MPPT Solar Converter

SOLAR CAR 2021

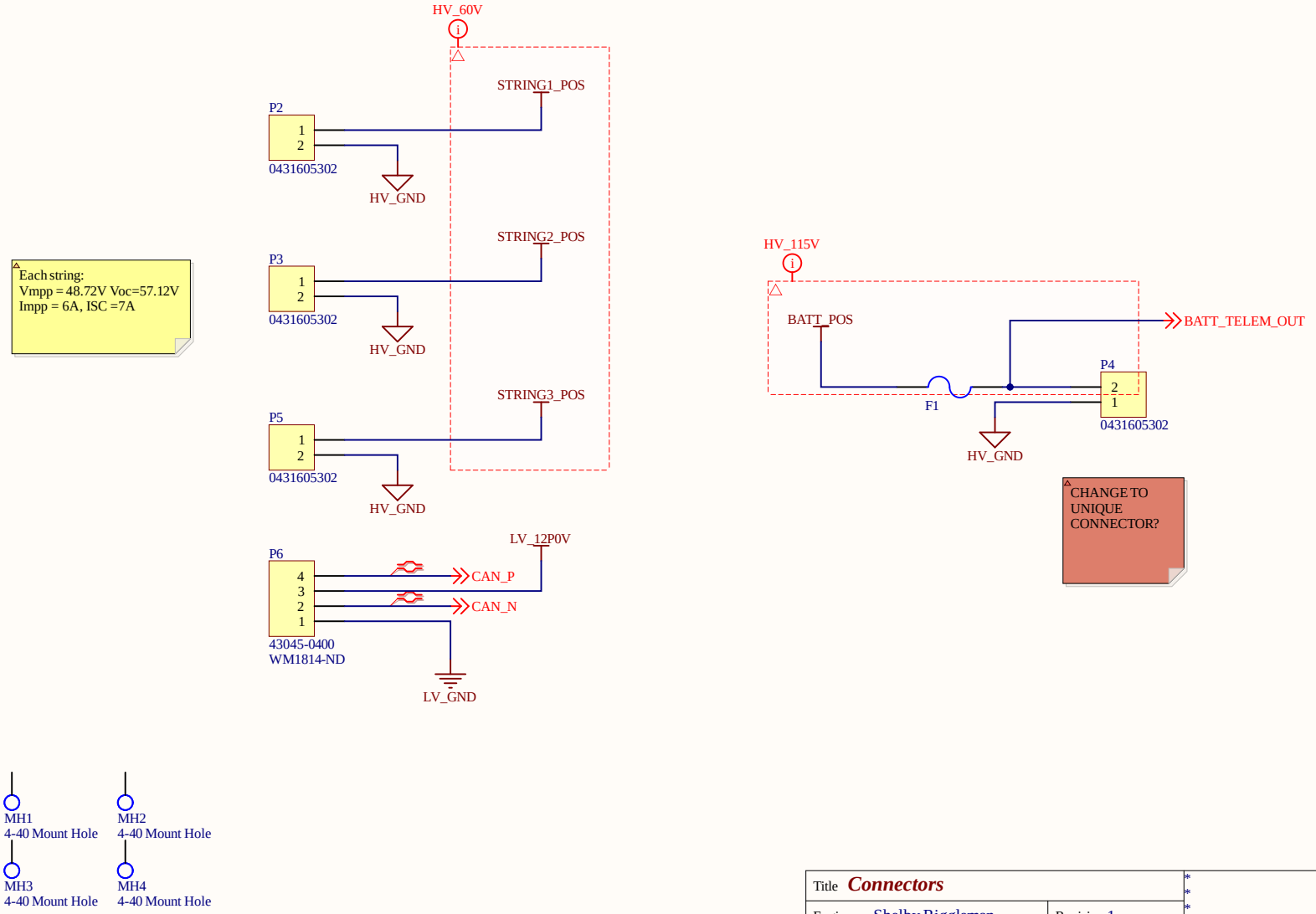
REV 2

Title	***COVER***	
Engineer: Shelby Riggleman	Revision: 1	
Date: 4/15/2022 Time: 10:37:09 AM	Sheet 1 of 10	
File: cover.SchDoc		

Badgerloop Electrical
133 Engineering Research Building
1500 Engineering Drive
Madison, Wi 53706

BADGER LOOP

Connectors

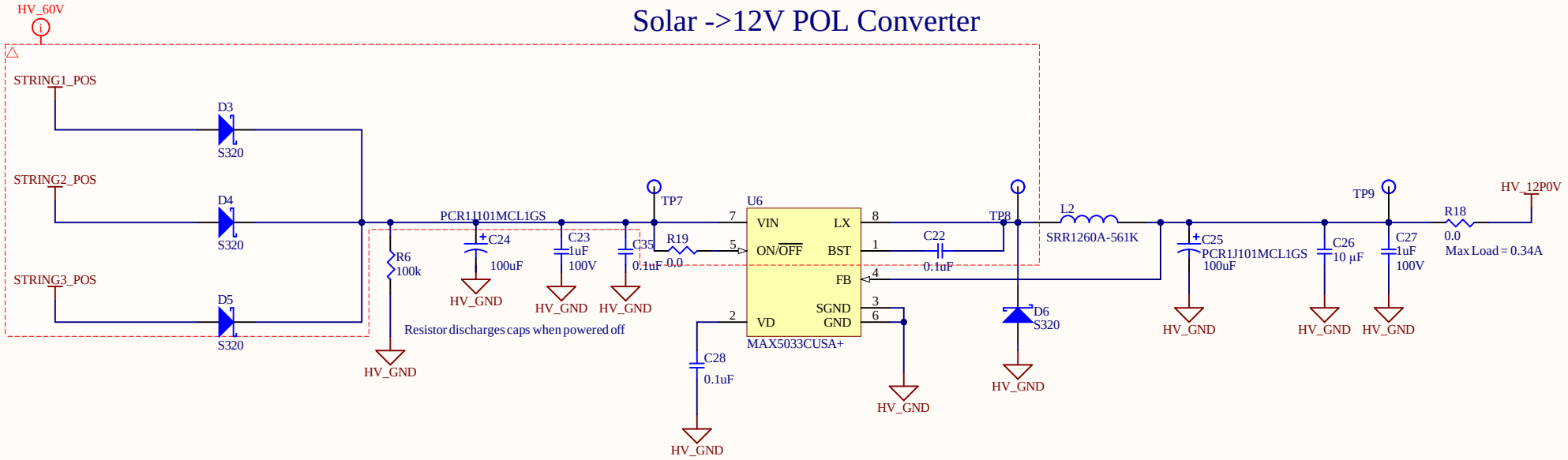


Title	***Connectors***	
Engineer: Shelby Riggleman		Revision:1
Date: 4/15/2022	Time: 10:37:10 AM	Sheet 2 of 10
File: Connectors.SchDoc		

