# Schematic: Expansion Accessory



## Revision History

| DATE | REVISION | DESCRIPTION |
|---|---|---|
| Oct. 16 2020 | v0.1 | 1. Initial release |
| Oct. 26 2020 | v0.2 | 1. Modify output current<br>2. Change the power supply priority<br>3. Add pull up resistors for I2C<br>4. Add 1K pull up resistor for SWCLK<br>5. Add reset button<br>6. Add chassis ground hole<br>7. Add analog ground |
| Oct. 27 2020 | v0.3 | 1. Setup default LED status<br>2. Modify USB input ESD circuit<br>3. Modify specification tables |
| Oct. 30 2020 | v0.4 | 1. Change MCP2515 to MCP2518FD and MCP2562 to MCP2562FD according Microchip's recommendation |
| Nov. 2 2020 | v0.5 | 1. Add adapter insertion detection |
| Nov. 3 2020 | v0.6 | 1. Modify the connection between RS485 transceiver to MCU for better performance<br>2. Modify OP Amp feeedback network to increase stability<br>3. Biased the unused OP Amp to a appropriate voltage |
| Dec. 15 2020 | v0.7 | 1. Modify the ADC circuit, remove the amplifier, add 2.5V reference<br>2. Change the eFuse to TPS25200DRVT for 3V3 and 5V<br>3. Change the pin assignment of DIOs and ADCs<br>4. Modify the signal assignment of the terminal block for better layout<br>5. Add capacitors for ESD protection |
| Dec. 16 2020 | v0.71 | 1. Change voltage reference to LM4030 |
| Dec. 16 2020 | v0.72 | 1. Fixed the connection of voltage reference signal |

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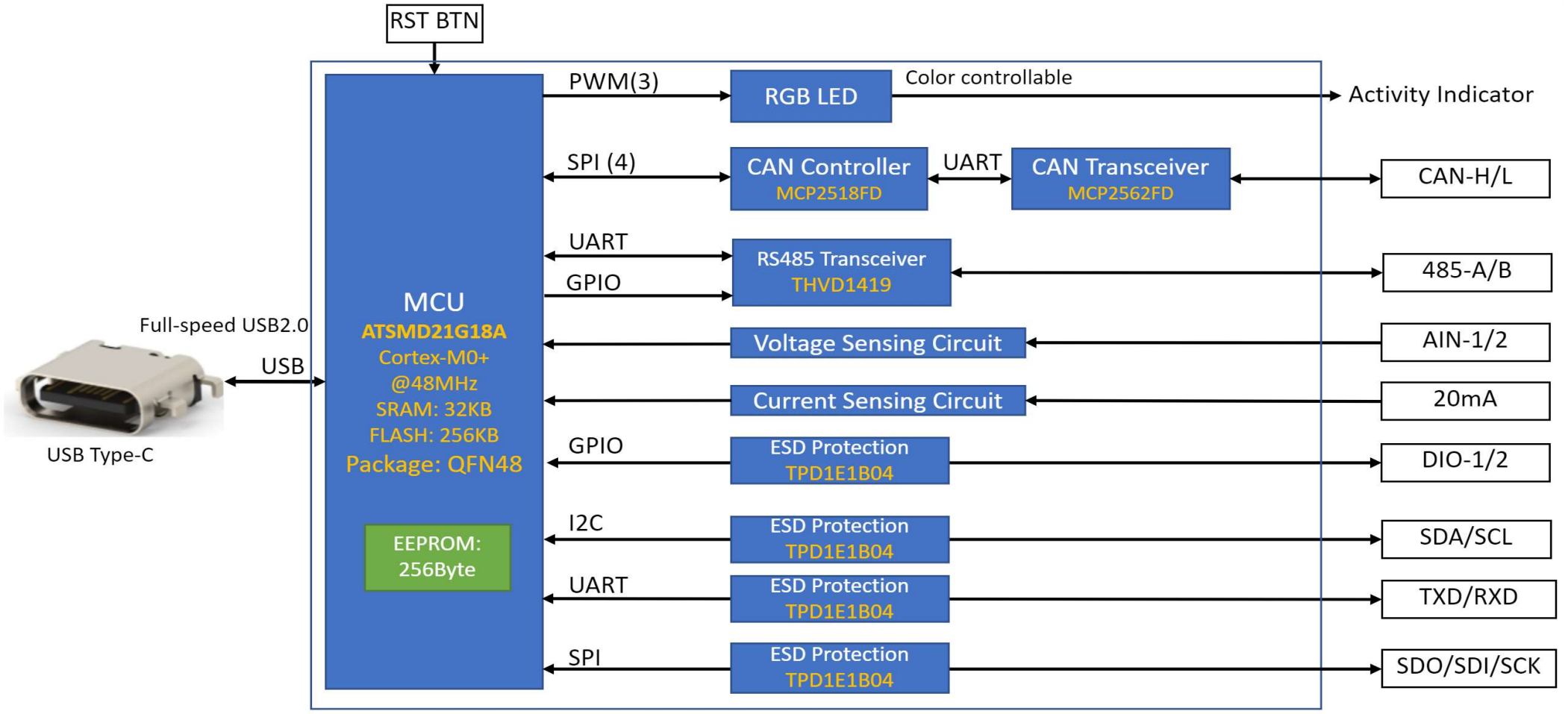
Title: Expansion Accessory

