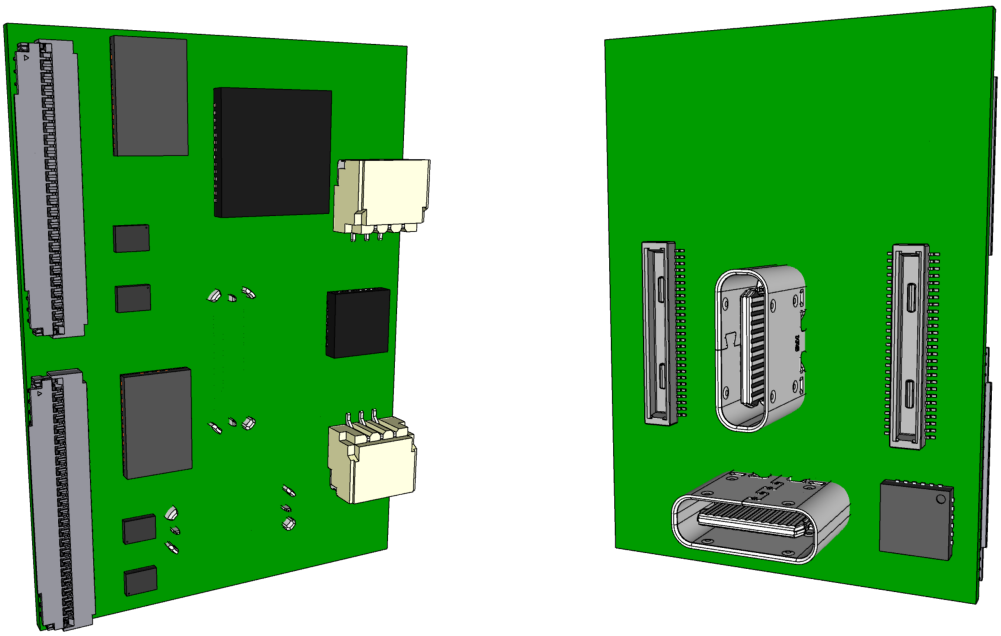
801 T-USB daughterboard

The 801 is a bridge board that connects daughter boards. 801 T-USB is one such daughter board.

The T-USB daughterboard has three functions

- Supply the system with power
- Provide data signals in the system over two USB-C connectors
- Manage autonomous system functions and waking state with an attached MCU.

The T-USB board exposes two vertical USB-C sockets and connects to the carrier board through two 50 pin B2B connectors. Two 45 pin debug connectors provides options to experiment with USB-C Alt. mode and connect a Stem MCU for Autonomous functions.



To facilitate feature development two additional connectors are added.

Recent changes

- Corrected the height specified here to 33mm, matching drawings.
- Testing board and Faceboard will use 50 pin sockets with clearing of 2.5mm. This allows thicker components on board underside
- The PCA9555 expanders have been replaced by a single MSP430FR2032.
- Expander now connects additional pins on 3 pin button connector, Charger and PD Controller chips
- Expander now connects additional pins on Alt Mode connectors and 50 pin connectors
- Max input current limit is partially driven by the Expander
- Debug pins for RP2040 have been remapped for MSP430
- BOTH_VSOM2 pin added on 50 pin connector (will need to be added to testing board breakouts)
- Pins added on Host Alt. Mode connector for additional T-USB Expander pins under MSP430

Open points

- Power LED & Indicator LEDs
- Add battery connector with temp. sensor JESDA?
- Optional connectors debug uart / jtag
- Annotations and Logo on the board
- TEST The Mux pin configurations
- How should PP_HV1 & PP_HV2 / PP1_CABLE PP2_CABLE be wired ?
- Default boot/SEL states connect USB 2.0/3.0 data routing and full power delivery / charging
- Enable VIN_5V/3V3 from PWR_SYS (TBD)
- Attachment signal / VSOM enable
- Detachment signal / Power down
- Trickle charging wireless coil over secondary connection on BQ24165, can this be supported on BQ24250 ?
- Reset button for RP, TPS, LiPo charger.

Core Components

- 2 * Hirose DF40-50DP-0.4V mated height 1.5mm Mouser
- 2 * Hirose USB-C CX80B1-24P
- 1 * TPS65988 Dual Port USB Type-C® and USB PD Controller, Power Switch, and High-Speed Multiplexer. Mouser
- 2 * HD3SS460 4 x 6 Channels USB Type-C Alternate Mode MUX. Connected to T-USB Host. Mouser. Dock Eval Kit
- 1 * MSP430 FR2032 IG56 TSSOP DGG56. Inventory 4870 at TO. @1000 $0.766. 52 IO pins, 1 UART/I2C, 1 UART/SPI.
- 4 * TS5USBC410 Dual 2:1 USB 2.0 Mux/DeMux Switch. Mouser
- 1 * BQ24250RGER battery charger $2 JLCPCB (4x4 mm package) Mouser
- 2 * 3 pin JST SH socket SM03B-SRSS-TB - JLCPCB - Farnell (Matched by JST PHR-3)

Dev. Connectors

- 2 * TE Connectivity 45PIN 0.3MM 571-4-2328724-5 FPC 3-2328724-5 $0.41

Alternate Components

- SuperSpeed MUX PI5USB30213A may be an option intead of CBTL04083
- Alternate USB 2.0 Mux/DeMux Mouser JLCPCB part
- Alternate 50 pins DF12NC(3.0)-50DS-0.5V(51)
- Multi cell design with BQ25792
- Optional SPI NOR flash 1Mbit 3.3V, 12MHz
- 2 * TPS63030 buck/boost converters (pick cheaper alternative to up/down regulate with enable pin)
- BQ25253 $5 JLCPCB (2.4x2.4 mm package)
- ANX7688 USB-C HDMI bridge replacing HD3SS460 for Host USB 3.0 Alt Mode. ANX7688 on PinePhone. Pinephone HDMI hot-plug-detection HW bug.
- Panasonic AXT534124 socket/receptacle - Mouser
- BM29B-6DP/2-0.35V(51) 6 pin Board to Board power connector