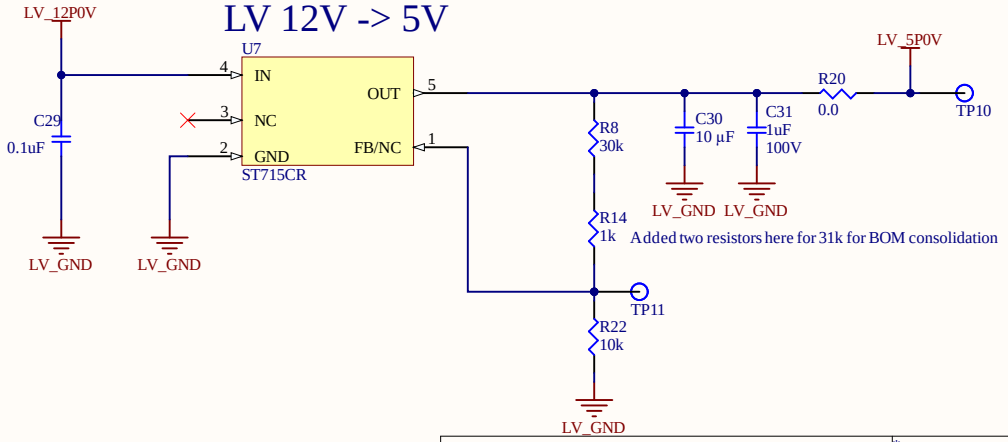
BADGER LOOP

Point of Load Converters

Solar ->12V POL Converter



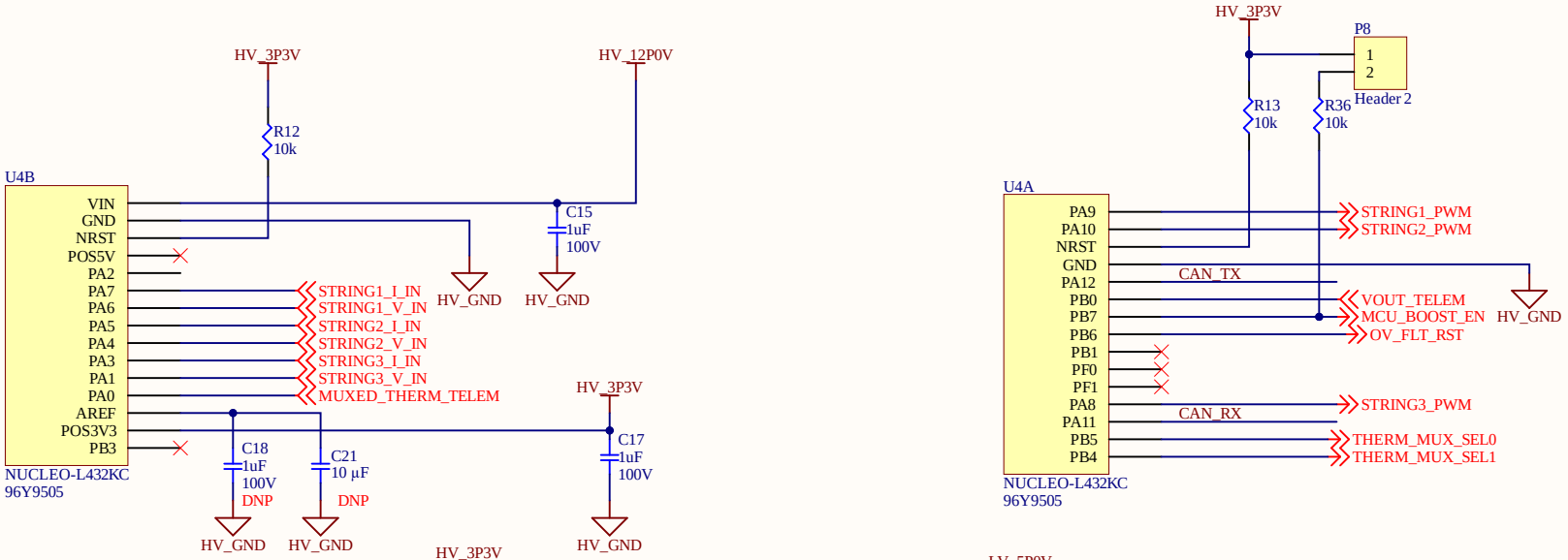
LV 12V -> 5V



Title	***Point of load converters***	
Engineer: Shelby Riggleman		Revision:1
Date: 4/15/2022	Time: 10:37:10 AM	Sheet 3 of 10
File: POL_converter.SchDoc		

BADGER LOOP

Nucleo MCU & CAN



CAN Baud rate max = 1Mbps
11th harmonic = 11Mbps
Speed of transmission =C/2
11th harmonic λ = 33m
1/10 of λ = 3m
Wire lengths << 3m -> no controlled impedance needed

Title	*Nucleo*	
Engineer: Shelby Riggleman		Revision:1
Date: 4/15/2022	Time: 10:37:10 AM	Sheet 4 of 10
File: Nucleo.SchDoc		

BADGER LOOP

Solar Strings MPPTs

STRING1
boost_converter.SchDoc;

STRING1_POS
STRING1_PWM
BOOST_EN
STRING_POS
PWM_IN
BOOST_EN
BOOST_OUT
I_IN_TELEM
V_IN_TELEM
THERM_TELEM
BATT_POS
STRING1_I_IN
STRING1_V_IN
STRING1_THERM

