Mounting Holes

H1 M3
H2 M3
H3 M3
H5 M3
H6 M3

Power

+12V
D1 LED
R2 3.3k
Resistor value might need adjustment for brightness
GND
+12V
PWR_FLAG
PWR_FLAG
GND
J3 PWR

Telemetry

Telemetry
+12V
+12V
CAN1_TX
CAN1_RX
CAN2_TX
CAN2_RX
CAN_C_TX
CAN_C_RX
CAN_S_TX
CAN_S_RX
File: telemetry.kicad_sch

CAN Bus

CAN-C Bus Transceiver
CAN_C_RX
CAN_C_TX
CAN_RX
CAN_TX
CAN_H
CAN_L
CAN_C+
CAN_C−
File: can-transceiver.kicad_sch
{CAN}
J6
CAN_C− 4
CAN_C+ 3
CAN_S− 2
CAN_S+ 1
CAN
CAN-S Bus Transceiver
CAN_S_RX
CAN_S_TX
CAN_RX
CAN_TX
CAN_H
CAN_L
CAN_S+
CAN_S−
File: can-transceiver.kicad_sch
CAN bus terminations:
- CAN-C: VCU and PM100DZ
- CAN-S: VCU and Orion BMS
CAN-C: critical systems
CAN-S: sensors / telemetry

Analogue and Digital Inputs

J1 IN
Shutdown state at +ve AIR
R5 10k
GND
GND
Can't hurt to have some extra grounds for shields
Input Shift
BPS_IN
SAGL_IN
APPS_2_IN
APPS_1_IN
SHDN_STATE
R2D_BTN
TS_ON_BTN
DRS_BTN
BPS_OUT
APPS_1_OUT
APPS_2_OUT
SAGL_OUT
DOUT_1
DOUT_2
DOUT_3
DOUT_4
File: input-shift.kicad_sch

+3.3V
+12V
STM32-F746ZG
VIN
+3.3V
BPS
APPS_1
APPS_2
SAGL
SHDN
R2D_BTN
TS_ON_BTN
DRS_BTN
CAN1_TX
CAN1_RX
CAN2_TX
CAN2_RX
CAN_C_TX
CAN_C_RX
CAN_S_TX
CAN_S_RX
STATUS
BRAKE_PRESSED
TS_ON
DRS
R2D_SIREN
R2D_SIREN_ON
R2D_LED
TS_ON_LED
DRS_LED
VC_LEDS
R2D_LED_ON
TS_ON_LED_ON
DRS_LED_ON
VC_LEDS_ON
EEPROM_WC
SDA
SCLD
EEPROM_SDA
EEPROM_SCL
File: mcu.kicad_sch
{CAN_INTERNAL}
{DASH_BUTTONS}
{DASH_LEDS_INTERNAL}
{EEPROM_I2C}

Digital Outputs

Output Level Shifting
+12V
DIN_1
DIN_2
DIN_3
DIN_4
DOUT_1
DOUT_2
DOUT_3
DOUT_4
File: output-shift.kicad_sch
J5 OUT
STATUS 1
BRAKE_PRESSED 2
TS_ON 3
4
5
DRS_PWM 6
7
8
GND

R2D Speaker

FSUK requires >90dB so R = 0
FSG requires <90dB so R > 0?
+12V
RTDS+ 1
RTDS− 2
3
4
J4
RTDS
GND
R11 1k
J15 FSUK_RTD
Pull to ground in case MCU disconnected
R10 3k3
Q5 FDN359BN
KP1600
99db @ 2m
2kHz-4kHz
260mA (max)

EEPROM (Config Memory)

