

A

A

B

B

C

C

D

D

# MPPT Solar Converter

## SOLAR CAR 2021

### REV 1

Rev 1 Biggest Risks:  
1. MCU Control Implementation  
2. HV Arcing  
3. Thermal

Title **COVER**

Engineer: Shelby Riggleman

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



Revision: 1

Date: 1/16/2022 Time: 9:24:08 PM Sheet 1 of 8

File: cover.SchDoc

# Connectors

A

A

B

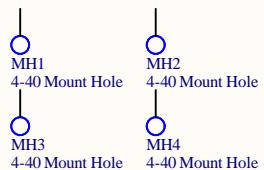
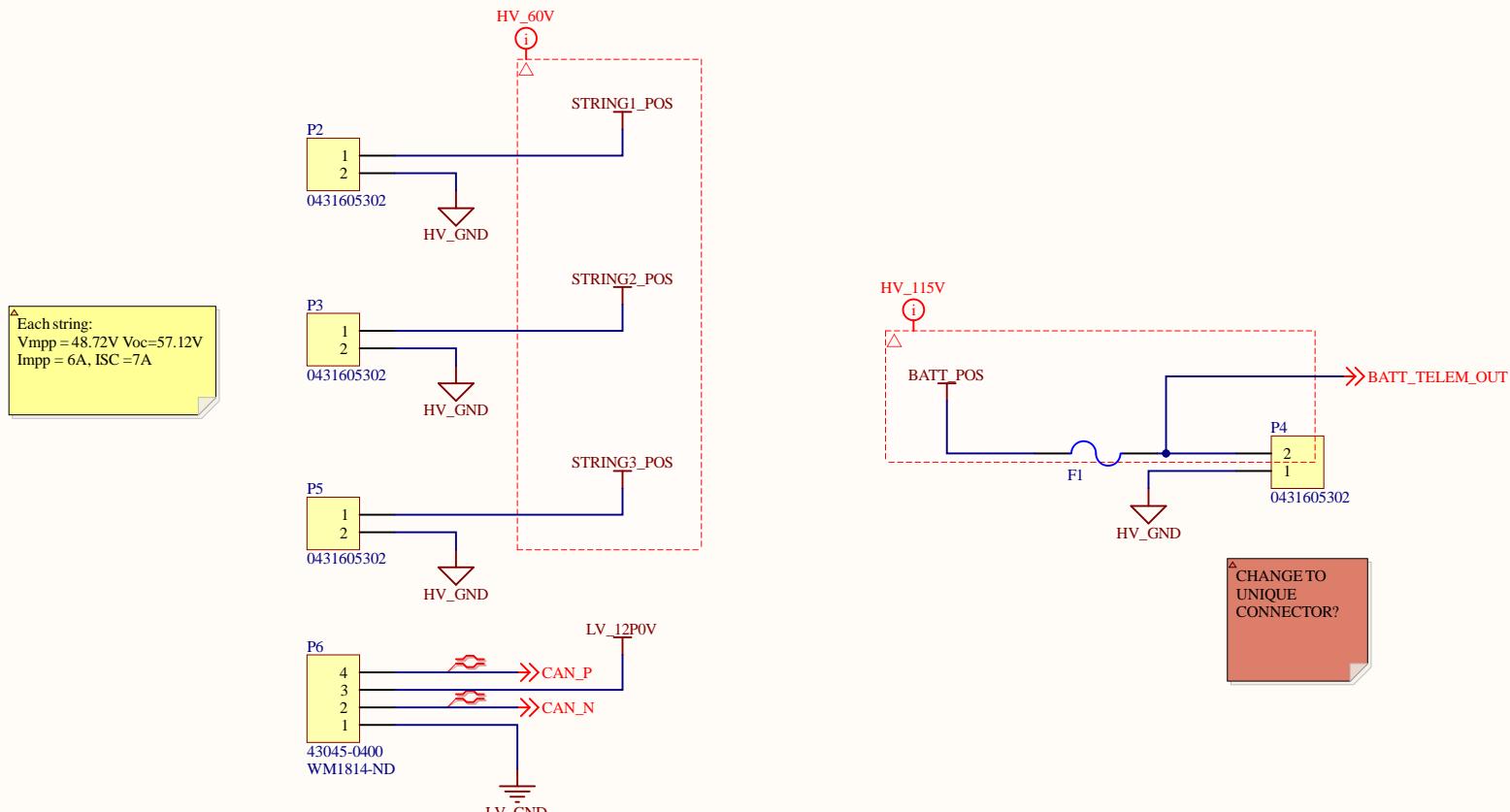
B

