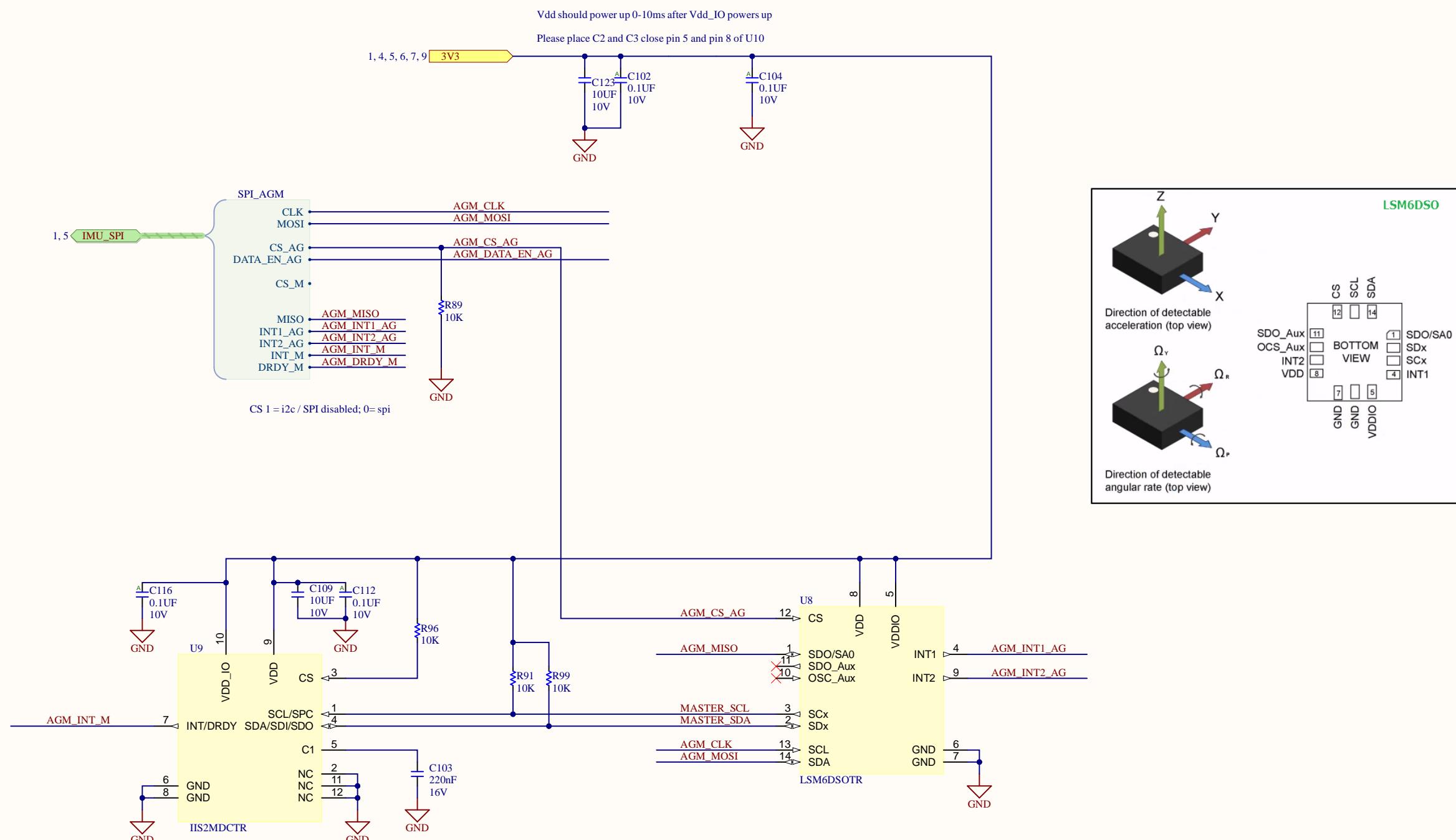


3D accelerometer, 3D gyroscope, 3D magnetometer



**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**

THIS DESIGN IS BEING PROVIDED FOR
NON-COMMERCIAL USE ONLY. THE USE
OF BETTY HOLBERTON'S NAME IN
CONNECTION WITH THE DESIGN IS NOT
INTENDED TO IMPLY THAT BETTY
HOLBERTON SPONSORS OR ENDORSES
THE DESIGN, GOOGLE LLC, OR ANY OF
GOOGLE LLC'S PRODUCTS OR SERVICES.

BARKOUR ROBOT

Accelerometer SabDab

Google DeepMind

1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043

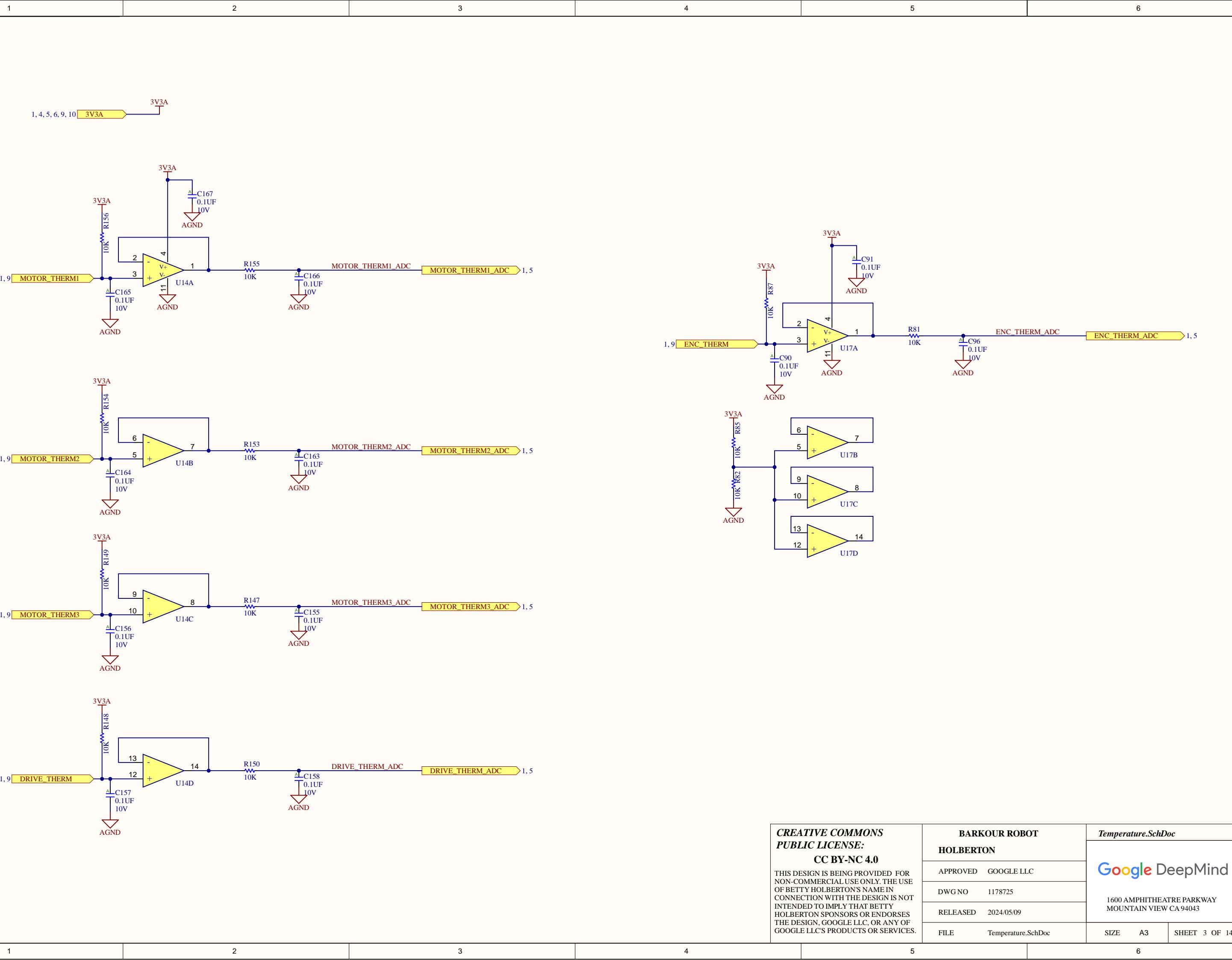
APPROVED GOOGLE LLC

DWG NO 1178725

RELEASED 2024/05/09

FILE Accelerometer.Sch

SIZE A3 SHEET 2 OF 14



**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**

THIS DESIGN IS BEING PROVIDED FOR NON-COMMERCIAL USE ONLY. THE USE OF BETTY HOLBERTON'S NAME IN CONNECTION WITH THE DESIGN IS NOT INTENDED TO IMPLY THAT BETTY HOLBERTON SPONSORS OR ENDORSES THE DESIGN, GOOGLE LLC, OR ANY OF GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**

