NVIDIA DRIVE AGX Orin Developer Kit Mechanical and Installation Guide

Installation Guide

DI-10587-003_v03 | February 2023

Document History

DI-10587-003_v03

Version	Date	Authors	Description of Change
01	June 27, 2022	JH, VS	Initial Release.

02	September 22, 2022	JH, VS	• Updated attachment: DRIVE_AGX_Orin_System_and_Tray_CAD.nvzip
			• Updated Figure 1-1 to change rubber feet height from 3.00mm to 3.50mm.
			• Replaced Figure 1-2 and Figure 1-3 with new images.
			• Updated Figure 1-4 description to remove "NOT FINAL".
			• Corrected the 1GbE RJ45 connector part number in Table 2-1.
			• Updates in Section 2.3: Cable Harness Connectors:
			  > Added Table 2-1 for the cable type/length as well as the breakout cables.
			  > Removed SPI3 support on the cable harness.
			  > Removed A2B feature and updated tables accordingly.
			  > Updated cable harness tables to change unsupported cable harness pins to "reserved" pins.
			  > Added Table 2-7 and Table 2-10 to list DB9 breakout cable lengths of the cable harness.
			• Added USB Type-C connector power support capability to Table 2-14.
			• Added Shock and Vibration information in Section 3.1: Shock and Vibration.

03	February 3, 2023	JH, VS	• Updated Table 1-1: Dimensions and Weight. • Updated Table 2-2 to add three Amphenol Mini-SAS cables in different lengths. • Updated Figure 2-6 for swapping MATEnet port-4 and port-6 locations and adding RJ45 reference designators. • Updated Figure 2-8 to show Mini-SAS pin numbers. • Updated Section 2.7 for describing why the standard Mini-SAS cable can't be used for system expansion • Added Figure 2-9 and Figure 2-10 to Section 2.7 to show the Mini-SAS cable connections for system expansion.

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Chapter 1. Mechanical Dimensions

1.1 Overview

The NVIDIA DRIVE AGX Orin™ System, hereinafter referred to as "developer system", is a modular design with the NVIDIA DRIVE Orin™ Module on the mainboard. This document describes the details for installing the developer system in a vehicle.

> Note: The NVIDIA DRIVE AGX Orin System, hereinafter referred to as "Orin Module", is a modular design with NVIDIA DRIVE Orin™ Module on the mainboard.
>
> All occurrences of "Orin" or "Orin SoC", in this document, refer to the NVIDIA DRIVE Orin-X™ SoC.

The 3D CAD models of the developer system and its accessories (mounting tray, 1G / 10G NIC adapter) in STP format are provided as the following attachment to this document:

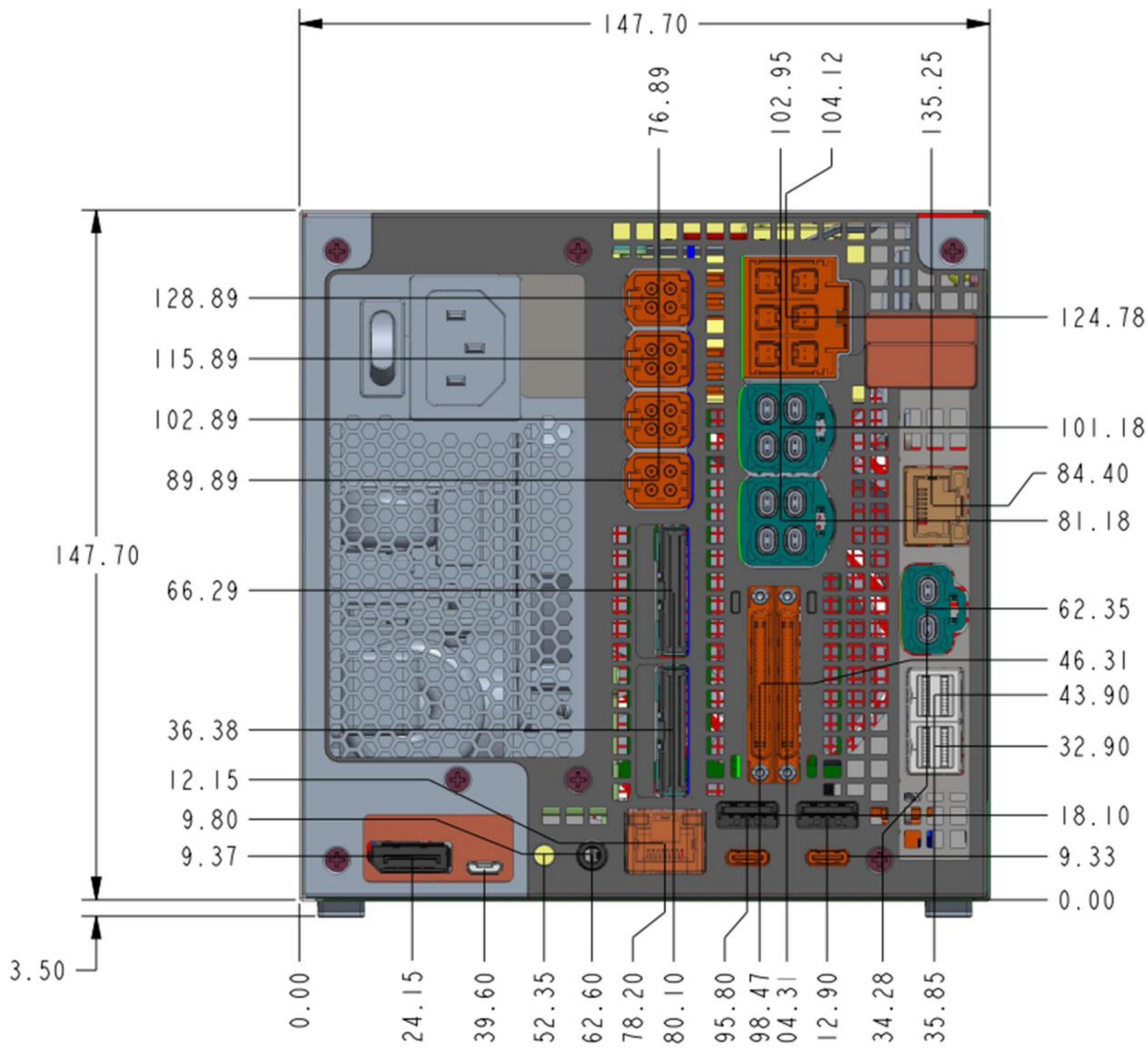
- DRIVE_AGX_Orin_System_and_Tray_CAD.nvzip

> Note: To access the attached file:
>
> - ***Download*** this PDF file to your local drive.
> - ***Click*** on the Attachment tab of the downloaded PDF (or the paper clip icon depending on your version of Acrobat Reader).
> - ***Select*** the file and use the Tool Bar options (Open, Save) to retrieve the documents.
> - ***Rename*** the **.nvzip** file to **.zip** before it can be extracted.

1.2 Dimensions and Weight

The detailed locations of the developer system connectors on the rear panel are shown in Figure 1-1.

Figure 1-1. Connector Locations



The dimensions and the weight of developer system are shown in Table 1-1 below.

Table 1-1. Dimensions and Weight

Dimensions (mm)	Development System Only	Development System with Tray
Length	370	370
Width	147.7	195.7
Height (without rubber feet)	147.7	151.7
Weight (kg)	**Development System Only**	**Development System with Tray**
Without Cable Harness and Accessories	5.6 ± 3%	6.27 ± 3%

1.3 Mounting Considerations

As shown in Figure 1-2, when mounting the developer system in a vehicle, make sure that there are no obstructions on the front and rear panels to block the airflow. There must be enough clearance around the fan opening on the front panel for the cooling solution.

See Table 1-2 for the recommended clearance for all four sides.

