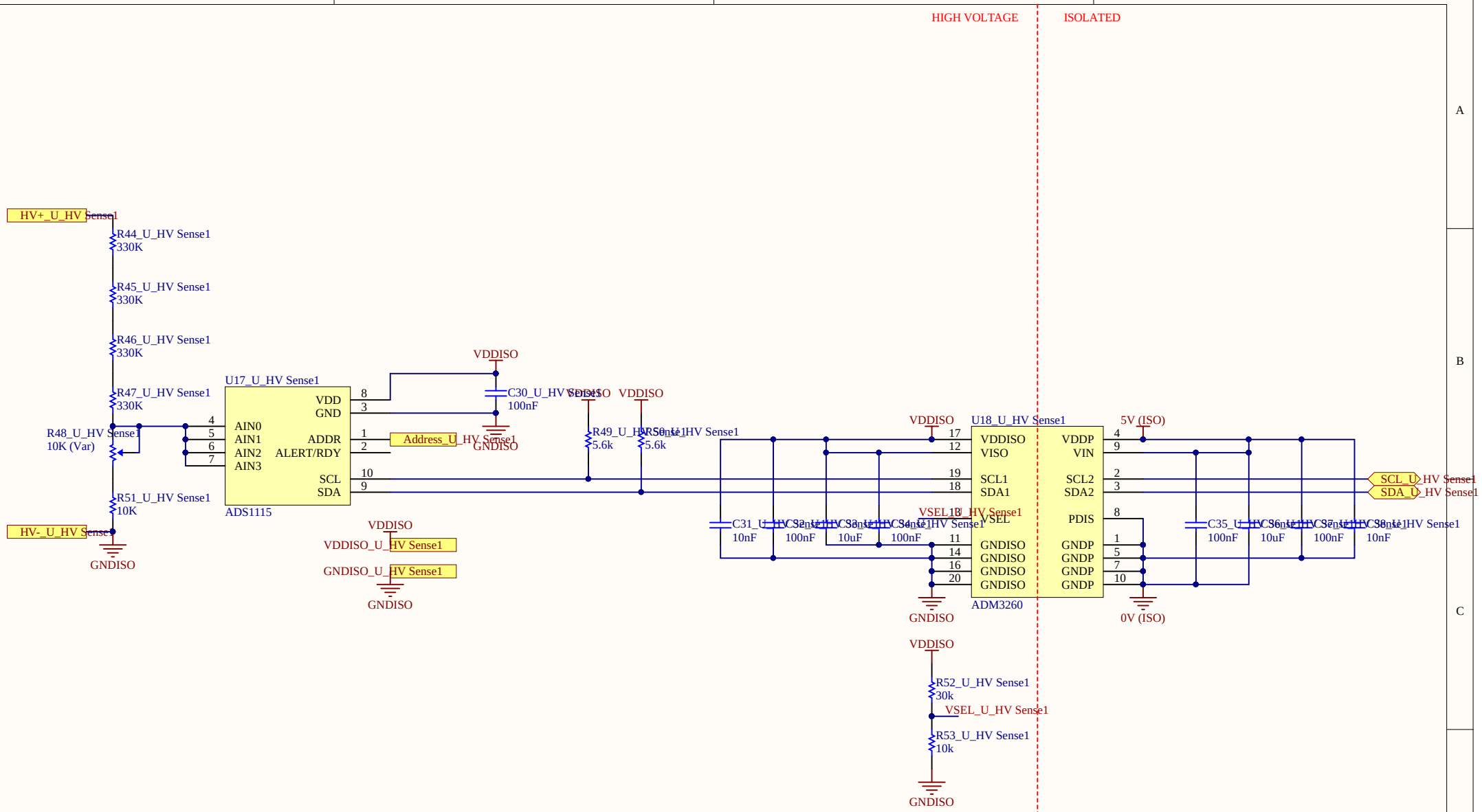

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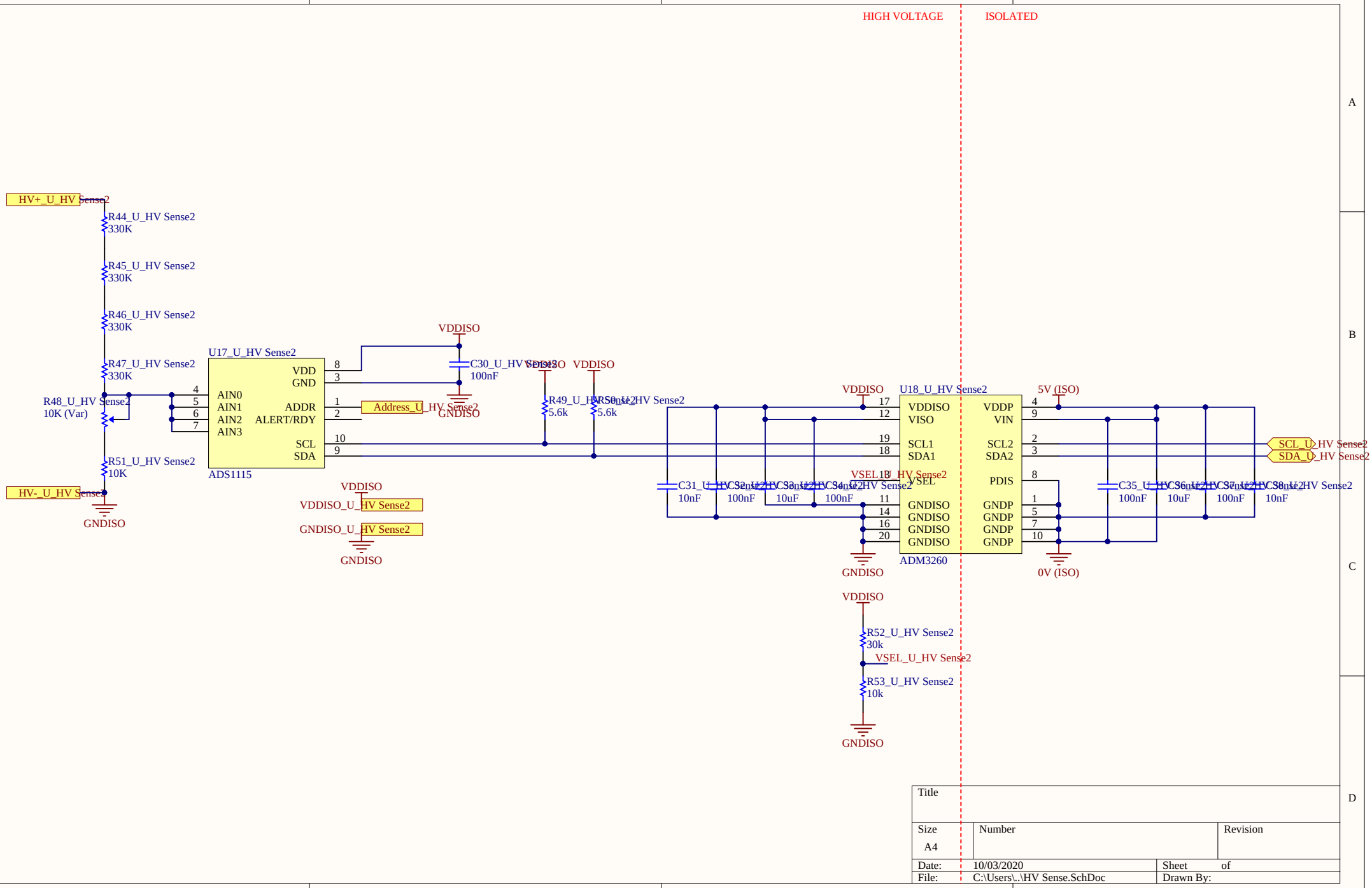
Size A4	Number	Revision
Date: 10/03/2020		Sheet of
File: C:\Users\..\HV Sense.SchDoc		Drawn By:



