SATURN SERIES TBR3206 MACHINE CONTROLLER

Changelog:
REV D:
Updated name and title of documents to reflect new component name.
Page 3 -
I2C Bus Pullup Correction: R405 R406 -> 2.74k. Fixed pullup strength for acceptable logic levels.
FPGA Programming Pin Correction: R126 R127 R128 -> 100k. Decreased strength of FPGA programming pins to account for FPGA pull-ups during programming.
HW Revision Bit Resistors updated to 3 // 0x011
Page 9 -
H-Bridge 1 Current Sense Fix: R211 -> 3mOhm. Resolved scenario where overcurrent conditions on H-Bridge 1 could damage uC.
Page 17-
Precharge timing correction: C475 -> 4.7uF, R436 R439 -> 23.7k. Reduced rate of precharge to meet 1.5A requirement.

REV E:
Page 4: Updated HW Rev Bits to 4
Pages 9-15: Replaced 0.033uF caps on gates of FETs with 10k resistors to eliminate ringing that was causing component damage.

PCB ○ Q25099-002

01_Title_Page.SchDoc

Rev	E
Size:	B
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	1 of 18

Title
01_Title_Page.SchDoc
Inputs_Logic_Analog
05_Inputs.SchDoc
Micro_Control
03_Micro_Control.SchDoc
DRIVER_CONTROL
04_Hardware_For_Micro_and_FPGA.SchDoc
H-BRIDGE1 10A Limit
09_H_BRIDGE1.SchDoc
HALF-BRIDGE1 60A Limit
06_HALF_BRIDGE1.SchDoc
HALF-BRIDGE2 60A Limit
07_HALF_BRIDGE2.SchDoc
H-BRIDGE2 10A Limit
10_H_BRIDGE2.SchDoc
HALF-BRIDGE3 60A Limit
08_HALF_BRIDGE3.SchDoc
LSD1 10A Limit
11_LSD1.SchDoc
LSD2 10A Limit
12_LSD2.SchDoc
LSD3 10A Limit
13_LSD3.SchDoc
LSD4 10A Limit
14_LSD4.SchDoc
LSD5 10A Limit
15_LSD5.SchDoc
LSD6 20A Limit
16_LSD6.SchDoc
Power and Connectors
17_Power_Connectors.SchDoc
J27
2384723-3
J28
2384723-4
GND

02_Top_Level.SchDoc

PROPRIETARY INFORMATION

THE INFORMATION IN THIS DOCUMENT IS PROPERTY OF TENNANT COMPANY. IT IS SUBJECT TO RETURN UPON DEMAND AND MAY NOT BE REPRODUCED OR DISCLOSED TO OTHERS WITHOUT WRITTEN PERMISSION OF TENNANT COMPANY

Rev	E
Size:	D
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	2 of 18

MICROCONTROLLER

INPUTS ARE NOT 5V TOLERANT, EXCEPT USB_VBUS.

"RESTRICT SIGNATURE"
This PCB_B input must be held low and must be immediately asserted at power-up and remain asserted until after the last power rail reaches its working voltage. In the absence of an external reset feeding the POR_B input, the internal POR circuitry will hold the MCU in reset for 16 milliseconds (MAX 1222ms) for further details and to ensure that all necessary requirements are being met.

ReHad page 2276
This module generates an internal POR_B signal that is logically AND'ed with any external POR_B signal to the chip. The internal POR_B signal will be held low until all of the following conditions are met:
• 4ms after the external power supply VDDHIGH_IN is valid
• 4ms after the VDD_SOC_IN is valid
The 4ms and 1.2ms delays are derived from counting the 32 kHz RTC clock cycles; the accuracy depends on the accuracy of the RTC. When the RTC crystal is either absent or in the process of powering up, an internal ring oscillator will be the source of RTC, which is not accurate enough for this.

If the external SRC_POR_B signal is used to control the processor POR, SRC_POR_B should be asserted (LOW) until the VDD_SOC supplies are stable.
If the external SRC_POR_B signal is not used (always held high or left unconnected), the processor defaults to the internal POR function (PMU controls generation of the POR based on the power supplies).

JTAG_RESET_B_NC_M

VDD_3p3V

U17 1G08_HC

C412 1uF

C136 0.01µF 25V

R108 10K

TP28

Protect nRESET line with GND on both sides.

nRESET

R111 10K

U19 APX803S05-26SR-7

FB1 300 Ohms

C138 0.01µF 25V

Place near uC

TP30

C135 18pF 25V

R107 2M

C137 18pF 25V

Y1 24.000MHZ

R112 10K

R113 10K

R114 10K

EEPROM_WR_PROT

MICRO is I2C ADDRESS 00

I2C_INT might not be needed now

I2C_SCL
I2C_SDA

R405 2.74k 1%
R406 2.74k 1%

SW1_uC
SW2_uC
SW3_uC
SW4_uC
nSW1_uC
nSW2_uC
nSW3_uC
nSW4_uC
nSW5_uC
nSW6_uC

R123 1K

BOARD REVISION BIT DECODER:

BIT	2	1	0	
REV 0	0	0	0	Beta
REV 1	0	0	1	P1.0
REV 2	0	1	0	P1.5
REV 3	0	1	1	P2
REV 4	1	0	0	Prod

BOARD_REVISION_BIT_2
BOARD_REVISION_BIT_1
BOARD_REVISION_BIT_0

FPGA_INITN needs to be tied HIGH
FPGA_DONE needs to be tied HIGH

FPGA_PROGRMN	
MICRO_ALIVE	
FPGA_INITN	#BOOT_CFG_0
FPGA_DONE	#BOOT_CFG_1
HALF_BRIDGE3_PWM_MICRO	#BOOT_CFG_2
HALF_BRIDGE2_PWM_MICRO	#BOOT_CFG_3
HALF_BRIDGE1_PWM_MICRO	#BOOT_CFG_4
H_BRIDGE1_PWM_MICRO	#BOOT_CFG_5
H_BRIDGE2_PWM_MICRO	#BOOT_CFG_6
LSD1_PWM_MICRO	#BOOT_CFG_7
LSD2_PWM_MICRO	#BOOT_CFG_8
LSD3_PWM_MICRO	#BOOT_CFG_9
LSD4_PWM_MICRO	
LSD5_PWM_MICRO	
LSD6_PWM_MICRO	
LSD6_STATUS	
LSD5_STATUS	
LSD4_STATUS	
LSD3_STATUS	
LSD2_STATUS	
LSD1_STATUS	
H_BRIDGE2_STATUS	
H_BRIDGE1_STATUS	
HALF_BRIDGE2_STATUS	
HALF_BRIDGE1_STATUS	

R122 R123 R125 R126 100k R127 100k R128 100k R130 R131 R132 R133 R134 R135 R136 R138 R139 R140 R141 R418 R419 R420 R421 R422 R423 R424 R425 R426 R427 R428 10K

U18A

XTALI
XTALO
RTC_XTALI
RTC_XTALO
ONOFF
PMIC_ON_REQ
PMIC_STBY_REQ
WAKEUP/GPIO5_IO[9]

GPIO_EMC_00 GPIO_EMC_01 GPIO_EMC_02 GPIO_EMC_03 GPIO_EMC_04 GPIO_EMC_05 GPIO_EMC_06 UART3_TX GPIO_EMC_07 UART3_RX GPIO_EMC_08 GPIO_EMC_09 GPIO_EMC_10 I2C4_SDA GPIO_EMC_11 I2C4_SCL GPIO_EMC_12 GPIO_EMC_13 GPIO_EMC_14 GPIO_EMC_15 GPIO_EMC_16/BOOT_MODE[0] GPIO_EMC_17/BOOT_MODE[1] GPIO_EMC_18 GPIO_EMC_19 GPIO_EMC_20 GPIO_EMC_21 GPIO_EMC_22 GPIO_EMC_23 GPIO_EMC_24 GPIO_EMC_25 GPIO_EMC_26 GPIO_EMC_27 GPIO_EMC_28 GPIO_EMC_29 GPIO_EMC_30 GPIO_EMC_31 GPIO_EMC_32 GPIO_EMC_33 GPIO_EMC_34 GPIO_EMC_35 GPIO_EMC_36 GPIO_EMC_37 GPIO_EMC_38 GPIO_EMC_39 GPIO_EMC_40 GPIO_EMC_41

TEST_MODE
GPANAIO

JTAG_TRST JTAG_TDO JTAG_TDI JTAG_MOD JTAG_TCK JTAG_TMS

GPIO_AD_B0_05 JTAG_TRST
GPIO_AD_B0_04 JTAG_TDO_M
GPIO_AD_B0_03 JTAG_TDI_M
GPIO_AD_B0_02
GPIO_AD_B0_01 JTAG_TCK_M
GPIO_AD_B0_00 JTAG_TMS_M

