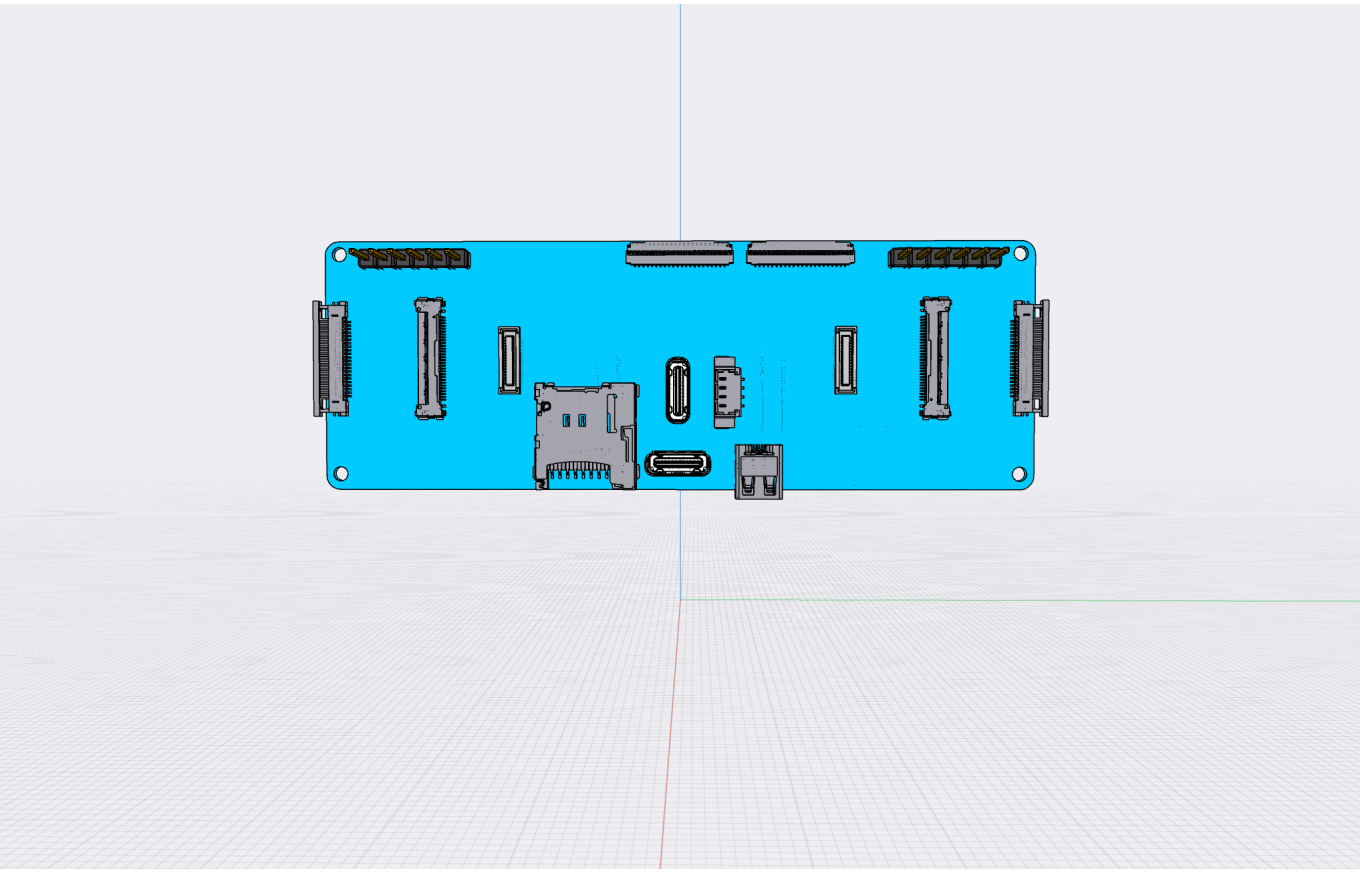
Bridge Board 909b

The 909b is a Bridge Board version made for testing and experiementation with the Ziloo attachments without attaching the SB-UCM i.MX8 board or directly attaching it. The setup enables connecting a Compulab SB-UCM-iMX8PLUS or I-Pi SMARC IMX8M Plus development board. Not all the 909 connectors will be mounted on the 801 production bridge board that mounts the i.MX8 board.

The board provides two key features: Dual USB connectivity for Webcam, Internet, Display & Power; MIPI CSI Stereo Camera. Alt. Mode, HDMI and extra MIPI CSI connectors are not intended for the production board.

- Some of the UCM-iMX8M-Plus carrier board interface pins are multifunctional. Up to 4 functions (ALT modes) are accessible through each multifunctional pin.
- All of the UCM-iMX8M-Plus digital interfaces operate at 3.3V voltage levels unless noted otherwise.
- NOTE: RGMII ENET1 signals operate at 1.8V voltage level
- NOTE: SD/SDIO port #2 can be configured to operate at 3.3V or 1.8V voltage levels. Voltage level is controlled by SoC pin GPIO1_IO04.



Open points

- Add second HD3SS460 for T-USB OTG.
- Describe T-USB Host ALT connector pinouts with ETH0 pins
- Connect HD3SS460 pins POL AMSEL EN
- Should HD3SS3220 be used to mux between M.2 and T-USB connector?
- Plan I2C addresses and which bus is used

- Can PD Controller control other chipsets or is it just a slave?
- Ensure all pins are connected to GPIO Expander
- Add bridge board EEPROM
- Should there be Boot origin switches like EVK? (4 bits? EVK)
- Add Reset/Power push buttons
- Document Camera sync breakout connector
- Revise the M.2 key type for the second one (currently key E)
- Document connections on the two M.2 connectors

