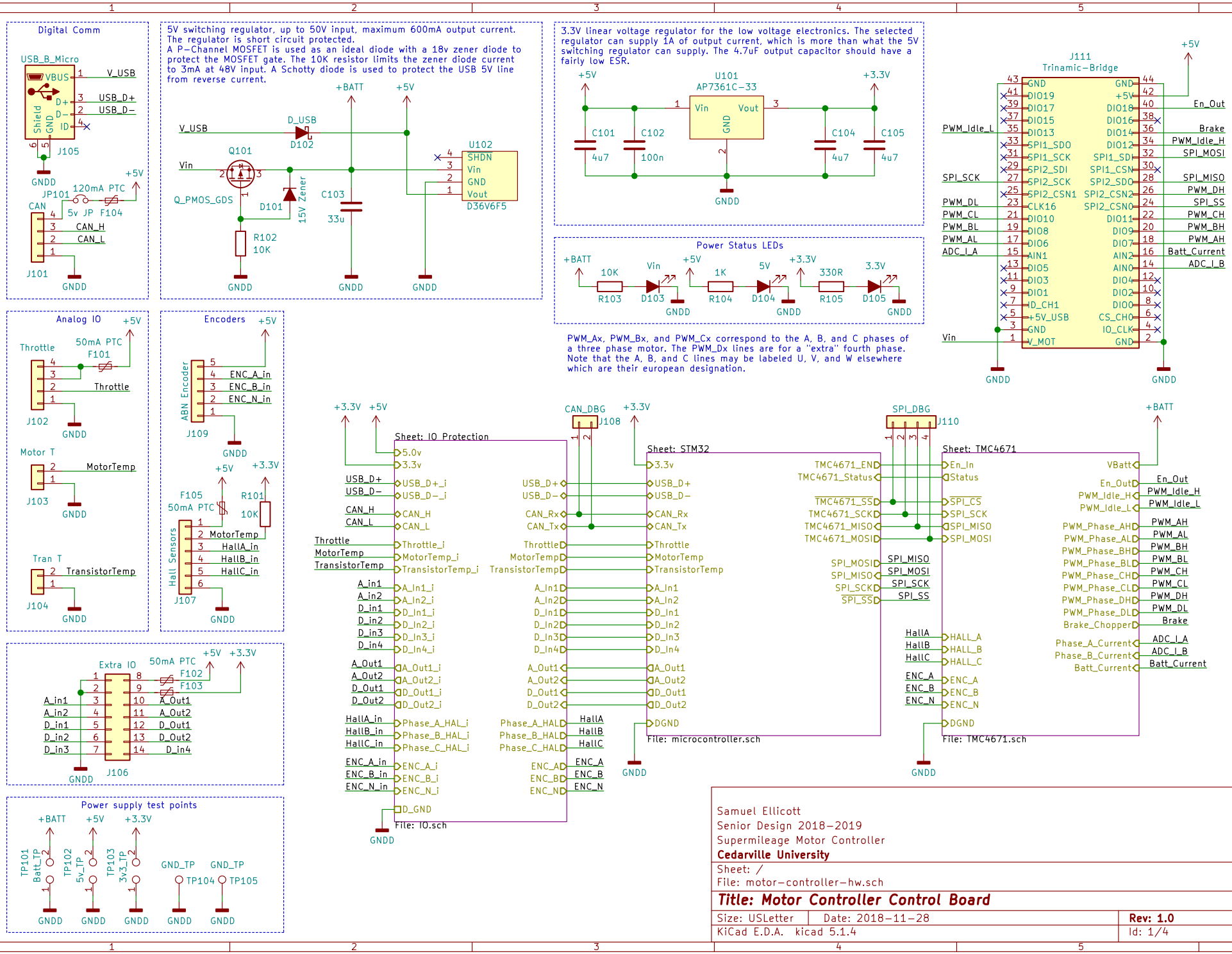
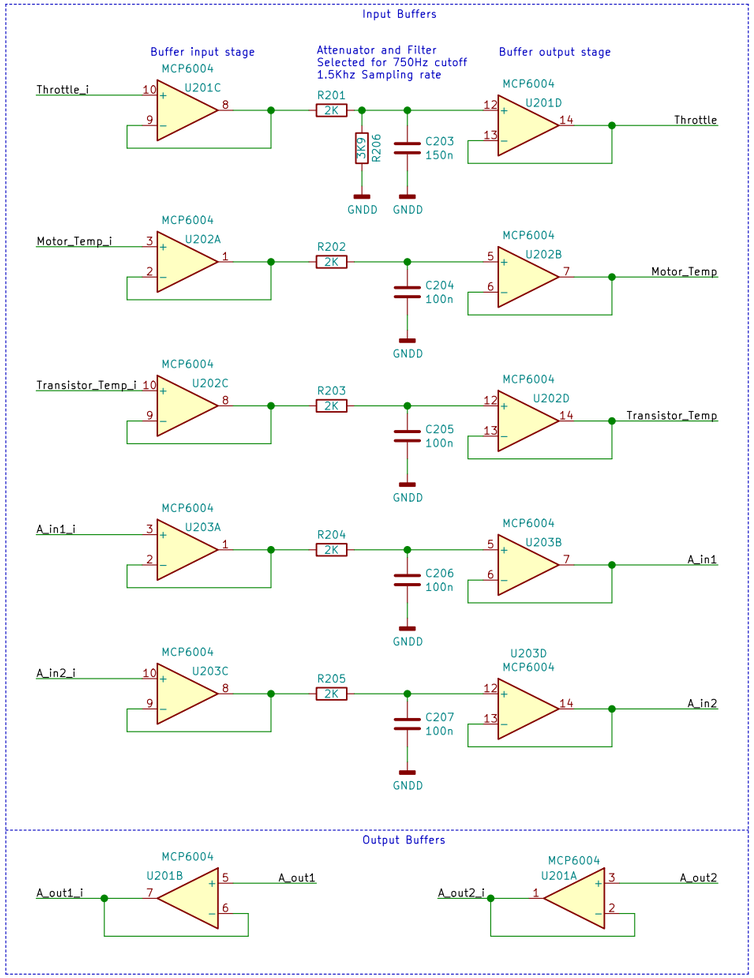
