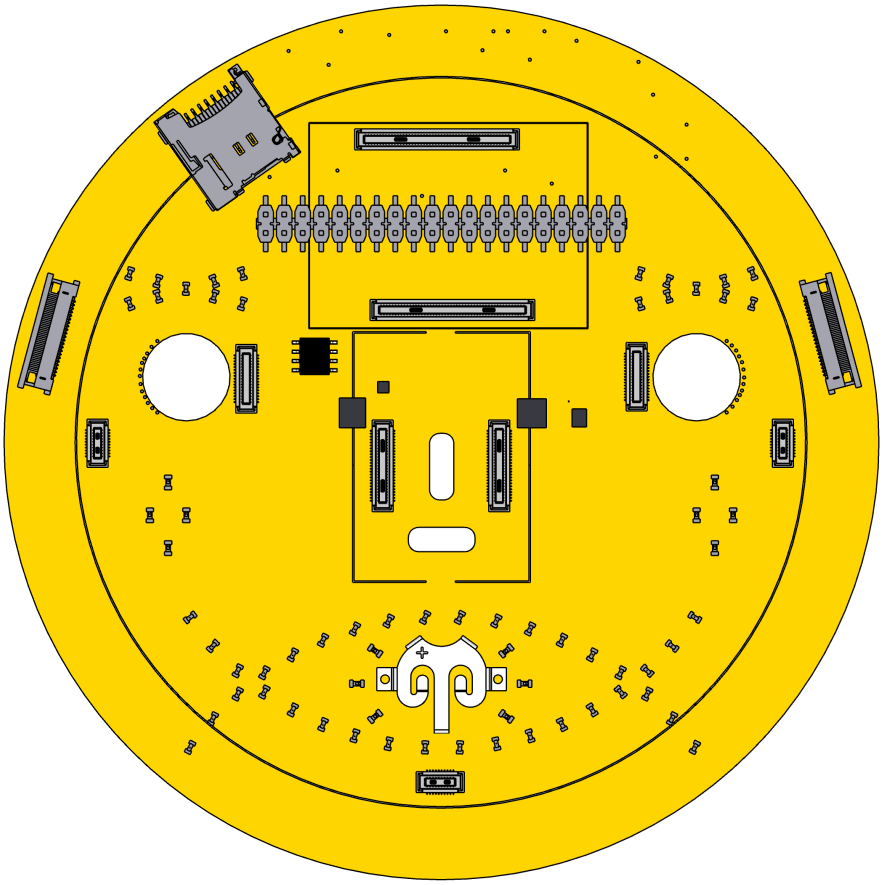
919 Smiley

Face board used to face the user and bridge daughterboards.

It contains a Bosch Sensortech 32 bit RISC processor that monitors 3D movement using a gyroscope and accelerometer. It communicates with the Host MCU via the Stem I2C bus (I2C3 for the MCU daughterboard). It exposes system control signals via the SYS I2C GPIO Expander 0. Sensors on camera modules are available via Master 2 & 3. A second chip is optional BMM150 to provide a magnetometer to get richer movement data.

Connectors are present to support attachement of two camera modules.

A LED matrix driver controls 120 LEDs producing expressions on the front of the board. The LEDs are 1mm long and embedded in the board in order to create a diffused light.



The board allows for experimental mounting of a an i.MX 8 Plus SoM. The production version 701 will have the SoM daughtercard and other components without mounting debug/development connectors.

Components

- 1 * Bosch Sensortech BHI260AP - Mouser
- 1 * NOR Flash 8M QSPI IS25WP080D-JNLE ISSI SOIC-8 - Mouser
- 1 * IS31FL3730 8x8 matrix output
- 1 * PCA9555 I/O Expander HVQFN24 package
- 1 * TXB0108YZPR2 8-Bit Bidirectional Voltage-Level Shifter with Auto Direction Sensing and +/-15-kV ESD Protect 20-DSBGA -40 to 85 - Mouser
- ? * Kingbright APHHS1005SYCK 1mm x 0.5mm yellow
- Würth 150040YS73220 1mm x 0.5mm yellow

Connectors placed on the board are,

- 2 * Hirose DF40C-34DS-0.4V (Mouser)
- 1 * TE Connectivity 45PIN 0.3MM 571-4-2328724-5 FPC 3-2328724-5 $0.41
- 1 * Battery clip 2894TR - Mouser - Alibaba
- 1 * Renata CR1220 cell battery - Alibaba CR1220
- 3 * Hirose DF40-20DS-0.4V mated height 1.5mm Mouser - JLCPCB socket

Development connectors placed on board are,

- 2 * TSM-120-01-F-DV Samtec 2*20 pins surface mounted .100 (Smiley model) Mouser
- 2 * Molex 22PIN 0.5mm pitch 54548-2271
- 1 * MicroHDMI (suggested Molex 46765-1301) Mouser Molex

701 components are,

- SB-UCM-iMX8PLUS System-on-Module
- 2 * PCA9555 I/O Expander HVQFN24 package
- 2 * Hirose DF40HC(3.0)-100DS-0.4V mated height 3.0mm
- M.2 key B connector H4.20mm Amphenol ICC 10128793001RLF
- M.2 key E connector H4.20mm Amphenol ICC 10128794001RLF

Alt Components [not currently used]

- LP5036 36 LED driver - Mouser
- Optional BMM150 Magnotometer
- Bosch Sensortech BHI160B - Mouser
- Würth 710-150040RS73220 1mm x 0.5mm red
- Würth 710-150040VS73220 1mm x 0.5mm green
- Würth 150040YS73240 1mm x 0.5mm yellow
- Bivar SM0402YC 1mm x 0.5mm yellow
- Lumex SML-LX0402SYC-TR 1mm x 0.5m yellow
- ROHM SML-P12YTT86R 1mm x 0.6nn yellow
- Alternate Cell Holder S8411-45R - Mouser
- 1 * EEMB / Hillflower LIR1220 Li-ion 3.6V battery rechargeable - Alibaba .. or
- 1 * ML1220 3V rechargable battery

Articles

- Led PCB Circuit Board
- Uncovering PCB Embedded Components
- Practical steps for creating embedded components with side-emitting LEDs
- Efficient LED Blinking for Embedded Systems
- Embedding of Passive Components into Flex PCB
- LED module design considerations for an aluminium board
- Led Bar array with stm32f103 microcontroller
- APA102 2020 RGB LED source
- Novel control strategy for synchronous PWM on a matrix converter
- Adafruit 16x9 Charlieplexed PWM LED Matrix Driver - IS31FL3731
- https://community.bosch-sensortec.com/t5/MEMS-sensors-forum/BNO055-vs-BHI260AB-fusion-accuracy/td-p/24263

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Camera connectors

Two sets of camera connectors are on the board for left and right sides respectively. The 22 pin connector allows a Development board to be connected with a Raspberry Pi Zero compatible flex cable. The 34 pin connector allows attachment of a 201 Camera Module made for it. Signals will be transferred directly between the two connectors using voltage shifters

The dual camera connectors are also connected to the SoM. 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 power supplied to the 34 pins connector can be driven by the 22 pin connector or the T-USB Power Module. VSOM from power module is down-regulated to 3V3, 2V8 and 1V8 from 3.7V - 5V. This downregulation can be shared between Left and Right cameras.

The 1.8V driving the Sensor I/O of the 201 modules will also be supplied via the Self powered direct battery input.

Board Power

The board can be powered by 3V+ via a directly attached battery, or a pin on back GPIO header, which is down regulated. The self power input will power the Motion Engine and camera sensors with 1.8V. This can be used to run the board in an always on mode that records movement while disconnected from the power module. The SELF_PWR input will be used to supply VCC_RTC pins.

When the Power module is connected it supplies VSOM, which powers the MotionEngine, LED Matrix driver and camera modules. VSOM is down regulated from around 4V to 1V8, 2V8 and 3V3. When connected, no power is drawn from the battery on the bridge board.

Voltage pins are

- Self powered 2V+ input
- Always on 1V8 output VCC_RTC
- Powered 1V8 output
- Powered 2V8 output
- Powered 3V3 output
- Powered 5V output
- VSOM output

[?] Is it possible to support both 5V in and out on the GPIO pins? 5V input would be downregulated to 4V if power module isn't connected. 5V output would be upregulated VSOM.

SELF_PWR Optional battery power input for driving the boards always on components while a power module isn't connected. Power might be supplied by a CR2032 or LIR1220 battery. This can be supplied by connecting to the pin on the backplane GPIO header or the RTC battery slot.

VSOM Supplied by power module over multiple pins. When all pins are connected it is passed on to full-on mode components as VCC_FULL.

VCC_RTC This powers always-on components on attached modules. It is sourced from any of the power module VCC_RTC or VSOM pins and downregulated. If the power module isn't connected or doesn't provide any power the fallback is SELF_PWR.

