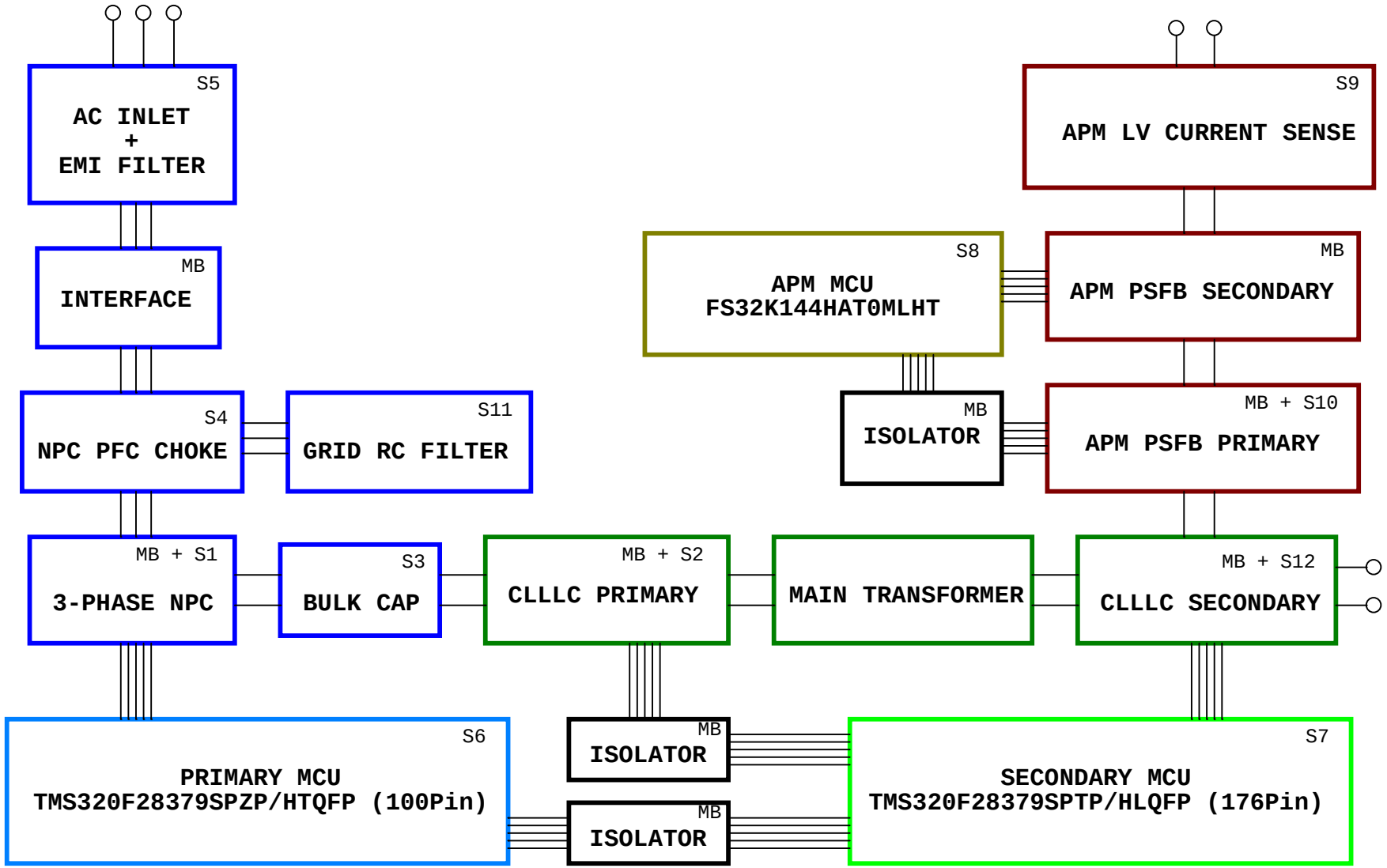


Title	11kW OBC + APM	
Size A4	Document Number <Doc>	Rev A2
Date: Tuesday, December 13, 2022	Sheet 1 of 53	

AC:
Line to N - 265V rms
Line to Line - 480V rms

TO AC EMI BOARD (S11)

CN7088
CON-4x2x4
PES-04-02-L-VT-LC

Vac(L1) — P03-1 P03-2 P03-3 P03-4 P03-5 P03-6 P03-7 P03-8
Vac(L2) — P02-1 P02-2 P02-3 P02-4 P02-5 P02-6 P02-7 P02-8
Vac(L3) — P01-1 P01-2 P01-3 P01-4 P01-5 P01-6 P01-7 P01-8
Vac(N) — P04-1 P04-2 P04-3 P04-4 P04-5 P04-6 P04-7 P04-8

CSA+ — RS5000 1m — CSA- — RS5001 1m — 265V/25A
CSB+ — RS5002 1m — CSB- — RS5003 1m — 265V/25A
CSC+ — RS5004 1m — CSC- — RS5005 1m — 265V/25A
32A — VAC_N

AC:
Line to N - 265V rms
Line to Line - 480V rms

TO PFC CHOKE BOARD (S4)

Vac(L1) — CN5100 — CON-4.15-1X2P-179102_EVPS
Vac(L2) — CN5101 — CON-4.15-1X2P-179102_EVPS
Vac(L3) — CN5102 — CON-4.15-1X2P-179102_EVPS
Vac(N) — CN7100 — CON-4.15-1X2P-179102_EVPS
CN5103 — CON-4.15-1X2P-179102_EVPS

R5014 390K R-1206_SMD
R5017 390K R-1206_SMD
R5020 390K R-1206_SMD
R7211 240K/1206/0.1%
R7206 390K/1206/0.1%
→ AC_NA_VOLT

R5013 390K R-1206_SMD
R5016 390K R-1206_SMD
R5019 390K R-1206_SMD
R7210 240K/1206/0.1%
R7207 390K/1206/0.1%
→ AC_NB_VOLT

R5012 390K R-1206_SMD
R5015 390K R-1206_SMD
R5018 390K R-1206_SMD
R7214 240K/1206/0.1%
R7215 390K/1206/0.1%
→ AC_NC_VOLT

CSA- : R5003 390K R-1206_SMD, R5006 390K R-1206_SMD, R5009 390K R-1206_SMD, R7204 390K/1206/0.1%, R7208 240K/1206/0.1% → AC_A_VOLT
CSB- : R5004 390K R-1206_SMD, R5007 390K R-1206_SMD, R5010 390K R-1206_SMD, R7205 390K/1206/0.1%, R7209 240K/1206/0.1% → AC_B_VOLT
CSC- : R5005 390K R-1206_SMD, R5008 390K R-1206_SMD, R5011 390K R-1206_SMD, R7213 390K/1206/0.1%, R7212 240K/1206/0.1% → AC_C_VOLT

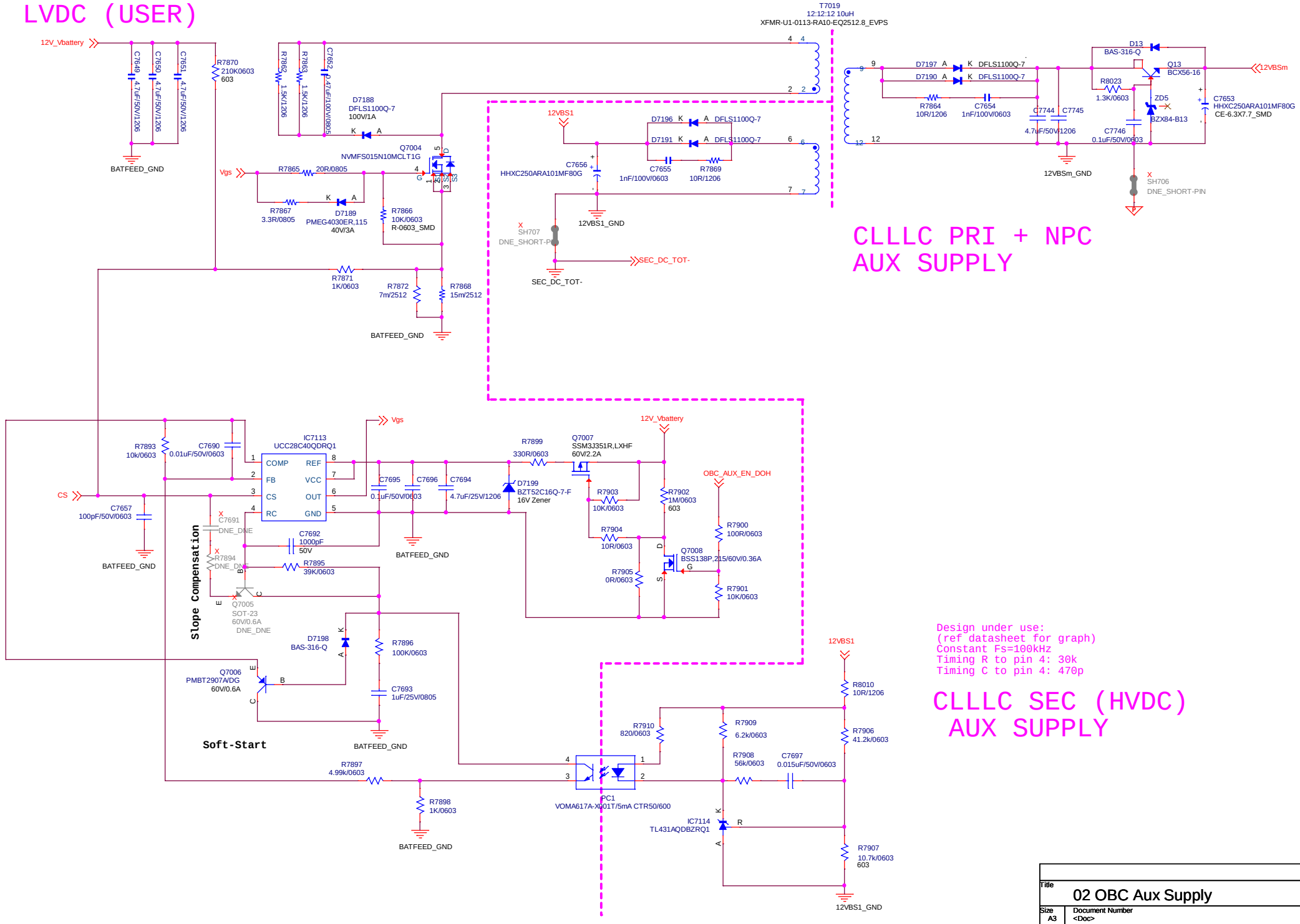
CN7092 — SB-U1-0113-RA10-S6_2.0T — Pri_MCU_support
CN7093 — SB-U1-0113-RA10-S7_2.0T — Sec_MCU_support
CN7094 — SB-U1-0113-RA10-S7_2.0T — APM_MCU_support

MB

Title: 01 AC Input

Size	Document Number	Rev
A3	<Doc>	A2

Date: Tuesday, December 13, 2022 Sheet 2 of 53


LVDC (USER)
T7019
12:12:12 10uH
XFMR-U1-0113-RA10-EQ2512.8_EVPS
12V_Vbattery
C7649 4.7uF/50V/1206
C7650 4.7uF/50V/1206
C7651 4.7uF/50V/1206
R7870 210K0603 603
BATFEED_GND
R7862 1.5K/1206
R7863 1.5K/1206
C7652 0.47uF/100V/0805
D7188 DFLS1100Q-7 100V/1A
Q7004 NVMFS015N10MCLT1G
Vgs
R7865 20R/0805
R7867 3.3R/0805
D7189 PMEG4030ER,115 40V/3A
R7866 10K/0603 R-0603_SMD
R7871 1K/0603
R7872 7m/2512
R7868 15m/2512
12VBS1
D7196 DFLS1100Q-7
D7191 DFLS1100Q-7
C7656 HHXC250ARA101MF80G
C7655 1nF/100V/0603
R7869 10R/1206
12VBS1_GND
SH707 DNE_SHORT-PIN
SEC_DC_TOT-
D7197 DFLS1100Q-7
D7190 DFLS1100Q-7
R7864 10R/1206
C7654 1nF/100V/0603
C7744 4.7uF/50V/1206
C7745
D13 BAS-316-Q
Q13 BCX56-16
R8023 1.3K/0603
ZD5 BZX84-B13
C7746 0.1uF/50V/0603
C7653 HHXC250ARA101MF80G CE-6.3X7.7_SMD
12VBSm
12VBSm_GND
SH706 DNE_SHORT-PIN
CLLLC PRI + NPC AUX SUPPLY
R7893 10k/0603
C7690 0.01uF/50V/0603
IC7113 UCC28C40QDRQ1
COMP REF FB VCC CS OUT RC GND
CS
C7657 100pF/50V/0603
C7691 DNE_DNE
R7894 DNE_DNE
C7692 1000pF 50V
R7895 39K/0603
Q7005 SOT-23 60V/0.6A DNE_DNE
Slope Compensation
C7695 0.1uF/50V/0603
C7696
C7694 4.7uF/25V/1206
R7899 330R/0603
Q7007 SSM3J351R,LXHF 60V/2.2A
D7199 BZT52C16Q-7-F 16V Zener
R7903 10K/0603
R7902 1M/0603 603
R7904 10R/0603
R7905 0R/0603
Q7008 BSS138P,215/60V/0.36A
OBC_AUX_EN_DOH
R7900 100R/0603
R7901 10K/0603
D7198 BAS-316-Q
Q7006 PMBT2907A/DG 60V/0.6A
R7896 100K/0603
C7693 1uF/25V/0805
Soft-Start
R7897 4.99k/0603
R7898 1K/0603
PC1 VOMA617A-X001T/5mA CTR50/600
IC7114 TL431AQDBZRQ1
12VBS1
R8010 10R/1206
R7910 820/0603
R7909 6.2k/0603
R7906 41.2k/0603
R7908 56k/0603
C7697 0.015uF/50V/0603
R7907 10.7k/0603 603
12VBS1_GND
Design under use:
(ref datasheet for graph)
Constant Fs=100kHz
Timing R to pin 4: 30k
Timing C to pin 4: 470p
CLLLC SEC (HVDC) AUX SUPPLY
MB
Title
02 OBC Aux Supply
Size A3
Document Number <Doc>
Rev A2
Date: Tuesday, December 13, 2022
Sheet 3 of 53

AC:
Line to N - 265V rms
Line to Line - 480V rms

DC link:
800V/15A between PFC_OUT to PFC_NEG
400V between PFC_OUT to GND-P
400V between PFC_NEG to GND-P

TO PFC CHOKE BOARD (S4)

CN7035
CON-4.15-1X2P-179102_EVPS
Vac(L1)
HSA+ HSA-
265V/25A

CN7091
CON-4.15-1X2P-179102_EVPS
Vac(L2)
HSB+ HSB-
265V/25A

CN7089
CON-4.15-1X2P-179102_EVPS
Vac(L3)
HSC+ HSC-
265V/25A

CN7090
CON-4.15-1X2P-179102_EVPS
Vac(N)
32A

CN7101
CON-4.15-1X2P-179102_EVPS

TO L1 NPC BOARD

CN7035 → CN7036 CON-1X1P → To CN1100

CN7000 18V DNE_DNE DRA1 G_DRA1
CN7001 18V DNE_DNE DRA2 G_DRA2
CN7002 18V DNE_DNE DRA3 G_DRA3
CN7003 18V DNE_DNE DRA4 G_DRA4
CN7004 T_NPC_A 3.3VAP DNE_DNE Thermistor
CN7006

TO L2 NPC BOARD

CN7091 → CN7037 CON-1X1P → To CN1100

CN7018 18V DNE_DNE DRB1 G_DRB1
CN7020 18V DNE_DNE DRB2 G_DRB2
CN7019 18V DNE_DNE DRB3 G_DRB3
CN7021 18V DNE_DNE DRB4 G_DRB4
CN7032 T_NPC_B 3.3VAP DNE_DNE Thermistor
CN7026
CN7027
CN7028
PFC_OUT
PFC_NEG

TO L3 NPC BOARD

CN7089 → CN7039 Value = CON-1X1P → To CN1100

CN7022 18V Value = DNE_DNE DRC1 G_DRC1
CN7024 18V Value = DNE_DNE DRC2 G_DRC2
CN7023 18V Value = DNE_DNE DRC3 G_DRC3
CN7025 18V Value = DNE_DNE DRC4 G_DRC4
CN7033 T_NPC_C 3.3VAP Value = DNE_DNE Thermistor
CN7030

CN7090 → 32A

TO BULK CAP BOARD (S3)

PFC_OUT → CN7009 M3L10 SMT Copper Stand Off
CN7012 M3L10 SMT Copper Stand Off
PFC_NEG → CN7015 M3L10 SMT Copper Stand Off

12VBSm
12V
C7000 10uF/25V/1206
RLY_DRV
12VBSm_GND
CN7008 ERF8-005-05.0-L-DV

CN7099 BBR-0113-RA10-PGND-MB_EVPS Custom

IC7000 ACS733KLATR-65AB-T
3.3VAP
R8018 2.2
C7001 0.1uF/50V/0603 50V/X7R/0603
R7005 6.8K/0603 +-1%/0.1W/0603
R7006 Value = 10K/0603
C7739 100pF 50V 603
R7007 1.69K/0603 +-1%/0.1W/0603
C7002 100p/50V/0603
AGND_1
IPHASE_A_FAULT
IPHASE_A_ADC
Put cap close to IC7000

IC7001 ACS733KLATR-65AB-T
3.3VAP
R8019 2.2
C7003 0.1uF/50V/0603 50V/X7R/0603
R7008 6.8K/0603 +-1%/0.1W/0603
R7004 Value = 10K/0603
C7740 100pF 50V 603
R7003 1.69K/0603 +-1%/0.1W/0603
C7004 100p/50V/0603
AGND_1
IPHASE_B_FAULT
IPHASE_B_ADC
Put cap close to IC7001