| Size: A3 | Document Number: 001_Title/Revision History | Rev: v0.71 |
|---|---|---|
| Draw By: Xiangnan | Date: Tuesday, December 22, 2020 | Sheet: 1 of 8 |

# System Block Diagram

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| Size: A3 | Document Number: 002_Block Diagram | Rev: v0.71 |
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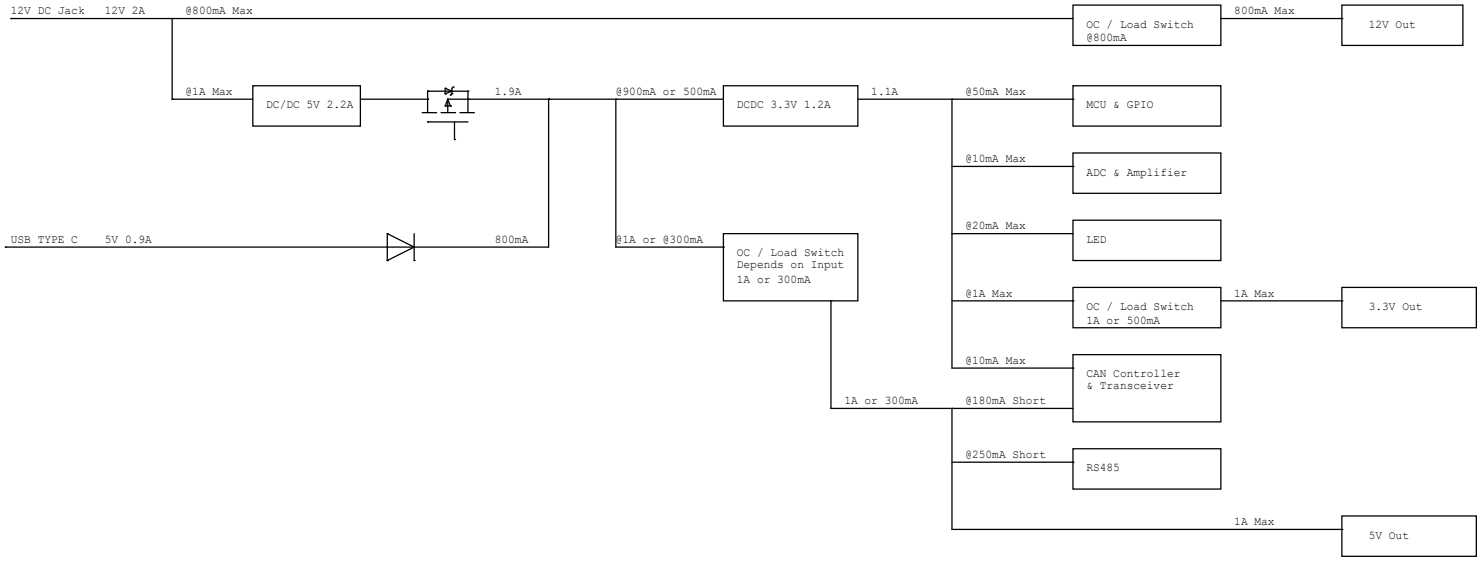
# Power tree