APPROVED GOOGLE LLC

DWG NO 1178725

RELEASED 2024/05/09

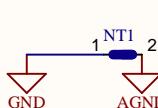
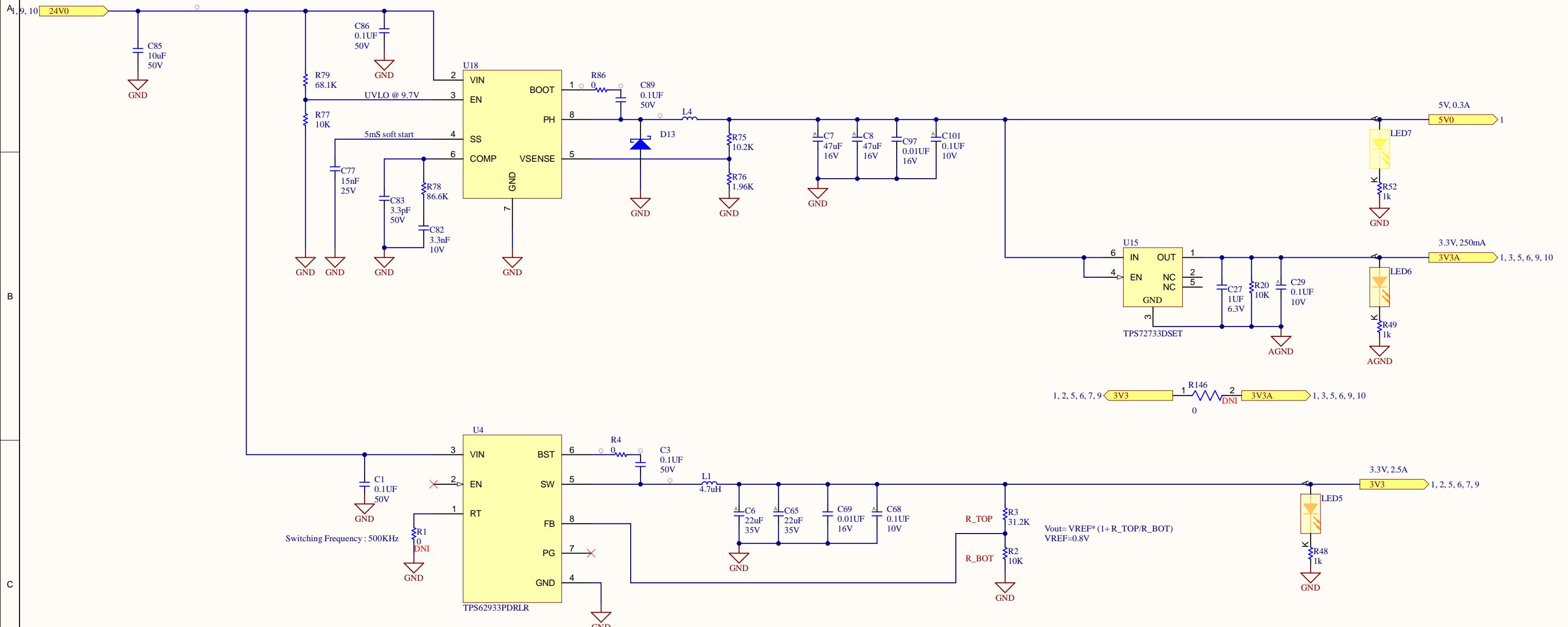
Temperature.SchDoc

Google DeepMind

1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043

FILE Temperature.SchDoc

SIZE A3 SHEET 3 OF 14



**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**
THIS DESIGN IS BEING PROVIDED FOR
NON-COMMERCIAL USE ONLY. THE USE
OF BETTY HOLBERTON'S NAME IN
CONNECTION WITH THE DESIGN IS NOT
INTENDED TO IMPLY THAT BETTY
HOLBERTON SPONSORS OR ENDORSES
THE DESIGN, GOOGLE LLC, OR ANY OF
GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**

Power.SchDoc
Google DeepMind
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043