Power module provides either,

- No power
- VCC_RTC only
- Some VSOM pins
- Full VSOM (all pins)

The power provided will force the system state to be

- Off
- Detached
- Suspended (fully powered)
- Running (fully powered)

The battery connector may be change to use LIR1220(3.6V) or ML1220(3V), which are rechargable. Additional circuitry will be added in the future to charge the battery from VCC_FULL(VSOM).

Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage IMU Analog Domain	IMU_VDD	1.71	1.8	3.6	V
Supply Voltage IMU I/O Domain	IMU_VDDIO	1.71	1.8	1.89	V
MotionEngine running CPU/Sensing		0.5	1	2.8	mA
LED Matrix chip	LED_VCC	2.7		5.5	V
LED Matrix chip	LED_IOUT		40		mA

T-USB Power connectors

The system power is driven by the T-USB module via the two 50 pin connectors. There is no need to power the board from other connectors than USB-C.

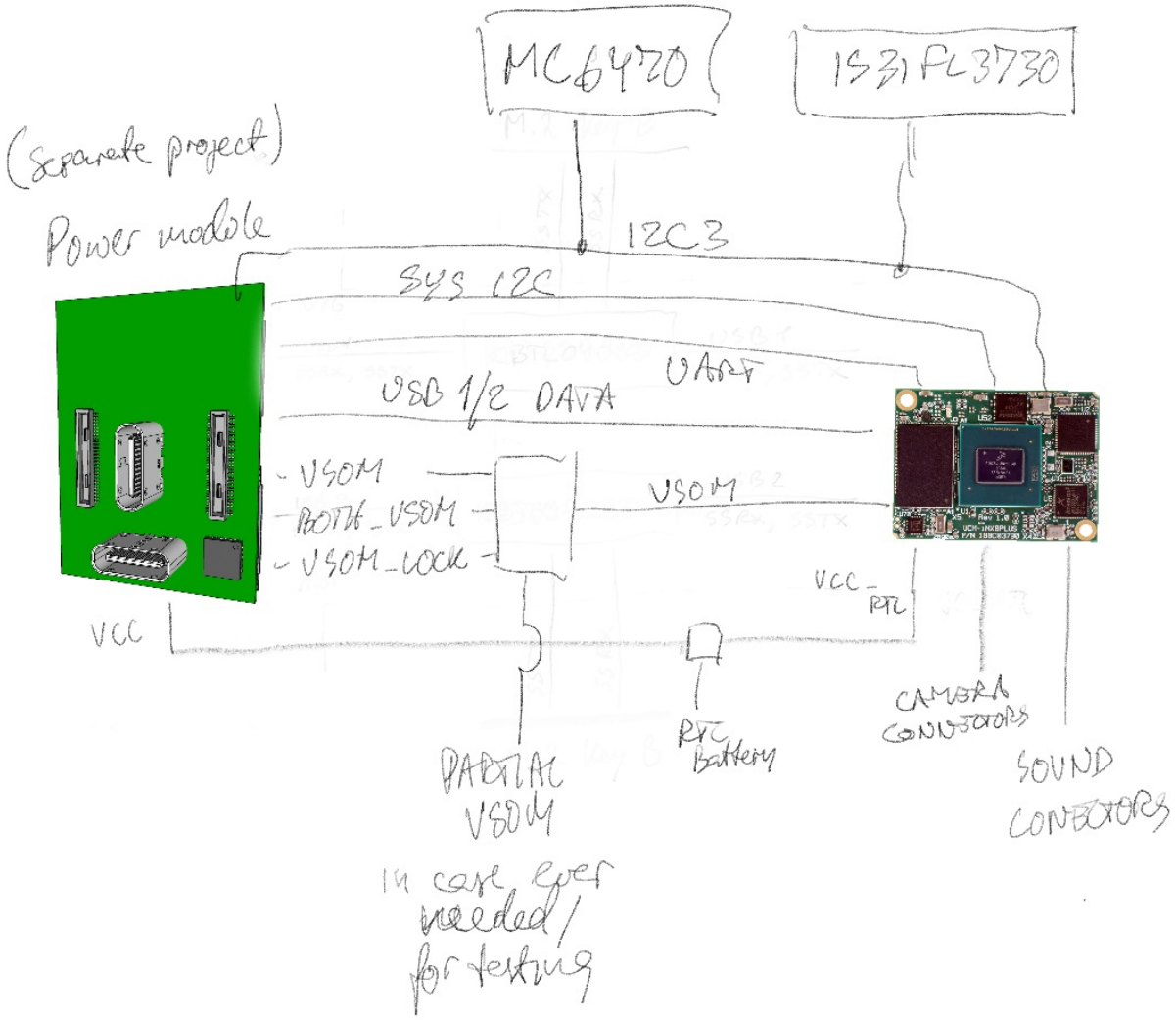
From it 5V0, 3V3, 2V8, and 1V8 are derived. 5V is stepped up from VSOM. These should not be mixed with the VIN_5V and VIN_3V3 on the T-USB module connector.

- m.2 connectors are based on 3V3 and 1V8
- Sound is based on 3V3 or 1V8
- Cameras are 1V8, 2V8 and 3V3
- HDMI can supply 5V / 50 mA
- HDMI signal level is 5V
- Debug connector 5V

So there are in total two uses of 5V

1. HDMI supply and signal (50 mA) from upregulated VSOM
2. 5V supply (100 mA) to T-USB module which is externally supplied.
3. Debug connector (directly connected with VIN_5V soldering pad)

VIN_5V is optional and separate from the power on the board. It is supplied from the soldering pad/point.



Physical T-USB Connection Establishment

When connecting the T-USB module to the Bridge Board VSOM is provided over multiple pins on both connectors. The bridge board can draw a limited current from individual pins, but must only drive the System Module with power when all VSOM pins are connected. This allows for avoiding damage or strange behavior, if the power module is partially inserted.

Stages of insertion are,

- No VSOM pins connected
- At least one VSOM pin is connected
- VSOM Pins from both connectors connected
- All VSOM pins connected (including VSOM_LOCK)

When at least one pin is connected the Bridge Board can power components that are low power and always-on. It should provide VCC_RTC to the System Module from the T-USB module whenever it is plugged in or the VCC_RTC pad.

The 801/909 board must short LDO_3V3 to SPI_3V3 on the connector to provide power to the flash on the power module.

When pins from both connectors are supplying VSOM the Bridge Board should raise BOTH_VSOM. The Power Module delivers VSOM to one of the pins dependent on BOTH_VSOM.

The locking mechanism of the backplate is also used to drive one of the VSOM connectors, named VSOM_LOCK, which prevent from the system activating until locked in place

As the first step in the detachment of the power module the physical unlock button must be pressed which raises PMIC_STBY_REQ. The next step is to turn the back plate which will disconnect the conditional VSOM_LOCK pin.

This requires logic on the 801/909/919 board.

Logic on Bridge board

The T-USB module is inserted onto the bridge board. As this gets inserted the bridge board must detect it and enable power as connection is established.

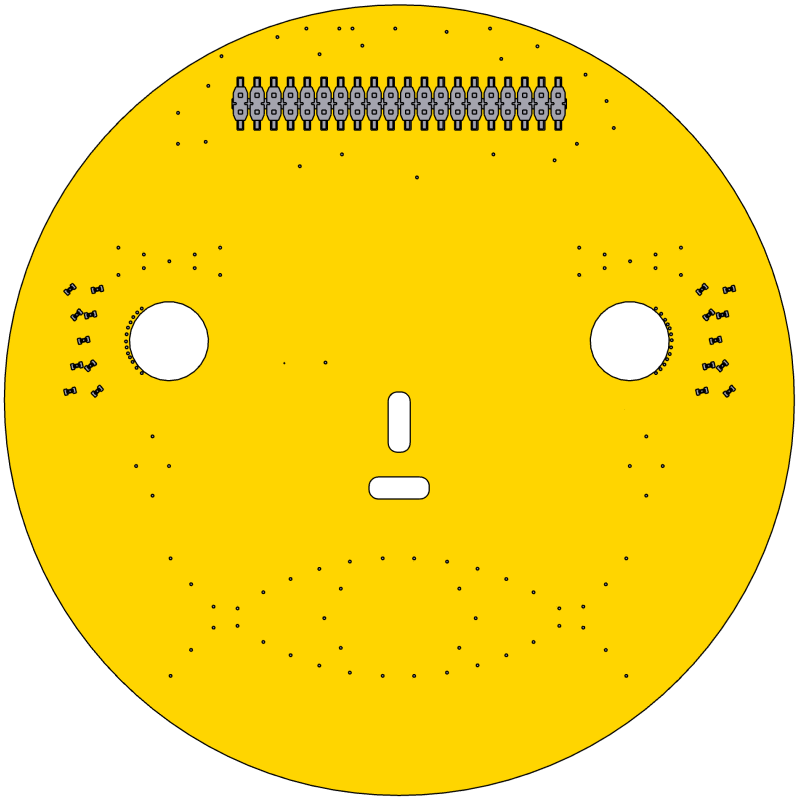
a) If at least one VSOM pin on both connectors is high, BOTH_VSOM is raised high by the bridge board. b) Directly connect VCC_RTC on T-USB connectors, soldering pad and System Module. c) If all 9 VSOM pins are supplying power, use it to power the System Module d) If all 10 VSOM and VSOM_LOCK pins are supplying power, deliver upregulated 5V e) If all 10 VSOM and VSOM_LOCK pins are supplying power, deliver 2.8V to camera modules f) If all 10 VSOM and VSOM_LOCK pins are supplying power, deliver power to m.2 modules g) If some VSOM pins are powered deliver it to always running circuits(like IMU) on bridge board(not on 909c).