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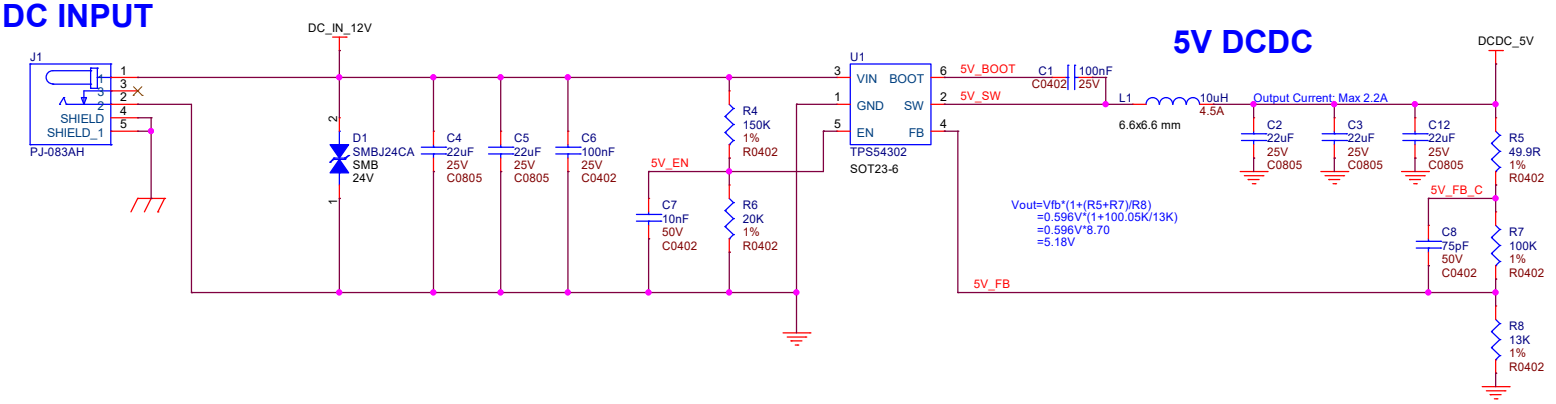
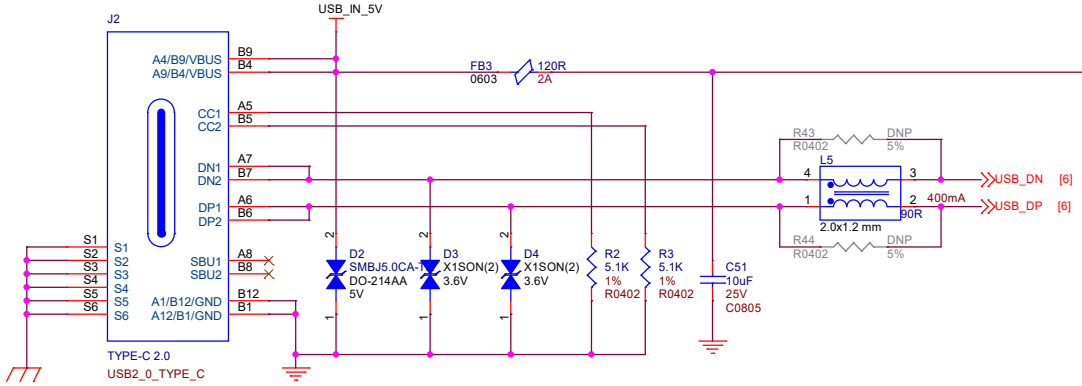
## 12V DC INPUT