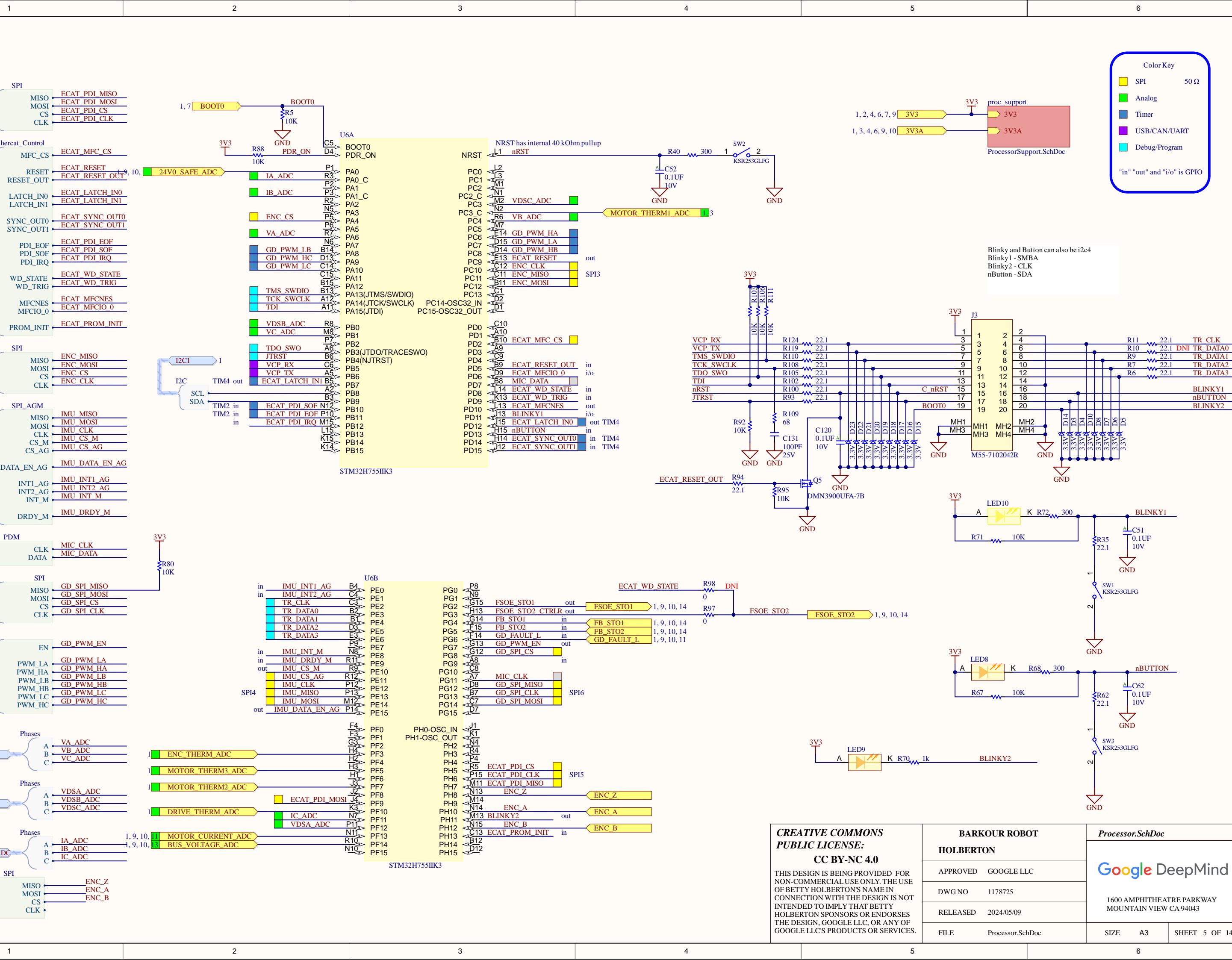
APPROVED GOOGLE LLC

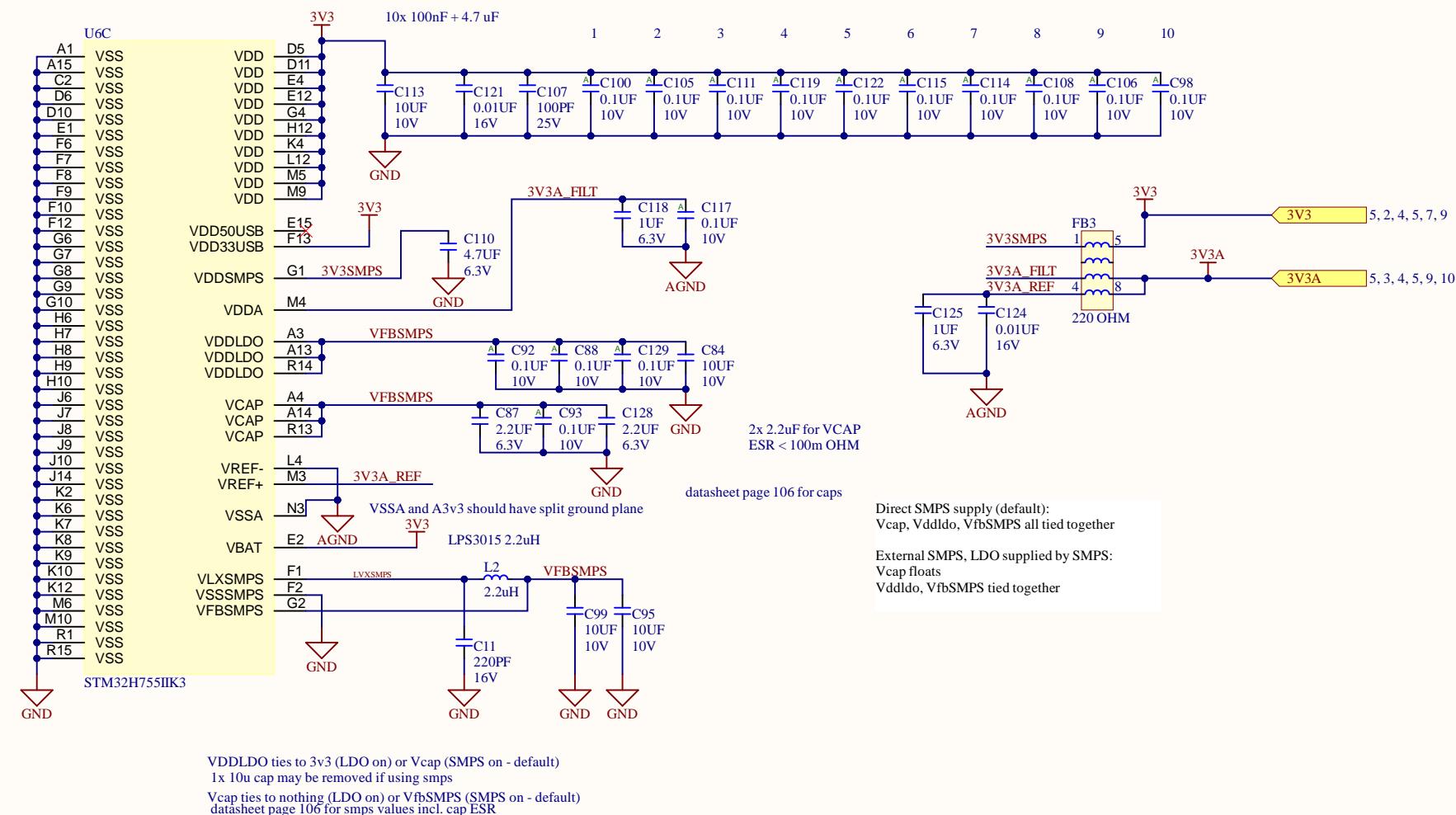
DWG NO 1178725

RELEASED 2024/05/09

FILE Power.SchDoc

SIZE A3 SHEET 4 OF 14





**CREATIVE COMMONS
PUBLIC LICENSE:**
CC BY-NC 4.0

CC BY-NC 4.0
THIS DESIGN IS BEING PROVIDED FOR NON-COMMERCIAL USE ONLY. THE USE OF BETTY HOLBERTON'S NAME IN CONNECTION WITH THE DESIGN IS NOT INTENDED TO IMPLY THAT BETTY HOLBERTON SPONSORS OR ENDORSES THE DESIGN, GOOGLE LLC, OR ANY OF GOOGLE LLC'S PRODUCTS OR SERVICES.

BARKOUR ROBOT

P. S. S. J. D.

Google DeepMind

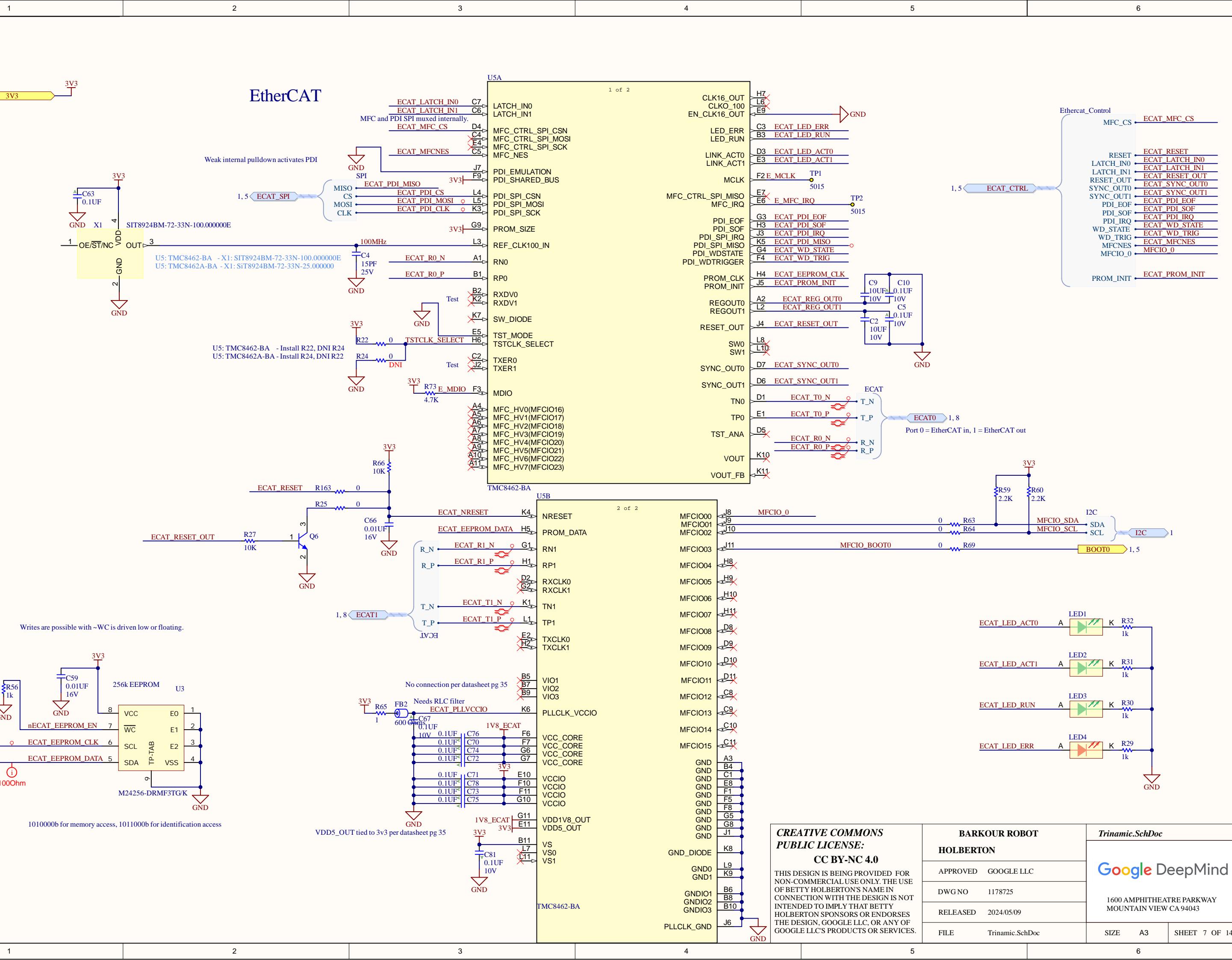
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94041