C

C

D

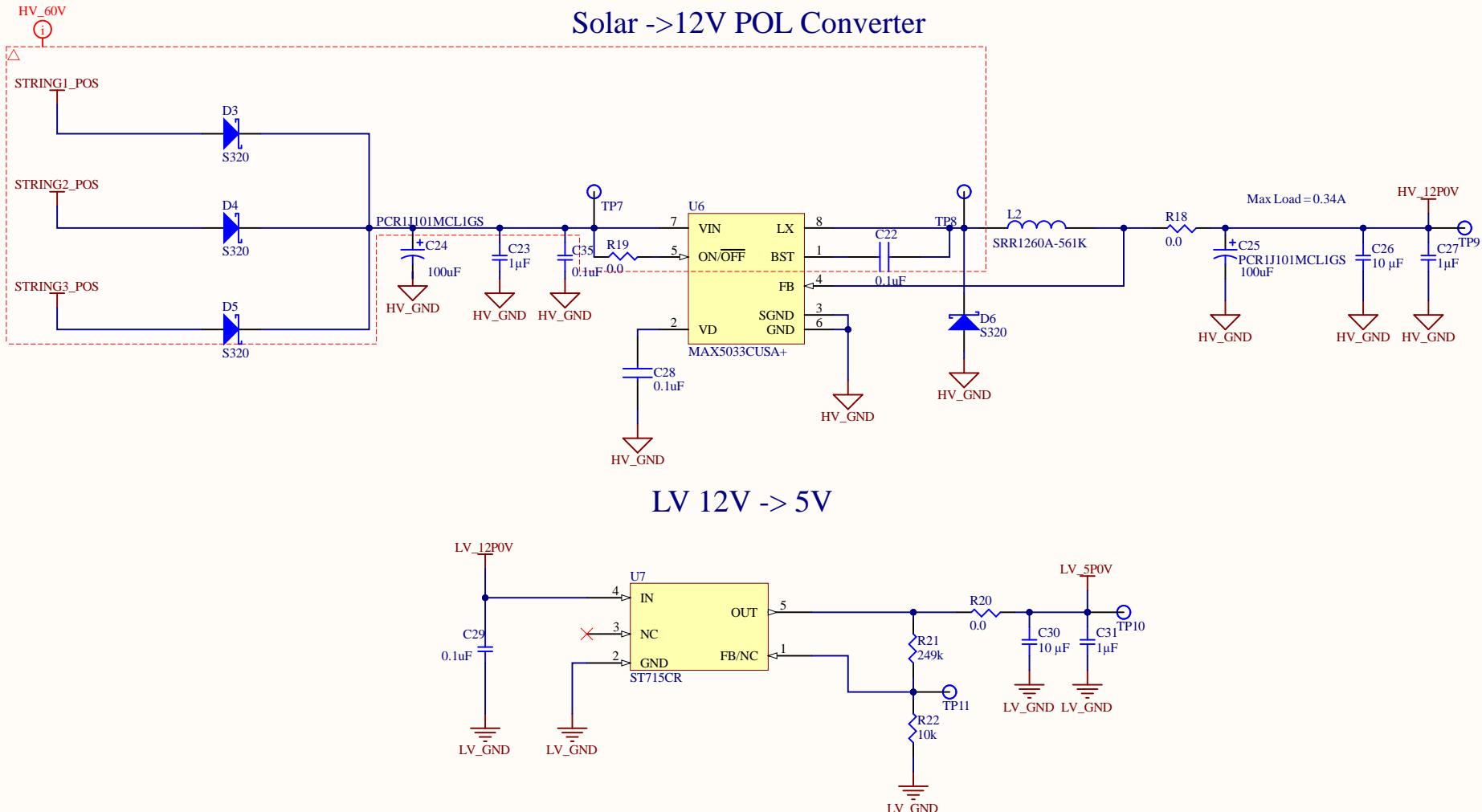
D



| Title <i>Connectors</i>    |                  |
|----------------------------|------------------|
| Engineer: Shelby Riggelman | Revision: 1      |
| Date: 1/16/2022            | Time: 9:24:08 PM |
| File: Connectors.SchDoc    | Sheet 2 of 8     |