Firmware Drivers

- TPS65988 Linux
- BQ2425x Linux
- MC6470 Linux

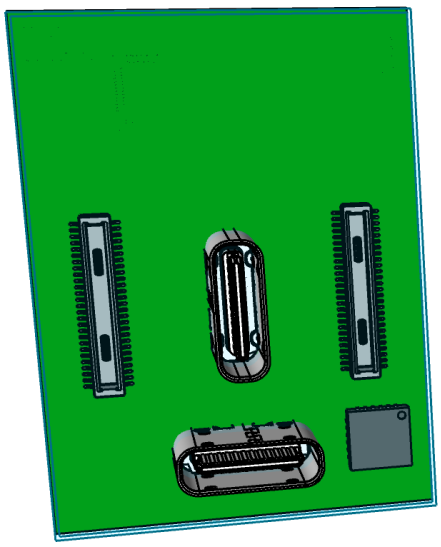
Data Routing

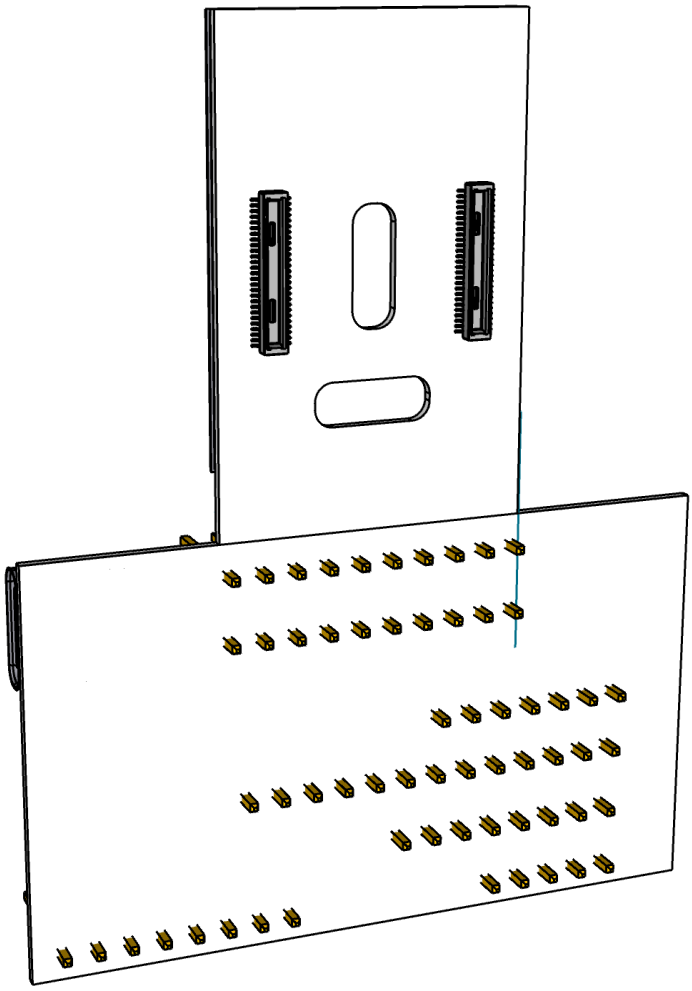
The basic data routing on the board is prepared for future expansion. There are a lot more connections into the board than are actually used.

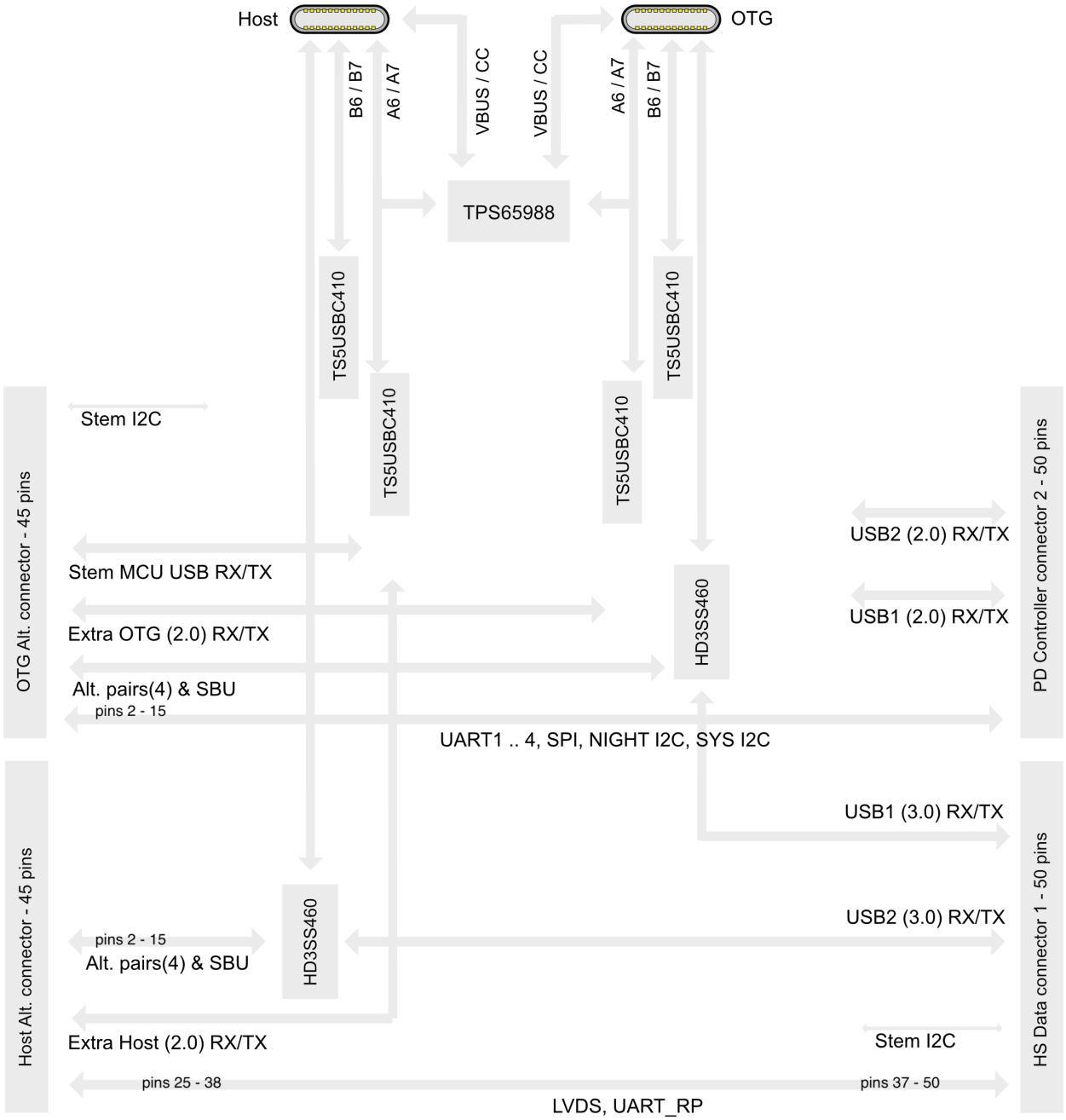
Possible future extensions

- USB-C Alt. mode HDMI/DP
- UART over USB 2.0
- I2C over USB 2.0

In the base setup without added logic the board routes USB 3.0/2.0 data through the two USB-C connectors.







Board

33 mm x 24 mm (height x width)

The length can be increased to 41mm for the development version of the board. Don't forget to ensure clearing on testing board.

The two 50 pin connectors are placed with a gap of 16 mm between their midpoint. These two connectors are vertically centered on the center of the vertical USB-C connector.

The two 45 pin data breakouts are placed on one edge with a 2 mm gap.

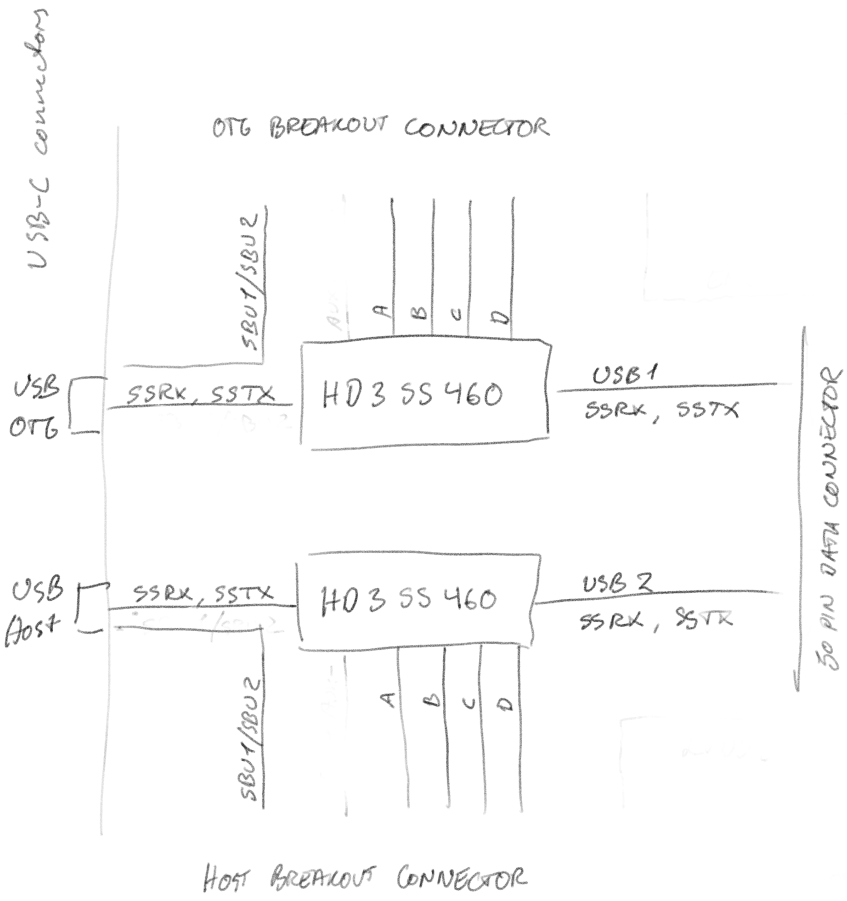
Components on the underside can be max 1.2mm thick. They can be placed above the horizontal USB-C.

