.06	494	Not Assigned	GPIO3_PC.03	19	Input	GPIO3_PH.03	379	Input
96	GPIO3_PM.01	385	Input	GPIO3_PCC.01	225	Input	GPIO3_PP.01	441	Input
97	GPIO3_PZ.07	495	Not Assigned	GPIO3_PC.04	20	Input	GPIO3_PY.03	515	Input
99	GPIO3_PX.04	476	Output	GPIO3_PD.01	25	Output	GPIO3_PX.00	504	Output
101	GPIO3_PX.05	477	Input	GPIO3_PD.02	26	Input	GPIO3_PX.01	505	Input
103	GPIO3_PX.06	478	Output	GPIO3_PD.03	27	Output	GPIO3_PX.02	506	Output
104	GPIO3_PY.02	482	Not Assigned	GPIO3_PB.04	12	Input	GPIO3_PV.03	491	Input
105	GPIO3_PX.07	479	Input	GPIO3_PD.04	28	Input	GPIO3_PX.03	507	Input
106	GPIO3_PY.00	480	Not Assigned	GPIO3_PB.06	14	Input	GPIO3_PV.01	489	Input
108	GPIO3_PY.01	481	Not Assigned	GPIO3_PB.05	13	Input	GPIO3_PV.02	490	Input
110	GPIO3_PY.03	483	Not Assigned	GPIO3_PB.07	15	Input	GPIO3_PV.04	492	Input
112	GPIO3_PY.04	484	Not Assigned	GPIO3_PDD.00	232	Input	GPIO3_PC.03	339	Input
114	GPIO3_PP.04	412	Output	GPIO3_PS.07	151	Output	GPIO3_PN.00	424	Output
116	GPIO3_PP.00	408	Output	GPIO3_PS.00	144	Output	GPIO3_PO.00	432	Output
118	GPIO3_PQ.05	421	Input	GPIO3_PS.05	149	Input	GPIO3_PN.01	425	Input
120	GPIO3_PP.05	413	Output	GPIO3_PT.00	152	Output	GPIO3_PN.03	427	Output
122	GPIO3_PP.01	409	Output	GPIO3_PS.01	145	Output	GPIO3_PO.01	433	Output
124	GPIO3_PQ.03	419	Input	GPIO3_PH.06	62	Input	GPIO3_PL.01	409	Input
126	GPIO3_PCC.00	264	Output	GPIO3_PI.02	66	Output	GPIO3_PL.02	410	Output
127	GPIO3_PCC.01	265	Input	GPIO3_PI.01	65	Output	GPIO3_PL.03	411	Output
128	GPIO3_PCC.02	266	Output	GPIO3_PH.07	63	Output	GPIO3_PL.00	408	Output
130	GPIO3_PCC.03	267	Output	GPIO3_PI.00	64	Output	GPIO3_PC.04	340	Output
143	GPIO3_PAA.03	251	Input				GPIO3_PZ.02	522	Output
145	GPIO3_PAA.02	250	Output				GPIO3_PZ.03	523	Input
178				GPIO3_PA.06	6	Output			
179	GPIO3_PL.02	378	Input	GPIO3_PA.02	2	Input	GPIO3_PA.02	322	Input
180				GPIO3_PA.01	1	Input	GPIO3_PA.01	321	Bidirectional
181				GPIO3_PA.00	0	Output	GPIO3_PA.00	320	Output
182	GPIO3_PK.02	370	Bidirectional				GPIO3_PA.06	326	Bidirectional
183	GPIO3_PK.03	371	Output				GPIO3_PA.05	325	Output
185	GPIO3_PCC.07	271	Bidirectional	GPIO3_PJ.01	73	Bidirectional	GPIO3_PC.05	341	Bidirectional
187	GPIO3_PDD.00	272	Bidirectional	GPIO3_PJ.00	72	Bidirectional	GPIO3_PC.06	342	Bidirectional
189				GPIO3_PJ.02	74	Bidirectional	GPIO3_PEE.00	288	Bidirectional
191				GPIO3_PJ.03	75	Bidirectional	GPIO3_PEE.01	289	Bidirectional
193	GPIO3_PT.06	446	Not Assigned	GPIO3_PJ.06	78	Input	GPIO3_PJ.01	393	Input
195	GPIO3_PT.07	447	Not Assigned	GPIO3_PJ.05	77	Input	GPIO3_PJ.02	394	Input