STRING2
boost_converter.SchDoc;

STRING2_POS
STRING2_PWM
BOOST_EN
STRING_POS
PWM_IN
BOOST_EN
BOOST_OUT
I_IN_TELEM
V_IN_TELEM
THERM_TELEM
BATT_POS
STRING2_I_IN
STRING2_V_IN
STRING2_THERM

STRING3
boost_converter.SchDoc;

STRING3_POS
STRING3_PWM
BOOST_EN
STRING_POS
PWM_IN
BOOST_EN
BOOST_OUT
I_IN_TELEM
V_IN_TELEM
THERM_TELEM
BATT_POS
STRING3_I_IN
STRING3_V_IN
STRING3_THERM

Debug Headers

P11
Header 2
BATT_POS

P12
Header 2
HV_GND

Overvoltage Detection

OV_detect
overvoltage_detection.SchDoc
BATT_POS
BATT_OUT
OV_FAULT
OV_FAULT_TELEM
OV_FLT_RST
OV_RST
OV_FAULT
OV_FAULT

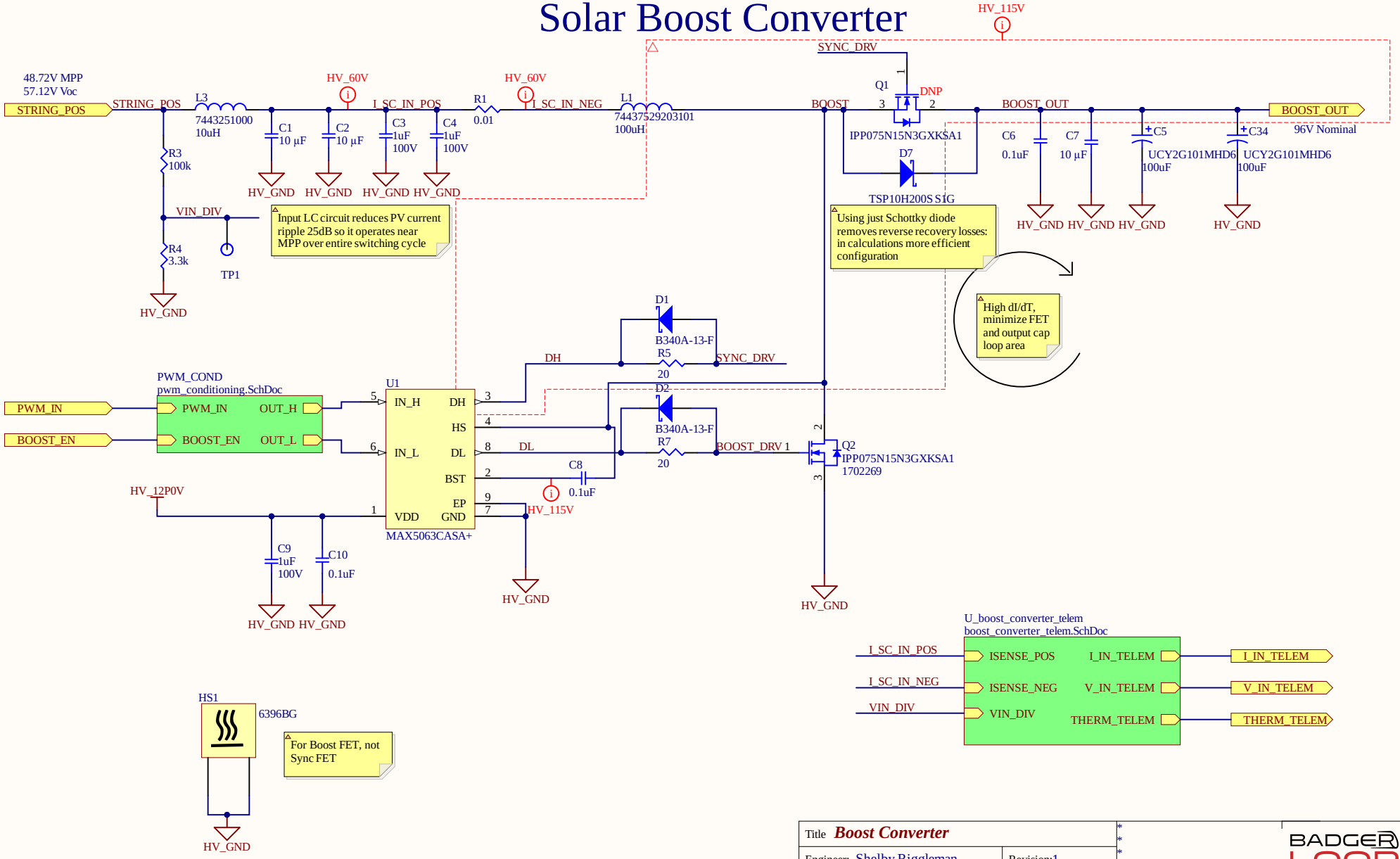
Boost Enable Signal (All)

HV_3P3V
C16
0.1uF
HV_GND
MCU_BOOST_EN
OV_FAULT
U14
A
B
VSS
VDD
Y
BOOST_EN
BU4S81G2-TR
HV_GND

Title	***Boost Strings***	
Engineer: Shelby Riggleman		Revision:1
Date: 4/15/2022	Time: 10:37:11 AM	Sheet 5 of 10
File: solar_boost_strings.SchDoc		