+3.3V
U1
M24256-DRD
+3.3V
E0
E1
E2
VSS
VCC
WC
SCK
SDA
EEPROM_WC
EEPROM_SCL
EEPROM_SDA
C1 100n
GND

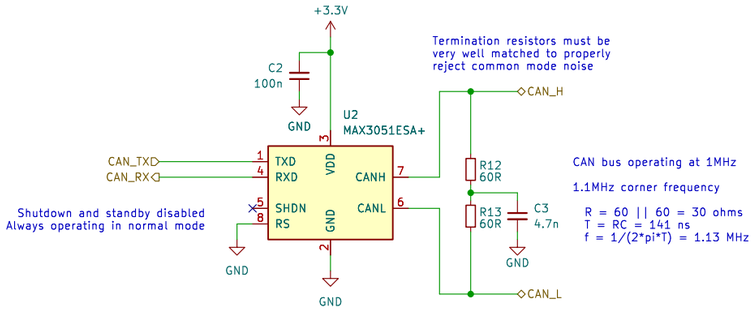
Dash Interface

+12V
J13
DASH 12V
VC_LEDS provides a connection to ground for 2s on start up
This is used to meet T11.9.5 ("visual check")
J2
DASH CONTROL
R2D_BTN
DRS_BTN
TS_ON_BTN
LVS_LED
DRS_LED
TS_ON_LED
R2D_LED
BMS_LED
IMD_LED
{DASH_LEDS}
J14
BMS+IMD LATCHING
R74 1k
R6 1k
R75 1k
R7 1k
R8 1k
R9 1k
R2D_LED_ON
TS_ON_LED_ON
DRS_LED_ON
VC_LEDS_ON
Q4 FDN359BN
Q3 FDN359BN
Q2 FDN359BN
Q1 FDN359BN
Q6 FDN359BN
R1 10k
R3 10k
R4 10k
Pull downs for dash buttons
For SCS safety, buttons should pull the line to 12V
All LED connections are current paths to ground via MOSFET, rather than a driving output
Other side of LED should be connected to 12V, current limiting resistors here are optional (could be external)
GND

Grid = 0.64mm !

Vehicle: STAG X	
Drawn By: Richard Karlson and Boris Van Griensven	
Checked By:	
CAD Part:	
SUFST	
Sheet:	
File: vcu.kicad_sch	
Title: VCU	
Size: A3	Date: 2023-12-08
KiCad E.D.A. kicad 7.0.9-1.fc38	Id: 1/11