197	GPIO3_PU.00	448	Not Assigned	GPIO3_PJ.04	76	Input	GPIO3_PJ.03	395	Input
199	GPIO3_PT.05	445	Not Assigned	GPIO3_PJ.07	79	Input	GPIO3_PJ.00	392	Input
203	GPIO3_PR.02	426	Output	GPIO3_PG.00	48	Output	GPIO3_PW.02	498	Output
205	GPIO3_PR.03	427	Input	GPIO3_PG.01	49	Input	GPIO3_PW.03	499	Input
206	GPIO3_PR.00	424	Input	GPIO3_PV.00	168	Input	GPIO3_PU.00	480	Input
207	GPIO3_PR.04	428	Not Assigned	GPIO3_PG.02	50	Input	GPIO3_PW.04	500	Input
208	GPIO3_PQ.02	418	Input	GPIO3_PZ.02	202	Input	GPIO3_PX.04	508	Input
209	GPIO3_PR.05	429	Not Assigned	GPIO3_PG.03	51	Input	GPIO3_PW.05	501	Input
211	GPIO3_PS.04	436	Not Assigned	GPIO3_PBB.00	216	Input	GPIO3_PJ.04	396	Input
212	GPIO3_PQ.01	417	Input	GPIO3_PV.01	169	Input	GPIO3_PC.01	337	Input
213	GPIO3_PP.02	410	Bidirectional	GPIO3_PS.02	146	Bidirectional	GPIO3_PO.02	434	Bidirectional
214	GPIO3_PG.00	336	Input	GPIO3_PX.06	190	Input	GPIO3_PFF.01	529	Input
215	GPIO3_PP.03	411	Bidirectional	GPIO3_PS.03	147	Bidirectional	GPIO3_PO.03	435	Bidirectional
216	GPIO3_PQ.06	422	Input	GPIO3_PZ.00	200	Input	GPIO3_PEE.02	290	Input
218	GPIO3_PCC.04	268	Not Assigned	GPIO3_PY.02	194	Input	GPIO3_PC.02	338	Input
219	GPIO3_PO.02	402	Bidirectional	GPIO3_PP.05	125	Bidirectional	GPIO3_PG.02	370	Bidirectional
220	GPIO3_PT.02	442	Output	GPIO3_PE.02	34	Bidirectional	GPIO3_PM.03	419	Output
221	GPIO3_PO.03	403	Bidirectional	GPIO3_PP.04	124	Bidirectional	GPIO3_PG.03	371	Bidirectional
222	GPIO3_PT.03	443	Input	GPIO3_PE.01	33	Input	GPIO3_PM.00	416	Input
223	GPIO3_PO.04	404	Bidirectional	GPIO3_PP.03	123	Bidirectional	GPIO3_PG.04	372	Bidirectional
224	GPIO3_PT.04	444	Bidirectional	GPIO3_PE.00	32	Bidirectional	GPIO3_PM.01	417	Bidirectional
225	GPIO3_PO.05	405	Bidirectional	GPIO3_PP.02	122	Bidirectional	GPIO3_PG.05	373	Bidirectional
226	GPIO3_PT.01	441	Bidirectional	GPIO3_PE.03	35	Bidirectional	GPIO3_PM.02	418	Bidirectional
227	GPIO3_PO.01	401	Bidirectional	GPIO3_PP.01	121	Bidirectional	GPIO3_PG.01	369	Bidirectional
228	GPIO3_PN.01	393	Input	GPIO3_PE.06	38	Input	GPIO3_PU.05	485	Input
229	GPIO3_PO.00	400	Output	GPIO3_PP.00	120	Output	GPIO3_PG.00	368	Output
230	GPIO3_PH.01	345	Output	GPIO3_PE.07	39	Output	GPIO3_PV.06	494	Output
232	GPIO3_PI.03	355	Bidirectional	GPIO3_PF.00	40	Bidirectional	GPIO3_PW.00	496	Bidirectional
234	GPIO3_PI.04	356	Bidirectional	GPIO3_PF.01	41	Bidirectional	GPIO3_PW.01	497	Bidirectional
236	GPIO3_PCC.05	269	Output	GPIO3_PU.00	160	Output	GPIO3_PT.00	472	Output
238	GPIO3_PCC.06	270	Input	GPIO3_PU.01	161	Input	GPIO3_PT.01	473	Input
240	GPIO3_PEE.04	284	Input	GPIO3_PX.05	189	Input	GPIO3_PFF.00	528	Input