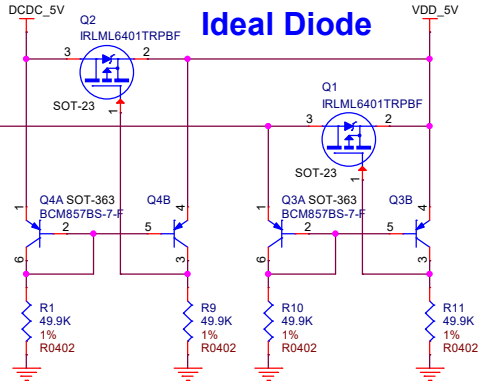

## 5V DCDC

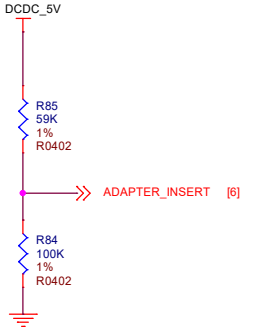
| 5V DCDC Design Parameters | |
|---|---|
| Input voltage range | 11 V to 13 V |
| Max input current | 1A |
| Output voltage | 5.18 V +/- 1.79% |
| Output Current | 2.2 A |
| EN threshold voltage | 10.5 V |
| Output voltage ripple | 50 mV |
| Efficiency | 92% |
| Frequency | 400 kHz |

## USB C 2.0

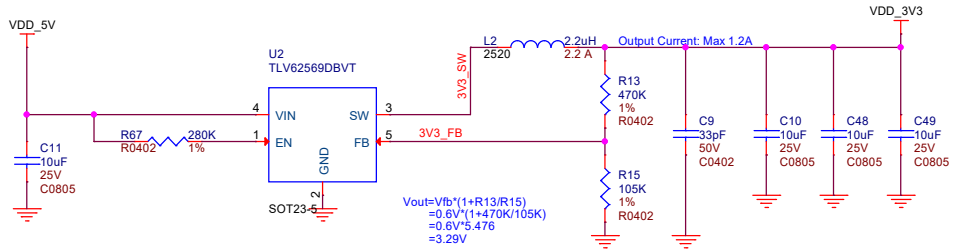



## Ideal Diode

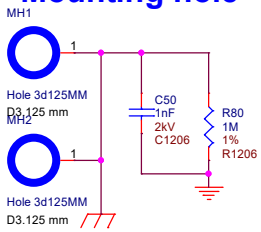



## 3V3 DCDC




## Mounting hole




| 3V3 DCDC Design Parameters | |
|---|---|
| Input voltage range | 4.5 V to 5.5 V |
| Max input current | 0.9 A |
| Output voltage | 3.29 V +/- 5.0% |
| Output Current | 1.2 A |
| EN threshold voltage | 1.2 V |
| Output voltage ripple | 30 mV |
| Efficiency | 92% |
| Frequency | 1.46 MHz |

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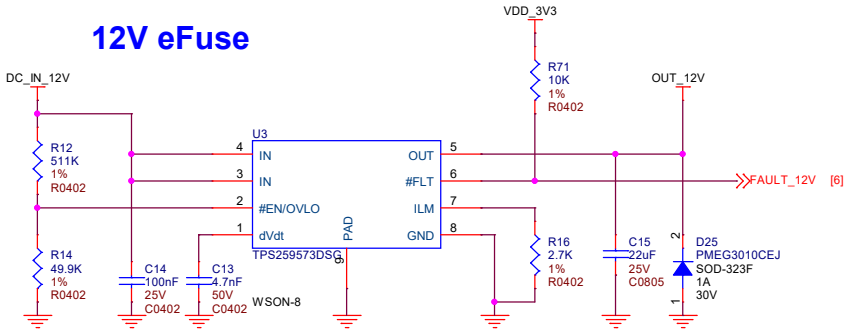
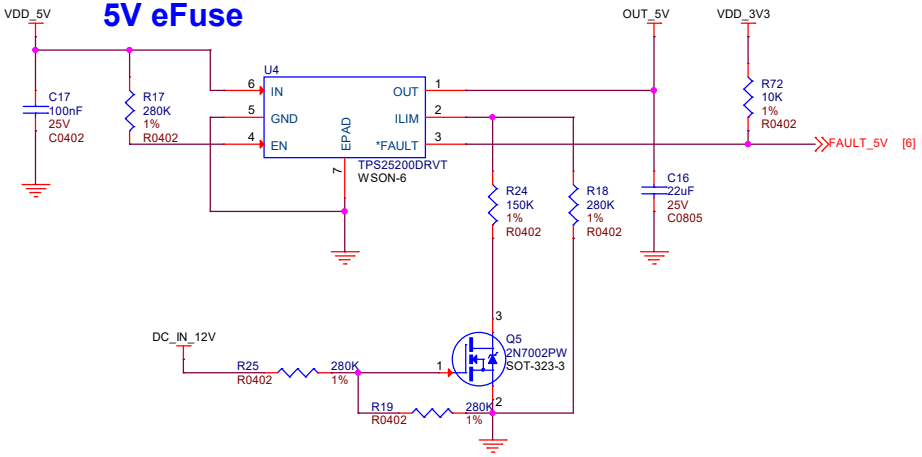
## 12V eFuse