[?] Connector layout and pin orientation diagram. [?] Full power logic

LED layout

LEDs are laid out as eyebrows and a mouth. They are connected to the multiplexer as 7 sets of 9 LEDs (7x9 mode).

1. Brow x 2
2. Eye sides x 2 (reverse of brow signal)
3. Smile x 2
4. Sad x 2 (reverse of smile signal)
5. Cheeks, split 4 left 4 right.
6. O x 6 (reverse of cheeks)



Numbering of individual LEDs are from top-left to right. The eyebrow sets are doubled up with the eye side using reverse polarity. The eye sides get signals from VIAs close to the eye hole.

The smile if formed by a left side and a right. LED numbering starts in the middle. A sad smile uses the same multiplexer banks but with reverse polarity.

LEDs are marked with identifiers on the connector side, but not on the front side.

Leds should be oriented perpendicular to the line they are arranged on. The orientation on the 3D model doesn't reflect what is intended.

LED Matrix driver

The LEDs are controlled via a IS31FL3730 chip connected to SOM(I2C3) and MotionEngine(Host I2C) if Host IF connected to I2C3. Note that I2C3 is also broken out over the 20 pin Sound module connectors.

It can be driven by 2.7V - 5.5V I/O can be up to Vcc+0.3V

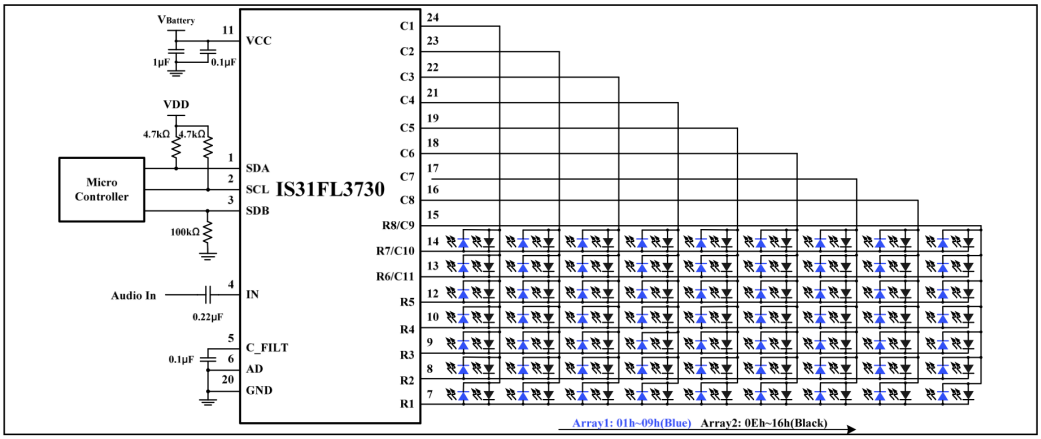


Figure 2 Typical Application Circuit Dual 7×9

LED mounting

Most LEDs are mounted by embedding them into the board. The PCB being 1mm thick a recess is made to fit the LED of 0.4mm. In the center a 0.4mm hole is drilled to let through light. We must determine the best way to produce accurate holes for a good fit. It is essential that the LEDs are placed accurately to have an equal distance between them.

While making the inital prototypes it will be very valuable to create boards that use a variation of LEDs such as yellow vs white. Variations in the embedding would also be great to test such as how deeply they are recessed or the thickness of the PCB. Pinhole or not is another variation to test.

MotionEngine I2C Sensor

The BOSCH sensor includes an embedded processor communicating via I2C. It boots from a 1MB flash chip. It runs and communicates on is 1.8V.

https://www.mouser.ch/ProductDetail/Bosch-Sensortec/BHI260AP?qs=T94vaHKWudTEPTnGI%252BTy9w%3D%3D

BHI260AB I2C modes support 3.4 Mbit/s. Put on SYS or 3 ? HSCX + HSDX. i.MX 8 can only do 400KHz.

Power comes from any of the SOM lines via the two 50 pins connectors. Isolate them and down regulate to 3.3V.

Host I2C is I2C3 on the CPU side. Master I2C 2 is I2C6 on the CPU side, Right CAM CSI2 SCCB & Ambient Light. Master I2C 3 is I2C5 on the CPU side, Left CAM CSI1 SCCB & Laser Scan. Master is is free for SPI communication.

Sensor linux driver source - https://github.com/BoschSensortec/BHY2-Sensor-API

? Event interrupts vs GPIO ? Timers ? Aux IMU I2C

Pin	Pad		to
1	M3SDA	Left CSI1 I2C SDA	SOM I2C5
2	M3SCL	Left CSI1 I2C SCL	SOM I2C5
3	HOSTBOOT	System Control	EX0.6
4	QSPI_D0	Flash	Flash chip
5	QSPI_CLK	Flash	Flash chip
6	VREG	Supply	1.8V

Pin	Pad		to
7	VDDIO	Supply	1.8V ?
8	QSPI_D3	Flash	Flash chip
9	RESETN	System Control	EX0.5
10	HIRQ	Host I2C IRQ	SOM I2C3 / EX0
11	HSDX	Host I2C SDA	SOM I2C3
12	VDDIO	Supply	
13	M2SCX	Right CSI2 I2C SCL	SOM I2C6
14	QSPI_CSN	Flash	Flash chip
15	QSPI_D1	Flash	Flash chip
16	MCSB3	GPIO / Chip Select 3	Breakout
17	GND	Supply	
18	MCSB2	GPIO / Chip Select 2	Breakout
19	MCSB4	GPIO / Chip Select 4	Breakout
20	QSPI_D2	Flash	Flash chip
21	OCSB	IMU Auxiliary	BMM150
22	ASCX	IMU Auxiliary	BMM150
23	JTAG_CLK	Debug	Breakout
24	JTAG_DIO	Debug	Breakout
29	M1SCX	Master 1 I2C SCL	Breakout
30	ASDX	IMU Auxiliary	BMM150
32	HDSO	I2C Address selector	LOW
33	HSCX	Host I2C SCL	SOM I2C3
37	M2SDI	GPIO	M2SDI
38	MCSB1	GPIO / Chip Select 1	Breakout
39	ASCX	IMU Auxiliary	BMM150
43	M1SDI	GPIO SPI Master 1	Breakout
44	M1SDX	Master 1 I2C SDA	Breakout

Address

HSDO is LSB selecting 0x28 or 0x29 = LOW by default (can be overridden)

QSPI Flash

Soldering Pads are reserved on the board for a 1MByte flash chip connected vis QSPI to the Bosch SensorTech

- CLK
- CSN
- D0..D3

It supports,

- Quad SPI / QPI modes
- 0.5 - 8 MBytes supported

I assume the voltage is 1.8V. Winbond is apparently a tested example.

I/O Expander 0

Expander #0 combines control signals. It is driven by SYS I2C. It is present used with and without SoM / m.2 modules.

The development board uses a single Expander. The 909 and 801 uses 2x PCA9555 to control more states The system expander input triggers interrupt via EX0_nINT (GPIO4_IO19).

This first expander, which is also on the dev. board maps,

Expander	Connected to
EX0.0	mPCIe_PERST on M2 Key B
EX0.1	mPCIe_PERST on M2 Key E
EX0.2	
EX0.3	
EX0.4	IMU_IRQ - Motion Controller
EX0.5	IMU_RESETN - Motion Controller
EX0.6	IMU_MODE - Motion Controller
EX0.7	
EX0.8	CSI1_PWR_DWN_B
EX0.9	LEFT_CAM_RESET
EX0.10	LEFT_ATT_INT
EX0.11	LEFT_ATT_XSHUT
EX0.12	CSI2_PWR_DWN_B
EX0.13	RIGHT_CAM_RESET
EX0.14	RIGHT_ATT_INT
EX0.15	RIGHT_ATT_XSHUT

This allows control of IMU and camera module state

Edge Sound Expansion connectors

One the edge there are three 20 pin connectors that allow connecting expansion modules providing Sound/Sensor support.