IC7002 ACS733KLATR-65AB-T
3.3VAP
R8020 2.2
C7005 0.1uF/50V/0603 50V/X7R/0603
R7002 6.8K/0603 +-1%/0.1W/0603
R7001 10K/0603
C7741 100pF 50V 603
R7000 1.69K/0603 +-1%/0.1W/0603
C7006 100p/50V/0603
AGND_1
IPHASE_C_FAULT
IPHASE_C_ADC
Put cap close to IC7002

Title	03 AC Current Sense + Connectors	MB
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TO BULK
CAP BOARD (S3)

CN7044
1
M3L10 SMT Copper Stand Off
DC+

DC link:
800V/15A between DC+ to DC-

TO PRI FB BOARD

CN7042
1
M3L8 Screw Torx
To CN2200

CN7050
1
M3L8 Screw Torx
To CN2400

To Hall Sensor
DC-
PRI_DC_TOT+

X
CN7041
1
2
DNE_DNE
To CN2000
CLLLC1_DRA_PRI
CLLLC1_G_DRA_PRI

X
CN7046
1
2
DNE_DNE
To CN2002
CLLLC1_DRC_PRI
CLLLC1_G_DRC_PRI

X
CN7045
1
2
DNE_DNE
To CN2001
CLLLC1_DRB_PRI
CLLLC1_G_DRB_PRI

X
CN7047
1
2
DNE_DNE
To CN2003
CLLLC1_DRD_PRI
CLLLC1_G_DRD_PRI

X
CN7103
1
2
DNE_DNE
12VBSm_GND

X
CN7053
1
2
DNE_DNE
To CN1004
T_CLLLC_P1
3.3VAP
Thermistor

CN7051
M-M4FIX-4.5PTH-PAD9_EVPS_SGP
1
To CN2300

CN7052
M-M4FIX-4.5PTH-PAD9_EVPS_SGP
1
To CN2100

CN7048
1
M3L10 SMT Copper Stand Off
DC-

AC (flywire to XFMR)
800V peak/20A max

T7000
B82801C2245A200
11
12
IS_P_A+
IS_P_A-
R7029
20R/1%/1206
R7030
20R/1%/1206
SECONDARY

TO CLLLC TRANSFORMER

To CN4001
CN7063
1
M4 SMT Nut

To CN4000
CN7065
1
M4 SMT Nut

SECONDARY

PQI6528+PQ6554+PQI6534.4
158uH/29uH
Lrp=35uH / Lrs=21uH
8:21:9:8

To CN4101
CN7067
1
M4 SMT Nut
SEC_FB1

To CN4100
CN7068
1
M4 SMT Nut

AC (flywire to XFMR)
470V peak/45A max

T7001
B82801C2245A200
11
12
SEC_TANKA-
IS_S_A+
IS_S_A-
R7031
20R/1%/1206
R7032
20R/1%/1206
SECONDARY

DC+
R8004 100/1206
R7009 300K/1206
R7010 300K/1206/ PN: 8A075Y
R7011 300K/1206/ PN: 8A075Y
R7012 300K/1206/ PN: 8A075Y
R7013 300K/1206/ PN: 8A075Y
PFC_OUT_DET

DC+
R8005 100/1206
R7014 300K/1206/ PN: 8A075Y
R7015 300K/1206/ PN: 8A075Y
R7016 300K/1206/ PN: 8A075Y
R7017 300K/1206/ PN: 8A075Y
R7018 300K/1206/ PN: 8A075Y
PFC_OUT_SEN

DC-
R8006 100/1206
R7019 300K/1206/ PN: 8A075Y
R7020 300K/1206/ PN: 8A075Y
R7021 300K/1206/ PN: 8A075Y
R7022 300K/1206/ PN: 8A075Y
R7023 300K/1206/ PN: 8A075Y
PFC_NEGA

DC-
R8007 100/1206
R7024 300K/1206/ PN: 8A075Y
R7025 300K/1206/ PN: 8A075Y
R7026 300K/1206/ PN: 8A075Y
R7027 300K/1206/ PN: 8A075Y
R7028 300K/1206/ PN: 8A075Y
PFC_NEGB

To Primary MCU

A1-> A2: Changed all dividers to 560kohm for higher voltage resolution

DC+
R8012 100/1206
R7037 560k/1206
R7038 560k/1206
R7039 560k/1206
R7040 560k/1206
R7041 560k/1206
DC_OUT+

PRI_DC_TOT+
R8013 100/1206
R7042 560k/1206
R7043 560k/1206
R7044 560k/1206
R7045 560k/1206
R7046 560k/1206
DC_OUT-

To Secondary MCU

MB

Title
04 CLLLC DC/DC Connectors

Size	Document Number	Rev
A3	<Doc>	A2

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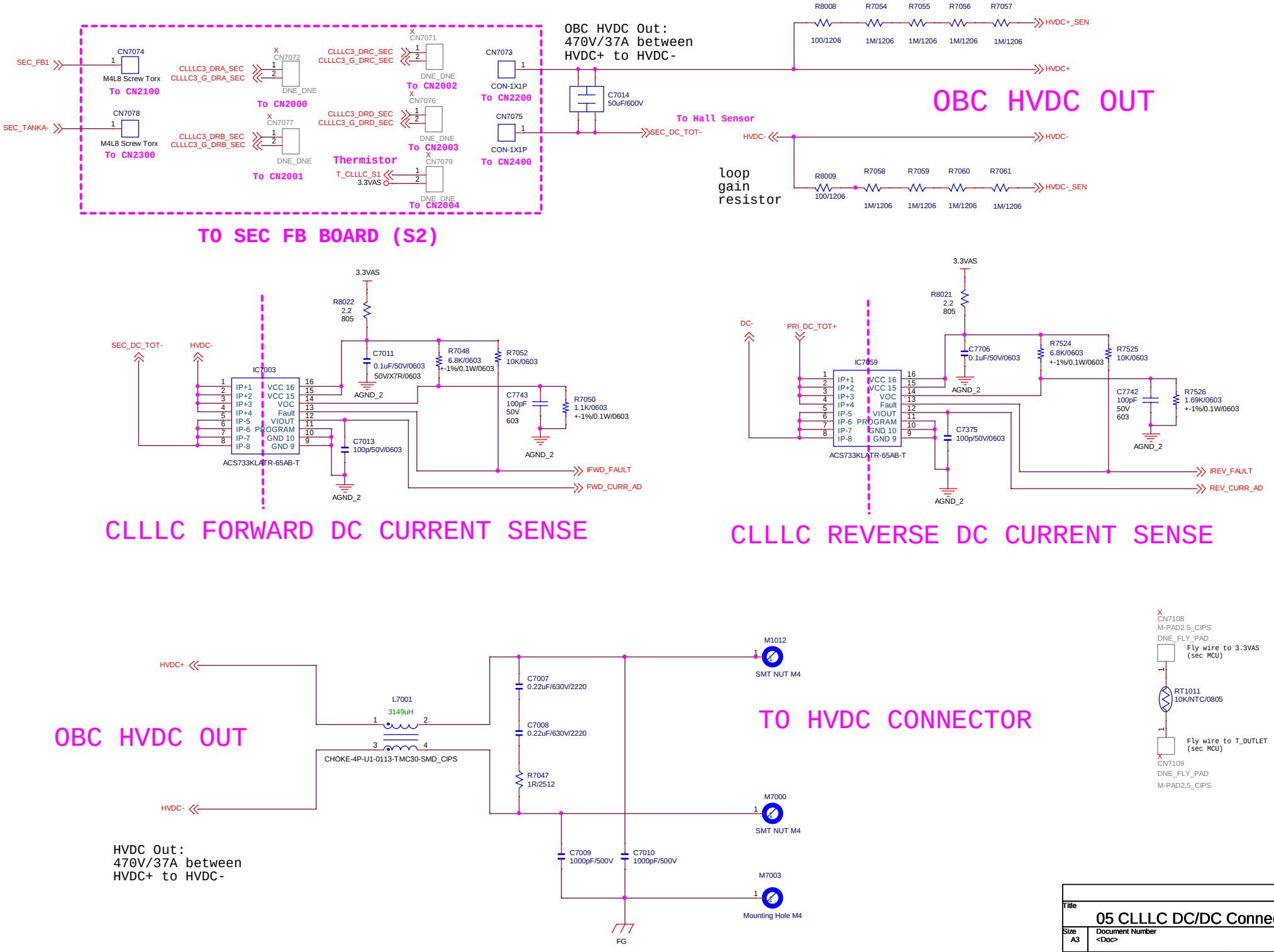
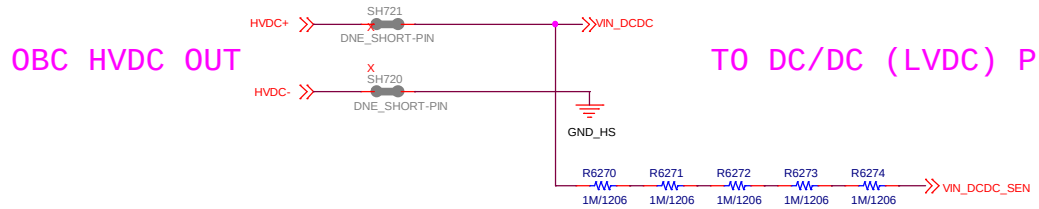
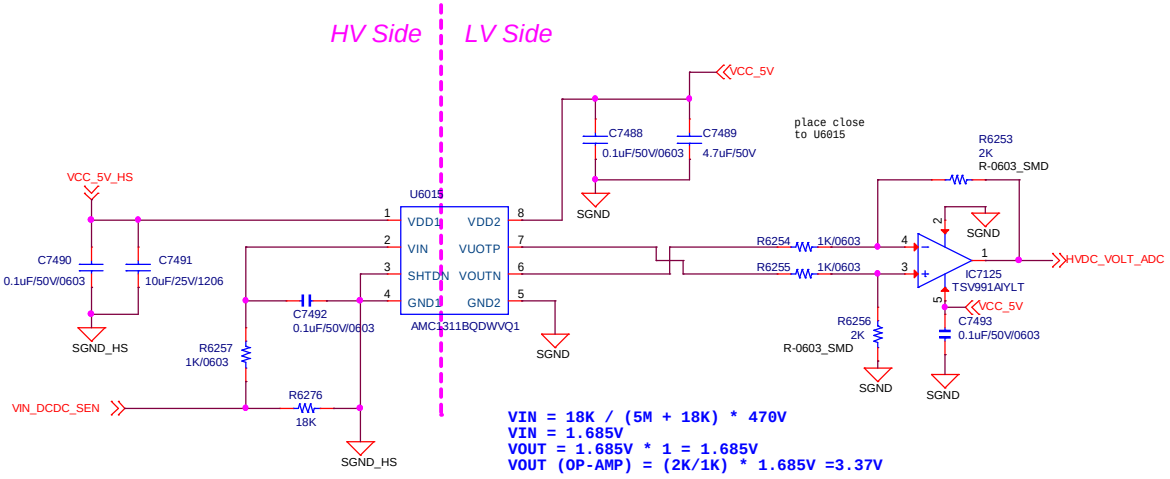


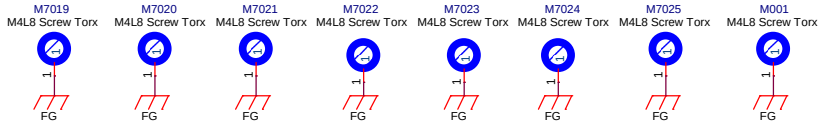
		MB
Title	05 CLLLC DC/DC Connectors	
Size A3	Document Number <Doc>	Rev A2
Date: Tuesday, December 13, 2022	Sheet 6 of 53	

OBC HVDC Out:
470V/12A between
HVDC+ to HVDC-

DC/DC Primary:
470V/12A between
VIN_DCDC to GND_HS



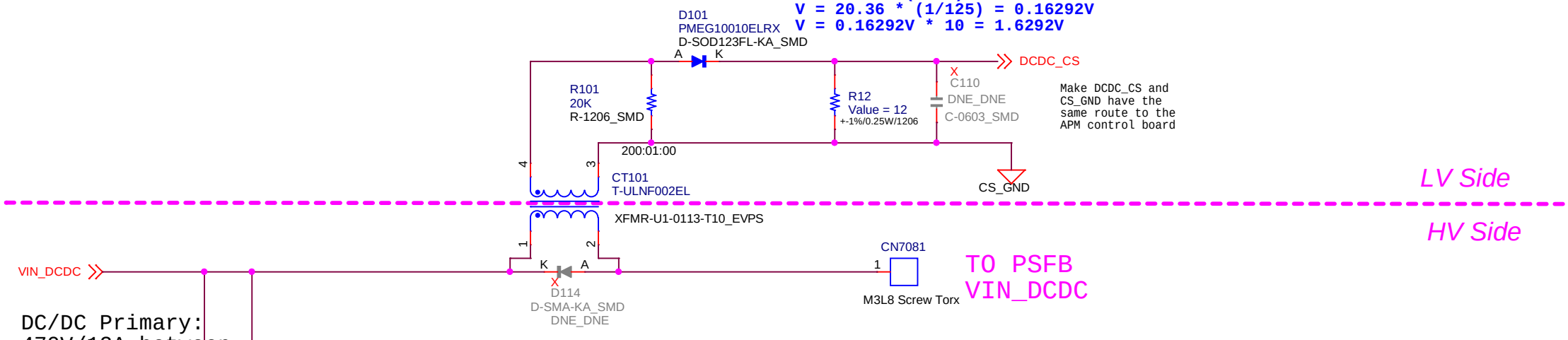




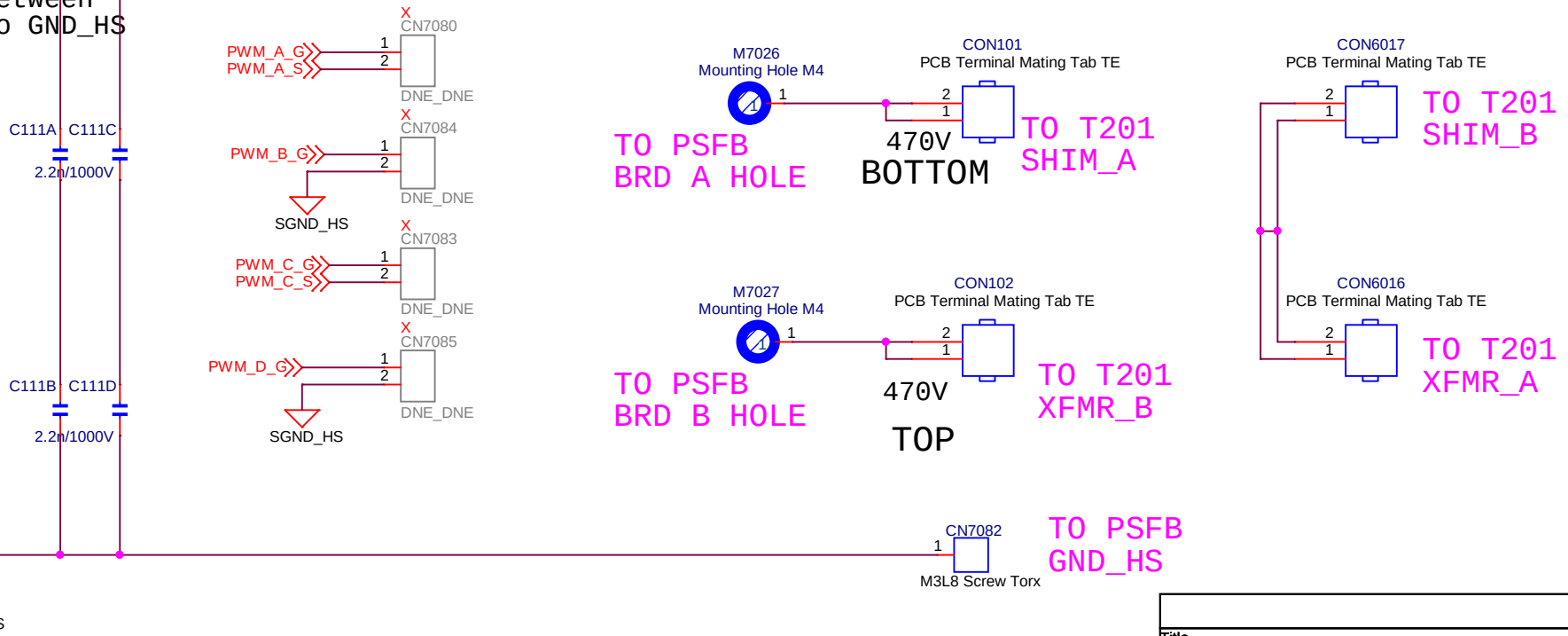
		MB
Title	06 HV Input EMI Filter	
Size	Document Number	Rev A2
Date: Tuesday, December 13, 2022	Sheet 7 of 53	

DC/DC (LVDC) SECONDARY

CS_LIM = 2.06V (Based on Datasheet)
I = P / V
I = 3600 / 250
I = 14.4A (RMS)
I = 20.36A (PEAK)
V = 20.36 * (1/125) = 0.16292V
V = 0.16292V * 10 = 1.6292V