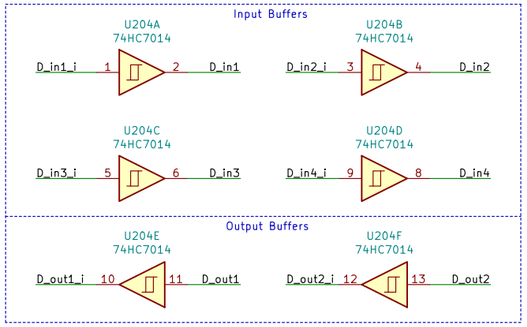
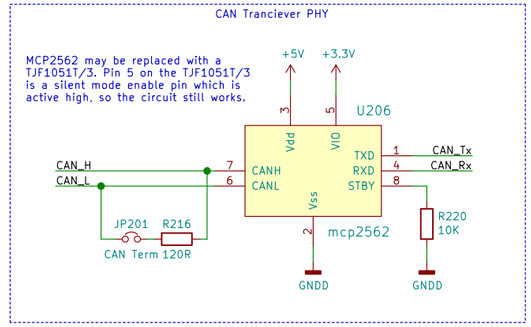
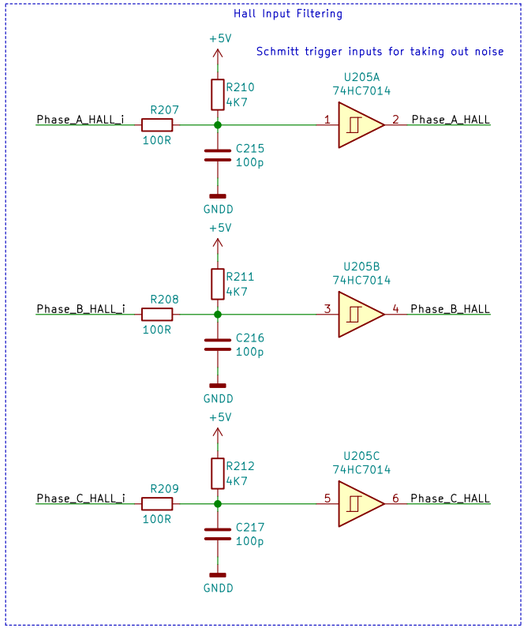
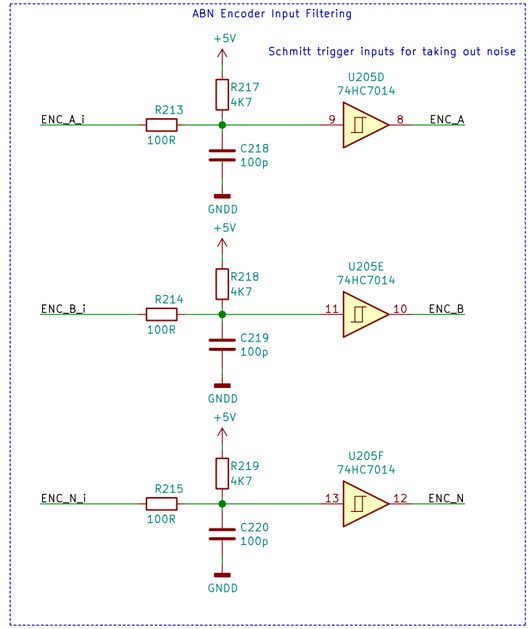