This Information is provided as is from Auvidea. Auvidea does not guarantee correctness but believes the numbers are correct. If you see any wrong information's, please let us know so we can correct the documentation.

10.3 How to calculate GPIOs

The above list should include every GPIO there is. This “how to” may help you find errors we did in our documentation ore to calculate GPIOs for upcoming models as the NVIDIA Jetson Orin.

10.3.1 GPIOnumber

The basic formular:

$$\text{GPIOnumber} = \text{GPIOletter}*8 + \text{GPIOdigit} + \text{GPIOoffset}$$

10.3.2 GPIOletter

The GPIOletter is located between [GPIO3_P] and [.digit]

GPIOname	GPIOletter	GPIOletter (referenced)
GPIO3_PO.01	O	14 (for Xavier NX)
GPIO3_PCC.04	CC	2 (for Xavier NX)

This letter needs to be referenced to a number.
This number is individual to every Jetson module and can be found in the “tegra-gpio.h” (name may differ depending on module).
Pleas also see the example table shown in GPIOoffset

10.3.3 GPIOdigit

The GPIOdigit is easiest to get and can be extracted directly from the name.
GPIO3_PO.[GPIOdigit]

GPIOname	GPIOdigit
GPIO3_PO.01	1
GPIO3_PCC.04	4

10.3.4 GPIOoffset

The offset is connected to the GPIOletter. The same GPIOletter has always the same GPIOoffset for one specific module and only differs for AON cores.
GPIOoffsets are listed later in the table.

10.3.5 Example

Calculating GPIO number GPIO3_PO.01 for Jetson Xavier NX:

$$\text{GPIOnumber} = \text{GPIOletter}*8 + \text{GPIOdigit} + \text{GPIOoffset}$$

$$\text{GPIOnumber} = 401 = 14*8 + 1 + 288$$

10.3.6 Table

Jetson Xavier NX			
Alpha Key	Value	Offset	Note
A.	0	288	
B.	1	288	
C.	2	288	
D.	3	288	
E.	4	288	
F.	5	288	
G.	6	288	
H.	7	288	
I.	8	288	
J.	9	288	
K.	10	288	
L.	11	288	
M.	12	288	
N.	13	288	
O.	14	288	
P.	15	288	
Q.	16	288	
R.	17	288	
S.	18	288	
T.	19	288	
U.	20	288	
V.	21	288	
W.	22	288	
X.	23	288	
Y.	24	288	
Z.	25	288	
AA	0	248	AON GPIO
BB	1	248	AON GPIO
CC	2	248	AON GPIO
DD	3	248	AON GPIO
EE	4	248	AON GPIO
FF	26	288	
GG	27	288	

Jetson Nano		
Alpha Key	Value	Offset
A.	0	0
B.	1	0
C.	2	0
D.	3	0
E.	4	0
F.	5	0
G.	6	0
H.	7	0
I.	8	0
J.	9	0
K.	10	0
L.	11	0
M.	12	0
N.	13	0
O.	14	0
P.	15	0
Q.	16	0
R.	17	0
S.	18	0
T.	19	0
U.	20	0
V.	21	0
W.	22	0
X.	23	0
Y.	24	0
Z.	25	0
AA	26	0
BB	27	0
CC	28	0
DD	29	0
EE	30	0
FF	31	0

