Product Design Guide for

Osbourne IO board

Based on Nvidia AGX Orin Module

DSC document no. 7462640 Revision 0.2

November 30, 2023

Revision	Date	Comment
0.1	27 Feb 2023	Initial Release
0.2	30 Nov 2023	Added details on Commercial IO board

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1. INTRODUCTION

This document is intended as a guide for designing a Custom I/O board for Osbourne base board. Osbourne is a Jetson AGX Orin module-based board with rich graphics and camera input capability. Osbourne board converts Jetson AGX Orin module into a complete embedded system by providing interface circuitry, I/O connector for all the major features of the module, camera interface, power supply and additional I/O capability.

I/O connector provides flexibility to users to design custom boards based on the application like commercial IO boards or Rugged latching connector-based IO boards.

Refer Osbourne user manual to get more details on features mapped on to the other connectors on the Osbourne base board.

1.1 I/O Features and Connector Type

All the I/O signals are routed to a 150pin single I/O Connector board with all circuitries included in the Osbourne base board to have only Passive connectors and minimal components on custom I/O board developed by third parties.

Main I/O Features	Description
Power	7V-20V wide input supply, typical18 V
RTC	3V power input for RTC functionality
USB	4x USB 2.0, 3x USB 3.2
Ethernet	1G/2.5G/5G/10G Multi Mode Gigabit Ethernet without on board Magnetics
	10/100/1000Mbps through RGMII adapter board without on board Magnetics
Audio	Via ALC5640 CODEC
Serial ports	2 x ports Software configurable RS-232/422/485 through SP336 transceivers with bypass option to access TTL signals
	2x ports fixed RS-232 through SP3243 transceivers with bypass option to access TTL signals
Display	1x HDMI 2.0a/b or DP directly from the Module
Digital IOs	8 Digital IO via I2C to GPIO
CAN	2x CAN with Non isolated transceivers
Utility	PWR_ON, RESET, FORCE RECOVERY, MEM_ERASE, I2C, SPI

1.2 Reference

- Osbourne User Manual
  https://www.diamondsystems.com/files/binaries/Osbourne%20user%20manual%20v0.3%2020230105.pdf
- Nvidia AGX Orin product design guide
  https://developer.nvidia.com/embedded/secure/jetson/agx_orin/jetson_agx_orin_design_guide_dg-10653-001_v0.2.pdf

1.3 Block Diagram of Osbourne Carrier Board

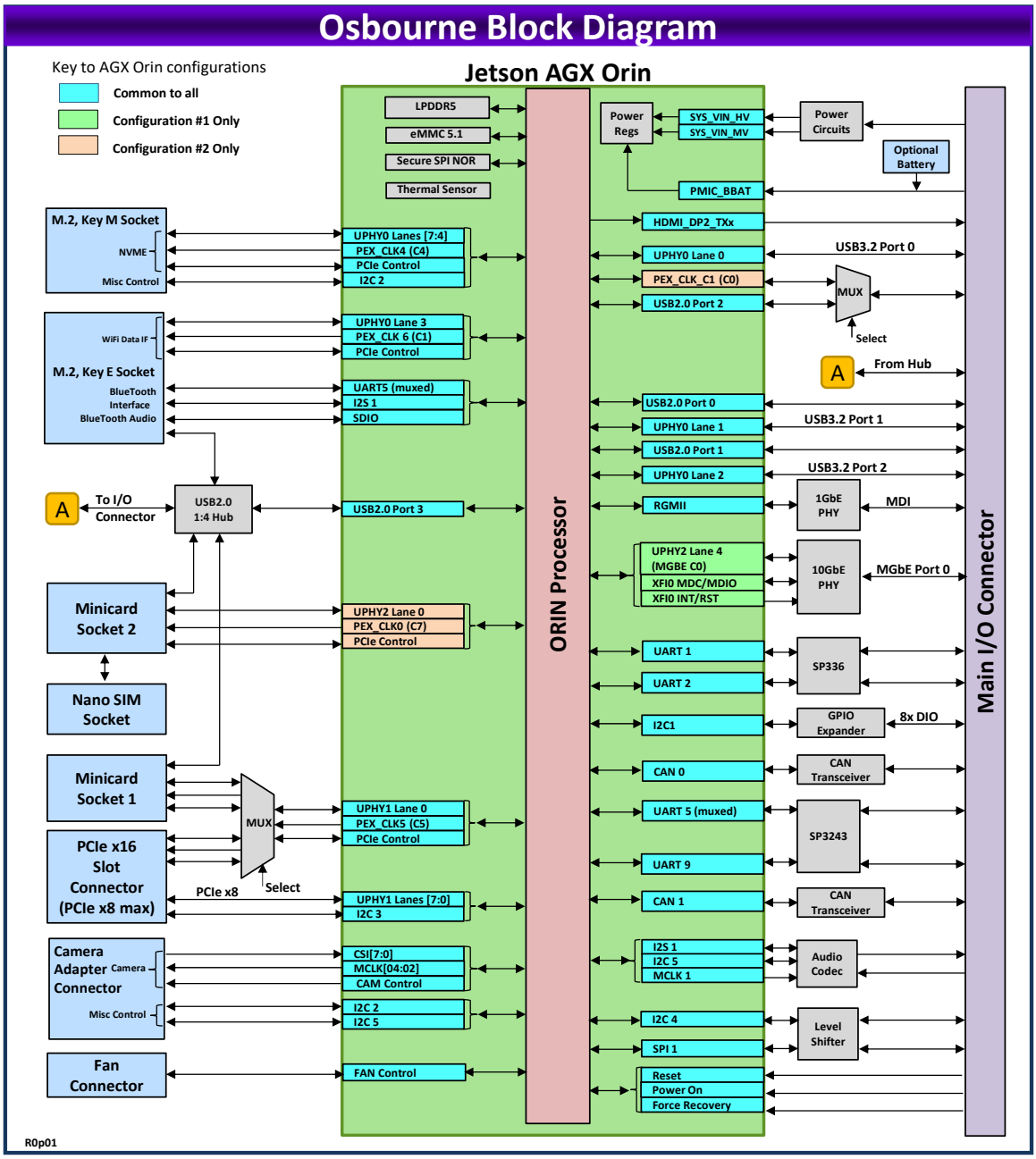


Figure 1: Osbourne Block Diagram

2. B2B CONNECTOR DETAILS AND MATED VIEWS

2.1 B2B connector details

Part number of IO connector used on the Osbourne baseboard is **ERF8-075-01-L-D-RA-L-TR**, from the Samtec ERM8 Right angle series.
https://www.samtec.com/products/erm8-ra?EmailTextbox=&FNameTextbox=&LNameTextbox=&auth=1

Mating Connector on the Custom I/O board can be decided based on in-line and right-angle configuration requirement of the I/O board.

1. Recommended B2B connector part number for in-line connector board is **ERM8-075-01-L-D-RA-L-TR.**
2. Recommended B2B connector part number for right angle connector board is **ERM8-075-02.0-L-DV-TR** (Part can be changed be based on the mating height).

2.2 B2B Connector Pinouts

Orin Pin #	Direction wrt Osbourne baseboard	Voltage level / pin type	Signal name	Pin no.	Pin no.	Signal name	Voltage level / pin type	Direction wrt Osbourne baseboard	Orin Pin #
	Output	Analog Output	AUDIO_HPOR_HDA	1	2	GND_AUD	Audio Ground	Ground	
	Output	Analog Output	AUDIO_HPOL_HDA	3	4	AUDIO_MIC_L	Analog Input	Input	
	Input	Power: 1.8V to 3.46V	V_3P0_RTC_CON	5	6	AUDIO_MIC_R	Analog Input	Input	
	Output	Power: 5.0V	V_5P0_A	7	8	AUDIO_PRSNT_L	1.8 V	Input	
	Output	Power: 3.3V /5.0 V	V_DIO	9	10	GND_DIG	Ground	Ground	
	Bi-directional	V_DIO	DIO_PA7	11	12	USB3/PCIE_UPHY_RX0_P	USB3 / PCIe Diff pair	Input	A22
	Bi-directional	V_DIO	DIO_PA6	13	14	USB3/PCIE_UPHY_RX0_N	USB3 / PCIe Diff pair	Input	A23
	Bi-directional	V_DIO	DIO_PA5	15	16	GND_DIG	Ground	Ground	
	Bi-directional	V_DIO	DIO_PA4	17	18	USB3/PCIE_UPHY_TX0_P	USB3 / PCIe Diff pair	Output	J22
	Bi-directional	V_DIO	DIO_PA3	19	20	USB3/PCIE_UPHY_TX0_N	USB3 / PCIe Diff pair	Output	J23
	Bi-directional	V_DIO	DIO_PA2	21	22	GND_DIG	Ground	Ground	
	Bi-directional	V_DIO	DIO_PA1	23	24	USB3_UPHY_RX1_P	USB3 Diff pair	Input	C23
	Bi-directional	V_DIO	DIO_PA0	25	26	USB3_UPHY_RX1_N	USB3 Diff pair	Input	C22
	Power	Power: 5.0V	V_USB3_1	27	28	GND_DIG	Ground	Ground	
C10	Bi-directional	USB2 Diff pair	USB2_D1_CH_N	29	30	USB3_UPHY_TX1_P	USB3 Diff pair	Output	G23
C11	Bi-directional	USB2 Diff pair	USB2_D1_CH_P	31	32	USB3_UPHY_TX1_N	USB3 Diff pair	Output	G22
	Output	Power: 5.0V	V_USB3_2	33	34	GND_DIG	Ground	Ground	
F13	Bi-directional	USB2 Diff pair	USB2_D0_CH_N	35	36	HDMI_DP2_TX0_CON_P	HDMI Diff pair	Output	D51
F12	Bi-directional	USB2 Diff pair	USB2_D0_CH_P	37	38	HDMI_DP2_TX0_CON_N	HDMI Diff pair	Output	D52
A58	Output	1.8 V	GPIO20_DP/HDMI_EN_1P8	39	40	GND_DIG	Ground	Ground	

G53	Output	Open-Drain, 1.8V (3.3V tolerant)	DP2_AUX_CH_P	41	42	HDMI_DP2_TX3_CON _P	HDMI Diff pair	Output	C51
G54	Bi-directional	Open Drain, 1.8V (3.3V tolerant	DP2_AUX_CH_N	43	44	HDMI_DP2_TX3_CON _N	HDMI Diff pair	Output	C50
J50	Bi-directional	Open Drain, 1.8V (3.3V tolerant	HDMI_CEC_CON	45	46	GND_DIG	Ground	Ground	
K50	Input	CMOS – 1.8V	DP2/HDMI_HPD	47	48	HDMI_DP2_TX2_CON _N	HDMI Diff pair	Output	A50
	Input	RS232 Signal	UART5_CTS_RS232	49	50	HDMI_DP2_TX2_CON _P	HDMI Diff pair	Output	A51
	Input	RS232 Signal	UART5_RX_RS232	51	52	GND_DIG	Ground	Ground	
	Output	RS232 Signal	UART5_RTS_RS232	53	54	HDMI_DP2_TX1_CON _N	HDMI Diff pair	Output	B52
	Output	RS232 Signal	UART5_TX_RS232	55	56	HDMI_DP2_TX1_CON _P	HDMI Diff pair	Output	B51
	Input	RS232 Signal	UART3_9_RX_RS232	57	58	GND_DIG	Ground	Ground	
	Output	RS232 Signal	UART3_9_TX_RS232	59	60	USB3_UPHY_RX20_P	USB3 Diff pair	Input	C34
	Power	Power: 5.0V	V_USB2_VBUS	61	62	USB3_UPHY_RX20_N	USB3 Diff pair	Input	C35
	Bi-directional	USB2 Diff pair	USB2_HUB_D4_CH_N	63	64	GND_DIG	Ground	Ground	
	Bi-directional	USB2 Diff pair	USB2_HUB_D4_CH_P	65	66	USB3_UPHY_TX20_P	USB3 Diff pair	Output	K32
	Power	Power: 5.0V	V_USB3_3	67	68	USB3_UPHY_TX20_N	USB3 Diff pair	Output	K33ss
A11/F17	Bi-directional	USB2 Diff pair/ PCIe Diff pair	USB2/PCIE_CLK_CH_N	69	70	GND_DIG	Ground	Ground	
A10/F16	Bi-directional	USB2 Diff pair/ PCIe Diff pair	USB2/PCIE_CLK_CH_P	71	72	N/C			
	Bi-directional	CAN Differential Pair	CAN1_L	73	74	N/C			
	Bi-directional	CAN Differential Pair	CAN1_H	75	76	N/C			
	Bi-directional	CAN Differential Pair	CAN0_L	77	78	N/C			
	Bi-directional	CAN Differential Pair	CAN0_H	79	80	N/C			
	Input	RS232/ RS422	CTS2/RX2_N	81	82	N/C			
	Input	RS232/ RS422	RX2/RX2_P	83	84	N/C			
	Bi-directional	RS232/ RS422/ RS485	RTS2/TX2_N/RX2_N	85	86	N/C			
	Bi-directional	RS232/ RS422/ RS485	TX2/TX2_P/RX2_P	87	88	N/C			
	Input	RS232/ RS422	CTS1/RX1_N	89	90	N/C			
	Input	RS232/ RS422	RX1/RX1_P	91	92	N/C			
	Bi-directional	RS232/ RS422/ RS485	RTS1/TX1_N/RX1_N	93	94	GND_DIG	Ground	Ground	
	Bi-directional	RS232/ RS422/ RS485	TX1/TX1_P/RX1_P	95	96	GBE_MDI0_P	1G Copper Diff pair	Bi-directional	
E60	Bi-directional	I2C data; 3.3 V	I2C_GP8_DAT_3P3	97	98	GBE_MDI0_N	1G Copper Diff pair	Bi-directional	
D61	Output	I2C Clock; 3.3 V	I2C_GP8_CLK_3P3	99	100	GND_DIG	Ground	Ground	

L61	Input	3.3 V	BUTTON_POWER_ON_N	101	102	GBE_MDI1_P	1G Copper Diff pair	Bi-directional	
L60	Bi-directional	Open Drain, 1.8V	SYS_RST_IN_N	103	104	GBE_MDI1_N	1G Copper Diff pair	Bi-directional	
L10	Input	CMOS – 1.8V	FORCE_RECOVERY#	105	106	GND_DIG	Ground	Ground	
			N/C	107	108	GBE_MDI2_P	1G Copper Diff pair	Bi-directional	
			N/C	109	110	GBE_MDI2_N	1G Copper Diff pair	Bi-directional	
B9	Output	Open-Drain, 3.3V	PEX_C1_RST_N	111	112	GND_DIG	Ground	Ground	
	Input	1.8 V	MEM_ERS_GPIO	113	114	GBE_MDI3_P	1G Copper Diff pair	Bi-directional	
A48	Output	1.8 V	SER_GPIO_SEL	115	116	GBE_MDI3_N	1G Copper Diff pair	Bi-directional	
H52	Output	1.8 V	CAN_SER_SEL2	117	118	GND_DIG	Ground	Ground	
D54	Output	1.8 V	CAN_SER_SEL1	119	120	MGBE0_PHY_A_P	10G Copper Diff pair	Bi-directional	
J57	Output	3.3 V	SPI1_SCK_3P3	121	122	MGBE0_PHY_A_N	10G Copper Diff pair	Bi-directional	
E55	Output	3.3 V	SPI1_CS0_3P3	123	124	GND_DIG	Ground	Ground	
A56	Input	3.3 V	SPI1_MISO_3P3	125	126	MGBE0_PHY_B_P	10G Copper Diff pair	Bi-directional	
D55	Output	3.3 V	SPI1_MOSI_3P3	127	128	MGBE0_PHY_B_N	10G Copper Diff pair	Bi-directional	
	Output	1.8 V	KSZ_LED2	129	130	GND_DIG	Ground	Ground	
	Output	1.8 V	KSZ_LED1	131	132	MGBE0_PHY_C_N	10G Copper Diff pair	Bi-directional	
	Output	Open Drain, 20mA	MGBE_LED2	133	134	MGBE0_PHY_C_P	10G Copper Diff pair	Bi-directional	
	Output	Open Drain, 20mA	MGBE_LED1	135	136	GND_DIG	Ground	Ground	
	Output	Open Drain, 20mA	MGBE_LED0	137	138	MGBE0_PHY_D_P	10G Copper Diff pair	Bi-directional	
	Output	Power: 3.3V	V_3P3	139	140	MGBE0_PHY_D_N	10G Copper Diff pair	Bi-directional	
	Ground	Ground	GND_DIG	141	142	GND_DIG	Ground	Ground	
	Input	Power: 7-20V	V_VIN	143	144	V_VIN	Power: 7-20V	Power	
	Input	Power: 7-20V	V_VIN	145	146	V_VIN	Power: 7-20V	Power	
	Input	Power: 7-20V	V_VIN	147	148	V_VIN	Power: 7-20V	Power	
	Input	Power: 7-20V	V_VIN	149	150	V_VIN	Power: 7-20V	Power	

2.3 B2B Connector Pin Orientation

IO connector pin numbering indications on the Osbourne baseboard are shown in Figure 2.