BADGER LOOP

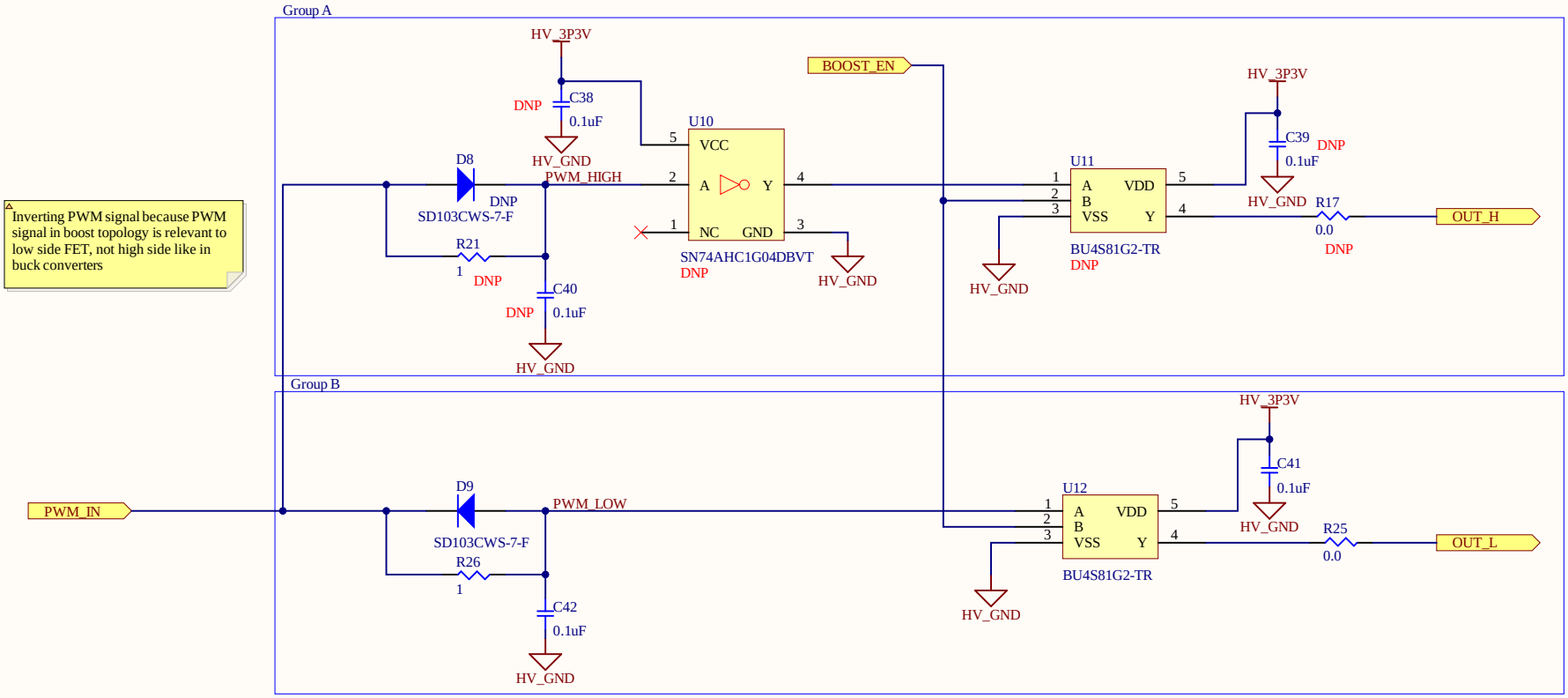
Solar Boost Converter



Title	*Boost Converter*
Engineer:	Shelby Riggleman
Revision:	1
Date:	4/15/2022
Time:	10:37:11 AM
Sheet	6 of 10
File:	boost_converter.SchDoc

BADGER LOOP

PWM Conditioning

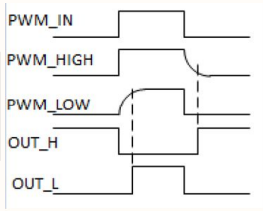


Different populations may be needed dependent on gate driver used/populated as they are available (default is MAX5063C):

Gate Driver	Sync. Config (2 FETS):	Async. Config (FET + Diode)
MAX5063A/MAX5063C	Populate all components	DNP Group A, or remove OUT_H resistor Short out PWM_LOW RC resistor
MIC4102	DNP Group B, or remove OUT_L resistor Short out PWM_HIGH RC resistor	DNP Group B, or remove OUT_L resistor Short out PWM_HIGH RC resistor
MIC4103	Populate all components	DNP Group A, or remove OUT_H resistor Short out PWM_LOW RC resistor

Default Configuration

RC Circuts create delays between FET on times to prevent shoot through when converter is in synchronous configuration:

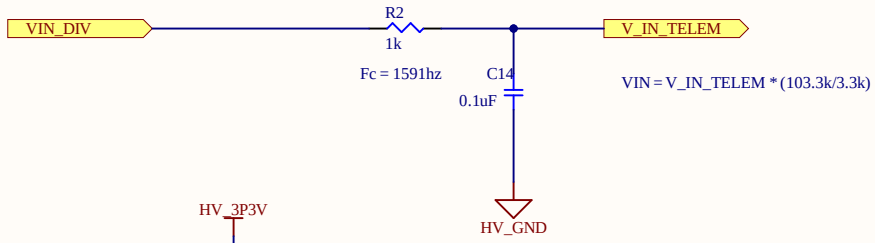


Title	*PWM Conditioning*
Engineer: Shelby Riggleman	Revision:1
Date: 4/15/2022 Time: 10:37:11 AM	Sheet 7 of 10
File: pwm_conditioning.SchDoc	