The expected DF40 socket the board inserts into creates 2.5mm clearing height. It has been increased to enable thicker components on the underside, specifically the MSP430.

Multiplexing USB

The board has two types USB busses 2.0 and 3.0 for both of the USB-C connectors. One off-board source are USB from the bridge board the module attaches to. The Bridge boards supplies USB1(supports OTG) and USB2(Host mode only).

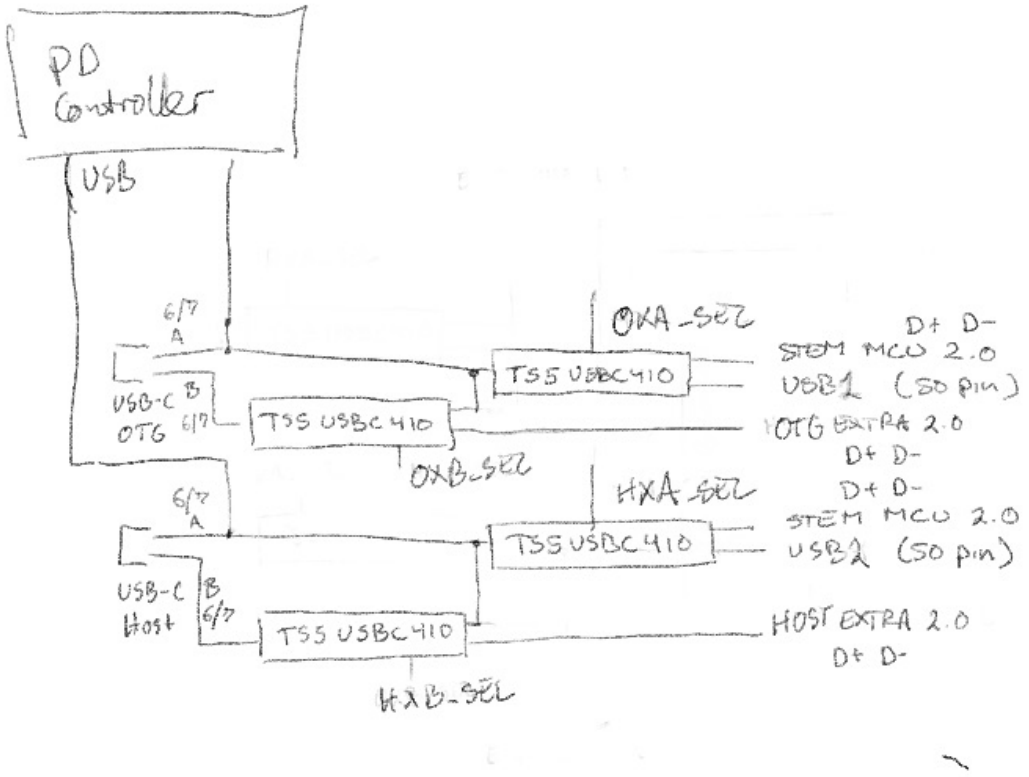
USB 3.0 is multiplexed as part of USB-C orientation support and is multiplexed between normal and alternate mode. With additional hardware the OTG USB 3.0 side can be made to support HDMI/DP in Alt. mode. The USB-C connector Alt. mode is managed by HD3SS460. The wiring is done very much like the diagram at page 1 of the datasheet.



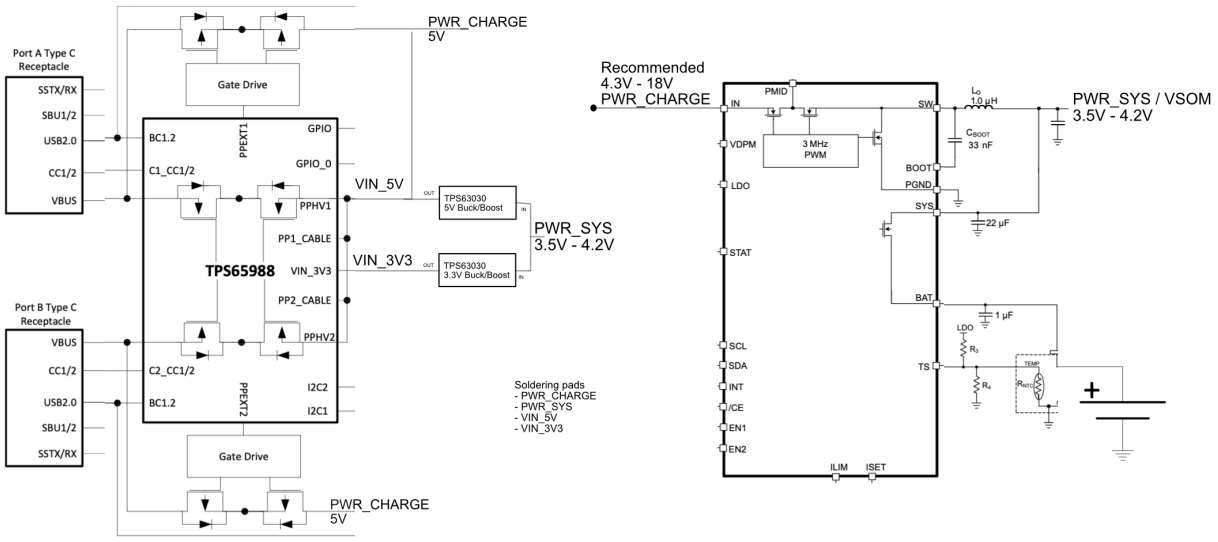
Each of the two USB-C connector USB 2.0 signals(A/B 6/7) are managed separately and multiplexed using TS5USBC41. This allows routing Stem MCU USB 2.0, System Module(OTG or Host) USB 2.0 and Extra USB 2.0(Alt Breakout connector) signals selectively via a 4 pins on a single USB-C connector.

The switching is done using nXA_SEL and nXB_SEL, where I assume that the default state is low. Mux A switches between the Stem MCU USB 2.0 signals and the System Module USB 2.0 signals. Mux B switches between the output of Mux A and the Extra USB 2.0 from the Alt Breakout connector.

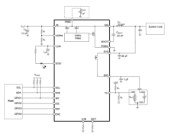
The default for Mux A is Stem MCU. The default for Mux B is Mux A.



Power Supply



On-board PD Controller circuit delivering VSOM for the bridge board. VIN_3V3 and VIN_5V are only provided on connector for debugging.



Power Output vs Input

The board is primarily a USB power sink, it isn't meant to be a significant source of USB power output. For testing purposes the connectors provide two VIN_5V pins, which are supplied with up to 500 mA from the

testing board by upscaling PWR_SYS to 5V. When connected to the regular bridge board VIN_5V and VIN_3V will not be supplied.

The board itself can be a source of 5V on one port, if it is a sink on the other port. For this purpose a direct connection is drawn from PWR_CHARGE to VIN_5V.

System Power

The system power is driven by the Battery Charger, while the charging power comes from the PD Controller.

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.