Rev: 1.4.0

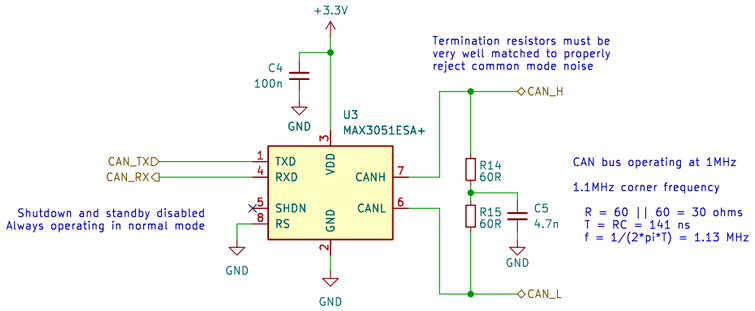


Vehicle: STAG X
Drawn By: Tim Brewis
Checked By: Max O'Brien
CAD Part:
SUFST

Sheet: CAN-C Bus Transceiver
File: can-transceiver.kicad_sch

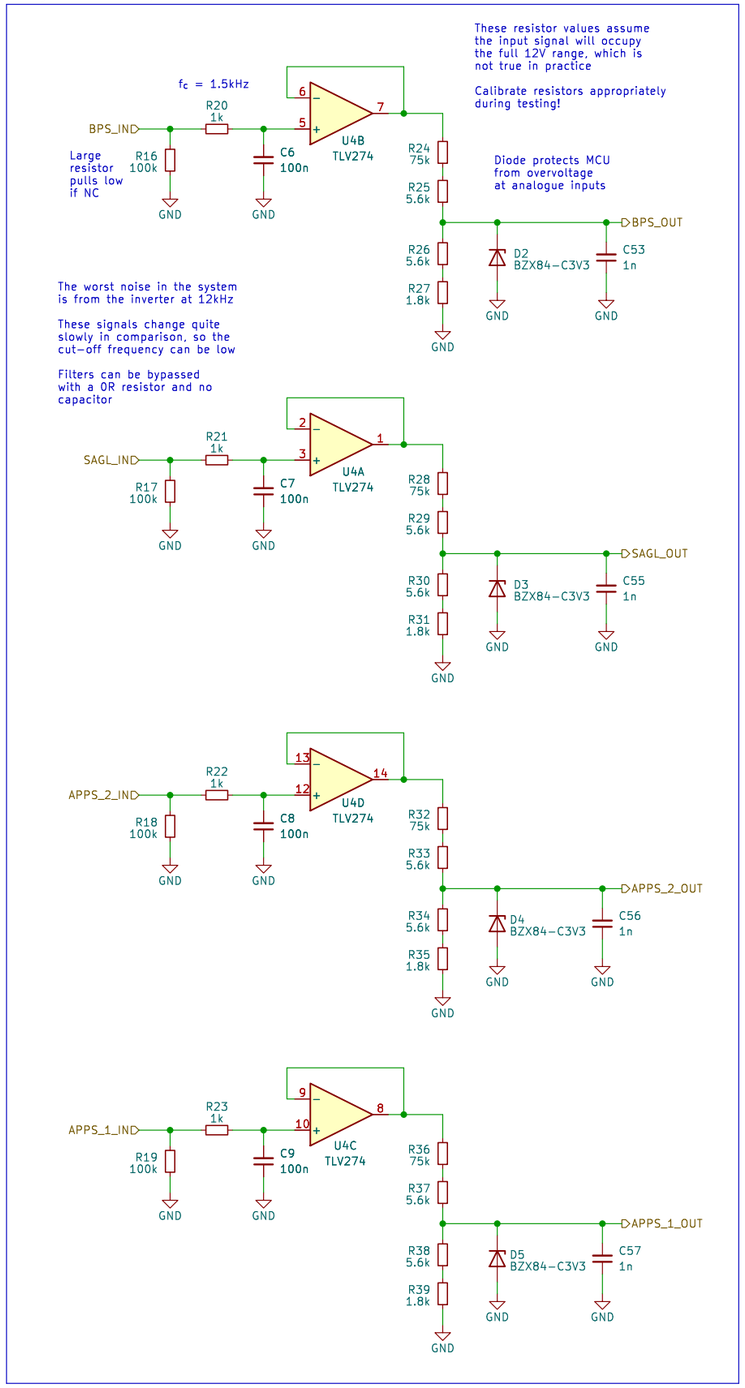
Title: VCU

Size: A3	Date: 2023-03-03	**Rev: 1.4.0**
KiCad E.D.A. kicad 7.0.9-1.fc38		Id: 2/11

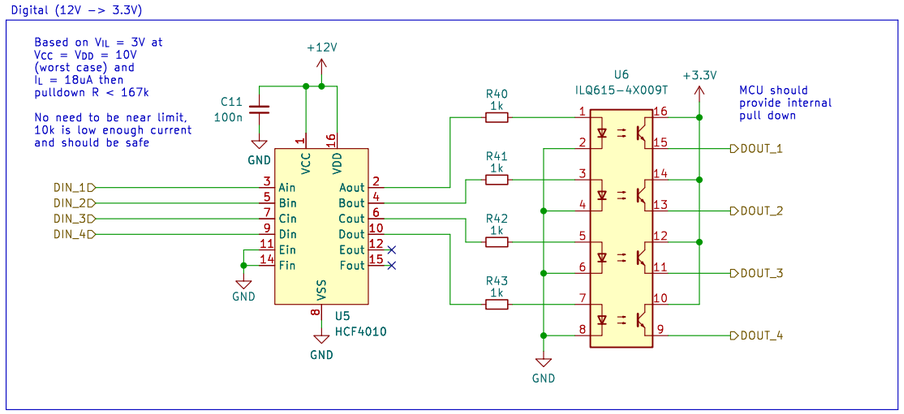


Vehicle: STAG X Drawn By: Tim Brewis Checked By: Max O'Brien CAD Part: **SUFST**		
Sheet: CAN-S Bus Transceiver File: can-transceiver.kicad_sch		
Title: VCU		
Size: A3	Date: 2023-03-03	**Rev: 1.4.0**
KiCad E.D.A. kicad 7.0.9-1.fc38		Id: 3/11

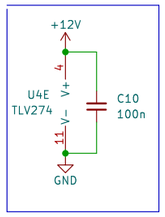
Analogue (12V -> 3.3V)



Digital (12V -> 3.3V)