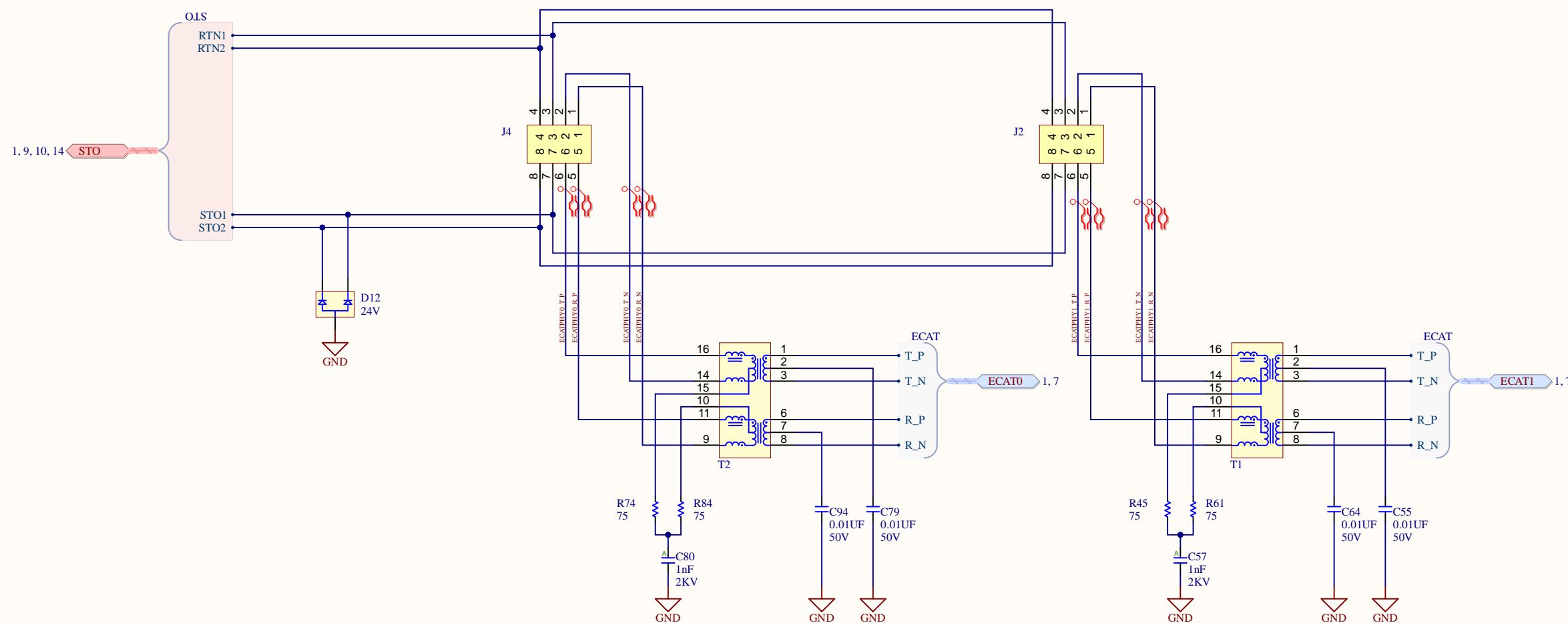
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043

MOUNTAIN VIEW CA 94043

Page 10 of 10

SIZE A3 SHEET 6 OF





**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**

THIS DESIGN IS BEING PROVIDED FOR
NON-COMMERCIAL USE ONLY. THE USE
OF BETTY HOLBERTON'S NAME IN
CONNECTION WITH THE DESIGN IS NOT
INTENDED TO IMPLY THAT BETTY
HOLBERTON SPONSORS OR ENDORSES
THE DESIGN, GOOGLE LLC, OR ANY OF
GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**