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Size A4	Number	Revision
Date: 10/03/2020		Sheet of
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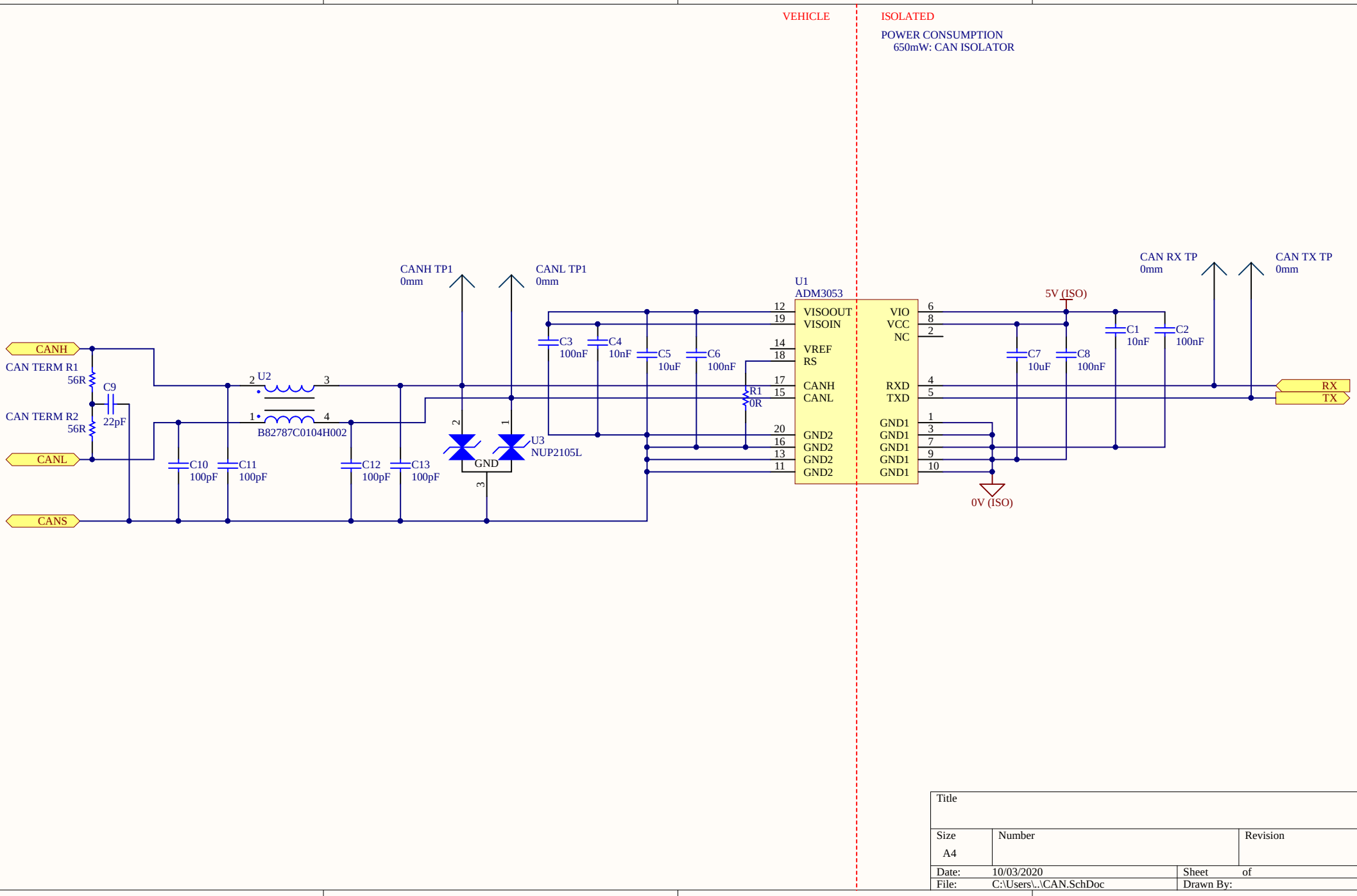
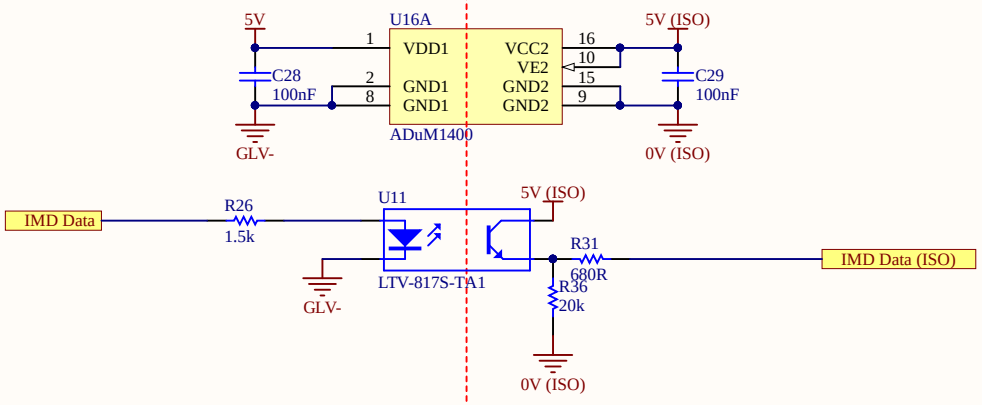

VEHICLE
ISOLATED
POWER CONSUMPTION
650mW: CAN ISOLATOR
CANH TP1
0mm
CANL TP1
0mm
CAN RX TP
0mm
CAN TX TP
0mm
U1
ADM3053
5V (ISO)
0V (ISO)
CANH
CANL
CANS
CAN TERM R1
56R
CAN TERM R2
56R
C9
22pF
U2
B82787C0104H002
U3
NUP2105L
GND
R1
0R
C1
10nF
C2
100nF
C3
100nF
C4
10nF
C5
10uF
C6
100nF
C7
10uF
C8
100nF
C10
100pF
C11
100pF
C12
100pF
C13
100pF
VISOOUT
VISOIN
VREF
RS
CANH
CANL
GND2
VIO
VCC
NC
RXD
TXD
GND1
RX
TX
Title
Size
A4
Number
Revision
Date:
10/03/2020
Sheet
of
File:
C:\Users\..\CAN.SchDoc
Drawn By:

SENSOR ISOLATED



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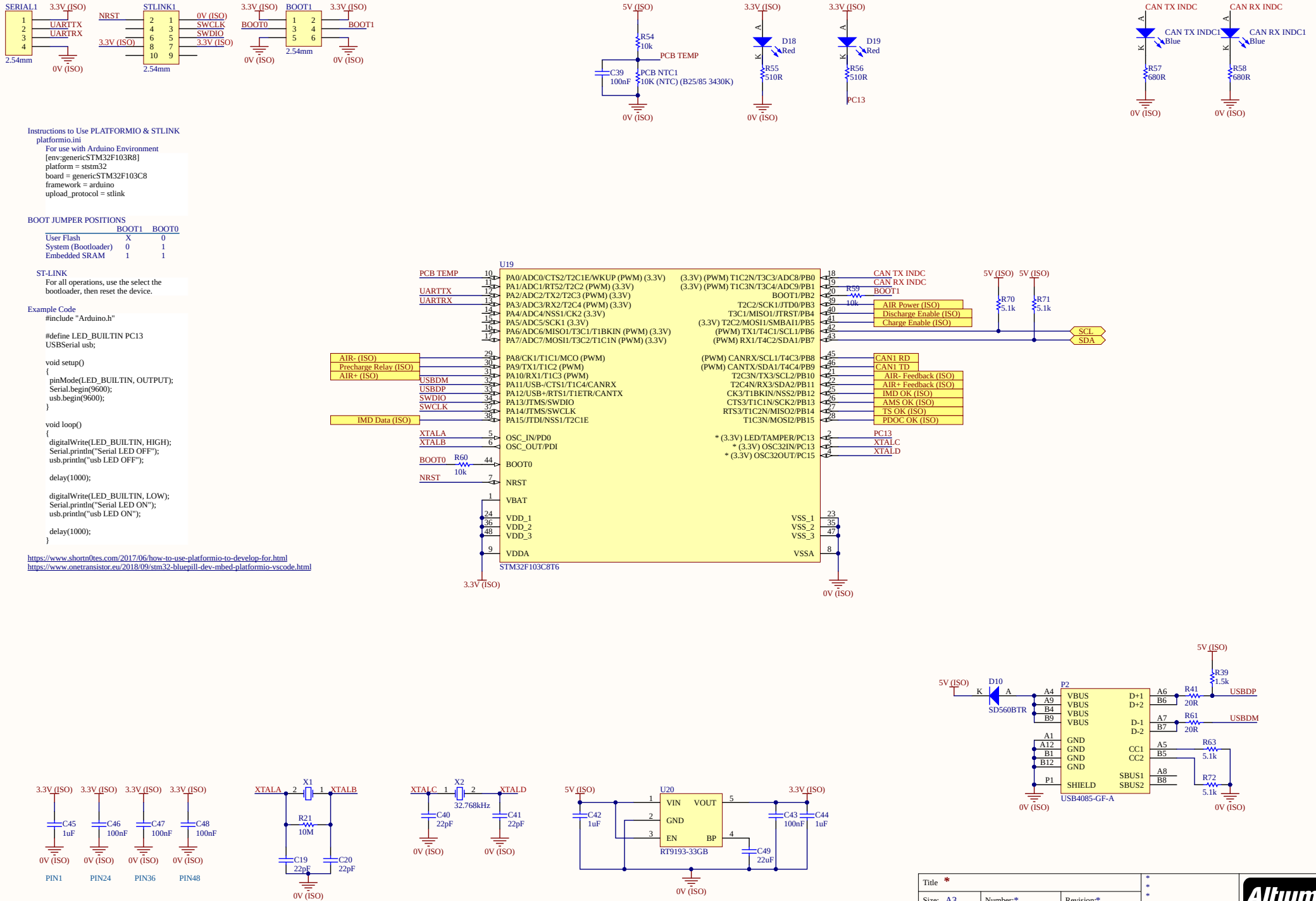
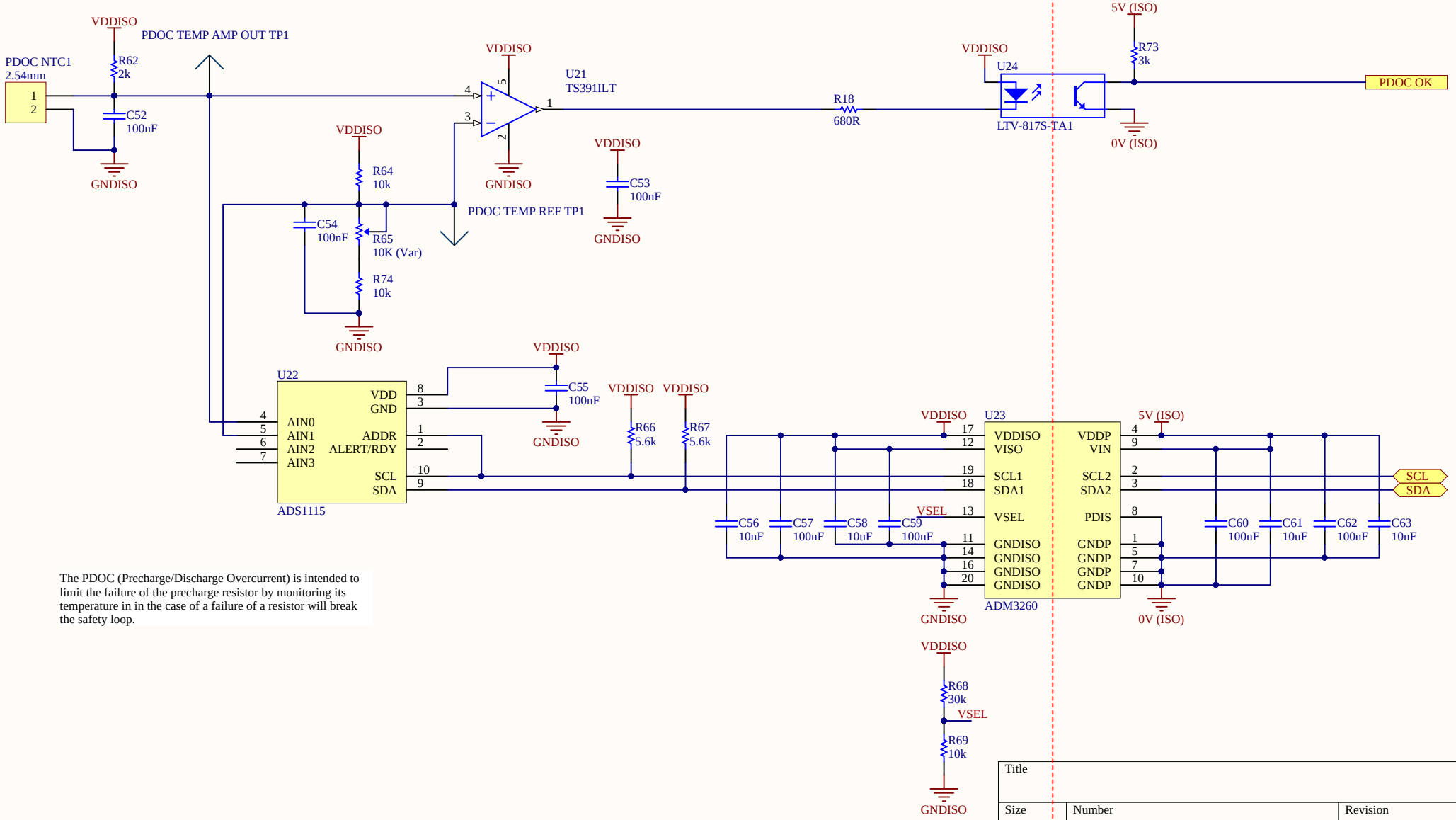