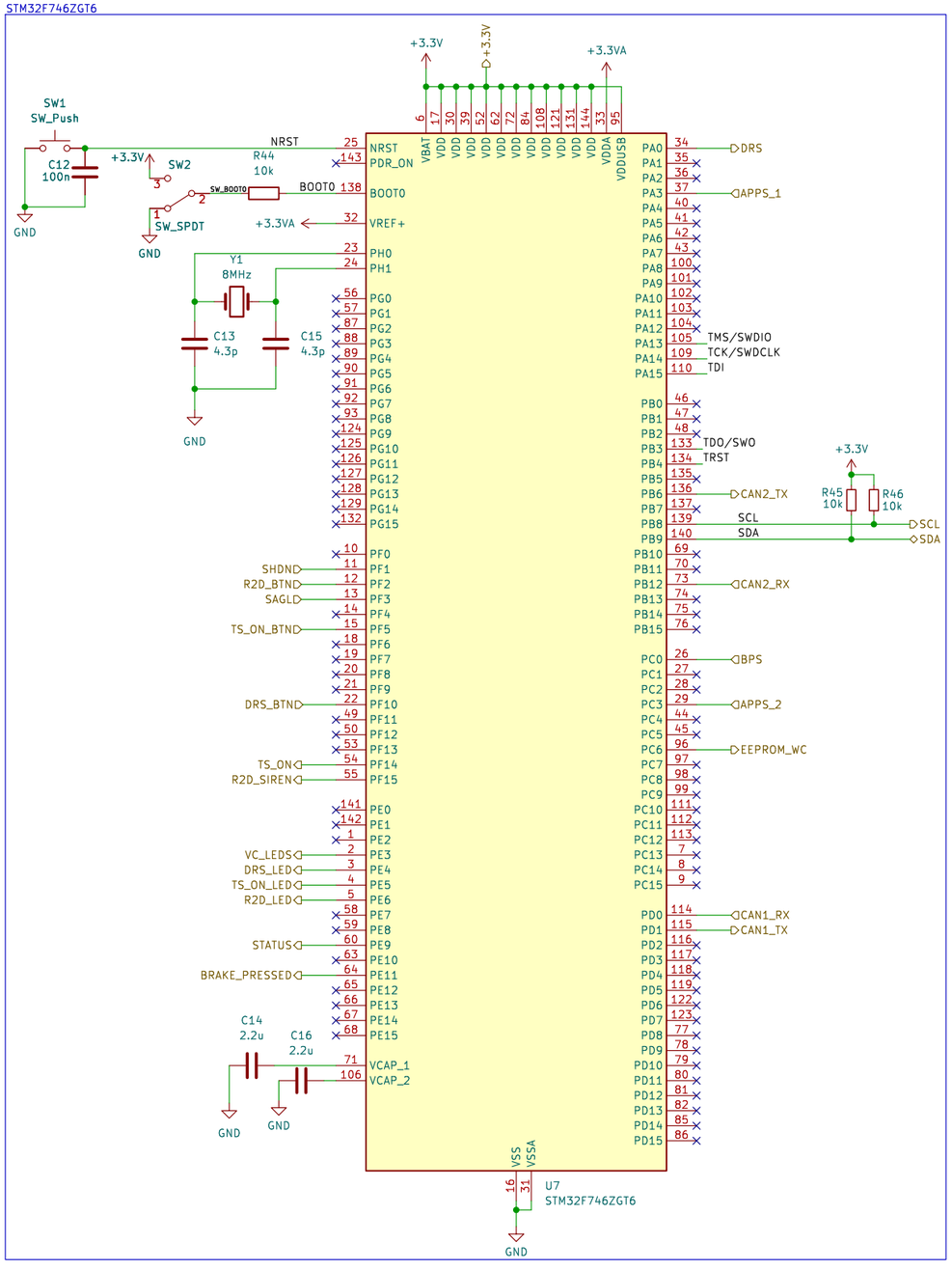


IC Power and Unused

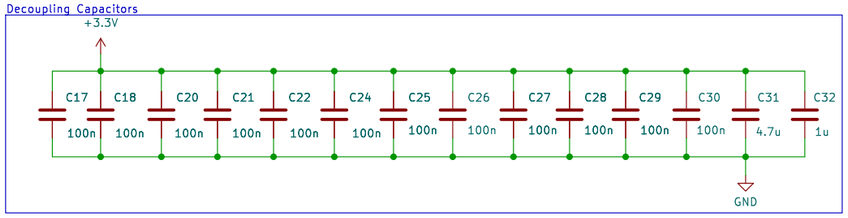


Vehicle: STAG X		
Drawn By: Tim Brewis		
Checked By: Max O'Brien		
CAD Part:		
SUFST		
Sheet: Input Shift		
File: input-shift.kicad_sch		
Title: VCU		
Size: A3	Date: 2024-01-11	**Rev: 1.4.0**
KiCad E.D.A. kicad 7.0.9-1.fc38		Id: 5/11