BADGER LOOP

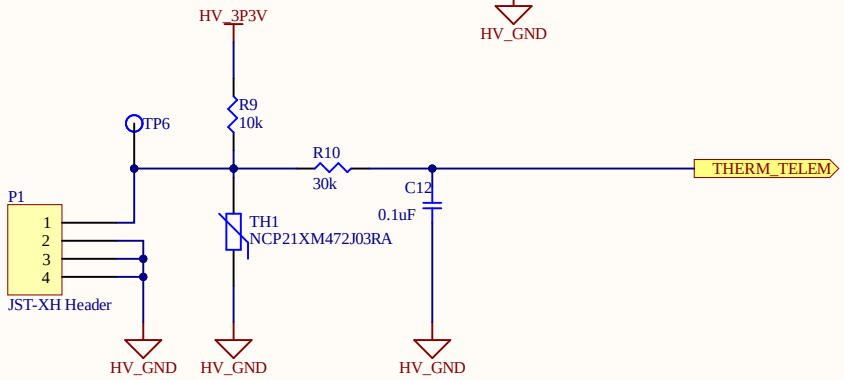
Solar Boost Converter Telemetry

String Input Voltage

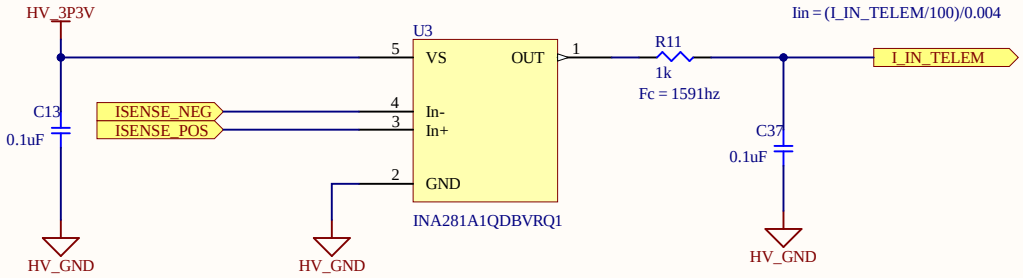


UPDATE COMPONENTS TO CREATE CORNER FREQUENCY HIGHER THAN CONTROL LOOP UPDATE RATE UPON TESTING

Thermistor Output



String Input Current



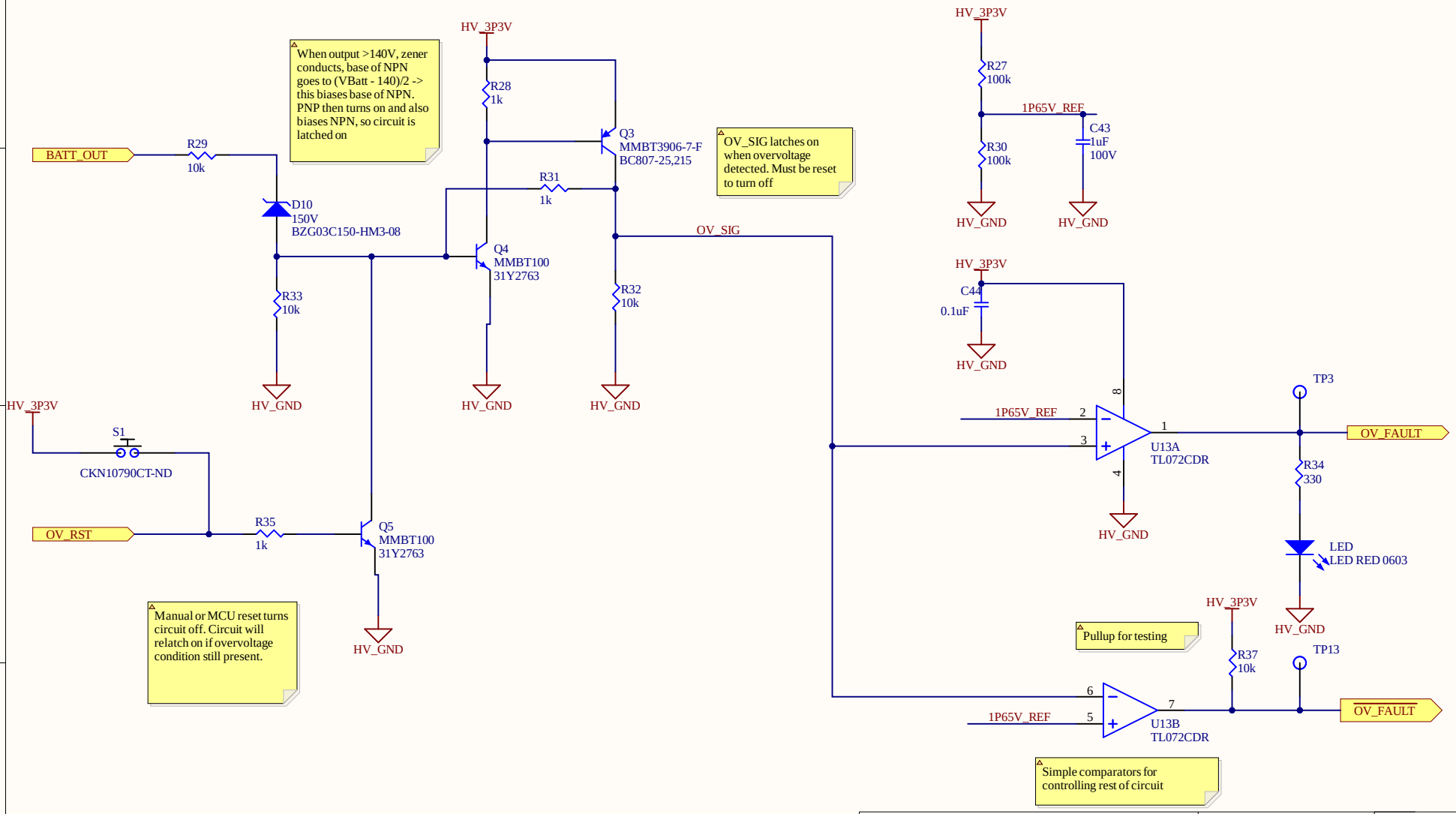
UPDATE COMPONENTS TO CREATE CORNER FREQUENCY HIGHER THAN CONTROL LOOP UPDATE RATE UPON TESTING

INA240 Max input voltage is 80V, cannot use on boost output. Use Vin, Vout, Iin to solve for Iout.