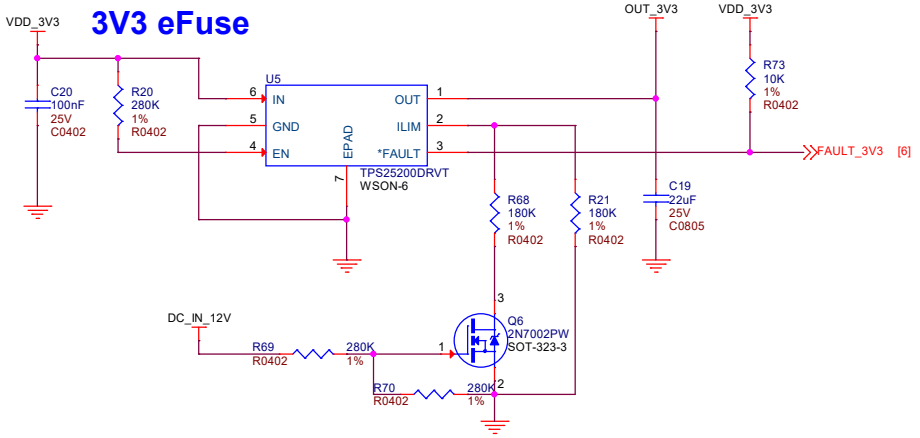

| 12V eFuse Design Parameters | |
|---|---|
| OVLO threshold | 13.5 V +/-6% |
| OVLO release | 12.4 V +/-6% |
| Current Limit | 0.78 A +/- 7.6% |
| Max continuous load | 0.72 A |

## 5V eFuse



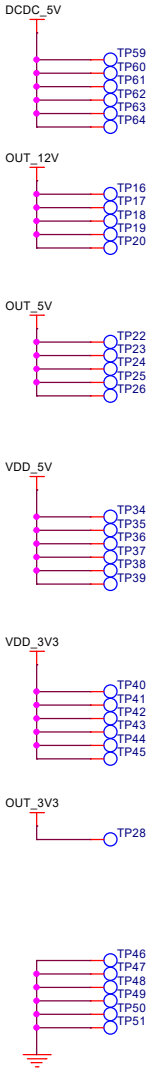

| 5V eFuse Design Parameters | |
|---|---|
| OVLO threshold | 7.6 V +/-4% |
| UVLO threshold | 2.35 V +/-4% |
| Current Limit @ USB | 0.35 A +/- 7% |
| Current Limit @ DC | 1.0 A +/- 7% |
| Max continuous load | 0.31A @ USB, 0.96 A @ DC |

## 3V3 eFuse




| 3V3 eFuse Design Parameters | |
|---|---|
| OVLO threshold | 7.6 V +/-4% |
| UVLO threshold | 2.35 V +/-4% |
| Current Limit @ USB | 0.55 A +/- 7% |
| Current Limit @ DC | 1.09 A +/- 7% |
| Max continuous load | 0.51A @ USB, 1.0 A @ DC |