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# Point of Load Converters



Title **Point of load converters**

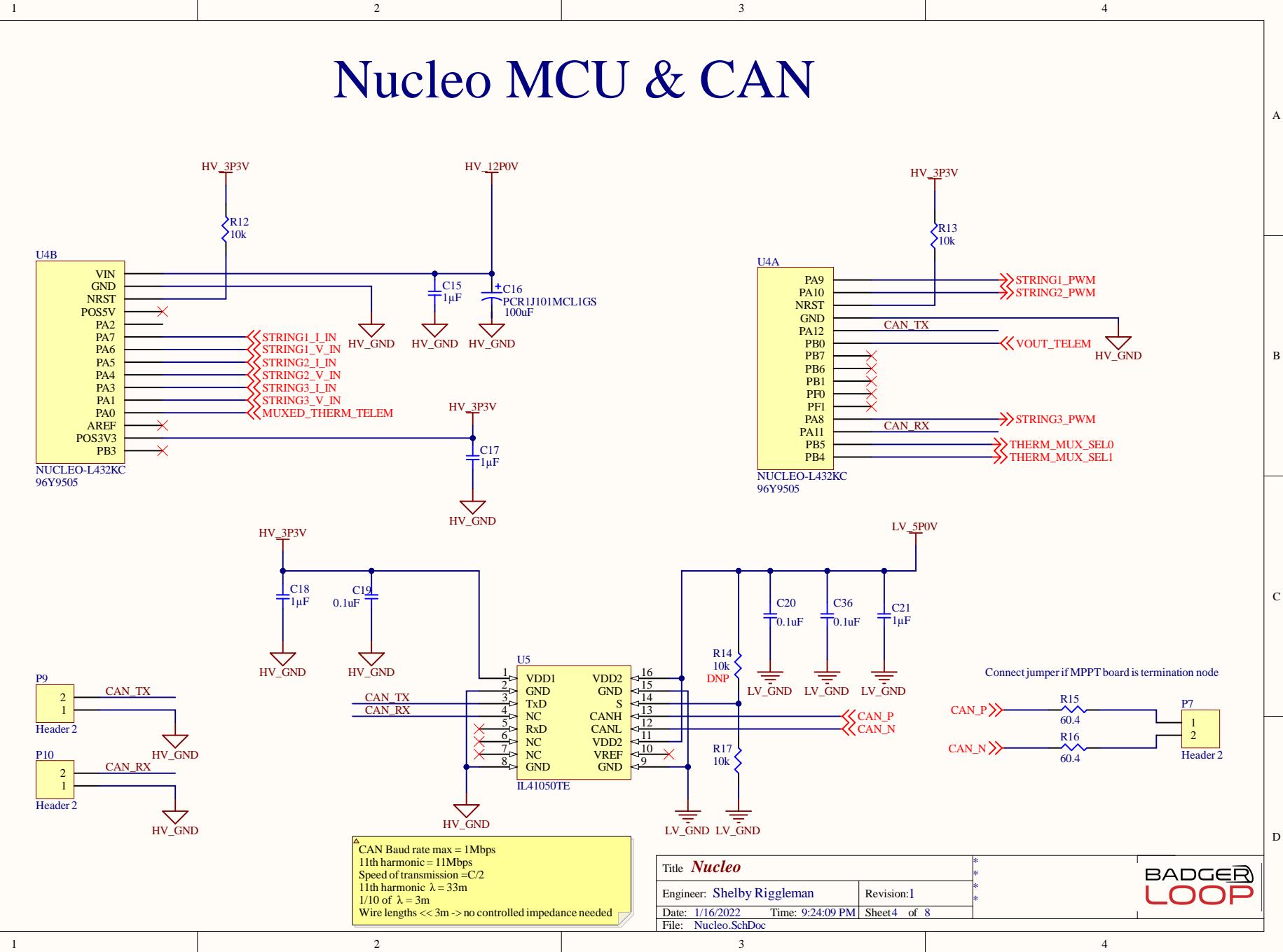
Engineer: Shelby Riggelman

Revision: 1

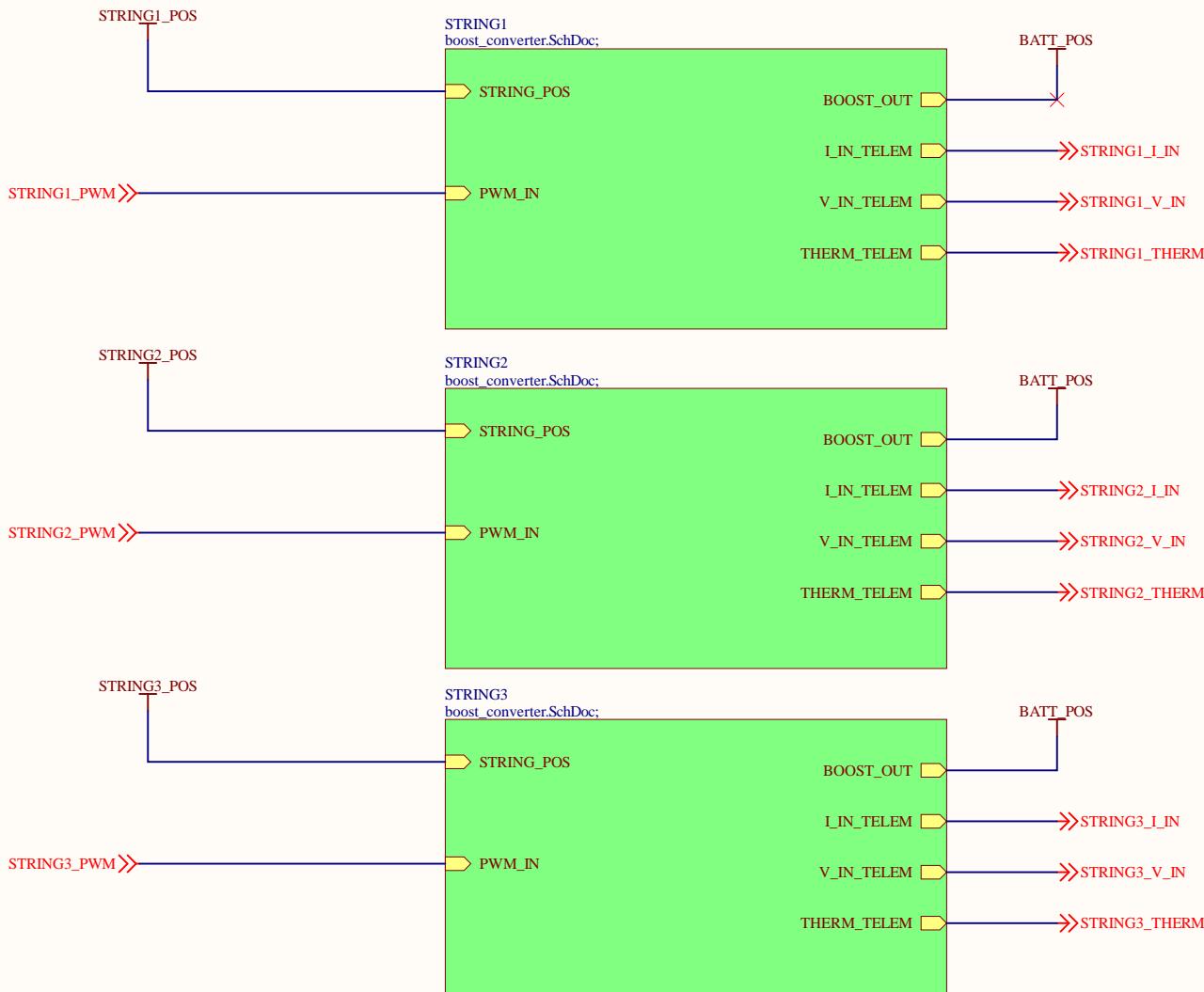
Date: 1/16/2022 Time: 9:24:08 PM Sheet 3 of 8

File: POL\_converter.SchDoc

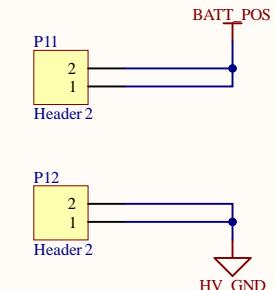
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# Solar Strings MPPTs



Debug Headers



| Title <b>Boost Strings</b>       |                  |
|----------------------------------|------------------|
| Engineer: Shelby Riggelman       | Revision: 1      |
| Date: 1/16/2022                  | Time: 9:24:09 PM |
| File: solar_boost_strings.SchDoc | Sheet 5 of 8     |

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# Solar Boost Converter

1 2 3 4

A

48.72V MPP  
57.12V Voc

B

**△** PWM signal must be  
OPPOSITE OF  
INDENDED DUTY  
CYCLE. Ex: For a  
desired 80% duty  
cycle, a 20% DC  
should be applied.  
This is due to the  
inverting nature of  
IN\_L, which drives  
the boost FET.