Digital Comm
USB_B_Micro
VBUS
Shield
GND
D+
D-
ID
V_USB
USB_D+
USB_D-
J105
GNDD
+5V
JP101
120mA PTC
5v JP F104
CAN
CAN_H
CAN_L
J101
GNDD
5V switching regulator, up to 50V input, maximum 600mA output current.
The regulator is short circuit protected.
A P-Channel MOSFET is used as an ideal diode with a 18v zener diode to protect the MOSFET gate. The 10K resistor limits the zener diode current to 3mA at 48V input. A Schotty diode is used to protect the USB 5V line from reverse current.
+BATT
+5V
V_USB
D_USB
D102
Q101
Vin
Q_PMOS_GDS
D101
15V Zener
R102
10K
C103
33u
U102
SHDN
Vin
GND
Vout
D36V6F5
GNDD
3.3V linear voltage regulator for the low voltage electronics. The selected regulator can supply 1A of output current, which is more than what the 5V switching regulator can supply. The 4.7uF output capacitor should have a fairly low ESR.
U101
AP7361C-33
C101
4u7
C102
100n
C104
4u7
C105
4u7
+3.3V
Power Status LEDs
10K
R103
D103
1K
R104
D104
330R
R105
D105
3.3V
PWM_Ax, PWM_Bx, and PWM_Cx correspond to the A, B, and C phases of a three phase motor. The PWM_Dx lines are for a "extra" fourth phase. Note that the A, B, and C lines may be labeled U, V, and W elsewhere which are their european designation.
J111
Trinamic-Bridge
PWM_Idle_L
SPI_SCK
PWM_DL
PWM_CL
PWM_BL
PWM_AL
ADC_I_A
Vin
En_Out
Brake
PWM_Idle_H
SPI_MOSI
SPI_MISO
PWM_DH
SPI_SS
PWM_CH
PWM_BH
PWM_AH
Batt_Current
ADC_I_B
Analog IO
Throttle
50mA PTC
F101
J102
Motor T
MotorTemp
J103
Tran T
TransistorTemp
J104
Encoders
ABN Encoder
ENC_A_in
ENC_B_in
ENC_N_in
J109
F105
50mA PTC
R101
10K
Hall Sensors
HallA_in
HallB_in
HallC_in
J107
Extra IO
F102
F103
A_in1
A_in2
D_in1
D_in2
D_in3
A_Out1
A_Out2
D_Out1
D_Out2
D_in4
J106
Power supply test points
TP101
Batt_TP
TP102
5v_TP
TP103
3v3_TP
GND_TP
TP104
TP105
Sheet: IO Protection
5.0v
3.3v
USB_D+
USB_D-
CAN_H
CAN_L
Throttle
MotorTemp
TransistorTemp
A_in1
A_in2
D_in1
D_in2
D_in3
D_in4
A_Out1
A_Out2
D_Out1
D_Out2
HallA_in
HallB_in
HallC_in
ENC_A_in
ENC_B_in
ENC_N_in
D_GND
File: IO.sch
CAN_DBG
J108
Sheet: STM32
CAN_Rx
CAN_Tx
DGND
File: microcontroller.sch
SPI_DBG
J110
Sheet: TMC4671
TMC4671_EN
TMC4671_Status
TMC4671_SS
TMC4671_SCK
TMC4671_MISO
TMC4671_MOSI
SPI_CS
SPI_SCK
SPI_MISO
SPI_MOSI
SPI_SS
En_In
Status
HallA
HallB
HallC
HALL_A
HALL_B
HALL_C
ENC_A
ENC_B
ENC_N
VBatt
En_Out
PWM_Idle_H
PWM_Idle_L
PWM_Phase_AH
PWM_Phase_AL
PWM_Phase_BH
PWM_Phase_BL
PWM_Phase_CH
PWM_Phase_CL
PWM_Phase_DH
PWM_Phase_DL
Brake_Chopper
Phase_A_Current
Phase_B_Current
Batt_Current
File: TMC4671.sch
Samuel Ellicott
Senior Design 2018-2019
Supermileage Motor Controller
Cedarville University
Sheet: /
File: motor-controller-hw.sch
Title: Motor Controller Control Board
Size: USLetter
Date: 2018-11-28
Rev: 1.0
KiCad E.D.A. kicad 5.1.4
Id: 1/4