## Test Point

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| Size: A3 | Document Number: 005_eFuse | Rev: v0.71 |
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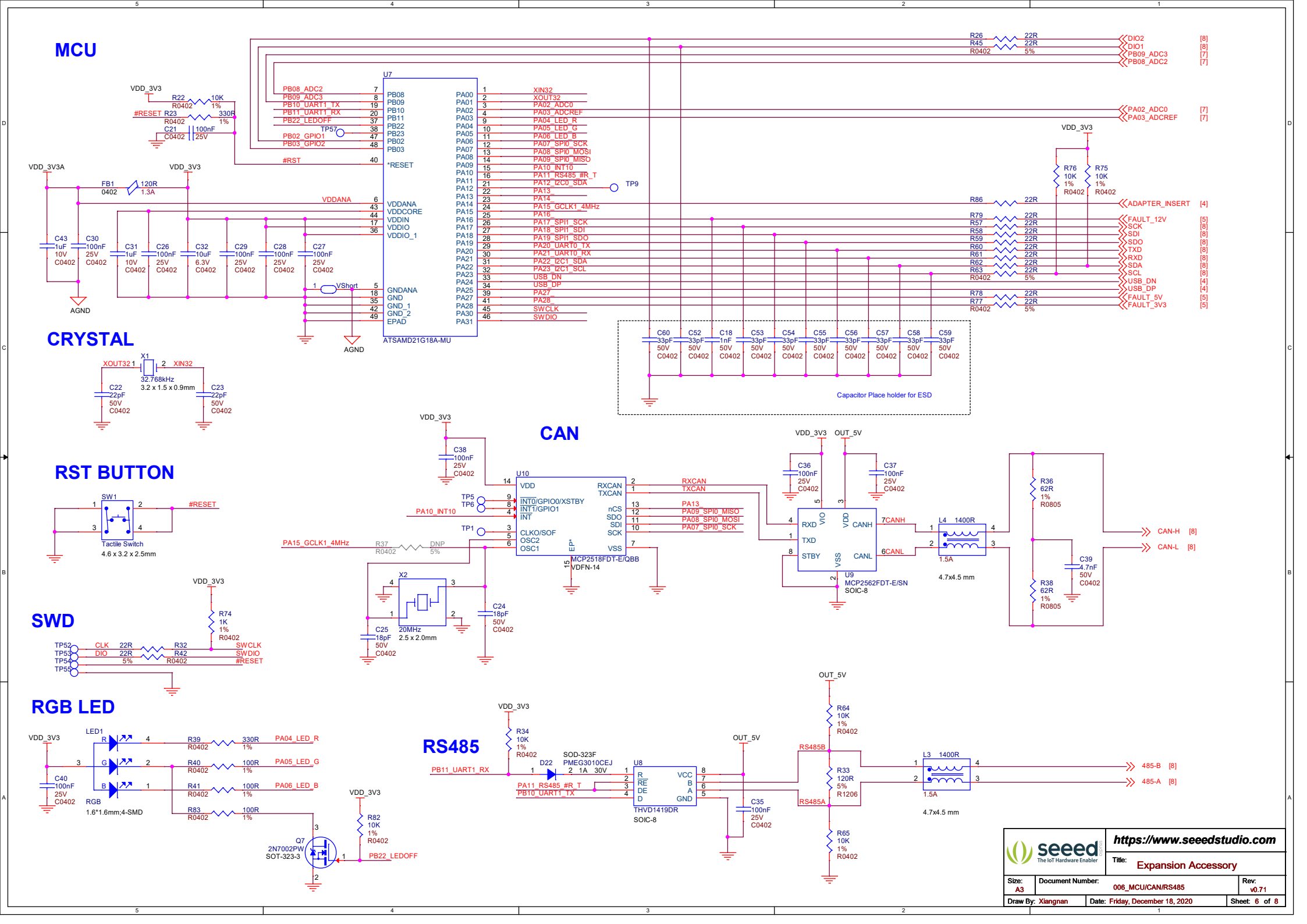
MCU
U7
ATSAMD21G18A-MU
CRYSTAL
X1
32.768kHz
3.2 x 1.5 x 0.9mm
Capacitor Place holder for ESD
RST BUTTON
SW1
Tactile Switch
4.6 x 3.2 x 2.5mm
CAN
U10
MCP2518FDT-E/QBB
VDFN-14
U9
MCP2562FDT-E/SN
SOIC-8
20MHz
2.5 x 2.0mm
SWD