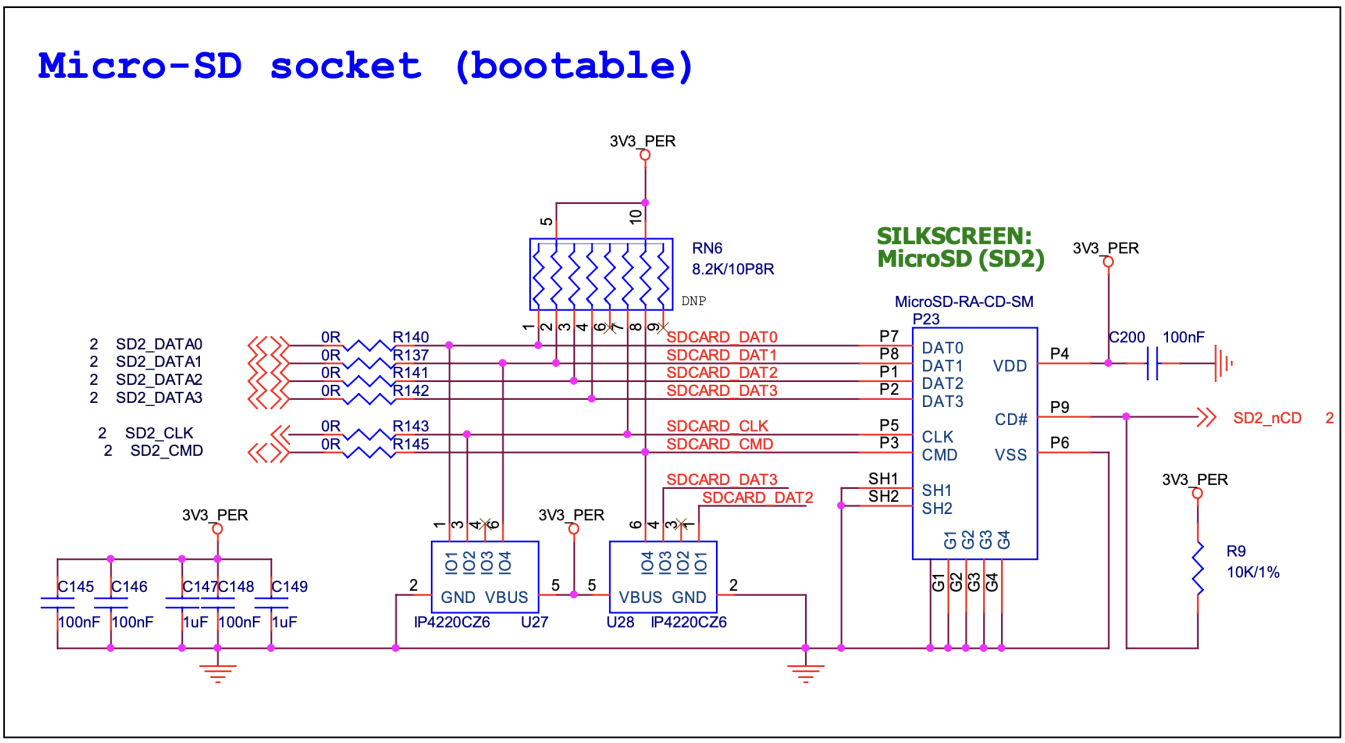
1.8V signals are needed for suspended state. Should it be 3.3V for audio?

3D Model libraries

https://kicad.github.io/packages3d/

MicroSD

The MicroSD connector is connected to SD2_DATA*, SD2_CLK, SD2_CMD, SD2_nCD on the i.MX8 module.



Wiring

Use this table to ensure correct board wiring.

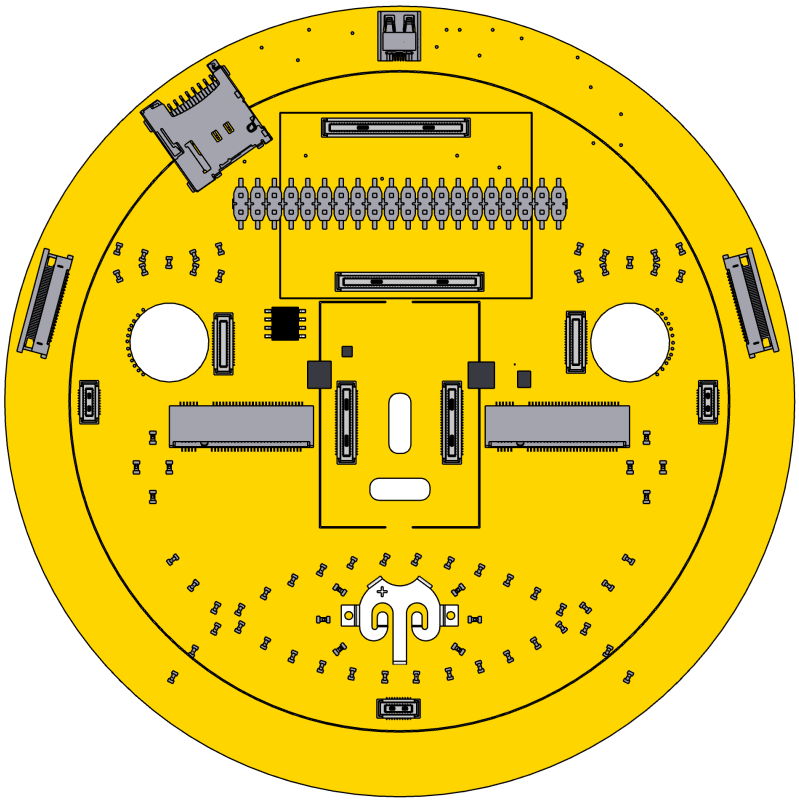
Signal	801 T-USB	BHI260AB	IS31FL3730	SOM / MCU	PCA9555	CAM connectors	Breakout
I2C3 SDA		Host IF	I2C3 SDA	I2C3 SDA			
I2C3 SCL		Host IF	I2C3 SCL	I2C3 SCL			
SYS SDA				SYS SDA	SDA 3V3		
SYS SCL				SYS SCL	SCL 3V3		

Signal	801 T-USB	BHI260AB	IS31FL3730	SOM / MCU	PCA9555	CAM connectors	Breakout
I2C5 SDA		Master 3		I2C5 SDA		Left SCCB	
I2C5 SCL		Master 3		I2C5 SCL		Left SCCB	
I2C6 SDA		Master 2 SDX		I2C6 SDA		Right SCCB	
I2C6 SCL		Master 2 SCX		I2C6 SCL		Right SCCB	
SPI SCK		M1SCK					SPI SCK
SPI MOSI		M1SDX					SPI MOSI
SPI MISO		M1SDI					SPI MISO
EX0_nINT					nINT		
EX0.2							
EX0.3							
EX0.4		BN_H_INTN				IMU_IRQ	
EX0.5		RESETN				IMU_RESETN	
EX0.6		HOSTBOOT				IMU_MODE	
EX0.7							
EX0.8						CSI1_PWR_DWN_B	
EX0.9						LEFT_CAM_RESET	
EX0.10						LEFT_ATT_INT	
EX0.11						LEFT_ATT_XSHUT	
EX0.12						CSI2_PWR_DWN_B	
EX0.13						RIGHT_CAM_RESET	
EX0.14						RIGHT_ATT_INT	
EX0.15						RIGHT_ATT_XSHUT	
		JTAG_CLK					JTAG_CLK
		JTAG_DIO					JTAG_DIO
			IN				LED_AUDIO
			C_FILT				LED_FILTER
		MCSB1					GPIO

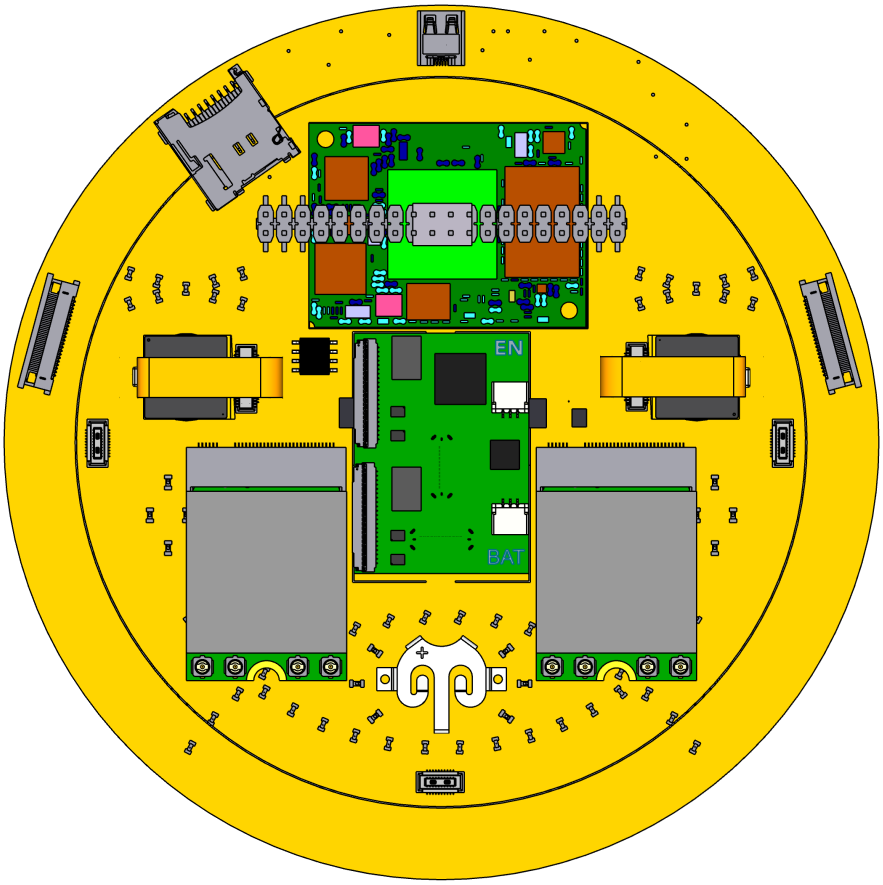
Signal	801 T-USB	BHI260AB	IS31FL3730	SOM / MCU	PCA9555	CAM connectors	Breakout
		MCSB2					GPIO
		MCSB3					GPIO
		MCSB4					GPIO
		M1SCX					M1SCX
		M1SDX					M1SDX
		M1SDI					M1SDI
Signal Level			3.3V		3.3V		
Standalone 1V8		Consumes				VCC_1V8	
VCC_SOM	Supplies		Consumes				VCC_SOM
Powered 3V3						AF_VDD	
Powered 1V8		Consumes				DOVDD + VCC_1V8	
Powered 2V8						AVDD_2V8	