Figure 1-2. Keep-out Clearance Around All Sides

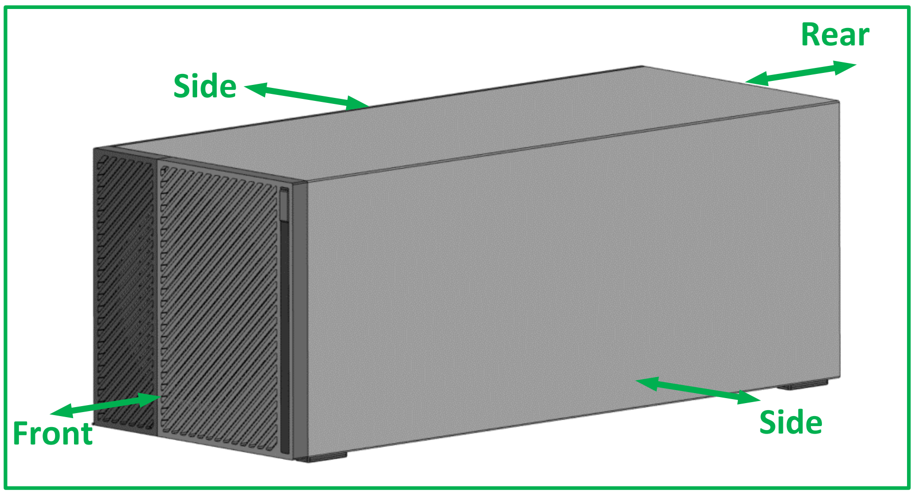


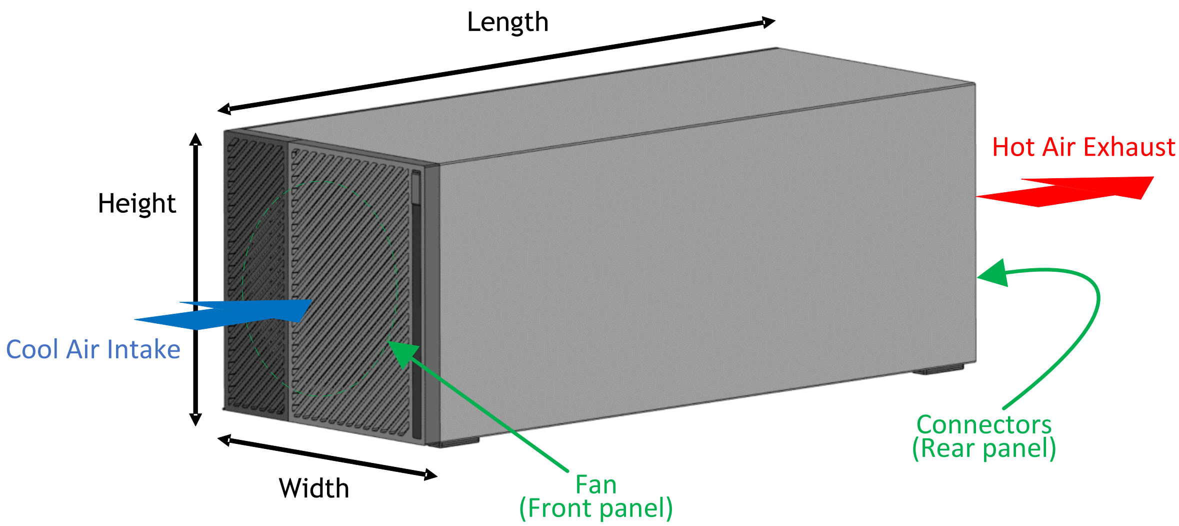
Table 1-2. Clearance Recommendation

Panel	Clearance (mm)
Front	80
Rear	100
Side	20

The airflow rate required for the developer system is 80 cfm. With proper clearance, the developer system fans can deliver greater than 80 cfm at max RPM. See Figure 1-3 for the airflow direction.

The rear panel also needs clearance for air exhaust to come out, plugging/unplugging the cables as well as accommodating for cable bend radius.

Figure 1-3. Airflow Direction



As shown in Figure 1-4, there are four mounting holes on the bottom of the developer system. Please follow the guidelines below when installing the developer system in vehicle.

- The rubber feet on the bottom are for bench use. Remove them before installing in the vehicle.
- Use four M6 screws through the mounting holes on the bottom side to secure the developer system to the tray.
- Ensure a dust free environment; ***do not mount on carpet***.
- Ensure a good GND connection to the chassis of the car.
- Ensure sufficient air flow.

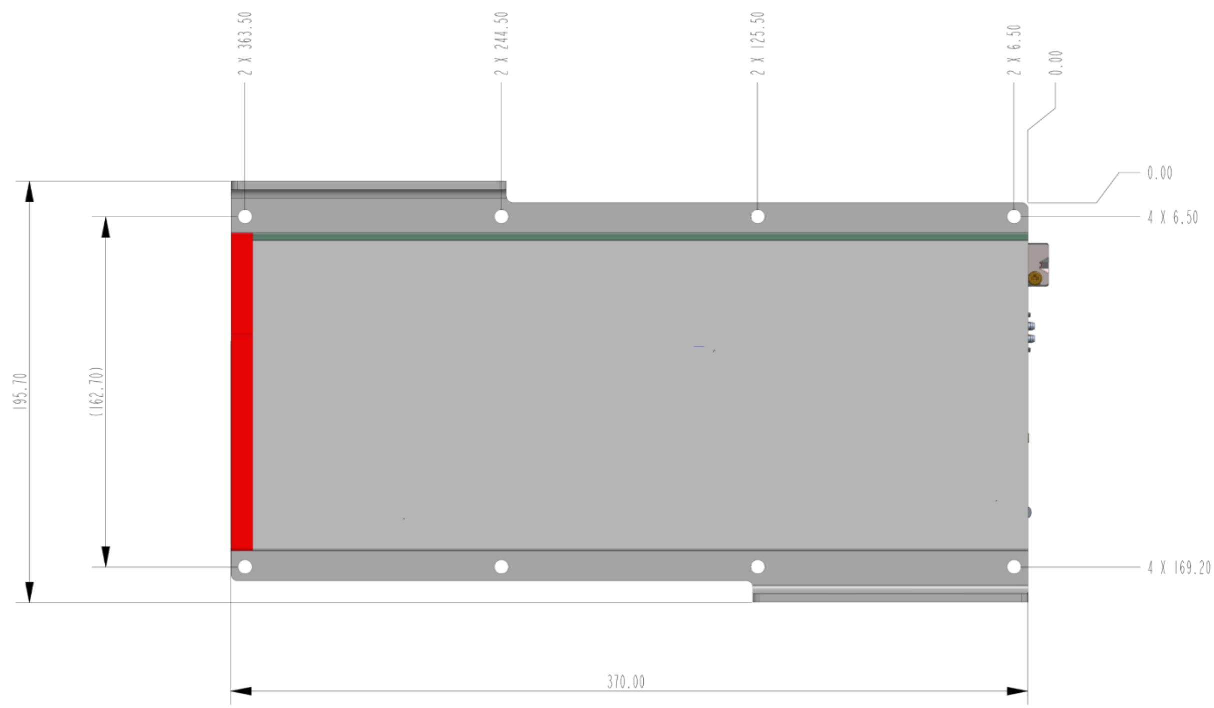
> ! CAUTION: The developer system must be mounted horizontally with the bottom side facing downwards. DO NOT mount in any other orientation.

Figure 1-4. Mounting Hole Locations - Bottom View

BOTTOM VIEW

4 × M6 Screw Locations (Max. Screw Length without Head: 4 mm)

Figure 1-5. Mounting Hole Locations – Top View



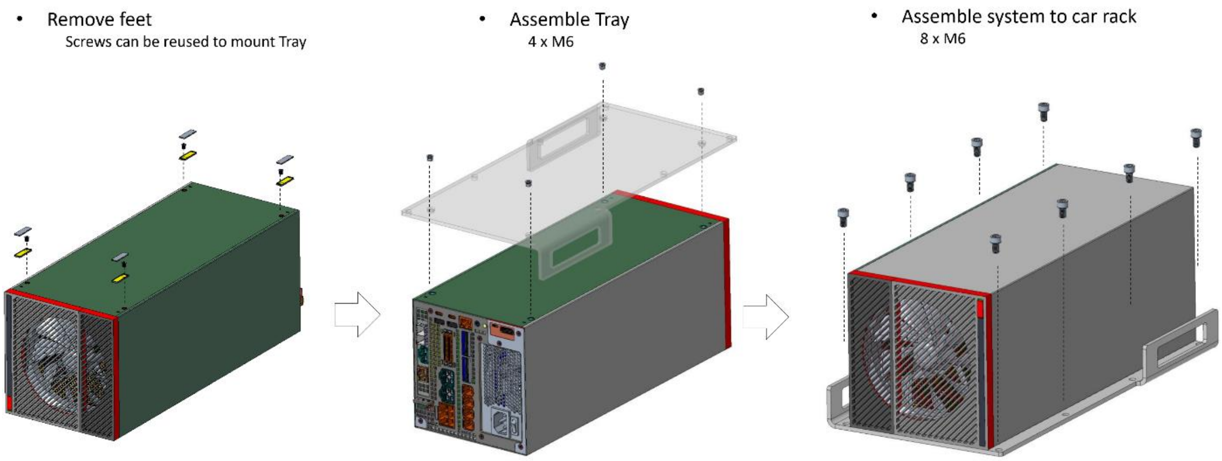
TOP VIEW with TRAY

8 × M6 Screw Locations

Figure 1-6 is an example of how to secure the system onto a rack tray of your vehicle. Customers may design the tray suited to their specific design.

> Note:
> Figure 1-6 is an example only. Customers may need to design their design-specific tray or contact NVIDIA for more details.

Figure 1-6. Procedure to Secure the System to a Tray



Chapter 2. Interface Connectors

2.1 Overview

The developer system is a modular design with the NVIDIA DRIVE Orin™ Module on the mainboard. This document depicts the details of the connectors of the developer system.

2.2 Connector Types and Supported Cables

The developer system connectors are on a single panel; their locations shown in Figure 2-1.

Figure 2-1. Rear Panel Connectors

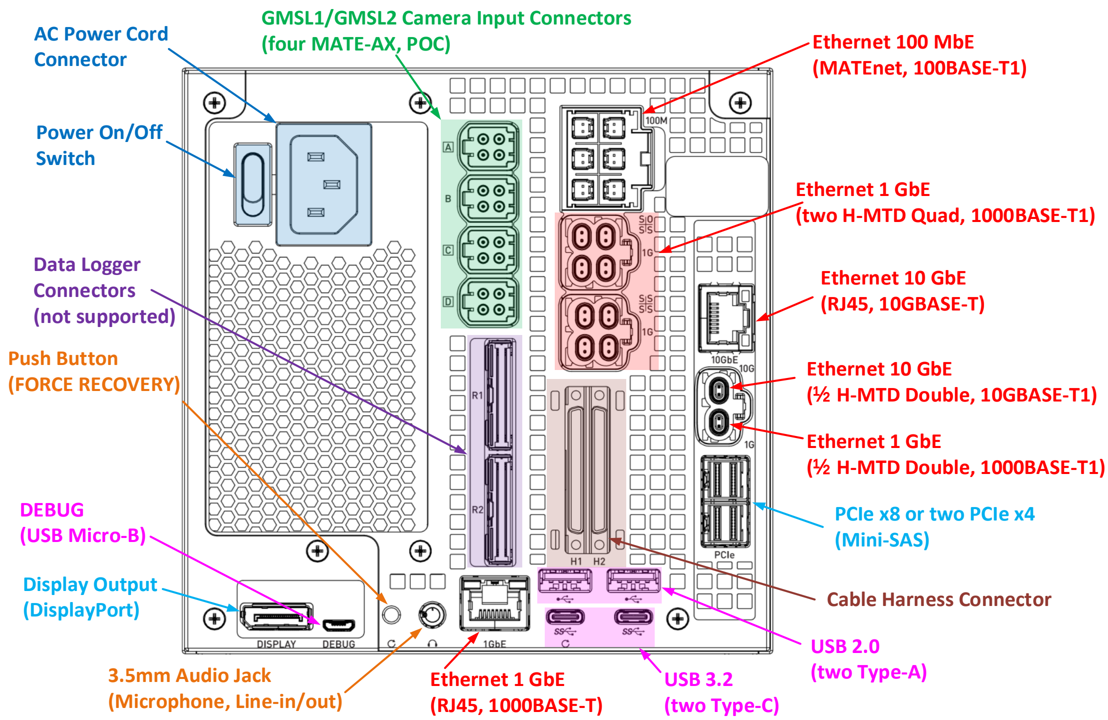


Table 2-1 lists the connectors on the panel.