SERIAL1
3.3V (ISO)
UARTTX
UARTRX
2.54mm
0V (ISO)
NRST
STLINK1
3.3V (ISO)
0V (ISO)
SWCLK
SWDIO
3.3V (ISO)
2.54mm
3.3V (ISO)
BOOT1
3.3V (ISO)
BOOT0
BOOT1
0V (ISO)
2.54mm
0V (ISO)
5V (ISO)
R54
10k
PCB TEMP
C39
100nF
PCB NTC1
10K (NTC) (B25/85 3430K)
0V (ISO)
3.3V (ISO)
D18
Red
R55
510R
0V (ISO)
3.3V (ISO)
D19
Red
R56
510R
PC13
CAN TX INDC
CAN TX INDC1
Blue
R57
680R
0V (ISO)
CAN RX INDC
CAN RX INDC1
Blue
R58
680R
0V (ISO)
Instructions to Use PLATFORMIO & STLINK
platformio.ini
For use with Arduino Environment
[env:genericSTM32F103R8]
platform = ststm32
board = genericSTM32F103C8
framework = arduino
upload_protocol = stlink
BOOT JUMPER POSITIONS
BOOT1 BOOT0
User Flash X 0
System (Bootloader) 0 1
Embedded SRAM 1 1
ST-LINK
For all operations, use the select the bootloader, then reset the device.
Example Code
#include "Arduino.h"
#define LED_BUILTIN PC13
USBSerial usb;
void setup()
{
pinMode(LED_BUILTIN, OUTPUT);
Serial.begin(9600);
usb.begin(9600);
}
void loop()
{
digitalWrite(LED_BUILTIN, HIGH);
Serial.println("Serial LED OFF");
usb.println("usb LED OFF");
delay(1000);
digitalWrite(LED_BUILTIN, LOW);
Serial.println("Serial LED ON");
usb.println("usb LED ON");
delay(1000);
}
https://www.shortn0tes.com/2017/06/how-to-use-platformio-to-develop-for.html
https://www.onetransistor.eu/2018/09/stm32-bluepill-dev-mbed-platformio-vscode.html
U19
PCB TEMP
UARTTX
UARTRX
AIR- (ISO)
Precharge Relay (ISO)
AIR+ (ISO)
USBDM
USBDP
SWDIO
SWCLK
IMD Data (ISO)
XTALA
XTALB
BOOT0
R60
10k
NRST
VBAT
VDD_1
VDD_2
VDD_3
VDDA
3.3V (ISO)
PA0/ADC0/CTS2/T2C1E/WKUP (PWM) (3.3V)
PA1/ADC1/RTS2/T2C2 (PWM) (3.3V)
PA2/ADC2/TX2/T2C3 (PWM) (3.3V)
PA3/ADC3/RX2/T2C4 (PWM) (3.3V)
PA4/ADC4/NSS1/CK2 (3.3V)
PA5/ADC5/SCK1 (3.3V)
PA6/ADC6/MISO1/T3C1/T1BKIN (PWM) (3.3V)
PA7/ADC7/MOSI1/T3C2/T1C1N (PWM) (3.3V)
PA8/CK1/T1C1/MCO (PWM)
PA9/TX1/T1C2 (PWM)
PA10/RX1/T1C3 (PWM)
PA11/USB-/CTS1/T1C4/CANRX
PA12/USB+/RTS1/T1ETR/CANTX
PA13/JTMS/SWDIO
PA14/JTMS/SWCLK
PA15/JTDI/NSS1/T2C1E
OSC_IN/PD0
OSC_OUT/PDI
BOOT0
NRST
VBAT
VDD_1
VDD_2
VDD_3
VDDA
STM32F103C8T6
(3.3V) (PWM) T1C2N/T3C3/ADC8/PB0
(3.3V) (PWM) T1C3N/T3C4/ADC9/PB1
BOOT1/PB2
T2C2/SCK1/JTD0/PB3
T3C1/MISO1/JTRST/PB4
(3.3V) T2C2/MOSI1/SMBAI1/PB5
(PWM) TX1/T4C1/SCL1/PB6
(PWM) RX1/T4C2/SDA1/PB7
(PWM) CANRX/SCL1/T4C3/PB8
(PWM) CANTX/SDA1/T4C4/PB9
T2C3N/TX3/SCL2/PB10
T2C4N/RX3/SDA2/PB11
CK3/T1BKIN/NSS2/PB12
CTS3/T1C1N/SCK2/PB13
RTS3/T1C2N/MISO2/PB14
T1C3N/MOSI2/PB15
* (3.3V) LED/TAMPER/PC13
* (3.3V) OSC32IN/PC13
* (3.3V) OSC32OUT/PC15
VSS_1
VSS_2
VSS_3
VSSA
0V (ISO)
CAN TX INDC
CAN RX INDC
BOOT1
R59
10k
AIR Power (ISO)
Discharge Enable (ISO)
Charge Enable (ISO)
CAN1 RD
CAN1 TD
AIR- Feedback (ISO)
AIR+ Feedback (ISO)
IMD OK (ISO)
AMS OK (ISO)
TS OK (ISO)
PDOC OK (ISO)
PC13
XTALC
XTALD
5V (ISO)
R70
5.1k
5V (ISO)
R71
5.1k
SCL
SDA
5V (ISO)
D10
SD560BTR
P2
USB4085-GF-A
VBUS
GND
SHIELD
D+1
D+2
D-1
D-2
CC1
CC2
SBUS1
SBUS2
R39
1.5k
R41
20R
USBDP
R61
20R
USBDM
R63
5.1k
R72
5.1k
0V (ISO)
3.3V (ISO)
C45
1uF
C46
100nF
C47
100nF
C48
100nF
PIN1
PIN24
PIN36
PIN48
X1
XTALA
XTALB
R21
10M
C19
22pF
C20
22pF
X2
32.768kHz
XTALC
XTALD
C40
22pF
C41
22pF
5V (ISO)
U20
VIN
GND
EN
VOUT
BP
RT9193-33GB
C42
1uF
C43
100nF
C44
1uF
C49
22uF
3.3V (ISO)
Title *
Size: A3
Number:*.
Revision:*
Date: 10/03/2020
Time: 9:54:09 PM
Sheet * of 10
File: C:\Users\patri\Google Drive\ts_19\Car\5. P&E\Future Schematics\ts_20-Precharge-Controller\200226 Precharge Controller R3\M
Altium