R109 10K
R110 10K

UART1_TX GPIO_AD_B0_06 DEBUG_TX
UART1_RX GPIO_AD_B0_07 DEBUG_RX

GPIO_AD_B0_08
GPIO_AD_B0_09
GPIO_AD_B0_10
GPIO_AD_B0_11
GPIO_AD_B0_12 HALF_BRIDGE1_CRT_SNS_u
GPIO_AD_B0_13 HALF_BRIDGE2_CRT_SNS_u
GPIO_AD_B0_14 H_BRIDGE1_CRT_SNS_u
GPIO_AD_B0_15 H_BRIDGE2_CRT_SNS_u

nSOURCE_1_TRIP
nSOURCE_2_TRIP
nSOURCE_3_TRIP

nRESET_uC_2_FPGA
R412 10k
C402 0.1UF
C403 0.1UF
C404 0.1UF

GPIO_AD_B1_00 nSW7_uC
GPIO_AD_B1_01 nSW8_uC
GPIO_AD_B1_02 H_BRIDGE2_CRT_SNS_u
GPIO_AD_B1_03 LSD1_CRT_SNS_u
GPIO_AD_B1_04 LSD2_CRT_SNS_u
GPIO_AD_B1_05 LSD3_CRT_SNS_u
GPIO_AD_B1_06 LSD4_CRT_SNS_u
GPIO_AD_B1_07 LSD5_CRT_SNS_u
GPIO_AD_B1_08 LSD6_CRT_SNS_u
GPIO_AD_B1_09 POWER_SOURCE_1_SNS_u
GPIO_AD_B1_10 POWER_SOURCE_2_SNS_u
GPIO_AD_B1_11 POWER_SOURCE_3_SNS_u
GPIO_AD_B1_12 PRECHARGE_OUT_SNS_u
GPIO_AD_B1_13 V_5V1_SNS_u
GPIO_AD_B1_14 V_5V2_SNS_u
GPIO_AD_B1_15 V_5V3_SNS_u

A/D filtering
PLACE CAPS CLOSE TO MICRO

GPIO_SD_B0_00 nSW9_uC
GPIO_SD_B0_01 CAN_LED
GPIO_SD_B0_02 MICRO_HEARTBEAT_LED
GPIO_SD_B0_03 nSW10_uC
GPIO_SD_B0_04 CAN_TX
GPIO_SD_B0_05 CAN_RX
GPIO_SD_B0_06 QSPI_B_FPGA_nCS

CAN1_TX GPIO_SD_B1_00 QSPI_B_IO3
CAN1_RX GPIO_SD_B1_01 QSPI_B_SCK
GPIO_SD_B1_02 QSPI_B_IO0
GPIO_SD_B1_03 QSPI_B_IO1
GPIO_SD_B1_04 QSPI_B_IO2
GPIO_SD_B1_05 QSPI_B_nCS
GPIO_SD_B1_06 QSPI_A_IO3
GPIO_SD_B1_07 QSPI_A_SCK
GPIO_SD_B1_08 QSPI_A_IO0
GPIO_SD_B1_09 QSPI_A_IO1
GPIO_SD_B1_10 QSPI_A_IO2
GPIO_SD_B1_11 QSPI_A_nCS

FLEXSPI_B_D3
FLEXSPI_B_SCLK
FLEXSPI_B_D0
FLEXSPI_B_D1
FLEXSPI_B_D2
FLEXSPI_B_SS0_B
FLEXSPI_A_D3
FLEXSPI_A_SCLK
FLEXSPI_A_D0
FLEXSPI_A_D1
FLEXSPI_A_D2
FLEXSPI_A_SS0_B

USB_OTG1_DN
USB_OTG1_DP
USB_OTG1_VBUS
USB_OTG1_CHD_B

MICRO_HEARTBEAT_LED
CAN_LED
R344 499
R345 499
D36 YLW
D37 GRN

U18B MIMXRT1021CAG4A

NVCC_GPIO NVCC_GPIO NVCC_GPIO NVCC_GPIO NVCC_GPIO NVCC_GPIO NVCC_GPIO NVCC_GPIO NVCC_SD0

VSS VSS VSS VSS VSS VSS VSS VSS NGND_KEL0

VDDA_ADC_3P3
VDD_HIGH_IN
VDD_SNVS_IN

DCDC_IN
DCDC_IN_Q
DCDC_LP
DCDC_PSWITCH
DCDC_GND
VDD_SOC_IN
VDD_HIGH_CAP
NVCC_PLL
VDD_SNVS_CAP
VDD_USB_CAP

VDD_HI_CAP_2.5V
NVCC_PLL 1.1V
VDD_SNVS 1.1V
VDD_USB_3.3V

Place these decoupling capacitors near the Micro.

C150 C166 C161 C162 C163 C164 C165 C166 2.2nF

C176 C177 C178 C179 C184 C185 C186 C187 C180 C183 C181 0.22µF 16V 0603; 4.7µF 16V; 6800pF; 1uF

C199 C200 1uF; 0.22UF 16V 0603

C205 4.7µF 16V
C206 0.22UF 16V 0603
C210 0.22UF 16V 0603

C169 0.22UF 16V 0603
C170 0.22UF 16V 0603
C168 4.7µF 16V
L4 4.7µH 1.4A
C173 C174 C175 10uF 16V 0805
C172 0.22UF 16V 0603
C188 0.22UF 16V 0603
C190 C191 C192 C193 C194 C196 0.22UF 16V 0603; 6800pF; 0.022UF
C195 C197 1uF; 4.7UF 16V
C200 C203 C207 C209 0.22UF 16V 0603; 4.7uF 16V
C201 0.22UF 16V 0603
C212 10uF 16V 0805
C213 0.22UF 16V 0603

R149 10k
C476 0.01µF 50V
U58 STM1061N30WX6F
Place USB and C476 as close to micro and C185 as possible.

C405 C406 4.7µF 16V; 0.22UF 16V 0603

A/D filtering
PLACE CAPS CLOSE TO MICRO

$0.03 per each function for the RC filtering and PWM signal(0.1uF, 121Ohms, 100pF)

NOTE: PLACE 0.1uF caps close to micro.

HALF_BRIDGE3_CRT_SNS_u $0.01 C47 0.01µF 25V R116 1k HALF_BRIDGE3_CURRENT_SENSE
HALF_BRIDGE2_CRT_SNS_u C48 0.01µF 25V R117 1k HALF_BRIDGE2_CURRENT_SENSE
HALF_BRIDGE1_CRT_SNS_u C49 0.01µF 25V R118 1k HALF_BRIDGE1_CURRENT_SENSE
H_BRIDGE1_CRT_SNS_u C149 0.01µF 25V R124 1k H_BRIDGE1_CURRENT_SENSE
H_BRIDGE2_CRT_SNS_u C150 0.01µF 25V R129 1k H_BRIDGE2_CURRENT_SENSE
LSD1_CRT_SNS_u C151 0.01µF 25V R137 1k LSD1_CURRENT_SENSE
LSD2_CRT_SNS_u C152 0.01µF 25V R142 1k LSD2_CURRENT_SENSE
LSD3_CRT_SNS_u C153 0.01µF 25V R143 1k LSD3_CURRENT_SENSE
LSD4_CRT_SNS_u C154 0.01µF 25V R144 1k LSD4_CURRENT_SENSE
LSD5_CRT_SNS_u C155 0.01µF 25V R145 1k LSD5_CURRENT_SENSE
LSD6_CRT_SNS_u C156 0.01µF 25V R146 1k LSD6_CURRENT_SENSE
POWER_SOURCE_1_SNS_u C157 0.01µF 25V R147 1k POWER_SOURCE_1_SENSE
POWER_SOURCE_2_SNS_u C158 0.01µF 25V R148 1k POWER_SOURCE_2_SENSE
POWER_SOURCE_3_SNS_u C167 0.01µF 25V R150 1k POWER_SOURCE_3_SENSE
PRECHARGE_OUT_SNS_u C171 0.01µF 25V R151 1k PRECHARGE_OUT_SENSE
V_5V1_SNS_u C182 0.01µF 25V R152 1k 5V_1_SENSE
V_5V2_SNS_u C189 0.01µF 25V R153 1k 5V_2_SENSE
V_5V3_SNS_u C190 0.01µF 25V R154 1k 5V_3_SENSE

EEPROM

U59 CAT24C256WI-GT3
A0 A1 A2 VSS VCC WP SCL SDA
I2C_SCL I2C_SDA
C514 0.1µF 16V
R507 2.1k
EEPROM_WR_PROT

7-bit I2C addresses (12C0)	
FPGA 1	0x40
FPGA 2	0x42
EEPROM	0xA0

TENNANT

Rev	E
Size	D
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date	12/18/2024
Sheet	3 of 18

03_Micro_Control.SchDoc

MICRO HARDWARE

BANK 0
LCMXO3LF-2100C-5BG256I

BANK 1
LCMXO3LF-2100C-5BG256I

BANK 2
LCMXO3LF-2100C-5BG256I

BANK 3
LCMXO3LF-2100C-5BG256I

BANK 4
LCMXO3LF-2100C-5BG256I

BANK 5
LCMXO3LF-2100C-5BG256I

BANK 0 - JTAG
LCMXO3LF-2100C-5BG256I

FLASH1
JTAG MASTER (ON SILKSCREEN)

FLASH2

DEBUG uC

uC JTAG
JTAG MASTER (ON SILKSCREEN)