Title	***Boost Converter Telemetry***	
Engineer: Shelby Riggleman		Revision:1
Date: 4/15/2022	Time: 10:37:12 AM	Sheet 8 of 10
File: boost_converter_telem.SchDoc		

BADGER LOOP

Overvoltage Detection

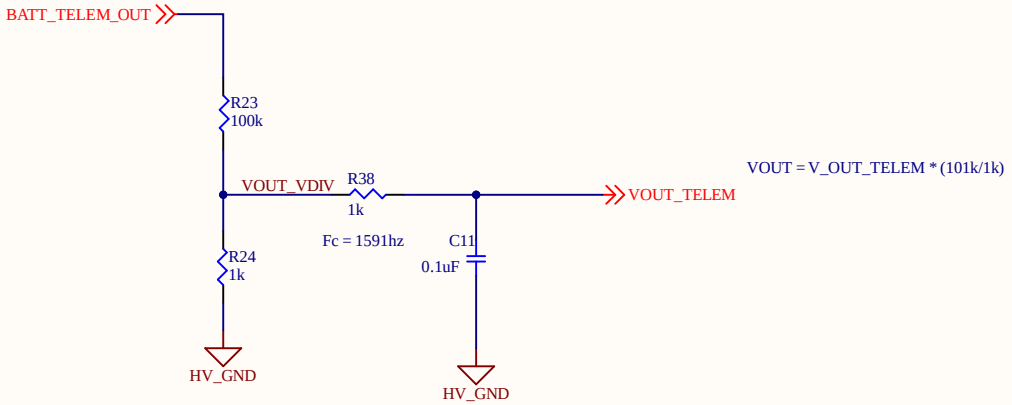


Title	***Over-Voltage Detection***	
Engineer: Shelby Riggleman		Revision:1
Date: 4/15/2022	Time: 10:37:12 AM	Sheet 9 of 10
File: overvoltage_detection.SchDoc		

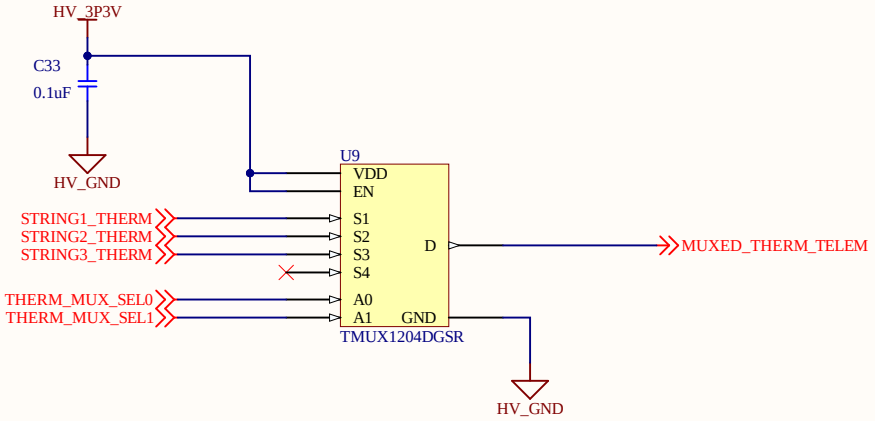
BADGER LOOP

Global Telemetry

Output (Battery) Voltage



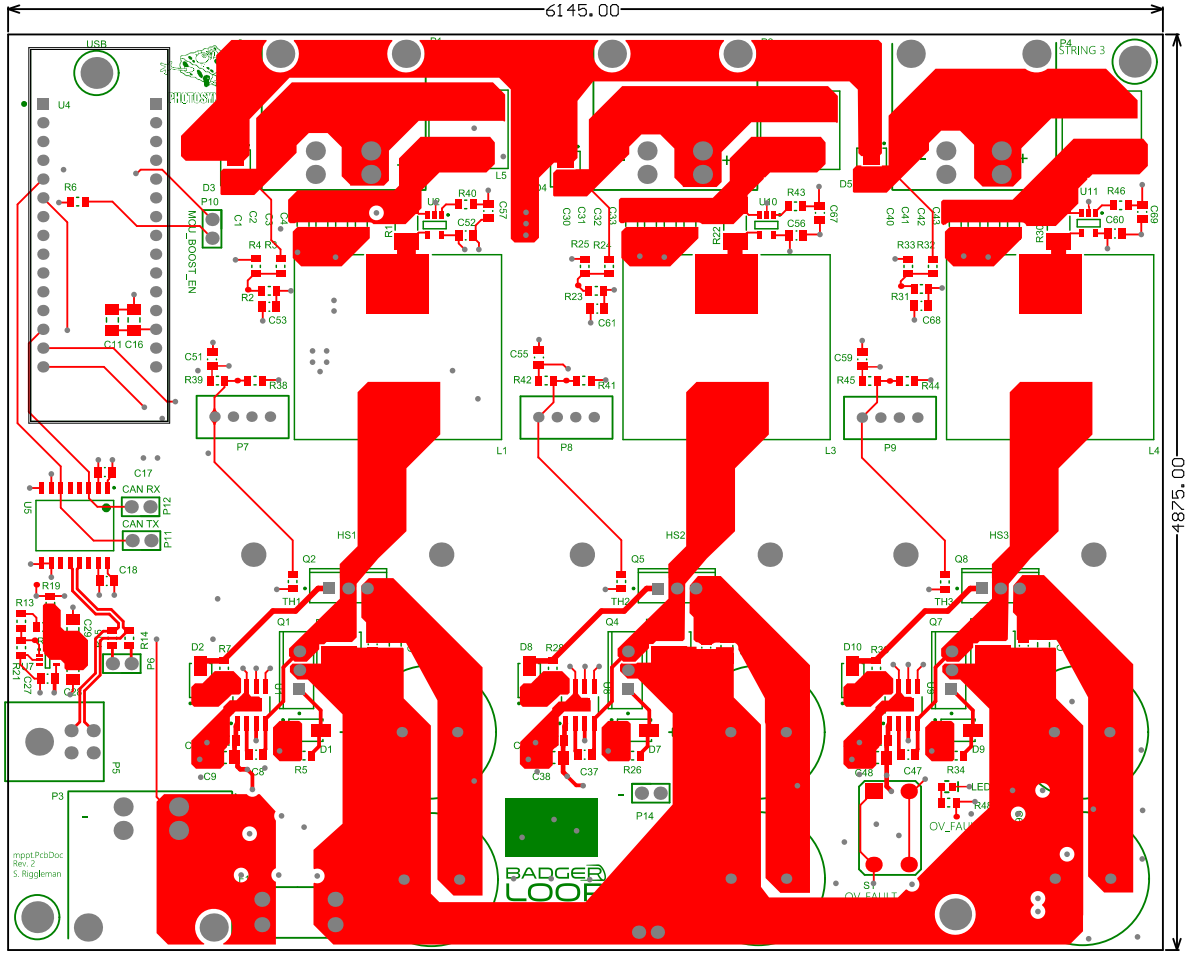
String Thermistor Telem (Muxed)