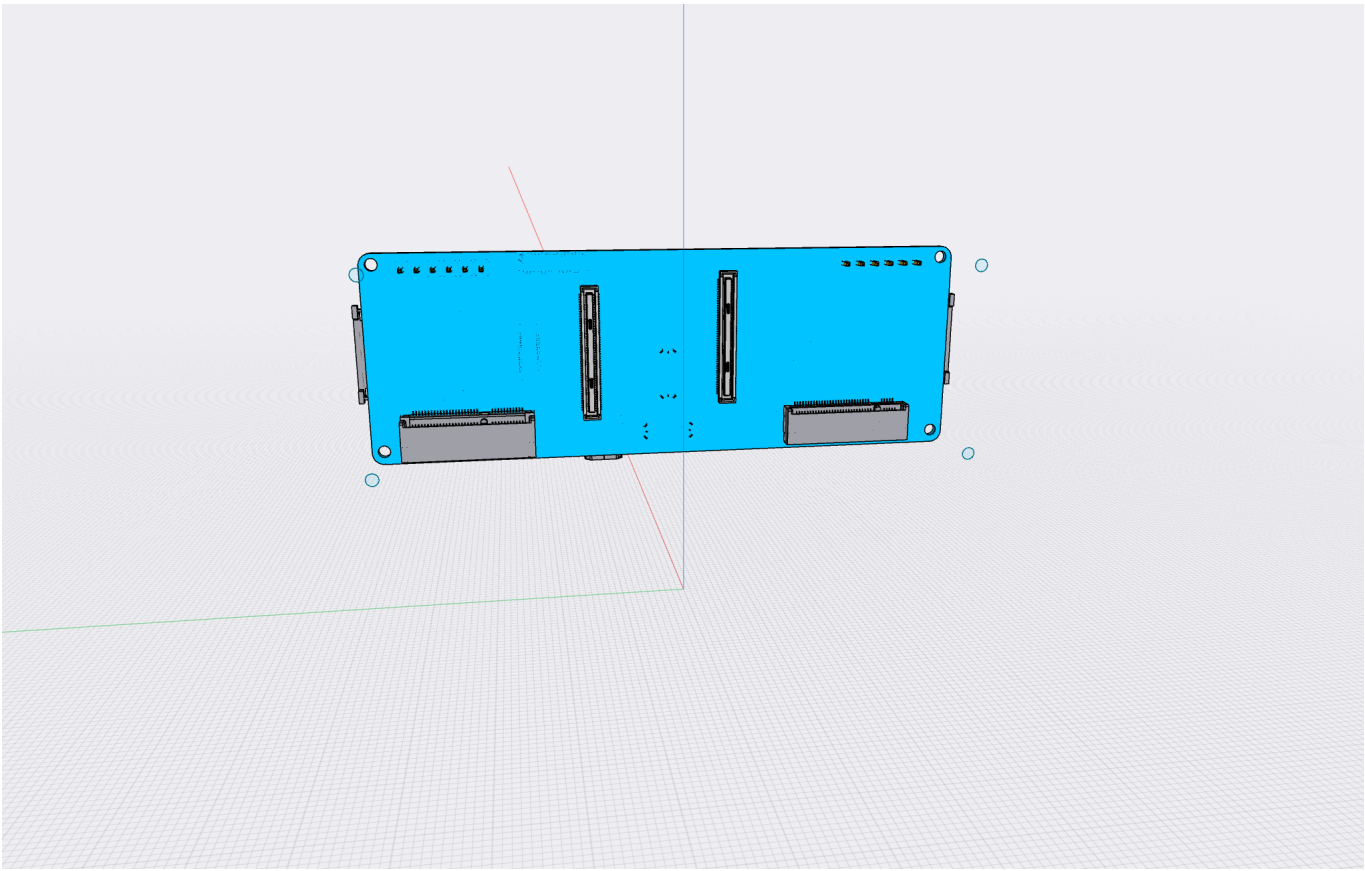
Connectors

Connectors placed on the board are,

- 2 * Molex 22PIN 0.5mm pitch 54548-2271
- 2 * I-PEX 30PIN 0.4mm pitch 20525-030E-02
- 2 * Hirose USB-C CX80B1-24P
- 1 * TE Connectivity 45PIN 0.3MM 571-4-2328724-5 FPC 3-2328724-5 $0.41
- 2 * Hirose DF40C-34DS-0.4V (Mouser)
- 2 * Hirose DF40HC(3.0)-100DS-0.4V mated height 3.0mm
- 1 * microSD card slot (suggested Molex 5031821852) push-push, compact. Mouser, Molex
- 1 * MicroHDMI (suggested Molex 46765-1301) Mouser Molex
- 1 * PicoBlade 4 pin 533980471 for the power ouput. Can be replaced with a higher quality/current connector.
- 1 * m.2 key B connector
- 1 * m.2 key E connector Amphenol ICC
-

Components

- 1 * TPS65982 USB Type-C® and USB PD Controller, Power Switch, and High-Speed Multiplexer
- 1 * HD3SS460 4 x 6 Channels USB Type-CTMAlternate Mode MUX. Connected to T-USB Host
- 2 * push buttons (RESET / POWER)
- 2 * PCA9555 I/O Expander
- 1 * 24C08 Carrier-board EEPROM
- 2 * HD3SS3220 10-Gbps USB 3.1 Type-C 2:1 mux with DRP Controller



USB Power source & Data connectivity

If one(or both) of the USB-C connectors supplies power, it is managed by the USB PD Controller circuit and routed to power regulators to provide board power as VIN.

The power connector sends the power from USB-C connectors away from the board as VIN and regulated 5V. If the USB connectors are not used the power connector can be used to supply the board over VIN.

The regulated 5V is also downregulated to 3V3, 2V8 and 1V8 to supply the board with power.

If no connected USB plug connected provides power, the board will have to be a power source. This would be from a yet to be defined battery connector.

In the specific case of CSI connectors being used without an i.MX8 module attached, the CSI input connectors must supply power, if no USB connector does.

Handling USB Connectors

The two USB ports may power the board. The powering is negotiated and handled by by TPS65988 (in future TPS65994AE). They also deliver data lanes which are multiplexed between the two USB busses on the i.MX8 module, m.2 connectors and T-USB alt connectors. This allows further development of alt mode connectivity.

Power regulators receive power from USB connectors and supply the VIN & 5V power for development carrier board through the power connector. The USB-C connectors can power the carrier board 12V through upregulating, which would be done on the In-Between cables.

If one USB port delivers power to the board, the other one can consume power.

Wiring and Connecting

The board can be used in different ways

1. Adding a daughterboard, two OV2735 camera modules and connecting a USB cable with power.
2. Adding a daughterboard, two RPi camera modules and connecting a USB cable with power.
3. Use the board to connect two OV2735 camera modules to Compulab SB-UCM-iMX8PLUS
4. Use the board to connect two OV2735 camera modules to I-Pi SMARC IMX8M Plus

Wiring within the board

30 pin CSI connectors are intended to be used without a daughter board and instead a separate i.MX8 development board is used. The 22 pin connectors are connected directly to the equivalent lines on the 30 pins, and a likewise meant for an external development board or for testing alternate camera modules. The CSI lanes on 34 pins connector is connected directly to the equivalent lines on the 30 pins. This assumes that a camera is connected to either a 34 pins connector or a 22 pins connector, not both. If a i.MX8 daughter board is used rather than development board the CSI lines from the daughter board must be connected to the 34 pin camera module connectors. i.MX8 CSI1 is used for left module, CSI2 is used for right module.

The two 34 pin CSI connectors are wired to run in sync via the STROBE pin.

The MicroHDMI connector is connected to the HTMI_TX* pins from the i.MX8 module.

The MicroSD connector is connected to SD2_* on the i.MX8 module.

The USB-C signal lines from the T-USB connector is managed by the Multiplexing chipsets around the PD Controller.

The Power pins on USB-C connectors go to the TPS65988 as well as VIN on 4 pins Power Connector. GND connected from everywhere as normal.

If power isn't connected over the USB-C plugs, the camera modules should be powered over the MIPI CSI connectors. In this case it should be possible to use either the 22 pin connectors or the 30 pin connectors for inputting the signal and power. This means that the 22 pin connectors can be used to input or output MIPI CSI lanes.