JTAG FPGA (ON SILKSCREEN)

FPGA JTAG

7-bit I2C addresses (12C0)	
FPGA 1	0x40
FPGA 2	0x42
EEPROM	0xA0

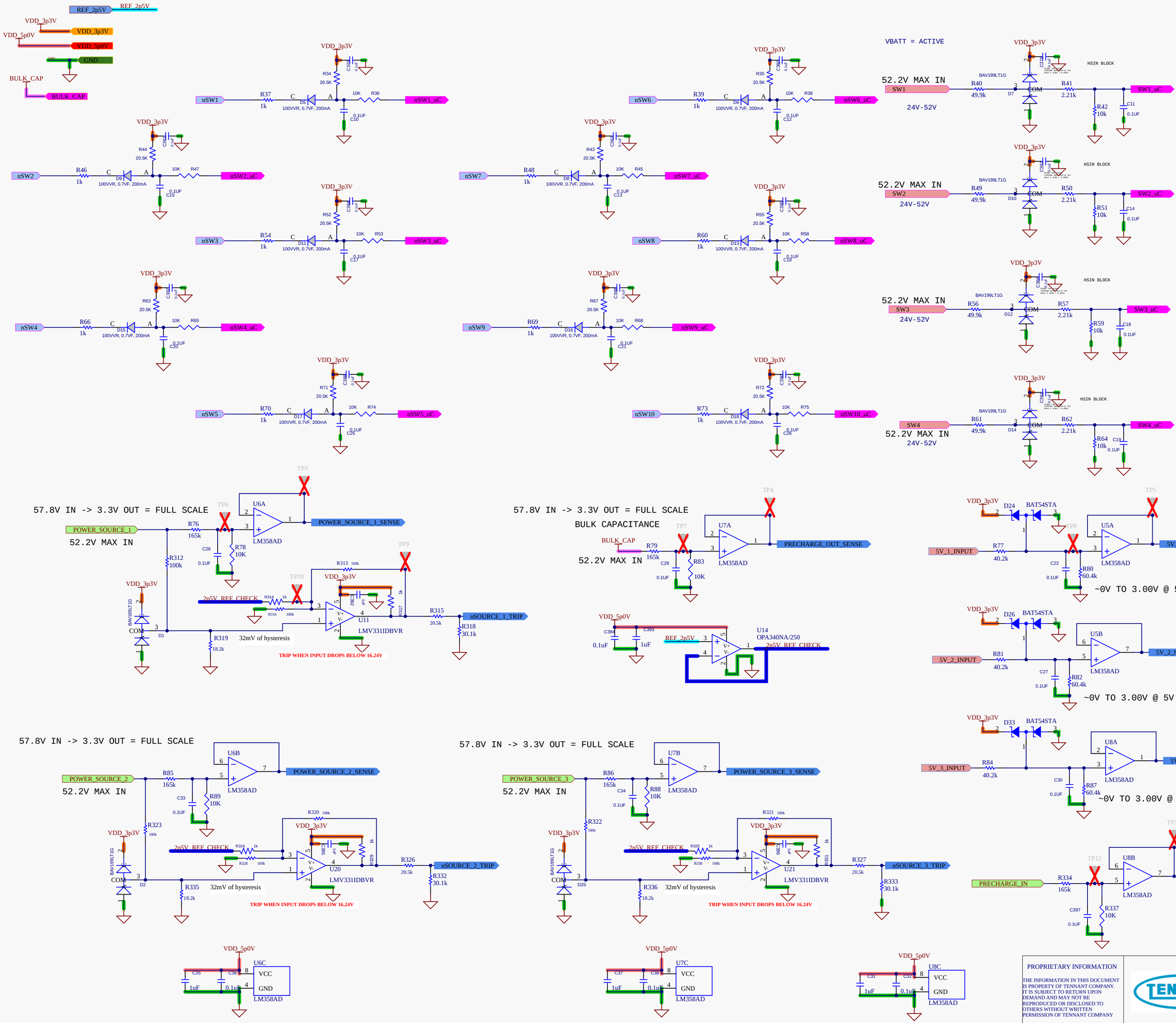
PROPRIETARY INFORMATION

THE INFORMATION IN THIS DOCUMENT IS PROPERTY OF TENNANT COMPANY. IT IS SUBJECT TO RETURN UPON DEMAND AND MAY NOT BE REPRODUCED OR DISCLOSED TO OTHERS WITHOUT WRITTEN PERMISSION OF TENNANT COMPANY

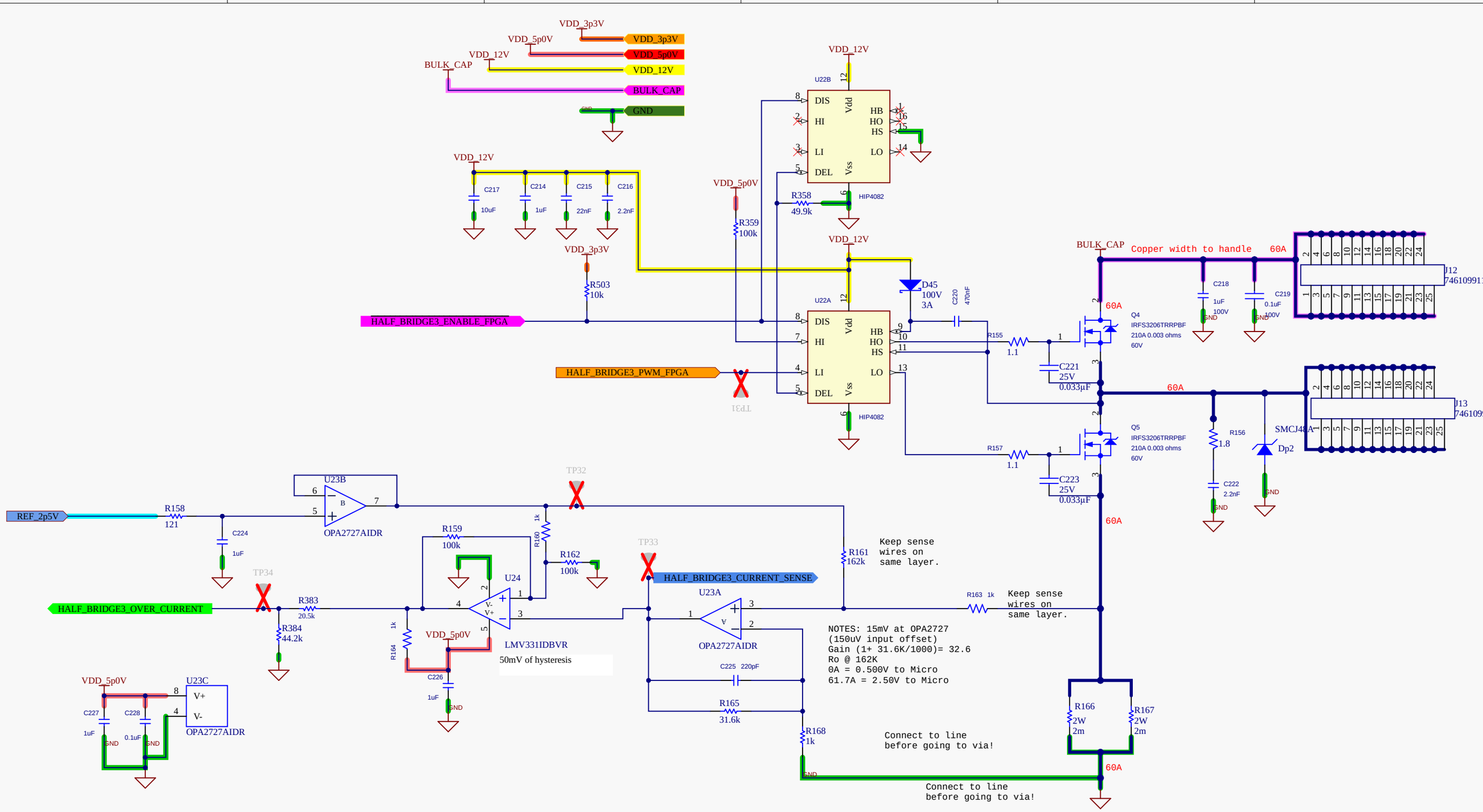
TENNANT

04_Hardware_For_Micro_and_FPGA.SchDoc

Rev: E
Size: C
Title: SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number: Q26051-002
Engineer: RDH
Date: 12/18/2024
Sheet 4 of 18