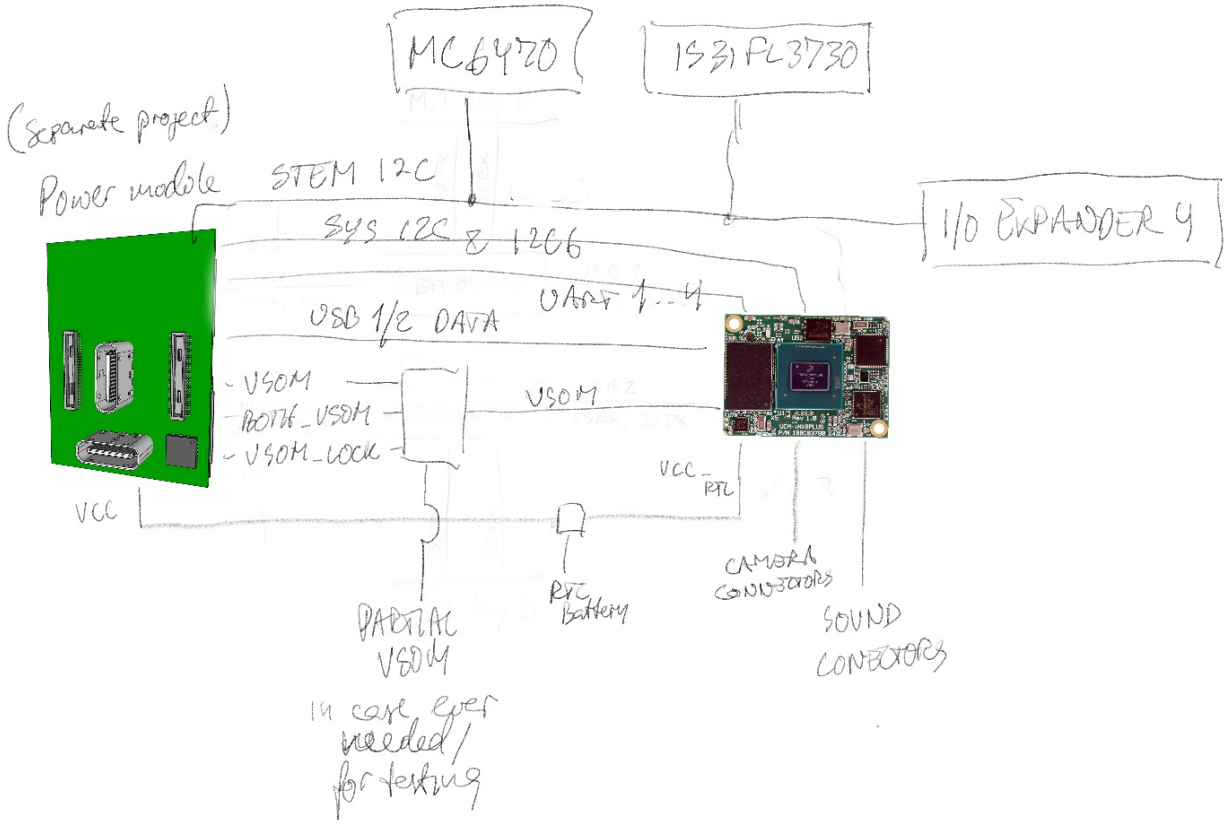
According to the UCM-IMX8PLUS Referene Guide the Supply Voltage is 3.45V to 4.4V. VSOM from the Power module provides this level. From it 5V0, 3V3, 2V8, and 1V8 are derived. 5V is stepped up from VSOM. These should not be mixed with the VIN_5V and VIN_3V3 on the T-USB module connector, which are for experimenting with power source role.

- 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
- LED matrix may need 5V
- Debug connector has 5V

So there are in total three(four) uses of 5V

1. HDMI supply and signal (50 mA) from upregulated VSOM
2. LED matrix(not on 801/909 board) may need 5V
3. 5V supply (100 mA) to T-USB module which is externally supplied (VIN_5V).
4. Debug connector for measuring/testing (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 from a VCC_RTC pad/connector.

When pins from both connectors are supplying VSOM the Bridge Board should raise BOTH_VSOM. The Power Module may restrict VSOM to some pins dependent on BOTH_VSOM.

The locking mechanism of the backplate is also used to drive one of the VSOM connectors, named VSOM_LOCK. This prevents the system activating until modules are 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 701/801/909/919 boards.

Powering Sensors and Camera modules

- Camera modules should receive power regardless of VSOM_LOCK supplying.
- Sensors (MC6470, VM3011) should receive power regardless of VSOM_LOCK supplying.
- EEPROM 24C08 should receive power regardless of VSOM_LOCK supplying.
- PCA9555 EX4 should receive power regardless of VSOM_LOCK supplying.
- USB Multiplexers should not receive power unsless all 10 VSOM are connected.

Power 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. This relates to when to provide the System Module and m.2 module with VSOM

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).

[?] connectors for the two buttons

Acceptance Criteria on Power

- High voltage USB-C (20V / 12V / 9V) power supplies never produces more than 5V SYS_PWR when connected.
- If one USB port receives power (5V) the other port can deliver power (5V).
- VSOM is 3.45V to 4.4V regardless of charger
- If a Apple Dedicated Charger 5V(1A BC1.2) is connected the board can draw 1A
- If a CDP(5V, 1A) compatible charger is connected the board can draw 1A
- If a CDP(5V, 3A) compatible charger is connected the board can draw 3A

T-USB Expander

Rather than the previous PCA9555 based I2C port expander an MSP430FR2032 is used. This controls around 40 state pins and connects multiple busses.

These pins are used in a special role

Function	VQFN32	LQFP	G56	Connected to
STEM INT	31	24	28	P1.0. 1-Wire event raising line between MCUs
UART3 RX	1	23	27	P1.1. USCI_A0. UCA0RXD.
UART3 TX	2	22	26	P1.2. USCI_A0. UCA0TXD.
MCU SYS INT	3	21	25	P1.3. 1-Wire event raising line between MCUs

Function	VQFN32	LQFP	G56	Connected to
SYS SCL	4	20	24	P1.4. 50 pin connector. TCK. JTAG test clock, input terminal for device programming and test
SYS SDA	5	19	23	P1.5. 50 pin connector. TMS. JTAG test clock, input terminal for device programming and test
MSP_TDI/analog	21	18	22	P1.6 TDI/TCLK. Host Alt. JTAG test data input or test clock input during programming and test.
MSP_TDO/analog	22	17	21	P1.7 TDO/TDI. Host Alt. JTAG test data output terminal or test data during programmign and test
UCB0_CE	nc	32	34	P5.0. nc
UCB0_CLK	nc	31	33	P5.1. nc
STEM SCL		29	31	P5.3. USCI_B0.
STEM SDA		30	32	P5.2. USCI_B0.
TA1.1/Cp	nc	12	18	P4.0 / Host Alt connector
XIN	nc	7	13	P4.1/XIN / Host Alt connector
XOUT	nc	6	12	P4.2/XOUT / Host Alt connector
TA1CLK/Compare	nc	14	20	P8.2 TA1CLK / Host Alt connector
TA1.2/Compare	nc	13	19	P8.3 / Host Alt connector

Pins used as GPIO

Function	VQFN32	LQFP	G56	Connected to
SHUTDOWN_BTN	9	40	42	P2.0. Shudown button pin on 3 pin Power Enable Connector
LOCK_BTN	10	39	41	P2.1. Lock button pin on 3 pin Power Enable Connector
POR_B_3P3	11	38	40	P2.2. Power on reset Input from PMIC. 50 pin connector
BOTH_VSOM	15	37	39	P2.3. Input from faceboard. 50 pin connector
T_USB_O_ALT_POL	16	36	38	P2.4. HD3SS460 (default = high-im)
T_USB_O_ALT_AMSEL	17	35	37	P2.5. HD3SS460 (default = high-im)
T_USB_H_ALT_POL	26	34	36	P2.6. HD3SS460 (default = high-im)
T_USB_H_ALT_AMSEL	25	33	35	P2.7. HD3SS460 (default = high-im)
T_USB_O_ALT_EN	SH1.0	56	56	P3.0. HD3SS460 (default = high-im)
T_USB_H_ALT_EN	SH1.1	55	55	P3.1. HD3SS460 (default = high-im)