Table 2-1. Interface Connector Quantities and Part Numbers

Interface		Type/Series	Quantity	Manufacturer	Part Number	Remarks
One PCIe x8 or two PCIe x4		Mini-SAS	1	Amphenol	U92-M211-1001-70	
Camera Input		MATE-AX	4	Tyco Electronics	0-2304168-9	Each has 4 POC inputs
Ethernet	100 MbE	MATEnet	1	TE Connectivity	2339800-9	Hexad connector
Ethernet	1 GbE	RJ45	1	Pulse Electronics	JT7-1119NL	
Ethernet	1 GbE	H-MTD Quad	2	Rosenberger	E6S20D-40MT5-Z	Each has 4 pairs
Ethernet	1 GbE / 10 GbE	H-MTD Double	1	Rosenberger	E6S20B-40MT5-Z	1 GbE on lower pair 10 GbE on upper pair
Ethernet	10 GbE	RJ45	1	Singatron Enterprise	2TJRTA-AD-0003	
Cable Harness		HDRA	1	HTK (Honda Tsushin Kogyo Co., Ltd.)	HDRA-E68W1LFDT1EC-SLD+	
Audio Input/Output		3.5mm Audio Jack	1	Astron Technology	505F206-0N087T-H	
Display Output		DisplayPort *	1	Astron Technology	699FA20-XN060D-H	
DEBUG		USB Micro-B	1	Singatron Enterprise	2UB2141-000111F	
USB 2.0		USB Type-A	2	Astron Technology	235F304-0N0C8T-H	
USB 3.2		USB Type-C	2	Astron International	237FC24-0N137T-H	
Data Logger		ARF6-RA	2	Samtec	ARF6-24-S-RA-TR	Not supported
Power Input		IEC 320 C14	1			Standard 3-pin IEC 320 C14 AC Power Socket

* VESA® DisplayPort™

The connectors on the rear panel are connected to the other systems, modules, or devices in the vehicle or on the bench through cables. Please refer to the connector part numbers above to find the appropriate mating connectors when creating cabling solution for the developer system. The maximum supported cable lengths of these cables are listed in Table 2-2 below.

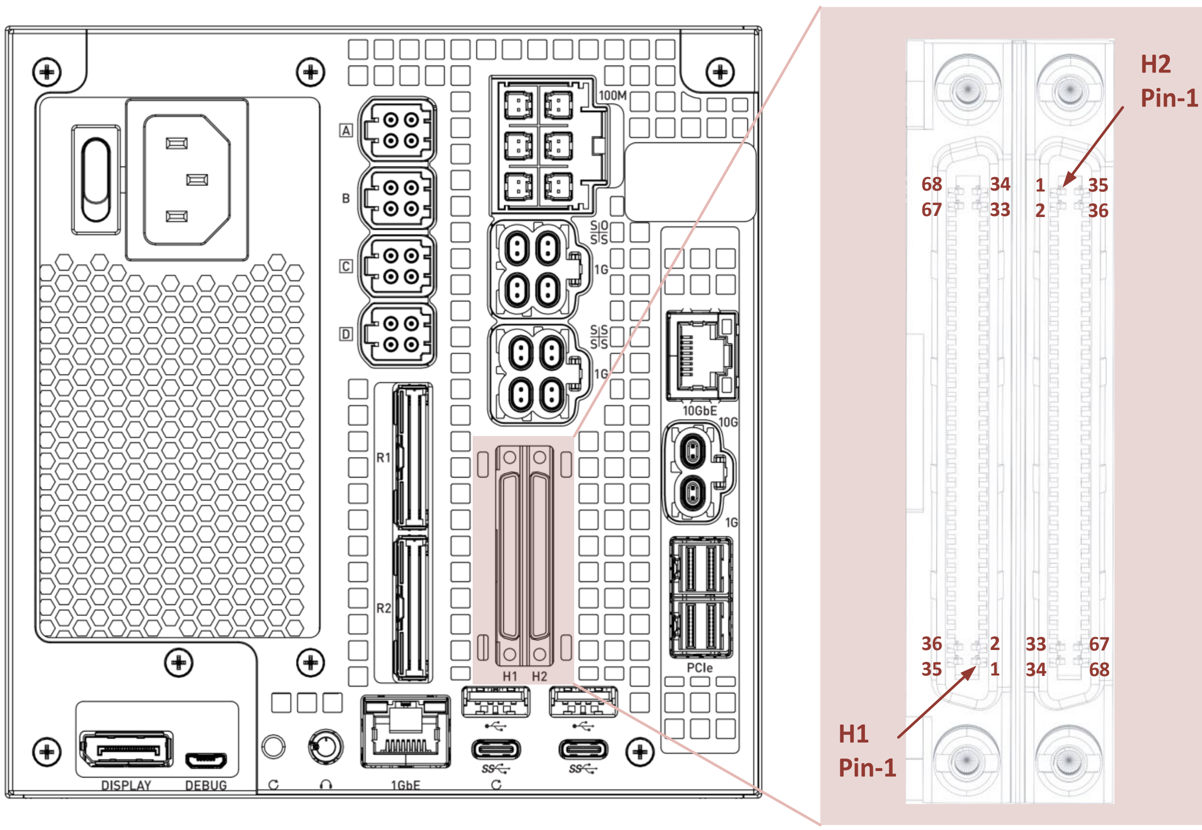
Table 2-2. Supported Interface Connector Cables and Cable Lengths

Interface		Connector Type/Series	Breakout Cable			Supported Cable	
			Manufacturer Part Number	System Side connector	Breakout Connectors	Cable Type	Maximum Length
One PCIe x8 or two PCIe x4		Mini-SAS	None	None	None	Amphenol NEDDDF-N904	0.5 meter
						Amphenol NEDDDF-N901	1 meter
						Amphenol NEDDDF-N903	3 meters
Camera Input		MATE-AX	TE Connectivity 2334699-1	TE Connectivity 2298721-9	4x FAKRA II Jack	LEONI Dacar® 302	15 meters (GMSL2)
Ethernet	100 MbE	MATEnet	MD Elektronik GmbH 342477	Tyco 2317303-1	6x Rosenberger E6Z003-001-Z	LEONI Dacar® 636	15 meters
	1 GbE	RJ45	None	None	None	Standard CAT5	100 meters
		H-MTD Quad	Rosenberger LCA-114-1000-Z-ZZZZ	Rosenberger E6Z017-001-Y	4x Rosenberger E6Z003-001-Y	LEONI Dacar® 636	15 meters
		H-MTD Double	Rosenberger LCA-115-1000-Z-ZZ	Rosenberger E6Z011-001-Y	2x Rosenberger E6Z003-001-Y	LEONI Dacar® 636	15 meters
	10 GbE						TBD
		RJ45	None	None	None	CAT6 CAT6A	55 meters 100 meters
Cable Harness	CAN	HDRA	None	HTK HDRA-E68MA1+ (with UL20276 AWG30)	DB9		Industry Standard
	USS				DB9		
	UART				DB9		
	FlexRay				DB9		
	LIN				DB9		
	GPIO/PPS				DB9		
Display Output		DisplayPort *	None	None	None		
DEBUG		USB Micro-B	None	None	None	Industry Standard	3 meters
USB 2.0		USB Type-A	None	None	None		3 meters
USB 3.2		USB Type-C	None	None	None		1 meter
Note: The maximum length includes the breakout cable length for those interfaces with breakout cables.							

2.3 Cable Harness Connectors

The developer system uses the HDRA series connector from HTK for cable harness connections. Each cable harness connector includes two 68-pin sections, marked as H1 and H2. The pin numbers of the connectors are shown in Figure 2-2.

Figure 2-2. Cable Harness Connectors



The pin assignments of the cable harness connector are listed in the following tables.