EtherCATConnectors.SchDoc

APPROVED GOOGLE LLC

DWG NO 1178725

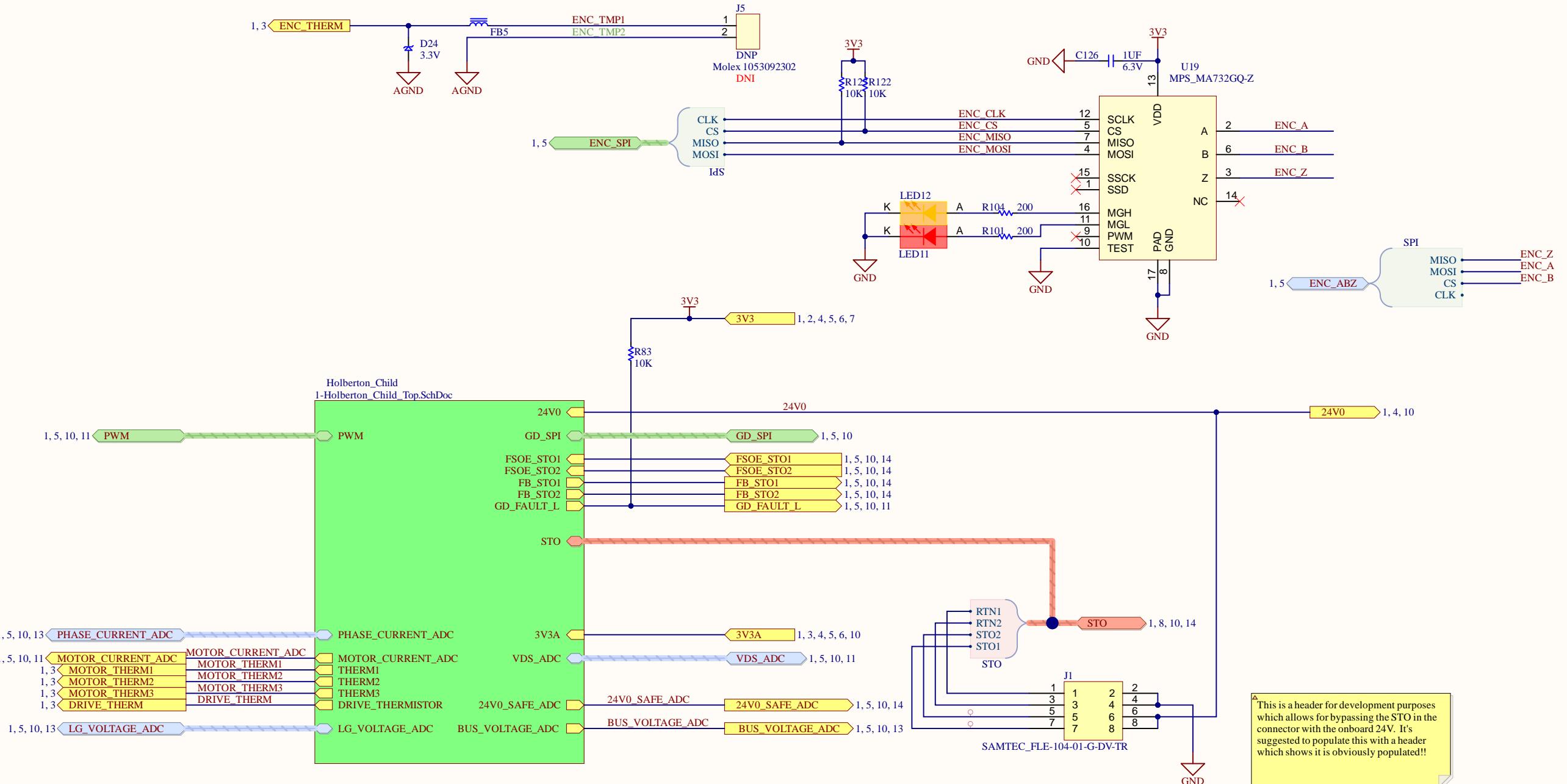
RELEASED 2024/05/09

FILE EtherCATConnectors.SchDoc

Google DeepMind

1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043

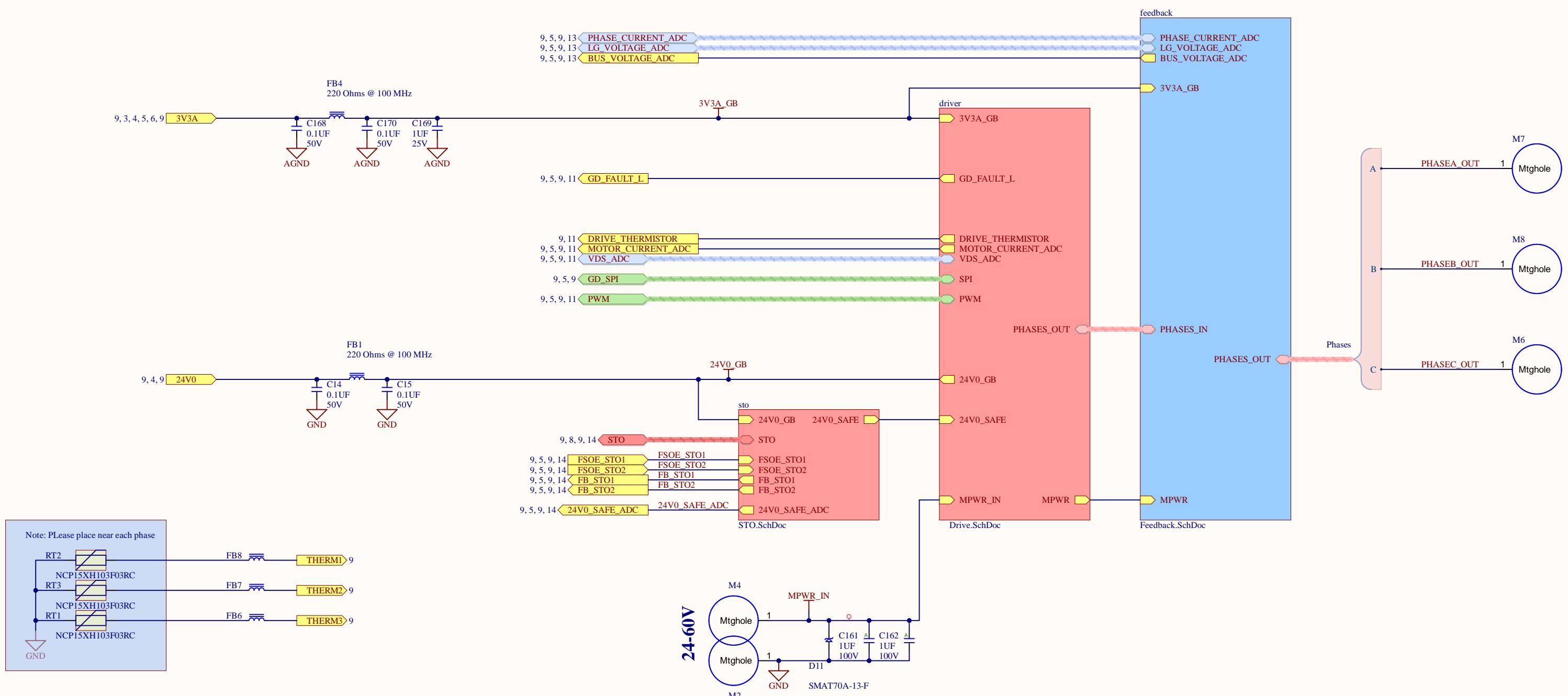
SIZE A3 SHEET 8 OF 14



**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**
THIS DESIGN IS BEING PROVIDED FOR NON-COMMERCIAL USE ONLY. THE USE OF BETTY HOLBERTON'S NAME IN CONNECTION WITH THE DESIGN IS NOT INTENDED TO IMPLY THAT BETTY HOLBERTON SPONSORS OR ENDORSES THE DESIGN, GOOGLE LLC, OR ANY OF GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**
APPROVED GOOGLE LLC
DWG NO 1178725
RELEASED 2024/05/09
FILE MezzanineConnectors_Cortes.SchDoc SIZE A3 SHEET 9 OF 14

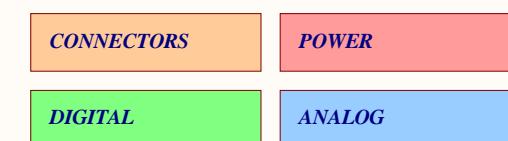
MezzanineConnectors_Cortes.SchDoc
Google DeepMind
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043



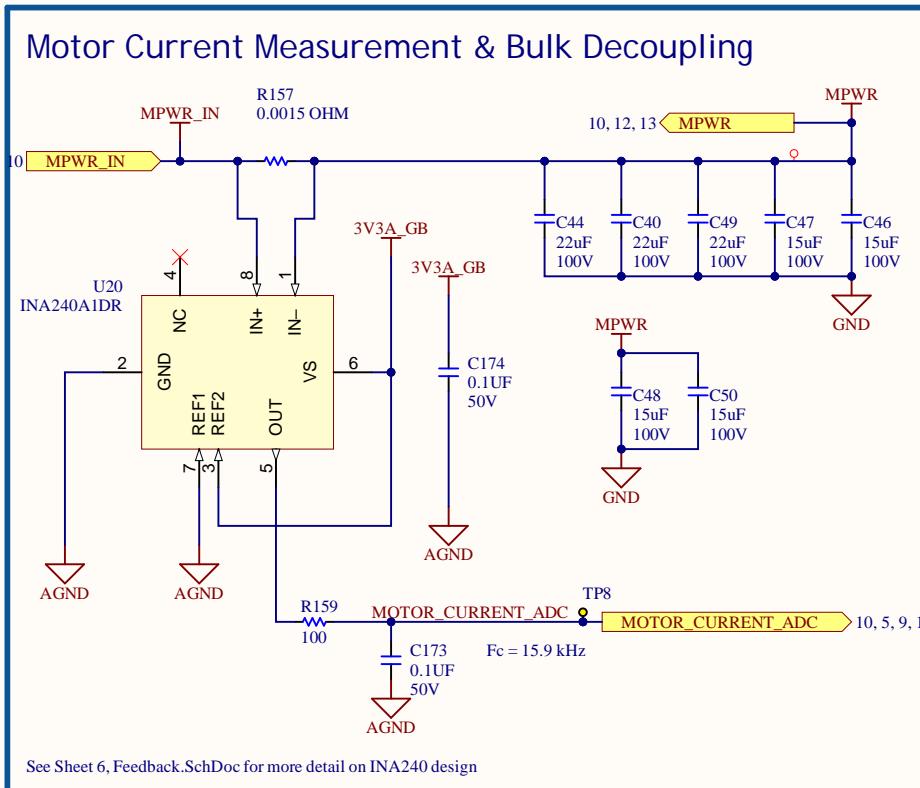
**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**
THIS DESIGN IS BEING PROVIDED FOR
NON-COMMERCIAL USE ONLY. THE USE
OF BETTY HOLBERTON'S NAME IN
CONNECTION WITH THE DESIGN IS NOT
INTENDED TO IMPLY THAT BETTY
HOLBERTON SPONSORS OR ENDORSES
THE DESIGN, GOOGLE LLC, OR ANY OF
GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**
APPROVED GOOGLE LLC
DWG NO 1178725
RELEASED 2024/05/09
FILE 1-Holberton_Child_Top.SchDoc

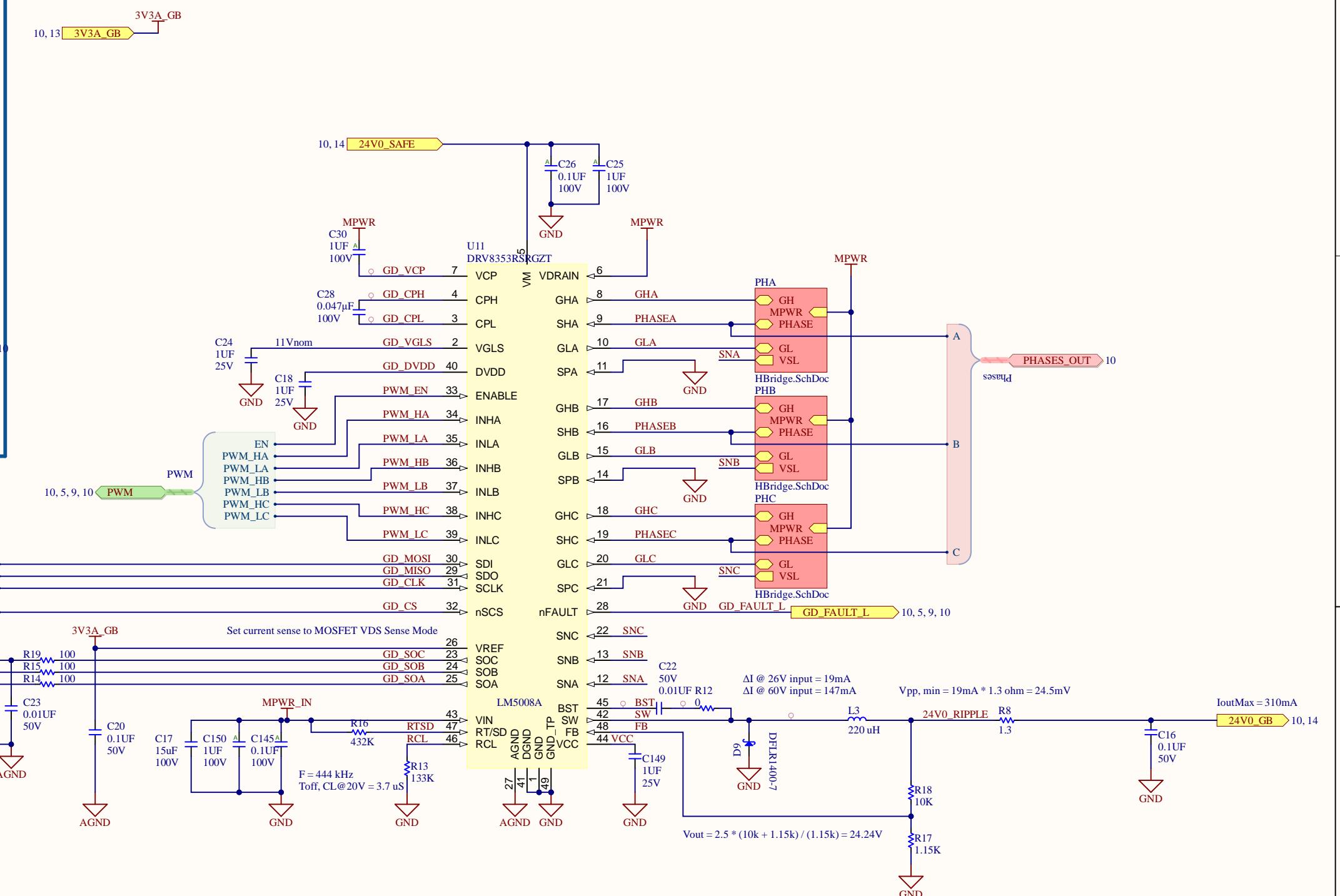
1-Holberton_Child_Top.SchDoc
Google DeepMind
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043