C

Makes inverted  
PWM signal in case  
using different gate  
driver w/ no  
inverting input for  
IN\_L

**△** Populate just pullup  
for MIC4102 alt. part  
to enable LS output.

**△** Populate both parts  
for MIC4103 alt. part.

D

PWM\_IN → Q3 ZVN4106FTA  
DNP

1

2

3

4

HV\_115V

Q1

BOOST

IPP075N15N3GXKSA1

C6

0.1uF

HV\_GND

D1

B340A-13-F

R5

0.0

SYNC\_DRV

DH

HS

DL

BOOST\_DRV 1

Q2

IPPO75N15N3GXKSA1

1702269

3

HV\_GND

D2

B340A-13-F

R7

0.0

i

0.1uF

HV\_115V

Q1

BOOST\_OUT

UCY2G101MHD6

100uF

HV\_GND

+C5

10uF

HV\_GND

+C34

96V Nominal

HV\_GND

SYNC\_DRV

U1

MAX5063DASA+

IN\_H

IN\_L

VDD

GND

HS

DL

BST

EP

HV\_115V

TP1

TP2

TP3

HV\_12P0V

R6

0.0

PWM\_N\_IN

C9

1uF

HV\_GND

C10

0.1uF

HV\_GND

HS1

6396BG

HV\_GND

LIN\_TELEM

VIN\_DIV

ISENSE\_POS

ISENSE\_NEG

THERM\_TELEM

LIN\_TELEM

VIN\_TELEM

ISENSE\_NEG

THERM\_TELEM

HS1

6396BG

HV\_GND

LIN\_TELEM

VIN\_TELEM

ISENSE\_POS

THERM\_TELEM

HS1

6396BG

HV\_GND

LIN\_TELEM

VIN\_TELEM

ISENSE\_NEG

THERM\_TELEM

HS1

6396BG

HV\_GND

LIN\_TELEM

VIN\_TELEM

ISENSE\_POS

THERM\_TELEM

HS1

6396BG

HV\_GND

LIN\_TELEM

VIN\_TELEM

ISENSE\_NEG

THERM\_TELEM

HS1

6396BG

HV\_GND

LIN\_TELEM

VIN\_TELEM

ISENSE\_POS

THERM\_TELEM

HS1

6396BG

HV\_GND

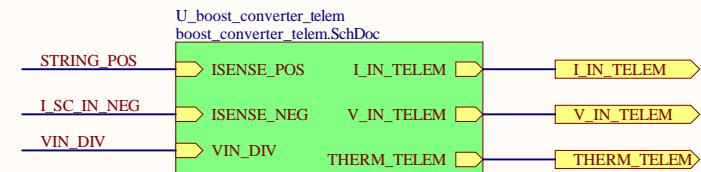
LIN\_TELEM

VIN\_TELEM

ISENSE\_NEG

THERM\_TELEM

△ High di/dt,  
minimize FET and output cap  
loop area



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Title **Boost Converter**

Engineer: Shelby Riggelman

Revision: 1

Date: 1/16/2022

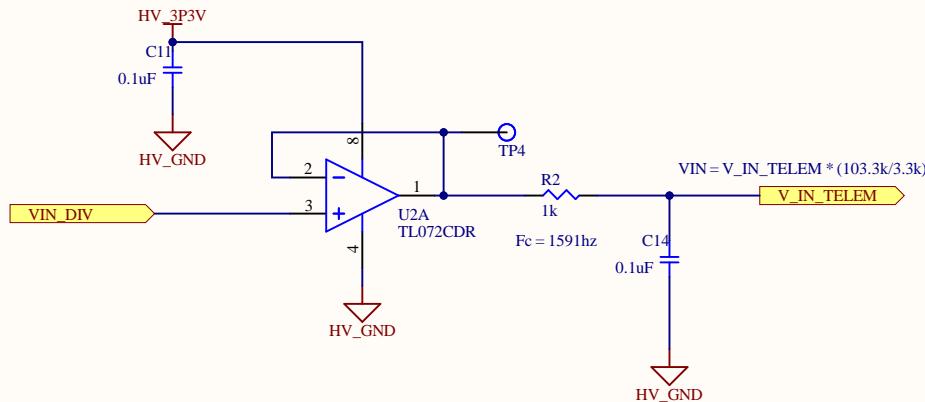
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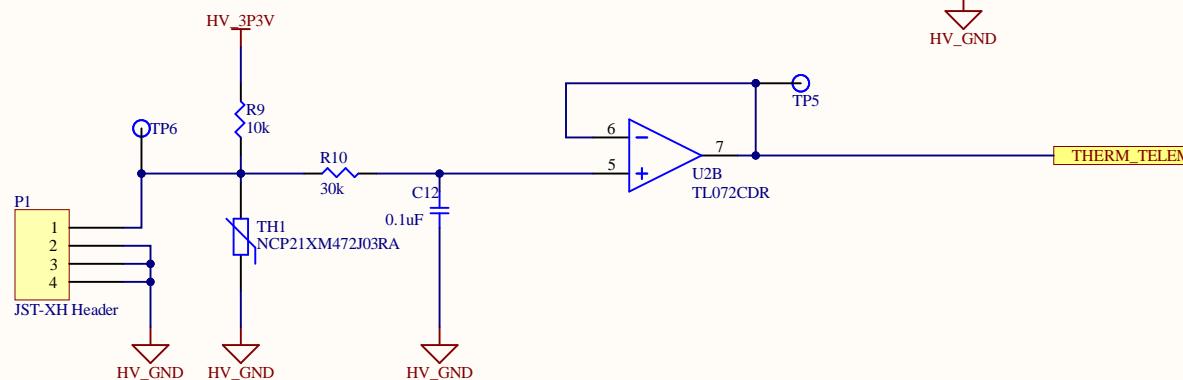
File: boost\_converter.SchDoc