DC/DC Primary:
470V/12A between
VIN_DCDC to GND_HS



DC/DC (LVDC) PRIMARY

		MB
Title	07 PSFB Power Stage	
Size	Document Number	Rev A2
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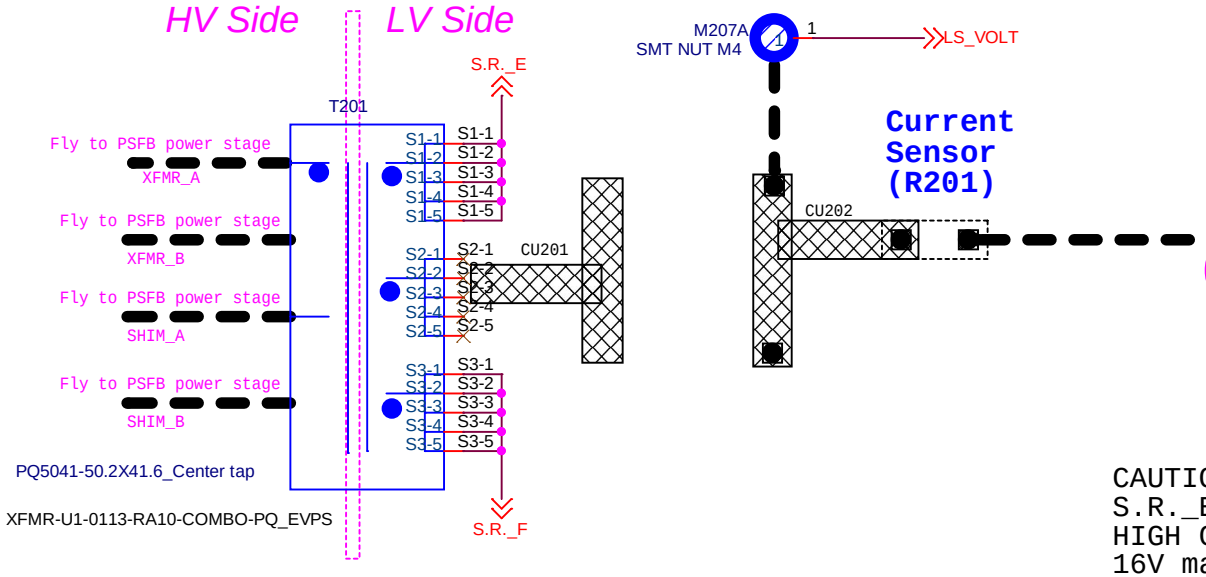
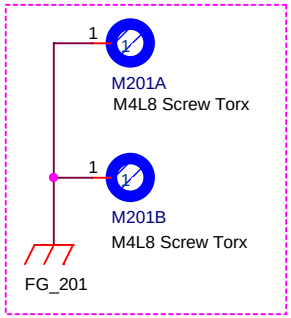
DC/DC (LVDC) SECONDARY

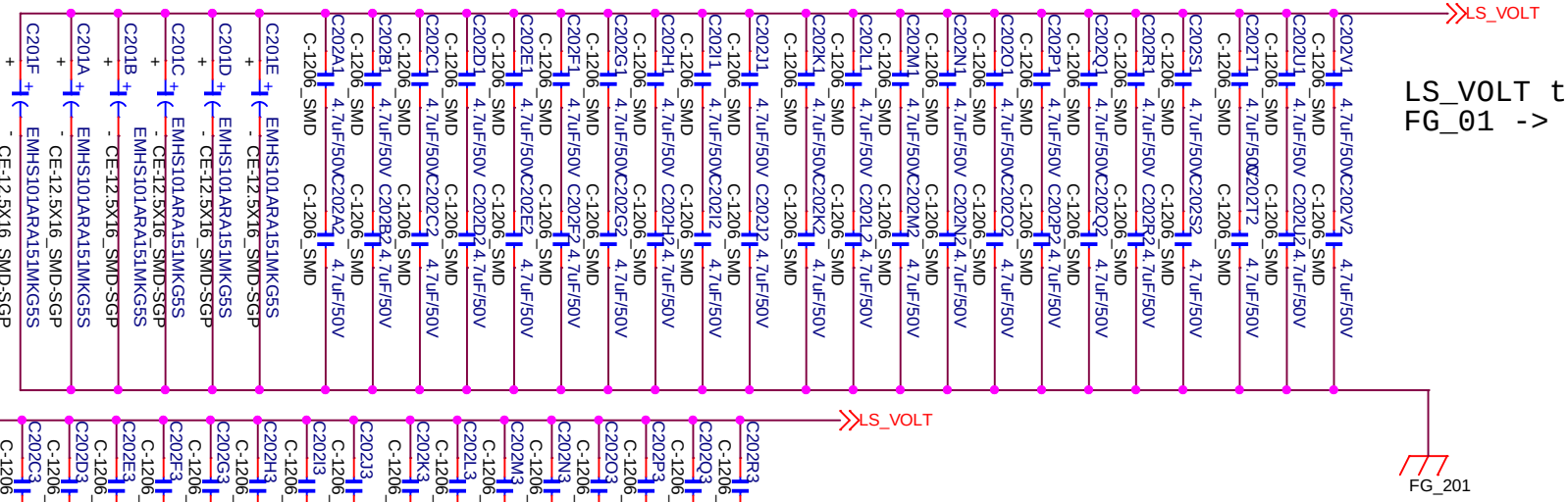


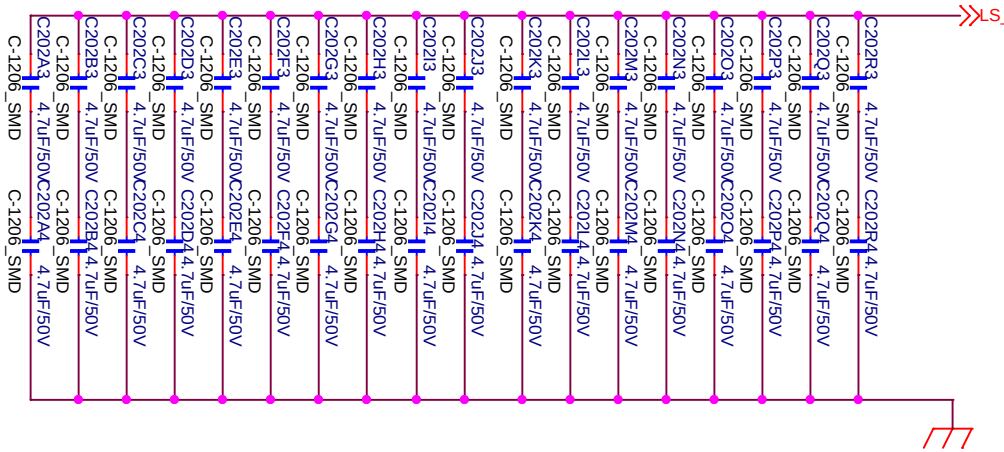
NOTE:
Inductor L201 to be changed -> get new Footprint and design from Magnetics and update

CAUTION on LV SIDE
S.R._E to FG_201 and S.R._F to FG_201
HIGH CURRENT OUTPUT (130.5A each -> Total 261A)
16V max

Output CAP Grounding







LS_VOLT to FG_01 -> 16V

			MB
Title	08 LVDC Power Train		
Size	Document Number		Rev A2
Date:	Tuesday, December 13, 2022	Sheet 9 of 53	

S.R. DRIVER MOSFET

DC/DC (LVDC) SECONDARY

LV Side

PWM_E → R210 1 R-1206_SMD → D203 PMEG4030ER,115 (A, K) → SR_G_E

R212 10R/1206

Q3010 DSS5320T-7 SOT-23

S.R._E

D201 SURS8360T3G D-SMC-KA_SMD (A, K) → LS_VOLT

C203A C203B 0.1uF/450V

C203C C203D 0.1uF/450V

R202A 2K R-2512_SMD, R202B 2K R-2512_SMD

R202C 2K R-2512_SMD, R202D 2K R-2512_SMD

R202E 2K R-2512_SMD, R202F 2K R-2512_SMD

R202G 2K R-2512_SMD, R202H 2K R-2512_SMD

R202I 2K R-2512_SMD, R202J 2K R-2512_SMD

Q201A NVBLS4D0N15MC

Q201B NVBLS4D0N15MC

Q201C NVBLS4D0N15MC

Q201D NVBLS4D0N15MC

Q201E NVBLS4D0N15MC

R208A 10K R-1206_SMD

R208B 10K R-1206_SMD

R208C 10K R-1206_SMD

R208D 10K R-1206_SMD

R208E 10K R-1206_SMD

CN7095 SR_Screw

CN7096 SR_Screw

FG_201

CAUTION on LV SIDE
S.R._E to FG_201 and S.R._F to FG_201
HIGH CURRENT OUTPUT (130.5A each -> Total 261A)
16V max

LV Side

PWM_F → R211 1 R-1206_SMD → D204 D-SOD123W-KA_SMD → PMEG4030ER,115 (A, K) → SR_G_F

R213 10R/1206 R-1206_SMD

Q3011 DSS5320T-7 SOT-23

S.R._F

D202 SURS8360T3G (A, K) → LS_VOLT

C204A C204B 0.1uF/450V

C204C C204D 0.1uF/450V

R203A 2K R-2512_SMD, R203B 2K R-2512_SMD

R203C 2K R-2512_SMD, R203D 2K R-2512_SMD

R203E 2K R-2512_SMD, R203F 2K R-2512_SMD

R203G 2K R-2512_SMD, R203H 2K R-2512_SMD

R203I 2K R-2512_SMD, R203J 2K R-2512_SMD

Q202A NVBLS4D0N15MC

Q202B NVBLS4D0N15MC

Q202C NVBLS4D0N15MC

Q202D NVBLS4D0N15MC

Q202E NVBLS4D0N15MC

R209A 10K R-1206_SMD

R209B 10K R-1206_SMD

R209C 10K R-1206_SMD

R209D 10K R-1206_SMD

R209E 10K R-1206_SMD

CN7097 SR_Screw

CN7098 SR_Screw

FG_201

Temp sensor for SR

NTC_PCB_ADC → RT6001 TMP6131QDYARQ1 → SGND

NTC_SR_ADC → RT2002 TMP6131QDYARQ1 place near Q202D → SGND

X CN7104 M-PAD2.5_CIPS DNE_FLY_PAD — Fly wire to NTC_COOLANT_ADC pad

RT2003 TMP6131QDYARQ1 INLET TEMPERATURE

X CN7105 DNE_FLY_PAD M-PAD2.5_CIPS — Fly wire to SGND pad

S.R. DRIVER IC

U202 UCC27524A1QDGNRQ1 IC-HVSSOP-8P-TH_SMD

DCDC_OUTF → R255 2.2K R-0603_SMD → ENBA, ENBB, INA, OUTA, GND, VDD, INB, OUTB → PWM_F

R250 1K/0603

C250 100pF/50V C-0603_SMD

12V_LVDC

C252 10uF/25V/1206 C-1206_SMD

FG_201

Input from PSFB Controller

LV Side

U203 UCC27524A1QDGNRQ1 IC-HVSSOP-8P-TH_SMD

DCDC_OUTE → R256 2.2K R-0603_SMD → ENBA, ENBB, INA, OUTA, GND, VDD, INB, OUTB → PWM_E

R252 1K/0603

C251 100pF/50V C-0603_SMD

12V_LVDC

C253 10uF/25V/1206 C-1206_SMD

FG_201

Output to S.R. MOSFETs

LV Side

X TIE204 M-SHORTPIN_SV DNE_TIENET

PGND

FG_201

		MB
Title	09 SR MOSFET	
Size	Document Number	Rev A2
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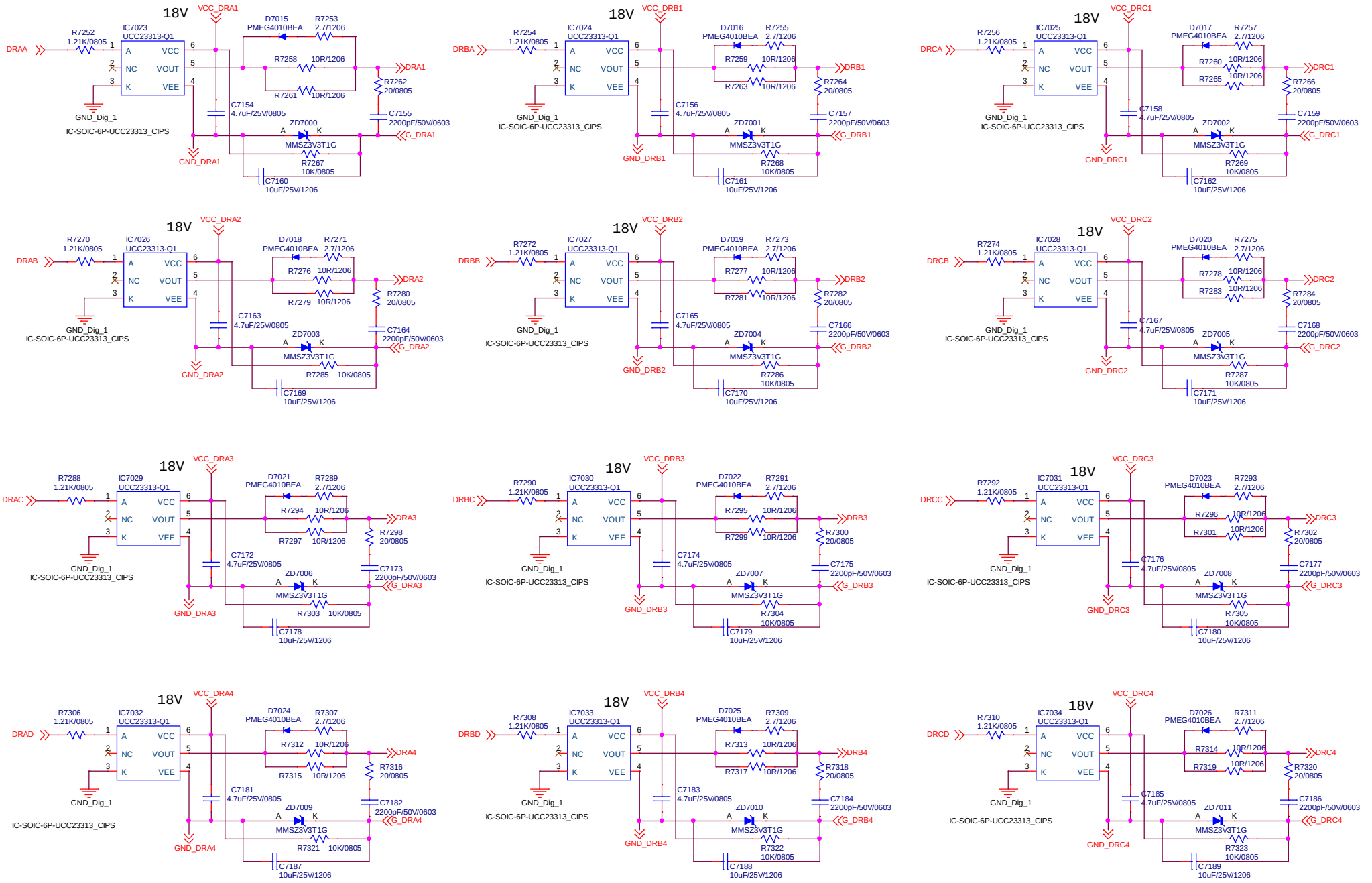
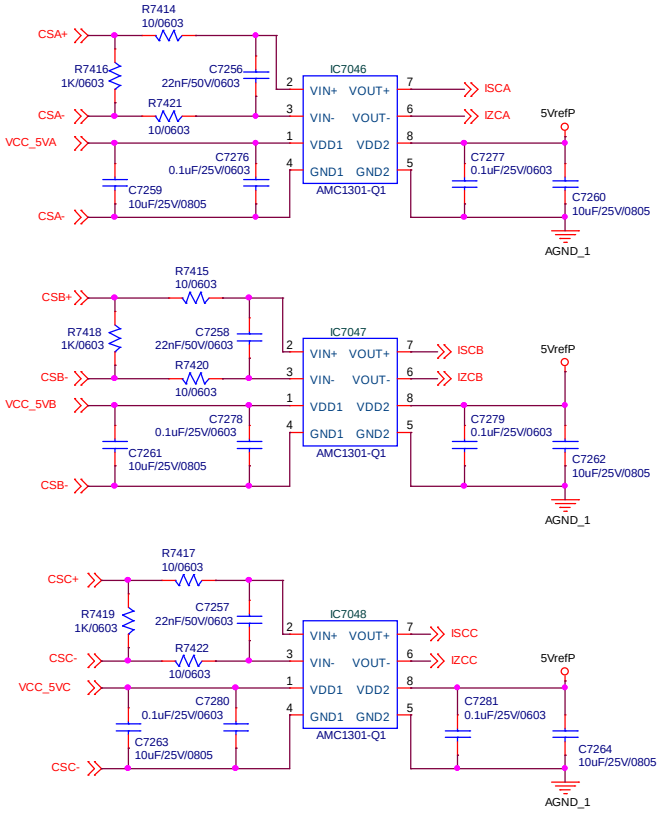