Function	VQFN32	LQFP	G56	Connected to
HXA_SEL	SH1.2	54	54	P3.2. Select Host Extra A6/A7
HXB_SEL	SH1.3	53	53	P3.3. Select Host Extra B6/B7
HX_OE	SH1.4	52	52	P3.4. Select Host Extra Enable
OXA_SEL	SH1.5	51	51	P3.5. Select OTG Extra A6/A7
OXB_SEL	SH1.6	50	50	P3.6. Select OTG Extra B6/B7
OX_OE	SH1.7	49	49	P3.7. Select OTG Extra Enable
PWRBTN	SH2.0	5	11	P4.3. 50 pin connector
ALT_BOOT	SH2.1	4	10	P4.4. 50 pin connector
QSPI_BOOT_EN_3P3	SH2.2	3	9	P4.5. 50 pin connector
VSOM_LOCK_EN	SH2.3	2	8	P4.6. Data output enabling VSOM_LOCK(300mA VSOM).
SYS_RST_PMIC	SH2.4	1	7	P4.7. 50 pin connector
PMIC_ON_REQ	SH2.5	28	30	P5.4. 50 pin connector
PMIC_STBY_REQ	SH2.6	27	29	P5.5. 50 pin connector
	SH2.7			
BOTH_VSOM2		48	48	P6.0. 50 pin connector
BAT_INT		47	47	P6.1. BQ24250
PD_CTL_INT_1		46	46	P6.2. TPS PD Controller
PD_CTL_INT_2		45	45	P6.3. TPS PD Controller
T_EXTRA	SH3.0	44	44	P6.4. 50 pin connector
BAT_CE	SH3.1	43	43	P6.5. BQ24250
BAT_EN1	SH3.2	6	6	P7.0. BQ24250
BAT_EN2	SH3.3	5	5	P7.1. BQ24250
PD_CTL_RESET	SH3.4	4	4	P7.2. TPS PD Controller
PD_EXT1	SH3.5	3	3	P7.3. TPS PD Controller
PD_EXT2	SH3.6	60	2	P7.4. TPS PD Controller
PD_VIN_EN	SH3.7	59	1	P7.5. TPS PD Controller

56 pin package excludes 8 pins: P8.0 P8.1 P5.6 P5.7 P6.6 P6.7 P7.6 P7.7 (only usable at 64 pin package)

I2C adressing

Stem I2C addresses

Address	Chipset	Description
0x28	BHI260AP	Motion Engine (alternate config)
0x40/0xC0 or 0x44	IS31FL3730	LED controller
0x42/0x43	PCA9555	16 bit expander EX1 on T-USB daughterboard (bits = 001)
0x46/0x47	PCA9555	16 bit expander EX3 on T-USB daughterboard (bits = 011)
0x48/0x49	PCA9555	16 bit expander EX4 on faceboard (bits = 100)
0x4C	MC6470	9-Axis Sensor
0x54..0x57	EEPROM	Faceboard EEPROM
0x60	VM3011	mic
0x6A	BQ24250	LiPO Battery Charger
0x7E 0x7F	TPS65988	PD Controller Port 2
0x98 0x99	MC6470	9-Axis Sensor

SYS I2C addresses

Reduced the devices connected to SYS bus

Address	Chipset	Description
0x20	PCA9555	16 bit expander EX0
0x25	PCA9450	Reserved 7 bit address
0x26	PCA9555	16 bit expander EX6
0x4A 0x4B	PCA9450	Power Management IC
0x68	PI6CG18200	PCIe clock generator
0x70 0x71	TPS65988	RESERVED for PD Controller Port 1 / SYS
0xD2/D3	RTC	AM1805 real time clock (RTC)

The Night I2C bus is just connected between 45 pin ALT_CONNECTOR and the 50 pin connector.

Battery Charging

Battery charging is an optional feature enabled by connecting a LiPO battery cell.

- Switch between trickle charge(0.1C) and fast charge(1.5C).
- Charge strategy timout setting
- Suspend on low power
- Resume on good power

In reference board design the PCIe clock is configured to use I2C address 0x68 which is needed by the BQ24250RGER. On the Ziloo Bridge board the PCIe clock circuit has been reconfigured.

Power output from Charging Controller

When operating with single cell Li-Ion batteries, output voltage range can be from 3.0V-4.2V. It is recommended not to operate at minimum battery voltage, to prolong a Li-Ion battery's life. Please refer to the battery manufacturer's data sheet or design guide for details.

- VSOM output Main power for board 3.5V - 4.2V
- Direct power input pads support 4V - 6V

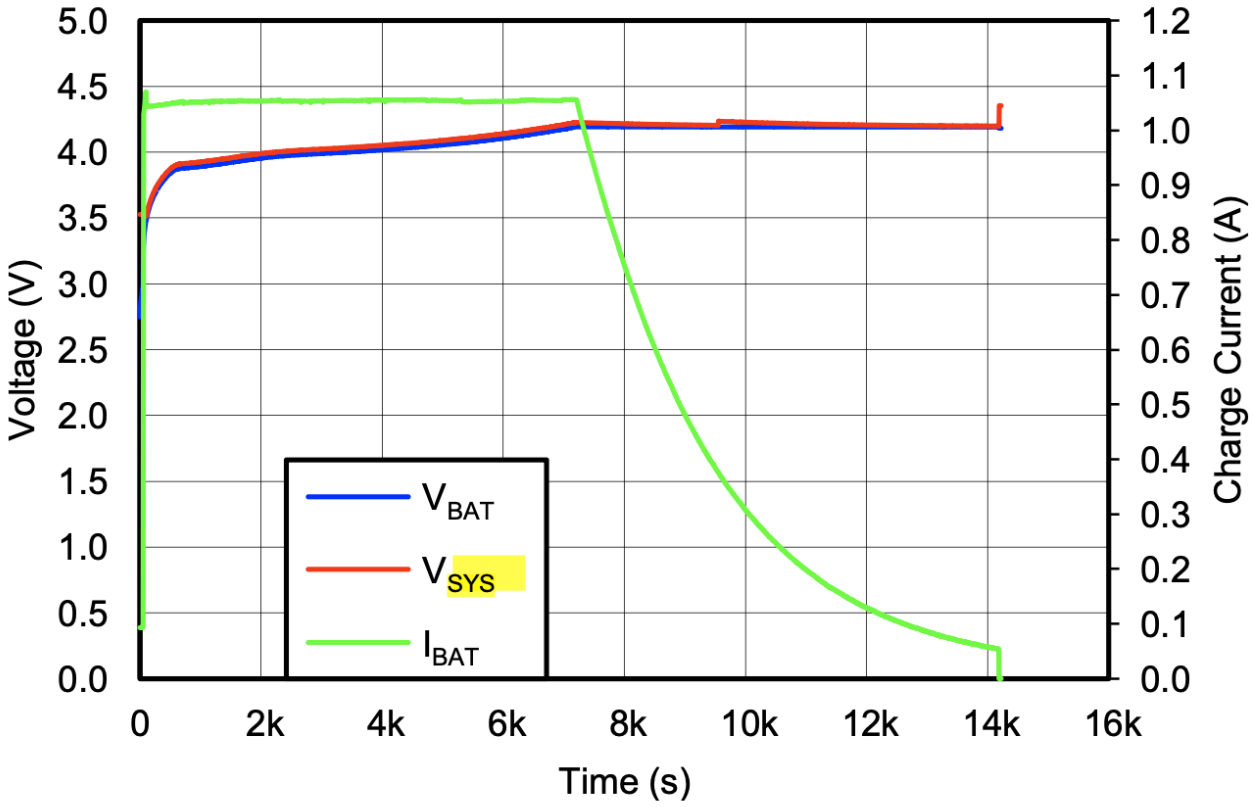
The board will attempt to constantly supply power. Either from a 3.7V LiPO battery, 5V input solder pads, or USB power source.