For debugging purposes pads must be put on the board for JTAG and debug UARTs 2 & 4.

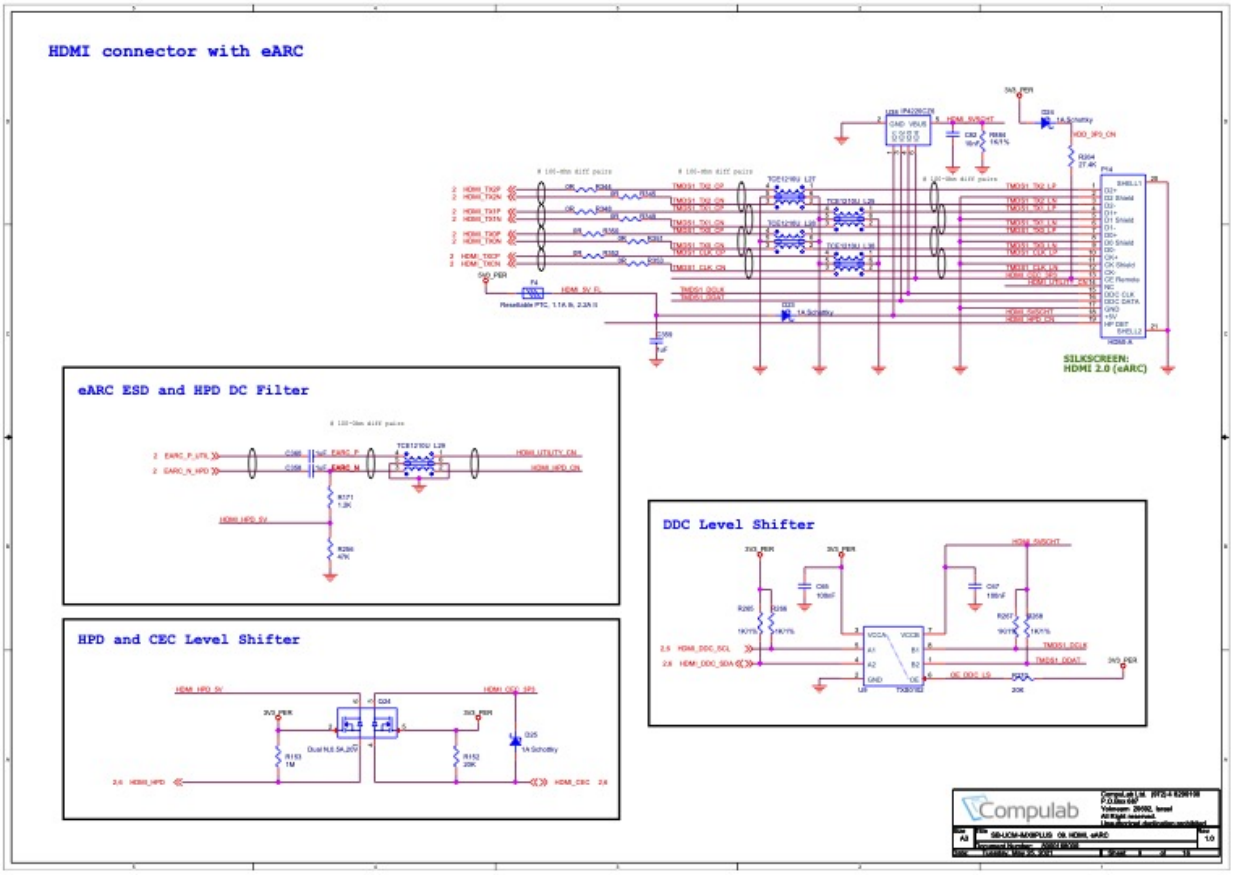
Signal voltage level

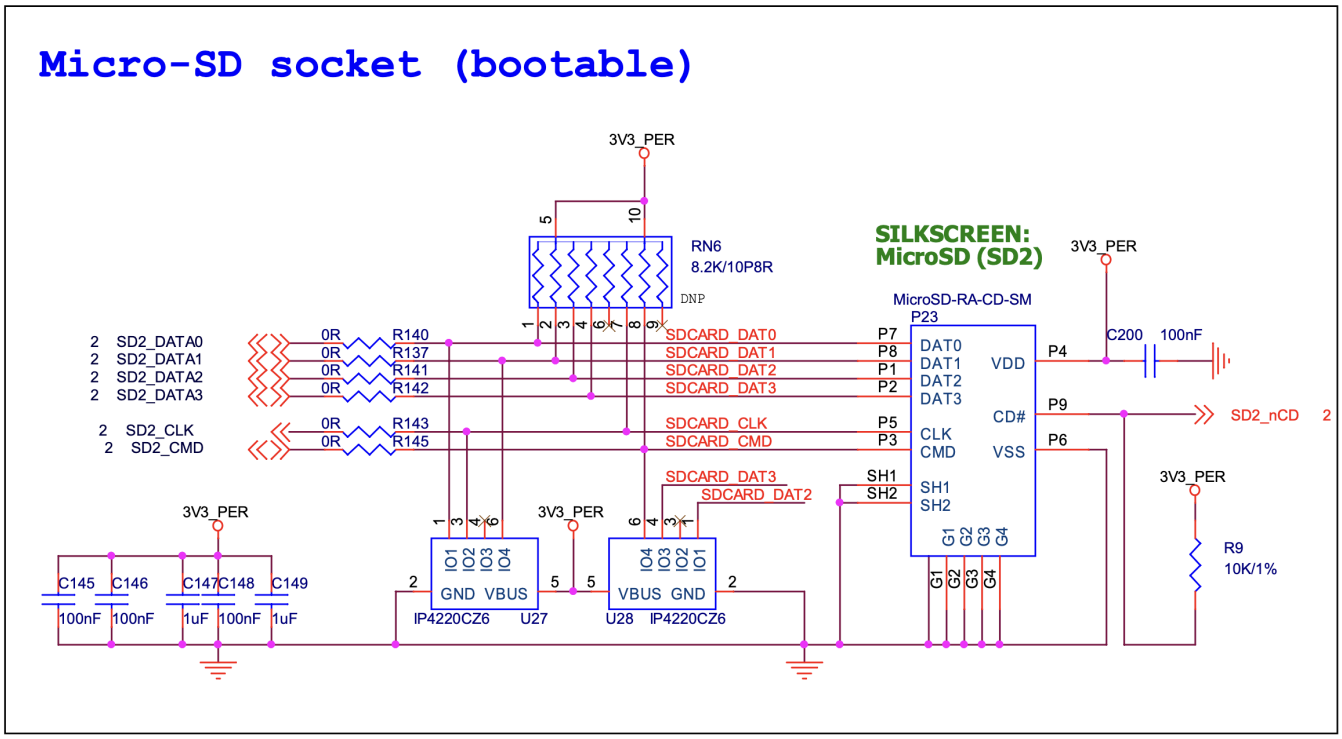
- 201 Camera Module uses 1.8V signals
- IMX477 sensor uses 1.8V for signals
- Does RPi cam module level shift the signals?
- UMC iMX8PLUS module uses 3.3V for signals by default
- UMC iMX8PLUS module RGMII ENET1 signals operate at 1.8V voltage level
- iMX8M plus is documented to use VDD_MIPI_1P8 power group for CSI1 & CSI2
- iMX8M plis is documented to use VDD_HDMI_1P8 power group for HDMI
- NVCC_SAI1_SAI5 power group?
- What will the I2C 5+6 power group be?
- USB 1 & 2 uses VDD_USB_3P3 power group

- Signal voltage PD Controller?

