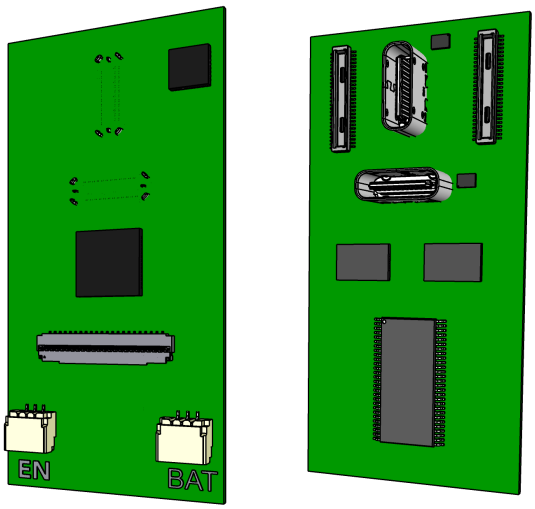
292 Power Module

The power module provides VSOM power to the Faceboard and routes data signals from the Faceboard through two USB plugs. A set of plugs are front facing and another set is back facing. Only one set can be used at a time.

The Power Module has specific power and data functions

- Supply the system with VSOM power
- Receive(sink role) power from OTG USB-C connector or a LiPo battery
- No need receiving(sink role) of power from Host USB-C for now
- Deliver max. 900mA to devices on Host USB
- No power delivery(source role) on OTG USB
- Charge the connected LiPo battery
- Provide Alt. Mode support on Host USB port
- Provide data signals from the Faceboard in the system over two USB-C connectors
- Manage autonomous system functions and waking state in collaboration with MSP430 MCU on faceboard

The Power Module exposes two vertical USB-C sockets and connects to the carrier/face board through two 50 pin B2B connectors. A 45 pin connector is used to experiment with Alt. Mode over the Host USB connector. The signal voltage on the board is 3.3V.



Components

- 2 * 50 pin connectors Hirose DF40-50DP-0.4V mated height 1.5mm Mouser
- 4 * Hirose USB-C CX80B1-24P

- 1 * TPS65988 Dual Port USB Type-C® and USB PD Controller, Power Switch, and High-Speed Multiplexer. Mouser
- 1 * W25X40CLSNIG NOR-Flash spiFlash, 4M-bit, 4Kb Uniform Sector - Mouser - In stock
- 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)
- 2 * TE Connectivity 45PIN 0.3MM 571-4-2328724-5 FPC 3-2328724-5 $0.41
- 2 * TPD6S300ARUKR ESD protection for USB-C port HD3SS3220IRNHT) WQFN (RNH) | 30 pin 250 tray Mouser
- 2 * TUSB546 Alt. Mode switch
- Smaller JST connector for buttons

Future Components

- 2 * TS5USBC410 Dual 2:1 USB 2.0 Mux/DeMux Switch. Mouser

Board

50 mm x 24 mm (height x width)

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.

Components on the underside can be max 1.2mm thick. The expected DF40 socket the board inserts into creates 1.5mm clearing height.

A half hole(like M.2 modules) should be added at the end of the board between the two 3 pin connectors.

I2C Bus

The board has 3 I2C busses. SYS, Stem and Power. Key chipsets on the board are on the Power bus, which by default is bridged onto the SYS I2C, so the two must take care to not clash on addresses.

Chips on the Power I2C bus

- TPS65988 PD Controller
- BQ24250 LiPo Charger
- TUSB546 Alt Mode Control
- USB 2.0 switches

The TPS PD Controller can be accessed and master various I2C busses. I2C1 connects to STEM. I2C2 is a slave on SYS. I2C3 is on POWER so it can master the other chips.

By default the chipsets can be controlled by Linux Device Driver Bindings(on i.MX SoM) via the SYS I2C. The future direction is to control them by the local MSP430 MCU, which exposes information in the STEM I2C bus.