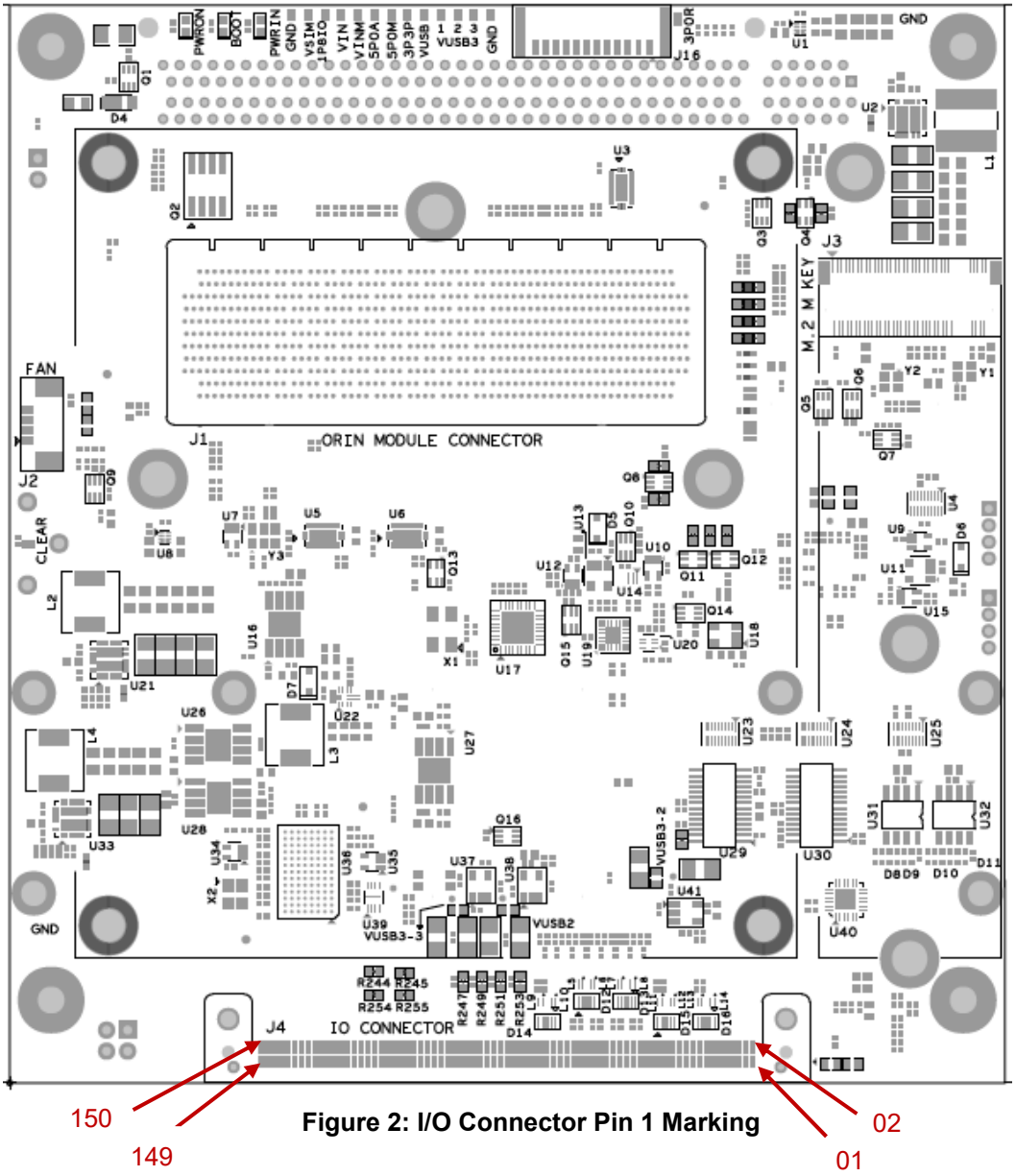


Figure 2: I/O Connector Pin 1 Marking

2.4 B2B Connector Mated Views

Below screenshot shows the mated view for in-line connector board

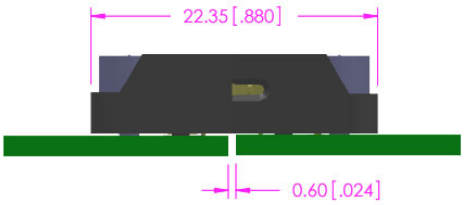


FIG 9
ERF8-RA MATED ERM8-RA

TABLE 16	
Fully Mated Connector to Connector Dimension with Contact Wipe of 1.50[.059]	Max Allowable Connector to Connector Dimension to Maintain Min Contact Wipe of 0.38[.015]
22.35 [.880]	23.47 [.924]

TABLE 17	
Fully Mated Board to Board Dimension with Contact Wipe of 1.50[.059]	Max Allowable Board to Board Dimension to Maintain Min Contact Wipe of 0.38[.015]
0.60 [.024]	1.72 [.068]

Below screenshot shows the mated view for right angle connector board

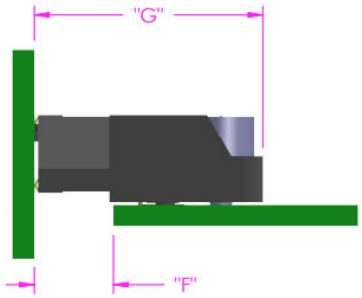


FIG 7
ERF8-DV MATED ERM8-RA

TABLE 12			
		ERM8-RA LEAD STYLE	
		-01	
		"F"	"G"
ERF8-DV LEAD STYLE	-05.0	5.71 [.225]	16.41 [.646]
	-07.0	7.63 [.300]	18.33 [.722]
	-09.0	9.71 [.382]	20.41 [.804]
	-10.0	10.71 [.422]	21.41 [.843]

TABLE 13	
Fully Mated Board to Board Dimension "F" with Contact Wipe of 1.50[.059]	Max Allowable Board to Board Dimension "F" to Maintain Min Contact Wipe of 0.38[.015]
SEE TABLE 12	TABLE 12 DIM "F" + 1.12[.044]

TABLE 14	
Fully Mated Connector to Board Dimension "G" with Contact Wipe of 1.50[.059]	Max Allowable Connector to Board Dimension "G" to Maintain Min Contact Wipe of 0.38[.015]
SEE TABLE 12	TABLE 12 DIM "G" + 1.12[.044]

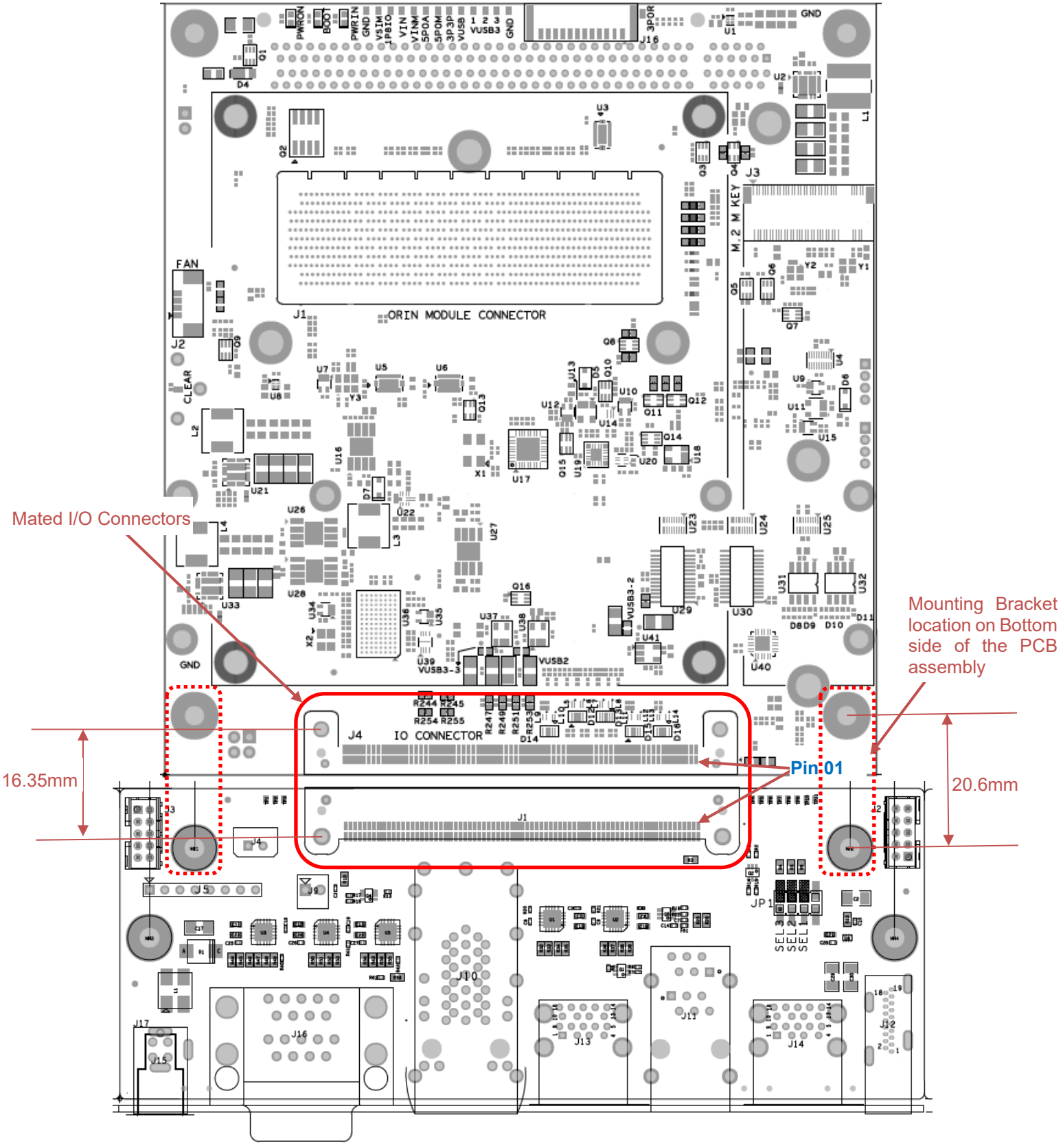


Figure 3: Osbourne Main Board and Sample I/O Board Mated View

Note: Mounting bracket part#**6882643** can be used to attach the Osbourne base board with the sample I/O board. The positioning of mounting holes and I/O connector should match Figure 3, If user wants to use mounting bracket to attach the Osbourne base board with the custom I/O board.

Recommended PCB thickness to match the Osbourne carrier board for in-line configuration is 2.3mm.

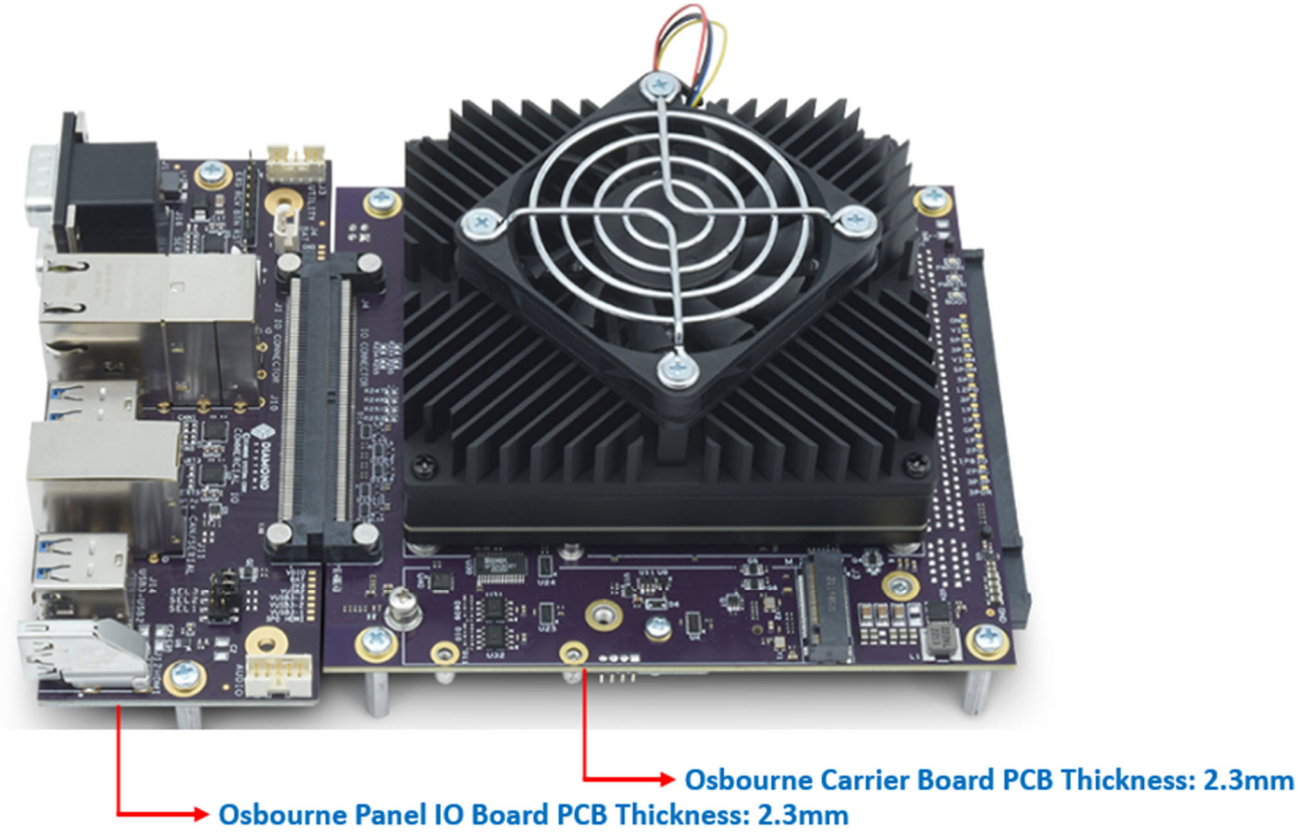


Figure 4: Osbourne Carrier Board with Osbourne Panel IO Board with PCB thickness for reference