The system should attempt to detect low power and suspend or power down before reaching VSOM 3.45V.

Measuring battery voltage

https://blog.ampow.com/lipo-voltage-chart/

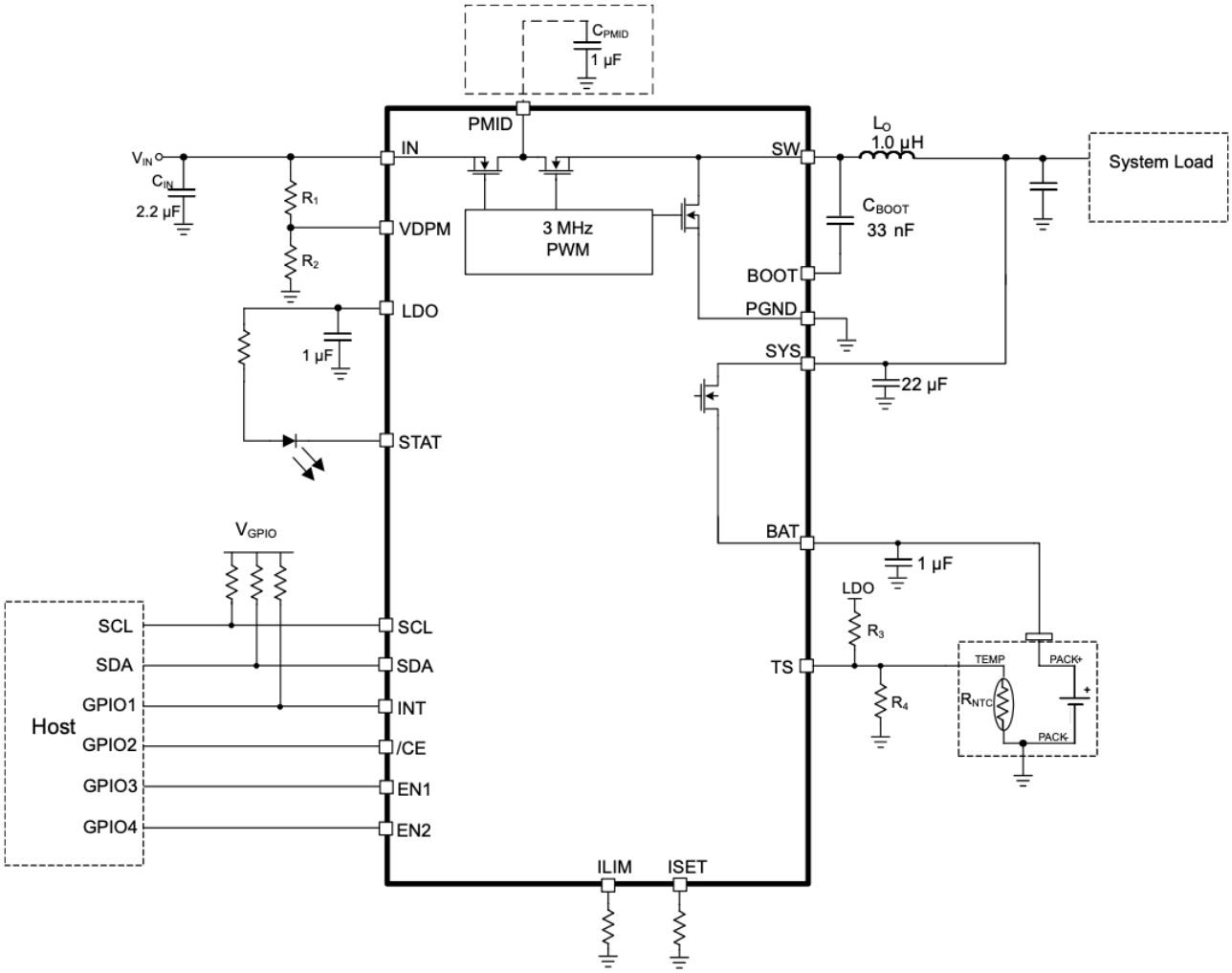
The battery charger will deliver a voltage close to 4.0V under normal charging conditions. It will deliver a steady 3.5V level during precharge during the ~120 s.



Drawing charger + PD = VSOM

Managed charging

The bq24250 device has two modes of operation: 1) I2C mode, and 2) standalone mode. In I2C mode, the host adjusts the charge parameters and monitors the status of the charger operation. In standalone mode, the external resistor sets the input-current limit, and charge current limit. Standalone mode also serves as the default settings when a DCP adapter is present. It enters host mode while the I2C registers are accessed and the watchdog timer has not expired (if enabled). The battery is charged in four phases: trickle charge, pre-charge, constant current and constant voltage. In all charge phases, an internal control loop monitors the IC junction temperature and reduces the charge current if the internal temperature threshold is exceeded.



Max input current limit

The circuit will be in I2C mode rather than standalone so perhaps the programming with a resistor isn't important. The documentation seems to indicate that it's used as a fallback.

Short ILIM to GND for default 2A input current(IN) limit. EN2 = Low EN1 = High

EN1 could be driven by extender to enable switching between 0.5A and 2A. It is now driven by MSP430.

R_ILIM = 270 / I_IC

Does this mean that 4 resistors of 540 ohm in parallel with breakable soldering points would allow adjusting the board to a specific battery? Charge current ISET resistor 500mA / 1A / 2A (4 resistors in parallel?)

Acceptance Criteria on Power With Battery

- If power is connected to USB the battery can charge
- If no power is connected the system is battery powered

801 T-USB Connector Pinouts

3 pin Power Enable Connector

The connector must be oriented along the board to allow packing of battery and board. These buttons drive inputs to the Expander / MSP430.

Pin	
LOCK_BTN	When raised high it signals the backplate is locked in
3V3	General board power
SHUTDOWN_BTN	When raised it signals a request to runtime modules to shut down

3 pin Battery Connector

Connect battery via GND, TEMP (TS), PACK+ (BAT). This is done over a 3 pin JST H 1mm pitch socket. The connector must be oriented along the board to allow packing of battery and board.

Pin	
GND	Ground Black
TS	TEMP White
BAT	PACK+ Red

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	MCU pin.
1	VSOM	Power	Main power for board 3.45V - 4.5V		Conn. detect	
2	USB1_RX_DP	USB	USB1 RX D+ (OTG)			HD3SS460 SSRX
3	USB1_RX_DN	USB	USB1 RX D- (OTG)			HD3SS460 SSRX
4	GND	Power	Ground			
5	USB1_TX_DP	USB	USB1 TX D+ (OTG)			HD3SS460 SSTX
6	USB1_TX_DN	USB	USB1 TX D- (OTG)			HD3SS460 SSTX
7	GND	Power	Ground			
8	USB2_RX_DP	USB	USB2 RX D+ (Host)			HD3SS460 SSRX
9	USB2_RX_DN	USB	USB2 RX D- (Host)			HD3SS460 SSRX
10	GND	Power	Ground			
11	USB2_TX_DP	USB	USB2 TX D+ (Host)			HD3SS460 SSTX
12	USB2_TX_DN	USB	USB2 TX D- (Host)			HD3SS460 SSTX
13	GND	Power	Ground			
14						
15						
16						
17	STEM SCL	I2C	STEM SCL			GP21 I2C0
18	STEM SDA	I2C	STEM SDA			GP20 I2C0
19	STEM INT	I2C	Sensor interrupts			
20	GND	Power	Ground			
21	T_SBWTCK	MSP430	SBWTCK / TEST / RTS			
22	T_EXTRA	MSP430				
23	T_SBWTDIO	MSP430	SBWTDIO / RST / NMI / DTR			

Pin	Code	Type	Details	Voltage	Misc	MCU pin.
24	PWR_CHARGE	Battery	Internal charge current for testing			
25	BAT_STAT	Battery	Internal charging status for testing			