Required distances/location

- Camera module distance 70mm
- USB-C connectors cannot be moved
- Board size can only be increased to save cost
- Holes in the corners should be the regular sort for mounting.
-





Multiplexing USB

The i.MX8 has two USB busses. USB1(supports OTG) and USB2(Host mode only).

- USB1 is muxed between the m.2 key E? and the T-USB OTG connector?.
- USB2 is muxed between the m.2 key B and the HD3SS460 for T-USB Host.
- T-USB Host connector is muxed with alternate connections using HD3SS460
- Ethernet may in the future be muxed over T-USB OTG

Open question:

- What should the I2C be used for on TPS65988 Port 1 - 3 ?
- Can PD Controller be wired to control the Alt Mode chips ()

I/O Expanders

The development board uses a single Expander. The 909 and 801 uses two PCA9555 to control more states The expanders input triggers interrupt via USB1_TCPC_nINT.

SYS I2C addresses

0x20 PCA9555 16 bit expander 0x21 PCA9555 16 bit expander (2nd) (EX2. / EX3.) 0x54..0x57 EEPROM I2C slave address: ? TPS65988 PD Controller

Expander	Connected to
EX0.0	mPCIe_PERST on M2
EX0.1	
EX0.2	UART_DEBUGSEL
EX0.3	

Expander	Connected to
EX0.4	_RESET
EX0.5	_RESET
EX0.6	LVDS_DISP_RESET
EX0.7	LVDS_TOUCH_RESET
EX1.0	CSI1_PWR_DWN_B
EX1.1	LEFT_CAM_RESET
EX1.2	LEFT_ATT_INT
EX1.3	LEFT_ATT_XSHUT
EX1.4	CSI2_PWR_DWN_B
EX1.5	RIGHT_CAM_RESET
EX1.6	RIGHT_ATT_INT
EX1.7	RIGHT_ATT_XSHUT
EX2.0	USB_H_ALT_EN
EX2.1	USB_H_ALT_POL
EX2.2	USB_H_ALT_AMSEL
EX2.3	USB_O_ALT_EN
EX2.4	USB_O_ALT_POL
EX2.5	USB_O_ALT_AMSEL
EX2.6	PD_CTL_INT
EX2.7	PD_CTL_RESET
EX3.0	
EX3.1	
EX3.2	
EX3.3	
EX3.4	
EX3.5	
EX3.6	
EX3.7	

PD Controller I2C GPIO

- USB_H_ALT_EN, POL, AMSEL

- USB_O_ALT_EN, POL, AMSEL
-

I2S (SAI5) 4 channel microphone input mapping

One lane goes to the 34 pins camera connectors

Full connection on the T-USB Alt connectors

| 14 | BCLK / SCK | I2S | Bit clock line | 1.8V | | 15 | WS / LRCLK | I2S | Word clock line | 1.8V | | 16 | SDATA1 | I2S | Input data 1 | 1.8V | | 17 | SDATA2 | I2S | Input data 2 (NC) | 1.8V |

8.1 Carrier Board Design Guidelines

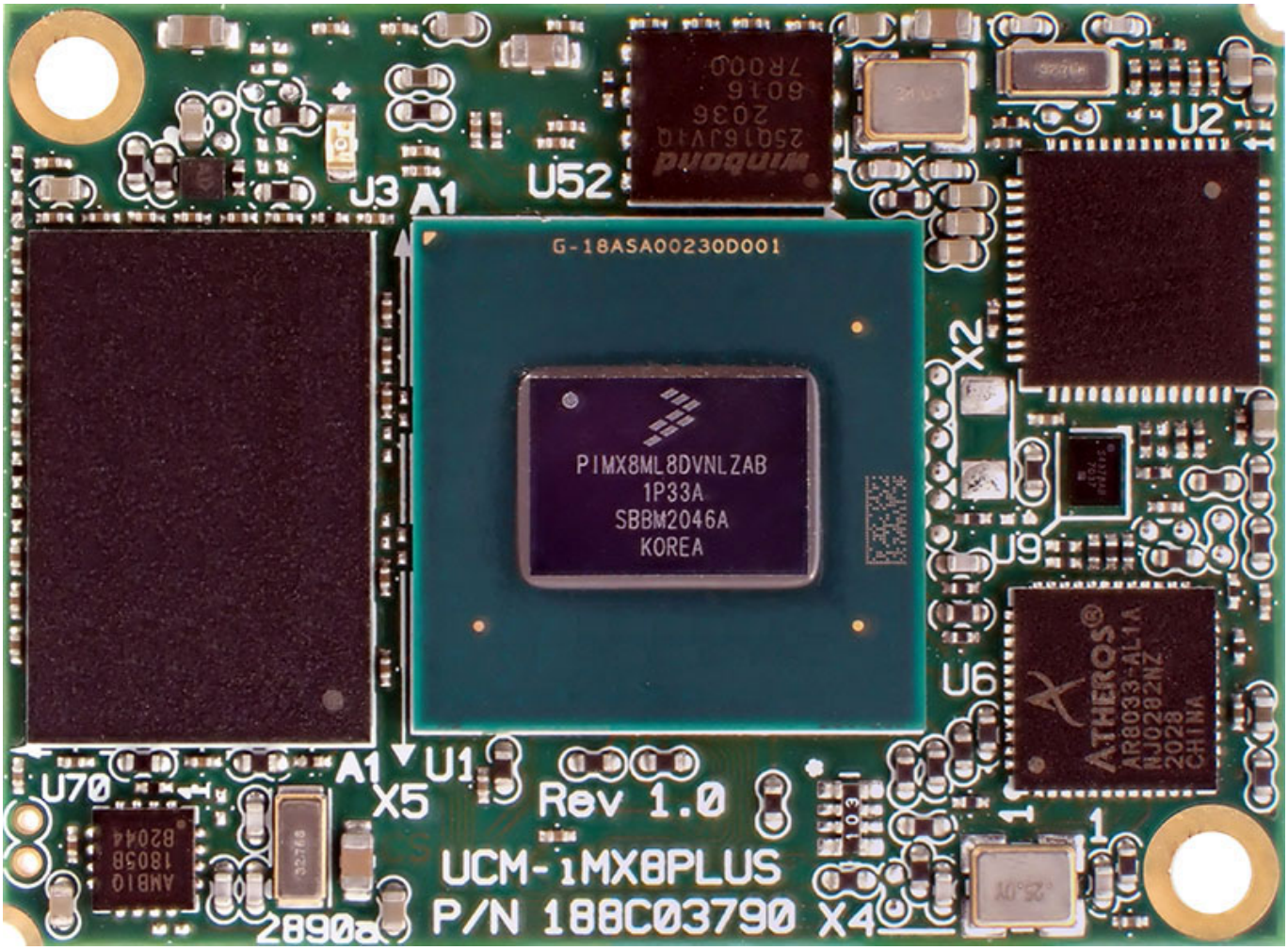
APPLICATION NOTES from UCM-iMX8M-Plus Reference guide.