Adding on SoM and m.2

After the initial round of the board it is time to make a version with SoM and m.2 module connectors. While the SoM connection was supported in round 1, not all connections were made.



This is how it looks with the modules mounted:



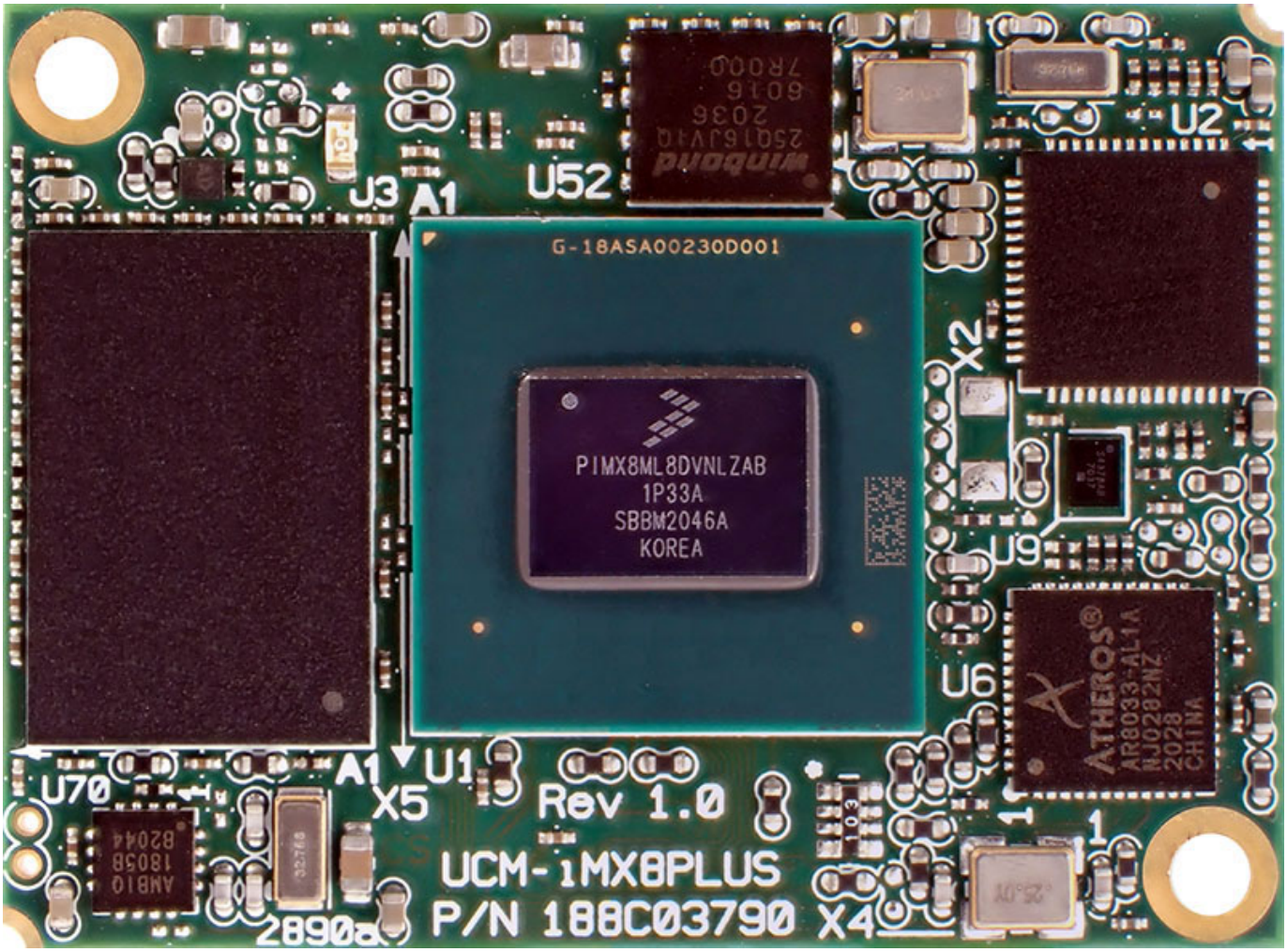
Connecting the SB-UCM-iMX8PLUS SoM

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. The USB1 and USB2 data will be connected to multiplexers
The 45 pins Debug connector will break out many additional signal lines

- 2 * Hirose 100 pin connectors are used to connect the SoM daughter board



Data to/from the Power Module

- I2C3, SYS I2C
- USB data Host/OTG
- LVDS data
- UARTx_xXD

Control/power signals from the Power Module

- VSOM
- BOTH_VSOM
- VSOM_LOCK
- VCC_RTC
- GND
- PWRBTN, ALT_BOOT, QSPI_BOOT_EN_3P3
- SYS_RST_PMIC, PMIC_ON_REQ, PMIC_STBY_REQ

- EX_OH_nINT, EX_T_nINT, EX0_nINT

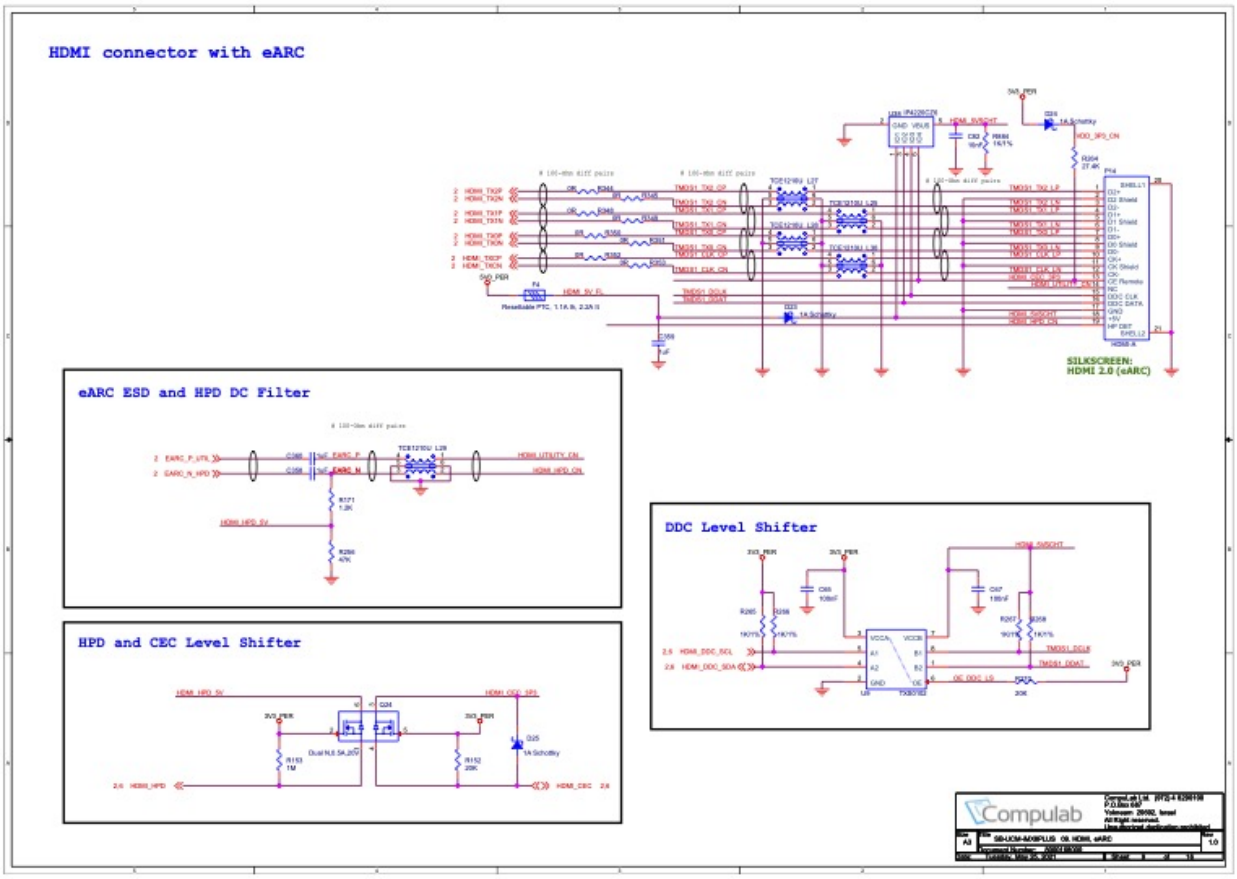
Booting

The board can boot from eMMC / SD or USB. Boot / Reset buttons are optionally on the T-USB Module.