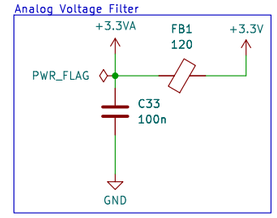
STM32F746ZGT6



Decoupling Capacitors

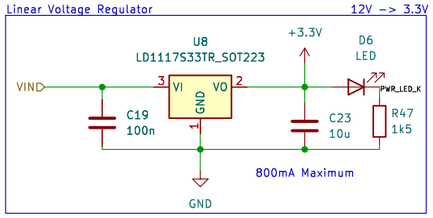


Analog Voltage Filter

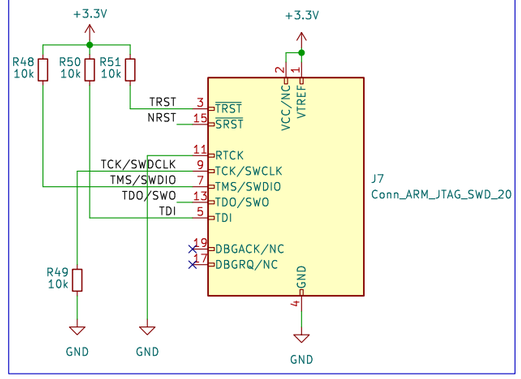


Linear Voltage Regulator

12V -> 3.3V

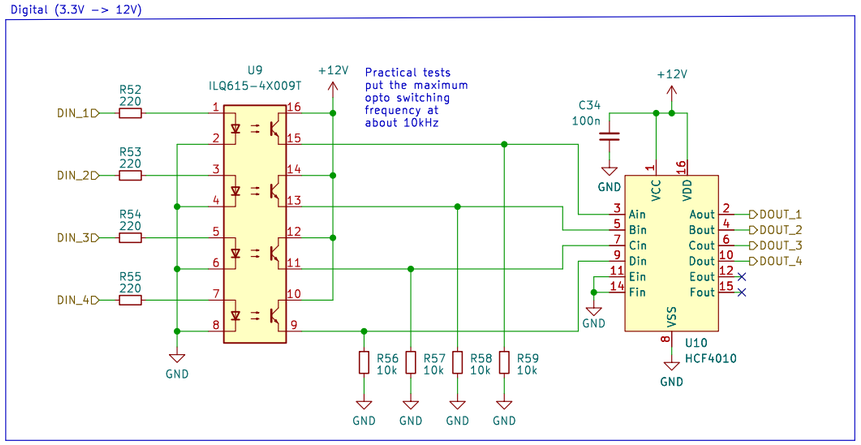


ARM 20-Pin JTAG(5-bits)/Serial Wire Debugger



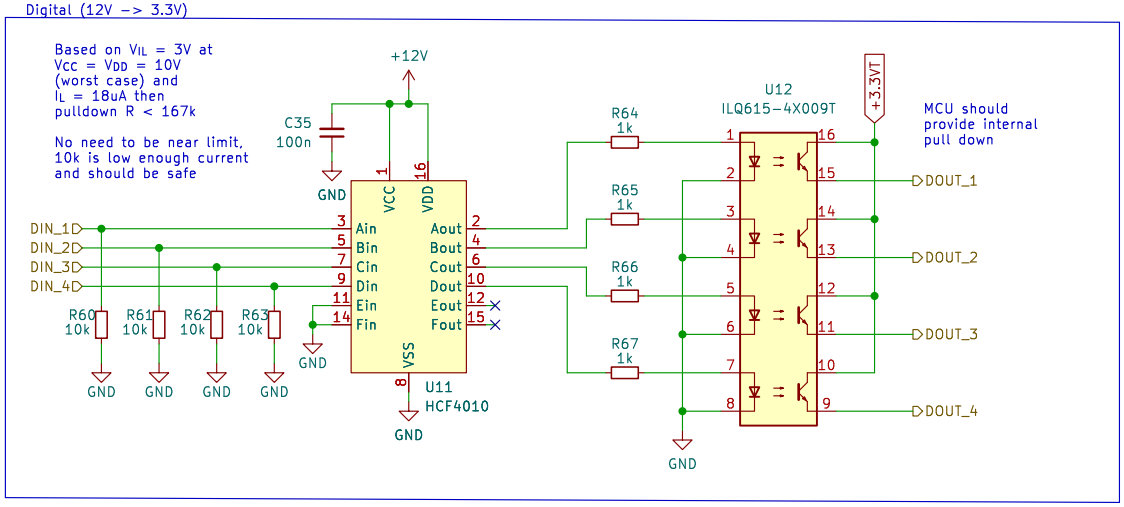
Vehicle: STAG X		
Drawn By: Richard Karlson		
Checked By:		
CAD Part:		
SUFST		
Sheet: STM32-F746ZG		
File: mcu.kicad_sch		
Title: VCU		
Size: A3	Date: 2023-11-28	**Rev: 1.3.0**
KiCad E.D.A. kicad 7.0.9-1.fc38		Id: 6/11

Digital (3.3V -> 12V)



Vehicle: STAG X		
Drawn By: Tim Brewis		
Checked By: Max O'Brien		
CAD Part:		
SUFST		
Sheet: Output Level Shifting		
File: output-shift.kicad_sch		
Title: VCU		
Size: A3	Date: 2023-03-03	**Rev: 1.4.0**
KiCad E.D.A. kicad 7.0.9-1.fc38		Id: 6/11

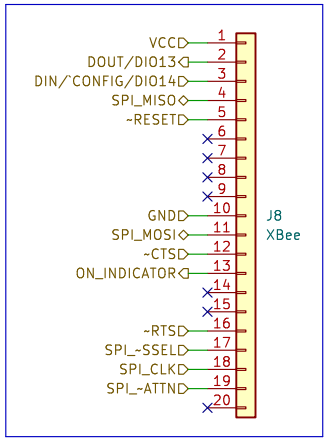
Digital (12V -> 3.3V)



WARNING: +3.3V is called +3.3VT locally to seperate the VCU and Telemetry 3.3V supplies. Any normal +3.3V power symbol is global and WILL connect to the VCU's 3.3V. Be careful.