- Ensure that all V_SOM and GND power pins are connected.
- Major power rails - V_SOM and GND must be implemented by planes, rather than traces. Using at least two planes is essential to ensure the system signal quality because the planes provide a current return path for all interface signals.
- It is recommended to put several 10/100uF capacitors between V_SOM and GND near the mating connectors.
- Except for a power connection, no other connection is mandatory for UCM-iMX8M-Plus operation. All power-up circuitry and all required pullups/pulldowns are available onboard UCM-iMX8M-Plus.
- If for some reason you decide to place an external pullup or pulldown resistor on a certain signal (for example - on the GPIOs), first check the documentation of that signal provided in this manual. Certain signals have on-board pullup/pulldown resistors required for proper initialization. Overriding their values by external components will disable board operation. For details please refer to section Error! Reference source not found..
- You must be familiar with signal interconnection design rules. There are many sensitive groups of signals. For example:
- PCIe, Ethernet, USB and more signals must be routed in differential pairs and by a controlled impedance trace.
- Audio input must be decoupled from possible sources of carrier board noise.
- The following interfaces should meet the differential impedance requirements with manufacturer tolerance of 10%:
- USB2.0: DP/DM signals require 90 ohm differential impedance.
- All single-ended signals require 50 ohm impedance.
- PCIe TX/RX data pairs and PCIe clocks require 85 ohm differential impedance.
- Ethernet, MIPI-CSI and MIPI-DSI signals require 100 ohm differential impedance.
- The carrier board interface connectors provide 3mm mating height. Bear in mind that there are components on the bottom side of UCM-iMX8M-Plus. It is not recommended to place any components underneath the UCM-iMX8M-Plus module.
- Refer to the SB-UCMIMX8PLUS carrier board reference design schematics.
- It is recommended to send the schematics of the custom carrier board to Compulab support team for review.

V_SOM is recommended between 3.45 and 4.4 volt, typical 3.7

for more information see UCM i.MX8 PLUS Reference Guide

Connecting the SB-UCM-iMX8PLUS daughter board



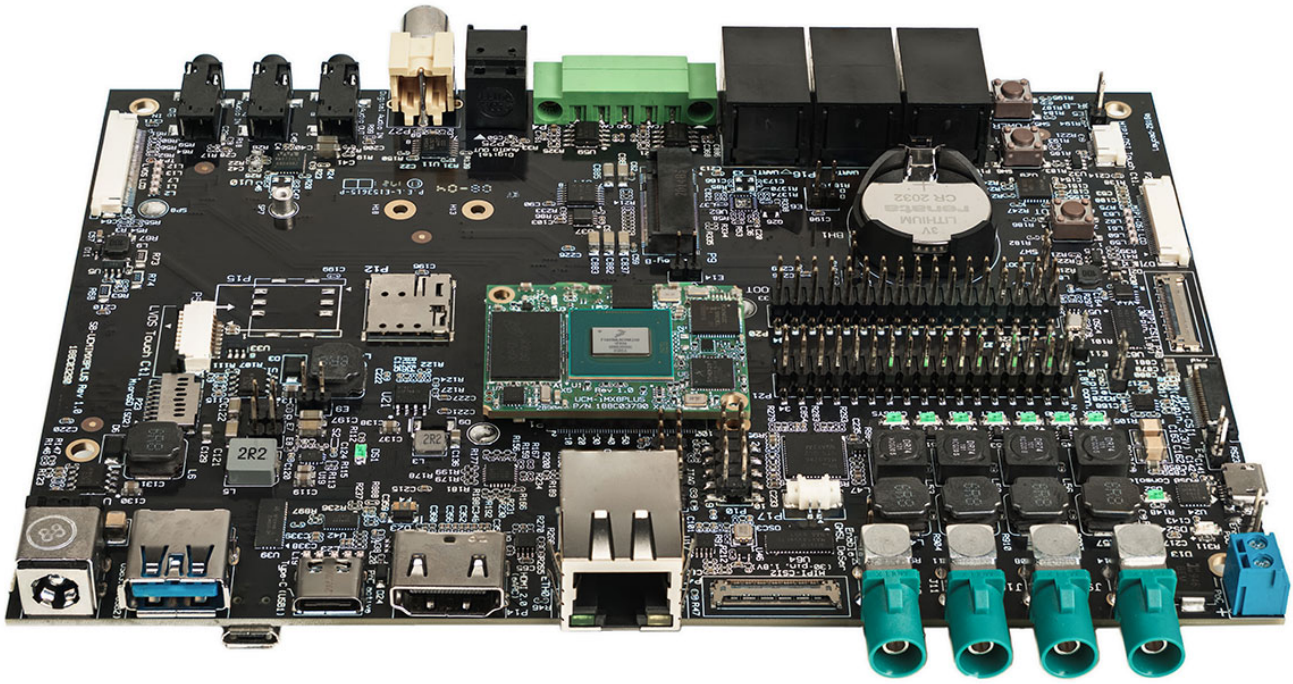
The daughter board clicks into the two Hirose 100pin board-to-board connectors.

For further details see Product Page.

The CSI1 & CSI2 are wired from the 100pin connectors to relevant CSI connectors. The CSI1 lanes are connected to Left CSI. The CSI2 lanes are connected to Right CSI.

- 2 * Hirose 100 pin connectors
- 45 pins connected to Inbetween breakout boards
- 10 pins power connector to Inbetween breakout boards
- USB-C connector to Inbetween breakout boards
- USB-A connector to Inbetween breakout boards

Connecting the SB-UCM-iMX8PLUS carrier board



For further details see Product Page.