Table 2-3. Cable Harness H1 Connector Pin Assignments (1 of 2)

Pin	Signal Name	Description	Note
68	ORIN_3V3_SENSOR_PPS	Sensor PPS input connected to Orin GP60	1
67	RSVD	Reserved	
66	RSVD	Reserved	
65	GND	Ground	
64	RSVD	Reserved	
63	GND	Ground	

Pin	Signal Name	Description	Note
62	GND	Ground	
61	RSVD	Reserved	
60	RSVD	Reserved	
59	RSVD	Reserved	
58	RSVD	Reserved	
57	GND	Ground	
56	ORIN_3V3_LIMITED	3.3V power output with current limit	2
55	RSVD	Reserved	
54	GND	Ground	
53	RSVD	Reserved	
52	RSVD	Reserved	
51	GND	Ground	
50	RSVD	Reserved	
49	GND	Ground	
48	NC	No connect	
47	NC	No connect	
46	NC	No connect	
45	NC	No connect	
44	SMCU_CAN4_L	CAN pin connected to Aurix CAN4 (P22.[7:6]) via CAN transceiver	3
43	SMCU_CAN4_L	CAN pin connected to Aurix CAN4 (P22.[7:6]) via CAN transceiver	3
42	GND	Ground	
41	SMCU_CAN4_H	CAN pin connected to Aurix CAN4 (P22.[7:6]) via CAN transceiver	3
40	SMCU_CAN4_H	CAN pin connected to Aurix CAN4 (P22.[7:6]) via CAN transceiver	3
39	NC	No connect	
38	GND	Ground	
37	WUP_SATELLITE	12V Wake-up output connected to Aurix P23.1	
36	GND	Ground	
35	WUP_SENSOR	12V Wake-up output connected to Aurix P23.0	

Notes:

1. Orin 1.8V balls are level-shifted to 3.3V.
2. This pin, combined with H2 pin-56, supports up to 40mA of 3.3V current when Orin is powered.
3. This CAN port also connects to Orin CAN2 (FSI_CAN0) via CAN transceiver.

Table 2-4. Cable Harness H1 Connector Pin Assignments (2 of 2)

Pin	Signal Name	Description	Note
34	NC	No connect	
33	NC	No connect	
32	GND	Ground	
31	AURIX_3V3_LIMITED	3.3V power output with current limit	1
30	NC	No connect	
29	GND	Ground	
28	NC	No connect	
27	NC	No connect	
26	NC	No connect	
25	RSVD	Reserved	
24	RSVD	Reserved	
23	RSVD	Reserved	
22	RSVD	Reserved	
21	RSVD	Reserved	
20	RSVD	Reserved	
19	ORIN_FSICAN1_H	CAN pin connected to Orin CAN3 (FSI_CAN1) via CAN transceiver	2
18	ORIN_FSICAN1_L	CAN pin connected to Orin CAN3 (FSI_CAN1) via CAN transceiver	2
17	GND	Ground	
16	SMCU_FLEXRAY1_BP	FlexRay pin connected to Aurix FlexRay (P02.x) via FlexRay transceiver	
15	SMCU_FLEXRAY1_BP	FlexRay pin connected to Aurix FlexRay (P02.x) via FlexRay transceiver	
14	GND	Ground	
13	SMCU_FLEXRAY1_BM	FlexRay pin connected to Aurix FlexRay (P02.x) via FlexRay transceiver	
12	SMCU_FLEXRAY1_BM	FlexRay pin connected to Aurix FlexRay (P02.x) via FlexRay transceiver	
11	GND	Ground	
10	SMCU_CAN6_H	CAN pin connected to Aurix CAN4 (P22.[11:10]) via CAN transceiver	3
9	SMCU_CAN6_H	CAN pin connected to Aurix CAN4 (P22.[11:10]) via CAN transceiver	3
8	GND	Ground	
7	SMCU_CAN6_L	CAN pin connected to Aurix CAN4 (P22.[11:10]) via CAN transceiver	3
6	SMCU_CAN6_L	CAN pin connected to Aurix CAN4 (P22.[11:10]) via CAN transceiver	3
5	SMCU_CAN5_H	CAN pin connected to Aurix CAN4 (P22.[9:8]) via CAN transceiver	4
4	SMCU_CAN5_H	CAN pin connected to Aurix CAN4 (P22.[9:8]) via CAN transceiver	4
3	GND	Ground	

Pin	Signal Name	Description	Note
2	SMCU_CAN5_L	CAN pin connected to Aurix CAN4 (P22.[9:8]) via CAN transceiver	4
1	SMCU_CAN5_L	CAN pin connected to Aurix CAN4 (P22.[9:8]) via CAN transceiver	4

Notes:

1. This pin, combined with H2 pin-31, supports up to 40mA of 3.3V current when Aurix is powered.
2. Only when Aurix P34.4 (signal ORIN_FSICAN1_SEL) is high, the Orin CAN3 (FSI_CAN1) is connected to a CAN transceiver.
3. This CAN port also connects to Orin CAN1 (GP19_CAN1_DOUT, GP20_CAN1_DIN) via CAN transceiver.
4. This CAN port also connects to Orin CAN0 (GP17_CAN0_DOUT, GP18_CAN0_DIN) via CAN transceiver.

Table 2-5. Cable Harness H2 Connector Pin Assignments (1 of 2)

Pin	Signal Name	Description	Note
1	USS_SENSOR01	Ultrasonic port-1 sensor input-1	1
2	USS_SENSOR02	Ultrasonic port-1 sensor input-2	1
3	USS_SENSOR03	Ultrasonic port-1 sensor input-3	1
4	USS_SENSOR04	Ultrasonic port-1 sensor input-4	1
5	USS_SENSOR05	Ultrasonic port-1 sensor input-5	1
6	USS_SENSOR06	Ultrasonic port-1 sensor input-6	1
7	USS_VOUT1_F	Fused ultrasonic port-1 power output	2
8	USS_VOUT1_F	Fused ultrasonic port-1 power output	2
9	USS_VOUT1_F	Fused ultrasonic port-1 power output	2
10	GND	Ground	
11	GND	Ground	
12	GND	Ground	
13	GND	Ground	
14	SMCU_CAN1_L	CAN pin connected to Aurix CAN1 (P00.[3:2]) via CAN transceiver	3
15	SMCU_CAN1_L	CAN pin connected to Aurix CAN1 (P00.[3:2]) via CAN transceiver	3
16	GND	Ground	
17	SMCU_CAN1_H	CAN pin connected to Aurix CAN1 (P00.[3:2]) via CAN transceiver	3
18	SMCU_CAN1_H	CAN pin connected to Aurix CAN1 (P00.[3:2]) via CAN transceiver	3
19	SMCU_CAN2_L	CAN pin connected to Aurix CAN2 (P00.[1:0]) via CAN transceiver	3
20	SMCU_CAN2_L	CAN pin connected to Aurix CAN2 (P00.[1:0]) via CAN transceiver	3
21	GND	Ground	
22	SMCU_CAN2_H	CAN pin connected to Aurix CAN2 (P00.[1:0]) via CAN transceiver	3
23	SMCU_CAN2_H	CAN pin connected to Aurix CAN2 (P00.[1:0]) via CAN transceiver	3
24	RSVD	Reserved	
25	GND	Ground	
26	RSVD	Reserved	
27	RSVD	Reserved	
28	RSVD	Reserved	
29	GND	Ground	

Pin	Signal Name	Description	Note
30	WUP_IN	Wake input	4
31	AURIX_3V3_LIMITED	3.3V power output with current limit	5
32	GND	Ground	
33	AURIX_RS232_TXD	RS232 pin connected to Aurix P14.0 via RS232 line transceiver	
34	AURIX_RS232_RXD	RS232 pin connected to Aurix P14.1 via RS232 line transceiver	

Notes:

1. Orin SPI3 is connected to an ultrasonic ASIC. An IO expander controlled by Orin I2C4 is used for scanning up to 12 ultrasonic sensors.
2. Fused ultrasonic power output from a high-side switch enabled via IO expander controlled by Orin I2C4.
3. Wake-up capable CAN port.
4. Minimum WUP_IN voltage is 2.5V.
5. This pin, combined with H1 pin-31, supports up to 40mA of 3.3V current when Aurix is powered.

Table 2-6. Cable Harness H2 Connector Pin Assignments (2 of 2)

Pin	Signal Name	Description	Note
35	USS_SENSOR11	Ultrasonic port-2 sensor input-1	1
36	USS_SENSOR12	Ultrasonic port-2 sensor input-2	1
37	USS_SENSOR13	Ultrasonic port-2 sensor input-3	1
38	USS_SENSOR14	Ultrasonic port-2 sensor input-4	1
39	USS_SENSOR15	Ultrasonic port-2 sensor input-5	1
40	USS_SENSOR16	Ultrasonic port-2 sensor input-6	1
41	USS_VOUT2_F	Fused ultrasonic port-2 power output	2
42	USS_VOUT2_F	Fused ultrasonic port-2 power output	2
43	USS_VOUT2_F	Fused ultrasonic port-2 power output	2
44	SMCU_LIN1	LIN pin connected to Aurix LIN1 (P02.[3:2]) via LIN transceiver	
45	LIN_VCC	LIN power output	3
46	GND	Ground	
47	RSVD	Reserved	
48	GND	Ground	
49	RSVD	Reserved	
50	HRN_E-STOP_OUT1	Output pin connected to Aurix P34.3	
51	GND	Ground	
52	HRN_E-STOP_IN1	Input pin connected to Aurix P34.1	
53	HRN_E-STOP_IN2	Input pin connected to Aurix P34.2	
54	GND	Ground	
55	NC	No connect	
56	ORIN_3V3_LIMITED	3.3V power output with current limit	5
57	GND	Ground	
58	RSVD	Reserved	

Pin	Signal Name	Description	Note
59	RSVD	Reserved	
60	ORIN_3V3_UART7_RX	UART pin connected to Orin GP102_UART7_RX	4
61	ORIN_3V3_UART7_TX	UART pin connected to Orin GP101_UART7_TX	4
62	GND	Ground	
63	GND	Ground	
64	ORIN_UART5_RX	UART pin connected to Orin GP42_UART5_RXD	4
65	GND	Ground	
66	ORIN_UART5_CTS*	UART pin connected to Orin GP44_UART5_CTS_N	4
67	ORIN_UART5_RTS*	UART pin connected to Orin GP43_UART5_RTS_N_DDRCODE0	4
68	ORIN_UART5_TX	UART pin connected to Orin GP41_UART5_TXD_DDRCODE1	4

Notes:

1. Orin SPI3 is connected to an ultrasonic ASIC. An IO expander controlled by Orin I2C4 is used for scanning up to 12 ultrasonic sensors.
2. Fused ultrasonic power output from high-side switch enabled via IO expander controlled by Orin I2C4.
3. LIN power output from a high-side switch.
4. Orin 1.8V balls are level-shifted to 3.3V.
5. This pin, combined with H1 pin-56, supports up to 40mA of 3.3V current when Orin is powered.