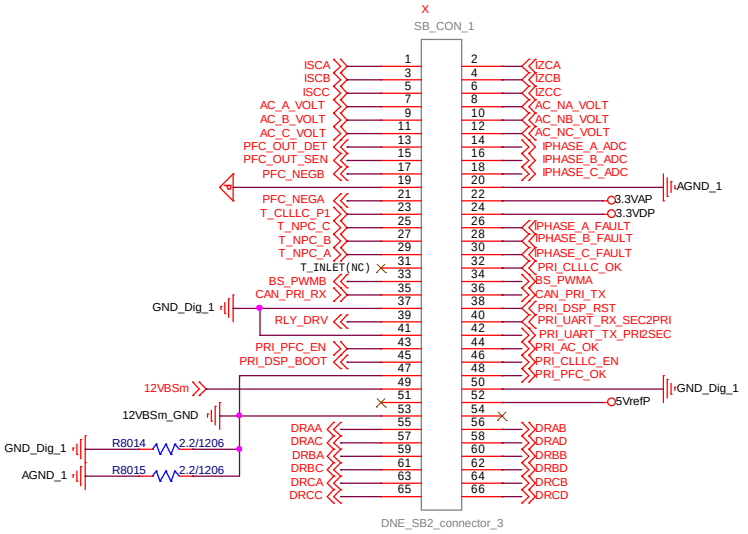
MB

Title: 10 PFC Driver

Size	Document Number	Rev
A3	<Doc>	A2

Date: Tuesday, December 13, 2022 Sheet 11 of 53





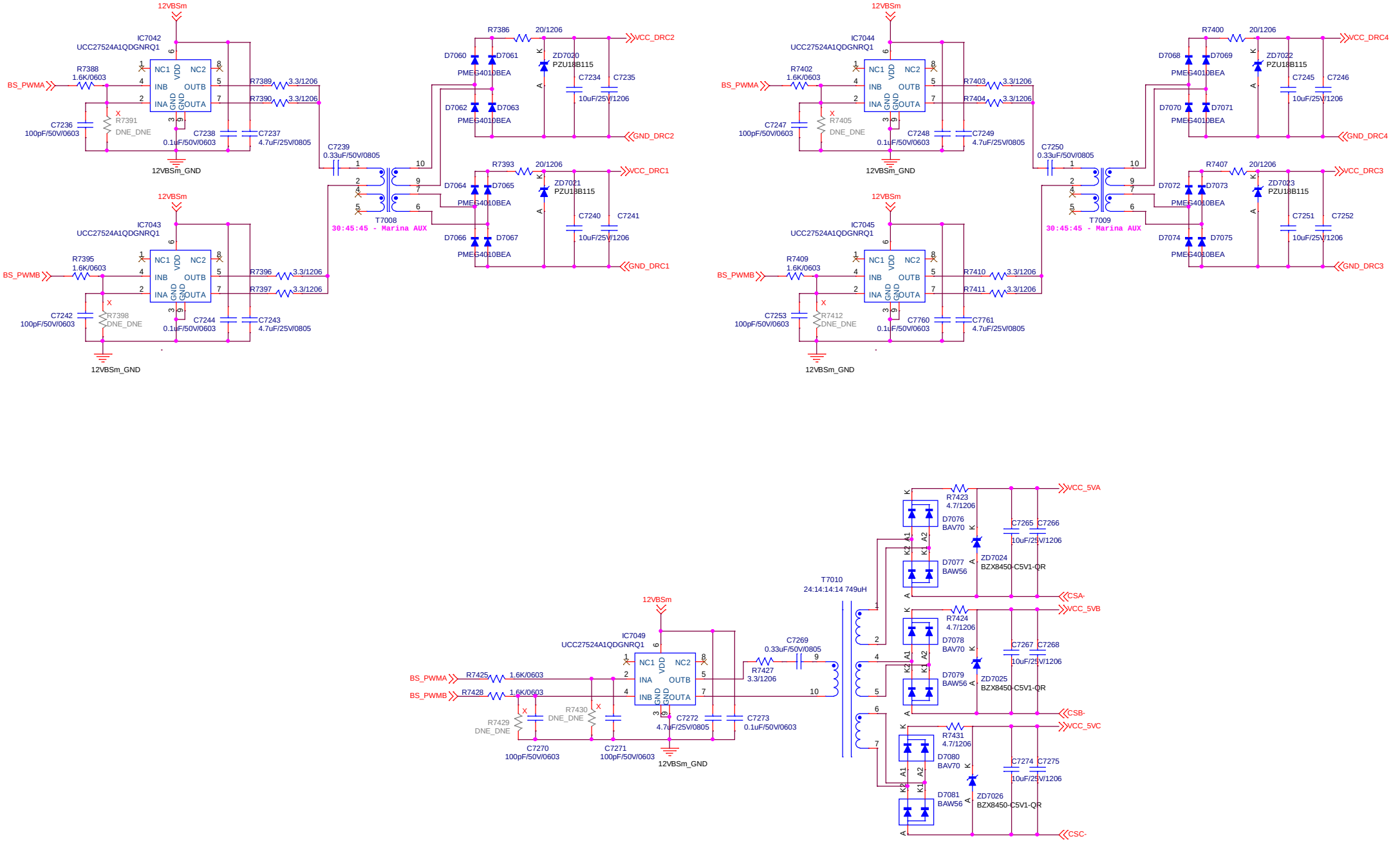
MB

Title

11 PFC Current Sense and Conn

Size	Document Number	Rev
A3	<Doc>	A2

Date: Tuesday, December 13, 2022 Sheet 12 of 53



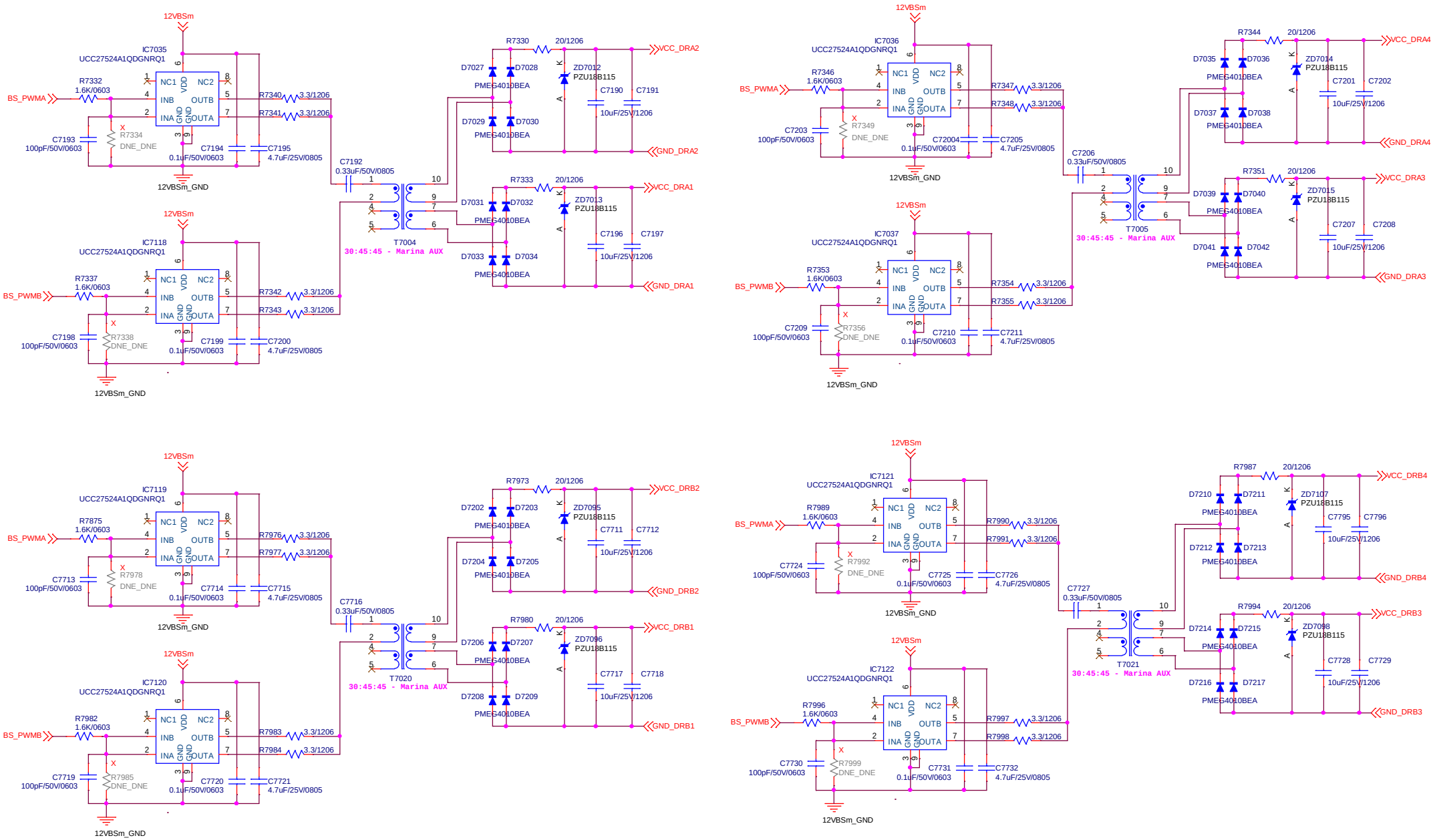
MB

Title

12 PFC AUX

Size	Document Number	Rev
A3	<Doc>	A2

Date: Tuesday, December 13, 2022 Sheet 13 of 53



MB

Title

13 PFC AUX

Size	Document Number	Rev
A3	<Doc>	A2

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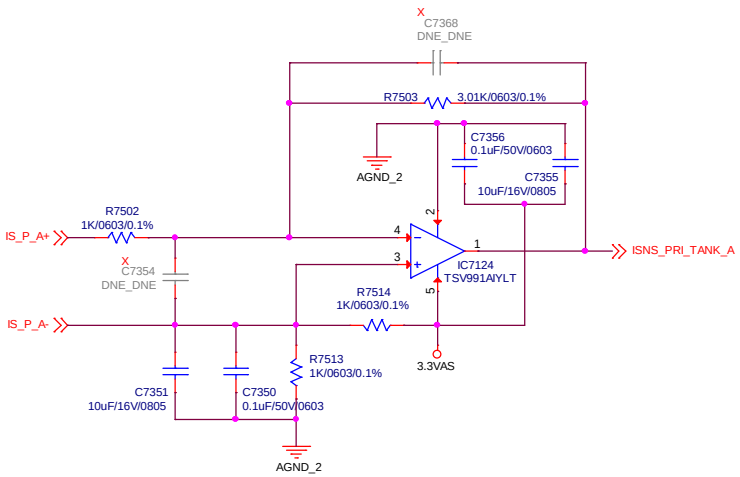
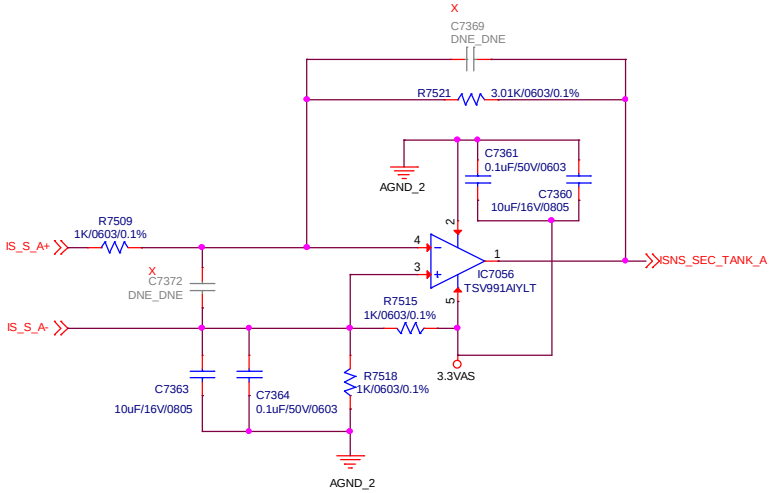
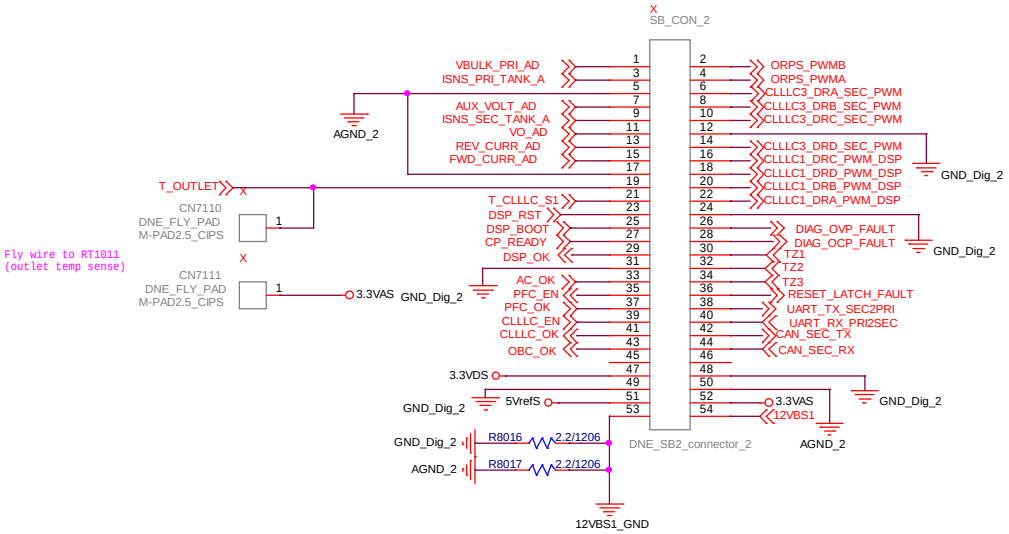
CLLLC PRI TANK CURRENT SENSE



CLLLC SEC TANK CURRENT SENSE





TO SECONDARY MCU (S7)

Title	14 CLLLC CS and Connector	
Size A3	Document Number	Rev A2
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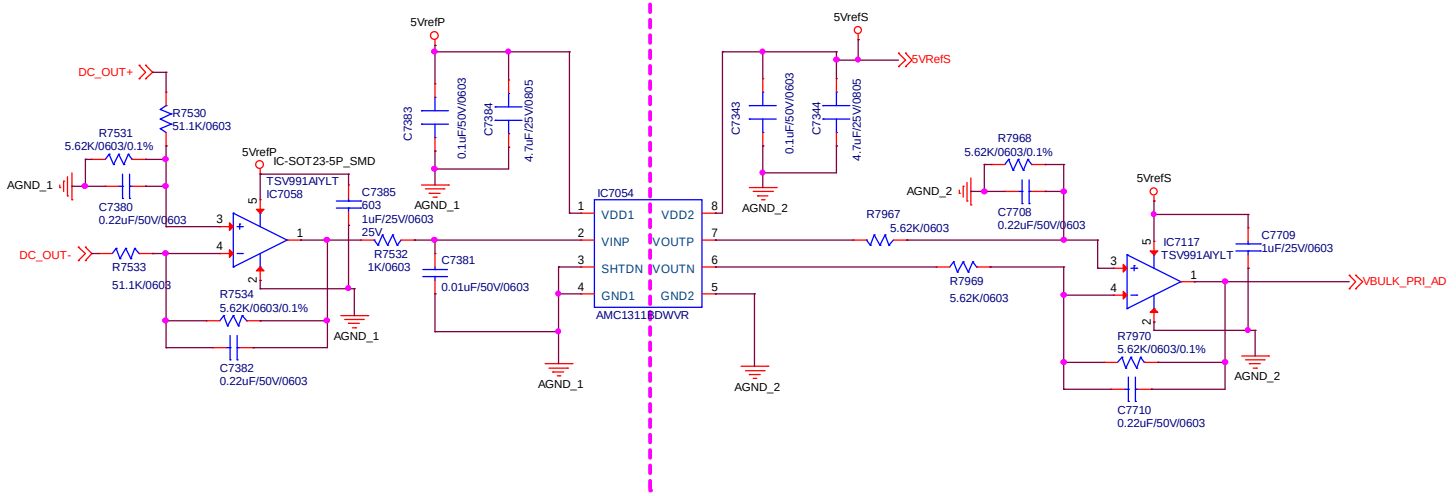
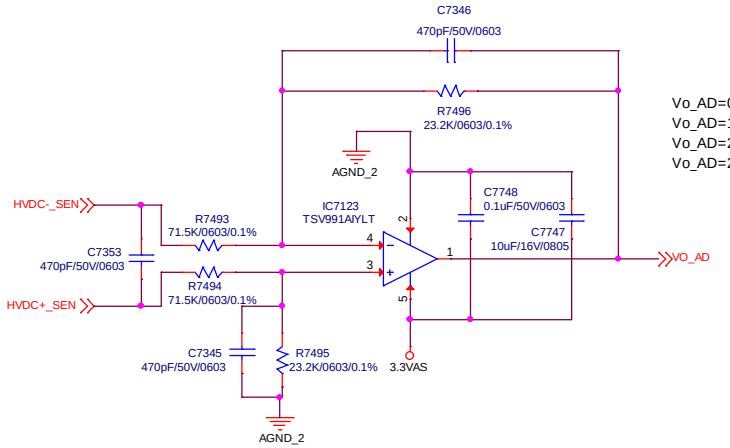
PRIMARY DC-LINK VOLTAGE SENSE