3. MECHANICAL DRAWINGS OF OSBOURNE CARRIER BOARD

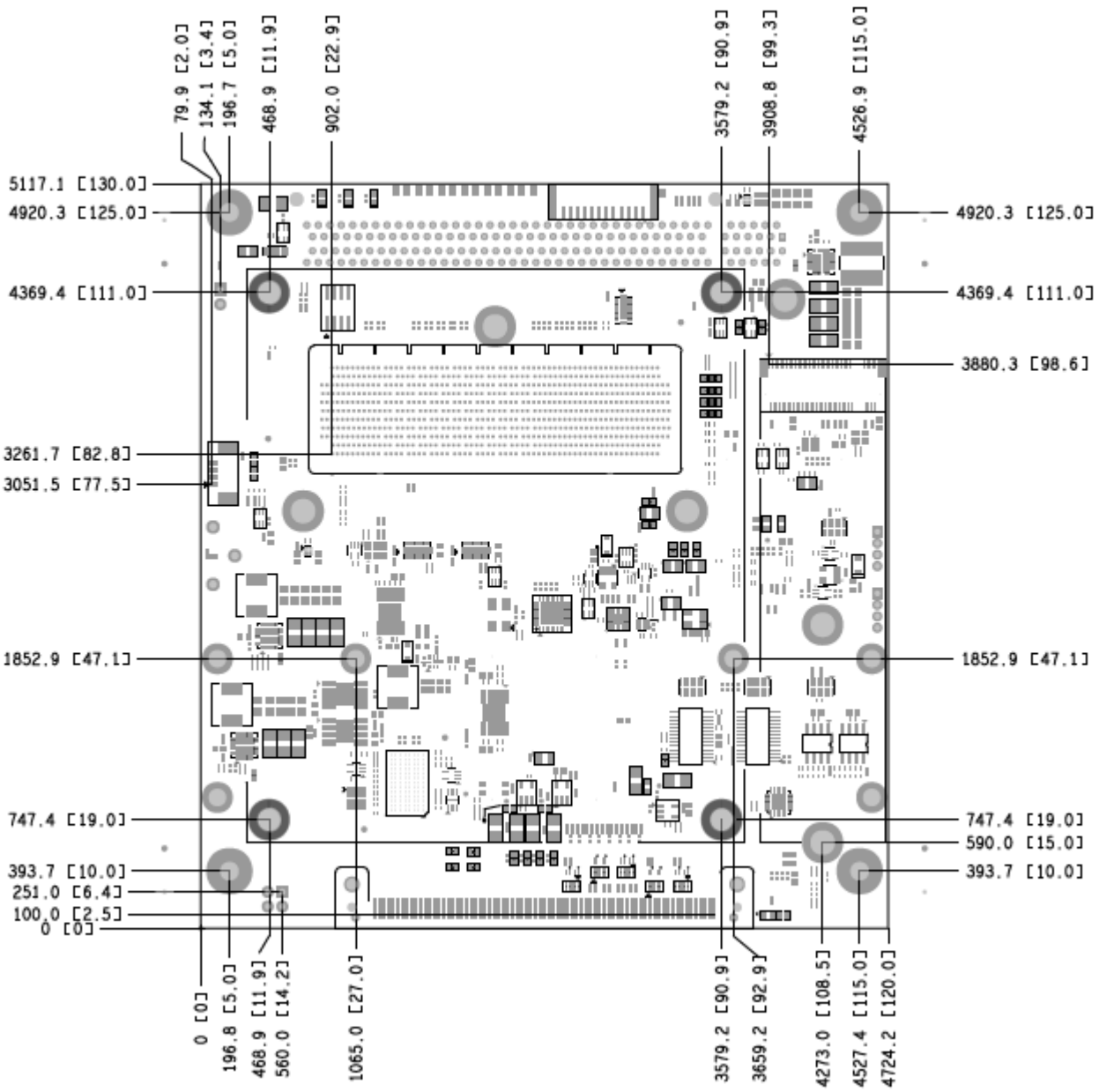


Figure 5: Osbourne Carrier Board - Top Dimension

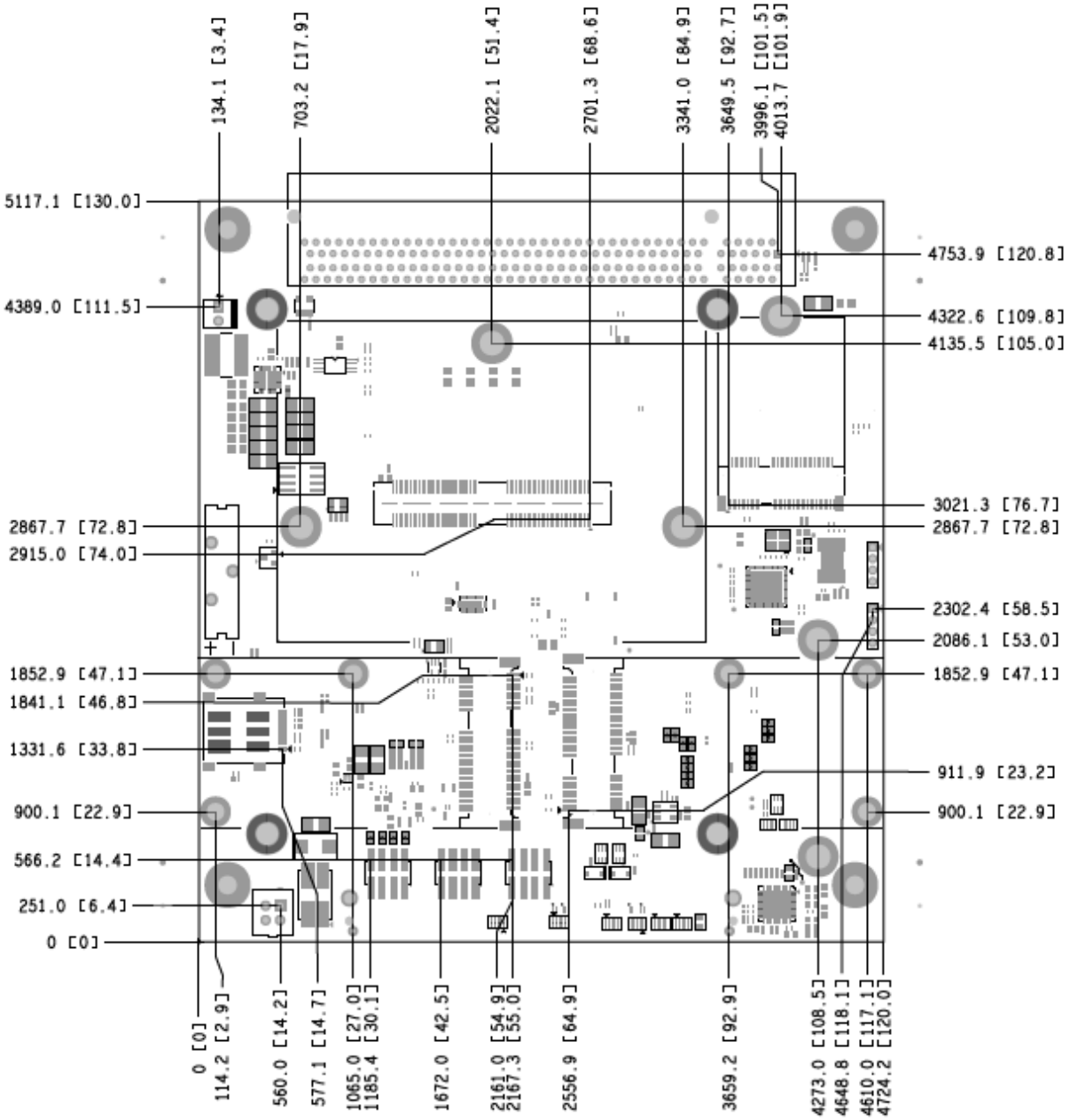


Figure 6: Osbourne Carrier Board - Bottom Dimension

4. DESIGN CONSIDERATIONS FOR THE VARIOUS I/O CIRCUITS

4.1 Power Supply

The Osbourne board can be powered from wide input voltage range of +7V to +20V, typically 18V. Supply input should be greater than 15V if PCIe x16 card is being used on the Osbourne board. The Input power supply is connected to pins 143 through 150 of I/O connector.

The Osbourne carrier board also provides 5V and 3.3V output voltages each with 100mA capacity on the I/O connector and these voltages can be used on custom IO board.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Description
143	V_VIN	Power: 7-20V	Connect to 7-20V or typical 18V input, 40W power supply +Ve
145	V_VIN	Power: 7-20V	
147	V_VIN	Power: 7-20V	
149	V_VIN	Power: 7-20V	
144	V_VIN	Power: 7-20V	
146	V_VIN	Power: 7-20V	
148	V_VIN	Power: 7-20V	
150	V_VIN	Power: 7-20V	
7	V_5P0_A	Power: 5.0V	5V, 100mA Output – Can be used for HDMI power
9	V_DIO	Power: 3.3V /5.0 V	3.3V, 100mA Output – Can be used for digital peripheral circuits

Connect supply -Ve to GND pins on the Osbourne board.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Description
02	GND_AUD	Audio Ground	Connect to Audio ground
10	GND_DIG	Ground	Connect to input power supply -Ve
16	GND_DIG	Ground	
22	GND_DIG	Ground	
28	GND_DIG	Ground	
34	GND_DIG	Ground	
40	GND_DIG	Ground	
46	GND_DIG	Ground	
52	GND_DIG	Ground	
58	GND_DIG	Ground	
64	GND_DIG	Ground	
70	GND_DIG	Ground	
94	GND_DIG	Ground	
100	GND_DIG	Ground	
106	GND_DIG	Ground	
112	GND_DIG	Ground	
118	GND_DIG	Ground	
124	GND_DIG	Ground	
130	GND_DIG	Ground	
136	GND_DIG	Ground	
141	GND_DIG	Ground	
142	GND_DIG	Ground	

4.1.1 Power routing through panel IO board to main board

By default, input voltage to the Osbourne carrier board is supplied from the IO board through IO connector. Custom IO board should have a power input connector that supports +7V to +20V, 40W power input.

Maximum allowable reflected ripple, measured at the voltage input connector is 50mV p-p. Over current protection, Bulk capacitor, EMI filter and reverse protection should be provided on the custom I/O board developed. Refer Figure 7Figure 7: Power Input Sample Circuit for sample input filter circuitry.

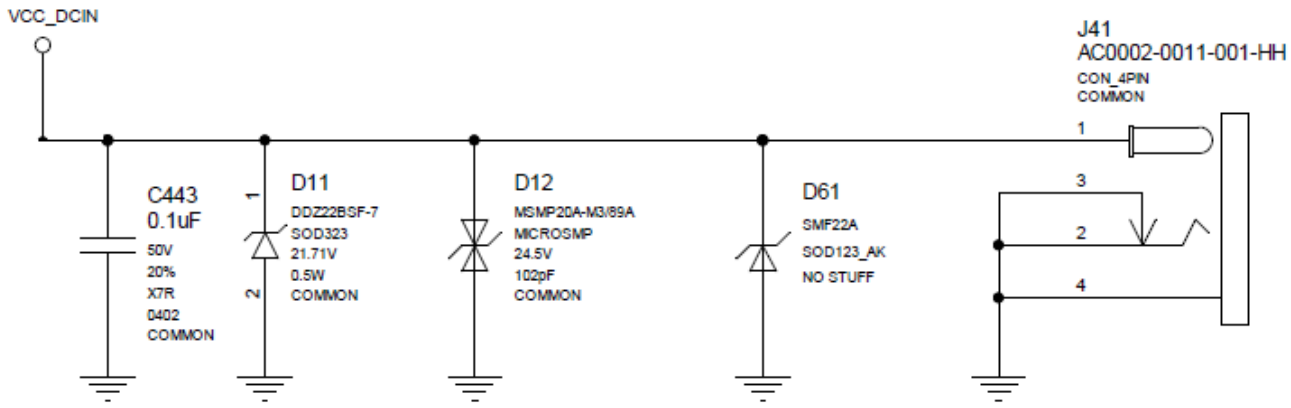


Figure 7: Power Input Sample Circuit

4.1.2 Power routing from main board to panel IO board

For testing purpose an auxiliary 2x2 IPL1 series power connector (J14) is provided on the Osbourne carrier board. The input voltage can be supplied to Osbourne board through this connector if it is not supplied from the custom IO board. The input voltage range is 7-20VD. The connector details and the pinouts for power input are as shown below:

VIN	1	2	GND
VIN	3	4	GND

Connector part number: IPL1-102-01-L-D-K
Mating connector: Samtec IPD1-02-D-K
Mating Cable: DSC # 6981507

4.2 Backup Battery

RTC of Orin module requires backup voltage from 1.85V to 5.5V max. The backup voltage signal is available on IO connector to connect external backup battery. Connect a Lithium Cell or similar power source. The board supports only non-rechargeable coin cells. The base board can boot and function normally without a backup battery as well. This is achieved by OR'ing circuit implemented on Osbourne base board. Figure 8 shows the OR'ing circuit implementation on Osbourne base board.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Description
5	V_3P0_RTC_CON	Power: 1.8V to 5.5V	Connect coin cell +Ve to this pin through OR'ing circuit and -Ve to GND

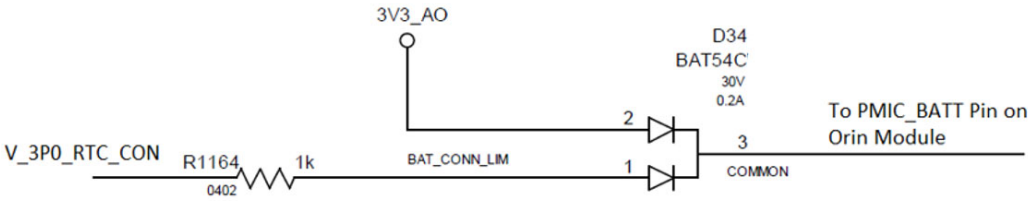


Figure 8: Coin cell OR'ing circuit

Note: 1K series resistor is also available on the Osbourne base board along with OR'ing circuitry.

4.3 Ethernet

The Osbourne board offers Two ethernet port one supports 1G and other supports the 10G ethernet speed.

10G Ethernet port derived using MGBE interface from Orin module using 10G ethernet PHY (part AQR113-B0-I). Three LED signals provided for Link, Activity, and Speed Indication.

The 10/100/1000 Ethernet port uses RGMII interface from Orin module through 1G PHY. Two LED signals are provided for Link, Activity, and Speed Indication.

Note: The Custom I/O board should have 10G and 1G magnetics along with the respective connector.

Both 10G and 1G port signals are routed to IO connector through following pins.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
96	GBE_MDI0_P	1G Copper Diff pair	100ohm	Connect to RJ45 pin through a 1G magnetics
98	GBE_MDI0_N	1G Copper Diff pair	100ohm	
102	GBE_MDI1_P	1G Copper Diff pair	100ohm	Connect to RJ45 pin through a 1G magnetics
104	GBE_MDI1_N	1G Copper Diff pair	100ohm	
108	GBE_MDI2_P	1G Copper Diff pair	100ohm	Connect to RJ45 pin through a 1G magnetics
110	GBE_MDI2_N	1G Copper Diff pair	100ohm	
114	GBE_MDI3_P	1G Copper Diff pair	100ohm	Connect to RJ45 pin through a 1G magnetics
116	GBE_MDI3_N	1G Copper Diff pair	100ohm	
120	MGBE0_PHY_A_P	10G Copper Diff pair	100ohm	Connect to RJ45 pin through a 10G magnetics
122	MGBE0_PHY_A_N	10G Copper Diff pair	100ohm	
126	MGBE0_PHY_B_P	10G Copper Diff pair	100ohm	Connect to RJ45 pin through a 10G magnetics
128	MGBE0_PHY_B_N	10G Copper Diff pair	100ohm	
132	MGBE0_PHY_C_N	10G Copper Diff pair	100ohm	Connect to RJ45 pin through a 10G magnetics
134	MGBE0_PHY_C_P	10G Copper Diff pair	100ohm	
138	MGBE0_PHY_D_P	10G Copper Diff pair	100ohm	Connect to RJ45 pin through a 10G magnetics
140	MGBE0_PHY_D_N	10G Copper Diff pair	100ohm	
129	KSZ_LED2	1.8 V Active Low	50ohm	1G PHY LED2
131	KSZ_LED1	1.8 V Active Low	50ohm	1G PHY LED1
133	MGBE_LED2	Active Low, Open Drain, 20mA	50ohm	10G PHY LED2
135	MGBE_LED1	Active Low, Open Drain, 20mA	50ohm	10G PHY LED1
137	MGBE_LED0	Active Low, Open Drain, 20mA	50ohm	10G PHY LED0

4.3.1 1G LED Configuration

KSZ_LED2 and KSZ_LED1 configuration is as shown in the following table.