RGB LED
LED1
RGB
1.6*1.6mm;4-SMD
RS485
U8
THVD1419DR
SOIC-8
SOD-323F
PMEG3010CEJ
2N7002PW
SOT-323-3
L3 1400R
L4 1400R
1.5A
4.7x4.5 mm
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Size: A3
Document Number: 006_MCU/CAN/RS485
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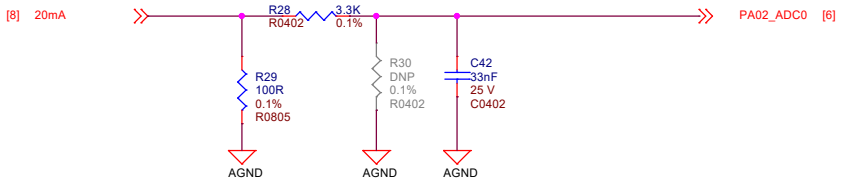
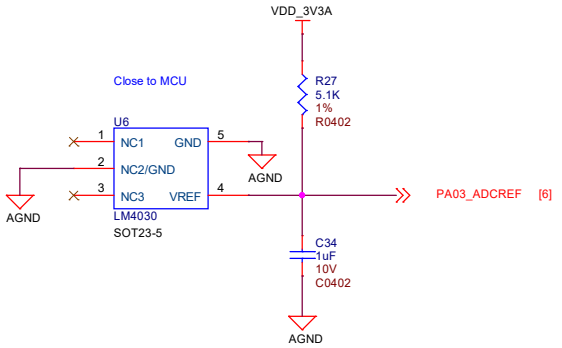
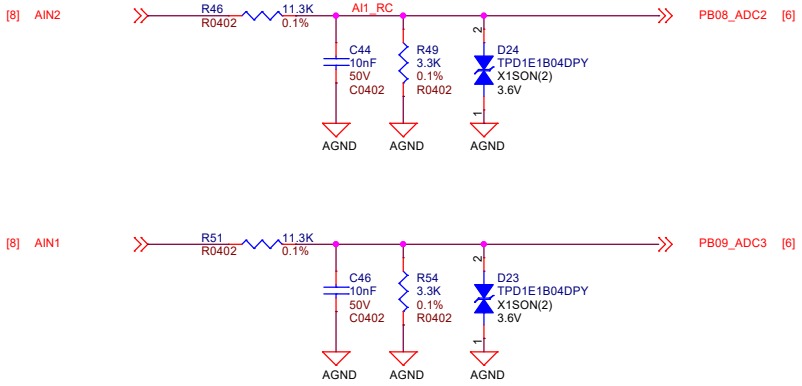
## 1x Analog Current Inputs 4~20mA