PRIMARY

SECONDARY

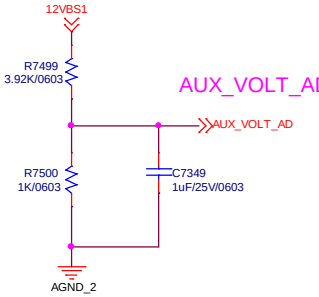


HVDC VOLTAGE SENSE



Vo_AD=0.005698*HVDC
Vo_AD=1.4245 @250V
Vo_AD=2.05128 @360V
Vo_AD=2.67806 @470V

12V STANDBY VOLTAGE SENSE



AUX_VOLT_AD=2.439V @12V

		MB
Title	15 Secondary Voltage Sense	
Size A3	Document Number <Doc>	Rev A2
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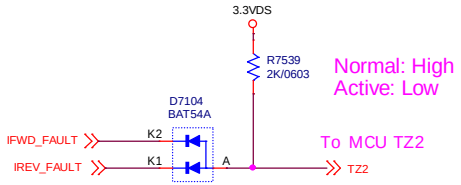
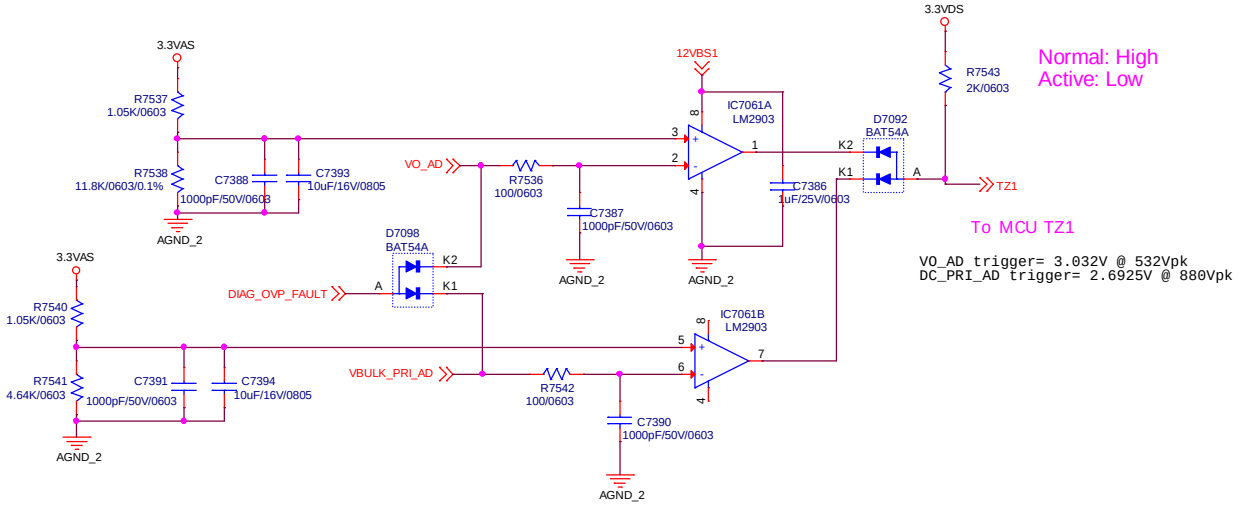
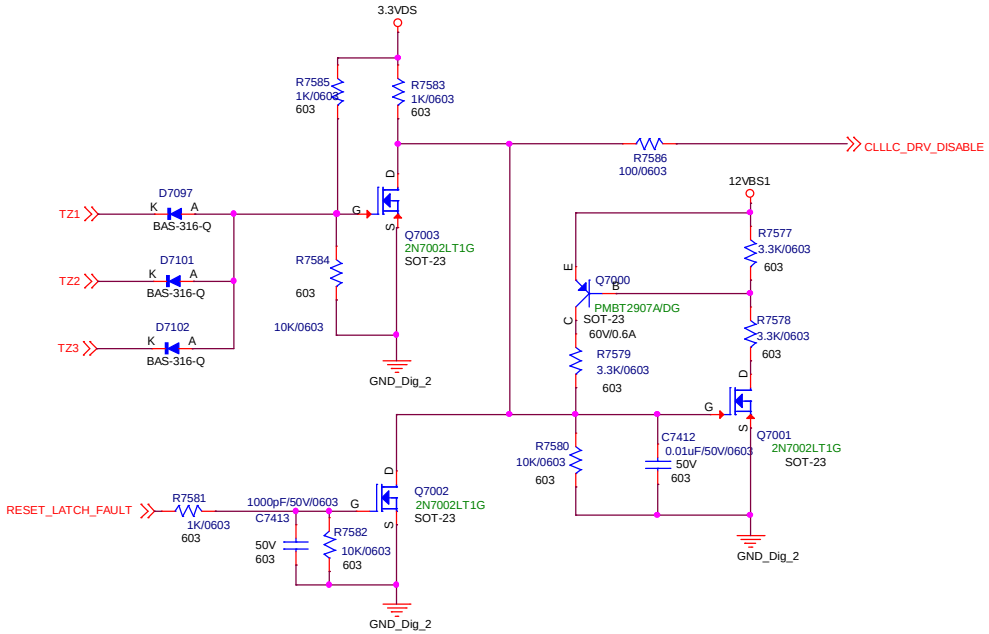
CLLLC DC CURRENT HW OCP



CLLLC DC VOLTAGE HW OVP



HW LATCH CIRCUIT DRIVE DISABLE



		MB
Title	16 Secondary Protection	
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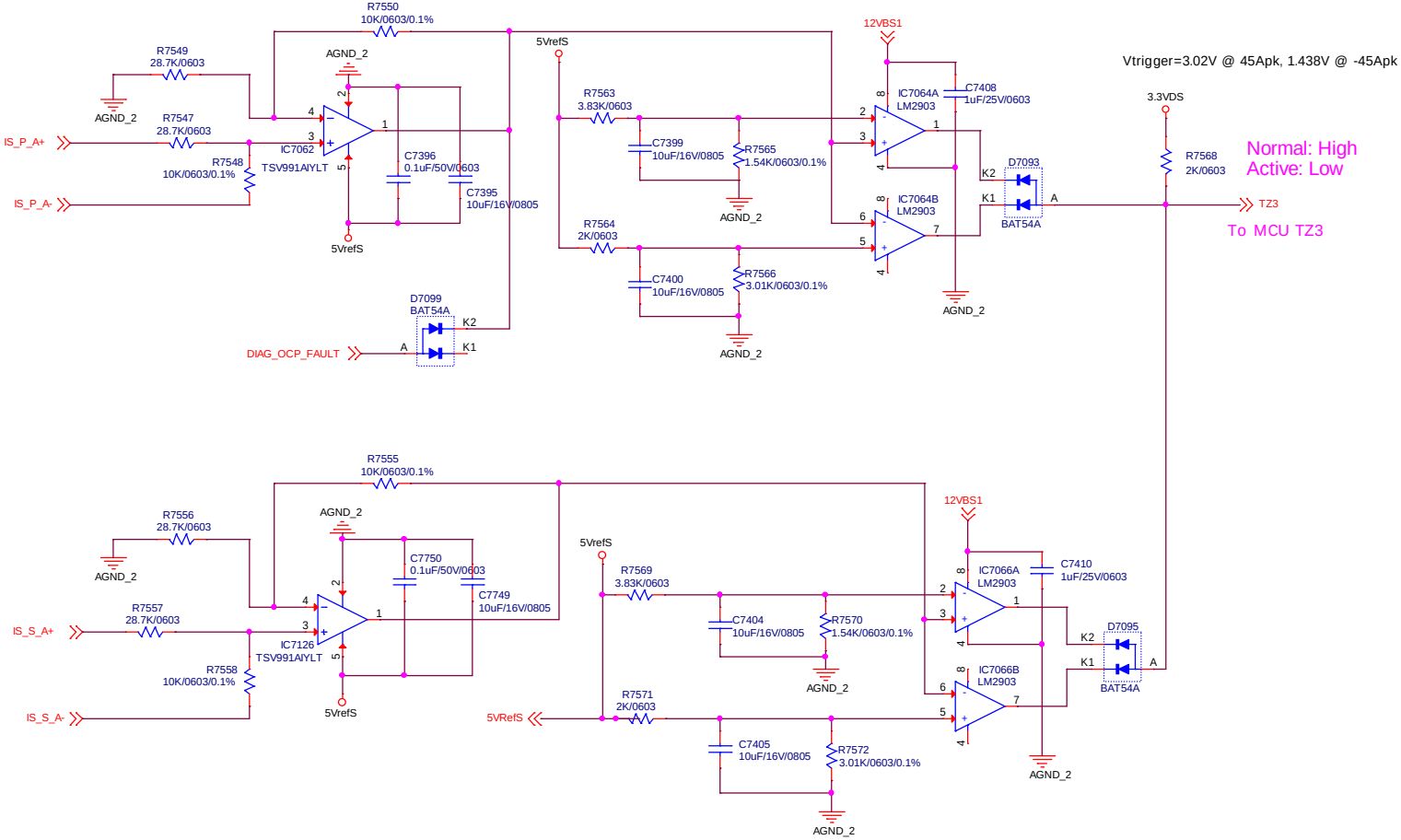
CLLLC TANK CURRENT HW OCP



Title	17 Secondary Protection	
Size A3	Document Number	Rev A2
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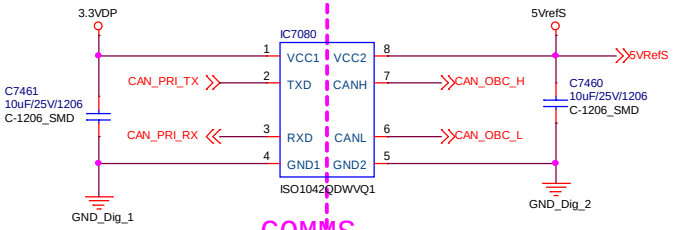
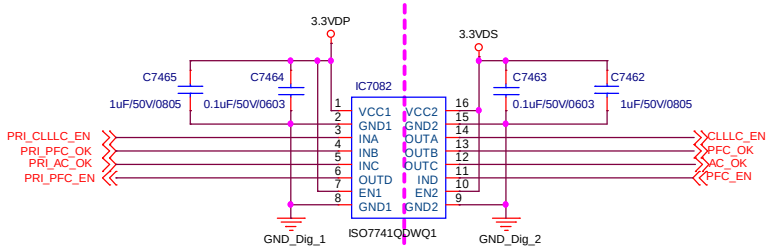
PRIMARY

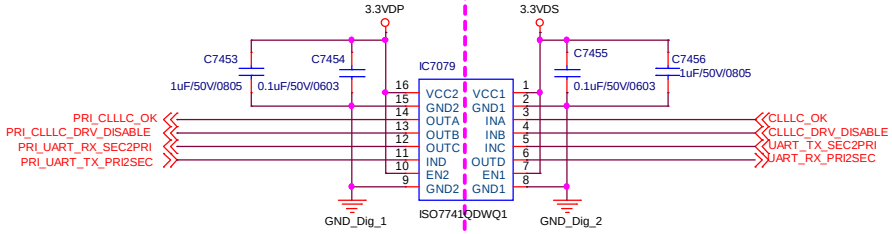
SECONDARY

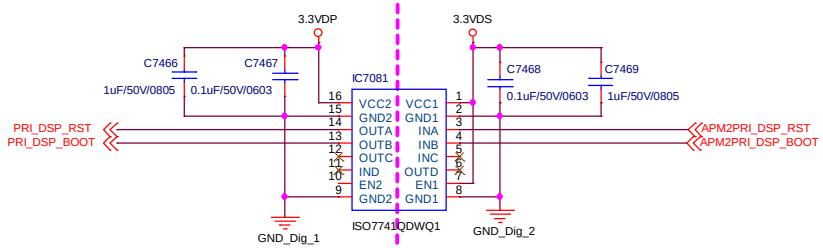
INTERNAL PRIMARY CAN



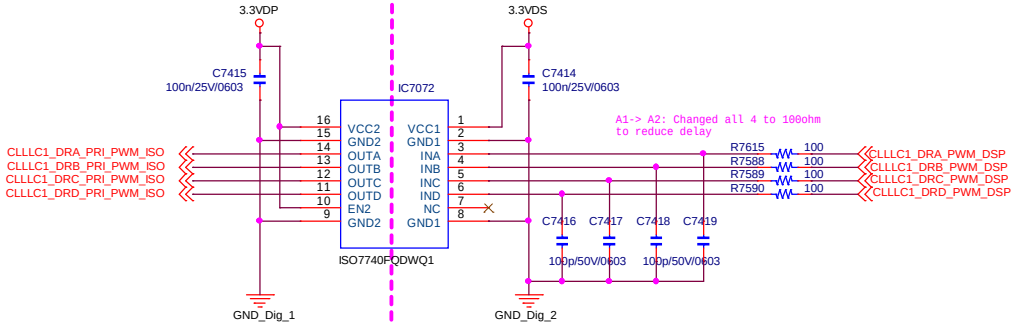
COMMS



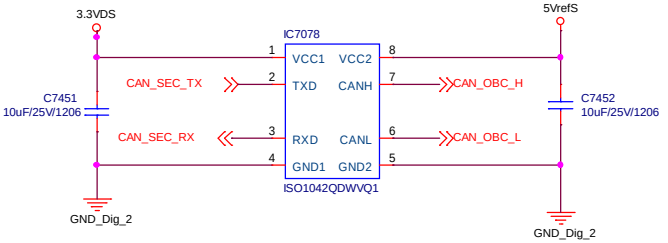




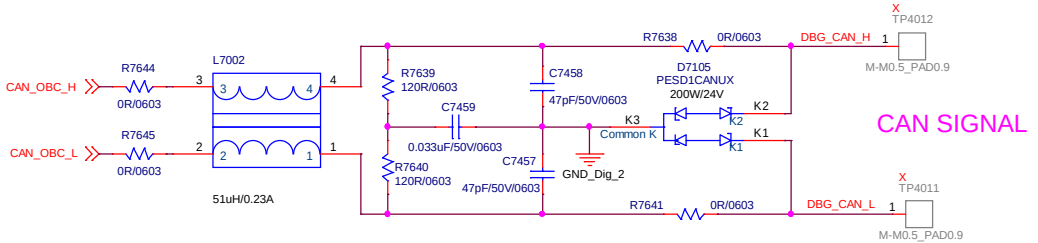
CLLLC GATE DRIVE SIGNAL ISOLATION



INTERNAL SECONDARY CAN



OBC CAN DEBUG SIGNALS



CAN SIGNAL

Title			MB
Size A3	Document Number	17 Sec Internal Comms	Rev A2
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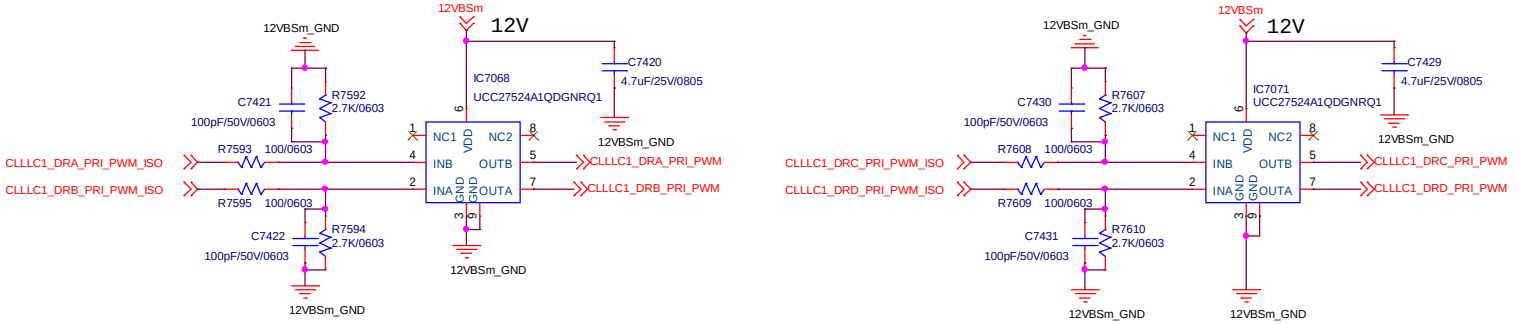
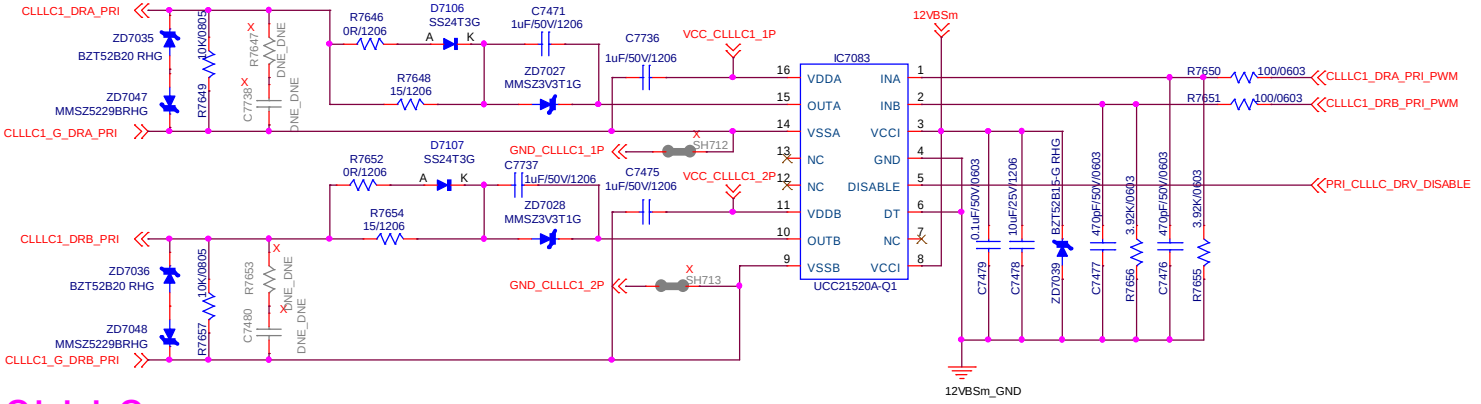
PRIMARY