Link/Activity	Pin State		LED Definition	
	LED2	LED1	LED2	LED1
Link Off	H	H	OFF	OFF
1000 Link/No Activity	L	H	ON	OFF
1000 Link/Activity (RX, TX)	Toggle	H	Blinking	OFF
100 Link/No Activity	H	L	OFF	ON
100 Link/Activity (RX, TX)	H	Toggle	OFF	Blinking
10 Link/No Activity	L	L	ON	ON
10 Link/Activity (RX, TX)	Toggle	Toggle	Blinking	Blinking

Note: In Tri-color Dual-LED mode, the KSZ_LED2 and KSZ_LED1 pin outputs toggle high pulses for transmit/receive activity indication. At low data rate (e.g., one frame per second), the LED pin drives high (OFF) with a narrow high pulse width of about 640ns.Typically, the LED toggle rate should be <10Hz (100ms clock period or 50ms high pulse width) to be visible to the human eye. A 640ns pulse is not visible. It is recommended to use a pulse stretching circuit on custom I/O board to detect high narrow pulse widths down to 500ns and stretch them to the visible width (e.g., >50ms).

The following Electronic Design web link article has a sample pulse stretching circuit:

http://electronicdesign.com/lighting/configurable-logic-chip-stretches-pulses-brighten-led-flash

4.3.2 10G LED Configuration

Refer following sample circuit for LED signal connections.

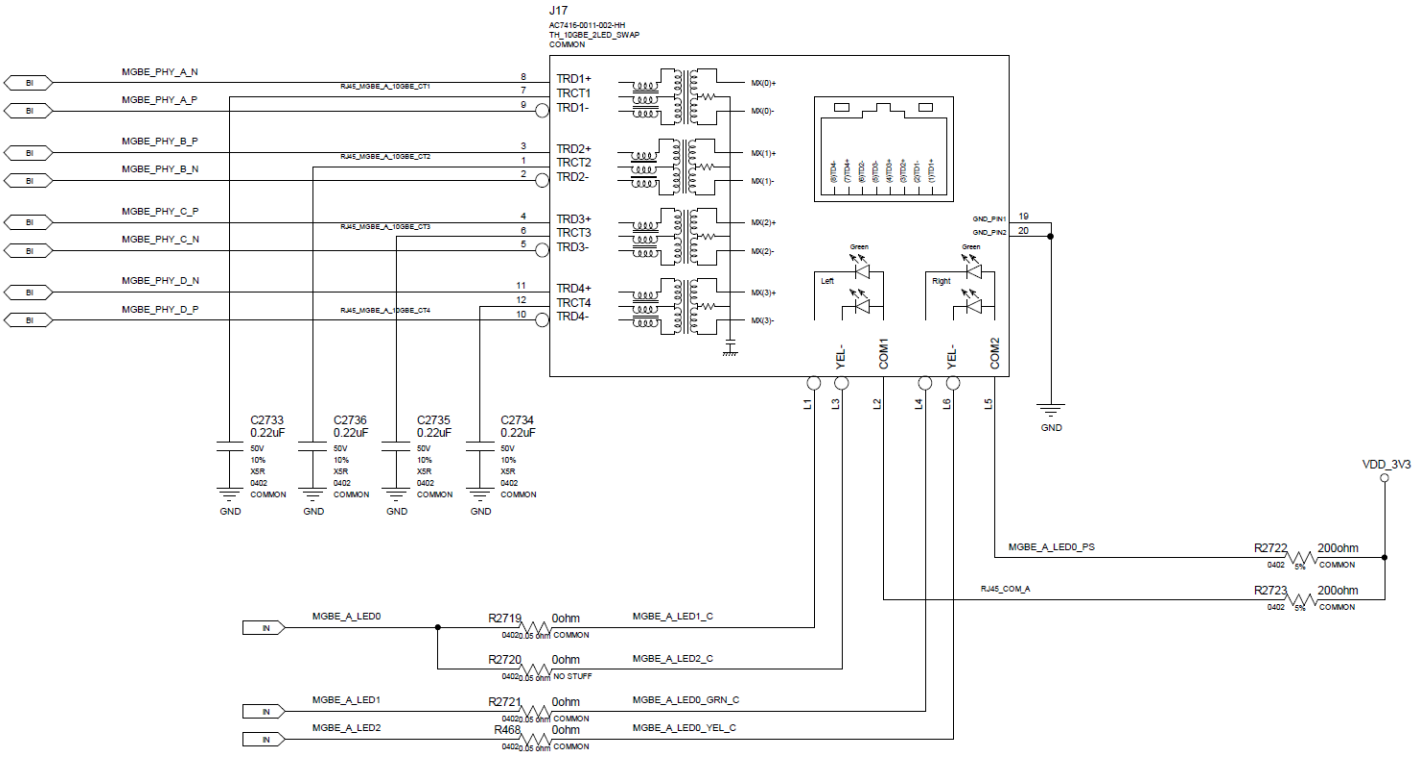


Figure 9: 10G LED Connection Sample Circuit

4.4 Display

The board offers one HDMI/DP video output option. The HDMI/DP port is directly from the Module and made available on the I/O connector.

Note: Custom IO board should include level shifter for signals DP2_AUX_CH_P and DP2_AUX_CH_N to change the voltage level from 1.8V/3.3V to 5V.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
36	HDMI_DP2_TX0_CON_P	HDMI/DP Diff pair, AC coupled	100ohm	DisplayPort 2 Lane 0 or HDMI Lane 2. AC-Coupled on Osbourne board.
38	HDMI_DP2_TX0_CON_N	HDMI/DP Diff pair, AC coupled	100ohm	
42	HDMI_DP2_TX3_CON_P	HDMI/DP Diff pair, AC coupled	100ohm	DisplayPort 2 Lane 1 or HDMI Lane 1. AC-Coupled on Osbourne board.
44	HDMI_DP2_TX3_CON_N	HDMI/DP Diff pair, AC coupled	100ohm	
48	HDMI_DP2_TX2_CON_N	HDMI/DP Diff pair, AC coupled	100ohm	DisplayPort 2 Lane 2 or HDMI Lane 0. AC-Coupled on Osbourne board.
50	HDMI_DP2_TX2_CON_P	HDMI/DP Diff pair, AC coupled	100ohm	
54	HDMI_DP2_TX1_CON_N	HDMI/DP Diff pair, AC coupled	100ohm	

56	HDMI_DP2_TX1_CON_P	HDMI/DP Diff pair, AC coupled	100ohm	DisplayPort 2 Lane 3 or HDMI Clk Lane. AC-Coupled on Osbourne board.
39	GPIO20_DP/HDMI_EN_1P8	1.8 V	50ohm	Can be used for HDMI/DP Power enable and termination selection through a load switch
41	DP2_AUX_CH_P	Open-Drain, 1.8V (3.3V tolerant)	90ohm	Connect to HDMI DDC SCL or DP Aux+ through Level shifter
43	DP2_AUX_CH_N	Open Drain, 1.8V (3.3V tolerant	90ohm	Connect to HDMI DDC SCL or DP Aux- through Level shifter
45	HDMI_CEC_CON	Open Drain, 1.8V (3.3V tolerant	50ohm	Connect to HDMI CEC
47	DP2/HDMI_HPD	CMOS – 1.8V	50ohm	Connect to HDMI port Hot Plug Detect pin. 10K pull-up to 1.8V is provided on Osbourne base board.

4.4.1 HDMI Configuration

By default, the configured display interface is HDMI. All the common choke, termination option and ESD protection circuitry are provided on the baseboard. In Figure 10 circuits marked in yellow box is implemented on Osbourne base board. The Custom I/O board should have required circuitry for I2C level shifting, load switch for enabling HDMI power along with the HDMI connector circuit.

Refer Figure 11 for more information on the protection circuit available on Osbourne board.

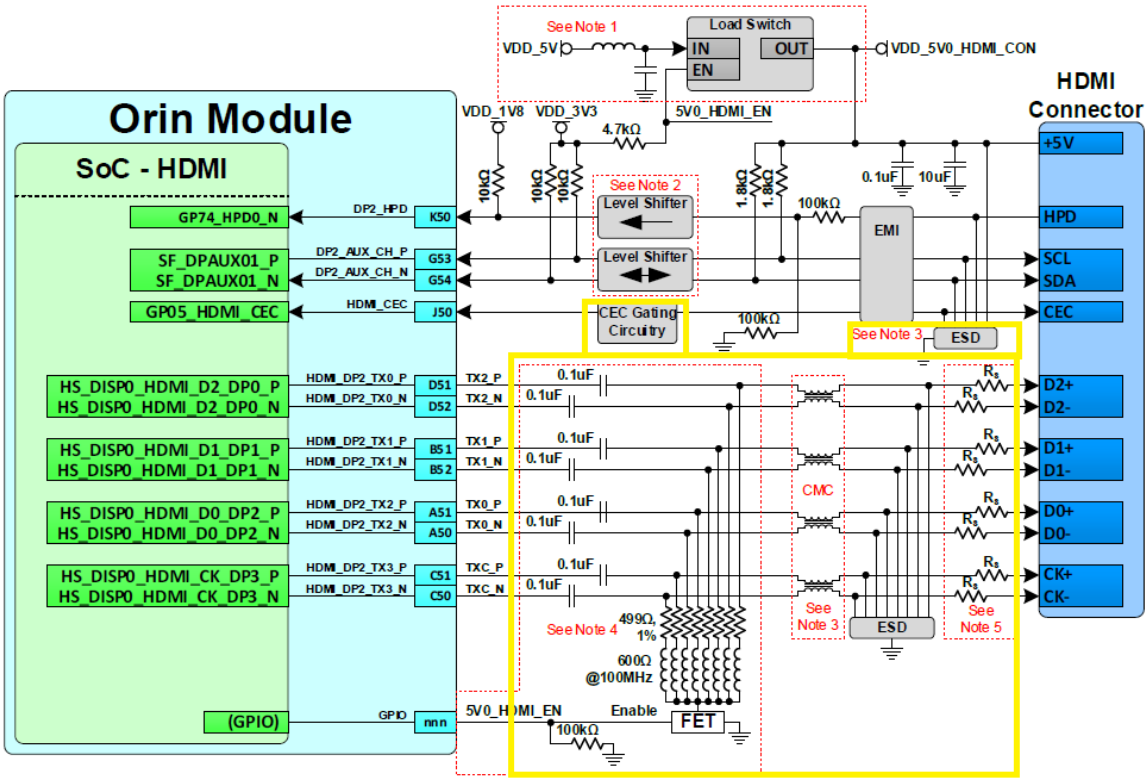


Figure 10: HDMI Configuration

Note 1: The load switch circuit shown is intended to remove power to the HDMI connector and related circuitry to avoid back drive on signals to the module. Other mechanisms may be used but must prevent module pins being driven when the module is off.

Note 2: Level shifters required on DDC/HPD. Orin module pads are not 5V tolerant and cannot directly meet HDMI VIL/VIH requirements. HPD level shifter can be non-inverting or inverting.

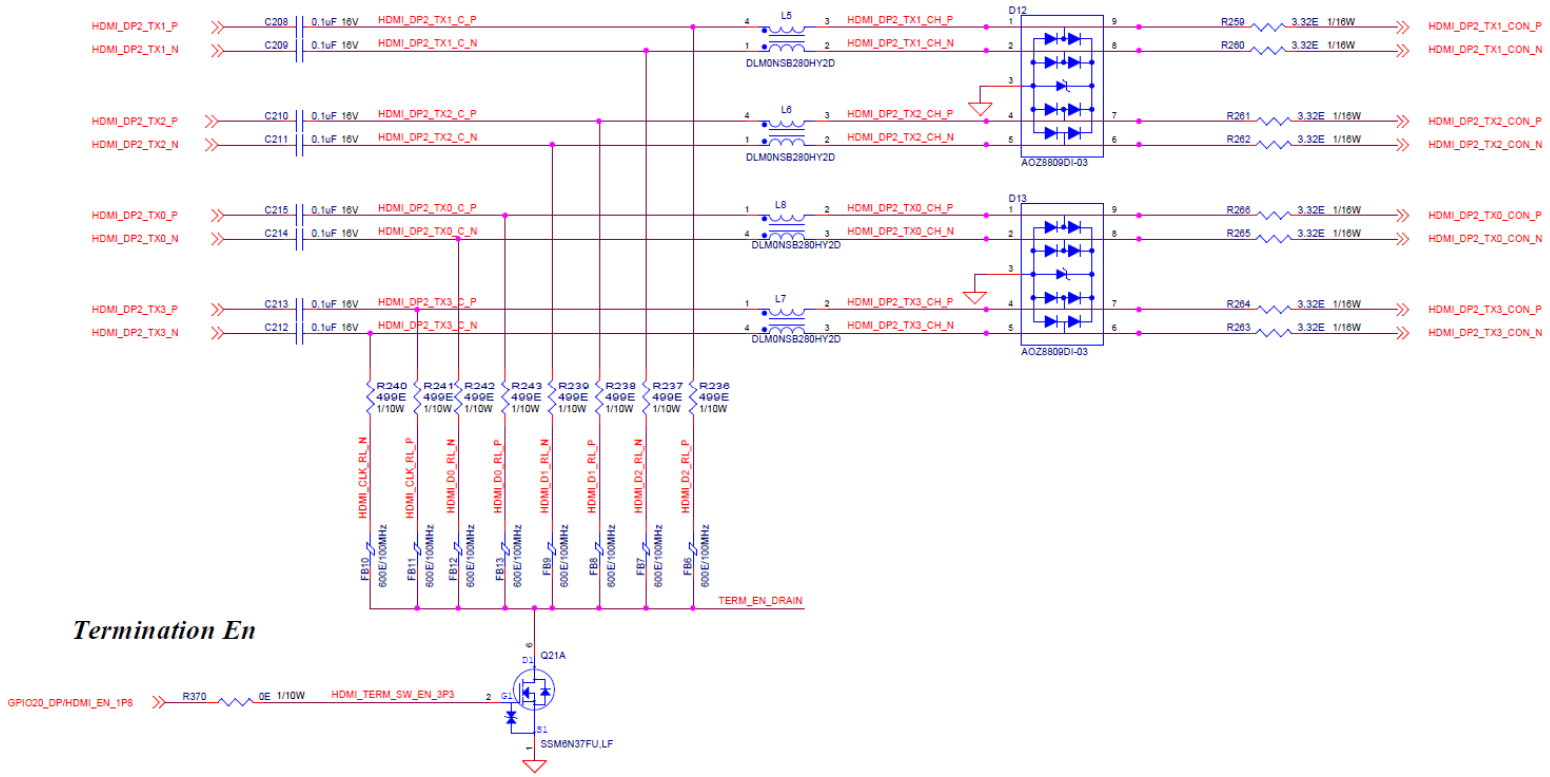


Figure 11: HDMI/DP Protection Circuit on Osbourne Carrier Board

Note: GPIO20_DP/HDMI_EN_1P8 should be driven low when used as Display Port (DP).

4.4.2 Display Port (DP) or eDP Configuration

The display interface can also be used in DP or eDP mode. Figure 12 shows display port connection example. The section marked in yellow box is implemented on the Osbourne base board. The load switch, level shifters, pull up/down configurations and connector need to be added on the custom IO board.