Jetson TX2 NX			
Alpha Key	Value	Offset	Note
A.	0	320	
B.	1	320	
C.	2	320	
D.	3	320	
E.	4	320	
F.	5	320	
G.	6	320	
H.	7	320	
I.	8	320	
J.	9	320	
K.	10	320	
L.	11	320	
M.	12	320	
N.	13	320	
O.	14	320	
P.	15	320	
Q.	16	320	
R.	17	320	
S.	18	320	
T.	19	320	
U.	20	320	
V.	21	320	
W.	22	320	
X.	23	320	
Y.	24	320	
Z.	25	320	
AA	0	256	AON GPIO
BB	1	256	AON GPIO
CC	2	256	AON GPIO
DD	3	256	AON GPIO
EE	4	256	AON GPIO
FF	26	320	
GG	27	320	

SECTION 11 Appendix C [I2C]

This Appendix shows the basic usage of the I2C bus.

11.1 I2C device bus

I2C Examples of configurations and how to use.

Bus	GEN1_I2C	GEN2_I2C	GEN3_I2C	CAM_I2C
Pins	185 and 187	189 and 191	232 and 234	213 and 215
Voltage (native)	3.3V	3.3V	1.8V	3.3V
Nano device				6
TX2 NX device	0			
Xavier NX device	1			2
Crypto chip		ATSHA204A		
CSI-2 camera	CSI-CD	CSI-E	CSI-F	CSI-AB
GPIO header	27 and 28	3 and 5		
EEPROM		24LC024		

11.2 I2C usage of devices and registers

11.2.1 List i2c devices on a specific bus

Syntax: i2cdetect [options] <busNr>

```
test@test-desktop:~$ i2cdetect -y -r 8
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00: -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- 76 --
test@test-desktop:~$
```

11.2.2 Dump i2c device registers

Syntax: i2cdump [options] <busNr> <deviceAddress>

```
test@test-desktop:~$ i2cdump -y -f 8 0x76
No size specified (using byte-data access)
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f  0123456789abcdef
00: 00 00 ff ff 00 00 ff ff XX XX XX XX XX XX XX XX ........XXXXXXXX
10: XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XXXXXXXXXXXXXXXX
20: XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XXXXXXXXXXXXXXXX
...
d0: XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XXXXXXXXXXXXXXXX
e0: XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XXXXXXXXXXXXXXXX
f0: XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XXXXXXXXXXXXXXXX
test@test-desktop:~$
```

11.2.3 Set register value:

Syntax: i2cset [options] <busNr> <deviceAddress> <register> <address> <value>

```
test@test-desktop:~$ sudo i2cset -y -f 8 0x76 0x06 0x00
test@test-desktop:~$
```

11.2.4 Read register value:

Syntax: i2cget [options] <busNr> <deviceAddress> <register> <address>

```
test@test-desktop:~$ sudo i2cget -y -f 8 0x76 0x06
0x00
test@test-desktop:~$
```

11.2.5 Test IMX219 camera stream

The parameter `sensor-id=` describes the camera target. This id can be found by using `ls /dev/`. If the camera correctly plugged in then there should be a device called `/dev/videoX`, where X is the camera id.

```
test@test-desktop:~$ gst-launch-1.0 nvarguscamerasrc sensor-id=0 ! 'video/x-
raw(memory:NVMM), width=(int)1280, height=(int)720, format=(string)NV12,
framerate=(fraction)30/1' ! nvvidconv ! queue ! xvimagesink
```

SECTION 12 Appendix D [SSD-Boot]

If you are interested at booting your system fully or partially from SSD pleas see our Software Setup Guide on our support site. https://auvidea.eu/manuals/
The information from this Appendix D has been moved to the Software Setup Guide.