A cable harness is built for the developer system using two the mating connector, HDRA-E68MA1+. The other end of the cable harness breaks out signals to several female DB9 connectors, P1~P9 and P11~P21. The breakout information of these DB9 connectors is shown in the tables below. The DB9 connector pinouts is shown in Figure 2-3.

Note:

The CAN bus topology is a bus line with two ends and multiple nodes connected to it in between. The CAN bus termination must be done at both bus ends with a single 120 Ω termination resistor between "CAN High" and "CAN Low" wires. If the CAN port is connected to the middle node, no termination is required. Therefore, a total number of two 120 Ω resistors are required for a single CAN bus, an external 120 Ω termination resistor is required for the CAN DB9 connectors (P3, P4, P11~P14) if the CAN node is connected to either end of a CAN bus. However, due to the internal termination, the ORIN_FSICAN1 on DB9 connector P15 is limited to be connected to the end node of a CAN bus.

Note:

The FlexRay bus topology is also a bus line with two ends and multiple nodes connected to it in between. Different from the CAN bus termination, the FlexRay termination is required at all nodes regardless of the node location. However, the termination at both bus ends should match the cable impedance at around 80 Ω to 110 Ω while the termination at the middle nodes can be much weaker. The preferred FlexRay termination is split termination. When split termination is used at the end node, two resistors with value between 40 Ω to 55 Ω should be used.

The developer system has only one FlexRay port (SMCU_FLEXRAY1) with internal weak 2596 Ω split termination, assuming that it is connected to the middle node of a FlexRay bus.

Table 2-7. Cable Harness H1 Connector DB9 Breakout Lengths (mm)

DB9 Cable Length Accuracy	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
± 30 (Unit: mm)	1100	1050	1000	950	900	850	800	750	700	650	600

Table 2-8. Cable Harness H1 Connector DB9 Breakouts (1 of 2)

Pin	Signal Name	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
68	ORIN_3V3_SENSOR_PPS											5
67	RSVD											4
66	RSVD											2
65	GND											3
64	RSVD											1
63	GND										6	
62	GND										3	
61	RSVD										5	
60	RSVD										4	
59	RSVD										2	
58	RSVD										1	
57	GND						3					
56	ORIN_3V3_LIMITED										9	
55	RSVD									2		
54	GND						6					
53	RSVD									8		
52	RSVD									7		
51	GND											
50	RSVD									3		
49	GND									5		
48	NC								9			
47	NC								7			
46	NC						2					
45	NC						1					
44	SMCU_CAN4_L				1							
43	SMCU_CAN4_L			1								
42	GND				3, 6							
41	SMCU_CAN4_H				8							
40	SMCU_CAN4_H			8								
39	NC				9							
38	GND								6			
37	WUP_SATELLITE								4			

Pin	Signal Name	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
36	GND							6				
35	WUP_SENSOR							8				

Table 2-9. Cable Harness H1 Connector DB9 Breakouts (2 of 2)

Pin	Signal Name	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
34	NC							3				
33	NC							2				
32	GND							5				
31	AURIX_3V3_LIMITED							1				
30	NC					9						
29	GND								3			
28	NC			9								
27	NC		9									
26	NC	9										
25	RSVD								1			
24	RSVD					1						
23	RSVD								8			
22	RSVD					8						
21	RSVD						5					
20	RSVD						4					
19	ORIN_FSICAN1_L					2						
18	ORIN_FSICAN1_H					7						
17	GND					3, 6						
16	SMCU_FLEXRAY1_BP				7							
15	SMCU_FLEXRAY1_BP			7								
14	GND			3, 6								
13	SMCU_FLEXRAY1_BM				2							
12	SMCU_FLEXRAY1_BM			2								
11	GND											
10	SMCU_CAN6_H		8									
9	SMCU_CAN6_H	8										
8	GND		3, 6									
7	SMCU_CAN6_L		1									
6	SMCU_CAN6_L	1										
5	SMCU_CAN5_H		7									
4	SMCU_CAN5_H	7										
3	GND	3, 6										
2	SMCU_CAN5_L		2									

Pin	Signal Name	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
1	SMCU_CAN5_L	2										

Table 2-10. Cable Harness H2 Connector DB9 Breakout Lengths (mm)

DB9 Cable Length Accuracy	P1	P2	P3	P4	P5	P6	P7	P8	P9
± 30 (Unit: mm)	1000	950	900	850	800	750	700	650	600

Table 2-11. Cable Harness H2 Connector DB9 Breakouts (1 of 2)

Pin	Signal Name	P1	P2	P3	P4	P5	P6	P7	P8	P9
1	USS_SENSOR01	2								
2	USS_SENSOR02	3								
3	USS_SENSOR03	4								
4	USS_SENSOR04	5								
5	USS_SENSOR05	6								
6	USS_SENSOR06	7								
7	USS_VOUT1_F	1								
8	USS_VOUT1_F	1								
9	USS_VOUT1_F	1								
10	GND	8								
11	GND	8								
12	GND	8								
13	GND		8							
14	SMCU_CAN1_L			2						
15	SMCU_CAN1_L				2					
16	GND			3, 6						
17	SMCU_CAN1_H			7						
18	SMCU_CAN1_H				7					
19	SMCU_CAN2_L			1						
20	SMCU_CAN2_L				1					
21	GND				3, 6					
22	SMCU_CAN2_H			8						
23	SMCU_CAN2_H				8					
24	RSVD					2				
25	GND					3				
26	RSVD					4				
27	RSVD					5				
28	RSVD					6				

Pin	Signal Name	P1	P2	P3	P4	P5	P6	P7	P8	P9
29	GND					7				
30	WUP_IN						1			
31	AURIX_3V3_LIMITED						4			
32	GND						5			
33	AURIX_RS232_TXD						2			
34	AURIX_RS232_RXD						3			

Table 2-12. Cable Harness H2 Connector DB9 Breakouts (2 of 2)

Pin	Signal Name	P1	P2	P3	P4	P5	P6	P7	P8	P9
35	USS_SENSOR11		2							
36	USS_SENSOR12		3							
37	USS_SENSOR13		4							
38	USS_SENSOR14		5							
39	USS_SENSOR15		6							
40	USS_SENSOR16		7							
41	USS_VOUT2_F		1							
42	USS_VOUT2_F		1							
43	USS_VOUT2_F		1							
44	SMCU_LIN1						7			
45	LIN_VCC						8			
46	GND						6			
47	RSVD							1		
48	GND		8							
49	RSVD							2		
50	HRN_E-STOP_OUT1							4		
51	GND							3		
52	HRN_E-STOP_IN1							5		
53	HRN_E-STOP_IN2							6		
54	GND							7		
55	NC					9				
56	ORIN_3V3_LIMITED							8		
57	GND							9		
58	RSVD								9	
59	RSVD									9
60	ORIN_3V3_UART7_RX								3	
61	ORIN_3V3_UART7_TX								2	
62	GND								5	

Pin	Signal Name	P1	P2	P3	P4	P5	P6	P7	P8	P9
63	GND		8							
64	ORIN_UART5_RX									3
65	GND									5
66	ORIN_UART5_CTS*									7
67	ORIN_UART5_RTS*									8
68	ORIN_UART5_TX									2

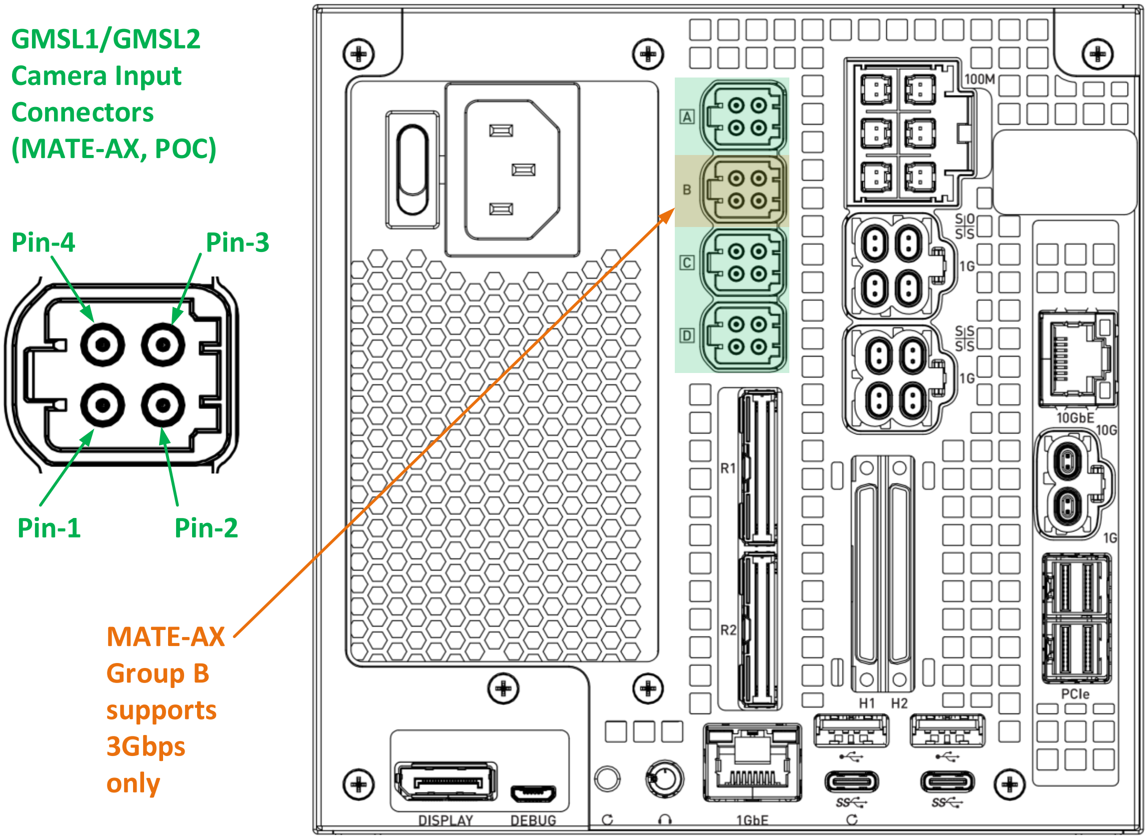
Figure 2-3. Cable Harness DB9 Connector Pinouts