# Solar Boost Converter Telemetry

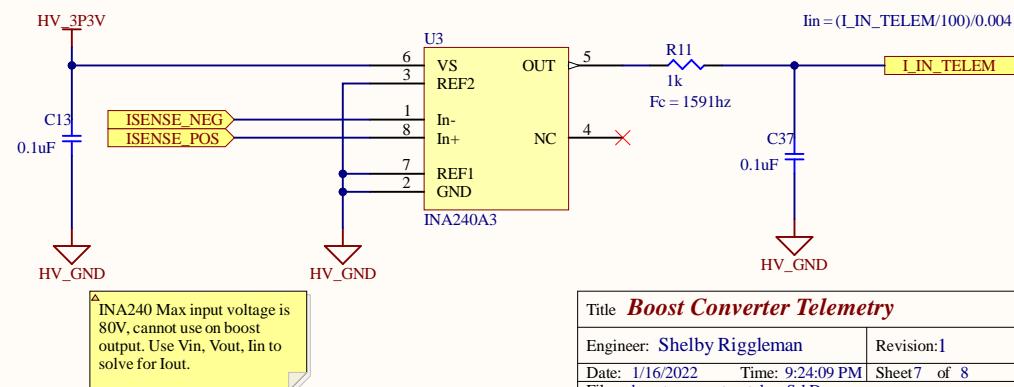
## String Input Voltage



## Thermistor Output



## String Input Current

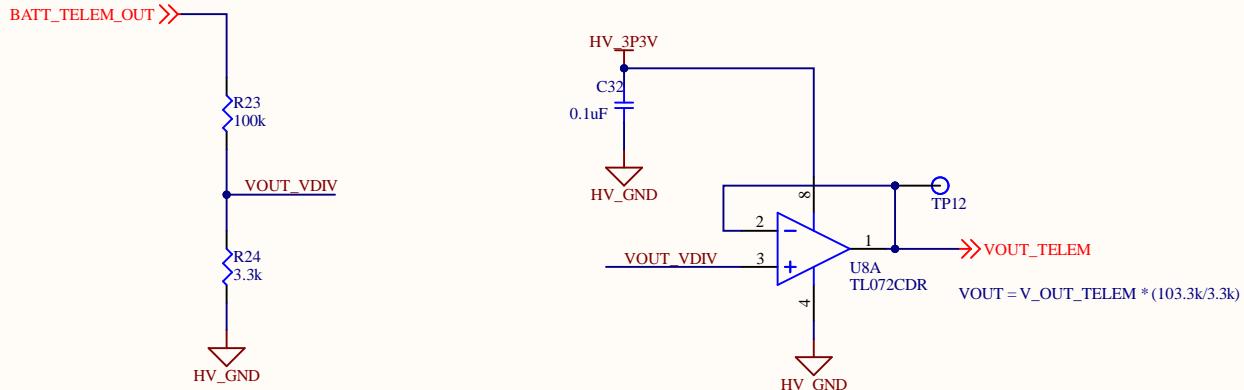


| Title <b>Boost Converter Telemetry</b> |                  |
|--|------------------|
| Engineer: Shelby Riggelman             | Revision: 1      |
| Date: 1/16/2022                        | Time: 9:24:09 PM |
| File: boost_converter_telem.SchDoc     | Sheet 7 of 8     |

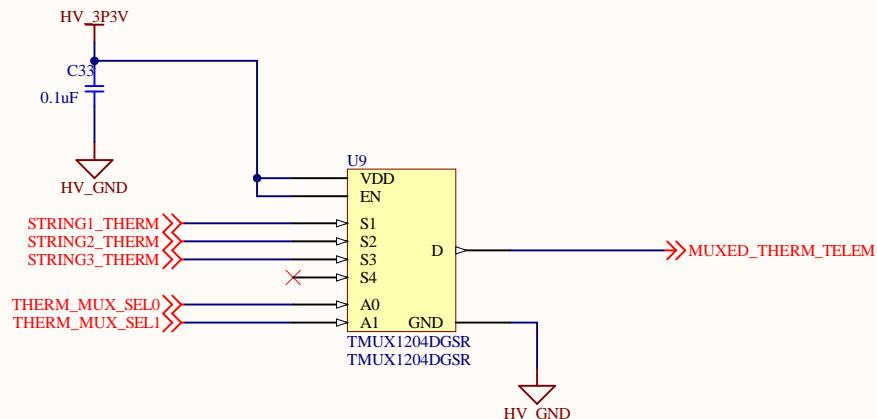
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# Global Telemetry