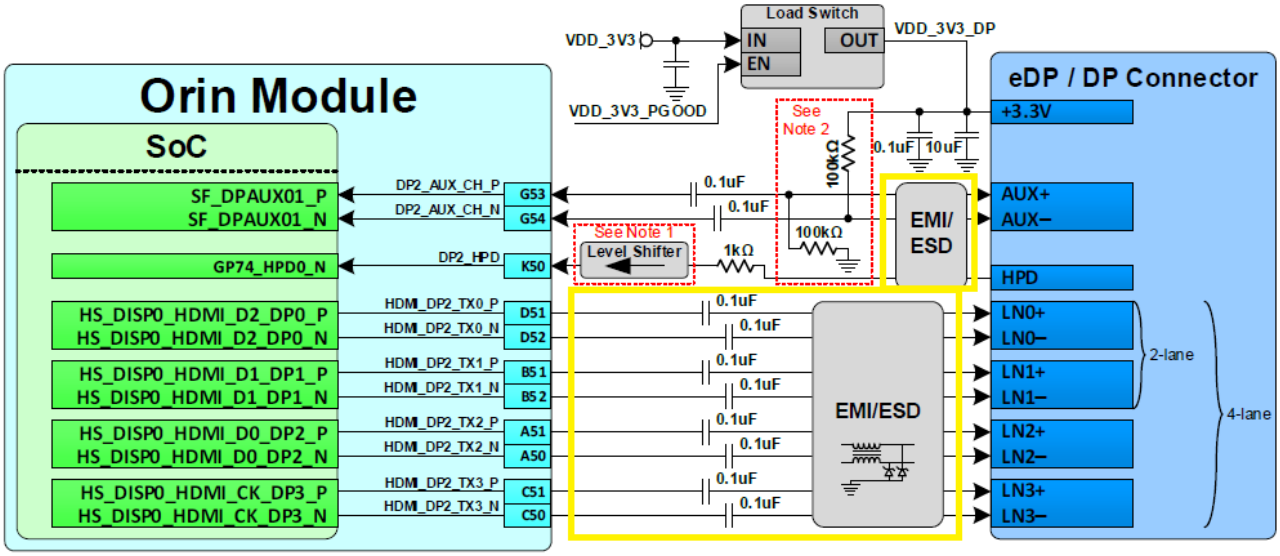


Figure 12: Display Port Configuration

Note 1: A Level shifter is required on HPD to avoid the pin from being driven when the module is off. The level shifter must be non-inverting (preserve polarity of the signal from the display).

Note 2: Pull-up/down only required for DP - not for eDP.

4.5 Audio

Audio I/O signals include stereo line out and mono/stereo mic in from the CODEC chip (Part# ALC5640). The audio signals made available on the I/O connector. All audio signals should be routed referenced to GND_AUD on custom I/O board. The Custom I/O board should have suitable protection circuitry to protect against ESD or any other electrical transients.

Figure 13 shows sample ESD protection circuit for individual audio signal lines.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
1	AUDIO_HPOR_HDA	Analog Output	50ohm	Headphone amplifier output right channel
3	AUDIO_HPOL_HDA	Analog Output	50ohm	Headphone amplifier output left channel
2	GND_AUD	Audio Ground		Reference ground for audio signals
4	AUDIO_MIC_L	1.8V, Analog Input	50ohm	Connect to Analog Microphone left channel
6	AUDIO_MIC_R	1.8V, Analog Input	50ohm	Connect to Analog Microphone right channel
8	AUDIO_PRSNT_L	1.8 V	50ohm	Active low Input used to detect a valid audio device connection

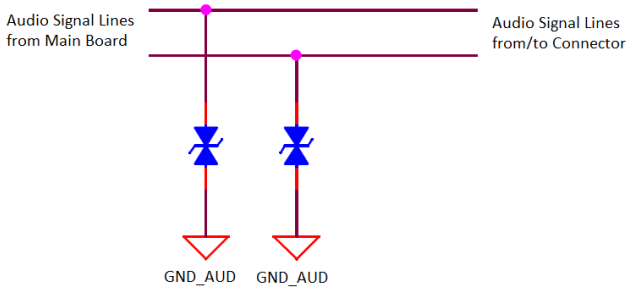


Figure 13: Audio Signal Protection Sample Circuit

Note: It is recommended to use low capacitance ESD diodes, which should not have any impact on the signals within audio frequency band (20Hz to 20KHz). Selection of ESD diode should also maintain the voltage across the diode well within 1.98V DC during ESD events.

4.6 Serial Ports

The board supports up to 4 serial ports from the module. Two serial ports, which can be configured as RS232 or RS422 or RS485 ports, are derived using single transceiver (Part#SP336EEY-L) on the Osbourne carrier board. The protocol selection is done through software control. Refer Osbourne user manual for more information about protocol selection. On board jumper option is provided to select termination (120 Ohm) for RS232/RS422/RS485 protocols. Refer section 386.1.1 for more information on jumper options.

Another Two fixed RS232 protocol ports are derived using another transceiver (Part#MAX3243EIPW) on the Osbourne carrier board. Fourth serial port does not support flow control feature.

The serial transceiver parts used on Osbourne carrier board have in-built protection against ESD up to +/-15kV airgap discharge and minimum +/-8kV contact discharge, hence not necessary to provide any additional protection against ESD on custom I/O board.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
49	UART5_CTS_RS232	RS232 Signal	50ohm	Serial Port 3: Connect to CTS pin on DB9 connector

51	UART5_RX_RS232	RS232 Signal	50ohm	Serial Port 3: Connect to RX pin on DB9 connector
53	UART5_RTS_RS232	RS232 Signal	50ohm	Serial Port 3: Connect to RTS pin on DB9 connector
55	UART5_TX_RS232	RS232 Signal	50ohm	Serial Port 3: Connect to TX pin on DB9 connector
57	UART3_9_RX_RS232	RS232 Signal	50ohm	Serial Port 4: Connect to RX pin on DB9 connector
59	UART3_9_TX_RS232	RS232 Signal	50ohm	Serial Port 4: Connect to TX pin on DB9 connector
81	CTS2/RX2_N	RS232/ RS422	50ohm	Serial Port 2: Connect to RS232 CTS2/RS422 RX2_N on DB9 connector
83	RX2/RX2_P	RS232/ RS422	50ohm	Serial Port 2: Connect to RS232 RX2/RS422 RX2_NP on DB9 connector
85	RTS2/TX2_N/RX2_N	RS232/ RS422/ RS485	50ohm	Serial Port 2: Connect to RS232 RTS2/RS422 TX2_P/ RS485 TX2+,RX2+ on DB9 connector
87	TX2/TX2_P/RX2_P	RS232/ RS422/ RS485	50ohm	Serial Port 2: Connect to RS232 TX2/RS422 TX2_P/ RS485 TX2+,RX2+ on DB9 connector
89	CTS1/RX1_N	RS232/ RS422	50ohm	Serial Port 1: Connect to RS232 CTS1/RS422 RX1_N on DB9 connector
91	RX1/RX1_P	RS232/ RS422	50ohm	Serial Port 1: Connect to RS232 RX1/RS422 RX1_P on DB9 connector
93	RTS1/TX1_N/RX1_N	RS232/ RS422/ RS485	50ohm	Serial Port 1: Connect to RS232 RTS1/RS422 TX1_N/ RS485 TX1-,RX1- on DB9 connector
95	TX1/TX1_P/RX1_P	RS232/ RS422/ RS485	50ohm	Serial Port 1: Connect to RS232 TX1/RS422 TX1_P/ RS485 TX1+,RX1+ on DB9 connector

4.7 CAN

The board provides two CAN interface from the AGX Orin module to the I/O connector. The CAN transceiver used (Part# MCP2551T-I/SN) supports baud rates from 60 kbaud up to 1 Mbaud. Bi-directional TVS diodes and noise filter circuits are provided on the Osbourne board. Refer Figure 14 for more information on protection available on the CAN bus signals.

I/O Conn. Pin	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
73	CAN1_L	CAN Differential Pair	50ohm	Connect to CAN LOW line on the CAN BUS
75	CAN1_H	CAN Differential Pair	50ohm	Connect to CAN HIGH line on the CAN BUS
77	CAN0_L	CAN Differential Pair	50ohm	Connect to CAN LOW line on the CAN BUS
79	CAN0_H	CAN Differential Pair	50ohm	Connect to CAN HIGH line on the CAN BUS

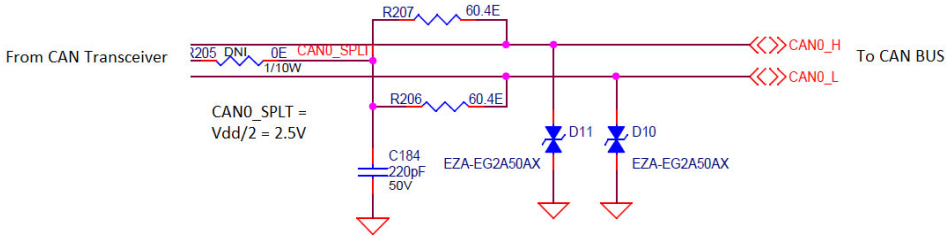


Figure 14: CAN filter and protection circuits on Osbourne Board

4.8 USB

The Osbourne board supports 1x USB2.0 via USB 2.0 hub routed to I/O connector. Three numbers of USB3.2 and three USB2.0 ports are also routed to the I/O connector. USB power switch, common choke and ESD protection circuitry are provided on the baseboard. One of the USB ports is shared with the PCIe when the Osbourne board work in configuration #2. Refer Nvidia AGX Orin design guide for more information on various configurations. Refer 6.1.3 for more information on jumper configurations. Figure 15 and Figure 16 shows the USB protection circuit available on the Osbourne board for USB2.0 and USB3.2 interfaces respectively.

I/O Conn Pin	Orin Module Connector Pin No.	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
27	NA	V_USB3_1	Power: 5.0V		Connect to V+ pin on USB3.2 Port 0 connector
29	C10	USB2_D1_CH_N	USB2 Diff pair	90ohm	Connect to D+ pin on USB2.0 Port 2 connector
31	C11	USB2_D1_CH_P	USB2 Diff pair	90ohm	Connect to D- pin on USB2.0 Port 2 connector
33s	NA	V_USB3_2	Power: 5.0V		Connect to V+ pin on USB3.2 Port 1 connector
35	F13	USB2_D0_CH_N	USB2 Diff pair	90ohm	Connect to D+ pin on USB2.0 Port 1 connector
37	F12	USB2_D0_CH_P	USB2 Diff pair	90ohm	Connect to D- pin on USB2.0 Port 1 connector
61	NA	V_USB2_VBUS	Power: 5.0V		Connect to D+ pin on USB2.0 Port 4 connector
63	G10*	USB2_HUB_D4_CH_N	USB2 Diff pair	90ohm	Connect to D- pin on USB2.0 Port 4 connector
65	G11*	USB2_HUB_D4_CH_P	USB2 Diff pair	90ohm	Connect to D- pin on USB2.0 connector
67	NA	V_USB3_3	Power: 5.0V		Connect to V+ pin on USB3.2 Port 2 connector
69	A11	USB2/PCIE_CLK_CH_N	USB2 Diff pair/ PCIe Diff pair	90ohm	Connect to D+ pin on USB2.0 Port 3 connector
71	A10	USB2/PCIE_CLK_CH_P	USB2 Diff pair/ PCIe Diff pair	90ohm	Connect to D- pin on USB2.0 Port 3 connector
12	A22	USB3/PCIE_UPHY_RX0_P	USB3 / PCIe Diff pair	85ohm	Connect to RX+ pin on USB3.2 Port 1 connector
14	A23	USB3/PCIE_UPHY_RX0_N	USB3 / PCIe Diff pair	85ohm	Connect to RX- pin on USB3.2 Port 0 connector
18	J22	USB3/PCIE_UPHY_TX0_P	USB3 / PCIe Diff pair	85ohm	Connect to TX+ pin on USB3.2 Port 0 connector
20	J23	USB3/PCIE_UPHY_TX0_N	USB3 / PCIe Diff pair	85ohm	Connect to TX+ pin on USB3.2 Port 0 connector
24	C23	USB3_UPHY_RX1_P	USB3 Diff pair	85ohm	Connect to RX+ pin on USB3.2 Port 1 connector
26	C22	USB3_UPHY_RX1_N	USB3 Diff pair	85ohm	Connect to RX- pin on USB3.2 Port 1 connector
30	G23	USB3_UPHY_TX1_P	USB3 Diff pair	85ohm	Connect to TX+ pin on USB3.2 Port 1 connector
32	G22	USB3_UPHY_TX1_N	USB3 Diff pair	85ohm	Connect to TX+ pin on USB3.2 Port 1 connector
60	C34	USB3_UPHY_RX20_P	USB3 Diff pair	85ohm	Connect to RX+ pin on USB3.2 Port 2 connector
62	C35	USB3_UPHY_RX20_N	USB3 Diff pair	85ohm	Connect to RX- pin on USB3.2 Port 2 connector
66	K32	USB3_UPHY_TX20_P	USB3 Diff pair	85ohm	Connect to TX+ pin on USB3.2 Port 2 connector
68	K33	USB3_UPHY_TX20_N	USB3 Diff pair	85ohm	Connect to TX+ pin on USB3.2 Port 2 connector

*Not direct connection from Orin module, connected through USB hub circuit

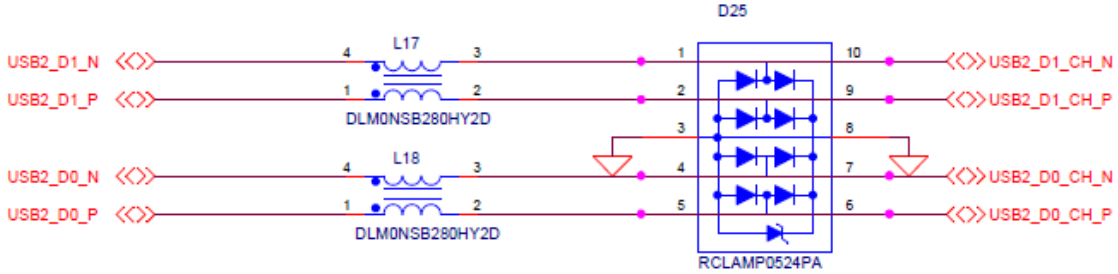


Figure 15: USB2.0 Circuit on Osbourne Carrier Board

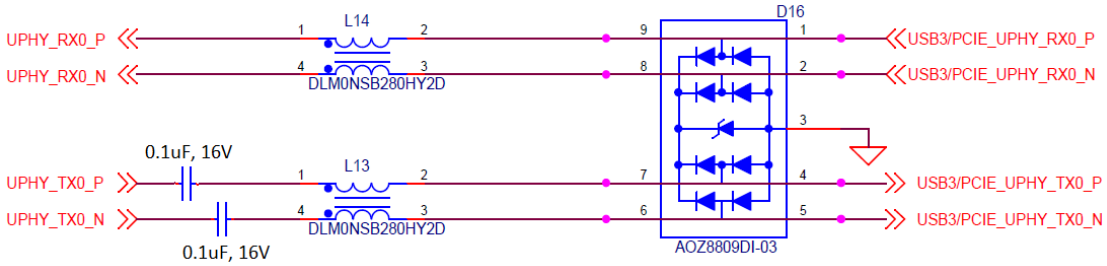


Figure 16: USB 3.2 Circuit on Osbourne Carrier Board

Note: USB3.2 Port 0 is shared between USB and PCIe. In configuration#1 it is used as USB3.2 and in configuration#2 it is used as PCIex1(C0) port. Refer 6.1.3 for more details on jumper configurations on Osbourne base board.

4.9 Digital I/O

The board provides 8 digital I/O's, which are individually configurable as an output or input. The I/Os are routed to the I/O connector. Figure 17 shows the ESD protection provided on the GPIO lines. Additional protection circuits shall be implemented on Custom I/O board as needed.

Provision is to select the DIO Voltage level of 3.3/5V and configure pull up (10K) and pull down(10K) though the Jumper JP2 is provided. Refer 6.1.2 for more information on jumper configuration.

I/O Conn Pin	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
11	DIO_PA7	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin
13	DIO_PA6	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin
15	DIO_PA5	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin
17	DIO_PA4	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin
19	DIO_PA3	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin
21	DIO_PA2	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin
23	DIO_PA1	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin
25	DIO_PA0	V_DIO (3.3V or 5V)	50ohm	Bi-directional general purpose I/O pin

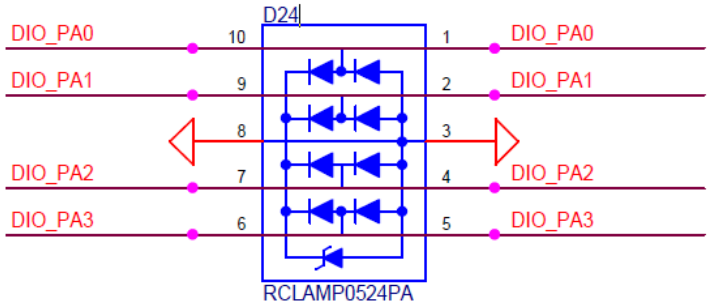


Figure 17: ESD protection on Digital IO Signals

4.10 SPI

SPI signals are connected to the I/O connector for interfacing external device. On board 1.8V to 3.3V level translator (Part#TXB0108DQSR / NLSX3018MUTAG) shifts SPI signals to 3.3V level. Custom I/O board should have ESD diodes, or any other protection circuitry as needed. Refer Nvidia AGX Orin product design guide for more information on specifications.