2.4 Camera Input Connectors

The developer system includes 4 MATE-AX connectors for camera input. Each MATE-AX connector has 4 input pins, and each pin can be connected to a single GMSL1/GMSL2 camera. The camera inputs of a MATE-AX connector will be sent to the same GMSL1/GMSL2 deserializer. There are total of 4 deserializers, and the panel silkscreen has the MATE-AX connectors marked as "A", "B", "C", and "D" to indicate which deserializer the camera's signal will be connected to. The MATE-AX pin information is shown in Figure 2-4.

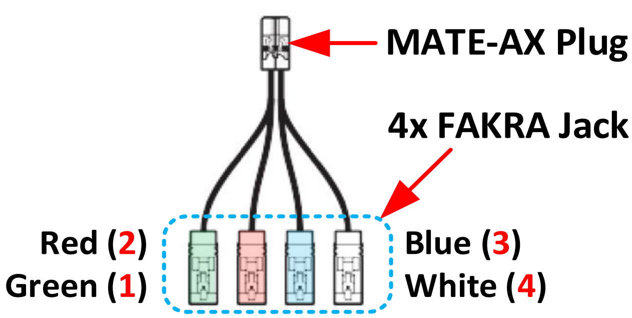
Among the four MATE-AX groups, the deserializers of Groups A, C, D can support 3Gbps or 6Gbps, but Group B can only support 3Gbps. To highlight this difference, the silkscreen marked with "B" has no outline like the "A", "C", and "D" groups.

Figure 2-4. Camera Input Connector



With the breakout cable shown in Figure 2-5, the camera module with FAKRA plug can be connected to the MATE-AX connector.

Figure 2-5. Camera Breakout Cable



Other than receiving GMSL1/GMSL2 camera streams, each of these FAKRA jacks also provide power and controls to the cameras with the POC technology. See Section 4.1 for the POC voltage and the current limit provided to each camera module.

2.5 Ethernet Connectors

The developer system includes 4 different types of connectors for 100Mbit, 1Gbit, and 10Gbit Ethernet – MATEnet, H-MTD Quad, H-MTD Double, and RJ45. The RJ45 is a standard Ethernet connector. The pin information of the other connectors is shown in Figure 2-6.

Figure 2-6. Ethernet Connectors

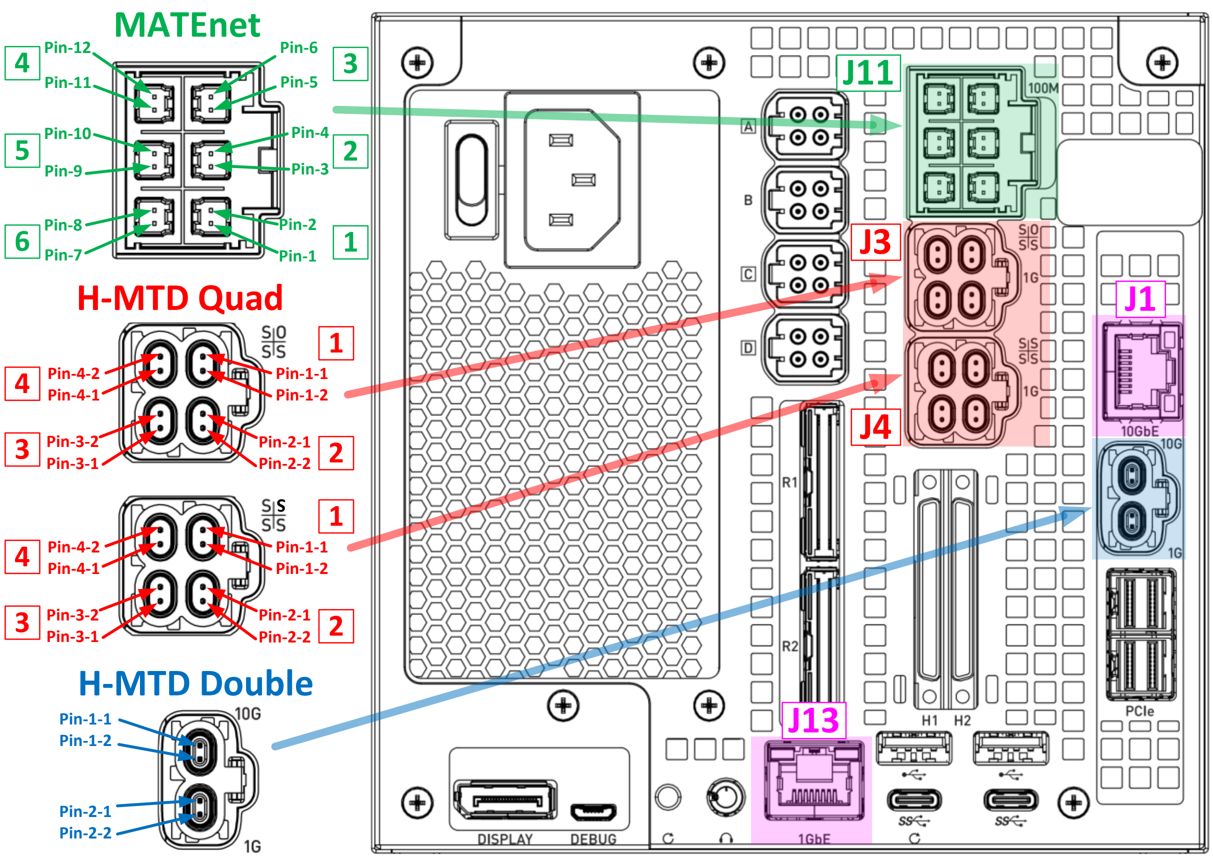


Table 2-13. Ethernet Connector List

Connector	Ethernet	Ports	Description
MATEnet	100BASE-T1	6	Connects to Ethernet Switch 1 through the switch's built-in PHY
H-MTD Quad (upper connector)	1000BASE-T1	4	Upper right pair (Pin 1-1/1-2): Connects through 1GbE PHY to Ethernet Switch 1 Other three pairs: Connect through 1GbE PHY to Ethernet Switch 2
H-MTD Quad (lower connector)	1000BASE-T1	4	Connects through 1GbE PHY to Ethernet Switch 2
H-MTD Double (top pair)	10GBASE-T1	1	Connects through 10GbE PHY to Orin-X MGBE controller C0 (UPHY2_L4)
H-MTD Double (bottom pair)	1000BASE-T1	1	Connects through 1GbE PHY then Ethernet Controller to Orin-X PCIe controller C7 (UPHY2_L0)
RJ45 (right)	10GBASE-T	1	Connects through 10GbE PHY to Orin-X MGBE controller C1 (UPHY2_L5)
RJ45 (bottom)	1000BASE-T	1	Connect through 1GbE PHY to Orin-X RGMII

2.6 Development Connectors

The developer system includes multiple display connectors and several USB connectors for use in the development process. These connectors are shown in Figure 2-7.