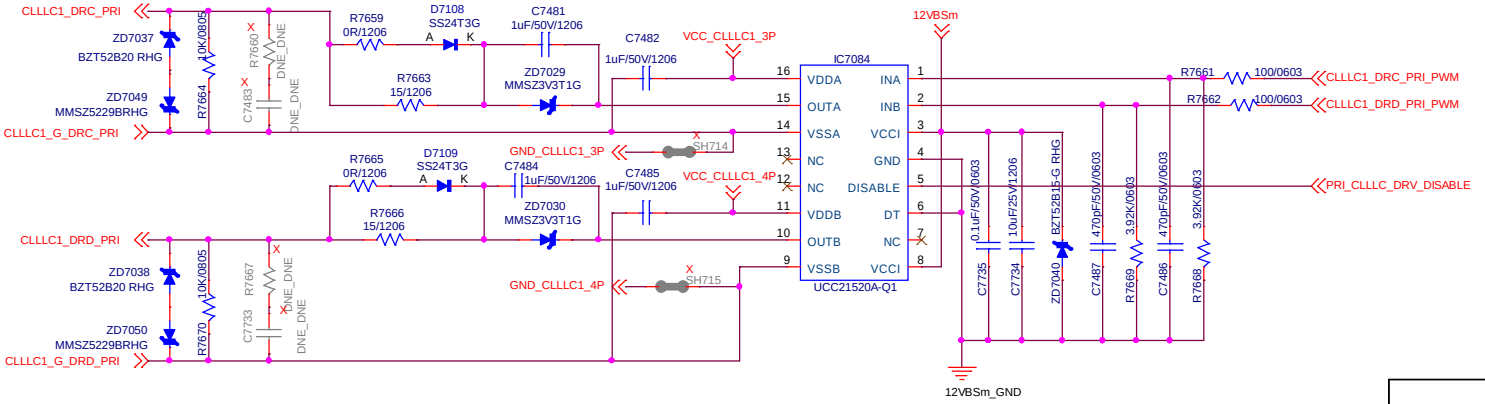
CLLLC PRI PWM DRIVER 1



CLLLC PRI PWM DRIVER 2



TO CLLLC PRIMARY MOSFETS



MB

Title: 19 Primary Full Bridge Driver

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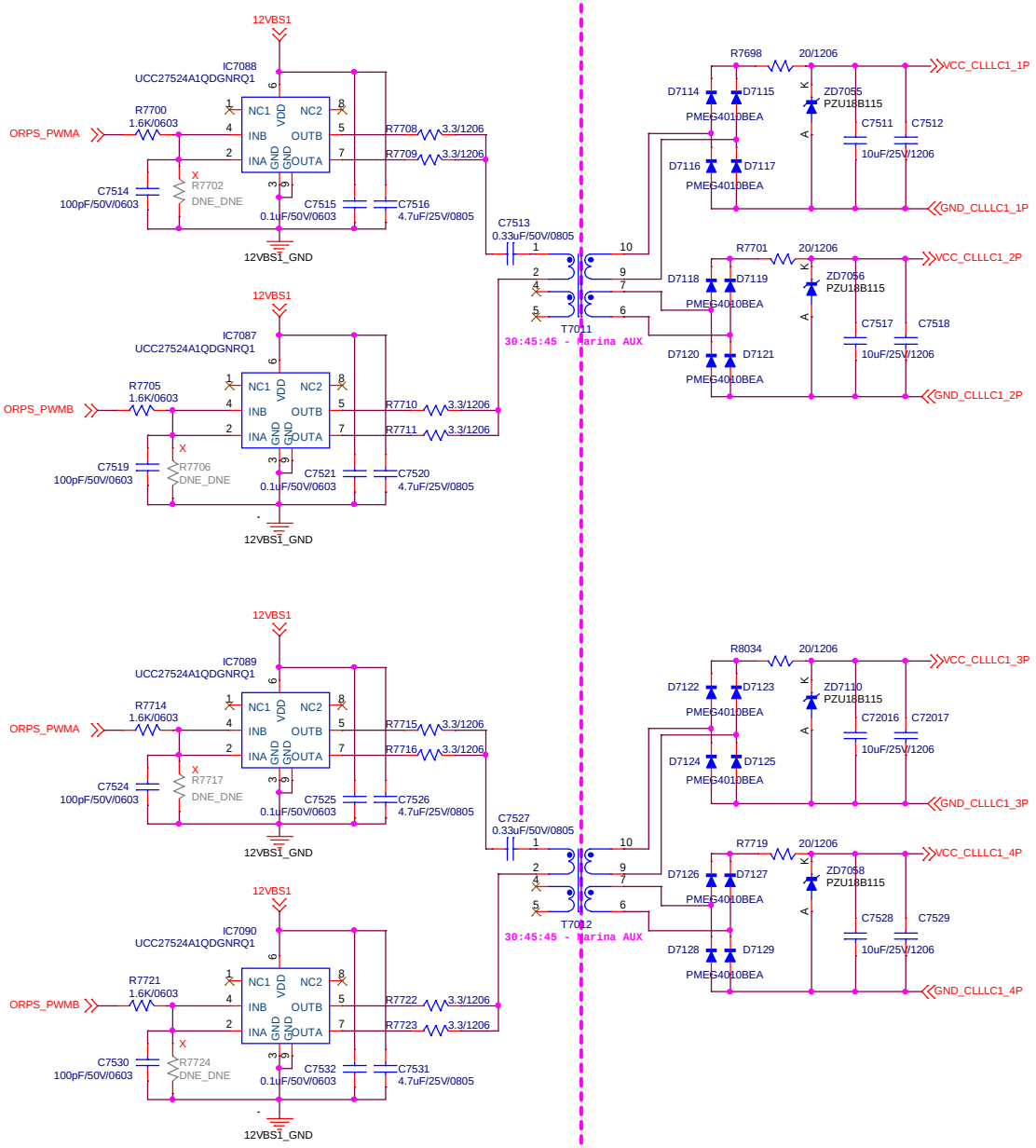
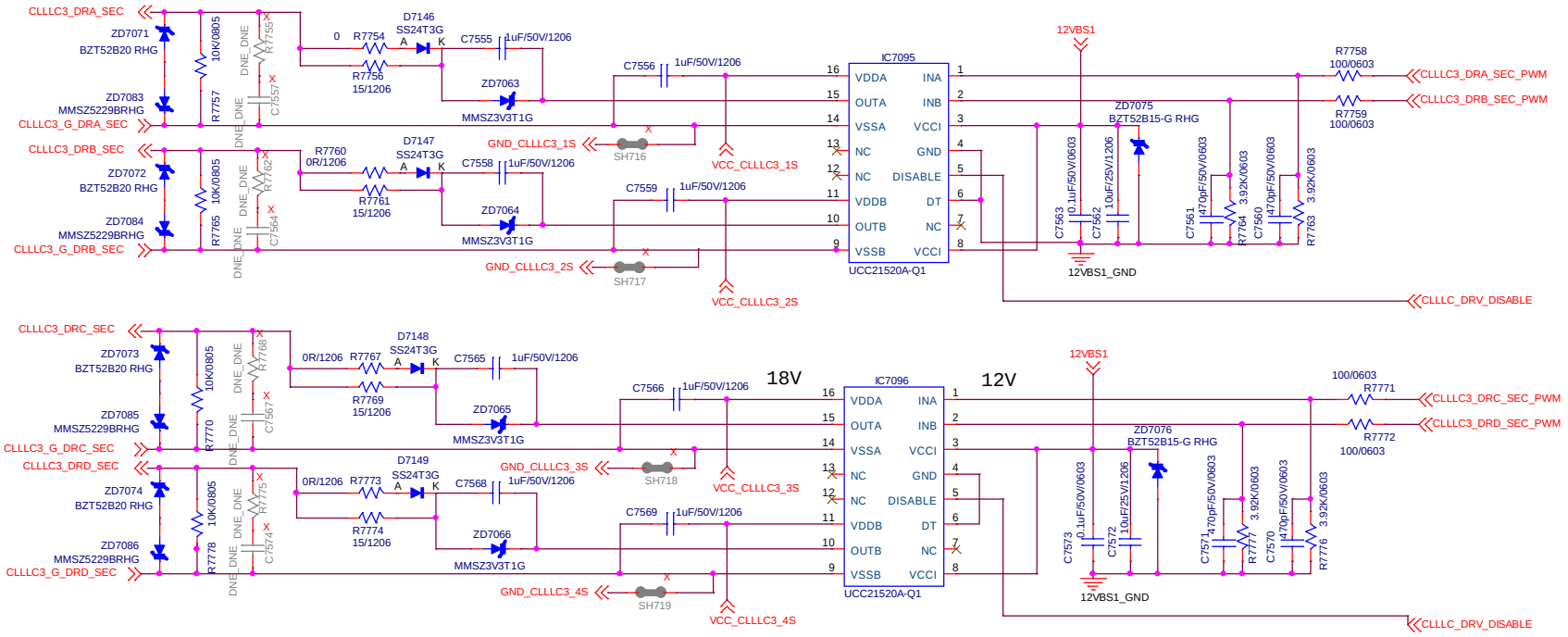
SECONDARY

PRIMARY



			MB
Title	20 Primary Full Bridge Bias		
Size A3	Document Number <Doc>		Rev A2
Date: Tuesday, December 13, 2022	Sheet 21 of 53		

SECONDARY



TO SECONDARY CLLLC_A MOSFETS

			MB
Title	21 Secondary Full Bridge Driver		
Size A3	Document Number <Doc>		Rev A2
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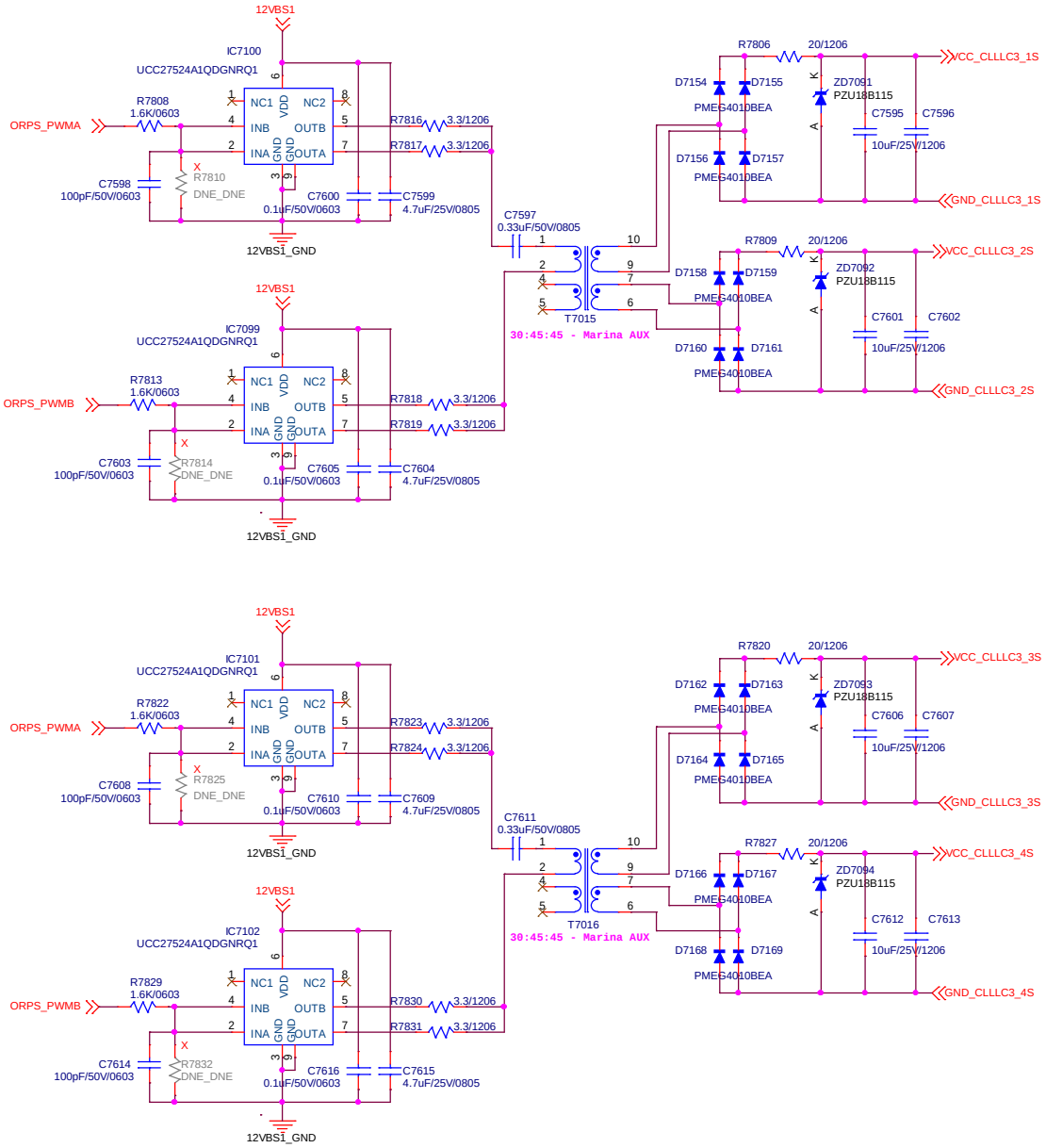
SECONDARY



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Title	22 Secondary Full Bridge Bias	
Size A3	Document Number <Doc>	Rev A2
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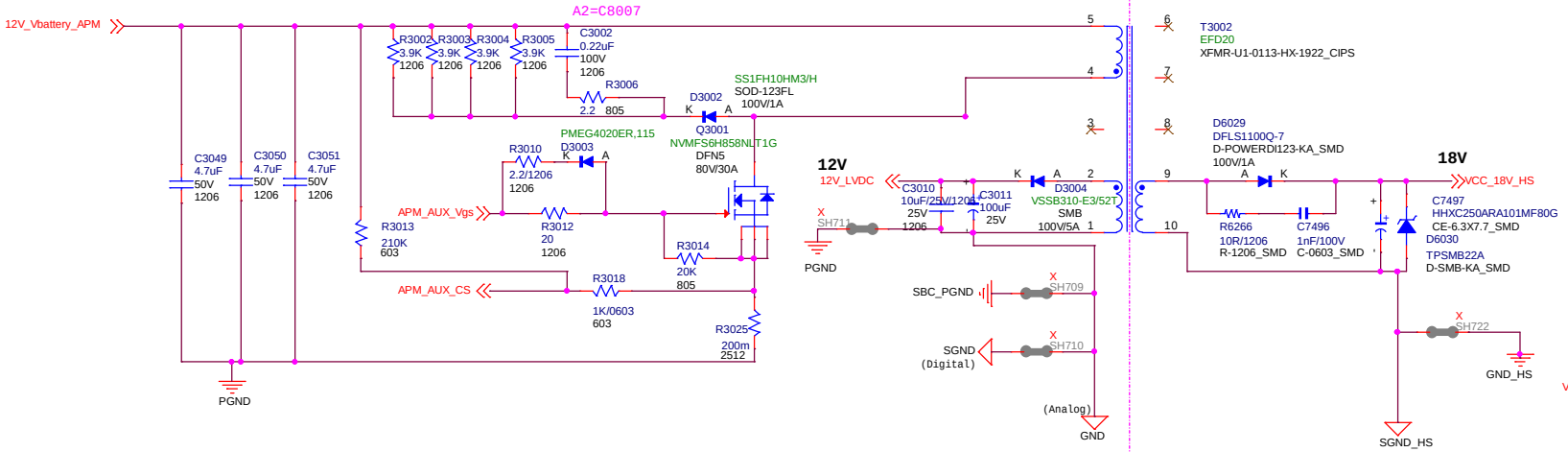
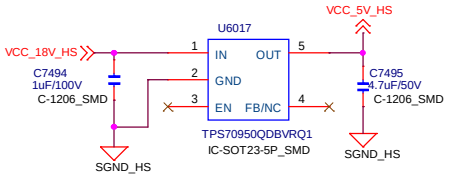
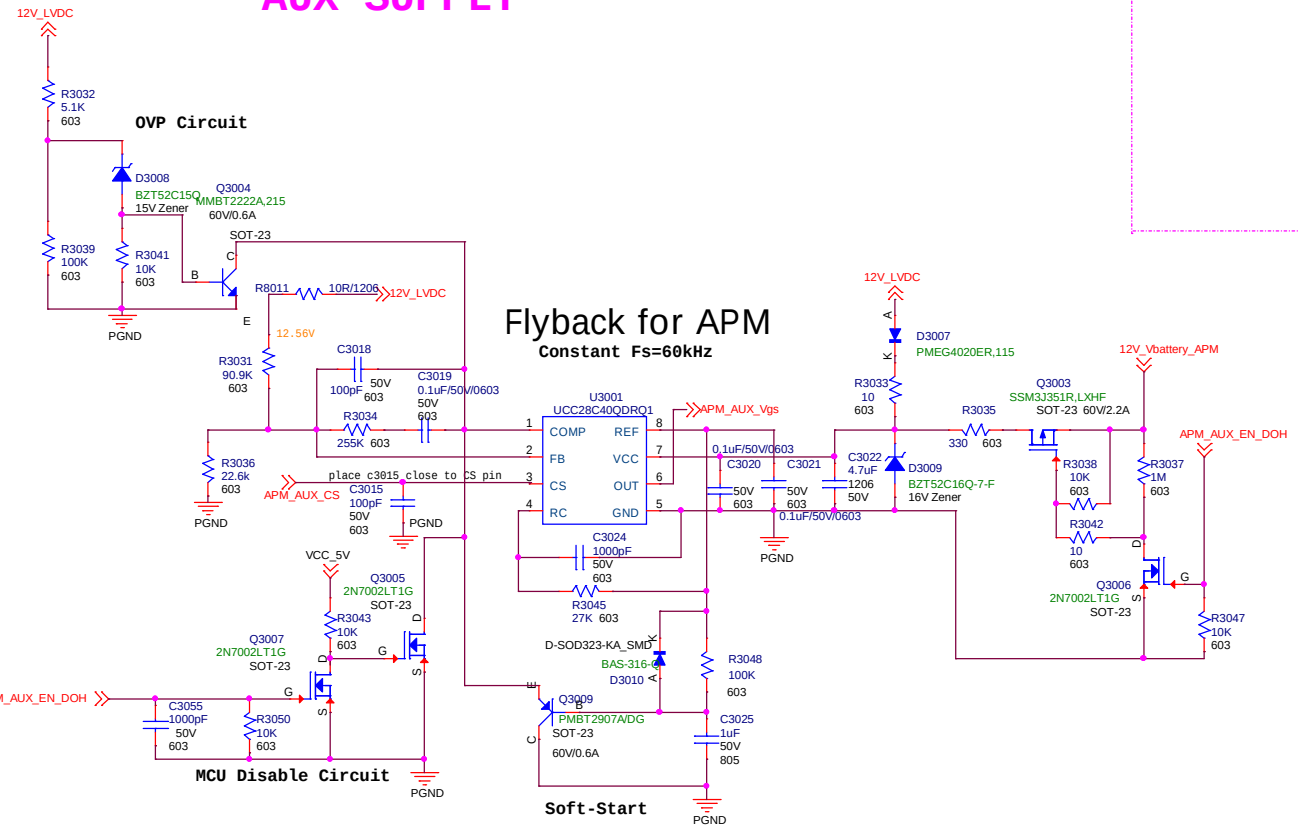
Flyback for APM