Other side

Pin	Code	Type	Details	Voltage	Misc	MCU pin.
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						
33	GND	Power	Ground			
32	CAN_RX		CAN1_RX		P21.12	
31	CAN_TX		CAN1_TX		P21.14	
30	BAT_LDO	Battery	4.9V 50mA LDO for STAT LED			
29	BOTH_VSOM2	MSP430	High if any VSOM pin on this connector supplies on Faceboard side.			
28	UART_T_TXD	MSP430				

Pin	Code	Type	Details	Voltage	Misc	MCU pin.
27	UART_T_RXD	MSP430				
26	VSOM	Power	Main power for board 3.45V - 4.5V			

Could also take in HDMI or PCIe lanes instead of LVDS

Connector 2 PD controller, close to power connectors

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

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	PD_SWD_CLK	Debug	PD Controller GPIO12		
10	PD_SWD_DAT	Debug	PD Controller GPIO13		
11	BOTH_VSOM	Enable	Bridge board signal;VSOM connected on both sides	3V3	
12	MCU_SYS_INT	IRQ	When state of MCUs change -> SoM		EX0.2
13	SYS I2C SCL	I2C			P21.7
14	SYS I2C SDA	I2C			P21.5
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

Pin	Code	Type	Details	Voltage	Misc
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
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. Connect CE to a high logic level to place the battery charger in standby mode.		
25	PD_VIN_EN	Future	Enable VIN_5V/3V3 from PWR_SYS (TBD)		

Other side

Pin	Code	Type	Details	Voltage	Misc	mcu pin
50	PD_HRESET	Future	PD Controller HRESET (High)			
49	GND	Power	Ground			
48	UART1_TXD	UART	P1.72 UART1 Tx		P20.9	GP4 UART1
47	UART1_RXD	UART	P1.19 UART1 Rx		P20.11	GP5 UART1
46	UART2_TXD	UART	UART2 Tx		P20.1	GP8 UART1.
45	UART2_RXD	UART	UART2 Rx		P20.3	GP9 UART1
44	UART3_TXD	UART	P1.61 UART3 Tx		P20.2	GP12 UART0
43	UART3_RXD	UART	P1.21 UART3 Rx		P20.4	GP13 UART0

Pin	Code	Type	Details	Voltage	Misc	mcu pin
42	UART4_TXD	UART	UART4 Tx		P20.8	GP20 UART1
41	UART4_RXD	UART	UART4 Rx		P20.10	GP21 UART1
40	MIC_CLK	Sensor	frontboard mic			
39	MIC_DATA	Sensor				
38	MIC_INT	Sensor			?	
37	MOTION_INT	Sensor	Spare interrupt pin for future		?	
36	NIGHT SCL	I2C	I2C6 SCL		P21.2	GP19 I2C1.
35	NIGHT SDA	I2C	I2C6 SDA		P21.4	GP18 I2C1.
34	NIGHT INT	I2C	Sensor interrupts			
33	SPI_CS	RP2040	RP SPI	3.3V		GP29 SPI1
32	SPI_CLK	RP2040	RP SPI	3.3V		GP10 SPI
31	SPI_MISO	RP2040	RP SPI	3.3V		GP28 SPI
30	SPI_MOSI	RP2040	RP SPI	3.3V		GP11 SPI
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	

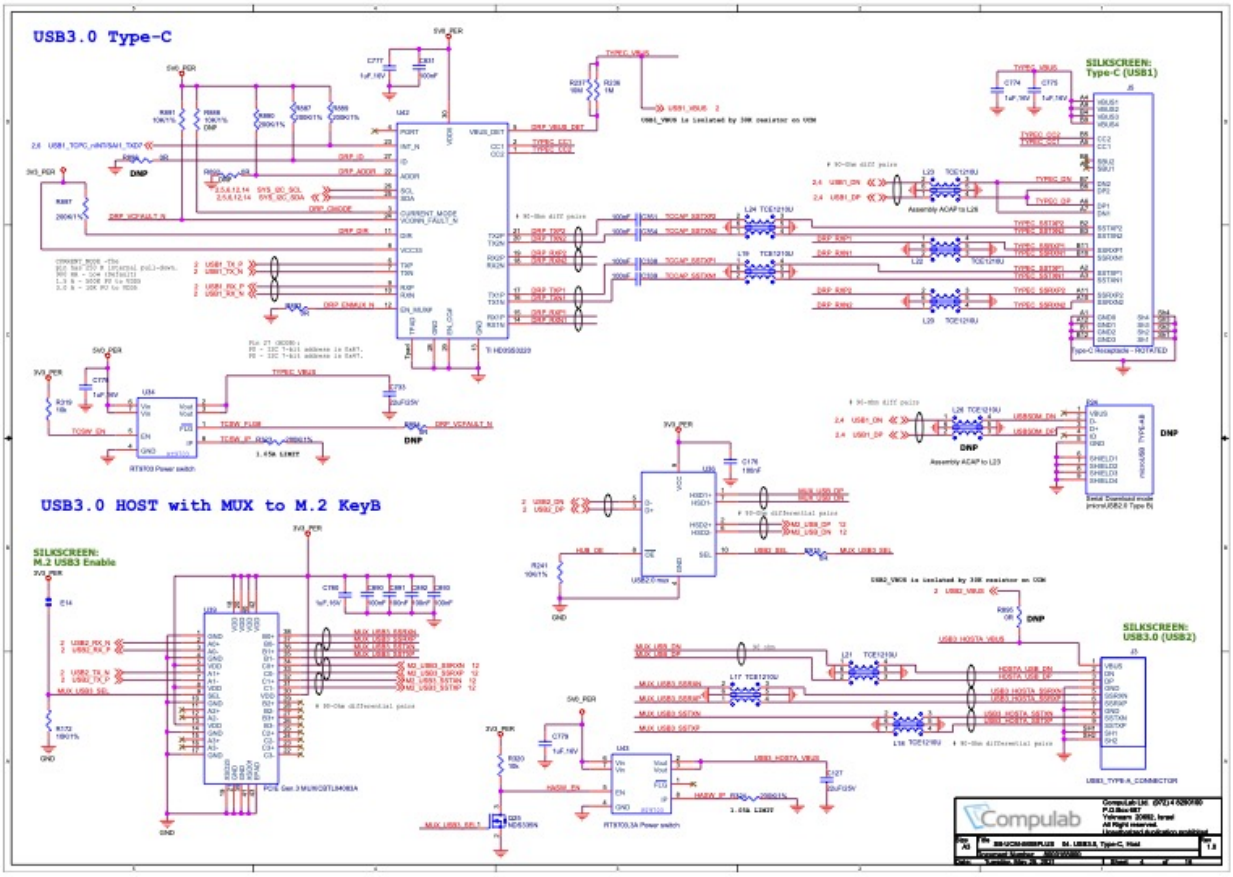
SPI pins will be exchanged for SDIO (MIC_INT / MOTION_INT / PD_HRESET likely to go away)

Consider SPI for PD Controller PD Controller IRQ I2C1

USB-C connectors arranged in a T

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.

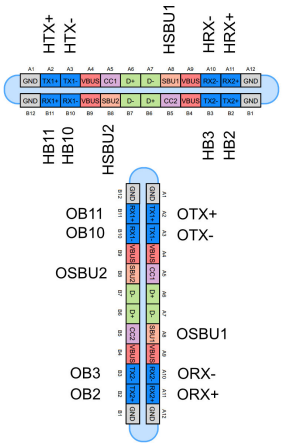
The pins are individually connected to chipsets in order to allow multiplexing based on the situation.



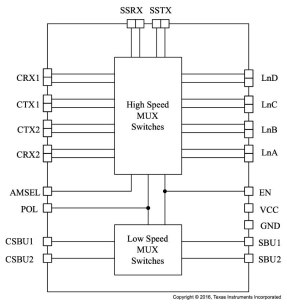
The USB connectors are named H (Host) and O (OTG). Host is the top of the T, OTG is the vertical base. To specify a specific pin H or O is prefixed I.E. OTX1+, HSBU2.