Vehicle: STAG X		
Drawn By: Esteban Norena, Tim Brewis		
Checked By: Tim Brewis		
CAD Part:		
SUFST – Southampton University Formula Student Team		
Sheet: telemetry input shift		
File: telemetryinput-shift.kicad_sch		
Title: On-Car Telemetry		
Size: A4	Date: 2023-04-04	**Rev: 1.4.0**
KiCad E.D.A. kicad 7.0.9-1.fc38		Id: 7/11

XBee Through-hole module

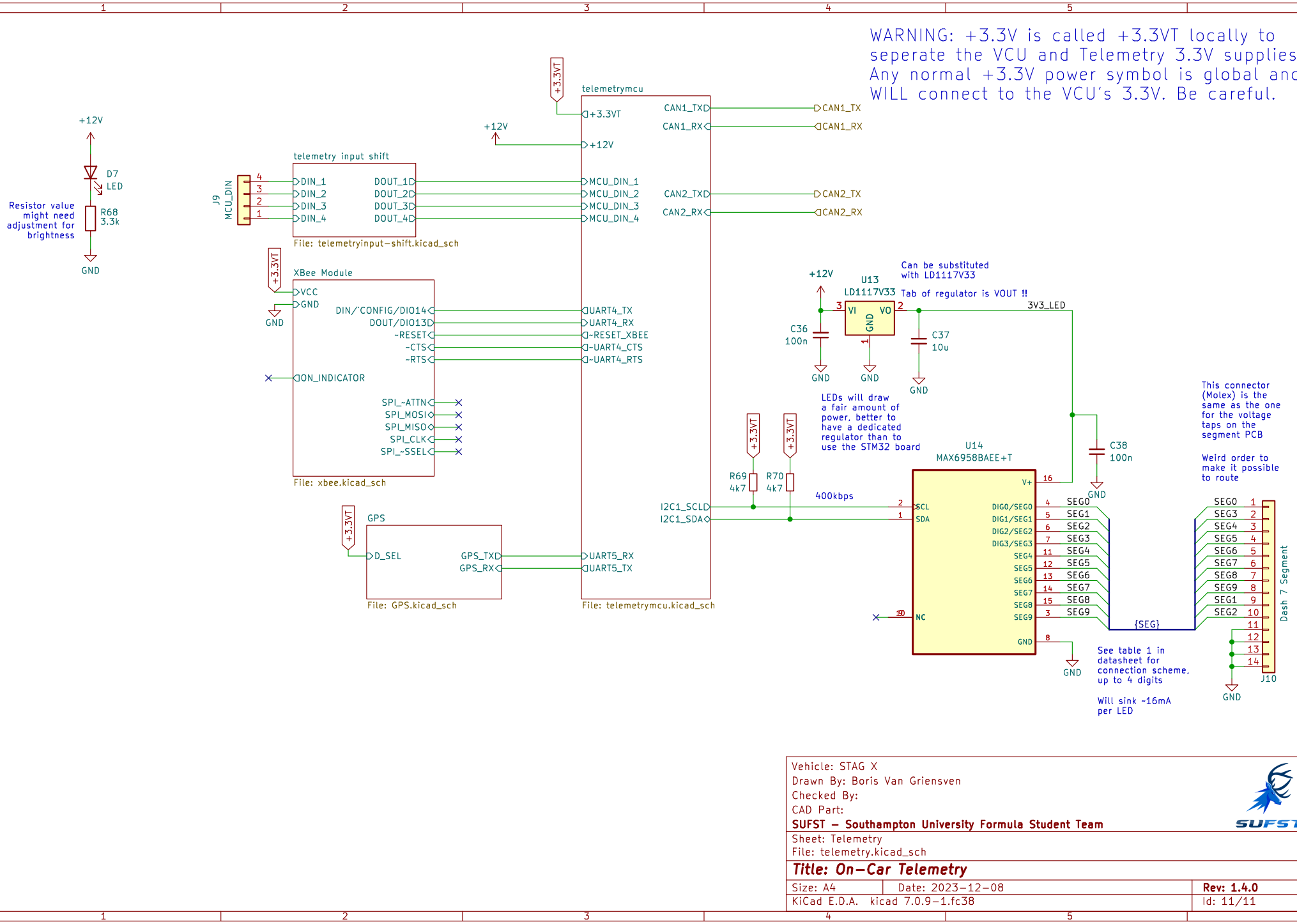


Vehicle: STAG X
Drawn By: Esteban Norena, Tim Brewis
Checked By: Tim Brewis
CAD Part:
SUFST – Southampton University Formula Student Team