Figure 2-7. Development Connectors

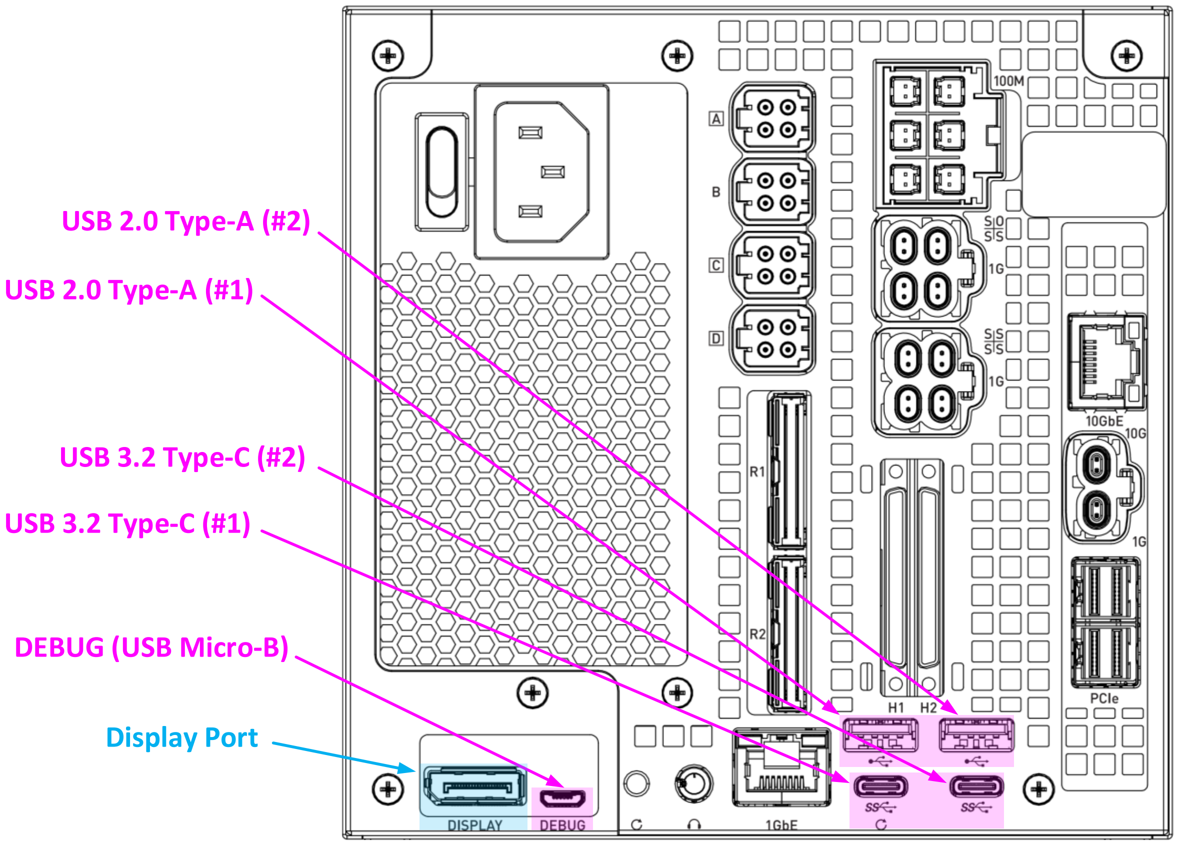


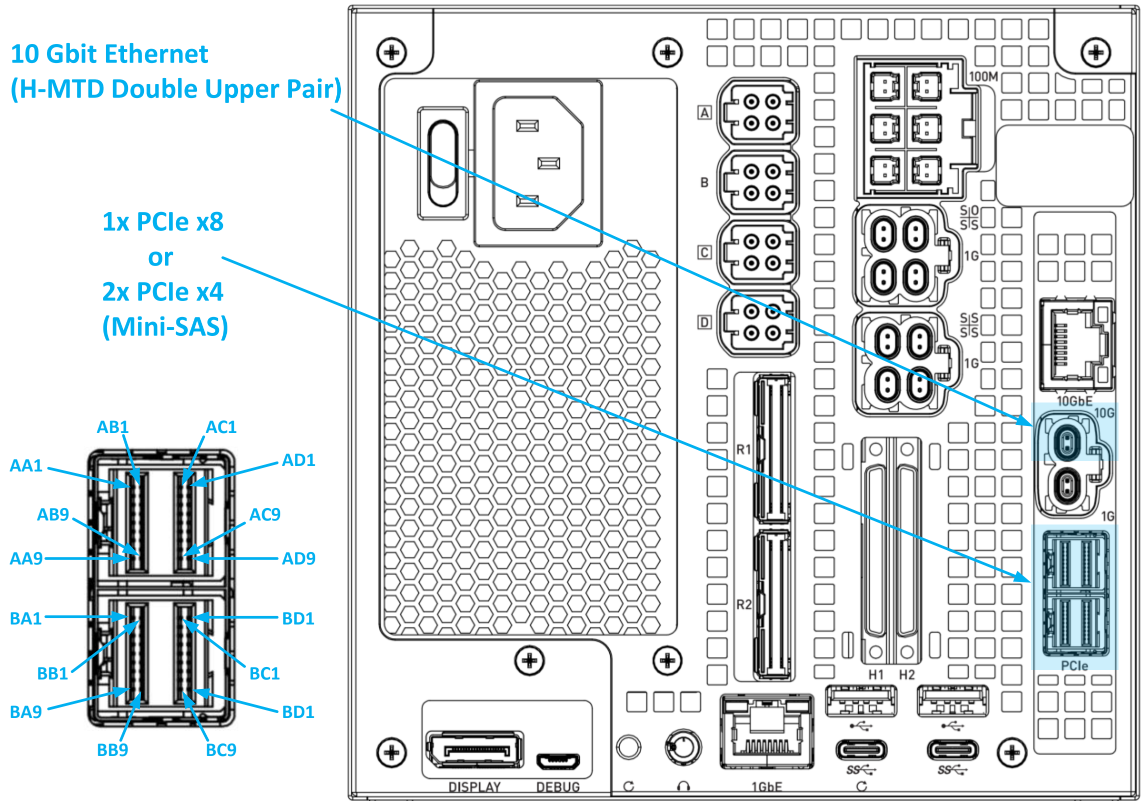
Table 2-14. Development Connector List

Connector	Location	Description
USB 2.0 Type-A	#1 (left)	• Host Port • Connect to Orin-X USB2 Port
USB 2.0 Type-A	#2 (right)	• Host Port • Connect to Orin-X USB3 Port
USB 3.2 Type-C	#1 (left)	• Host Port / Device Port (Recovery Mode) • Connections to Orin-X: > USB0 Port for USB 2.0 up to 480Mbps > UPHY0[1] for SuperSpeed USB 10Gbps > UPHY0[1:0] for HSSTP • Support power up to 15W (5V@3A)
USB 3.2 Type-C	#2 (right)	• Host Port • Connections to Orin-X: > USB1 Port for USB 2.0 up to 480Mbps > UPHY0[2] for SuperSpeed USB 10Gbps • USB PD (Power Delivery) support up to 60W (20V@3A)
USB 2.0 Micro-B	Lower-left corner	• Development/Debug Port
DisplayPort	Lower-left corner	• Can be used for displaying the video stream captured by cameras

2.7 Expansion Connectors

The developer system includes Mini-SAS connectors for one PCIe x8 or two PCIe x4. It also includes a H-MTD Double connector with two connection pairs. The upper connection pair of this H-MTD Double connector is used for 10Gbit Ethernet. These connectors can be used for system expansion to allow two or four developer systems being connected for achieving a much higher system performance. These connectors are shown in Figure 2-8.

Figure 2-8. Expansion Connectors



The usage of the expansion connectors is listed in Table 2-15.

Table 2-15. Expansion Connector List

Connector	Interface	Description
Mini-SAS	PCIe x8	This is for connecting two developer systems together to expand to a dual-Orin system.
H-MTD Double (Upper pair)	10Gbit Ethernet	This is for connecting two of the dual-Orin systems together to expand to a quad-Orin system.

Please note that a customized Mini-SAS HD connector (SFF-8644) pin definition is used for system expansion by connecting Mini-SAS cables between developer systems. The standard PCIe Gen4 Mini-SAS cables, which have different connections on the sideband signals, will not work. Please refer to the supported cables in Table 2-2 for Mini SAS expansion.

For system expansion by Mini-SAS connector using multiple developer systems, please see the following two figures for the cable connections.