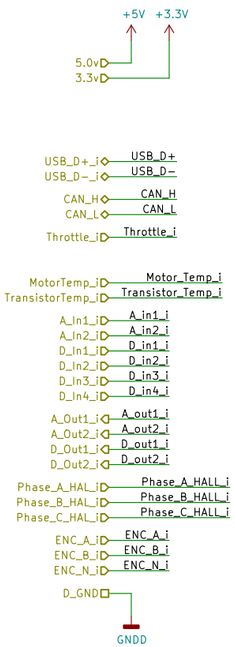


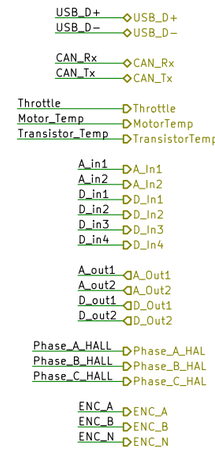












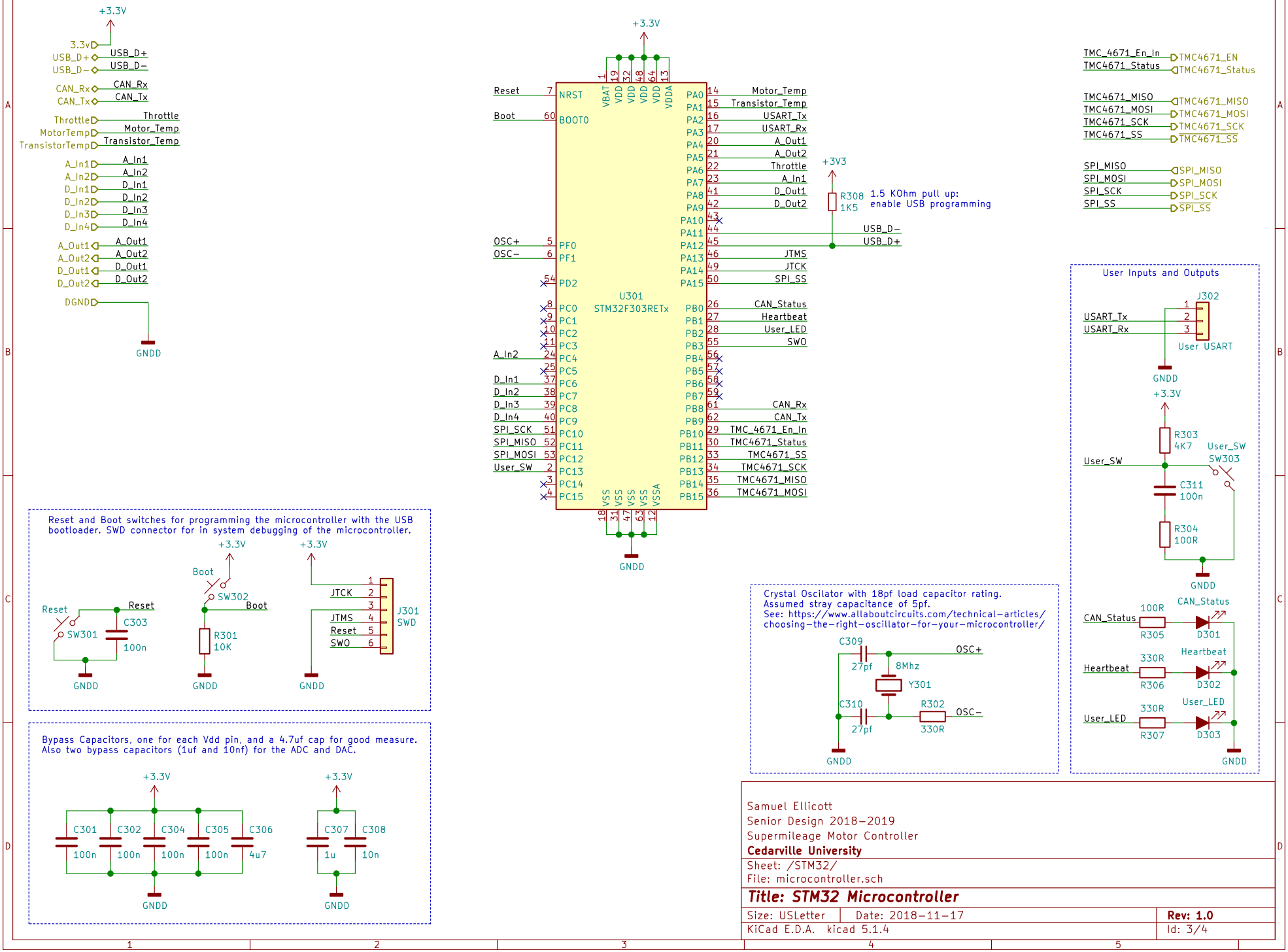
This sheet contains input/output proteciton and conditioning circuitry.
Note that the stm32 USB lines pass through this sheet
without modification.