Title	*Global Telemetry*	
Engineer: Shelby Riggleman		Revision: 1
Date: 4/15/2022	Time: 10:37:13 AM	Sheet 10 of 10
File: global_telem.SchDoc		

BADGER LOOP

Layer	Name	Material	Thickness	Constant	Board Layer Stack
	Top Overlay				
	Top Solder	Solder Resist	0.40mil	3.5	
1	Top Layer		1.40mil		
	Dielectric 2	PP-006	2.80mil	4.1	
2	Layer 1	CF-004	1.38mil		
	Dielectric 1	FR-4	12.60mil	4.8	
3	Layer 2	CF-004	1.38mil		
	Dielectric 3	PP-006	2.80mil	4.1	
4	Bottom Layer		1.40mil		
	Bottom Solder	Solder Resist	0.40mil	3.5	
	Bottom Overlay				



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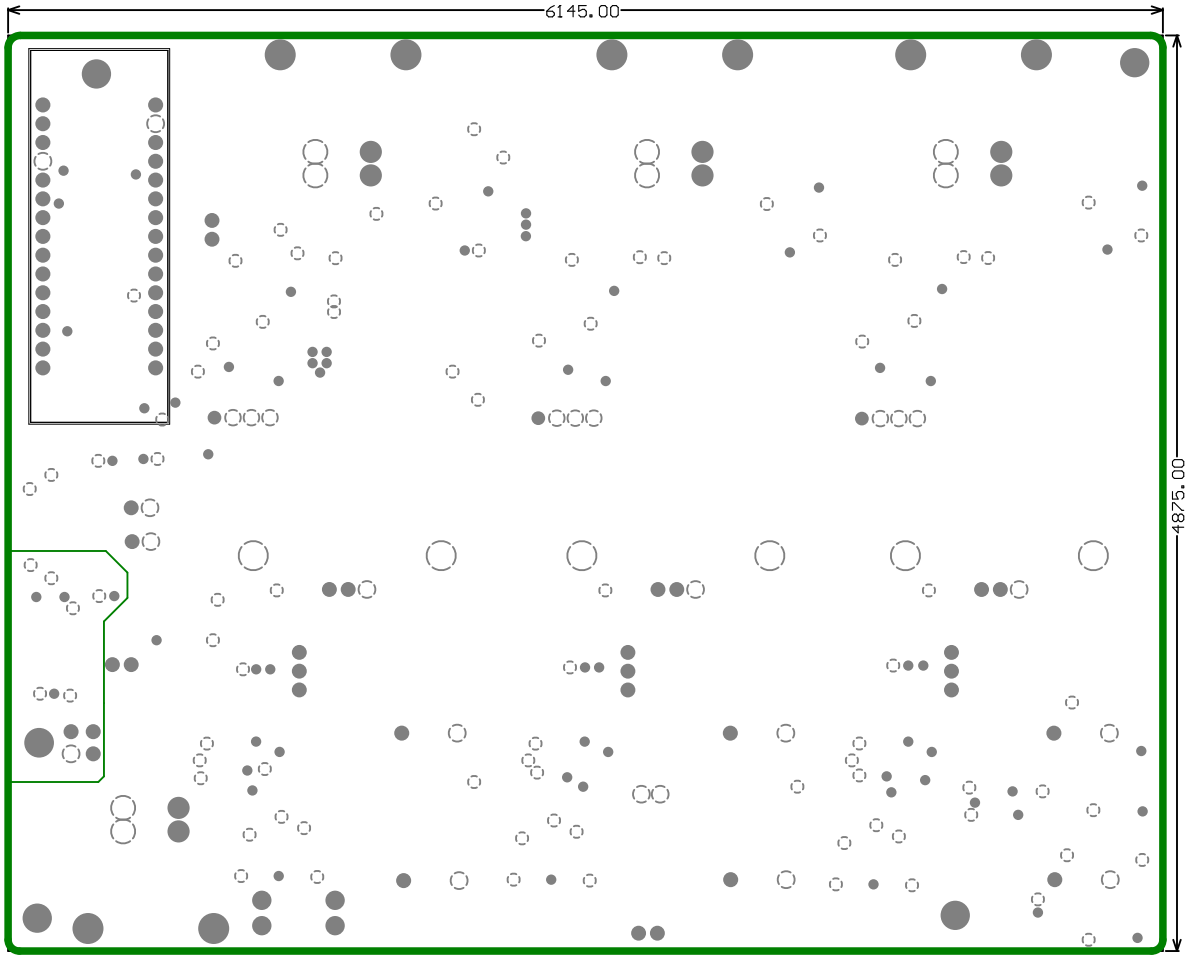
	Bottom Overlay				