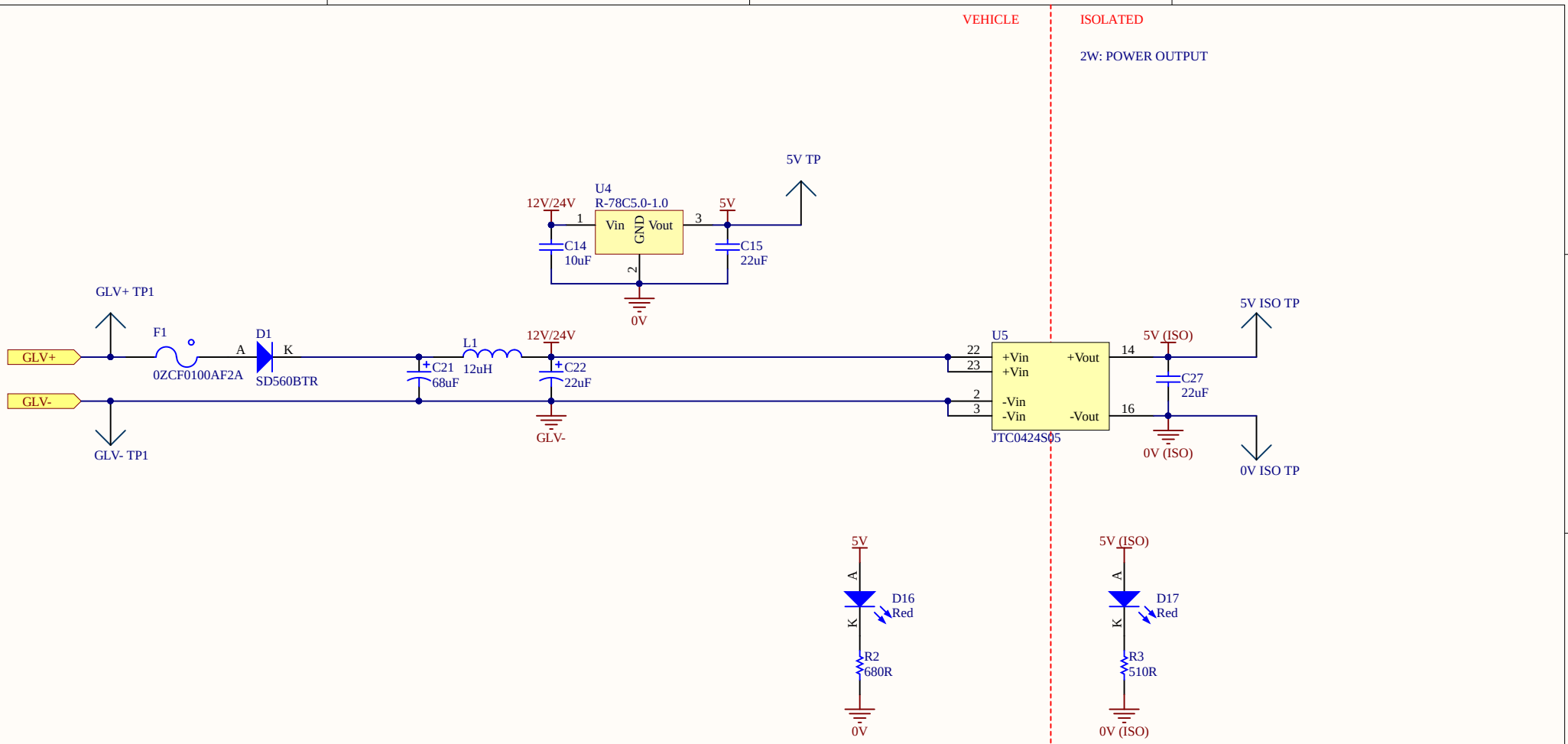
https://www.cantherm.com/wp-content/uploads/2017/05/CWF_11x17_OCT_2014_1.pdf

HIGH VOLTAGE ISOLATED



The PDOC (Precharge/Discharge Overcurrent) is intended to limit the failure of the precharge resistor by monitoring its temperature in in the case of a failure of a resistor will break the safety loop.

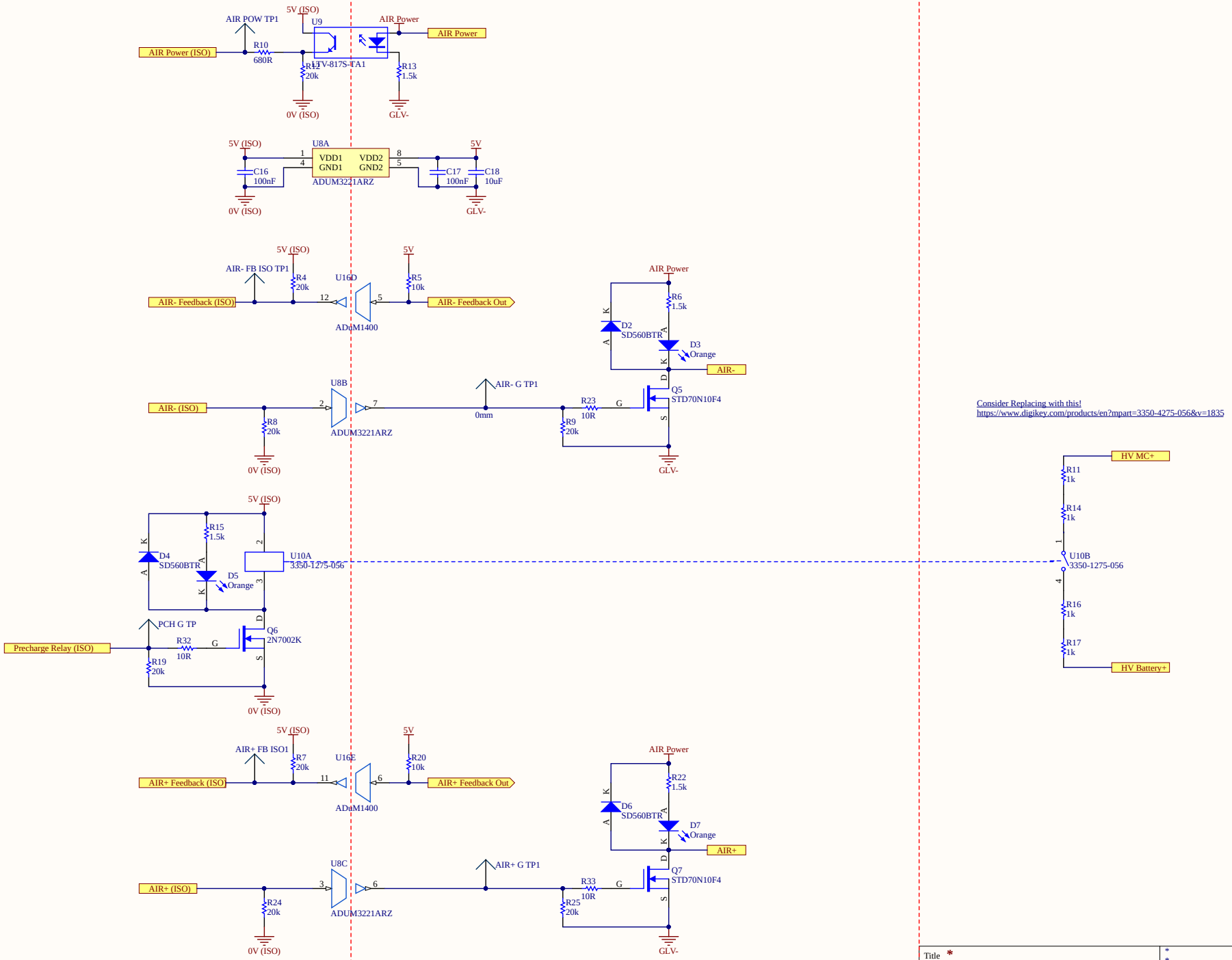
Title		
Size A4	Number	Revision
Date: 10/03/2020		Sheet of
File: C:\Users\..\PDOC.SchDoc		Drawn By:



Title		
Size: A4	Number	Revision
Date: 10/03/2020		Sheet of
File: C:\Users\..\Power Supply.SchDoc		Drawn By:

18mW: GATE DRIVER x2
0.6W: REED SWITCH

ISOLATED | VEHICLE | VEHICLE | HIGH VOLTAGE



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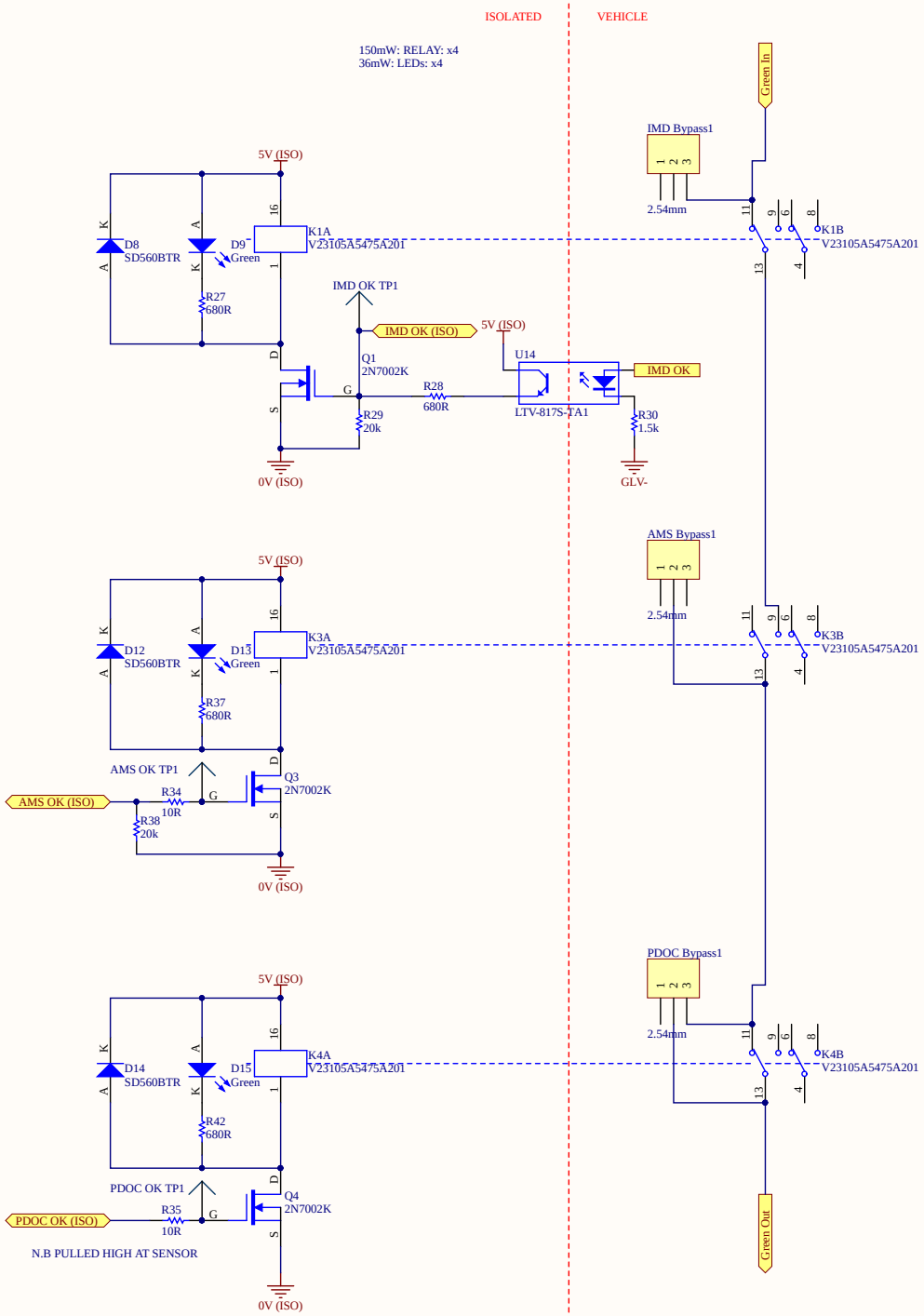

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EXTERNAL ISOLATED

PRIMARY INTERFACE

GLV+
CANH
AIR- Feedback Out
Green Out
GLV- REF
AIR Power
AIR+ Feedback Out
AIR- Feedback Out
2 1
4 3
6 5
8 7
10 9
12 11
14 13
16 15
18 17
20 19
CANL
CANS
Green In
CHASSIS REF
GLV-
AIR Power
AIR+
AIR Power
AIR-
GLV-
GLV-
39300200

HV MC+ — 1 2 — HV MC+ — 39300020

HV BATTERY+ — 1 2 — HV Battery+ — 39300020

HV BATTERY- — 2 1 — HV Battery- — 39300020

HV MC- — 2 1 — HV MC- — 39300020

P1 — 12V/24V
GLV- REF — 2 1 — IMD OK
CHASSIS REF — 4 3 — IMD Data
6 5
GLV-
39300060

HV IMD+ — 2 1 — HV MC+ — 39300020

HV IMD- — 2 1 — HV MC- — 39300020

ABBREVIATIONS
- AMS - Accumulator Managmeent System
- AIR - Accumulator Isolation Relay
- BATT - Battery
- MC - Motor Controller
- TL - Tractive Loop
- FB - Feedback
- PDOC - Precharge/Discharge Over-Current

FUTURE FEATURES TO BE ADDED
- USB 2.0 Interface for MCU
- Separation Cutouts underneath Isolated Components & Fuses
- Additional Fusing of HV Connection to IMD
- Possibility of Refined Precharge Voltage Detection without I2C
- AAI to be on Separate PCB alongside IMD
- Possibility of Cheaper DC-DC Isolator for GLV interface & using U4 as Preregulator

KNOWN ISSUES
- Designators Misaligned
- Safety Loop Jumpers not routed
- I2C Vulnerable, worth Switching to SPI?