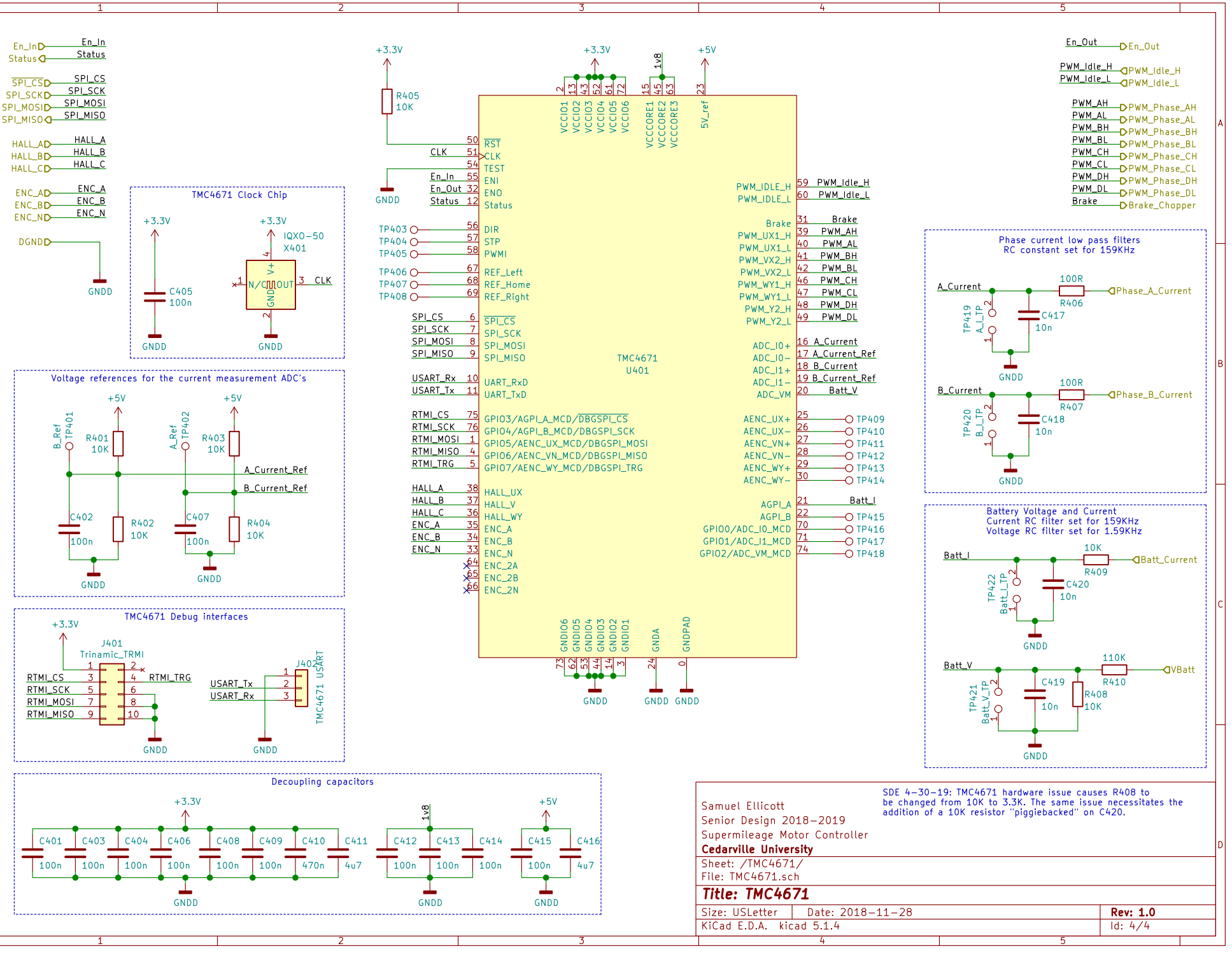
Samuel Ellicott
Senior Design 2018-2019
Supermileage Motor Controller
Cedarville University