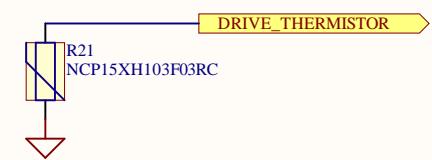
Motor Current Measurement & Bulk Decoupling



See Sheet 6, Feedback.SchDoc for more detail on INA240 design



Place near gate drive / FET



**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**

THIS DESIGN IS BEING PROVIDED
NON-COMMERCIAL USE ONLY. THE
NAME OF BETTY HOLBERTON'S NAME IN
CONNECTION WITH THE DESIGN
INTENDED TO IMPLY THAT BETTY
HOLBERTON SPONSORS OR ENDORSES
THE DESIGN, GOOGLE LLC, OR A
GOOGLE LLC'S PRODUCTS OR SERVICES.

BARKOUR ROBOT
HOLBERTON

	<i>Drive.SchDoc</i>
	 The logo consists of the word "Google" in its signature blue, red, yellow, and green colors, followed by the words "DeepMind" in a black sans-serif font.
	1600 AMPHITHEATRE PARKWAY MOUNTAIN VIEW CA 94043

A

B

C

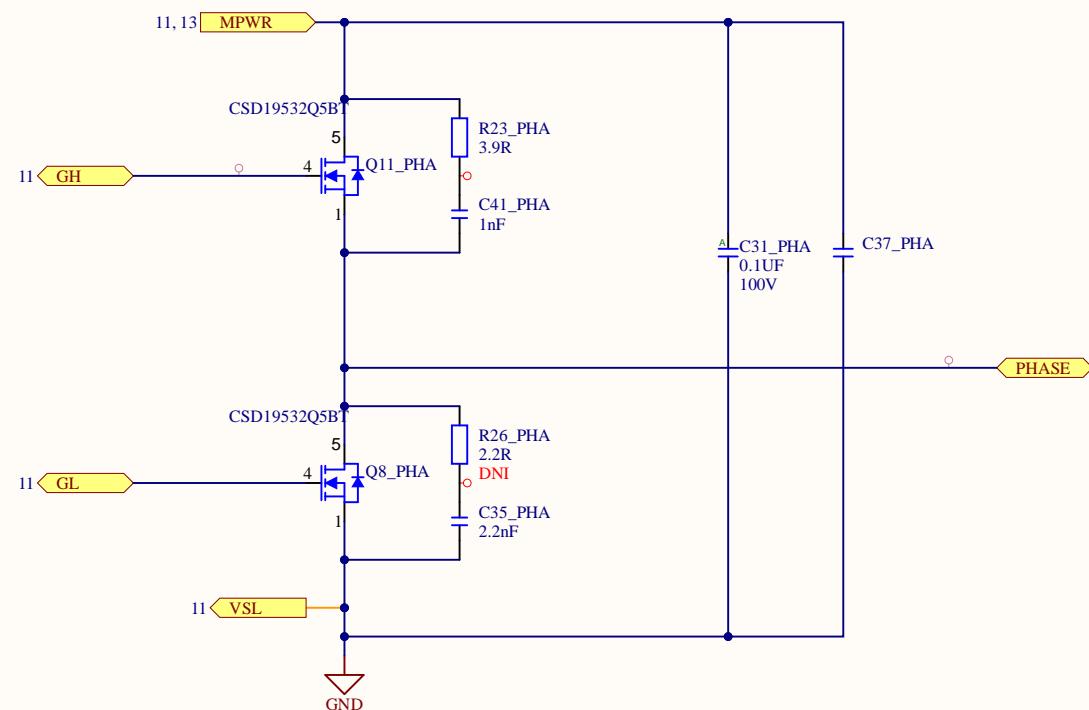
D

A

B

C

D



TI Snubber Design procedure for Motor Drivers

STEP 1
Measure the oscillation frequency f_0 of VDS ringing with no RC snubber:
 $f_{0L} = 111.11\text{MHz}$, $f_{0H} = 114.94\text{MHz}$

STEP 2
Add capacitor C_1 ($>>$ MOSFET C_{RSS}) in parallel and measure shifted oscillation frequency f_1 :
 $C_{RSS} = 14\text{pF}$; $C_1 = 100\text{pF}$
 $f_{1L} = 104.17\text{MHz}$, $f_{1H} = 102.04\text{MHz}$

STEP 3
Calculate frequency shift ratio $m = f_0/f_1$
 $m_L = 1.067$, $m_H = 1.126$

STEP 4
Calculate circuit parasitic capacitance $C_0 = C_1 / (m^2 - 1)$
 $C_{0L} = 722.1\text{pF}$, $C_{0H} = 373.3\text{pF}$

STEP 5
Calculate circuit parasitic inductance $L = (m^2 - 1) / (2\pi f_0^2 * C_1)$
 $L_{L,L} = 2.825\text{nH}$, $L_{H,H} = 5.154\text{nH}$

STEP 6
Calculate snubber capacitor value $C_{snub} = 3C_0$
 $C_{snub,L} = 2.179\text{nF} \rightarrow 2.2\text{nF}$, $C_{snub,H} = 1.116\text{nF} \rightarrow 1\text{nF}$

STEP 7
Calculate snubber resistor value $R_{snub} = \sqrt{L/C_0}$
 $R_{snub,L} = 1.97 \rightarrow 2.0\Omega$, $R_{snub,H} = 3.72 \rightarrow 3.9\Omega$

BONUS STEP
Calculating resistor power rating
<https://www.ti.com/seclit/an/slup100/slup100.pdf>
Page 2-5
 $P = fCV^2$
We have experimented with frequencies up to 40kHz and will use a battery with peak voltage of 60V.
 $P = 40e3 * 2.2e-9 * 60^2$
 $P = 318\text{mW}$

**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**

THIS DESIGN IS BEING PROVIDED FOR NON-COMMERCIAL USE ONLY. THE USE OF BETTY HOLBERTON'S NAME IN CONNECTION WITH THE DESIGN IS NOT INTENDED TO IMPLY THAT BETTY HOLBERTON SPONSORS OR ENDORSES THE DESIGN, GOOGLE LLC, OR ANY OF GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**