The board has a power LED driven by VSOM.

MicroHDMI

The MicroHDMI connector is connected to the HTMI_TX*, HDMI_DDC_*, HDMI_CEC, HDMI_HPD pins from the i.MX8 module.



I2C EEPROM

Add an EEPROM like 24C08 present on the UCM carrier board.

I/O Expander 1 & 2

Expander #1 and #2 gives access to m.2 connector controls. It is driven by SYS I2C.

The development board uses a single Expander. The 909 and 801 uses 2x PCA9555 to control more states.

The EX1 expander input triggers interrupt via EX_OH_nINT (GPIO1_IO0). The pins relate to USB1 OTG and M.2 Key E.

The EX1 expander allows controlling T-USB maps,

The 3 pins for each Alt. Mode controller determines how signals are mapped to USB-C high speed lines. Refer to the datasheet for HD3SS460 for full truth table. The regular USBSS setup is chosen by POL=L, AMSEL=M, EN=H.

Expander	Connected to
EX1.0	
EX1.1	
EX1.2	
EX1.3	MUX_USB2_SEL
EX1.4	MUX_USB3_SEL
EX1.5	COEX4
EX1.6	DEV_WLAN_WAKE
EX1.7	ALERT / I2C_IRQ
EX1.8	GPIO3 on 65988 (HPD1)
EX1.9	LED / DAS / DSS
EX1.10	W_DISABLE2#
EX1.11	W_DISABLE1#
EX1.12	UART WAKE
EX1.13	SDIO WAKE
EX1.14	LED2#
EX1.15	

The development board uses a single Expander. The 909 and 801 uses 2x PCA9555 to control more states.

The EX2 expander input triggers interrupt via EX_OH_nINT (GPIO1_IO0). The pins relate to USB2 Host and M.2 Key B.

The EX2 expander allows controlling T-USB maps,

The 3 pins for each Alt. Mode controller determines how signals are mapped to USB-C high speed lines. Refer to the datasheet for HD3SS460 for full truth table. The regular USBSS setup is chosen by POL=L, AMSEL=M, EN=H.

Expander	Connected to
EX2.0	
EX2.1	
EX2.2	
EX2.3	MUX_USB2_SEL
EX2.4	MUX_USB3_SEL
EX2.5	M2B_PWROFF
EX2.6	RESET#

Expander	Connected to
EX2.7	ALERT / I2C_IRQ
EX2.8	GPIO4 on 65988 (HPD2)
EX2.9	LED / DAS / DSS
EX2.10	W_DISABLE_2#
EX2.11	W_DISABLE#
EX2.12	DEVSLP 3V3
EX2.13	
EX2.14	CONFIG_1
EX2.15	

USB Data and m.2 Module Wiring

M.2 Key B

See EXPANSION document for more information.

Note that some pins are connected to I/O Expander 2 meant for USB2 and Key B.

T-USB Data and M.2 Key E Expansion

Data is routed primarily over the two USB-C connectors via the Power Module, but it is also available over the two M.2 Expansion connectors.

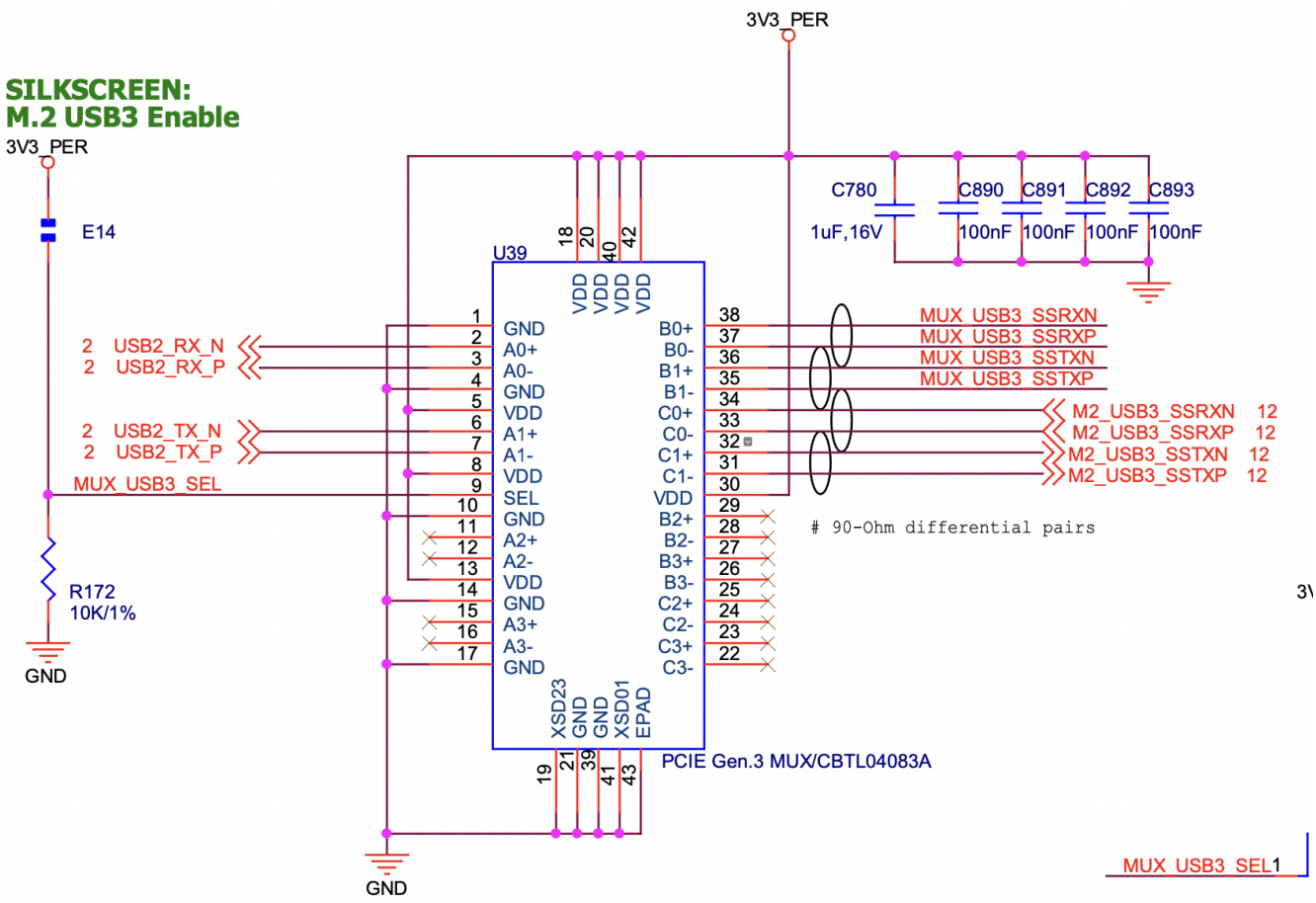
T-USB connector 3.0 data mapping

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 from the T-USB connector is managed by the Multiplexing chipsets around the PD Controller. The USB-C signal lines for the OTG connector in T-USB come from USB1(OTG cabable 2.0 & 3.0). The SBU1/SBU2 are connected to AUX-/AUX+ pins on the T-USB OTG alt connector. The USB 3.0 superspeed data pairs and SBU1/SBU2 are passed from USB-C connectors to HD3SS460.

The Host USB-C connector is similarily connected. The HD3SS460 chips are controlled over I2C by the MCU using SYS I2C.