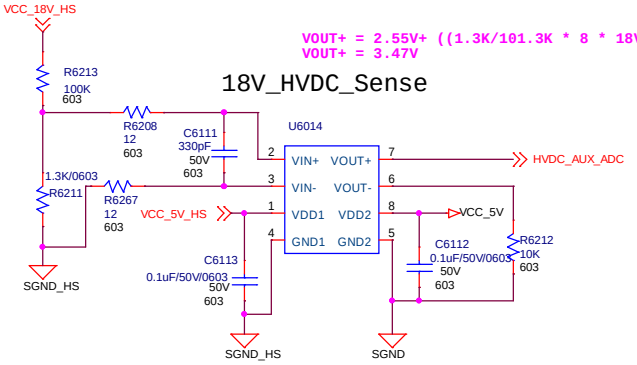


APM HVDC AUX SUPPLY



USER & APM LVDC AUX SUPPLY





		MB
Title	23 APM Aux Supply	
Size	Document Number	Rev A2
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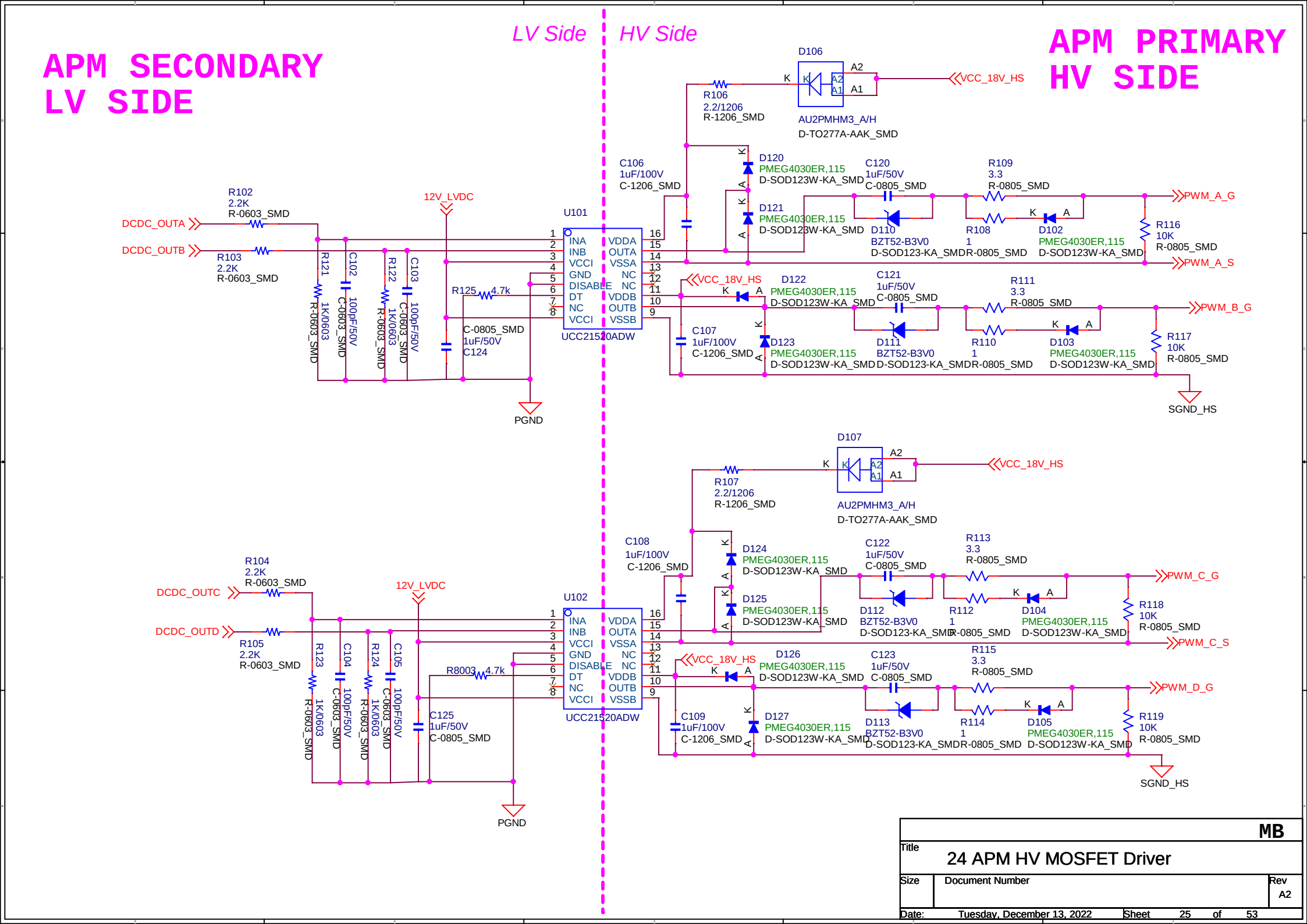
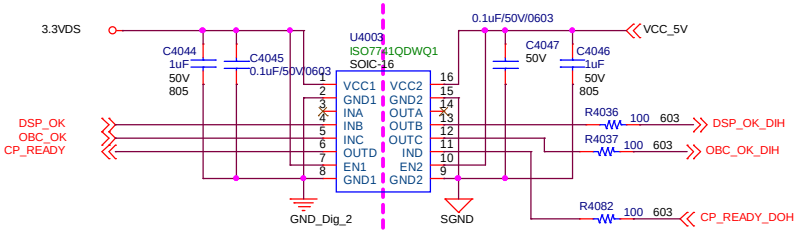

APM SECONDARY
LV SIDE
LV Side
HV Side
APM PRIMARY
HV SIDE
U101
U102
UCC21520ADW
INA
INB
VCCI
GND
DISABLE
DT
NC
VDDA
OUTA
VSSA
NC
NC
VDDB
OUTB
VSSB
DCDC_OUTA
DCDC_OUTB
DCDC_OUTC
DCDC_OUTD
12V_LVDC
PGND
SGND_HS
VCC_18V_HS
PWM_A_G
PWM_A_S
PWM_B_G
PWM_C_G
PWM_C_S
PWM_D_G
AU2PMHM3_A/H
D-TO277A-AAK_SMD
PMEG4030ER,115
D-SOD123W-KA_SMD
BZT52-B3V0
D-SOD123-KA_SMD
R-0603_SMD
R-0805_SMD
R-1206_SMD
C-0603_SMD
C-0805_SMD
C-1206_SMD
Title
24 APM HV MOSFET Driver
MB
Size
Document Number
Rev
A2
Date:
Tuesday, December 13, 2022
Sheet
25
of
53

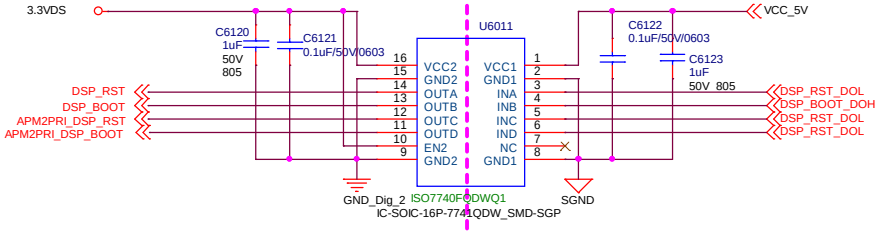
OBC HVDC SIDE

APM SECONDARY LV SIDE

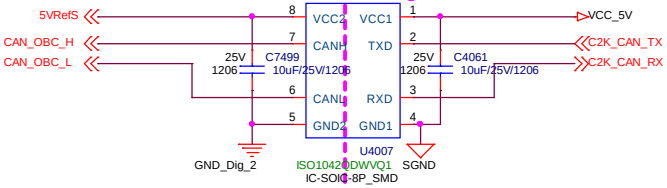
OBC- -LVDC



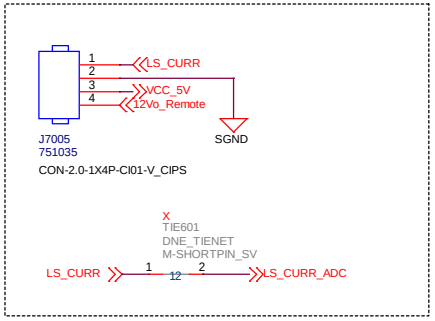
OBC- -LVDC



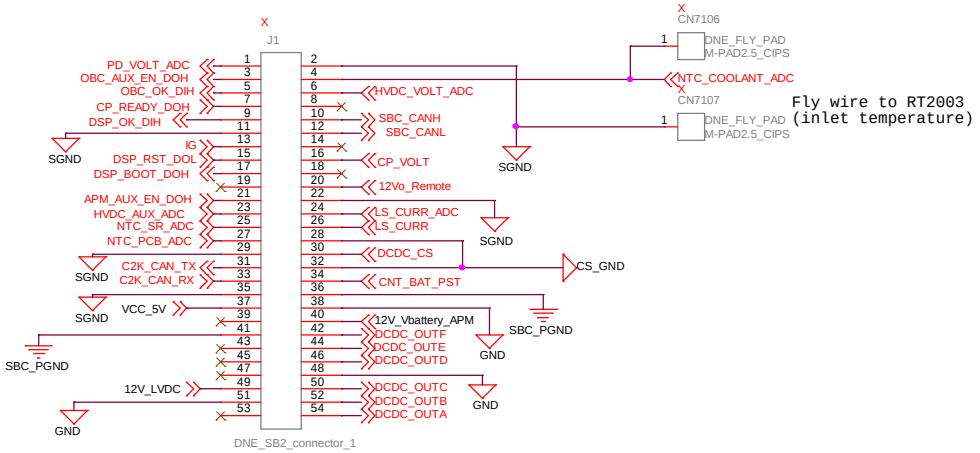
DSP debug COMM



LV Current sensor connector



TO APM SUB BOARD



APM SECONDARY LV SIDE

		MB
Title	25 APM Isolation and Signals	
Size	Document Number	Rev A2
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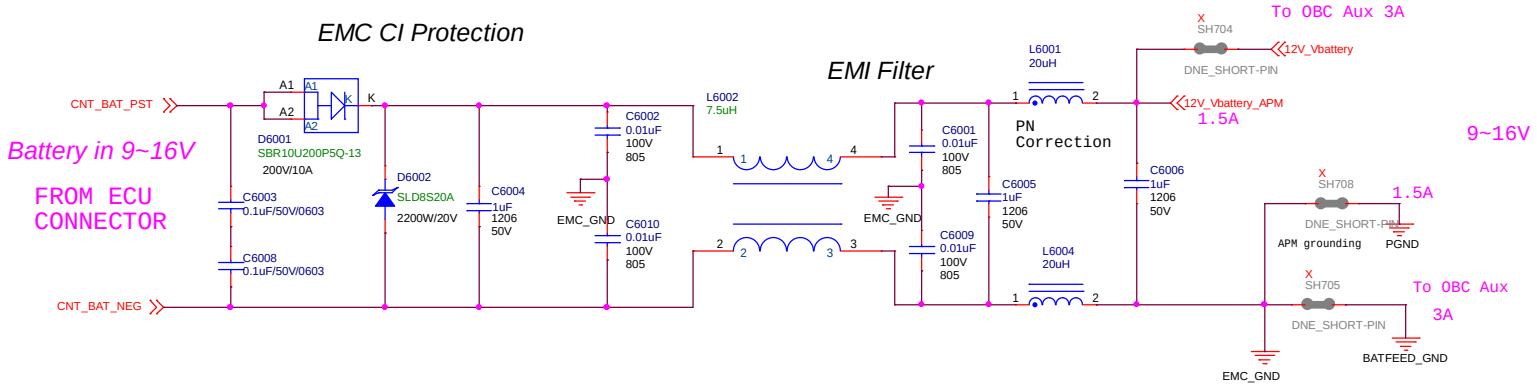

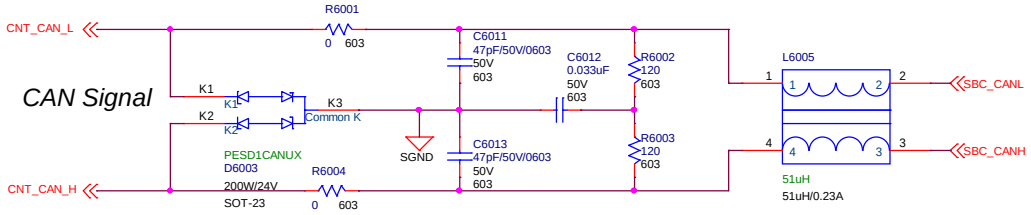

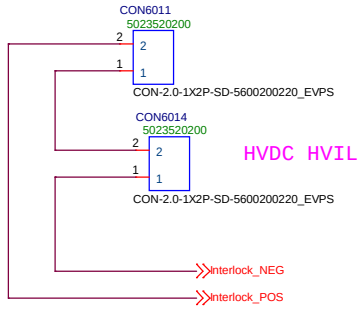

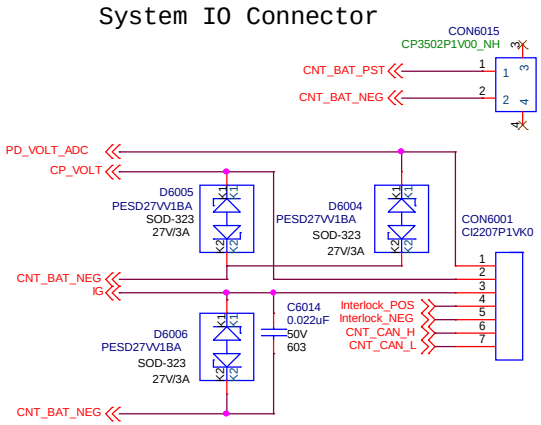

		MB
Title	26	
Size	Document Number	Rev A2
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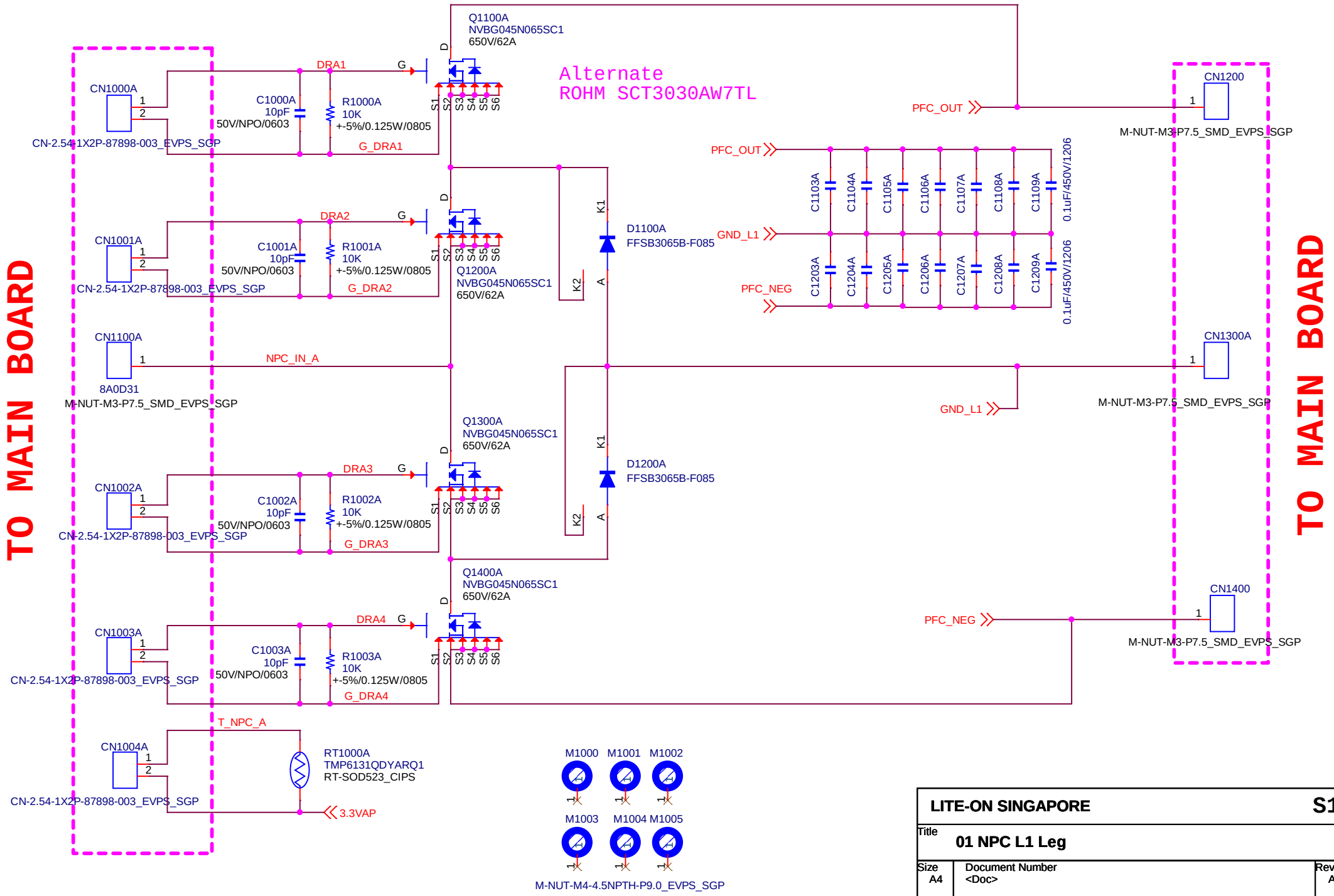
NPC LEG BOARD (11kW OBC) L1