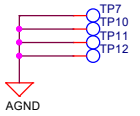



## Voltage Refference 2.5V




## 2x Analog Voltage Inputs 0~10V




| Voltage sensing Design Parameters | |
|---|---|
| Input voltage range | 0 V to 10 V |
| Output voltage range | 0 V to 2.26V |
| ADC REF Voltage | 2.5 V |
| Resolution | 2.70 mV/LSB @ 12bit |
| Accuracy | 1% FSR @ 0~40C |

| Current sensing Design Parameters | |
|---|---|
| Input Current range | 0 mA to 20 mA |
| Output voltage range | 0 V to 2.0 V |
| ADC REF Voltage | 2.5 V |
| LSB with Input | 6.1 uA/LSB @ 12bit |
| Accuracy | 1% FSR @ 0~40C |

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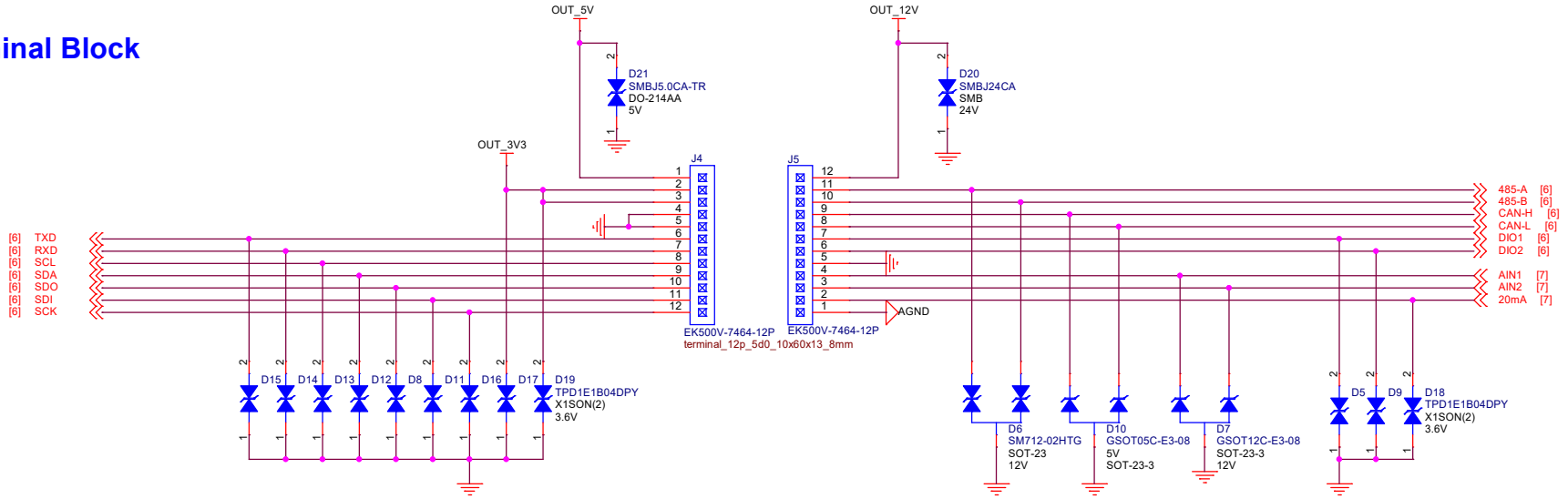
# Terminal Block




## IO Electrical Design Spec

| Pin Name | Output voltage | Output current | Input voltage | Input current | Signaling rate | Signal BW | ESD rate |
|---|---|---|---|---|---|---|---|
| 5V | 4.95 to 5.2V type<br>6.15 V max | 0.3 A @ USB<br>1 A @ DC IN | - | - | - | - | +/- 8 kV Contact<br>+/- 15 kV Air-Gap |
| 3.3V | 3.13 to 3.45V type<br>3.76V max | 0.5 A @ USB<br>1 A @ DC IN | - | - | - | - | |
| TXD / RXD | 0 to 3.3 V | IOL:10 mA<br>IOH: 7 mA | 0 to 3.3 V | +/- 1 uA Leakage | up to TBD<br>115200 bps | - | |
| SCL / SDA | 0 to 3.3 V | IOL:10 mA<br>IOH: 7 mA | 0 to 3.3 V | 0.33 mA | up to 400 kbps | - | |
| SDO / SDI / SCK | 0 to 3.3 V | IOL:10 mA<br>IOH: 7 mA | 0 to 3.3 V | +/- 1 uA Leakage | TBD | - | |
| | | | | | | | |

| PIN Name | Output voltage | Output current | Input voltage | Input current | Signaling rate | Signal BW | ESD rate |
|---|---|---|---|---|---|---|---|
| 12V | 12.0 V type<br>13.5 V max | 0.8 A | - | - | - | - | +/- 8 kV Contact<br>+/- 15 kV Air-Gap |
| 485-A/485-B | 0 to 5 V | Driver<br>+/- 60 mA type | +/- 12 V CM | Receiver<br>+/- 8 mA type | up to 250 kbps | - | |
| AIN1/AIN2 | - | - | 0 to 10 V | 0.8 mA max | - | 0 to 16 kHz | |
| 20mA | - | - | 0 to 2 V | 0 to 20 mA | - | 0 to 2.4 kHz | |
| CAN-H/CAN-L | 0 to 5 V | +/- 5mA R<br>+/- 85 mA SC | +/- 12 V CM | +/- 5 uA Leakage | up to 8 Mbps | - | |
| DIO1 / DIO2 | 0 to 3.3 V | 10 mA OL<br>7 mA OH | 0 to 3.3 V | +/- 1 uA Leakage | 15 ns TR/TF | - | |

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