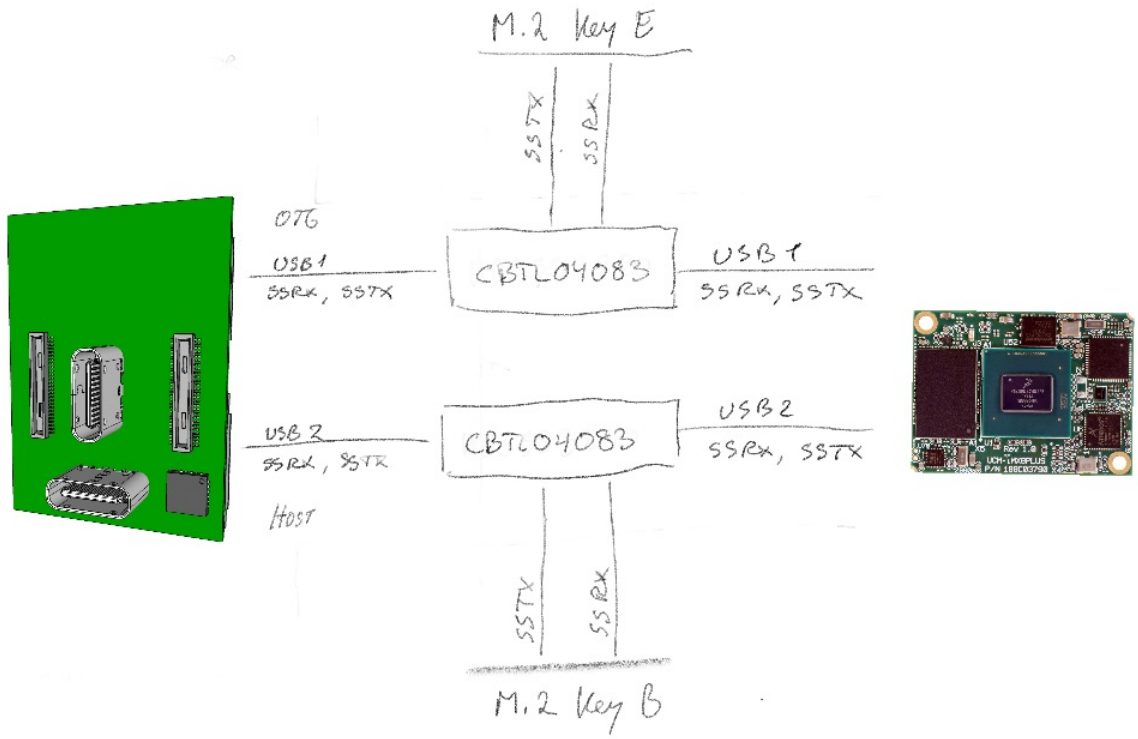
One side of the RX/TX pins are carried to the T-USB alt connector, and not connected to USB1 signals. (Should the side be muxed?)



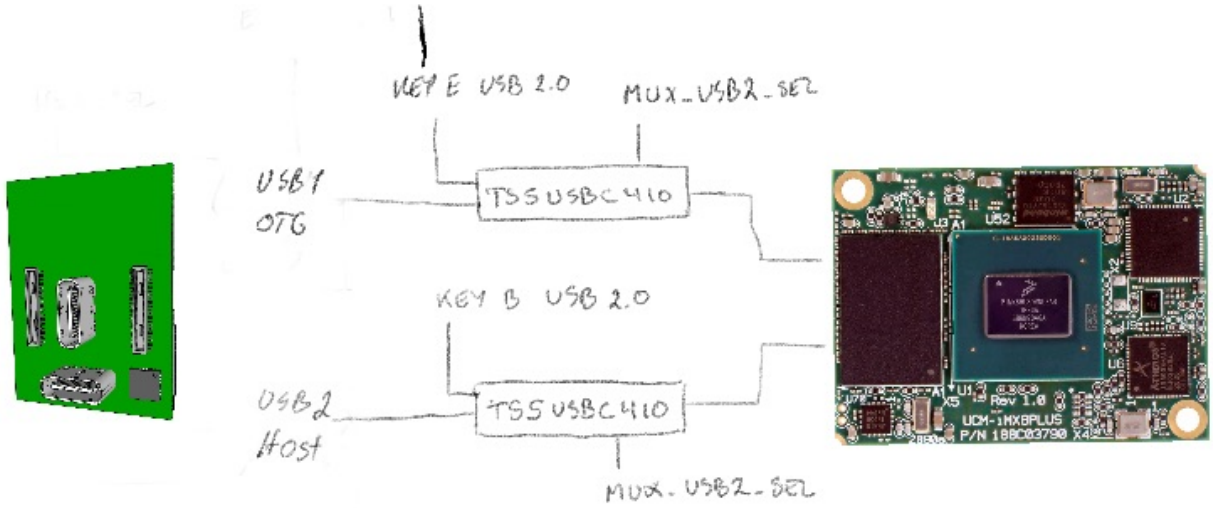
Multiplexing USB

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

The USB 3.0 superspeed USB1/USB2 from the SoM are multiplexed using CBTL04083 and controlled by MUX_USB3_SEL pins. The USB-C connector Alt. mode is managed by HD3SS460. The default(SEL = low?) state is to connect USB2 to USB-C plug via HD3SS460.



The USB 2.0 USB1/USB2 from the SoM are multiplexed using TS5USBC41 and controlled by MUX_USB2_SEL pins. The USB-C connector USB 2.0 signals(A/B 6/7) are managed separately and multiplexed using TS5USBC41. This allows routing an Extra USB 2.0 signal selectively via the Debug Breakout connector.



SEL	Connect to
High	m.2
Low	USB-C via HD3SS460

Key E

See EXPANSION document for more information.

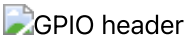
919 Connector Pinouts

Front facing GPIO header

The GPIO header is made to be compatible with RPi expansion hardware. It has fewer GND pins which are mapped to GPIO or receiving pins.

Features:

- Spare GPIOs
- SPI Image Boot
- Power 5V / 3V3 / 1V8 / RTC
- SPI / SAI7 I2S Out
- Stem and System I2C
- UART1 / UART3
- PWM1..3


GPIO header

Left side	Function	Pin	Pin	Function	Right side
	3V3	1	2	5V	
I2C3_SDA / GPIO5_IO19	SDA 3	3	4	5V	
I2C3_SCL / GPIO5_IO18	SCL 3	5	6	GND	
ETH0_MDI2P / SAI7_TX_SYNC	SAI7 SYNC	7	8	TxD	UART1 TxD / GPIO5_IO23
	GND	9	10	RxD	UART1 RxD / GPIO5_IO22
EX_OH_nINT / GPIO1_IO0	GPIO1_IO0	11	12	GPIO1_IO1	GPIO1_01 / EX_T_nINT
EX0_nINT / GPIO4_IO19	GPIO4_IO19	13	14	GPIO2_IO19	
	GPIO2_IO8	15	16	GPIO4_IO16	
Powering suspended	VCC_RTC	17	18	GPIO4_IO17	
ECSPI2_MOSI / GPIO5_IO11	MOSI	19	20	GND	
ECSPI2_MISO / GPIO5_IO12	MISO	21	22	GPIO1_IO19	TD2
ECSPI2_SCLK / GPIO5_IO10	SCLK	23	24	SPI CE0	ECSPI2_SS0 / GPIO5_IO13
	GPIO2_IO9	25	26	QSPI BOOT	QSPI_BOOT_EN_3P3
SYS I2C	SYS SDA	27	28	SYS SCL	SYS I2C
UART3_TXD / GPIO5_IO27	UART3_TXD	29	30	GPIO5_IO26	UART3_RXD / GPIO5_IO26
GPIO5_IO4	PWM2	31	32	PWM3	GPIO5_IO3
GPIO5_IO5	PWM1	33	34	CAN1_RX	GPIO4_IO25 (RPi GND)
UART2_RXD / GPIO5_IO24	GPIO5_IO24	35	36	CAN1_TX	GPIO4_IO22
UART2_TXD / GPIO5_IO25	GPIO5_IO25	37	38	CAN2_RX	GPIO4_IO27
	GND	39	40	CAN2_TX	GPIO4_IO26

Back facing GPIO header


Back GPIO header

Left side	Function	Pin	Pin	Function	Right side
	3V3	1	2	VSOM	VSOM when fully connected
I2C3_SDA / GPIO5_IO19	SDA 3	3	4	VSOM	VSOM when fully connected
I2C3_SCL / GPIO5_IO18	SCL 3	5	6	GND	
IMU Host SDA / MOSI	HSDX	7	8	JTAG_CLK	IMU JTAG
	GND	9	10	JTAG_DIO	IMU JTAG
IMU Host SCL / SCK	HSCX	11	12	SWD_CLK	PD SWD
IMU nINT	GPIO4_IO19	13	14	SWD_DAT	PD SWD
IMU Host MISO / ADR0	HSDO	15	16	HCSB	IMU Select I2C / SPI
Powering suspended	VCC_RTC	17	18	GPIO4_IO17	
IMU M1SDX	MOSI	19	20	GND	
IMU M1SDI	MISO	21	22	GPIO	IMU MCSB2
IMU M1SCK	SCLK	23	24	SPI CE0	IMU MCSB1
	GPIO2_IO9	25	26	GPIO	IMU MCSB3
SYS I2C	SYS SDA	27	28	SYS SCL	SYS I2C
Self powered 2V+	SELF_PWR	29	30	GPIO5_IO26	IMU MCSB4
LED IN	LED_AUDIO	31	32		GPIO5_IO3
LED C_FILT	LED_FILTER	33	34		
T-USB 50 pins LDO	BAT_LDO	35	36		GPIO4_IO22
T-USB 50 pins	LDO_3V3	37	38		
T-USB 50 pins	SPI_3V3	39	40		

7 available GPIO pins

EX_OH_nINT

[?] Mapping of SOM GPIO to IMU GPIO ?