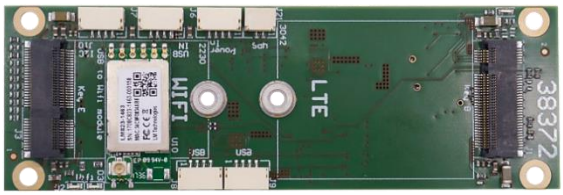
SECTION 13 Appendix E [Wi-Fi]

This appendix describes how you can bring Wi-Fi functionality to one of Auvidea JN boards afterwards. If you possess a different carrier board line-up parts of this Appendix still apply and provide valuable information.
Please note that exclusively USB-only Wi-Fi cards are supported at the moment.
This excludes PCIe Wi-Fi cards from Intel ore other vendors.
Future development aims to also provide solutions for PCIe Wi-Fi cards.
Please contact Auvidea for custom solutions when needed.

13.1 Options from AUVIDEA

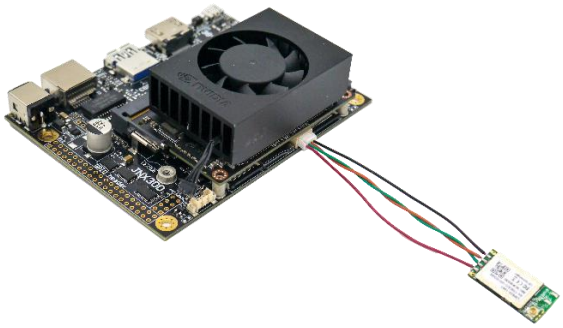
13.1.1 U100 Adapter

The U100 is an adapter board with four port USB 2.0 hub and 1x M.2 Key E slot for USB only Wi-Fi cards and M.2 Key B for LTE cards.
A version of U100 with already integrated LM823 Wi-Fi is available from Auvidea.

	U100	Note
Image		This adapter connects to the J8 connector as shown in “LM823 with cable” https://auvidea.eu/product/38372/

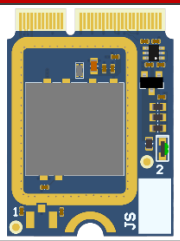
13.1.2 LM823 with cable

Simple solution to connect a LM823 (5V only!) module to the J8 connector on the JNX30D carrier board.

	Setup example	Kabel + LM823-module
Image		

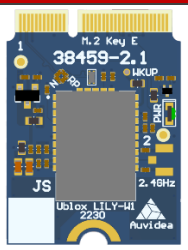
Please contact Auvidea for samples.

13.1.3 38458 Wi-Fi card

	38458 Wi-Fi card	Note
		M.2 Key E Wi-Fi card with RTL8188 module.

Please contact Auvidea for samples.

13.1.4 38459 Wi-Fi card

	38459 Wi-Fi card	38459 Wi-Fi card	Note
			M.2 Key E Wi-Fi card with Ublox Lily W-131 module.

Please contact Auvidea for samples.

13.1.5 U101 Adapter

[in development] A simple adapter from internal USB connector to M.2. Enables the use of USB only Wi-Fi cards.
Please contact Auvidea for samples.

13.1.6 U102 Adapter

[in development] A simple adapter board for the LM823 module with 3.3V power for the 3.3V version of LM823.
Please contact Auvidea for samples.

13.2 Options from other sources

13.2.1 ST60-2230C-UU by Laird

The M.2 Key E ST60-2230C-UU by Laird is evaluated and validated from Auvidea. Can be installed in the U100 Adapter. Auvidea can provide this card. Please ask for a quote.

13.2.2 Further modules

Also, any M.2 USB only Wi-Fi cards should be compatible with the boards from Auvidea.
When using different modules then suggested you must conduct your own verification process.

13.3 DIY integration

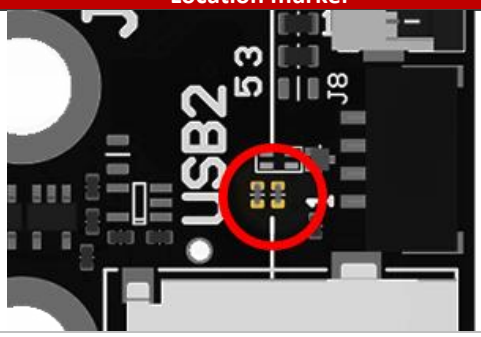
This example shows the integration of LM823 Wi-Fi module into the JN30D (38488-2). Similar steps may be applicable to your product.
Note that not all carrier boards support this modification/integration!
Please contact Auvidea for support if you have problems with different carrier boards.