- 2 * I-PEX connector directly between UCM carrier board and bridge board
- 45 pins connected to Inbetween breakout boards
- 10 pins power connector to Inbetween breakout boards
- USB-C connector to Inbetween breakout boards
- USB-A connector to Inbetween breakout boards
- HDMI female to Inbetween breakout boards

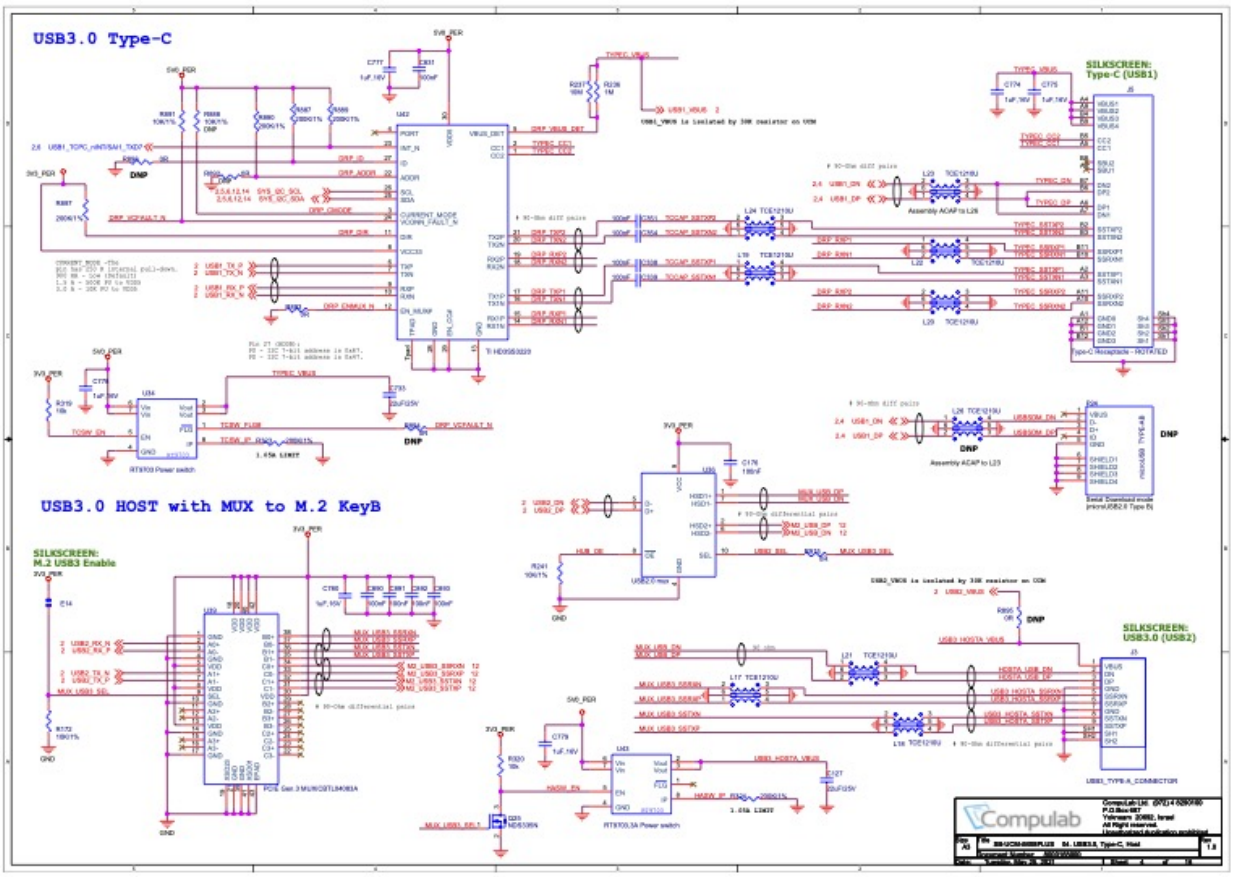
T-USB connector mapping

Two USB-C connectors are arranged in a T shape and the normal way to use it is with a combined connector attached. This means that the wires will normally be connected in a particular orientation. The system takes advantage of this by detecting when both USBs are connected in the normal arrangement.

The USB-C signal lines for the OTG connector in T-USB come from USB1(OTG capbale 2.0 & 3.0). The SBU1/SBU2 are connected to OSBU1/OSBU2 pins on the T-USB alt connector One side of the RX/TX pins are carried to the T-USB alt connector, and not connected to USB1 signals. (Should the side be muxed?)

The USB-C signal lines for the Host connector in T-USB can be muxed. They either come from USB2(Host only 2.0 & 3.0), or they come from T-USB alt connector pins prefixed by H*. The SBU1/SBU2 on the HD3SS460 are connected to HSBU1/HSBU2. The Host only USB2 from i.MX8 is Muxed between the T-USB Host connector and the M.2 connector.

The HD3SS460 chips are controlled over I2C by either the MCU using SYS I2C or by the PD Controller.



The USB connectors are named H (Host) and O (OTG). Host is the top of the T, OTG is the vertical base. To specify a specific pin H or O is prefixed I.E. OTX1+, HSBU2.

Where possible data pins are not combined but carried through individually.

The GND/VBUS pins are connected to the power charging circuit as normal. The system should accept charging power from either connector.

T-USB Layout

No.	Pin	Usage	OTG connect to..	Host connect to..
1	A1	GND		
2	A2	TX1+		HD3SS460
3	A3	TX1-		HD3SS460
4	A4	VBUS		
5	A5	CC1	TPS65988	TPS65988
6	A6	D+	65988 & MCU	65988 & MCU
7	A7	D-	65988 & MCU	65988 & MCU
8	A8	SBU1		HD3SS460
9	A9	VBUS	65988 & Regs	65988 & Regs

No.	Pin	Usage	OTG connect to..	Host connect to..
10	A10	RX2-		HD3SS460
11	A11	RX2+		HD3SS460
12	A12	GND		
13	B1	GND		
14	B2	TX2+		HD3SS460
15	B3	TX2-		HD3SS460
16	B4	VBUS	65988 & Regs	65988 & Regs
17	B5	CC2	TPS65988	TPS65988
18	B6	D+	65988 & MCU	65988 & MCU
19	B7	D-	65988 & MCU	65988 & MCU
20	B8	SBU2		HD3SS460
21	B9	VBUS	65988 & Regs	65988 & Regs
22	B10	RX1-		HD3SS460
23	B11	RX1+		HD3SS460
24	B12	GND		

The USB Type-C connector has 24 pins. Figures 1 and 2, respectively, show the pins for the USB Type-C receptacle and plug.

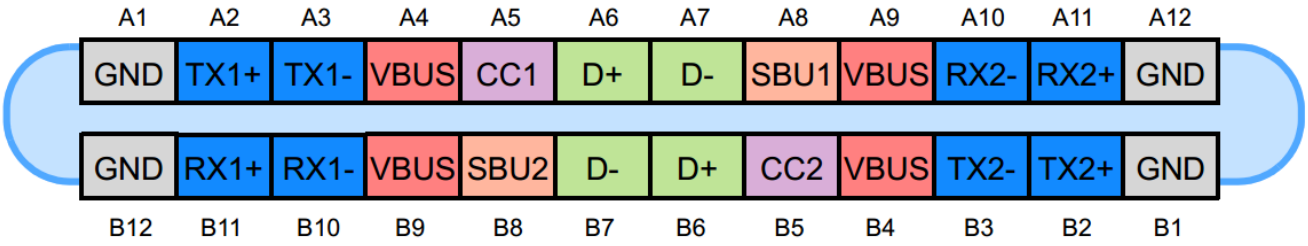


Figure 1. The USB Type-C receptacle. Image courtesy of Microchip.