The back facing also loosely follows RPi GPIO layout.

50 pin B2B connectors

Two connectors tie the daughterboard to the bridge board. Both are of a 50 pin Highrose B2B type.

- JLCPCB plug
- JLCPCB socket

default height 1.5mm

Connector 1: High Speed Data Connector 2: PD Controller, Debug, USB 2.0

Power	Max Current	Pins
VSOM	3.0 A	10
GND	3.0 A	10
VCC_RTC	600 mA	2
VIN_3V3	300 mA	1
VIN_5V	600 mA	2
LDO_3V3	300 mA	1

Connector 1 high-speed data, close to Alt Mode Breakout connectors

- 6 * GND
- 7 * VSOM

One side

Pin	Code	Type	Details	Voltage	Misc
1	VSOM	Power	Main power for board 3.45V - 4.5V		Conn. detect
2	USB1_RX_DP	USB	USB1 RX D+		
3	USB1_RX_DN	USB	USB1 RX D-		
4	GND	Power	Ground		
5	USB1_TX_DP	USB	USB1 TX D+		
6	USB1_TX_DN	USB	USB1 TX D-		
7	GND	Power	Ground		
8	USB1_RX_DP	USB	USB2 RX D+		
9	USB1_RX_DN	USB	USB2 RX D-		
10	GND	Power	Ground		
11	USB1_TX_DP	USB	USB2 TX D+		
12	USB1_TX_DN	USB	USB2 TX D-		
13	GND	Power	Ground		
14	T_USB_O_ALT_EN	AltMode	Exposed EX3		
15	T_USB_O_ALT_POL	AltMode	Exposed EX3		
16	T_USB_O_ALT_AMSEL	AltMode	Exposed EX3		
17	T_USB_H_ALT_EN	AltMode	Exposed EX3		
18	T_USB_H_ALT_POL	AltMode	Exposed EX3		
19	T_USB_H_ALT_AMSEL	AltMode	Exposed EX3		

Pin	Code	Type	Details	Voltage	Misc
20	GND	Power	Ground		
21					
23					
24	PWR_CHARGE	Battery	Internal charge current for testing		
25	BAT_STAT	Battery	Internal charging status for testing		

TODO remove EX3 exposure

Other side

Pin	Code	Type	Details	Voltage
50	LVCLK+	LVDS	LVDS CLK+	
49	LVCLK-	LVDS	LVDS CLK-	
48	VSOM	Power	Main power for board 3.45V - 4.5V	
47	LVD0+	LVDS	LVDS D0+	
46	LVD0-	LVDS	LVDS D0-	
45	VSOM	Power	Main power for board 3.45V - 4.5V	
44	LVD1+	LVDS	LVDS D1+	
43	LVD1-	LVDS	LVDS D1-	
42	VSOM	Power	Main power for board 3.45V - 4.5V	
41	LVD2+	LVDS	LVDS D2+	
40	LVD2-	LVDS	LVDS D2-	
39	VSOM	Power	Main power for board 3.45V - 4.5V	
38	LVD3+	LVDS	LVDS D3+	
37	LVD3-	LVDS	LVDS D3-	
36	VSOM	Power	Main power for board 3.45V - 4.5V	
35				
34				
20	GND	Power	Ground	
32				
31				
30	BAT_LDO	Battery	4.9V 50mA LDO for STAT LED	
28				
27				

Pin	Code	Type	Details	Voltage
26	VSOM	Power	Main power for board 3.45V - 4.5V	

Could also take in HDMI or PCIe lanes

Connector 2 PD controller, close to power connectors

- 2 * VSOM, 3 * GND, 1 * VCC_RTC, 1 * VIN_3V3
- 1 * VSOM, 1 * GND, 1 * VCC_RTC, 2 * VIN_5V, 1 * LDO_3V3

One side

Pin	Code	Type	Details	Voltage	Misc
1	VSOM	Power	Main power for board 3.45V - 4.5V		Conn. detect
2	GND	Power	Ground		
3	USB1_DP	USB	USB1 D+		
4	USB1_DN	USB	USB1 D-		
5	GND	Power	Ground		
6	USB2_DP	USB	USB2 D+		
7	USB2_DN	USB	USB2 D-		
8	GND	Power	Ground		
9	SWD_CLK	Debug	PD Controller GPIO12		
10	SWD_DAT	Debug	PD Controller GPIO13		
11	BOTH_VSOM	Enable	Signal from bridge board that VSOM is connected on both sides		
12	EX0_nINT	IRQ	Interrupt signal (GPIO4_IO19)		P21.30
13	EX_OH_nINT	IRQ	Interrupt signal (GPIO1_IO0)		P20.12
14	EX_T_nINT	IRQ	Interrupt signal (GPIO1_IO1).		P20.14
15	VSOM_LOCK	Power	Main power for board 3.45V - 4.5V, if mechanical lock shorted		Mech. lock
16	SYS_RST_PMIC	Reset	PMIC reset input pin. Internally pulled up with LDO1 power rail. Once low, PMIC performs reset.		P10.9
17	POR_B_3P3	Reset	Power On reset output pin. Open drain output requiring external pull up resistor.		P10.7
18	PMIC_ON_REQ	Reset	PMIC ON input from Application processor. When high, the device starts power on sequence.		P10.5

Pin	Code	Type	Details	Voltage	Misc
19	PMIC_STBY_REQ	Reset	Standby mode input from Application processor. When high, device enters STANDBY mode.		P10.3
20	VCC_RTC	Power	Low power mode supply		
21	PWRBTN	Boot	Power button trigger		
22	ALT_BOOT	Boot	Alternate boot		
23	QSPI_BOOT_EN_3P3	Boot	SPI boot		P21.18
24	BAT_CE#	Charger	Charge Enable Active-Low Input. Connect CE to a high logic level to place the battery charger in standby mode.		
25	PD_VIN_EN		Enable VIN_5V/3V3 from PWR_SYS (TBD)		

Other side

Pin	Code	Type	Details	Voltage	Misc
50	PD_HRESET		PD Controller HRESET (High)		
49	GND	Power	Ground		
48	UART1_TXD	UART	P1.72 UART1 Tx		P20.9
47	UART1_RXD	UART	P1.19 UART1 Rx		P20.11
46	UART2_TXD	UART	UART2 Tx		P20.1
45	UART2_RXD	UART	UART2 Rx		P20.3
44	UART3_TXD	UART	P1.61 UART3 Tx		P20.2
43	UART3_RXD	UART	P1.21 UART3 Rx		P20.4
42	UART4_TXD	UART	UART4 Tx		P20.8
41	UART4_RXD	UART	UART4 Rx		P20.10
40	I2C SCL	I2C	P1.99 SYS SCL		P21.7
39	I2C SDA	I2C	P1.97 SYS SDA		P21.5
38	I2C3 SCL	I2C	Stem SCL		P21.2 ?
37	I2C3 SDA	I2C	Stem SDA		P21.4 ?
36	VCC_RTC	Power	Low power mode supply		
35	LDO_3V3	Power	Supply for SPI Flash. Current 50 mA	3.3V	
34	SPI_3V3	Power	Power to the flash chip. Bridge connects to VIN_3V3	3.3V	
33	SPI_CS	PD	Programming/External flash directly	3.3V	
32	SPI_CLK	PD	Programming/External flash directly	3.3V	

Pin	Code	Type	Details	Voltage	Misc
31	SPI_MISO	PD	Programming/External flash directly	3.3V	
30	SPI_MOSI	PD	Programming/External flash directly	3.3V	
29	VIN_3V3		Supply for TPS64988 circuitry and I/O. Current 50 mA	3.3V	
28	VIN_5V	Power	System 5V power source (PPHV1, PPHV2, PP1_CABLE, PP2_CABLE). 500 mA.	5V	
27	VIN_5V	Power	System 5V power source (PPHV1, PPHV2, PP1_CABLE, PP2_CABLE). 500 mA.	5V	
26	VSOM	Power	Main power for board 3.45V - 4.5V		Conn. detect

RPI FPC 22 pins

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	
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	

Pin	Code	Type	Details	Voltage
22	VCC	Power	3.3V Power Supply	

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	I2C?_SCL(pullup resistor 2.2K)	1.8V
13	I2C_SDA	I/O	I2C?_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			

Pin	Code	Type	Details	Voltage
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	
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