I/O Conn Pin	Orin Module Connector Pin No.	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description

121	J57	SPI1_SCK_3P3	3.3 V	50ohm	SPI 1 Serial clock – connect to slave clock pin
123	E55	SPI1_CS0_3P3	3.3 V	50ohm	SPI 1 chip select – connect to slave select pin
125	A56	SPI1_MISO_3P3	3.3 V	50ohm	SPI 1 master in slave out – connect to slave MISO line
127	D55	SPI1_MOSI_3P3	3.3 V	50ohm	SPI 1 master out slave in – connect to slave MOSI line

4.11 I2C

I2C signals are connected to the I/O connector for interfacing external device. On board 1.8V to 3.3V level shifter circuit (Part#TXB0108DQSR / NLSX3018MUTAG) shifts I2C signals to 3.3V level. 2K pull-ups to 3.3V are also provided on both I2C clock and Data lines on Osbourne Carrier board. Custom I/O board should have ESD diodes, or any other protection circuitry as needed. Refer Nvidia AGX Orin product design guide for more information on specifications.

I/O Conn Pin	Orin Module Connector Pin No.	Signal Name	Voltage Level/Pin Type	Recommended Impedance	Description
97	E60	I2C_GP8_DAT_3P3	I2C data; 3.3 V	50ohm	Connect to I2C bus serial data
99	D61	I2C_GP8_CLK_3P3	I2C Clock; 3.3 V	50ohm	Connect to I2C bus serial clock

4.12 Power and System Signals

Power and system signal pins such as Power button, Force recovery, Reset are available on the IO connector. Refer Nvidia AGX Orin product design guide for more details. Memory erase signal for M.2 Key M SSD is also available on I/O connector.

I/O Conn Pin	Orin Module Connector Pin No.	Signal Name	Voltage Level/Pin Type	Description
101	L61*	BUTTON_POWER_ON_N	3.3 V	Low Input from push button switch enables the power to the system. This feature is currently not enabled on Osbourne base board. Refer Nvidia AGX Orin module design guide for more details.
103	L60	SYS_RST_IN_N	Open Drain, 1.8V	When asserted, the SoC, eMMC, & QSPI are in reset. Refer Nvidia AGX Orin module design guide for more details.
105	L10	FORCE_RECOVERY#	CMOS – 1.8V	Force Recovery strap pin: Held low when SYS_RESET_N goes inactive (power-on or reset button press) to enter force recovery mode. Force recovery mode is used to program Orin module through USB2.0 USB0N/P or USB3.2 port#1. Refer Nvidia AGX Orin module design guide for more details.
111	B9	PEX_C1_RST_N	Open-Drain, 3.3V	PCIe Reset for controller #0. 4.7KΩ pull-up to 3.3V on Orin module. This pin is used to reset end point device when UPHY_RX0/TX0 is configured as PCIe x1 (C0) port instead of USB3.2 port.
113	NA	MEM_ERS_GPIO	1.8 V	Connected to Pin 6 and 8 of M.2 M Key connector. This functionality is module specific and can be used only on supported modules.

*Not direct connection to Orin module, connected through power sequencer circuit

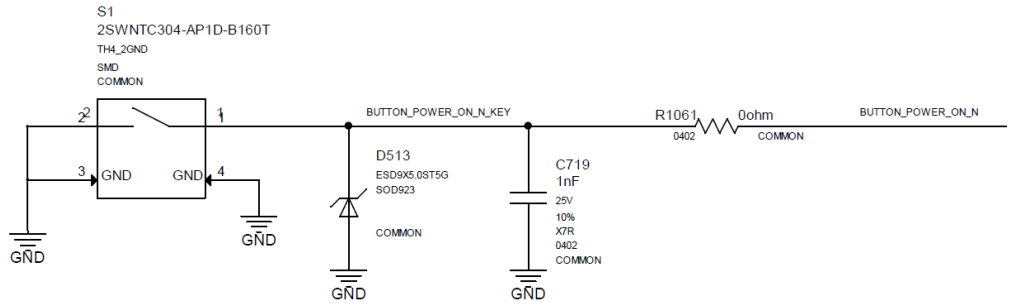


Figure 18: Button Power ON Sample Circuit

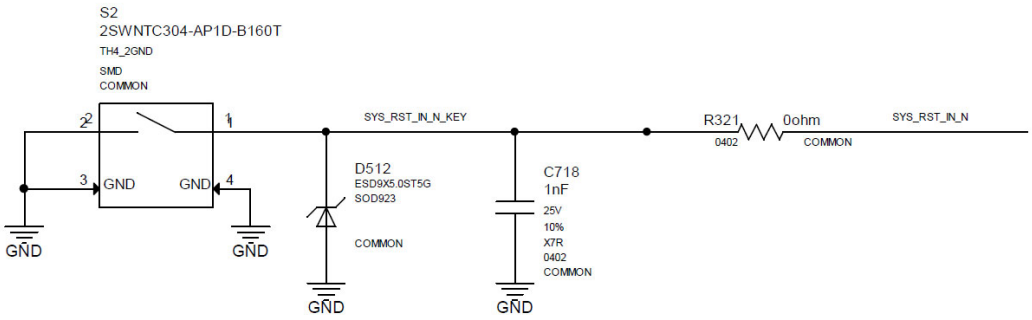


Figure 19: Reset Circuit Sample

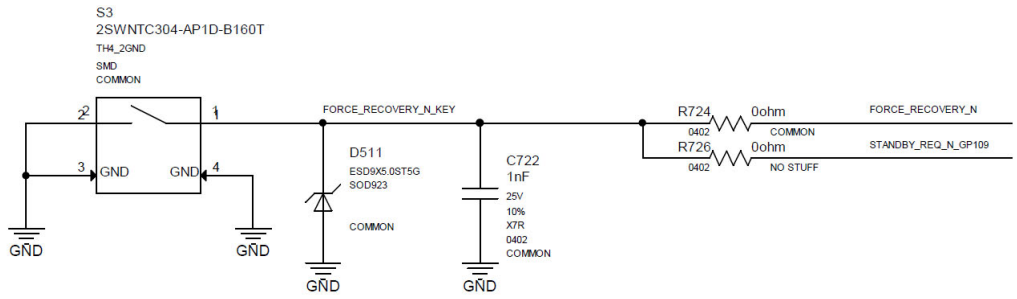


Figure 20: Force Recovery Sample Circuit

Note: 1nF debouncing capacitor and ESD protection (Part#RCLAMP0524PA) is already available on the Osbourne base board on SYS_RST_IN_N, FORCE_RECOVERY# and BUTTON_POWER_ON_N signals, so the custom I/O board doesn't need to duplicate these components.

4.13 Additional Control GPIOs

Osbourne board provides following GPIOs which can be used for general purposes.

I/O Conn Pin	Orin Module Connector Pin No.	Signal Name	Voltage Level/Pin Type	Description
115	A48	SER_GPIO_SEL	1.8 V	General purpose IO pin from Orin Module. Used as input for multiplexing digital IO and Serial port 2 signals on IO board using analog switch/mux.
117	H52	CAN_SER_SEL2	1.8 V	General purpose IO pin from Orin Module. Used for multiplexing CAN0 and UART5 signals on IO board using analog switch/mux.
119	D54	CAN_SER_SEL1	1.8 V	General purpose IO pin from Orin Module. Used for multiplexing CAN1 and UART3 signals on IO board using analog switch/mux

5. COMMERCIAL IO BOARD

This section provides details of Osbourne commercial IO board and can be used as a reference to design custom I/O board. Commercial I/O board provides access to all the signals available on the 150pin I/O connector to standard HDMI, USB, RJ45, DB9 and RJ11 type connectors.

5.1 Block Diagram for Commercial I/O Board

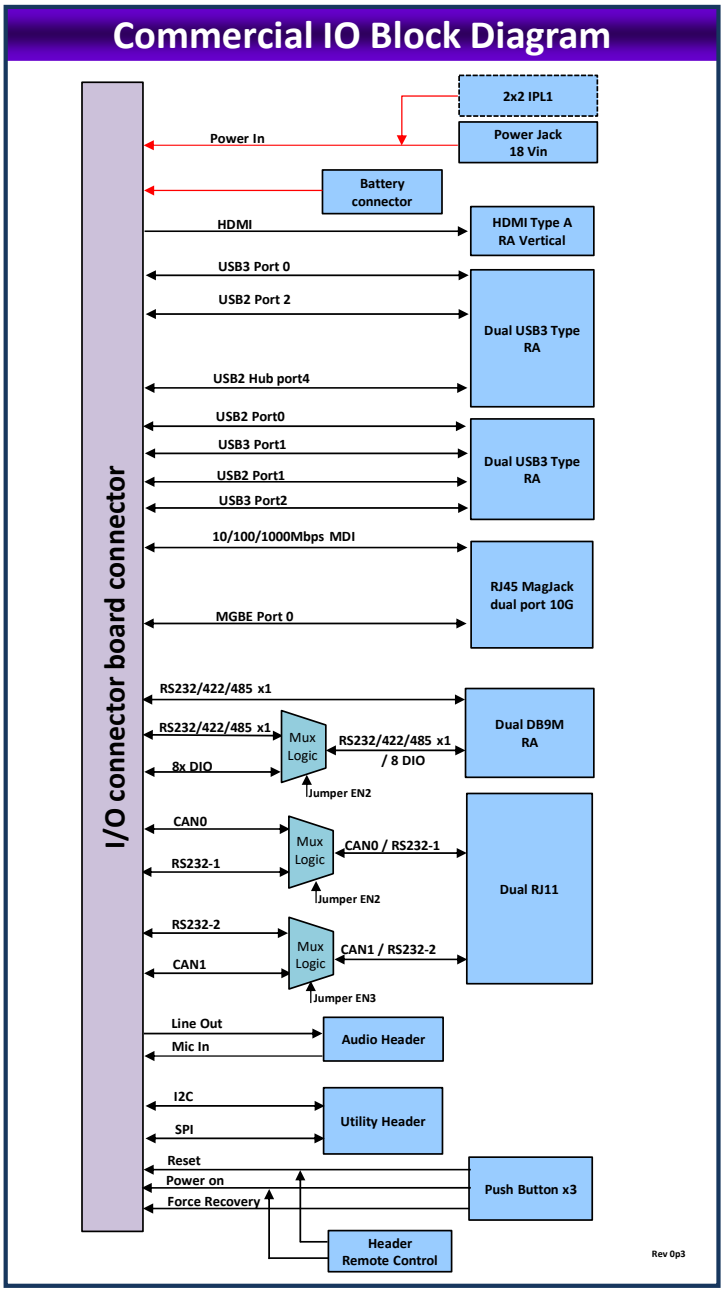


Figure 5-1: Commercial I/O Board Block Diagram

5.1.1 Mechanical Drawings for Commercial I/O Board

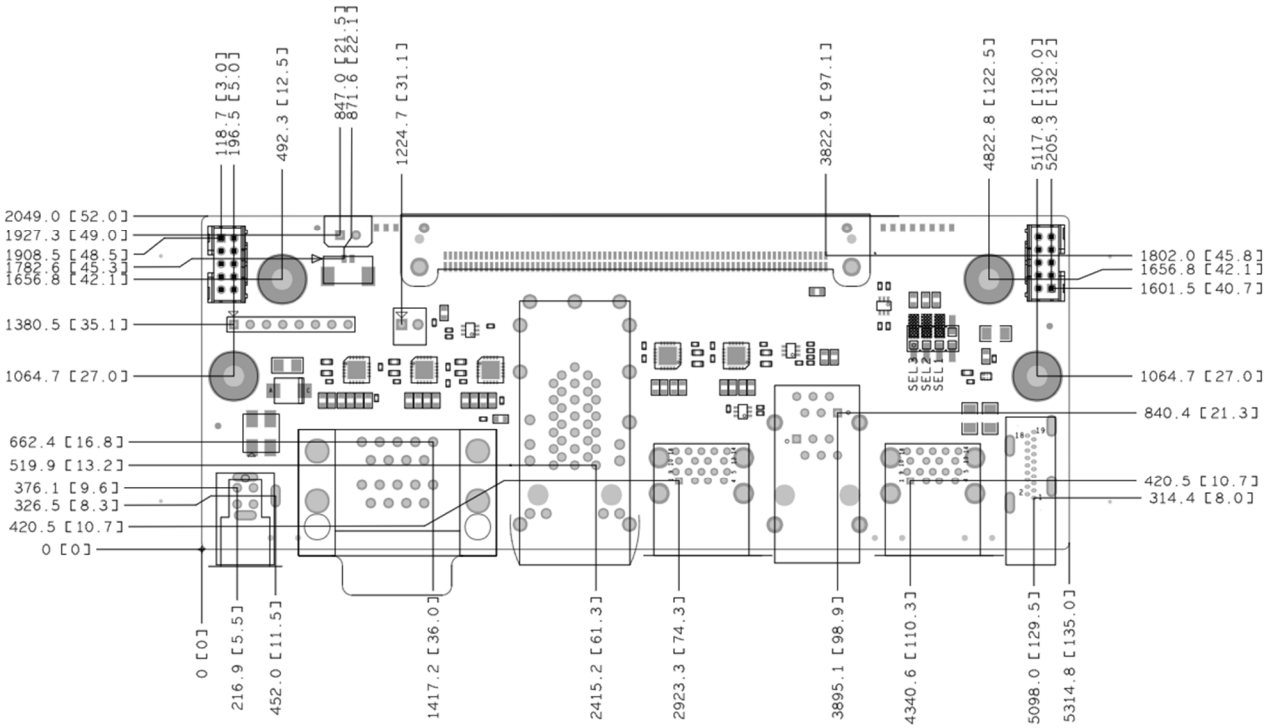


Figure 5-2: Commercial I/O Mechanical outline

5.1.2 Connector and Jumper Location

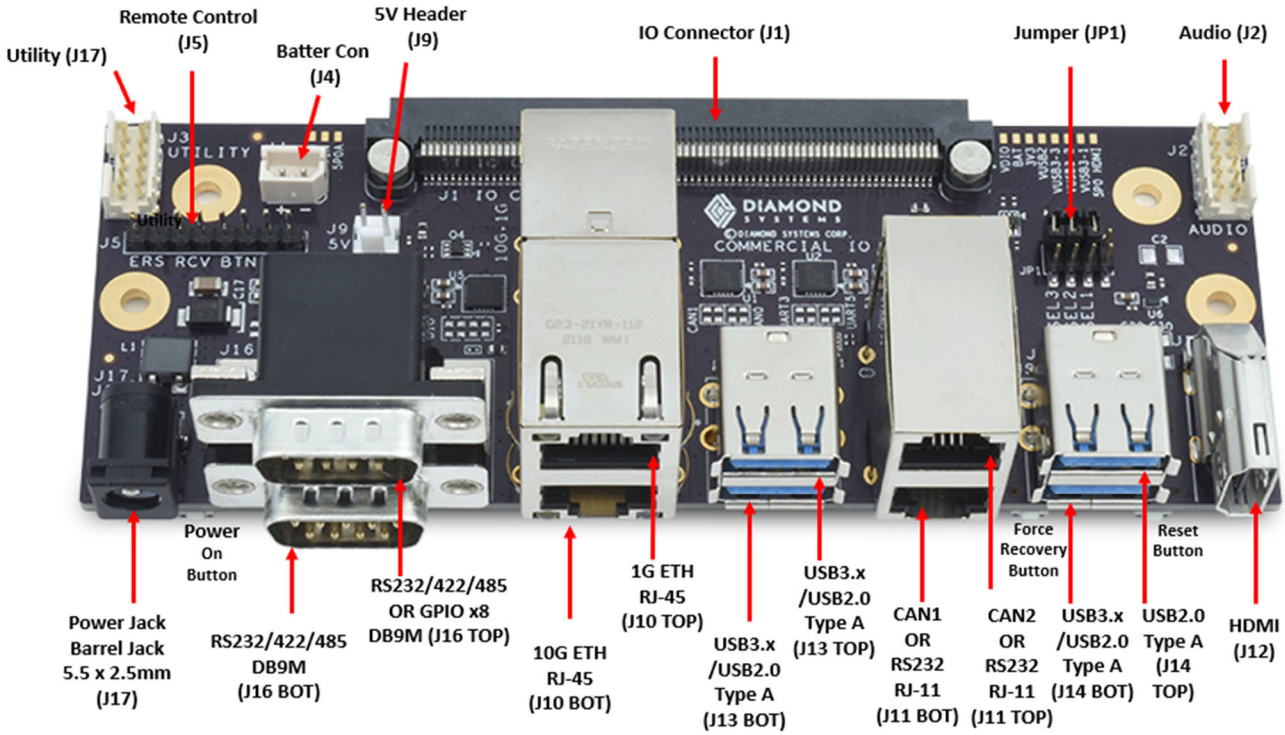


Figure 5-3: Commercial IO Connector locations

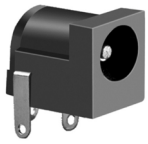
5.2 Connector Pinout Specification

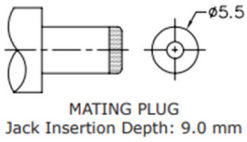
5.2.1 Power Connector on Osbourne Commercial IO Board