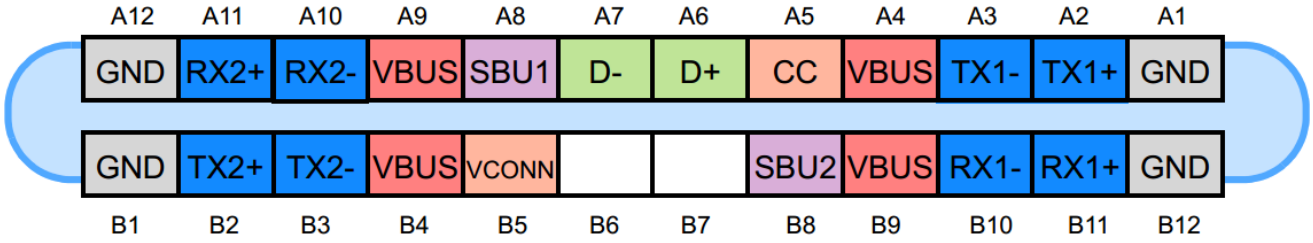


Figure 1. The USB Type-C plug. Image courtesy of Microchip.

For later revision

Only **one side** of the connectors are connected to the matching USB connector that leads to the Dev Board.

The following pins are connected to the extras connector: TX2+, TX2-, SBU1, SBU2, RX-, RX1+, DX+, DX-

The following pins are treated as normally USB-C connection pins: A1-A7, A9-A12, B5.

Power supply TI chipset

TPS65982 USB Type-C® and USB PD Controller, Power Switch, and High-Speed Multiplexer

The TPS65982 device is a stand-alone USB Type-C and Power Delivery (PD) controller providing cable-plug and orientation detection at the USB Type- C connector. Upon cable detection, the TPS65982 device communicates on the CC wire using the USB PD protocol. After successful USB PD negotiation is complete, the TPS65982 enables the appropriate power path and configures alternate mode settings for internal and (optional) external multiplexers.

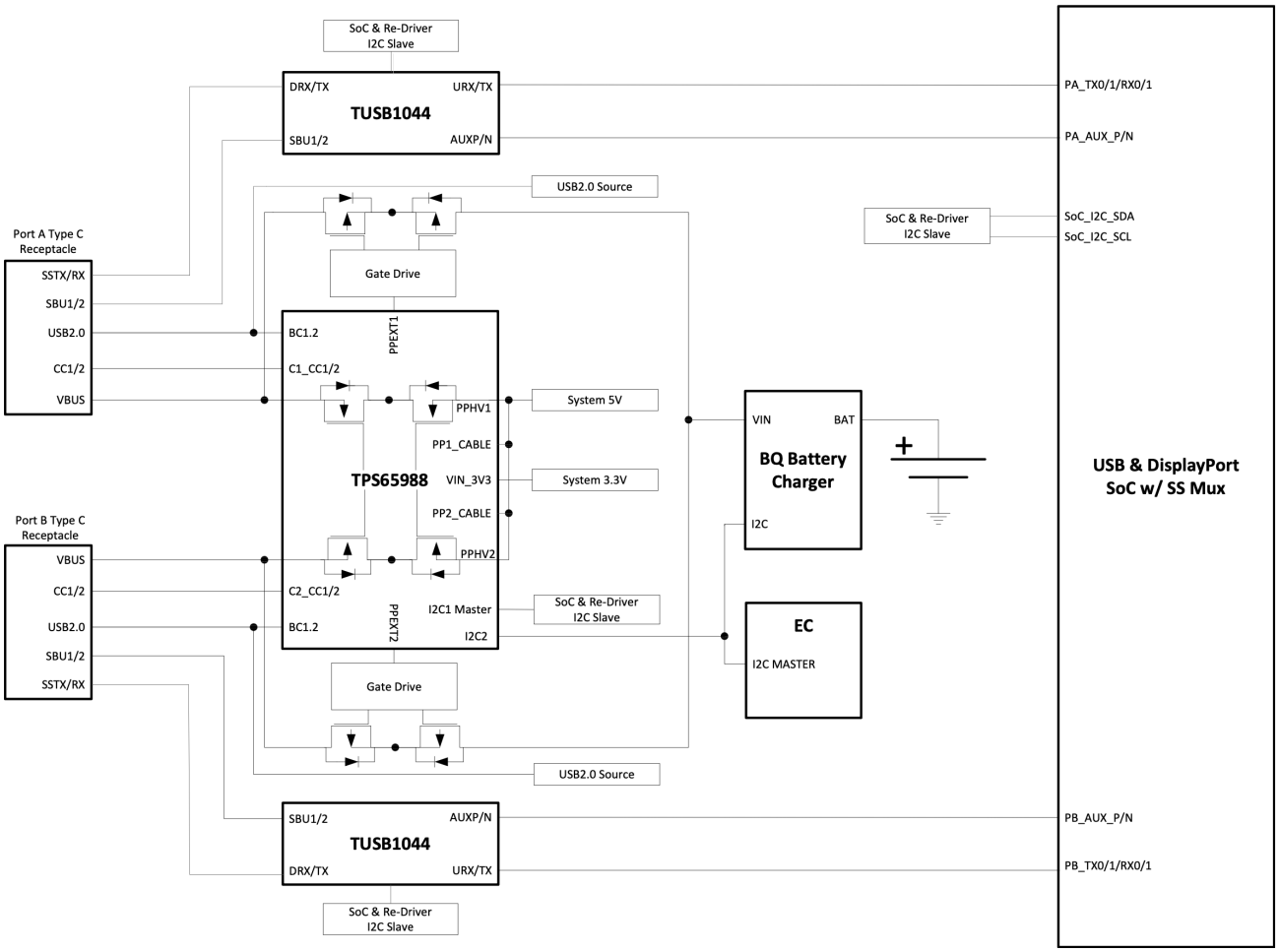


Figure 9-10. TPS65988 and SoC & Redriver I2C

A minimal version of this setup should be placed on the 909 to handle power. I.E. No TUSB1044

The 4 pin power connector and T-USB alt connector can be used to test the chipset and USB devices attached.

Board Power 4 pins Connector

The power connector supplies external boards with power. Max 5V/1A. Max VIN/1A.

No.	Pin	Description
1	5V	Board Power 5V
2	GND	GND
3	GND	GND
4	VIN	Voltage Input from USB-C

Max. Current per pin 1A

T-USB alt mode connector

This connector(only on the 909 model) enables experimentation with alternate modes and directional pins.