## Output (Battery) Voltage



## String Thermistor Telem (Muxed)



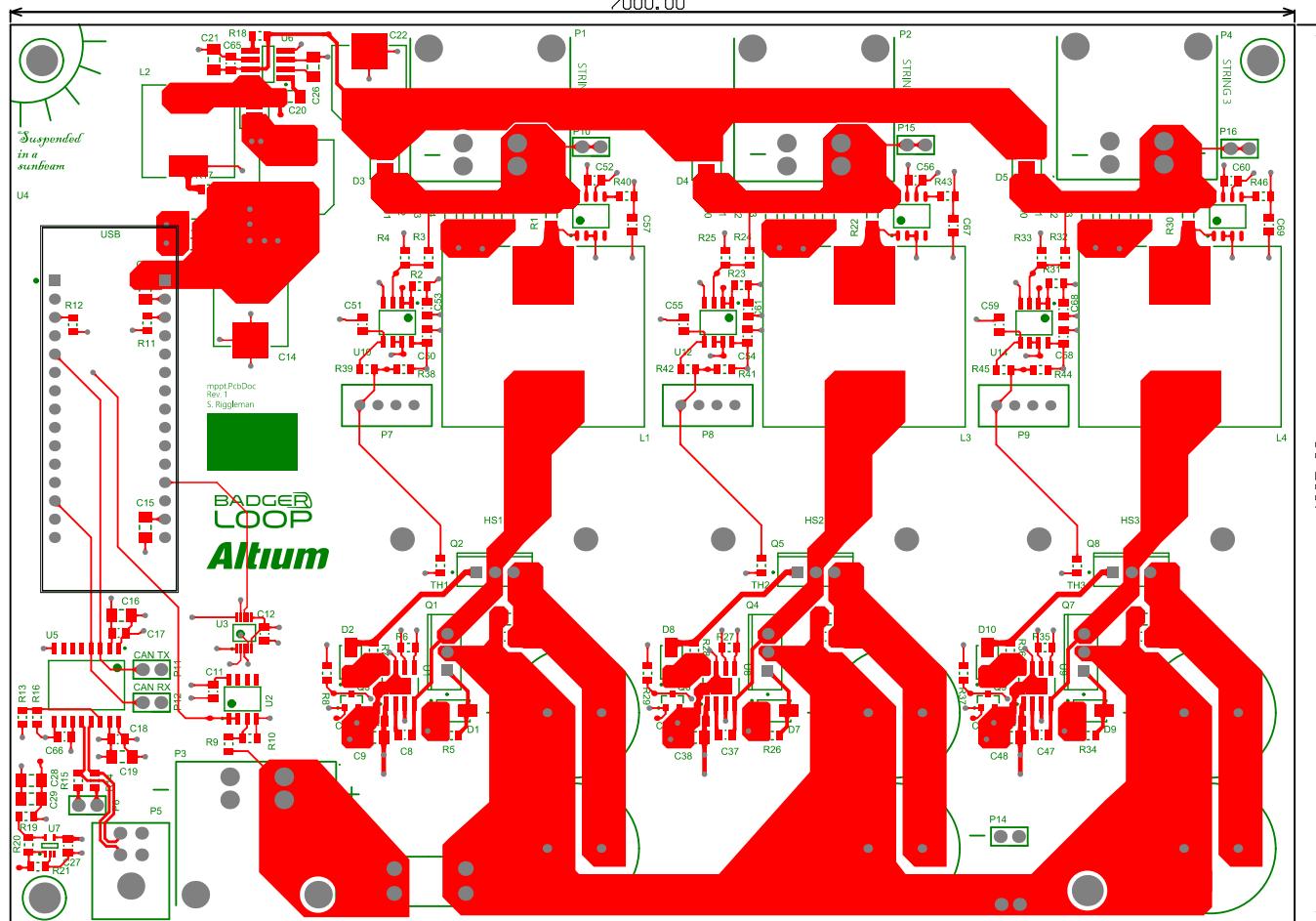
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|-------------------------------|------------------|
| Title <b>Global Telemetry</b> |                  |
| Engineer: Shelby Riggelman    | Revision: 1      |
| Date: 1/16/2022               | Time: 9:24:10 PM |
| File: global_telem.SchDoc     | Sheet 8 of 8     |

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| 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 |               |           |          |                   |