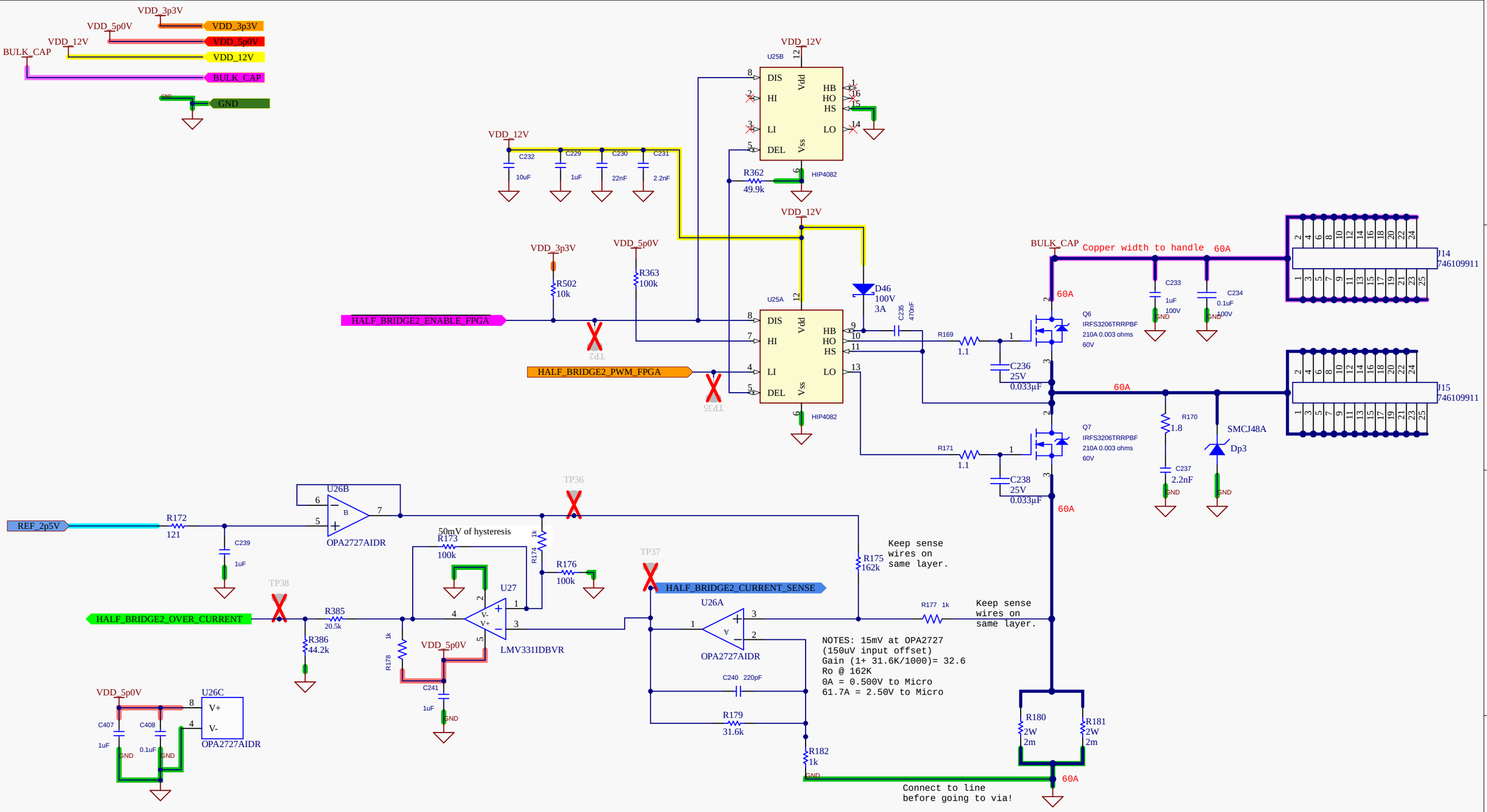


05_Inputs.SchDoc	
Rev: E	Title: SATURN SERIES TBR3206 MACHINE CONTROLLER
Size: C	
Document Number: Q26051-002	Engineer: RDH
Date: 12/18/2024	Sheet 5 of 18

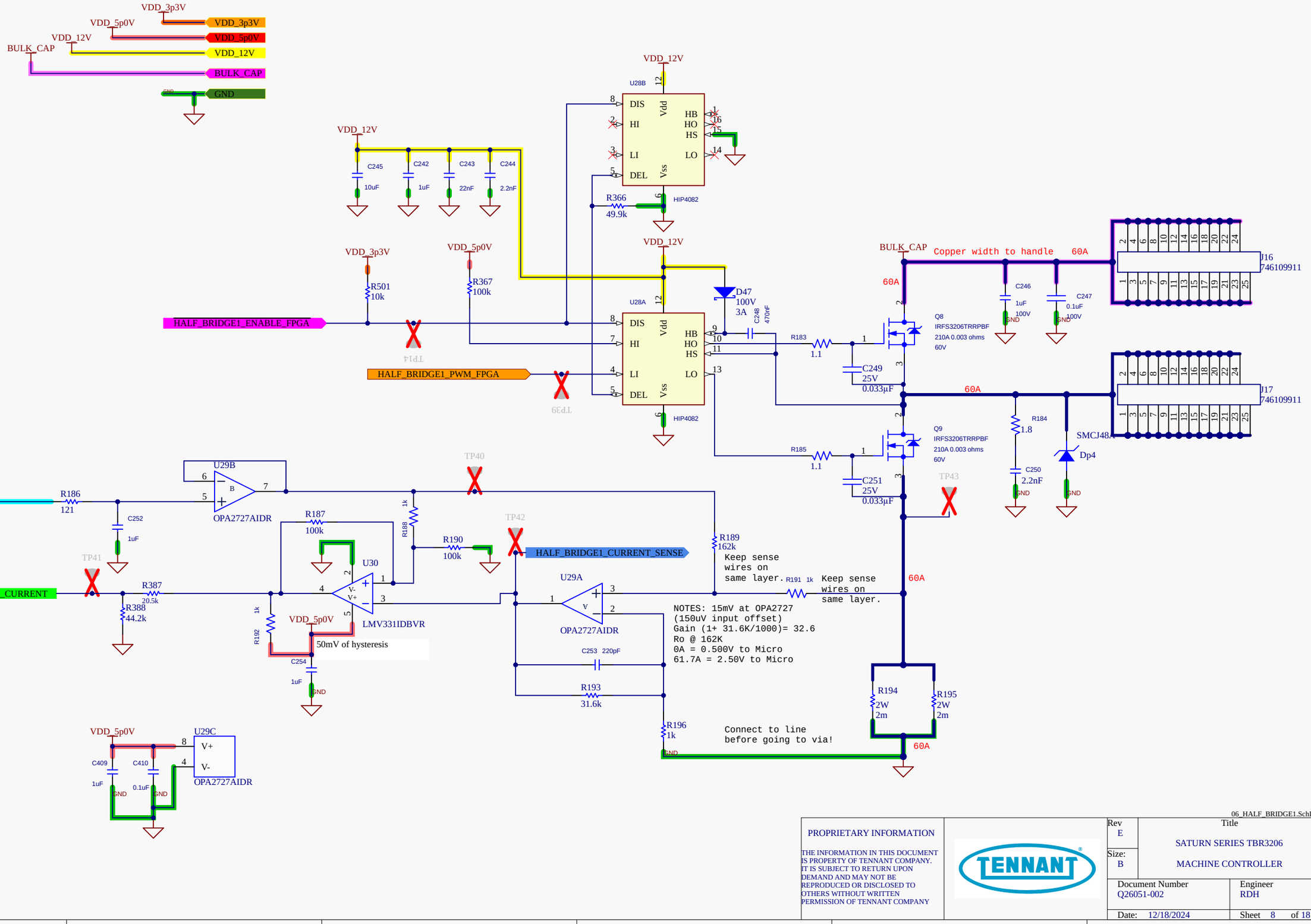


08_HALF_BRIDGE3.SchDoc

Rev: E	Title: SATURN SERIES TBR3206 MACHINE CONTROLLER
Size: B	
Document Number: Q26051-002	Engineer: RDH
Date: 12/18/2024	Sheet 6 of 18