Sheet: /IO Protection/
File: IO.sch

Title: Input Protection and Filtering

Size: USLedger	Date: 2018-11-28	**Rev: 1.0**
KiCad E.D.A. kicad 5.1.4		Id: 2/4


+3.3V
3.3v
USB_D+
USB_D−
USB_D+
USB_D−
CAN_Rx
CAN_Tx
CAN_Rx
CAN_Tx
Throttle
MotorTemp
TransistorTemp
Throttle
Motor_Temp
Transistor_Temp
A_In1
A_In2
D_In1
D_In2
D_In3
D_In4
A_In1
A_In2
D_In1
D_In2
D_In3
D_In4
A_Out1
A_Out2
D_Out1
D_Out2
A_Out1
A_Out2
D_Out1
D_Out2
DGND
GNDD
+3.3V
Reset
Boot
OSC+
OSC−
A_In2
D_In1
D_In2
D_In3
D_In4
SPI_SCK
SPI_MISO
SPI_MOSI
User_SW
U301
STM32F303RETx
NRST
BOOT0
PF0
PF1
PD2
PC0
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PC8
PC9
PC10
PC11
PC12
PC13
PC14
PC15
VBAT
VDD
VDD
VDD
VDD
VDDA
VSS
VSS
VSS
VSS
VSSA
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
PA10
PA11
PA12
PA13
PA14
PA15
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PB8
PB9
PB10
PB11
PB12
PB13
PB14
PB15
Motor_Temp
Transistor_Temp
USART_Tx
USART_Rx
A_Out1
A_Out2
Throttle
A_In1
D_Out1
D_Out2
JTMS
JTCK
SPI_SS
CAN_Status
Heartbeat
User_LED
SWO
CAN_Rx
CAN_Tx
TMC_4671_En_In
TMC4671_Status
TMC4671_SS
TMC4671_SCK
TMC4671_MISO
TMC4671_MOSI
+3V3
R308
1K5
1.5 KOhm pull up:
enable USB programming
USB_D−
USB_D+
GNDD
TMC_4671_En_In
TMC4671_Status
TMC4671_MISO
TMC4671_MOSI
TMC4671_SCK
TMC4671_SS
TMC4671_EN
TMC4671_Status
TMC4671_MISO
TMC4671_MOSI
TMC4671_SCK
TMC4671_SS
SPI_MISO
SPI_MOSI
SPI_SCK
SPI_SS
SPI_MISO
SPI_MOSI
SPI_SCK
SPI_SS
User Inputs and Outputs
J302
USART_Tx
USART_Rx
User USART
GNDD
+3.3V
R303
4K7
User_SW
SW303
User_SW
C311
100n
R304
100R
GNDD
CAN_Status
100R
R305
D301
Heartbeat
330R
R306
D302
User_LED
330R
R307
D303
GNDD
Reset and Boot switches for programming the microcontroller with the USB bootloader. SWD connector for in system debugging of the microcontroller.
+3.3V
+3.3V
Boot
SW302
Boot
R301
10K
Reset
Reset
SW301
C303
100n
JTCK
JTMS
Reset
SWO
J301
SWD
GNDD
GNDD
GNDD
Bypass Capacitors, one for each Vdd pin, and a 4.7uf cap for good measure.
Also two bypass capacitors (1uf and 10nf) for the ADC and DAC.
+3.3V
+3.3V
C301
C302
C304
C305
C306
100n
100n
100n
100n
4u7
C307
C308
1u
10n
GNDD
GNDD
Crystal Oscilator with 18pf load capacitor rating.
Assumed stray capacitance of 5pf.
See: https://www.allaboutcircuits.com/technical−articles/choosing−the−right−oscillator−for−your−microcontroller/
C309
27pf
OSC+
8Mhz
Y301
C310
27pf
R302
330R
OSC−
GNDD
Samuel Ellicott
Senior Design 2018−2019
Supermileage Motor Controller
Cedarville University
Sheet: /STM32/
File: microcontroller.sch
Title: STM32 Microcontroller
Size: USLetter
Date: 2018−11−17
Rev: 1.0
KiCad E.D.A. kicad 5.1.4
Id: 3/4



SDE 4-30-19: TMC4671 hardware issue causes R408 to be changed from 10K to 3.3K. The same issue necessitates the addition of a 10K resistor "piggiebacked" on C420.

Samuel Ellicott
Senior Design 2018-2019
Supermileage Motor Controller
Cedarville University

Sheet: /TMC4671/
File: TMC4671.sch

Title: TMC4671

Size: USLetter	Date: 2018-11-28	**Rev: 1.0**
KiCad E.D.A. kicad 5.1.4		Id: 4/4