Total board thickness: 24.56mil

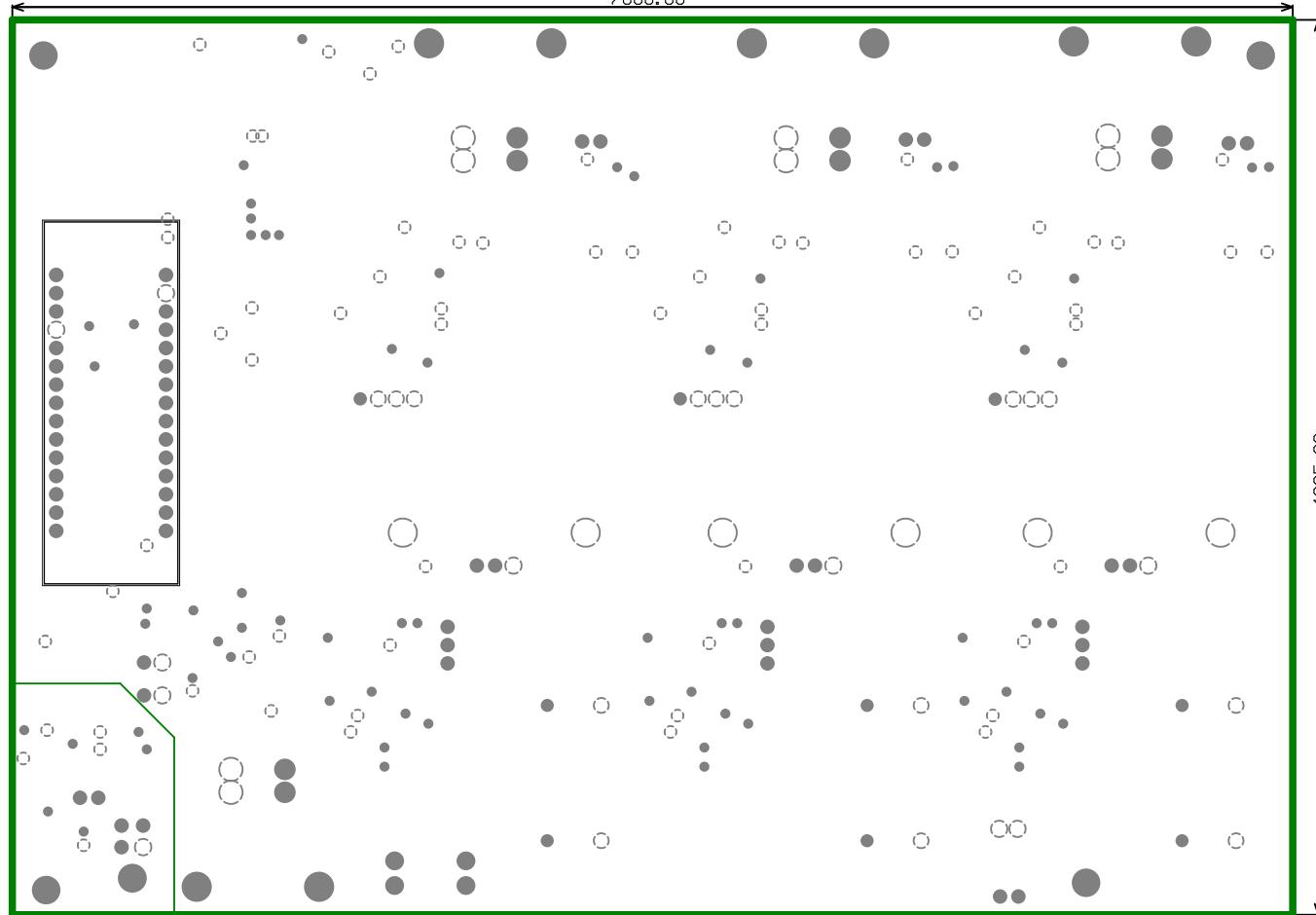
7000.00



| Layer | Name           | Material      | Thickness | Constant | Board Layer Stack |
|-------|----------------|---------------|-----------|----------|-------------------|
|       | Top Overlay    |               |           |          |                   |
|       | Top Solder     | Solder Resist | 0.40mil   | 3.5      |                   |
| 1     | Top Layer      |               | 1.40mil   |          |                   |
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|       | Bottom Solder  | Solder Resist | 0.40mil   | 3.5      |                   |
|       | Bottom Overlay |               |           |          |                   |