SYS I2C addresses

Reduced the devices connected to SYS bus

Address	Chipset	Description

Address	Chipset	Description
0x20	PCA9555	16 bit expander EX0
0x25	PCA9450	Reserved 7 bit address
0x4A 0x4B	PCA9450	Power Management IC
0x68	PI6CG18200	PCIe clock generator
0xD2/D3	RTC	AM1805 real time clock (RTC)

POWER I2C adresses which may be exposed to SYS I2C

Address	Chipset	Description
0x0F	TUSB546	OTG Alt. Mode
0x38	TPS65988	On chips USB Port 1 with default address
0x3F	TPS65988	On chips USB Port 2 with default address
0x47	TUSB546	Host Alt. Mode
0x67	HD3SS3220	OTG USB C orientation and PD Controller
0x6A	BQ24250	LiPO Battery Charger

1st Music Sculpture

GPIO exposed to SoM

- TPS65988 nINT
- TPS65988 USB-C endpoint?
- BQ24250 INT
- TUSB546 ?

USB-C state change interrupt?

Device Tree

device tree bindings for

- TPS65988. A variant of this controller known as Apple CD321x or Apple ACE is also present on hardware with Apple SoCs such as the M1.
- BQ24250

Linux kernel support

- BQ24250
- TPS65988 Linux
- BQ2425x Linux
- Linux Getting Driver For USB Type-C DisplayPort Alternate Mode
- API for USB Type-C Alternate Mode drivers

TPS65988

Interrupt pin = SYS_EX_nINT

```
    i2c0 {
        #address-cells = <1>;
        #size-cells = <0>;

        tps6598x: tps6598x@38 {
            compatible = "ti,tps6598x";
            reg = <0x38>;

            interrupt-parent = <&msmgpio>;
            interrupts = <107 IRQ_TYPE_LEVEL_LOW>;
            interrupt-names = "irq";

            pinctrl-names = "default";
            pinctrl-0 = <&typec_pins>;

            //
https://code.googlesource.com/linux/torvalds/linux/+/942cb357ae7d9249088e3
687ee6a00ed2745a0c7/Documentation/devicetree/bindings/connector/usb-
connector.yaml
            typec_con: connector {
                compatible = "usb-c-connector";
                label = "USB-C";
                port {
                    typec_ep: endpoint {
                        remote-endpoint = <&otg_ep>;
                    };
                };
            };
        };
    };
```

BQ24250

See Bindings

```
config CHARGER_BQ24257
    tristate "TI BQ24250/24251/24257 battery charger driver"
    depends on I2C
    depends on GPIOLIB || COMPILE_TEST
    select REGMAP_I2C
    help
      Say Y to enable support for the TI BQ24250, BQ24251, and BQ24257
battery
      chargers.
```

```
bq24250 {
    compatible = "ti,bq24250";
    reg = <0x6a>;
    interrupt-parent = <&gpio1>;
    interrupts = <16 IRQ_TYPE_EDGE_BOTH>;

    ti,battery-regulation-voltage = <4200000>;
    ti,charge-current = <500000>;
    ti,termination-current = <50000>;
    ti,current-limit = <900000>;
    ti,ovp-voltage = <9500000>;
    ti,in-dpm-voltage = <4440000>;
};
```

HD3SS3220

See Linux Documentation

Power

USB DRP means dual-role power.

Internal Power

LDO_3V3(PD) provides up to 25mA to drive the SPI flash and other essential circuits: LIVE_3V3 is downregulated from LiPo BQ SYS

LDO_3V3 budget:

- Flash 15mA

LIVE_3V3

- TUSB456 250mA

LDO(LiPo) provides up to 50mA, 4.9V for temp/LED

VCONN on PPx_CABLE input is needed to support alternate mode negotiation over CC pins.

Consider msg trail eDP over Type-C: CM4

- SN65DSI86 Dual-channel MIPI® DSI to embedded DisplayPort™ (eDP) bridge with Linux Kernel Driver
- CYPD3120: HDMI over Type-C (No Display Port)