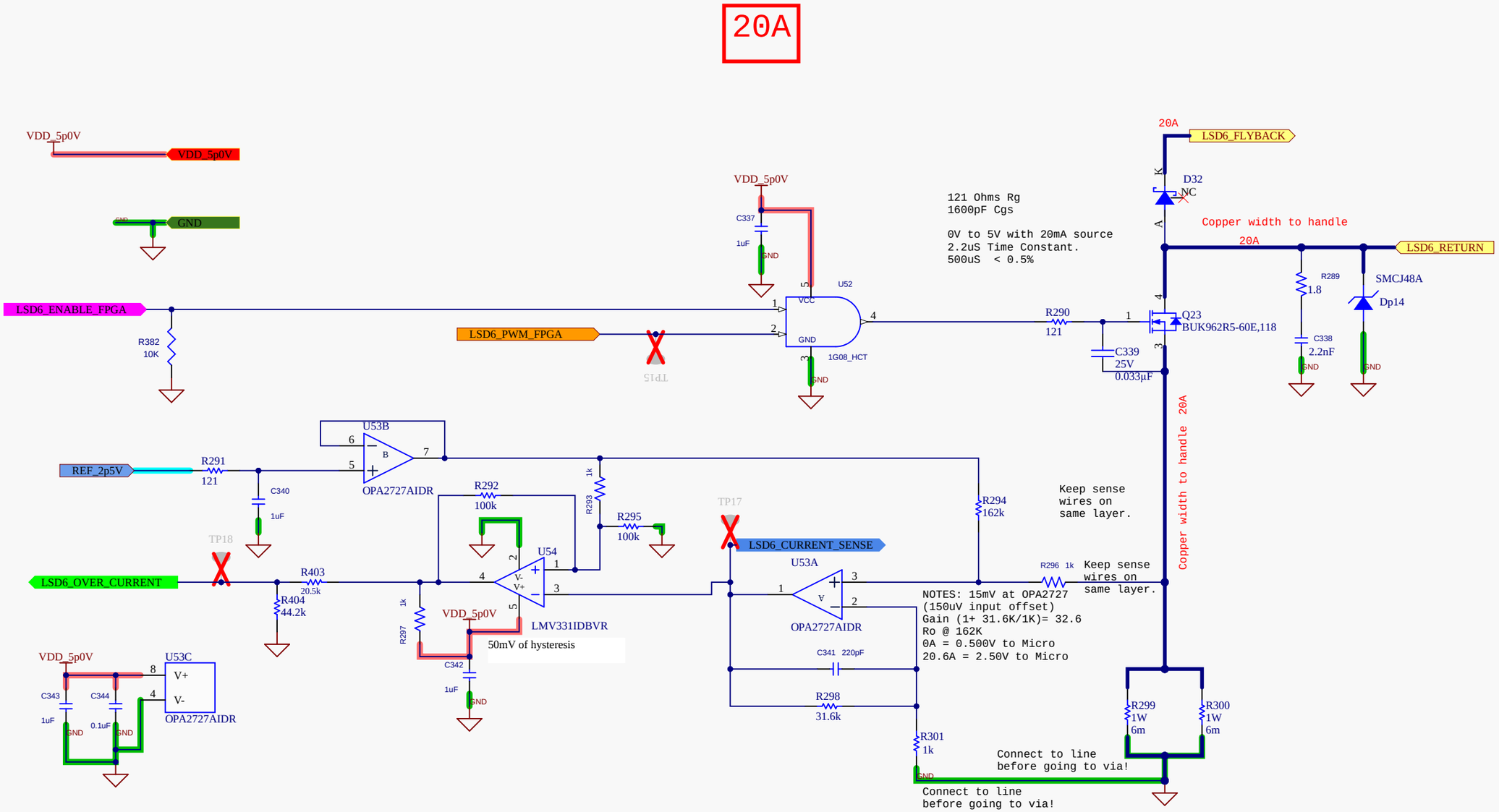


PROPRIETARY INFORMATION THE INFORMATION IN THIS DOCUMENT IS PROPERTY OF TENNANT COMPANY. IT IS SUBJECT TO RETURN UPON DEMAND AND MAY NOT BE REPRODUCED OR DISCLOSED TO OTHERS WITHOUT WRITTEN PERMISSION OF TENNANT COMPANY	07_HALF_BRIDGE2.SchDoc Rev E Title: SATURN SERIES TBR3206 MACHINE CONTROLLER Size: B Document Number Q26051-002 Engineer RDH Date: 12/18/2024 Sheet 7 of 18