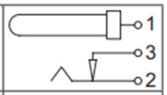
The pinouts for power input are as shown below:

VIN	1
	3
GND	2

+VIN = +7V to +20V

Connector PN: PJ-202BH Mating Cable PN: Standard 2.5mm DC plug	



SCHEMATIC	
Model	PJ-202BH
Center Pin	Ø2.5 mm

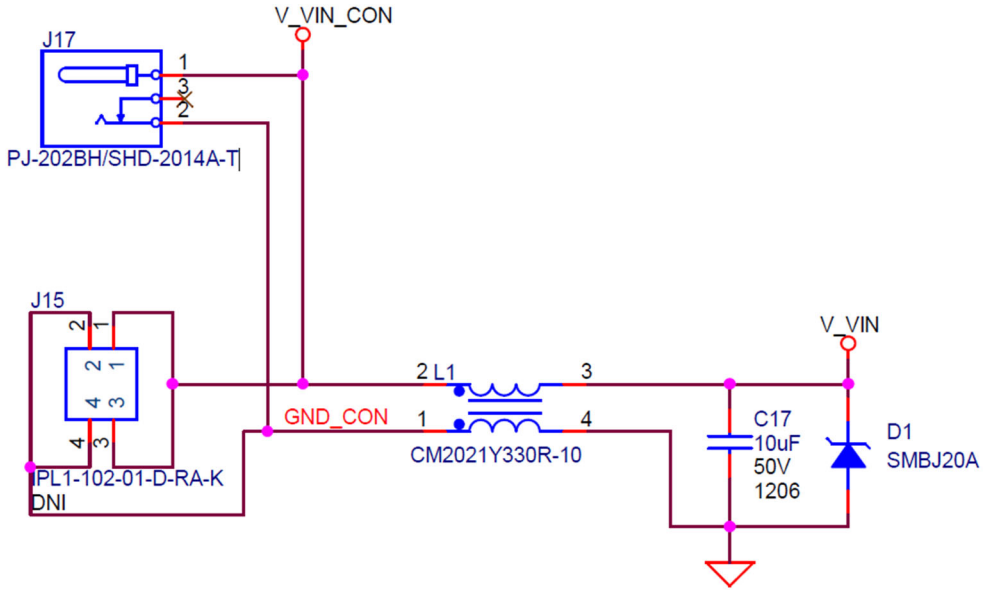


Figure 4: Schematic example for Power Input on Panel IO Board

Optional latching 2x2 IPI1 series power connector (J15) can be populated isntead of Power jack.

5.2.2 RTC Connector on Osbourne Commercial IO Board

Two Pin connector is used to connect the external battery.

The pinouts are as shown below:

V_3P0_RTC_CON	1
GND	2

Connector PN: 0533980271	

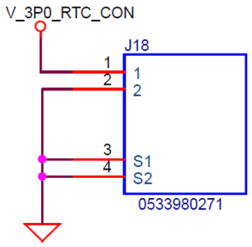


Figure 5: Schematic example for RTC connector on Panel IO Board

5.2.3 Ethernet Connector on Osbourne Commercial IO Board

Dual Port vertically stacked RJ45 connector with inbuilt magnetics are used. The passive components of Led are mounted on the commercial board and MDI signals are routed from main board through I/O connector.

The pinouts of 10G connector are as shown below

MGBE0_PHY_A_P	**B1**
MGBE0_PHY_A_N	**B2**
GND	**B3**
MGBE0_PHY_B_P	**B4**
MGBE0_PHY_B_N	**B5**
GND	**B6**
MGBE0_PHY_C_P	**B7**
MGBE0_PHY_C_N	**B8**
GND	**B9**
MGBE0_PHY_D_P	**B10**
MGBE0_PHY_D_N	**B11**
GND	**B12**
V_3P3	**B13**
MGBE0_LED0	**B14**
V_3P3	**B15**
MGBE0_LED2/ MGBE0_LED1	**B16**

The pinouts of 1G connector are as shown below

GBE_MDI0_P	**T1**
GBE_MDI0_N	**T2**
GND	**T3**
GBE_MDI1_P	**T4**
GBE_MDI1_N	**T5**
GND	**T6**
GBE_MDI2_P	**T7**
GBE_MDI2_N	**T8**
GND	**T9**
GBE_MDI3_P	**T10**
GBE_MDI3_N	**T11**
GND	**T12**
V_3P3	**T13**
KSZ_LED1	**T14**
KSZ_LED2	**T15**
V_3P3	**T16**

Connector PN: G23-21YR-112 Mating Cable PN: Standard CAT6A cable for 10G and Cat5 cable for 1G port	

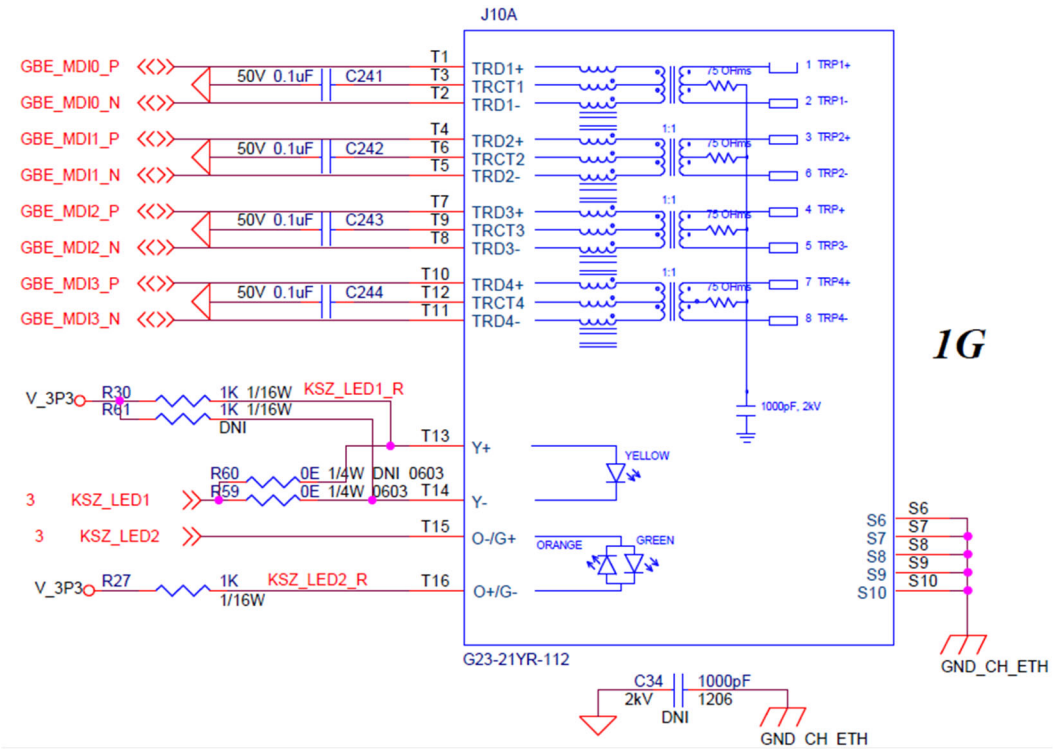


Figure 6: Schematic example for 1G connector on Panel IO Board

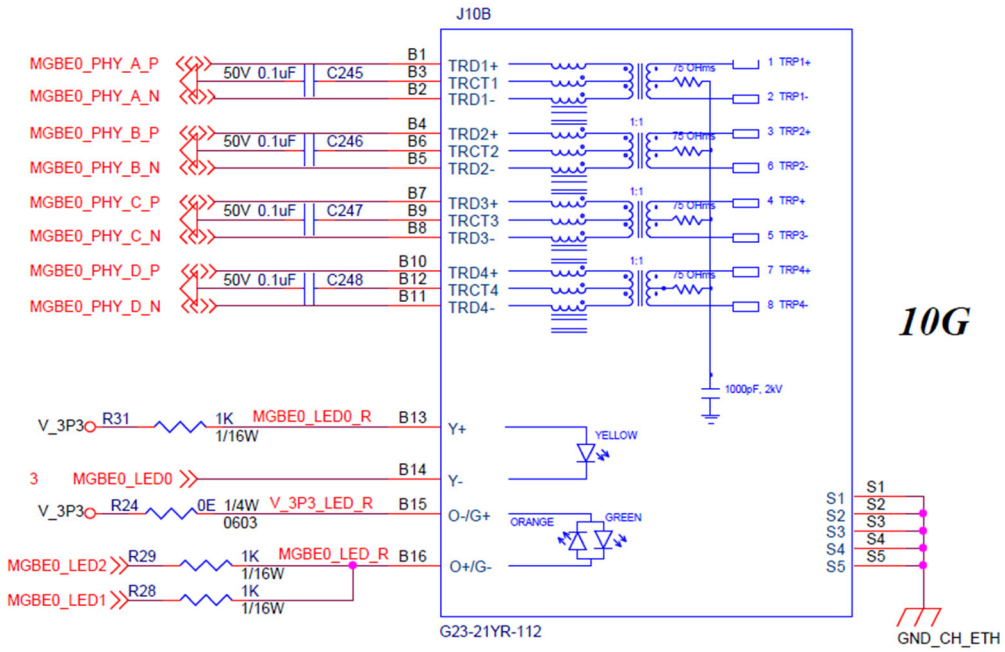


Figure 7: Schematic example for 10G connector on Panel IO Board

5.2.4 HDMI Connector on Osbourne Commercial IO Board

The pinouts for power input are as shown below

HDMI_DP2_TX0_CON_P	1
GND	2
HDMI_DP2_TX0_CON_N	3
HDMI_DP2_TX1_CON_P	4
GND	5
HDMI_DP2_TX1_CON_N	6
HDMI_DP2_TX2_CON_P	7
GND	8
HDMI_DP2_TX2_CON_N	9
HDMI_DP2_TX3_CON_P	10
GND	11
HDMI_DP2_TX3_CON_N	12
HDMI_CEC_CON	13
RSRVD	14
HDMI_SCL_CON	15
HDMI_SDA_CON	16
GND	17
V_5P0_HDMI	18
HDMI_HPD_CON	19

Connector on IO Board: TE Connectivity 2007435-1	

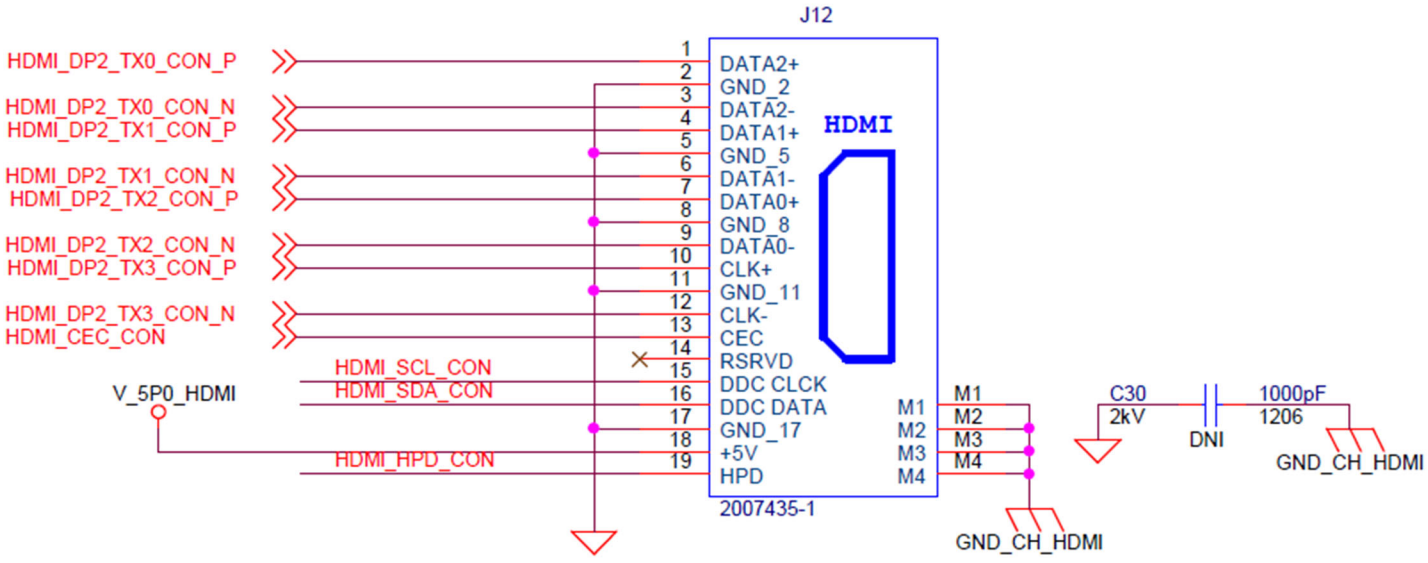


Figure 8: Schematic example for 10G connector on Panel IO Board

5.2.5 Audio Connector on Osbourne Commercial IO Board

This connector provides the analog audio interface from the IO connector.

The pinouts are as shown below:

AUDIO_HPOL_HDA	1	2	AUDIO_HPOR_HDA
GND_AUD	3	4	GND_AUD
NC	5	6	NC
GND_AUD	7	8	GND_AUD
AUDIO_MIC_L	9	10	AUDIO_MIC_R

Connector type: 2x5 2mm Header	

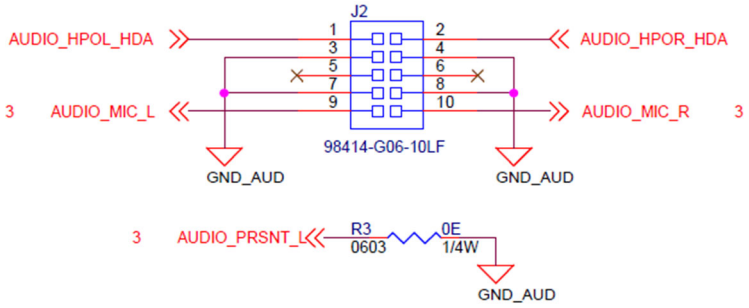


Figure 9: Schematic example for Audio connector on Panel IO Board

5.2.6 Serial Connectors on Osbourne Commercial IO Board

The serial ports 1 is routed to dual DB9 bottom port. Serial port 2 muxed with DIO is terminated at dual DB-9 top port. By default, Top port supports GPIO interface and bottom port support Serial port. Configurations can be changed using CAN/Serial/DIO Jumper (JP1). Two hex screws are provided on the DB9 connector to fix the mating connector after attaching.