APPROVED GOOGLE LLC

DWG NO 1178725

RELEASED 2024/05/09

FILE HBridge.SchDoc

HBridge.SchDoc

Google DeepMind

1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043

A

B

C

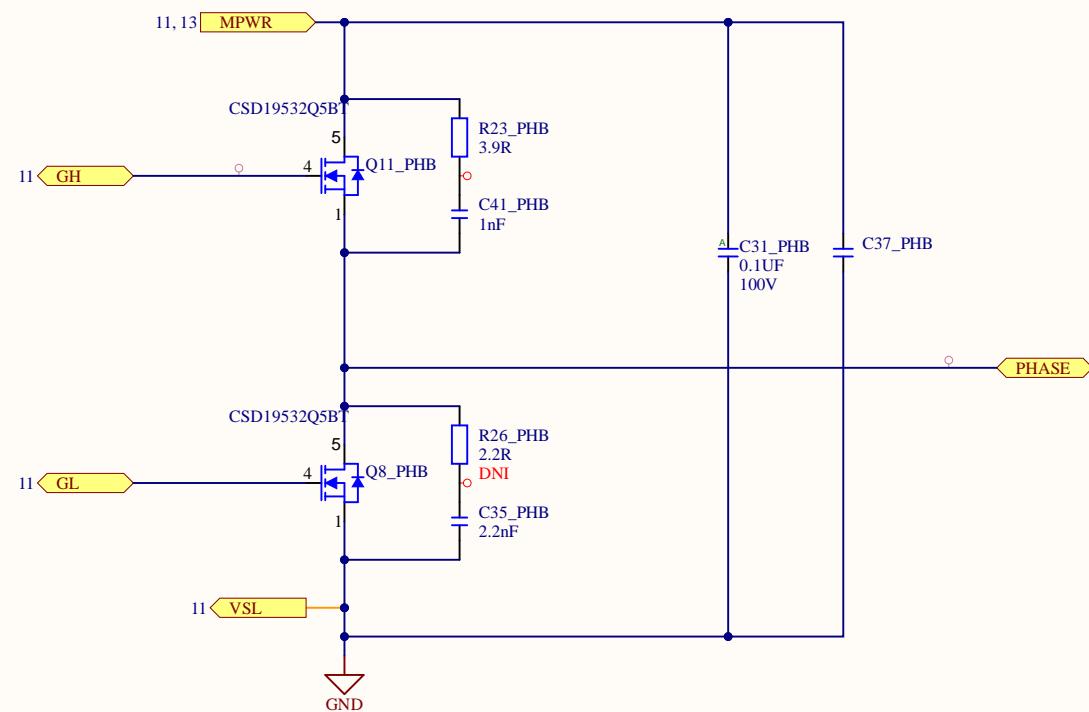
D

A

B

C

D



TI Snubber Design procedure for Motor Drivers

STEP 1
Measure the oscillation frequency f_0 of VDS ringing with no RC snubber:
 $f_{0L} = 111.11\text{MHz}$, $f_{0H} = 114.94\text{MHz}$

STEP 2
Add capacitor C_1 ($>>$ MOSFET C_{RSS}) in parallel and measure shifted oscillation frequency f_1 :
 $C_{RSS} = 14\text{pF}$; $C_1 = 100\text{pF}$
 $f_{1L} = 104.17\text{MHz}$, $f_{1H} = 102.04\text{MHz}$

STEP 3
Calculate frequency shift ratio $m = f_0/f_1$
 $m_L = 1.067$, $m_H = 1.126$

STEP 4
Calculate circuit parasitic capacitance $C_0 = C_1 / (m^2 - 1)$
 $C_{0L} = 722.1\text{pF}$, $C_{0H} = 373.3\text{pF}$

STEP 5
Calculate circuit parasitic inductance $L = (m^2 - 1) / (2\pi f_0)^2 * C_1$
 $L_{-L} = 2.825\text{nH}$, $L_{-H} = 5.154\text{nH}$

STEP 6
Calculate snubber capacitor value $C_{snub} = 3C_0$
 $C_{snubL} = 2.179\text{nF} \rightarrow 2.2\text{nF}$, $C_{snubH} = 1.116\text{nF} \rightarrow 1\text{nF}$

STEP 7
Calculate snubber resistor value $R_{snub} = \sqrt{L/C_0}$
 $R_{snubL} = 1.97 \rightarrow 2.0\Omega$, $R_{snubH} = 3.72 \rightarrow 3.9\Omega$

BONUS STEP
Calculating resistor power rating
<https://www.ti.com/seclit/an/slup100/slup100.pdf>
Page 2-5
 $P = fCV^2$
We have experimented with frequencies up to 40kHz and will use a battery with peak voltage of 60V.
 $P = 40e3 * 2.2e-9 * 60^2$
 $P = 318\text{mW}$

**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**

THIS DESIGN IS BEING PROVIDED FOR NON-COMMERCIAL USE ONLY. THE USE OF BETTY HOLBERTON'S NAME IN CONNECTION WITH THE DESIGN IS NOT INTENDED TO IMPLY THAT BETTY HOLBERTON SPONSORS OR ENDORSES THE DESIGN, GOOGLE LLC, OR ANY OF GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**

APPROVED GOOGLE LLC

DWG NO 1178725

RELEASED 2024/05/09

FILE HBridge.SchDoc

HBridge.SchDoc

Google DeepMind

1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043

A

B

C

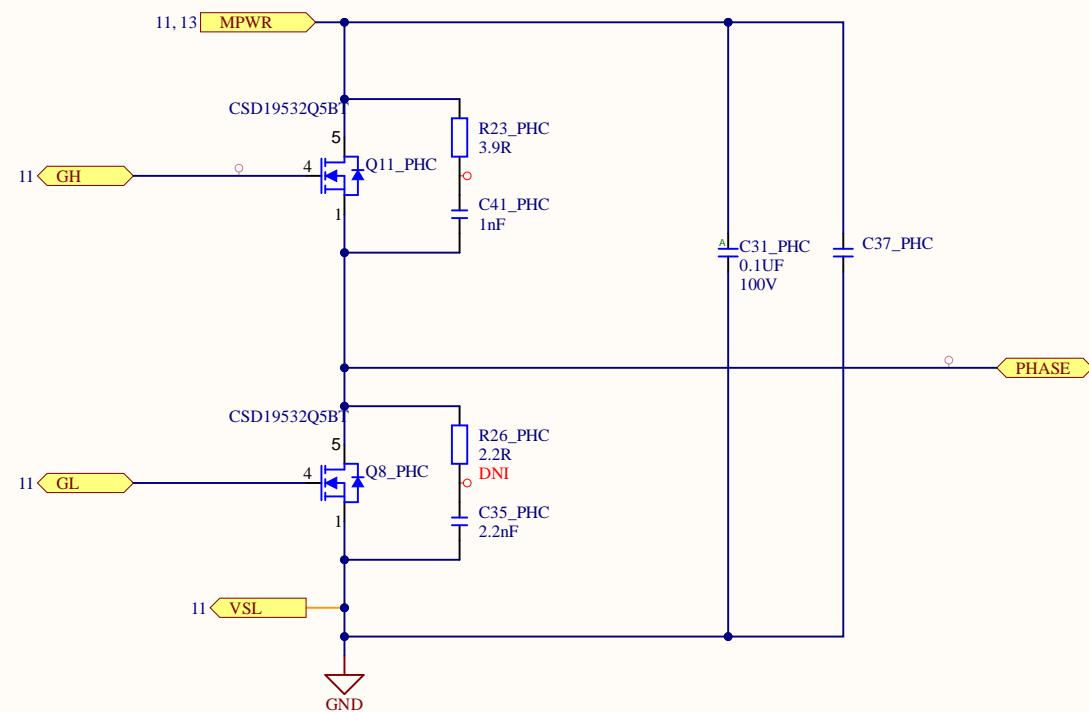
D

A

B

C

D



TI Snubber Design procedure for Motor Drivers

STEP 1
Measure the oscillation frequency f_0 of VDS ringing with no RC snubber:
 $f_{0L} = 111.11\text{MHz}$, $f_{0H} = 114.94\text{MHz}$

STEP 2
Add capacitor C_1 ($>>$ MOSFET C_{RSS}) in parallel and measure shifted oscillation frequency f_1 :
 $C_{RSS} = 14\text{pF}$; $C_1 = 100\text{pF}$
 $f_{1L} = 104.17\text{MHz}$, $f_{1H} = 102.04\text{MHz}$

STEP 3
Calculate frequency shift ratio $m = f_0/f_1$
 $m_L = 1.067$, $m_H = 1.126$

STEP 4
Calculate circuit parasitic capacitance $C_0 = C_1 / (m^2 - 1)$
 $C_{0L} = 722.1\text{pF}$, $C_{0H} = 373.3\text{pF}$

STEP 5
Calculate circuit parasitic inductance $L = (m^2 - 1) / (2\pi f_0)^2 * C_1$
 $L_{-L} = 2.825\text{nH}$, $L_{-H} = 5.154\text{nH}$