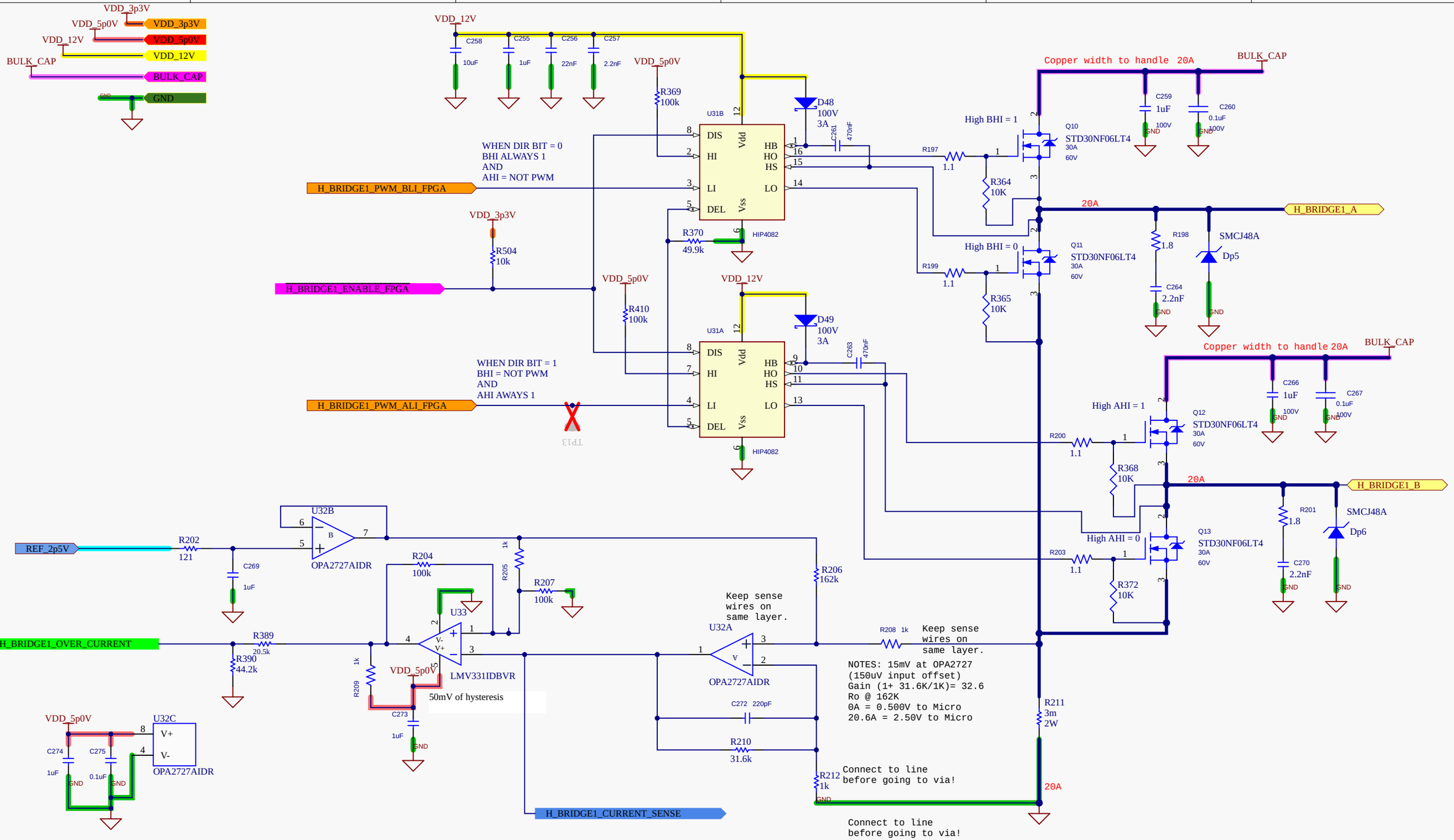
06_HALF_BRIDGE1.SchDoc

Rev	E
Size:	B
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	8 of 18



16_LSD6.SchDoc

Rev	E
Size:	B
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	9 of 18



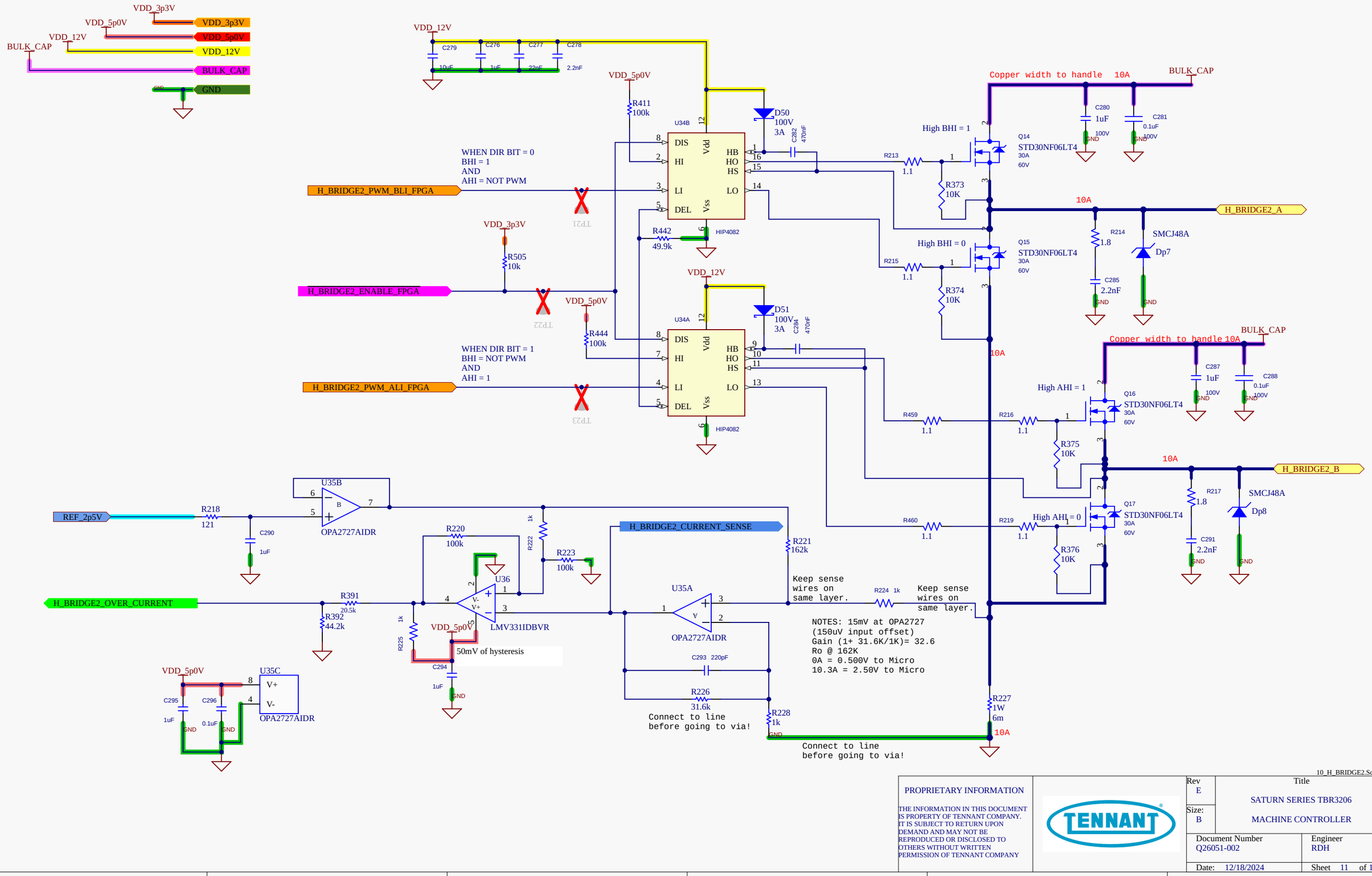
09_H_BRIDGE1.SchDoc

PROPRIETARY INFORMATION

THE INFORMATION IN THIS DOCUMENT IS PROPERTY OF TENNANT COMPANY. IT IS SUBJECT TO RETURN UPON DEMAND AND MAY NOT BE REPRODUCED OR DISCLOSED TO OTHERS WITHOUT WRITTEN PERMISSION OF TENNANT COMPANY

TENNANT

Rev	Title
E	SATURN SERIES TBR3206
Size: B	MACHINE CONTROLLER
Document Number Q26051-002	Engineer RDH
Date: 12/18/2024	Sheet 10 of 18



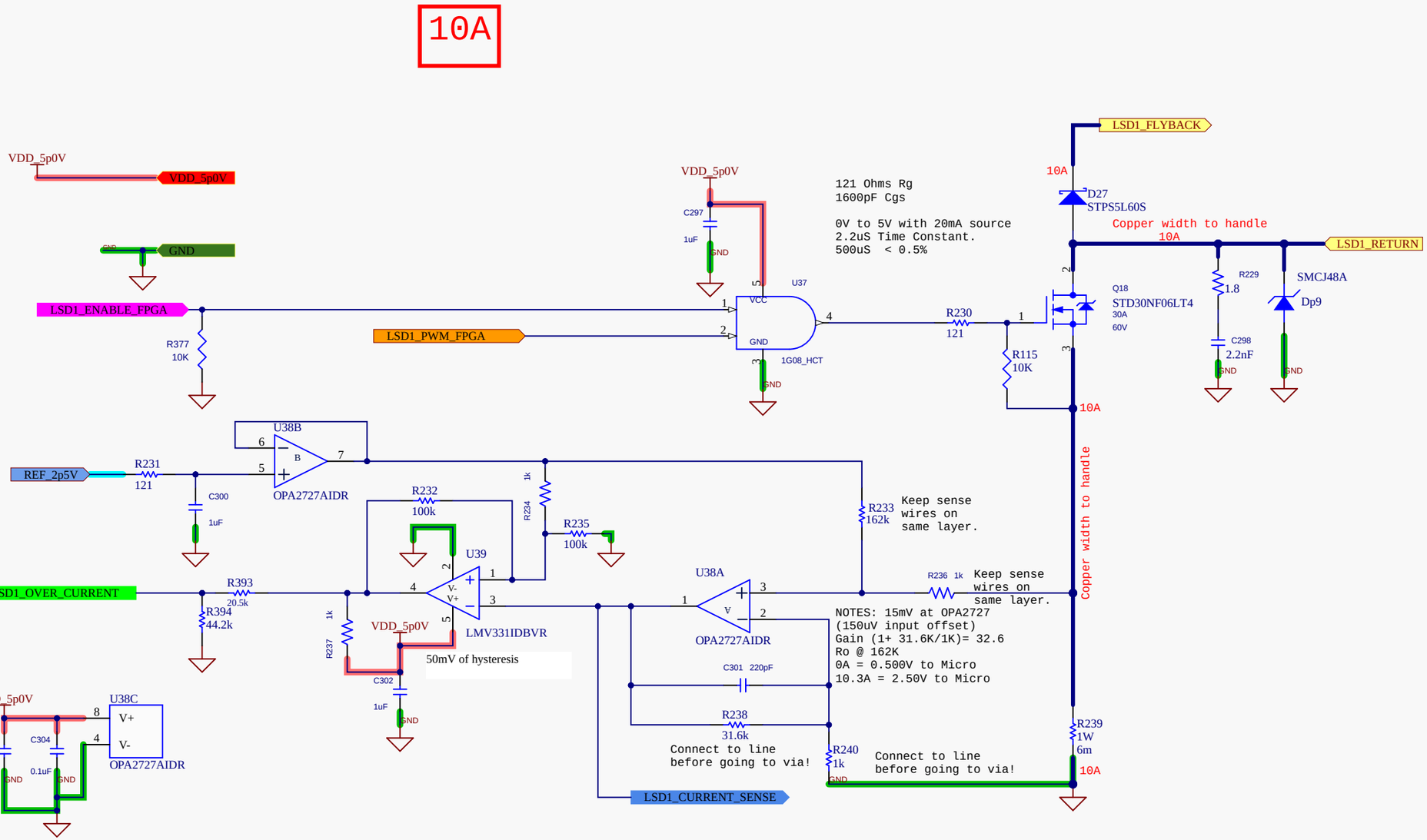
10_H_BRIDGE2.SchDoc

PROPRIETARY INFORMATION

THE INFORMATION IN THIS DOCUMENT IS PROPERTY OF TENNANT COMPANY. IT IS SUBJECT TO RETURN UPON DEMAND AND MAY NOT BE REPRODUCED OR DISCLOSED TO OTHERS WITHOUT WRITTEN PERMISSION OF TENNANT COMPANY