Sheet: XBee Module
File: xbee.kicad_sch

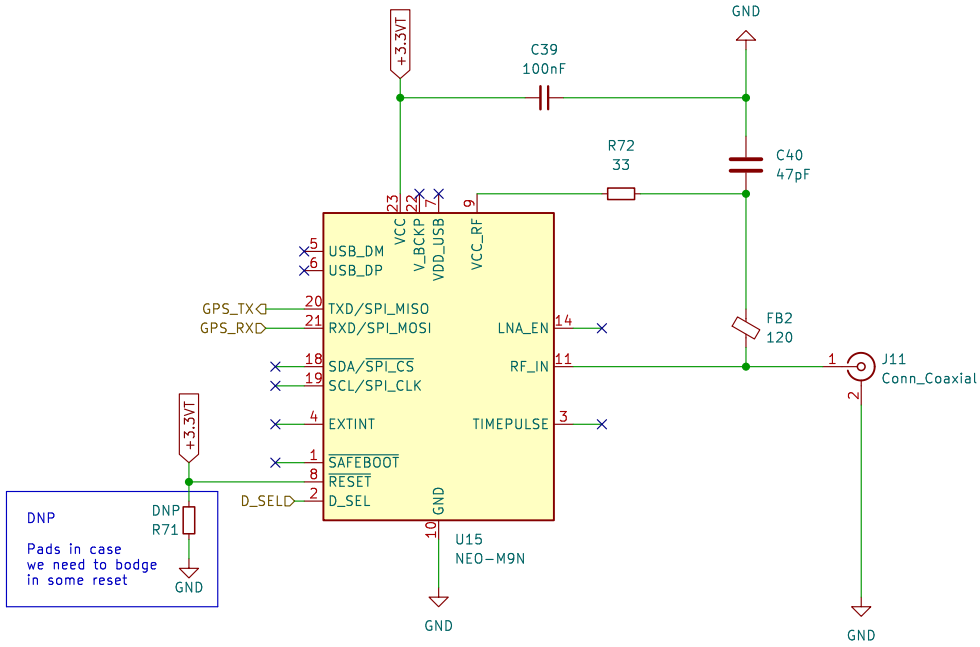
Title: On-Car Telemetry

Size: A4	Date: 2023-04-04	**Rev: 1.4.0**
KiCad E.D.A. kicad 7.0.9-1.fc38		Id: 8/11