3940mW CONSUMPTION — 3000mW CONSUMPTION
U_Power Supply
Power Supply.SchDoc
GLV+
GLV-
GLV+
GLV-
GLV-

STATES
- 0: FAULT
- 1: IDLE
- 2: PRECHARGING
- 3: ACTIVE

PRECHARGE TRIGGERS
- (0x18FF50E5) : ELCON/TC CHARGER ACTIVE
- (0x306) BYTE1: VEHICLE PRECHARGE BUTTON

PRECHARGE STATES
- 0: SET CONTACTORS INACTIVE
- 1: SET AIR- & PRECHARGE ACTIVE
- 2: START PRECHARGE TIMER (5 SECS)
- 3: CHECK PRECHARGE VOLTAGE ABOVE 95%
- 4: SET AIR+ ACTIVE

FAULTS
- IMD BREAKDOWN
- DISCHARGE FAIL
- PDOC OVERTEMPERATURE
- NO AIR POWER
- ORION TIMEOUT
- DISCHARGE ACTIVE IN STATE 2/3

WARNINGS
- PCB TEMPERATURE TOO HOT
- SEVERE HV VOLTAGE MISMATCH

U_CAN — CAN.SchDoc — 650mW
CANH
CANL
CANS
CANH
CANL
CANS
5mW
TX
RX
CAN TX
CAN RX

U_Microcontroller — Microcontroller.SchDoc — 1010mW
CAN1 TD
CAN1 RD

U_Safety Loops — Safety Loops.SchDoc — 756mW
Green In
AMS OK
IMD OK
TS Out
TS In
Green Out
Green In
AMS OK
IMD OK
TS Out
TS In
Green Out
AMS OK (ISO)
IMD OK (ISO)
TS OK (ISO)
PDOC OK (ISO)
AMS OK (ISO)
IMD OK (ISO)
TS OK (ISO)
PDOC OK (ISO)
AMS OK (ISO)
IMD OK (ISO)
TS OK (ISO)
PDOC OK (ISO)

U_PDOC — PDOC.SchDoc — 31.5mW
PDOC OK
SCL
SDA
SCL
SDA
SCL
SDA

U_HV Sense — HV Sense.SchDoc — 12mW
HV Battery+
HV Battery-
HV+
HV-
Address
VDDISO
GNDISO
SCL
SDA

U_HV Sense — HV Sense.SchDoc — 12mW
HV MC+
HV MC-
HV+
HV-
Address
VDDISO
GNDISO
SCL
SDA

U_Digital Isolation — Digital Isolation.SchDoc — 5mW — 5mW
IMD Data
Discharge Enable
Charge Enable
IMD Data
Discharge Enable
Charge Enable
IMD Data (ISO)
Discharge Enable (ISO)
Charge Enable (ISO)
IMD Data (ISO)
Discharge Enable (ISO)
Charge Enable (ISO)
IMD Data (ISO)
Discharge Enable (ISO)
Charge Enable (ISO)

U_Precharge — Precharge.SchDoc — 94mW — 535mW
AIR Power
AIR+
AIR+ Feedback Out
AIR-
AIR- Feedback Out
AIR- Feedback In
HV MC+
HV Battery+
AIR Power
AIR+
AIR+ Feedback Out
AIR-
AIR- Feedback Out
HV MC+
HV Battery+
AIR Power (ISO)
AIR+ (ISO)
AIR+ Feedback (ISO)
AIR- (ISO)
AIR- Feedback (ISO)
Precharge Relay (ISO)
AIR Power (ISO)
AIR+ (ISO)
AIR+ Feedback (ISO)
AIR- (ISO)
AIR- Feedback (ISO)
Precharge Relay (ISO)

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Size: A3	Number:*.	Revision:*	
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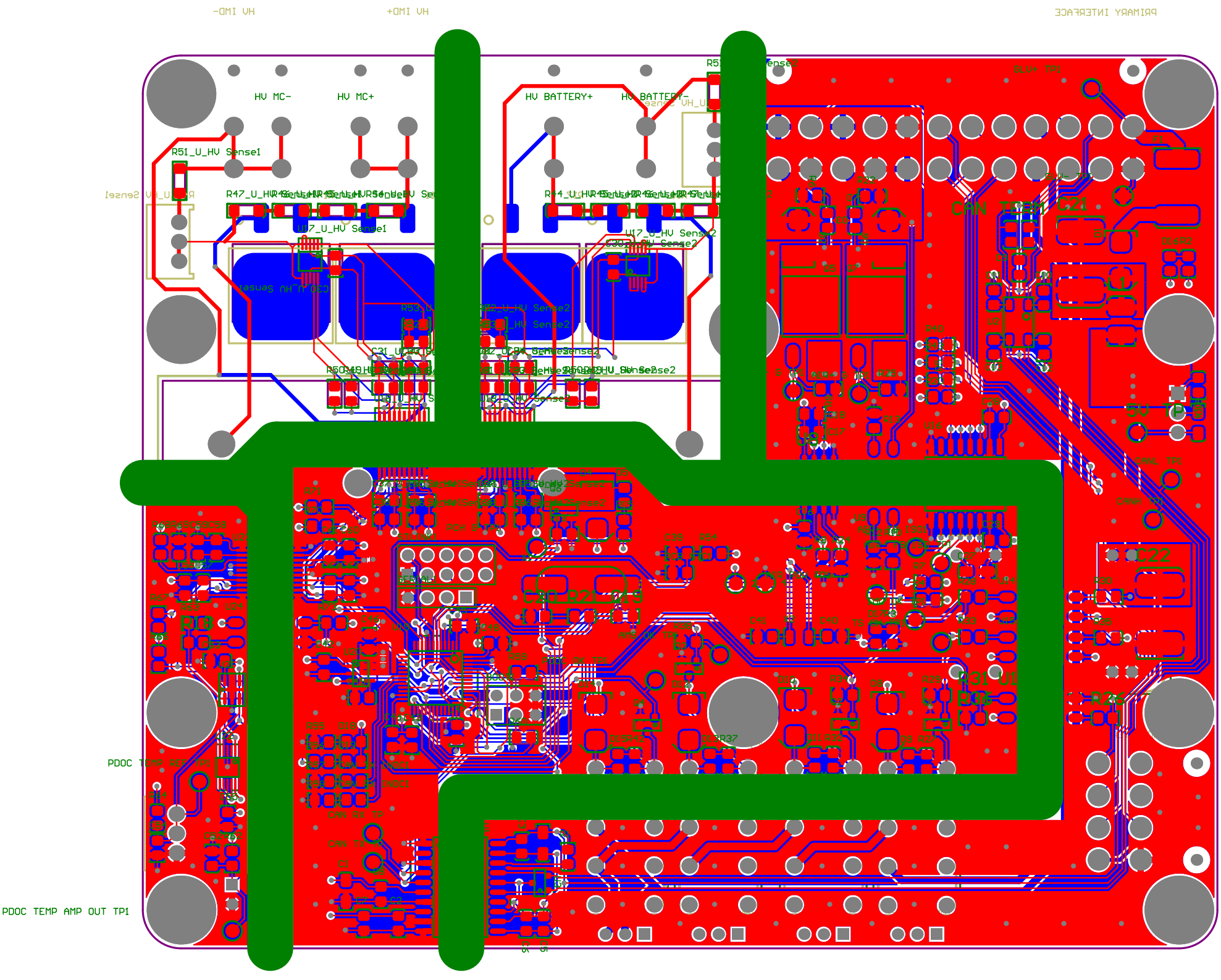
HV MC-
HV MC+
HV BATTERY+
HV BATTERY-
R51_U_HV Sense1
CAN TERM
PDOC TEMP REF TP1
PDOC TEMP AMP OUT TP1