STEP 6
Calculate snubber capacitor value $C_{snub} = 3C_0$
 $C_{snubL} = 2.179\text{nF} \rightarrow 2.2\text{nF}$, $C_{snubH} = 1.116\text{nF} \rightarrow 1\text{nF}$

STEP 7
Calculate snubber resistor value $R_{snub} = \sqrt{L/C_0}$
 $R_{snubL} = 1.97 \rightarrow 2.0\Omega$, $R_{snubH} = 3.72 \rightarrow 3.9\Omega$

BONUS STEP
Calculating resistor power rating
<https://www.ti.com/seclit/an/slup100/slup100.pdf>
Page 2-5
 $P = fCV^2$
We have experimented with frequencies up to 40kHz and will use a battery with peak voltage of 60V.
 $P = 40e3 * 2.2e-9 * 60^2$
 $P = 318\text{mW}$

**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**

THIS DESIGN IS BEING PROVIDED FOR NON-COMMERCIAL USE ONLY. THE USE OF BETTY HOLBERTON'S NAME IN CONNECTION WITH THE DESIGN IS NOT INTENDED TO IMPLY THAT BETTY HOLBERTON SPONSORS OR ENDORSES THE DESIGN, GOOGLE LLC, OR ANY OF GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**

APPROVED GOOGLE LLC

DWG NO 1178725

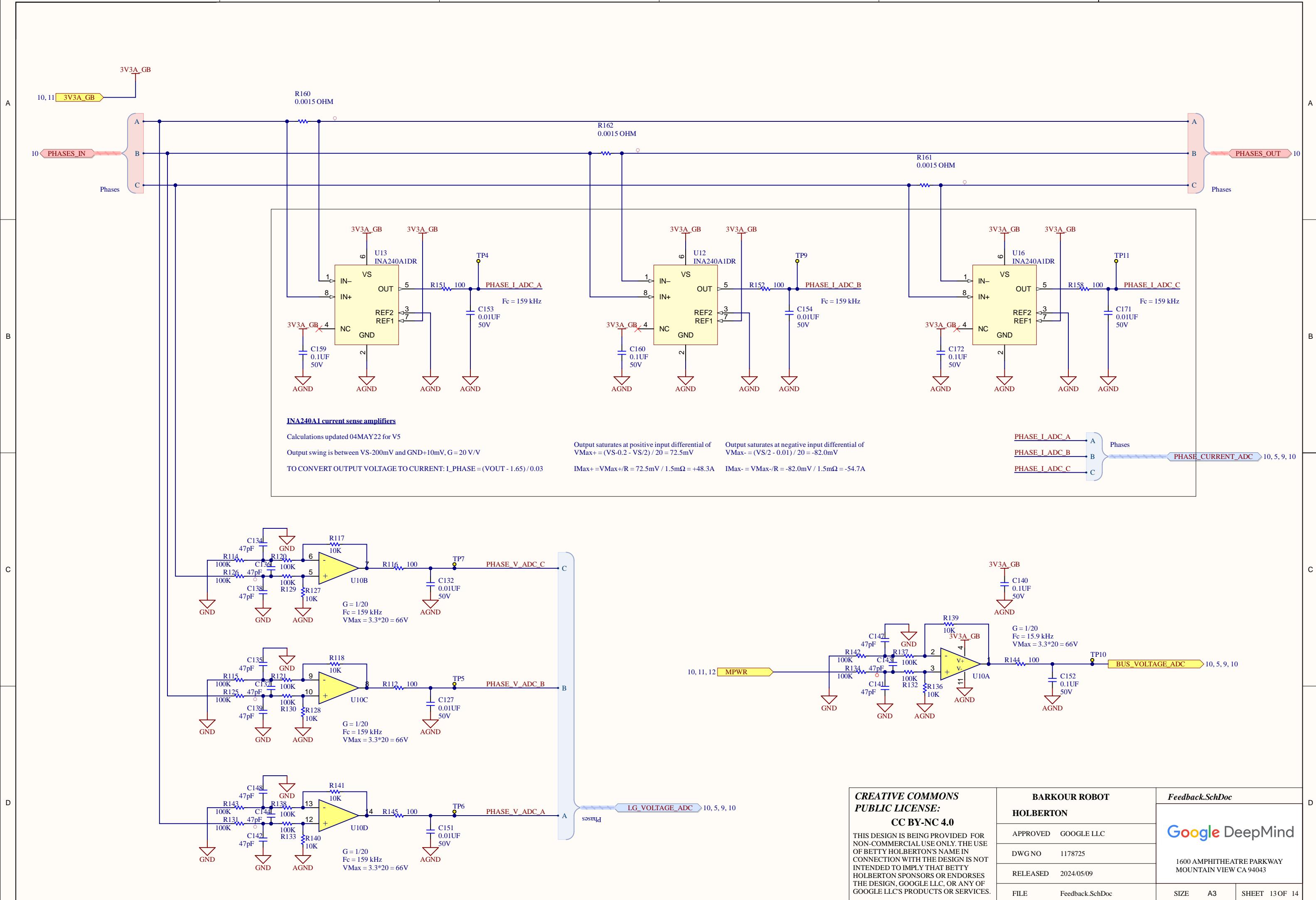
RELEASED 2024/05/09

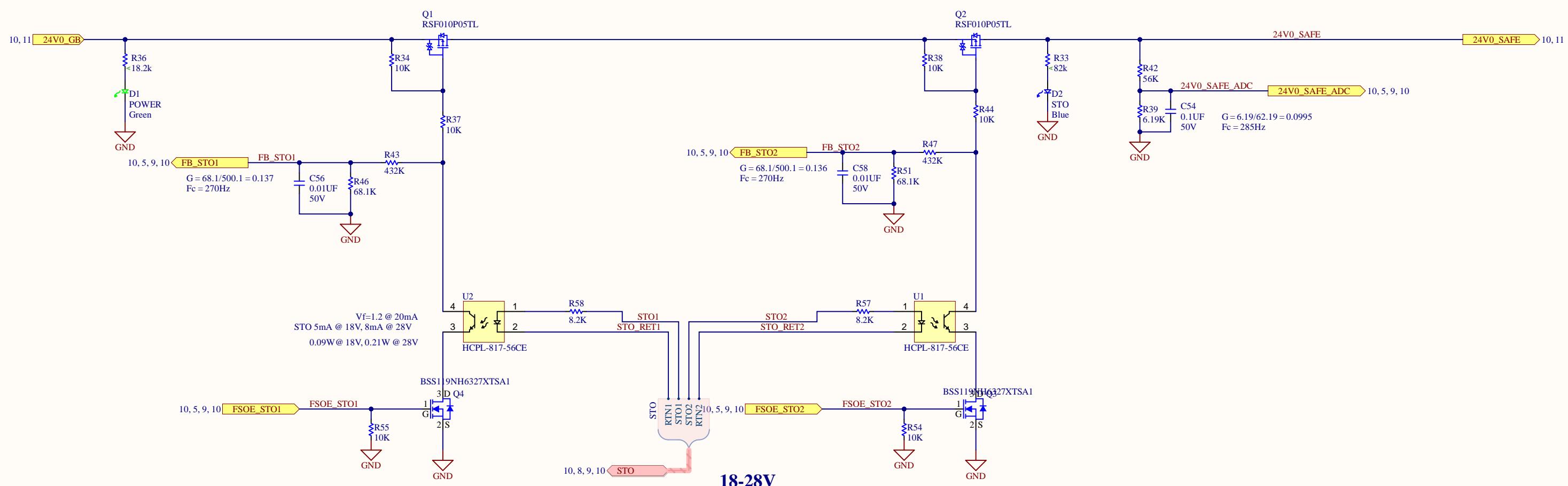
FILE HBridge.SchDoc

HBridge.SchDoc

Google DeepMind

1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043





**CREATIVE COMMONS
PUBLIC LICENSE:
CC BY-NC 4.0**
THIS DESIGN IS BEING PROVIDED FOR
NON-COMMERCIAL USE ONLY. THE USE
OF BETTY HOLBERTON'S NAME IN
CONNECTION WITH THE DESIGN IS NOT
INTENDED TO IMPLY THAT BETTY
HOLBERTON SPONSORS OR ENDORSES
THE DESIGN, GOOGLE LLC, OR ANY OF
GOOGLE LLC'S PRODUCTS OR SERVICES.

**BARKOUR ROBOT
HOLBERTON**
APPROVED GOOGLE LLC
DWG NO 1178725
RELEASED 2024/05/09
FILE STO.SchDoc

STO.SchDoc
Google DeepMind
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA 94043
SIZE A3 SHEET 14 OF 14