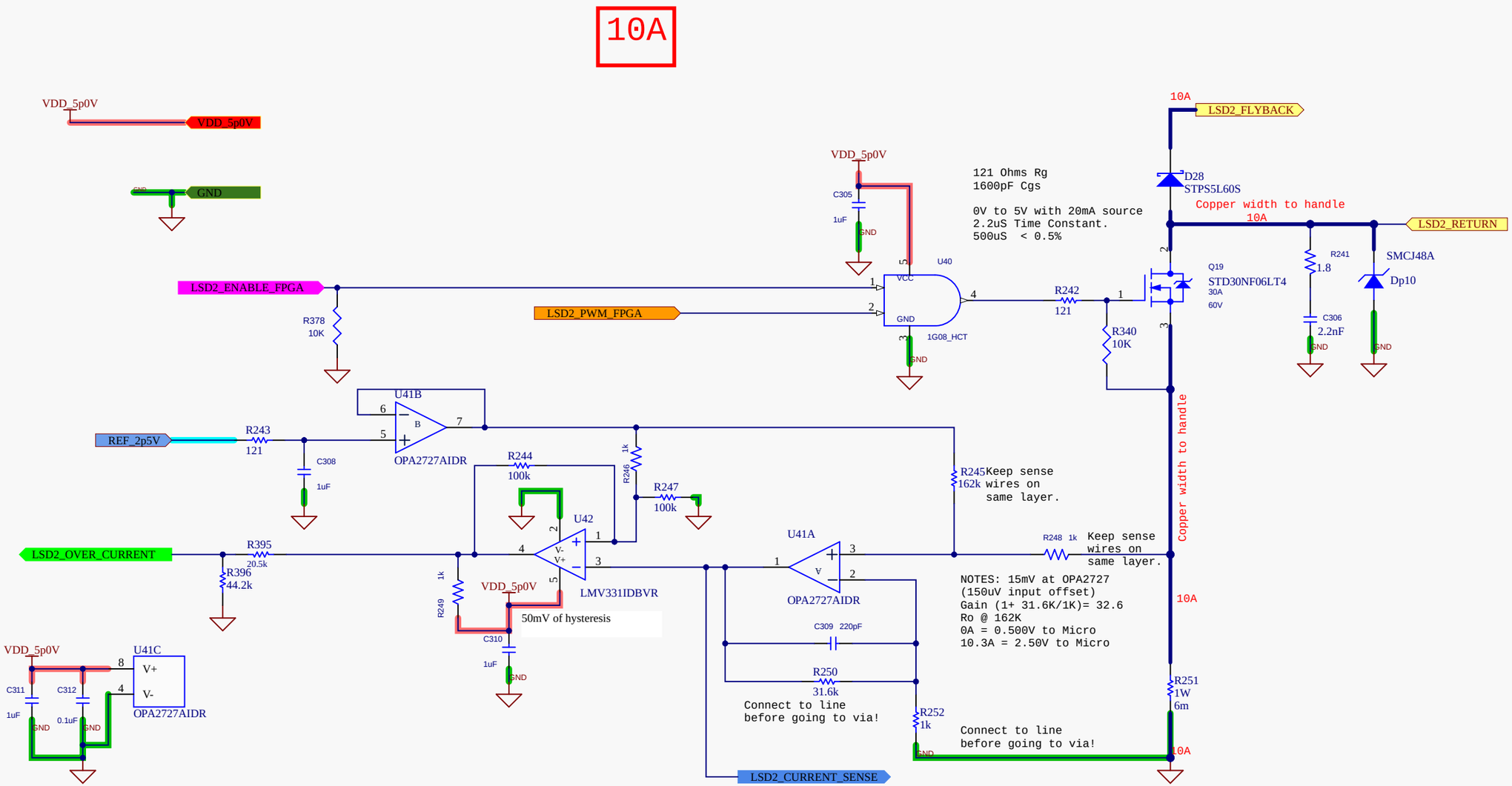
TENNANT

Rev: E	Title: SATURN SERIES TBR3206 MACHINE CONTROLLER
Size: B	
Document Number: Q26051-002	Engineer: RDH
Date: 12/18/2024	Sheet 11 of 18



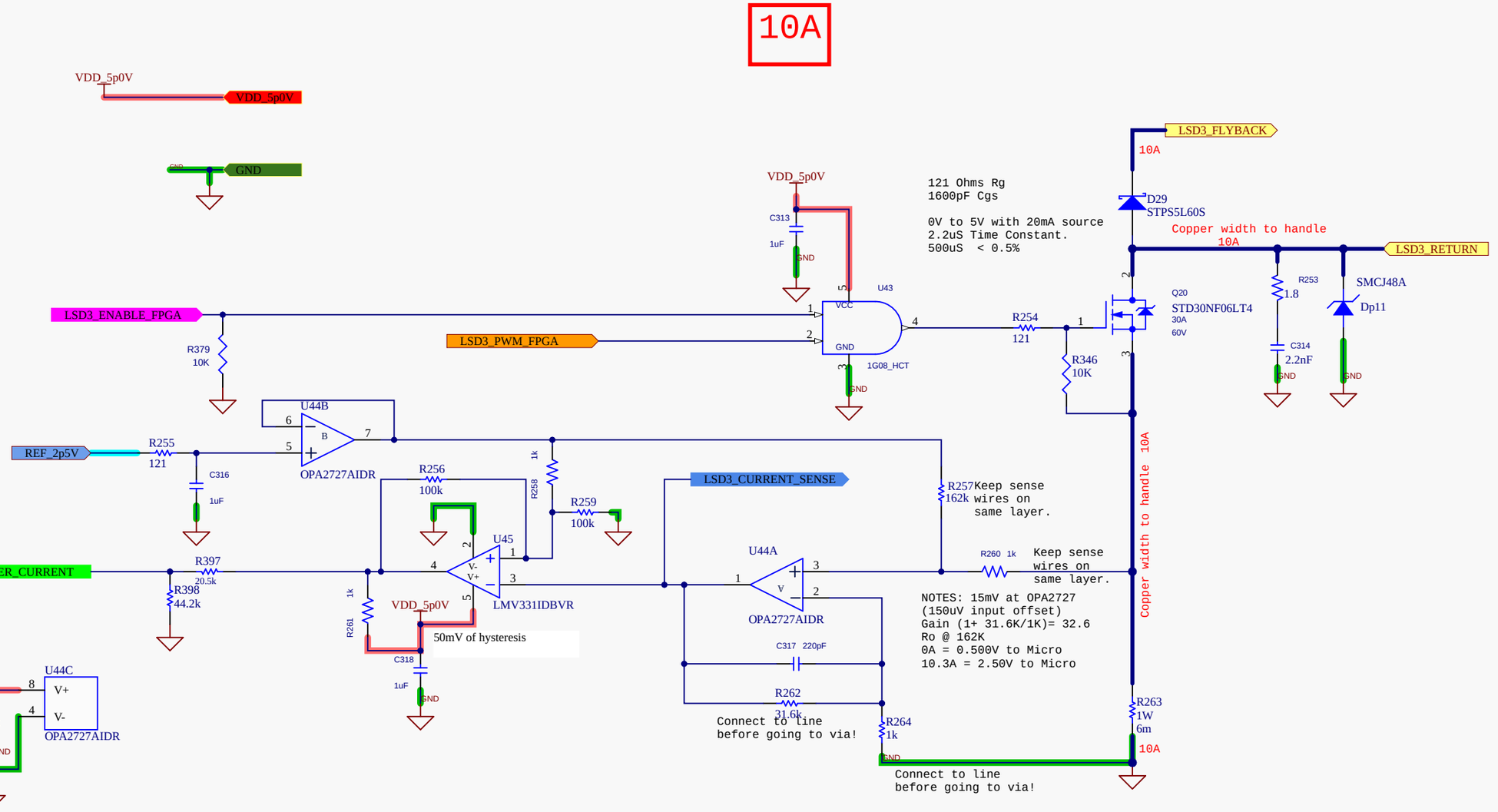
11_LSD1.SchDoc

Rev	E
Size:	B
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	12 of 18



12_LSD2.SchDoc

Rev	E
Size:	B
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	13 of 18



13_LSD3.SchDoc

Rev	E
Size:	B
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	14 of 18

10A

VDD_5p0V

VDD_5p0V

GND

GND

LSD4_ENABLE_FPGA

R380
10K

LSD4_PWM_FPGA

VDD_5p0V

C321
1uF

GND

U46
VCC
GND
1G08_HCT

121 Ohms Rg
1600pF Cgs

0V to 5V with 20mA source
2.2uS Time Constant.
500uS < 0.5%

R266
121

LSD4_FLYBACK

10A

D30
STPS5L60S

Copper width to handle
10A

LSD4_RETURN

Q21
STD30NF06LT4
30A
60V

R265
1.8

C322
2.2nF

SMCJ48A
Dp12

R360
10K

Copper width to handle 10A

U47B
B
OPA2727AIDR

REF_2p5V

R267
121

C324
1uF

R268
100k

R270
1k

R271
100k

LSD4_CURRENT_SENSE

R269
162k

Keep sense
wires on
same layer.

U48
V-
V+
LMV331IDBVR

LSD4_OVER_CURRENT

R399
20.5k

R400
44.2k

R273
1k

VDD_5p0V

50mV of hysteresis

C326
1uF

GND

U47A
V
OPA2727AIDR

R272 1k

Keep sense
wires on
same layer.

NOTES: 15mV at OPA2727
(150uV input offset)
Gain (1+ 31.6K/1K)= 32.6
Ro @ 162K
0A = 0.500V to Micro
10.3A = 2.50V to Micro

C325 220pF

R274
31.6k

R276
1k

Connect to line
before going to via!

R275
1W
6m

Connect to line
before going to via!