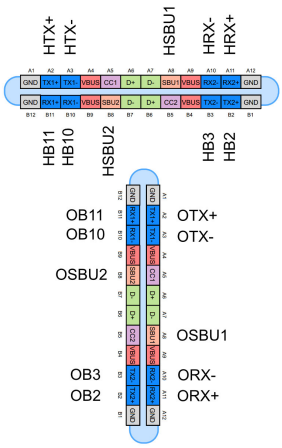
Where possible data pins are not combined but carried through individually.

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



T-USB plugged in combo





DisplayPort over Host USB

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
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	X+	65988 & MCU	65988 & MCU
19	B7	X-	65988 & MCU	65988 & MCU
20	B8	SBU2		HD3SS460
21	B9	VBUS	65988 & Regs	65988 & Regs

No.	Pin	Usage	OTG connect to..	Host connect to..
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.

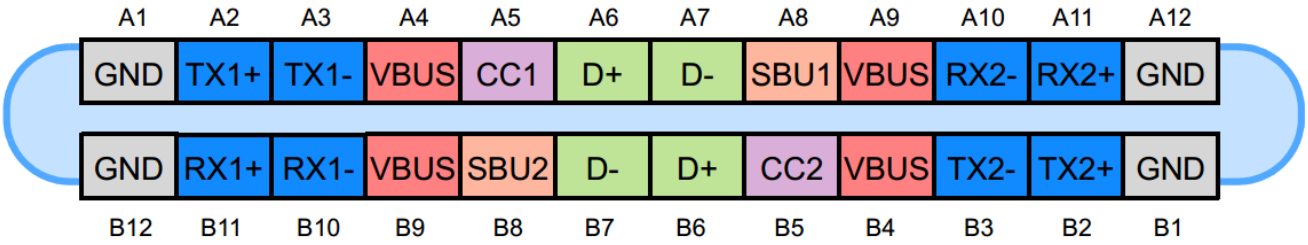


Figure 1. The USB Type-C receptacle. Image courtesy of Microchip.

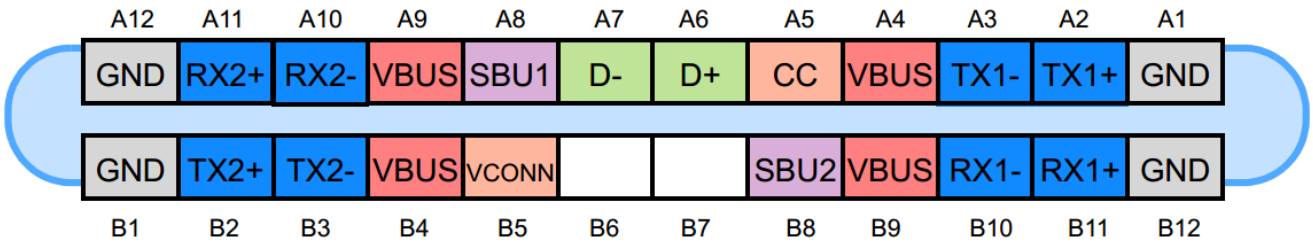


Figure 1. The USB Type-C plug. Image courtesy of Microchip.

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.

T-USB alt mode connectors

These connectors(only on the development model) enables experimentation with alternate modes and directional pins.

Host ALT

Pin	Code	Description
1	3V3	
2	SBU2	Host AUX+ / SBU2
3	SBU1	Host AUX- / SBU1

Pin	Code	Description
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	MSP_TDI	MSP430
18	MSP_TDO	MSP430
19	GND	
20	HX+	Host Extra 2.0 D+
21	HX-	Host Extra 2.0 D-
22	XIN	MSP430
23	XOUT	MSP430
24	GND	
25	LVCLK+	LVDS CLK+
26	LVCLK-	LVDS CLK-
27	GND	
28	LVD0+	LVDS D0+
29	LVD0-	LVDS D0-
30	GND	
31	LVD1+	LVDS D1+
32	LVD1-	LVDS D1-
33	GND	

Pin	Code	Description
34	LVD2+	LVDS D2+
35	LVD2-	LVDS D2-
36	GND	
37	LVD3+	LVDS D3+
38	LVD3-	LVDS D3-
39	GND	
40	TA1CLK	MSP430
41	TA1.1	MSP430
42	TA1.2	MSP430
43	T_EXTRA	MSP430
44	UART_T_TXD	Debug
45	UART_T_RXD	Debug.

OTG ALT

Pin	Code	Category	Description	Voltage	SoM pin	MCU pin
1	3V3	Power				
2	SBU2	USB	OTG AUX+ / SBU2			
3	SBU1	USB	OTG AUX- / SBU1			
4	3V3					
5	OA+	USB	OTG A+			
6	OA-	USB	OTG A-			
7	3V3					
8	OB+	USB	OTG B+			
9	HB-	USB	OTG B-			
10	3V3					
11	OC+	USB	OTG C+			
12	OC-	USB	OTG C-			
13	3V3					
14	OD+	USB	OTG D+			
15	OD-	USB	OTG D-			

Pin	Code	Category	Description	Voltage	SoM pin	MCU pin
16	GND					
17	OX+	USB	OTG Extra 2.0 D+			
18	OX-	USB	OTG Extra 2.0 D-			
19	MCU_D+	USB	Stem MCU 2.0 D+			
20	MCU_D-	USB	Stem MCU 2.0 D-			
21	GND					
22	STEM SCL	I2C	STEM SCL			GP17 I2C0
23	STEM SDA	I2C	STEM SDA			GP16 I2C0
24	STEM INT	I2C	Sensor interrupts			
25	NIGHT SCL	I2C	I2C6 SCL		P21.2 ?	GP19 I2C1.
26	NIGHT SDA	I2C	I2C6 SDA		P21.4 ?	GP18 I2C1.
27	NIGHT INT	I2C	Sensor interrupts			
28	SYS I2C SCL	I2C			GP15 I2C1.	
29	SYS I2C SDA	I2C			GP14 I2C1.	
30	GND	Power	Ground			
31	T_SBWTCK					
32	T_SBWTDIO					
33	GND	Power	Ground			
34	UART1_TXD	UART	P1.72 UART1 Tx		P20.9	GP4 UART1
35	UART1_RXD	UART	P1.19 UART1 Rx		P20.11	GP5 UART1
36	UART2_TXD	UART	UART2 Tx		P20.1	GP8 UART1.
37	UART2_RXD	UART	UART2 Rx		P20.3	GP9 UART1
38	UART3_TXD	UART	P1.61 UART3 Tx		P20.2	GP12 UART0

Pin	Code	Category	Description	Voltage	SoM pin	MCU pin
39	UART3_RXD	UART	P1.21 UART3 Rx		P20.4	GP13 UART0
40	UART4_TXD	UART	UART4 Tx		P20.8	GP20 UART1
41	UART4_RXD	UART	UART4 Rx		P20.10	GP21 UART1
42	SPI_CS	RP2040	Programming/External flash directly	3.3V		GP29 SPI1
43	SPI_CLK	RP2040	Programming/External flash directly	3.3V		GP26 SPI1
44	SPI_MISO	RP2040	Programming/External flash directly	3.3V		GP28 SPI1
45	SPI_MOSI	RP2040	Programming/External flash directly	3.3V		GP27 SPI1

Soldering Pads

A number of connections should be broken out on the board as soldering pads (no through hole)

Pin	Function
VSOM	Output or Input
VCC_RTC	Power input RTC battery 1.8V
PP_HV1	PD Controller power
PP_HV2	PD Controller power
VIN_5V	PD Controller System 5V for PP1_CABLE, PP2_CABLE
VIN_3V3	PD Controller System 3.3V
GND	