Pin	Code	Description
1	3V3	
2	AUX+	Host alt AUX+ (SBU2)
3	AUX-	Host alt AUX- (SBU1)
4	3V3	
5	HA+	Host A+
6	HA-	Host A-
7	3V3	
8	HB+	Host B+
9	HB-	Host B-
10	3V3	
11	HC+	Host C+
12	HC-	Host C-
13	3V3	
14	HD+	Host D+
15	HD-	Host D-
16	GND	
17	OSBU1	OTG alt SBU1
18	OSBU2	OTG alt SBU2
19	GND	
20	LVCLK+	LVDS CLK+
21	LVCLK-	LVDS CLK-

Pin	Code	Description
22	GND	
23	LVD0+	LVDS D0+
24	LVD0-	LVDS D0-
25	GND	
26	LVD1+	LVDS D1+
27	LVD1-	LVDS D1-
28	GND	
29	LVD2+	LVDS D2+
30	LVD2-	LVDS D2-
31	GND	
32	LVD3+	LVDS D3+
33	LVD3-	LVDS D3-
34	GND	
35	I2C6 SCL	LVDS TOUCH SCL
36	I2C6 SDA	LVDS TOUCH SDA
37	TOUCH_INT	LVDS TOUCH INT
38	TOUCH_RST	LVDS TOUCH Reset

SYS I2C UART2 RXD TXD

TODO wiring up the extra enable/gpio pins wiring up the master I2C and others which lines LVDS are needed for conversion chip alt layout on Key E

RPI FPC 22 pins

Raspberry Pi connectors

- 1-7342485-5 TE Connectivity 15 pins vertical Pi Board A/B
- 54548-2271 Molex 22 pins Right angle Pi Zero & Compute module
- SFW15R-2STE1LF Amphenol FCI 15 pins Right angle Camera Module

Pin	Code	Type	Details	Voltage
1	GND	Power	Ground	
2	CAM_D0_N	Data	MIPI Data Lane 0 Negative	
3	CAM_D0_P	Data	MIPI Data Lane 0 Positive	
4	GND	Power	Ground	

Pin	Code	Type	Details	Voltage
5	CAM_D1_N	Data	MIPI Data Lane 1 Negative	
6	CAM_D1_P	Data	MIPI Data Lane 1 Positive	
7	GND	Power	Ground	
8	CAM_CK_N	Data	MIPI Clock Lane Negative	
9	CAM_CK_P	Data	MIPI Clock Lane Positive	
10	GND	Power	Ground	
11	CAM_D2_N	Data	MIPI Data Lane 2 Negative	
12	CAM_D2_P	Data	MIPI Data Lane 2 Positive	
13	GND	Power	Ground	
14	CAM_D3_N	Data	MIPI Data Lane 3 Negative	
15	CAM_D3_P	Data	MIPI Data Lane 3 Positive	
16	GND	Power	Ground	
17	CAM_IO0	Power	Power Enable	
18	CAM_IO1	LED	LED Indicator	
19	GND	Power	Ground	
20	SCL	I2C	I2C SCL	
21	SDA	I2C	SCCB serial Interface data IO	
22	VCC	Power	3.3V Power Supply	

NVIDIA FPC 30 pins

The connector is an I-PEX type 20525-030E-02 with 0.4mm pitch & 30 pins. Data pins are 1.8V level.

Pin	Code	Details
1	CAM_3V3	3.3V Power Input
2	CAM_3V3	
3	CAM_1V8	1.8V Power Input
4	GND	
5	GND	
6	PWR DWN	PWRDN on 34pin
7	I2C SCL	
8	I2C SDA	

Pin	Code	Details
9	GND	
10	CSI D2-	
11	CSI D2+	
12	TRIGGER	
13	MCLK	EXTCLK on 34pin
14	Reserved	
15	CSI D1-	
16	CSI D1+	
17	GND	
18	GND	
19	CSI D0-	
20	CSI D0+	
21	RESET	RESET on 34pin
22	GND	
23	Reserved	
24	CSI CLK-	
25	CSI CLK+	
26	GND	
27	CSI D3-	
28	CSI D3+	
29	Flash	
30	Reserved	

Refs

- https://www.leopardimaging.com/product/accessories/cables/faw-1233-03/
- https://www.mouser.com/datasheet/2/233/LI-TX1-CB-6CAM_datasheet-1395894.pdf
- https://connecttech.com/ftp/pdf/ASG006_Spacely.pdf
- https://www.i-pex.com/product/cabline-ca

Ziloo Camera Module 34 pin connector

Just to be clear: All CSI lanes are laid out on one side of the connector with GND between.

Pin 1 is indicated on the board by a dot.

Toward thin part with microphone and other sensors

Pin	Code	Type	Details	Voltage
1	AF_VDD	Power	Reserved for Autofocus	3.3V
2	AVDD_2V8	Power	Analog, Max 500mA	2.8V
3	DOVDD	Power	Power for I/O circuit, Max 500mA	1.8V
4	VCC_1V8	Power	1.8V ,MAX 200mA	1.8V
5	GND	Power	GND	
6	CAM_FSIN	I/O	Frame sync input	
7	CAM_STROBE	I/O	Frame sync output	
8	EXTCLK	Input	External Clock Input (MCLK)	
9	ATT_INT	Output	Interrupt Attached Sensor, Active L	1.8V?
10	ATT_XSHUT	Input	Attached Sensor XSHUTDOWN	1.8V
11	Reserved	AF/PWM	PWM Motor control (NC)	
12	I2C_SCL	I/O	I2C1_SCL(pullup resistor 2.2K)	1.8V
13	I2C_SDA	I/O	I2C1_SDA(pullup resistor 2.2K)	1.8V
14	BCLK / SCK	I2S	Bit clock line	1.8V
15	WS / LRCLK	I2S	Word clock line	1.8V
16	SDATA1	I2S	Input data 1	1.8V
17	SDATA2	I2S	Input data 2 (NC)	1.8V

Towards image sensors

Pin	Code	Type	Details	Voltage
34	AGND	Power	Analog ground	
33	RESET	Input	Camera Reset, Active Low (RSTB)	
32	PWRDN	Input	Camera Power Down	
31	Reserved			
30	Reserved			
29	-		GND	
28	CSI_RX_D0P	Camera	MIPI_CSI_RX_D0+	1.8V
27	CSI_RX_D0N	Camera	MIPI_CSI_RX_D0-	1.8V
26	-		GND	

Pin	Code	Type	Details	Voltage
25	CSI_RX_D1P	Camera	MIPI_CSI_RX_D1+	1.8V
24	CSI_RX_D1N	Camera	MIPI_CSI_RX_D1-	1.8V
23	-		GND	
22	CSI_RX_D2P	Camera	MIPI_CSI_RX_D2+	1.8V
21	CSI_RX_D2N	Camera	MIPI_CSI_RX_D2-	1.8V
20	-		GND	
19	CSI_RX_CLKP	Camera	MIPI_CSI_RX_CLK+	1.8V
18	CSI_RX_CLKN	Camera	MIPI_CSI_RX_CLK-	1.8V

Camera Breakout connector 6 pins

No.	Pin	Description
1	5V	Board Power 5V
2	3V3	Board Power 3.3V
3	GND	GND
4	CAM_FSIN	Frame sync input
5	CAM_STROBE	Frame sync output
6	EXTCLK	External Clock Input (MCLK)

Max. Current per pin 1A