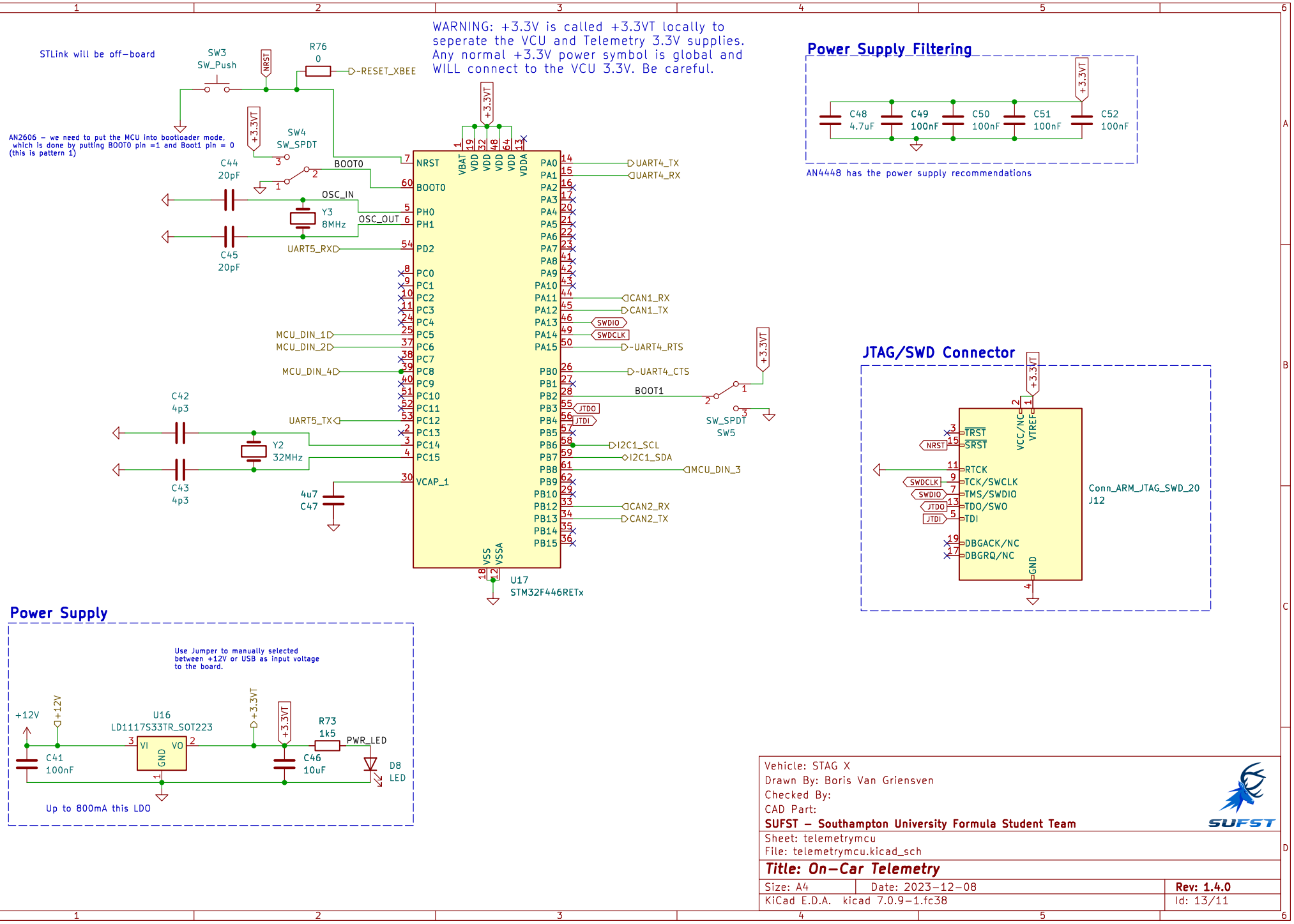


Vehicle: STAG X	
Drawn By: Boris Van Griensven	
Checked By:	
CAD Part:	
SUFST – Southampton University Formula Student Team	
Sheet: Telemetry	
File: telemetry.kicad_sch	
Title: On-Car Telemetry	
Size: A4	Date: 2023-12-08
KiCad E.D.A. kicad 7.0.9-1.fc38	**Rev: 1.4.0**
	Id: 11/11

WARNING: +3.3V is called +3.3VT locally to
seperate the VCU and Telemetry 3.3V supplies.
Any normal +3.3V power symbol is global and
WILL connect to the VCU 3.3V. Be careful.



Vehicle: STAG X	
Drawn By: Esteban Norena, Tim Brewis	
Checked By: Tim Brewis	
CAD Part:	
SUFST – Southampton University Formula Student Team	
Sheet: GPS	
File: GPS.kicad_sch	
Title: On-Car Telemetry	
Size: A4	Date: 2023-04-04
KiCad E.D.A. kicad 7.0.9-1.fc38	**Rev: 1.4.0**
	Id: 12/11


WARNING: +3.3V is called +3.3VT locally to seperate the VCU and Telemetry 3.3V supplies. Any normal +3.3V power symbol is global and WILL connect to the VCU 3.3V. Be careful.
STLink will be off-board
SW3
SW_Push
NRST
R76
0
~RESET_XBEE
+3.3VT
SW4
SW_SPDT
AN2606 – we need to put the MCU into bootloader mode, which is done by putting BOOT0 pin =1 and Boot1 pin = 0 (this is pattern 1)
BOOT0
C44
20pF
OSC_IN
Y3
8MHz
OSC_OUT
C45
20pF
UART5_RX
MCU_DIN_1
MCU_DIN_2
MCU_DIN_4
C42
4p3
Y2
32MHz
C43
4p3
UART5_TX
4u7
C47
VCAP_1
NRST
BOOT0
PH0
PH1
PD2
PC0
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PC8
PC9
PC10
PC11
PC12
PC13
PC14
PC15
VBAT
VDD
VDD
VDD
VDDA
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
PB12
PB13
PB14
PB15
UART4_TX
UART4_RX
CAN1_RX
CAN1_TX
SWDIO
SWDCLK
~UART4_RTS
~UART4_CTS
BOOT1
JTDO
JTDI
I2C1_SCL
I2C1_SDA
MCU_DIN_3
CAN2_RX
CAN2_TX
U17
STM32F446RETx
SW_SPDT
SW5
Power Supply Filtering
C48
4.7uF
C49
100nF
C50
100nF
C51
100nF
C52
100nF
AN4448 has the power supply recommendations
JTAG/SWD Connector
TRST
SRST
RTCK
TCK/SWCLK
TMS/SWDIO
TDO/SWO
TDI
DBGACK/NC
DBGRQ/NC
VCC/NC
VTREF
GND
Conn_ARM_JTAG_SWD_20
J12
Power Supply
Use Jumper to manually selected between +12V or USB as input voltage to the board.
+12V
U16
LD1117S33TR_SOT223
VI
VO
GND
C41
100nF
C46
10uF
R73
1k5
PWR_LED
D8
LED
Up to 800mA this LDO
Vehicle: STAG X
Drawn By: Boris Van Griensven
Checked By:
CAD Part:
SUFST – Southampton University Formula Student Team
Sheet: telemetrymcu
File: telemetrymcu.kicad_sch
Title: On-Car Telemetry
Size: A4
Date: 2023-12-08
Rev: 1.4.0
KiCad E.D.A. kicad 7.0.9-1.fc38
Id: 13/11