10A

VDD_5p0V

U47C
V+
V-
OPA2727AIDR

C327
1uF

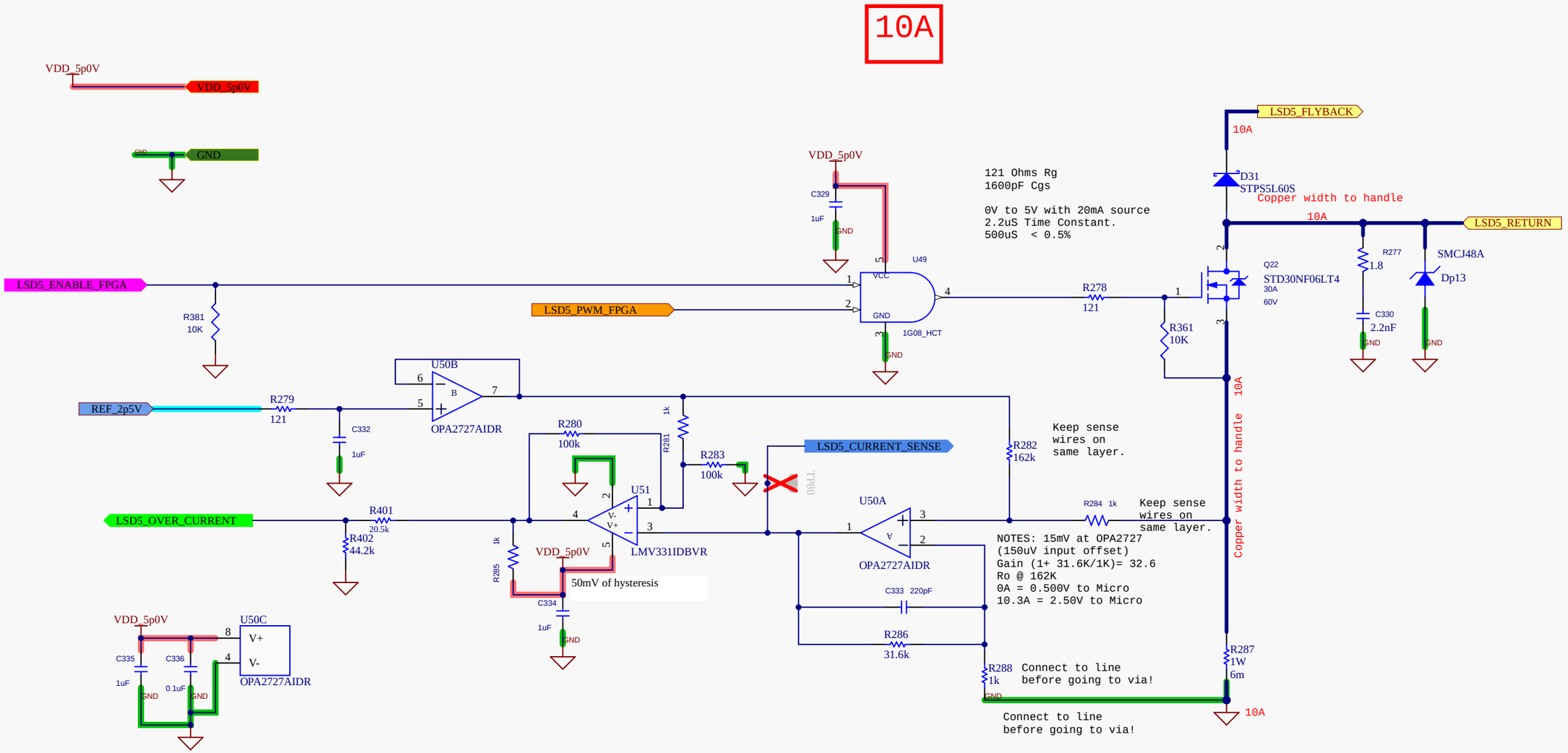
C328
0.1uF

GND

14_LSD4.SchDoc

TENNANT

Rev	Title
E	SATURN SERIES TBR3206
Size: B	MACHINE CONTROLLER
Document Number Q26051-002	Engineer RDH
Date: 12/18/2024	Sheet 15 of 18

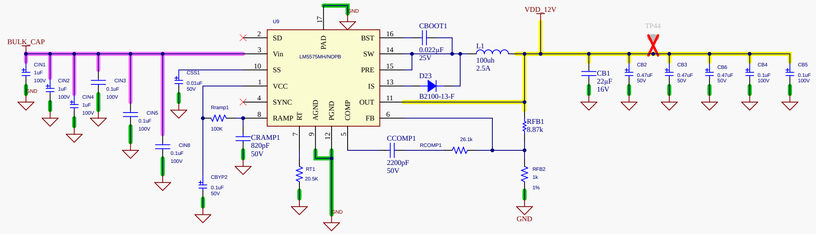


15_LSD5.SchDoc

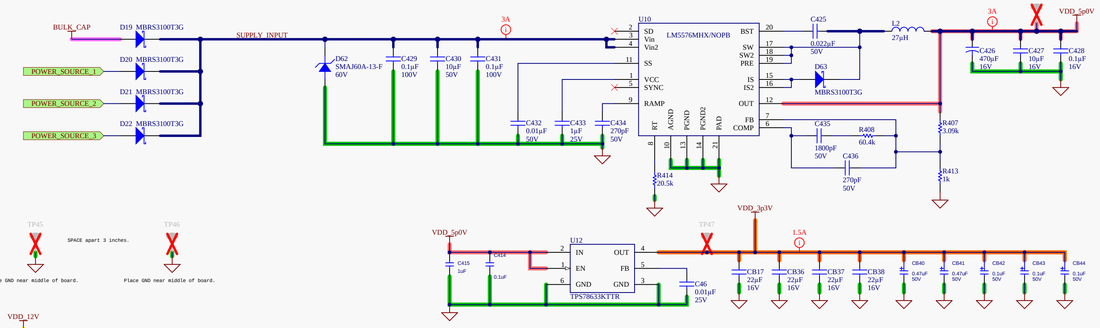
Rev	E
Size:	B
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date:	12/18/2024
Sheet	16 of 18

POWER INPUT
52.2V MAX.
+36V/+24/+12 NOMINAL
+6V MIN

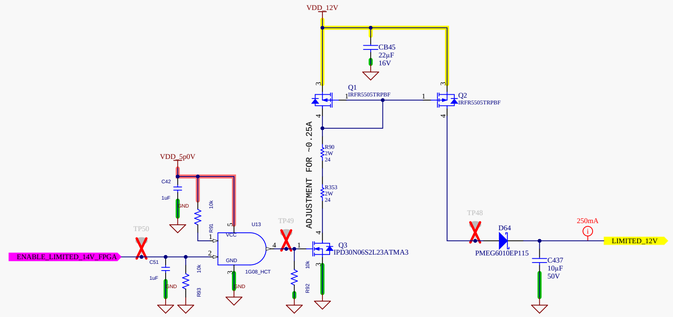
12V

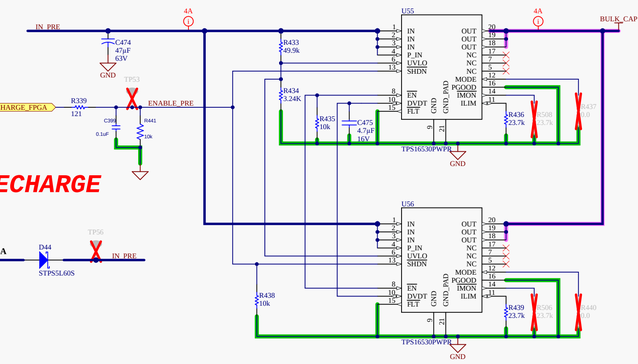


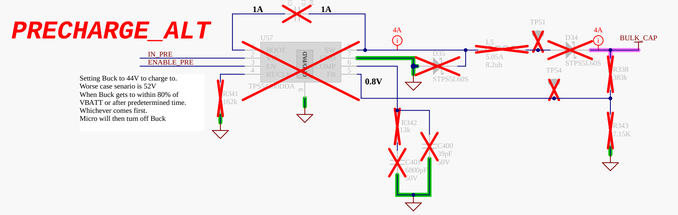
5V

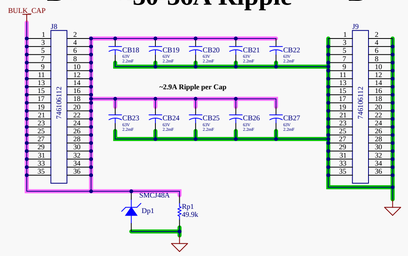


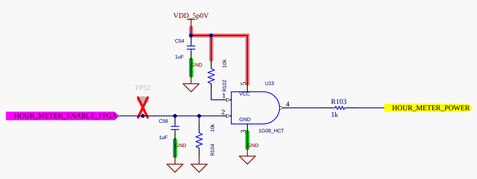
TP45 TP46
SPACE apart 3 inches.
Place GND near middle of board. Place GND near middle of board.

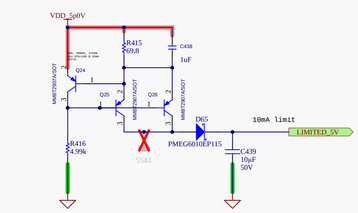


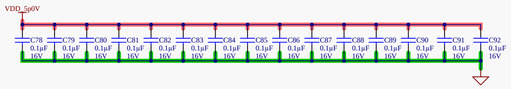




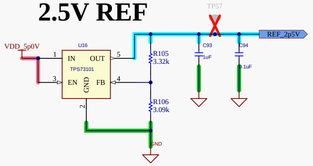


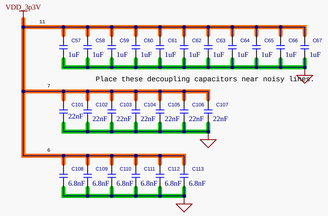


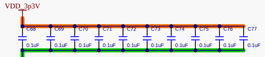




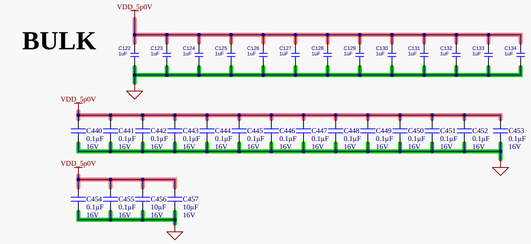
2.5V REF



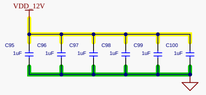




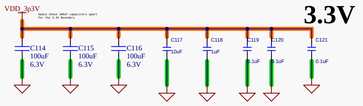
BULK



BULK



3.3V



TENNANT

Rev	E
Size	D
Title	SATURN SERIES TBR3206 MACHINE CONTROLLER
Document Number	Q26051-002
Engineer	RDH
Date	12/18/2024
Sheet	17 of 18