Total board thickness: 24.56mil

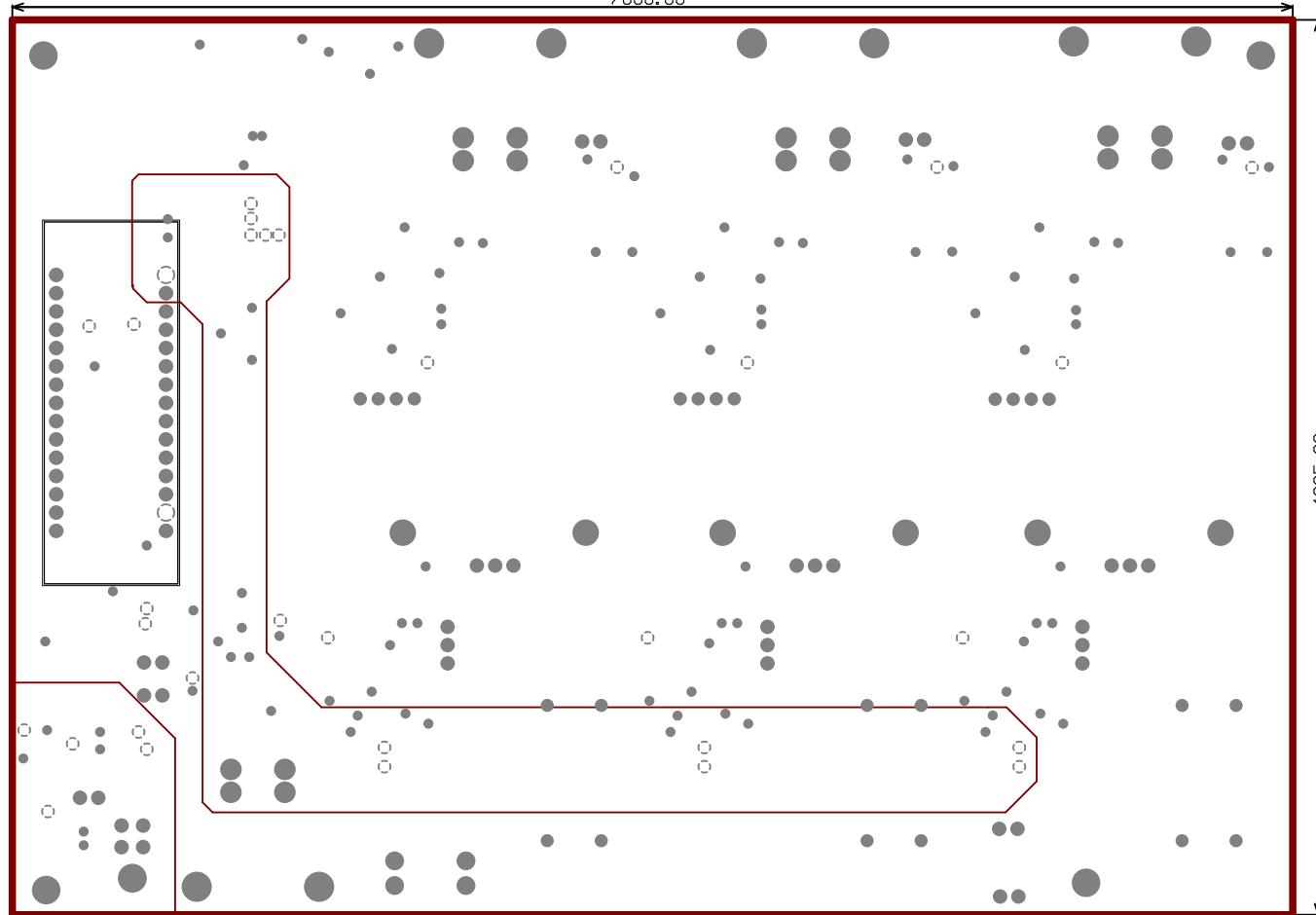
2000.00



| Layer | Name           | Material      | Thickness | Constant | Board Layer Stack |
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| 4     | Bottom Layer   |               | 1.40mil   |          |                   |
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|       | Bottom Overlay |               |           |          |                   |

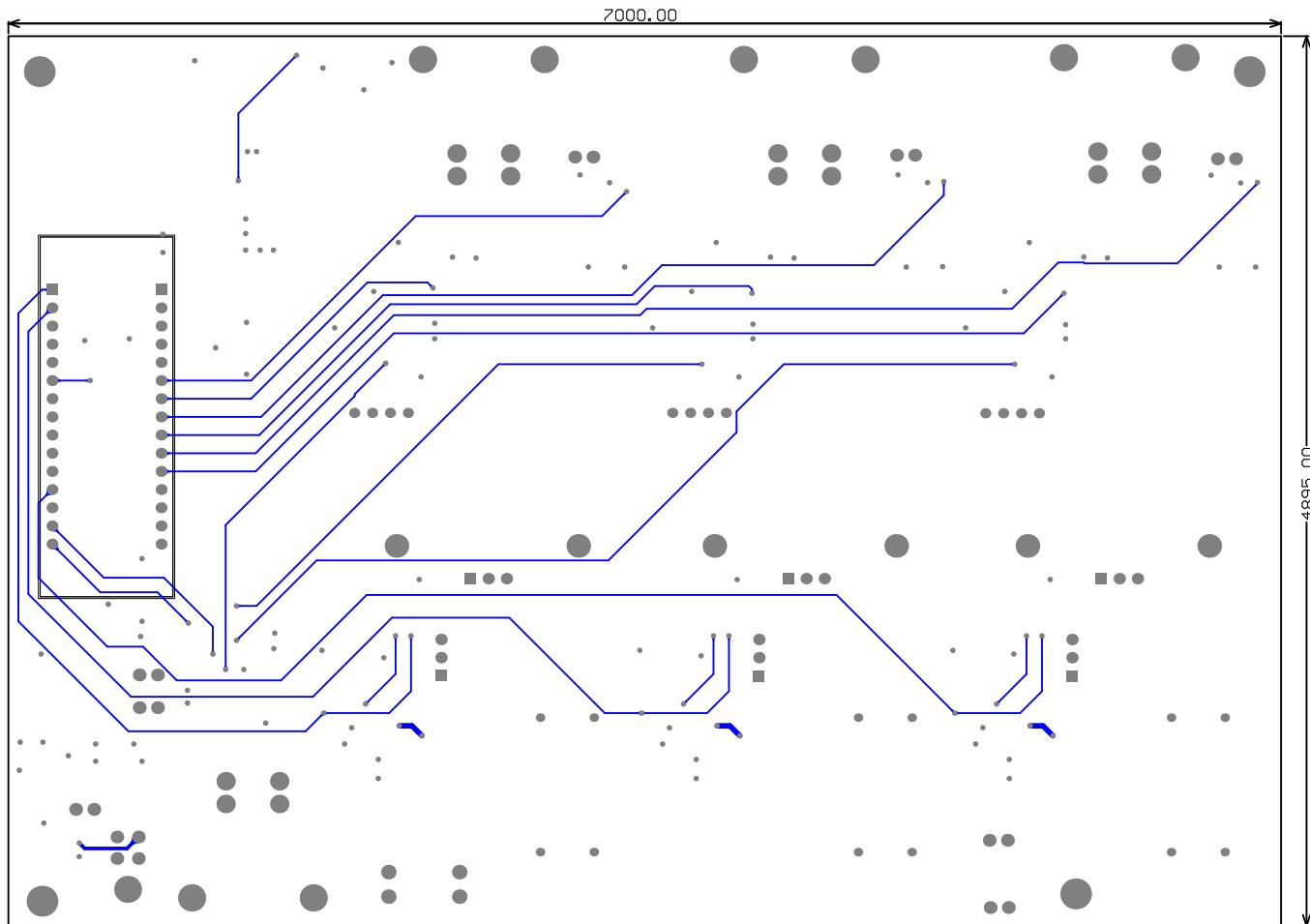
Total board thickness: 24.56mil

2000.00



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| 4     | Bottom Layer   |               | 1.40mil   |          |                   |
|       | Bottom Solder  | Solder Resist | 0.40mil   | 3.5      |                   |
|       | Bottom Overlay |               |           |          |                   |

Total board thickness: 24.56mil

7000.00