You will need:

- LM823 Module (3.3V or 5V)
- Three beads (0201 0-Ohm)
- Soldering skills

13.3.1 Enable USB interface

The LM823 module when soldered to the appropriate bay is using the USB 2.0 lanes from the J8 USB connector. When performing this modification, the J8 USB port must not be used afterwards!

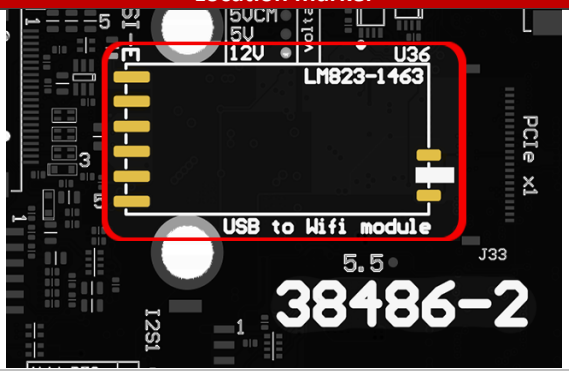
	Location marker	Note
USB-beads		Solder two beads next to the J8 USB 2.0 connector (vertical orientation) to the location marked with the red circle. This will connect J8 to the LM823 solder pins.

13.3.2 Set voltage

On the underside pleas first set the appropriate voltage for your LM823 module.

	Location marker	Note
Voltage select		Soldering on a bead to ether the 3 (3.3V) ore 5 (5V) location as displayed in the picture. Please check your LM823 module needs.

13.3.3 Soldering on Module

	Location marker	Note
LM823 bay		The LM823 module can be easily soldered to the pins.

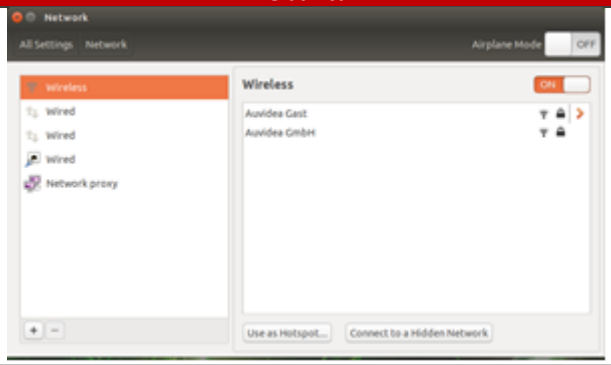
13.3.4 Result

	Location marker	Note
Reference		After soldering on your module your result should look like displayed here. After connecting the antenna to the Wi-Fi module, you can start your system and test if it gets recognised.

13.4 Test Wi-Fi module connection

13.4.1 With GUI

You can check Wi-Fi functionality with the Ubuntu GUI

	Ubuntu	Note
Wi-Fi test		After installing a Wi-Fi module, it should be a visible network in the Ubuntu Network GUI.

13.4.2 Without GUI

USB devices can also be listed with lsusb:
Module is highlighted in red.

```
test@test-desktop:~$ lsusb
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 001 Device 003: ID 0bda:8179 Realtek Semiconductor Corp. RTL8188EUS 802.11n Wireless Network
Adapter <- LM module
Bus 001 Device 006: ID 1058:25a2 Western Digital Technologies, Inc.
Bus 001 Device 005: ID 04ca:007d Lite-On Technology Corp.
Bus 001 Device 004: ID 046d:c077 Logitech, Inc. M105 Optical Mouse
Bus 001 Device 002: ID 05e3:0608 Genesys Logic, Inc. Hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
test@test-desktop:~$
```

SECTION 14 END OF DOKUMENT

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