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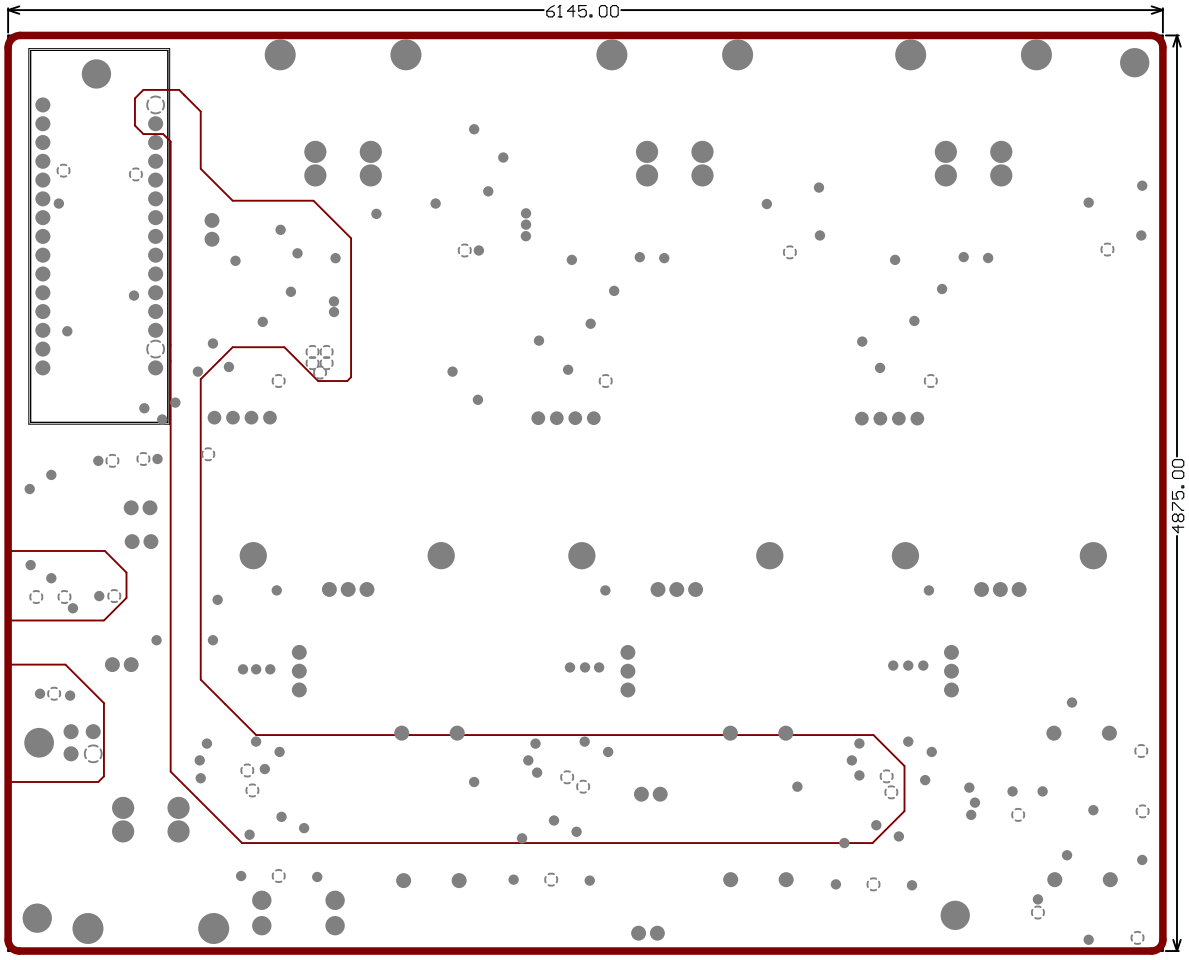

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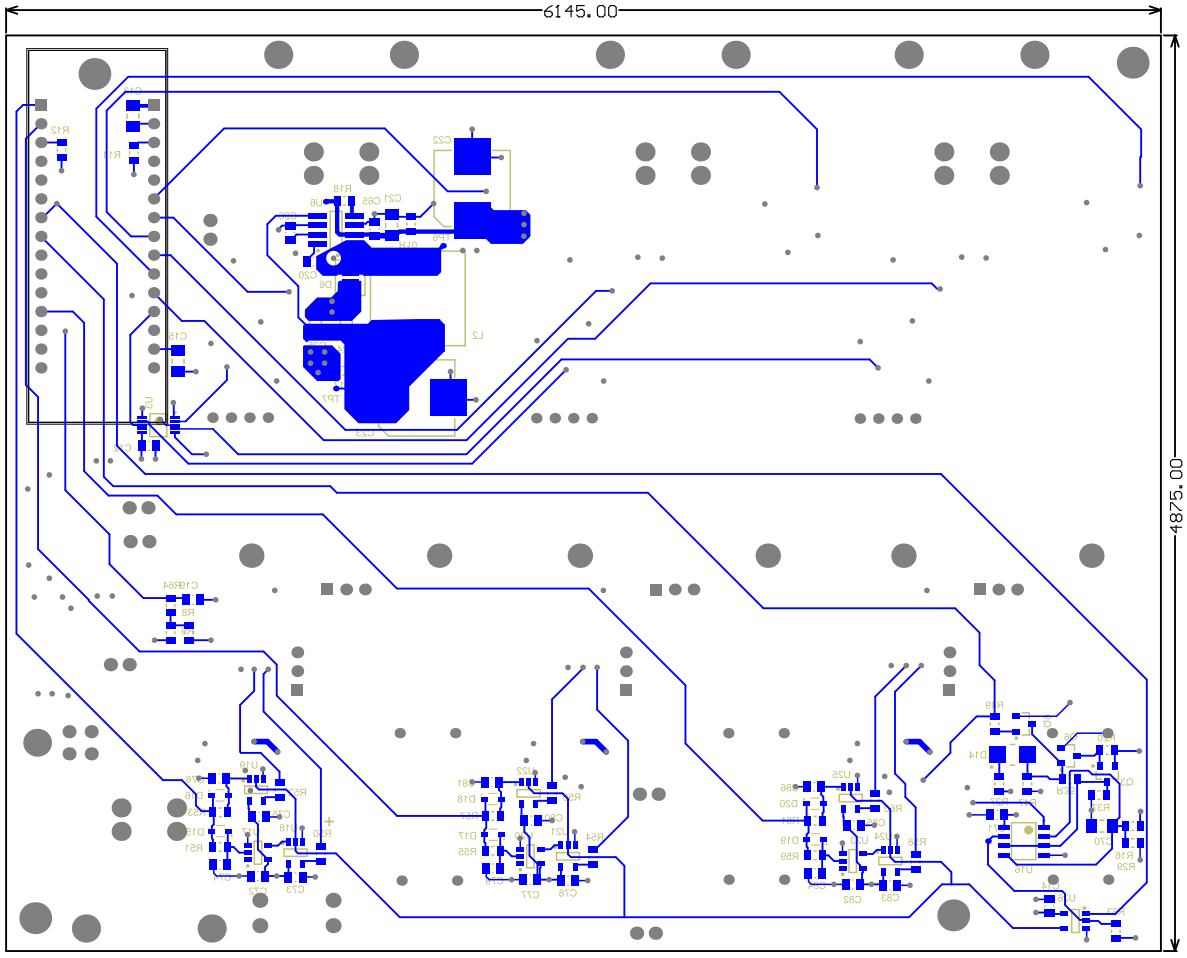

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