Comment	Description	Designator	Footprint	LibRef	Quantity
0mm		0V ISO TP, 5V ISO	SMD Test Point	SMD Test Point	
2.54mm		AMS Bypass1, IMD E	TH 2.54mm Header 1	TH 2.54mm Header 1	
2.54mm		BOOT1	TH 2.54mm Header 2	TH 2.54mm Header 2	
10nF		C1, C4	1206	GCM3195C2A103JA1	
100nF		C2, C3, C6, C8, C16	0805	GCM21BR71E104KA	
10uF		C5, C7, C14, C18, C	0805	GRM21BR6YA106KE	
22pF		C9, C19, C20, C40, C	0805	GCM21B5C1H220JA	
100pF		C10, C11, C12, C13	0805	GCM21B5C1H101JA	
22uF		C15, C27	1206	CC1206MKX5R7BB22	
68uF		C21	2924	TAJV686K035RNJ	
22uF		C22	2924	TAJV226K050RNJ	
10nF		C31_U_HV Sense1	0805	GCM21BR71H103KA	
1uF		C42, C44, C45	0805	GCM21BR71A105KA	
22uF		C49	0805	GRM21BR61A226ME	
Blue	LED BLUE CLEAR 201	CAN RX INDC1, CAN	0805 LED	SML-MN2BCTT86C	
56R		CAN TERM R1, CAN T	0805	RC0805FR0756RL	
SD560BTR	1.2V_F 600V 5A SMB	D1, D2, D4, D6, D8,	SMB Diode	SD560BTR	
Orange	Orange LED Indicati	D3, D5, D7	0805 LED	SML-211DTT86	
Green	Green LED Indicatio	D9, D13, D15	0805 LED	SML-210FTT86	
Red	Red LED Indication -	D16, D17, D18, D19	0805 LED	SML-210LTT86	
0ZCF0100AF2A	PTC RESETFUSE 60V	F1	2920	0ZCF0100AF2A	
39300020		HV BATTERY-, HV BA	39300020	39300020	
V23105A5475A201	5V DPDT Relay 3A 22	K1, K3, K4	TI 2-DIL	V23105A5475A201	
12uH		L1	1812	RLS-126	
39300060		P1	39300060	39300060	
USB4085-GF-A	USB-C (Type-C) U	P2	USB4085-GF-A	USB4085-GF-A	
10K (NTC) (B25/85 3430K)		PCB NTC1	0805	NTCS0805E3103FLT	
2.54mm		PDOC NTC1	TH 2.54mm Header 1	TH 2.54mm Header 1	
39300200		PRIMARY INTERFACE	39300200	39300200	
2N7002K	60V 380mA, NFET	Q1, Q3, Q4, Q6	SOT-343_N	2N7002K	
STD70N10F4	N-Channel 100V 60	Q5, Q7	SOT-343_N	STD70N10F4	
0R		R1	0805	RC0805FR070RL	
680R		R2, R10, R18, R27, R	0805	RC0805FR07680RL	
510R		R3, R55, R56	0805	RC0805FR07510RL	
20k		R4, R7, R8, R9, R12,	0805	RC0805FR0720KL	
10k		R5, R20, R53_U_HV	0805	RC0805FR0710KL	
1.5k		R6, R13, R15, R22, R	0805	RC0805FR071K5L	
1k		R11, R14, R16, R17	BTO-263	PWR263S-35-1001J	
10M		R21	0805	RC0805FR0710ML	
10R		R23, R32, R33, R34,	0805	RC0805FR0710RL	
20R		R41, R61	0805	RC0805FR0720RL	
330K		R44_U_HV Sense1,	VB0204	MMA02040C3303FB3	
10K (Var)		R48_U_HV Sense1,	B3296	3296W-1-103LF	
5.6k		R49_U_HV Sense1,	0805	RC0805FR075K6L	
10K		R51_U_HV Sense1,	VB0204	MMA02040C1002FB3	
30k		R52_U_HV Sense1,	0805	RC0805FR0730KL	
2k		R62	0805	RC0805FR072KL	
5.1k		R63, R70, R71, R72	0805	RC0805FR075K1L	
3k		R73	0805	RC0805FR073KL	
2.54mm		SERIAL1	TH 2.54mm Header 1	TH 2.54mm Header 1	
2.54mm		STLINK1	TH 2.54mm Header 2	TH 2.54mm Header 2	
ADM3053	Isolated CAN Transc	U1	AD SOIC-W20	ADM3053	
B82787C0104H002	100µH @ 100kHz 2L	U2	TDK 4-PC Pad	B82787C0104H002	
NUP2105L	Dual Line CAN Bus P	U3	ON SOT-23 BJT	NUP2105L	
R-78C5.0-1.0	CONV DC/DC 1A 5V	U4	RECOM 3-SIP	R-78C5.0-1.0	
JTC0424S05	DC DC CONVERTER	U5	24-DIP Module, 7 Les	JTC0424S05	
ADUM3221ARZ	4A Gate Driver Mag	U8	AD 8-SOIC	ADUM3221ARZ	
LTV-817S-TA1	35V 50ma Optocoup	U9, U11, U14, U24	ON 4-SMD	LTV-817S-TA1	
3350-1275-056	RELAY REED HV SP	U10	CI SPST	3350-1275-056	
ADuM1400	General Purpose Dig	U16	AD 16-SOIC	ADuM1400	