A dual DB9 connector pin out for serial 1-2 RS232 protocol is below

	A1	B1	NC
RX2	A2	B2	RX1
TX2	A3	B3	TX1
	A4	B4	
GND_DIG	A5	B5	GND_DIG
	A6	B6	
RTS2	A7	B7	RTS1
CTS2	A8	B8	CTS1
	A9	B9	NC

A dual DB9 connector pin out for Serial 1- 2 RS422 protocol is below

	A1	B1	NC
RX2_P	A2	B2	RX1_P
TX2_P	A3	B3	TX1_P
	A4	B4	
GND_DIG	A5	B5	GND_DIG
	A6	B6	
TX2_N	A7	B7	TX1_N
RX2_N	A8	B8	RX1_N
	A9	B9	NC

A dual DB9 connector pin out for serial 1-2 RS485 protocol is below

	A1	**B1**	
	A2	**B2**	
RX2_P	**A3**	**B3**	RX1_P
	A4	**B4**	
GND_DIG	**A5**	**B5**	GND_DIG
	A6	**B6**	
RX2_N	**A7**	**B7**	RX1_N
	A8	**B8**	
	A9	**B9**	

Connector type: Dual DB9 Connector PN: ASUB-277-09TP23 Mating Cable PN: Standard DB9 Connector	

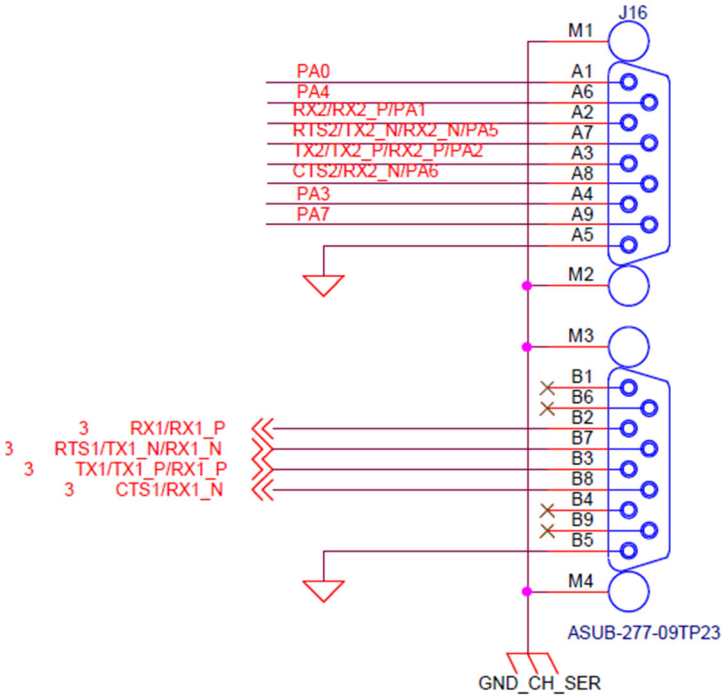


Figure 10: Schematic example for DB9 Serial connector on Panel IO Board

The serial ports 3 - 4 are muxed with CAN 1 - 2 and terminated at dual RJ11 connector. By default, CAN interface is supported on both the ports. Configuration can be changed using CAN/Serial/DIO Jumper (JP1).

The pinouts for Serial 3-4 RS232 are as shown below (T = top connector, B = bottom connector):

	T1	**B1**	RS232_2_RTS*
RS232_1_TX	**T2**	**B2**	RS232_2_TX
RS232_1_RX	**T3**	**B3**	RS232_2_RX
	T4	**B4**	
GND_DIG	**T5**	**B5**	GND_DIG
	T6	**B6**	RS232_2_CTS*

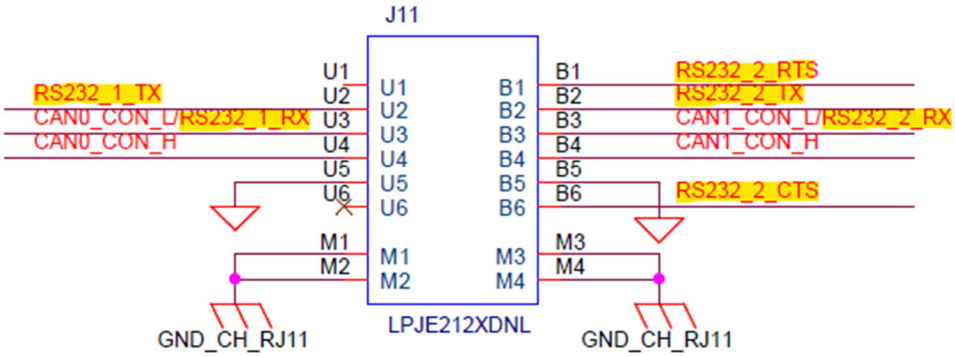


Figure 11: Schematic example for RJ11 Serial connector on Panel IO Board

Figure 12: USB 3.2 Circuit on Osbourne Carrier Board

Note: USB3.2 Port 0 is shared between USB and PCIe. In configuration#1 it is used as USB3.2 and in configuration#2 it is used as PCIex1(C0) port. Refer 6.1.3 for more details on jumper configurations on Osbourne base board.

5.2.7 USB Connectors on Osbourne Commercial IO Board

Two vertically stacked USB 3.2 port are provided on the commercial board with signals routed from the carrier board through I/O connector.

J13 pinouts are as shown below:

V_USB3_2	1
USB2_D0_CH_N	2
USB2_D0_CH_P	3
GND	4
USB3_UPHY_RX1_N	5
USB3_UPHY_RX1_P	6
GND	7
USB3_UPHY_TX1_N	8
USB3_UPHY_TX1_P	9
V_USB3_3	10
USB2_D1_CH_N	11
USB2_D1_CH_P	12
GND	13
USB3_UPHY_RX20_N	14
USB3_UPHY_RX20_P	15
GND	16
USB3_UPHY_TX20_N	17
USB3_UPHY_TX20_P	18

J14 pinouts are as shown below:

V_USB3_1	1
USB2/PCIE_CLK_CH_N	2
USB2/PCIE_CLK_CH_P	3
V_GND_RST	4
USB3/PCIE_UPHY_RX0_N	5
USB3/PCIE_UPHY_RX0_P	6
GND	7
USB3/PCIE_UPHY_TX0_N	8
USB3/PCIE_UPHY_TX0_P	9
V_USB2_VBUS	10
USB2_HUB_D4_CH_N	11
USB2_HUB_D4_CH_P	12

GND	**13**
NC	**14**
NC	**15**
GND	**16**
NC	**17**
NC	**18**

Bottom port of J13 can be used for module programming purpose and Top port of J14 supports only USB2.0 interface.

Connector on IO Board: Molex 0484060003	

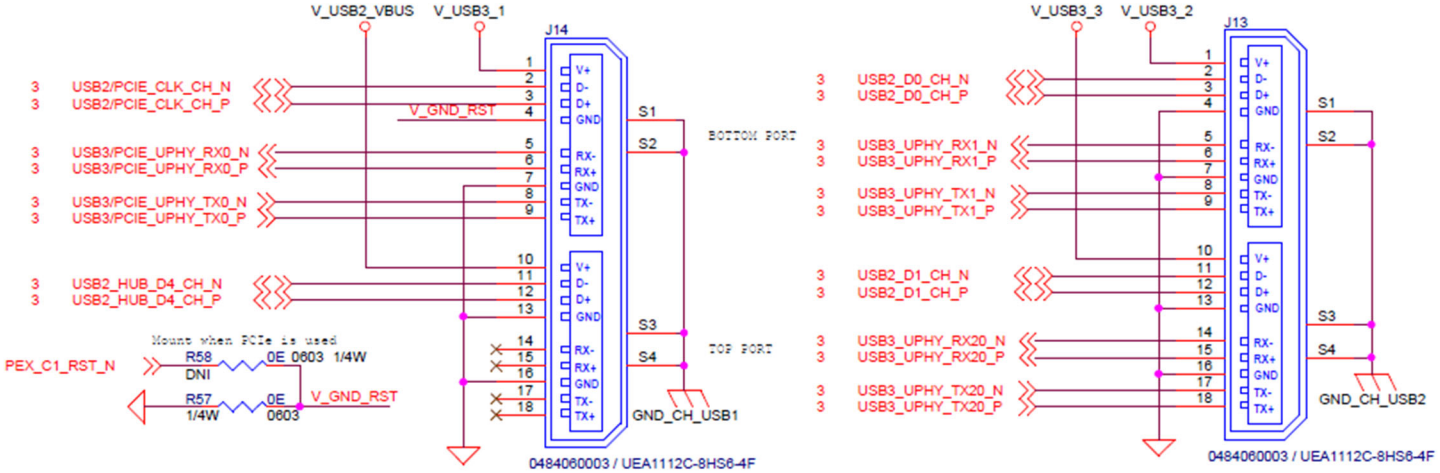


Figure 13: Schematic example for USB connectors on Panel IO Board

5.2.8 DIO Connector on Osbourne Commercial IO Board

Serial port 2 muxed with DIO is terminated at dual DB-9 top port. By default, Top port supports GPIO interface and bottom port support Serial port. Configurations can be changed using CAN/Serial/DIO Jumper (JP1).

A dual DB9 connector pin out for DIO is below:

PA0	**A1**	**B1**
PA1	**A2**	**B2**
PA2	**A3**	**B3**
PA3	**A4**	**B4**
GND_DIG	**A5**	**B5**
PA4	**A6**	**B6**
PA5	**A7**	**B7**
PA6	**A8**	**B8**
PA7	**A9**	**B9**

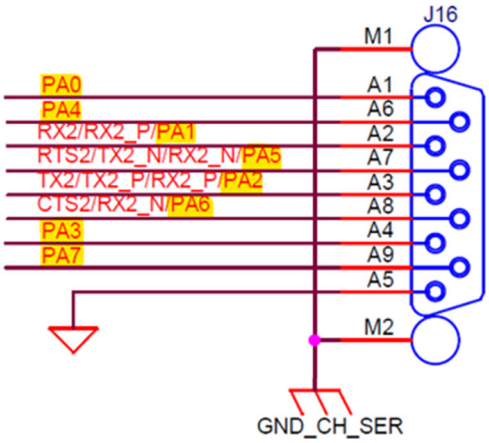


Figure 14: Schematic example for DIO connector on Panel IO Board

5.2.9 CAN Connector on Osbourne Commercial IO Board

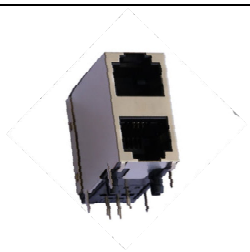
The serial ports 3 - 4 are muxed with CAN 1 - 2 and terminated at dual RJ11 connector. By default, CAN interface is supported on both the ports. Configuration can be changed using CAN/Serial/DIO Jumper (JP1).

The pinouts for CAN 0-1 are as shown below

	U1 **B1**	
	U2 **B2**	
CAN0_CON_L	**U3** **B3**	CAN1_CON_L
CAN0_CON_H	**U4** **B4**	CAN1_CON_H
GND_DIG	**U5** **B5**	GND_DIG
	U6 **B6**	

*By default, 6P4C connector is mounted so pins 1 and 6 will not be accessible.

Top port RS232 can also be used for debug console purpose.

Connector PN: LPJE212XDNL Mating Cable PN: Standard	

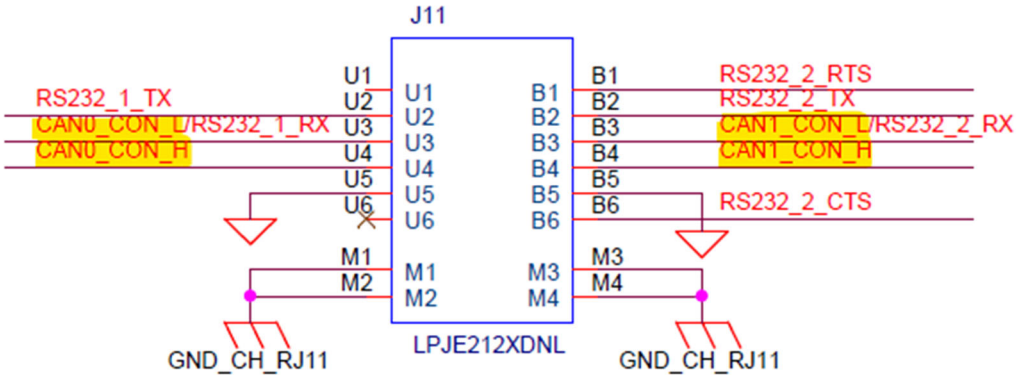


Figure 15: Schematic example for CAN connector on Panel IO Board

5.2.10 SPI and I2C Connectors on Osbourne Commercial IO Board

The utility connector provides access to SPI and I2C. Both interfaces are 3.3V level.

The pinouts are as shown below

V_3P3	**1**	**2**	I2C_GP8_CLK_3P3
BUTTON_POWER_ON_N	**3**	**4**	I2C_GP8_DAT_3P3
GND	**5**	**6**	SPI_CLK
SYS_RST_IN_N	**7**	**8**	SPI_MISO
SPI_CS0	**9**	**10**	SPI_MOSI

Connector Type: 2x5 2mm Header	

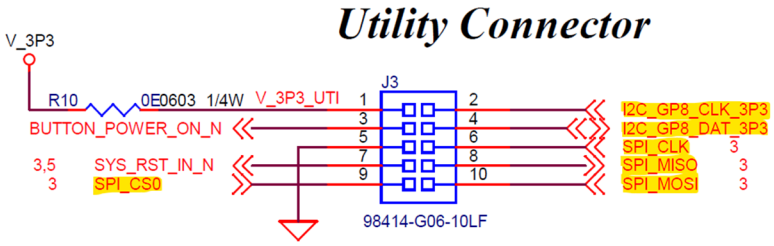


Figure 16: Schematic example for CAN connector on Panel IO Board

6. APPENDIX

6.1 Jumper Configuration on Osbourne Base Board

6.1.1 JP1 Jumper Configuration

JP1 Jumpers Configuration are provided enable and disable the termination of serial ports1-2.

Position	Function	IN	OUT
TX1	121E Termination Enabled for SER1 TX RS-485/RS-422 Mode	Enabled	**Disabled***
RX1	121E Termination Enabled for SER1 RX RS-485/RS-422 Mode	Enabled	**Disabled***
TX2	121E Termination Enabled for SER2 TX RS-485/RS-422 Mode	Enabled	**Disabled***
RX2	121E Termination Enabled for SER2 RX RS-485/RS-422 Mode	Enabled	**Disabled***
***Default Mode**			

6.1.2 JP2 Jumper Configuration

JP2 Jumpers are provided to select the voltage level and Pullup/pull down configuration of the DIO. By default, the DIOs are 3.3 Volare pulled down. The configuration is as shown below:

Position	Function	IN	OUT
5V	DIO Voltage Level	5V	
3V3	DIO Voltage Level	**3.3V***	
PU	DIO Pull up Enable	Enabled	Disabled
PD	DIO Pull down Enable	**Enabled***	Disabled
***Default Mode**			

Note: Make sure 5V and 3V3 Jumper are not IN at same time.

6.1.3 JP3 Jumper Configuration

JP3 Jumpers Configuration are provided to select the Boot configuration, x16 PCIe or MINICARD, Wake on LAN selection and auto power selection. The configuration is as shown below:

Position	Function	IN	OUT
PCIE	x16 PCIE / MINICARD Selection	x16 PCIE	**MINICARD***
CFG	Boot Configuration	Config #2	**Config #1 ***
WOL	Wake on LAN	Enabled	**Disabled***
AUTO	Auto Power	Enabled	**Disabled***
***Default Mode**			

6.2 Jumper Configuration on Osbourne Carrier Board

6.2.1 CAN/Serial/DIO Jumper (JP1)

The Jumper block JP1 on the Commercial IO board is used to configure the IO connectors on the front panel to Serial Port/GPIO on DB9M Top port, CAN/Serial Port on RJ11 port. Fixed Configuration board is also based on the ordering part number.

The following table describes the Jumper Block on the Commercial Io board.

Position	Function	IN	OUT
SEL1	Serial/CAN (J11 Bottom Port)	Serial	CAN*
SEL2	Serial/CAN (J11 Top Port)	Serial	CAN*
SEL3	Serial/DIO (J16 Top Port)	Serial	DIO*
***Default Mode**			

6.3 Schematic and BOM of Osbourne Carrier Board for reference

Please contact DSC for complete details on schematic and BOM of Osbourne Commercial IO board.