Figure 2-9. Cable Connections between two Developer Systems

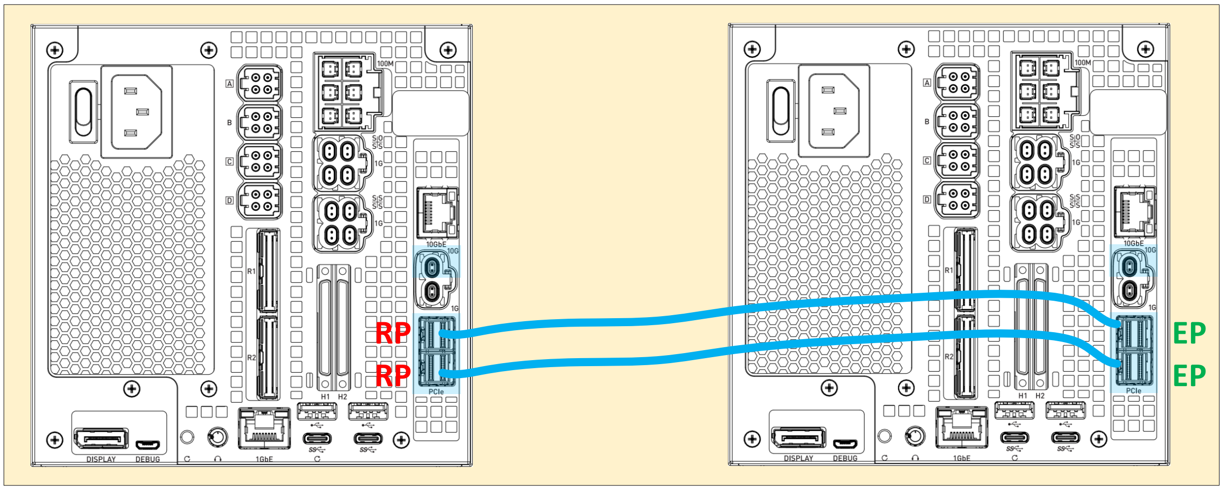
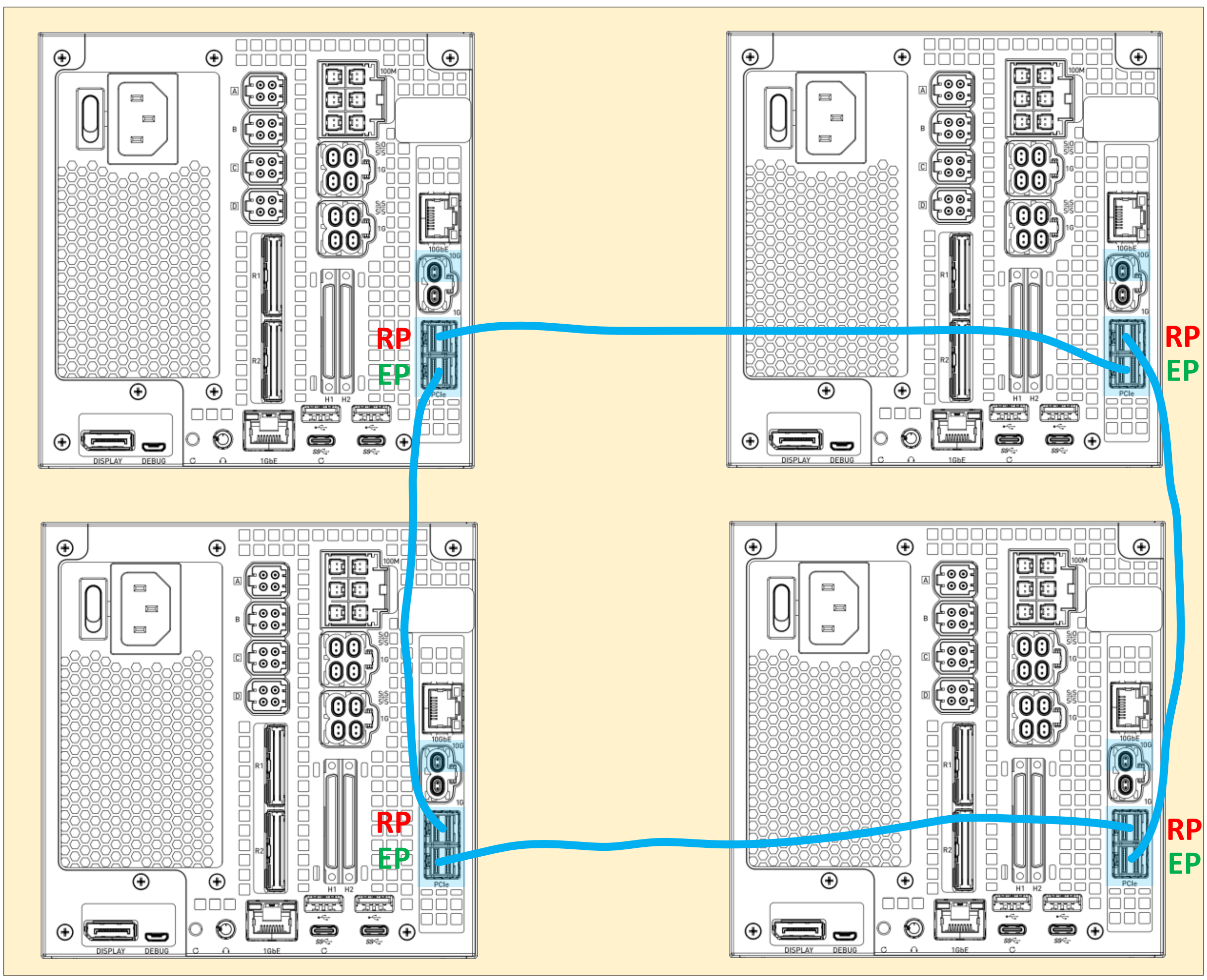


Figure 2-10. Cable Connections between four Developer Systems



2.8 Others

The developer system also includes an audio jack and a FORCE RECOVERY push button as shown in the Figure 2-11.

Figure 2-11. Audio Jack and FORCE RECOVERY Button

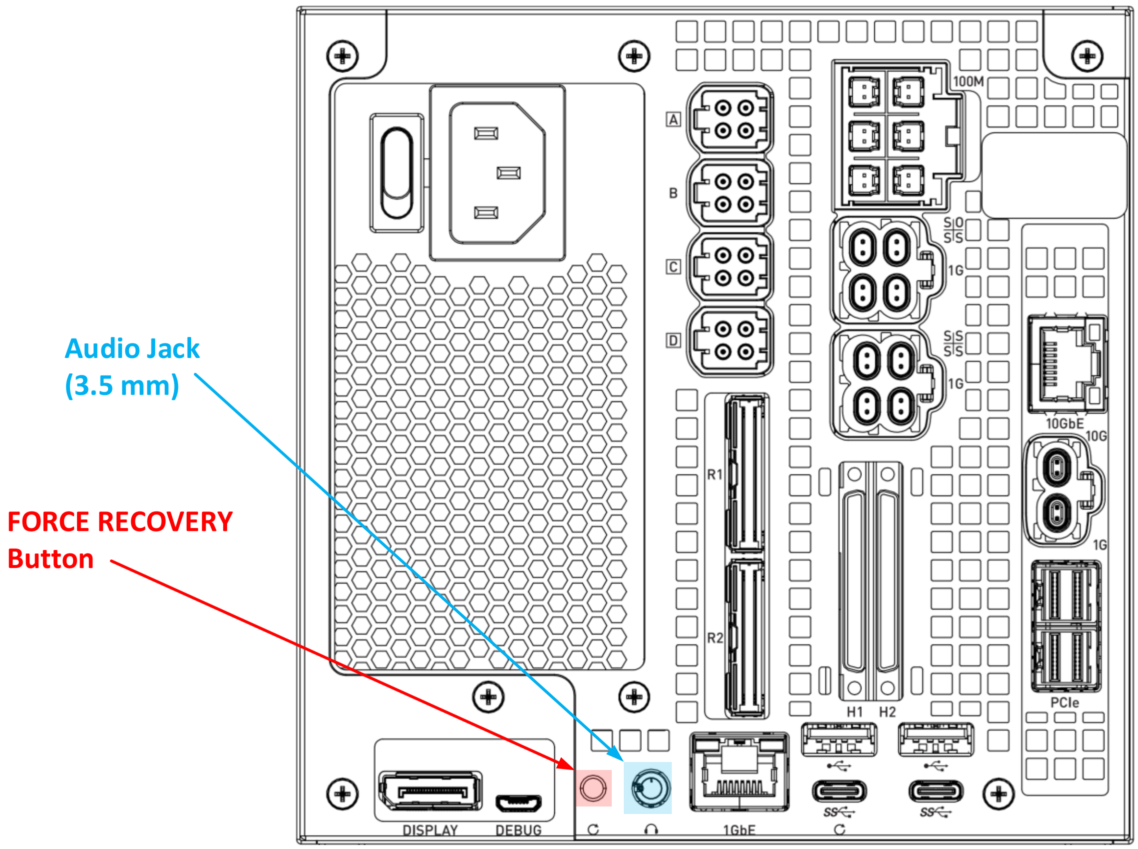


Table 2-16. Audio Connector and Push Button

Connector	Interface	Description
3.5mm Audio Jack	Audio	The signal of this audio jack is connected to the audio codec.
Push Button	FORCE RECOVERY	This button is used for forcing Orin-X into Recovery mode. Press and hold this button while powering on the system will force Orin-X going into Recovery mode.

Chapter 3. Environmental Requirements

3.1 Shock and Vibration

The developer system should not exceed the shock and the vibration constraints summarized below.

- Mechanical Shock Constraints:
  - Half Sine Wave at 50 G, 6 ms duration
  - 10 shocks in Z-direction, with system mounted horizontally and the bottom tray facing downwards.
- Mechanical Vibration Constraints:
  - Excitation with wide-band random vibration
  - RMS value of acceleration: 2.833 G_{rms}
  - Frequency range is 10-1000 Hz following ISO16750

3.2 Temperature and Humidity

The developer system should be operating and stored within a certain temperature range.

- The operating temperature refers to the external ambient temperature required for the developer system to operate normally when it is powered and running.
- The storage temperature refers to the external temperature of the developer system when it is powered off and stored.

3.2.1 Operating Temperature

The developer system should be operating within the temperature range listed below.

Table 3-1. Operating Temperature

Temperature	Minimum	Maximum
Operating Temperature	0°C	45°C
Note: The Operating Temperature range is defined as the ambient temperature at the fan inlet (the cool air intake in Figure 1-3).		

3.2.2 Storage Temperature and Humidity

The developer system should be stored within the temperature range and humidity listed in Table 3-2.

Table 3-2. Storage Temperature and Humidity

Temperature	Minimum	Maximum
Storage Ambient Temperature	- 20°C	65°C
Storage Humidity	5% RH	95% RH

Chapter 4. Electrical Installation

4.1 Operating Voltage and Current

The power to the developer system is supplied by an SFX12V PSU included in the system.

The input specification of the SFX12V PSU is listed in Table 4-1.

Table 4-1. SFX PSU Input Specification

Power Input	Minimum	Nominal	Maximum
AC Voltage (VAC)	90VAC	100 ~ 240VAC	264VAC
AC Current (A)		100VAC: 4A 240VAC: 2A	
Frequency (Hz)	47		63
Note: When installing the developer system in vehicle, we recommend using an inverter to convert the DC power of the vehicle battery/alternator to AC for powering the SFX PSU power supply.			

The developer system also sources power to the camera modules with the POC technology via MATE-AX connectors. Each MATE-AX connector has 4 pins, so a maximum number of 16 cameras can be supported. The POC power output specification for each camera is listed in Table 4-2.

Table 4-2. MATE-AX Pin Power Output Specification

Power Output	Nominal
POC Voltage	12V
POC Current (per camera)	500mA
Note: The total current of all 16 cameras is limited to 5A even though the current per camera can be as high as 500mA.	

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