LITE-ON SINGAPORE		S1
Title: 01 NPC L1 Leg		
Size: A4	Document Number: <Doc>	Rev: A2
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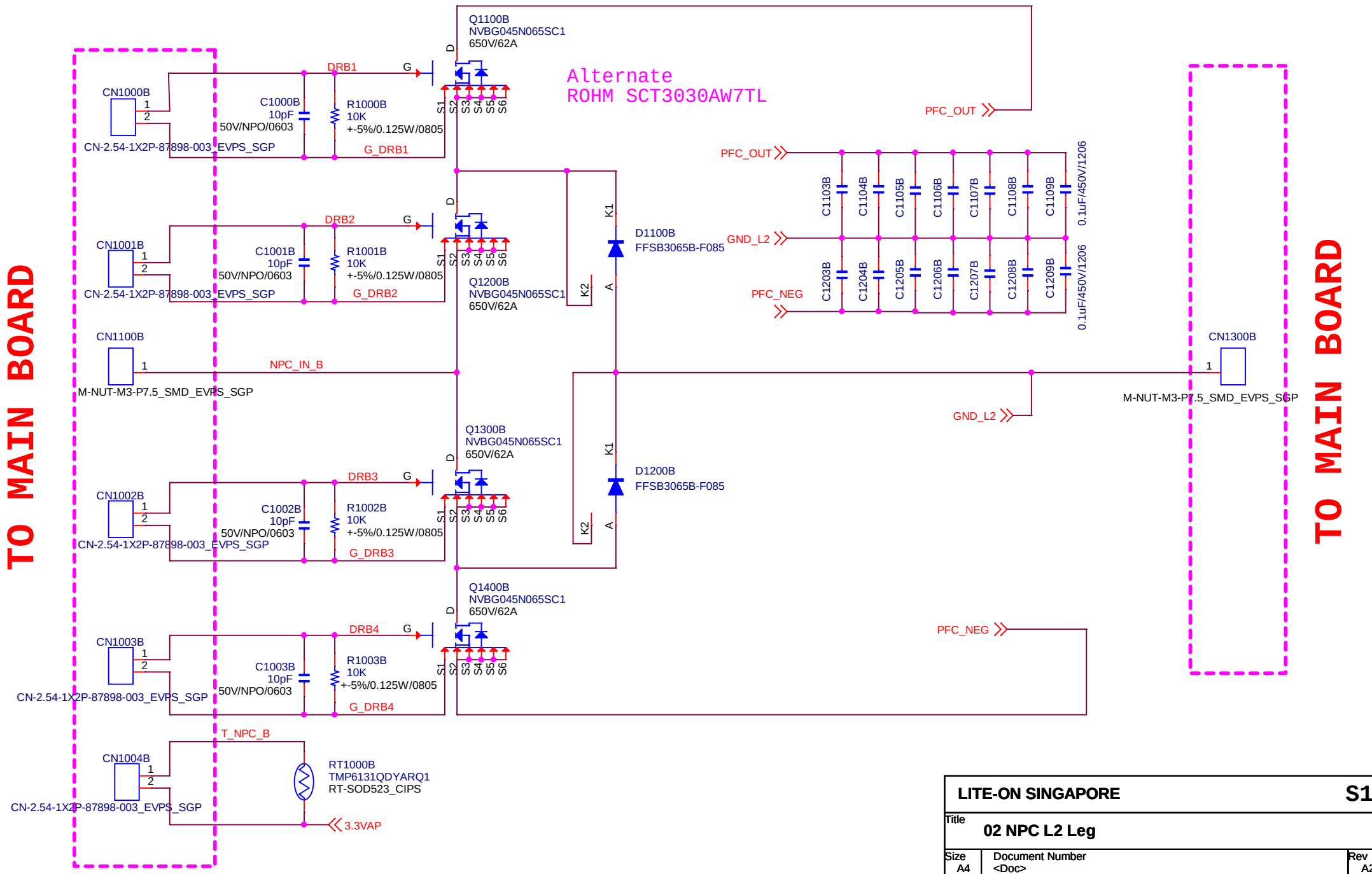
NPC LEG BOARD (11kW OBC) L2



LITE-ON SINGAPORE		S1
Title: 02 NPC L2 Leg		
Size: A4	Document Number: <Doc>	Rev: A2
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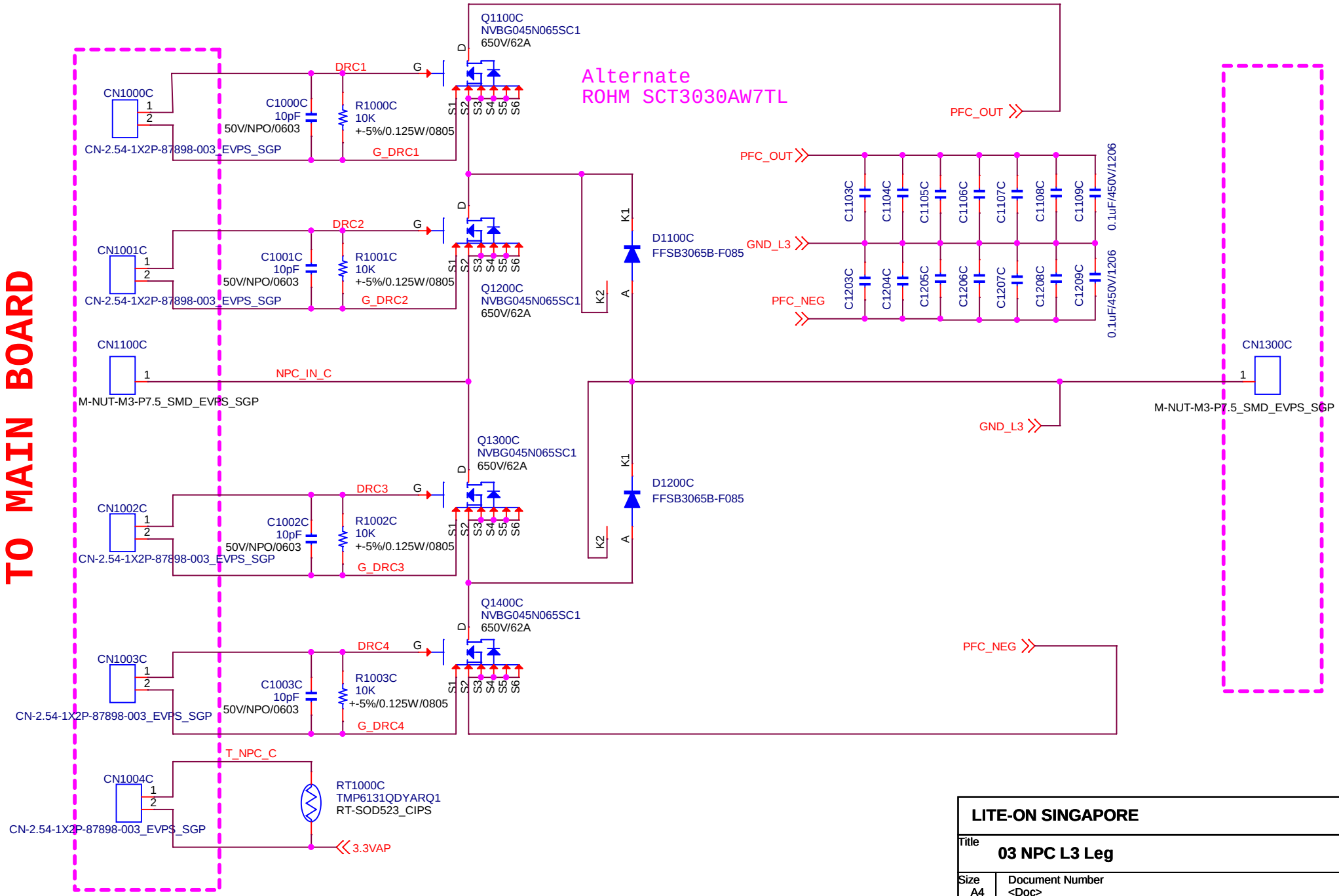
NPC LEG BOARD (11kW OBC) L3



LITE-ON SINGAPORE		S1
Title: 03 NPC L3 Leg		
Size: A4	Document Number: <Doc>	Rev: A2
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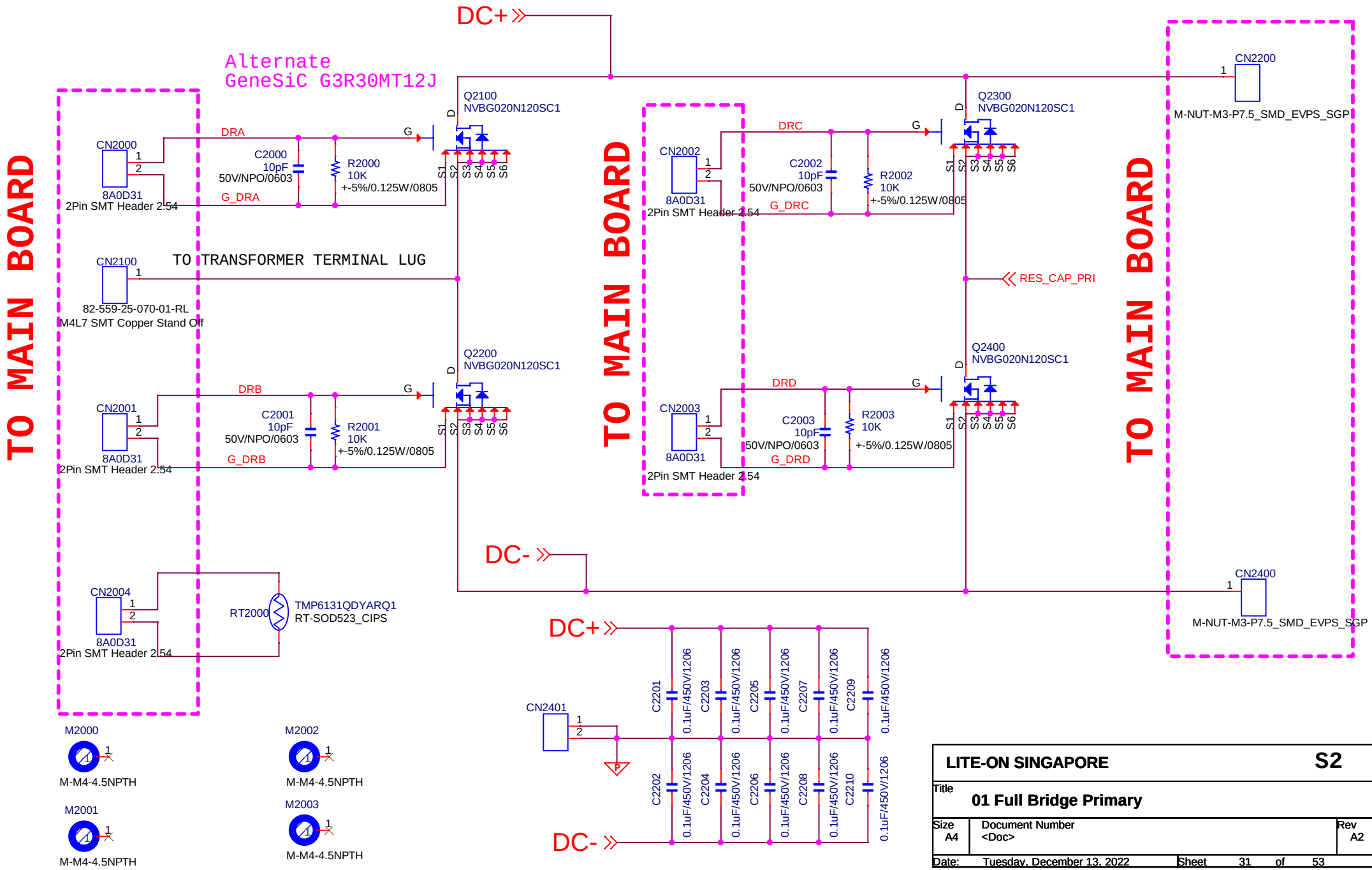
FULL BRIDGE BOARD (11kW OBC)



LITE-ON SINGAPORE		S2
Title: 01 Full Bridge Primary		
Size: A4	Document Number: <Doc>	Rev: A2
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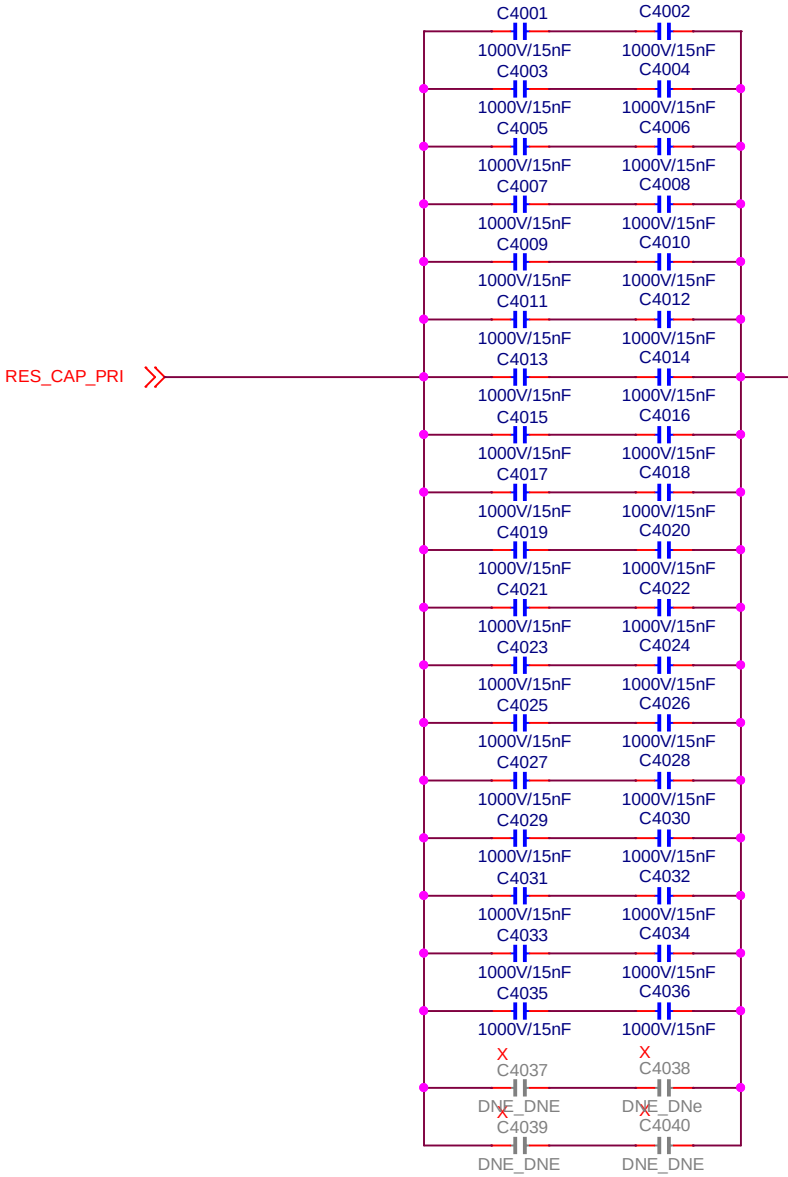
Crp = 135nF = (15nF/2)*18 - 36pc - 2 series, 18 parallel
Crs = 220nF = (22nF/2)*20 - 40pc - 2 series, 20 parallel



TO TRANSFORMER TERMINAL LUG MAIN BOARD

Crp = CGA6P1C0G3A153J250AC
Crs = CGA6P1C0G3A223J250AC

LITE-ON SINGAPORE		S2
Title: 02 Res Caps Primary		
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BULK CAPACITOR BOARD (11kW OBC)

TO MAIN BOARD NPC SIDE

DC link:
+800V/15A between PFC_OUT to PFC_NEG
+400V between PFC_OUT to GND-P
-400V between PFC_NEG to GND-P

Note:
Footprint to be updated for the bulk cap

TO MAIN BOARD CLLLC SIDE

RELAY (HIGH SIDE)

CN3100
M-NUT-M3-3.8PTH-P7.5_EVPS_SGP
PFC_OUT

R3100
B59451C1130B70Z15
RT-15D7.5-P5T

12VBSm
D3000
1A/40V
C3000
10uF/25V/1206
C3001
0.1uF
C8007
10uF/25V/1206
D3001
1A/40V
12VBSm_GND
COM
NO
C1
C2
RE3100
65A/277V
897P1-1AH-C 12VDC
R3000
100R
RLY_DRV
Q3000
2N7002
C3003
100p/50V
R3001
10K/0603
12V
12VBSm_GND

32A

CN3103
M-NUT-M3-3.8PTH-P7.5_EVPS_SGP
R9029
2.2/1206
A2=R8015
12VBSm_GND

C3115
10uF/1100V

C3100 390uF
C3102 390uF
C3104 390uF
C3106 390uF
C3116 390uF
450NXK390MEFCSN35X35
450NXK390MEFCSN35X35

R3102
510k
R-1206_SMD
R3103
510k
R-1206_SMD
R3104
510k
R-1206_SMD

C3114
10uF/1100V

C3101 390uF
C3103 390uF
C3105 390uF
C3107 390uF
C3117 390uF
450NXK390MEFCSN35X35
450NXK390MEFCSN35X35

R3105
510k
R-1206_SMD
R3106
510k
R-1206_SMD
R3107
510k
R-1206_SMD

PFC_NEG
CN3106
M-NUT-M3-3.8PTH-P7.5_EVPS_SGP

R3101
B59451C1130B70Z15
RT-15D7.5-P5T

M-NUT-M3-3.8PTH-P7.5_EVPS_SGP
CN3109
DC+

M-NUT-M3-3.8PTH-P7.5_EVPS_SGP
CN3111
DC-

RELAY (LOW SIDE)

12VBSm
C3008
10uF/25V/1206
25V/X7S/1206
RLY_DRV
CN3000
CON-2X5P
ERM8-005-05.0-L-DV-P-TR
12VBSm_GND

A2=D3002
D7218
1A/40V
12VBSm
C3004
10uF/25V/1206
C3005
0.1uF
C3006
10uF/25V/1206
D3005
1A/40V
COM
NO
C1
C2
RE3101
65A/277V
897P1-1AH-C 12VDC
A2=R300
12VBSm_GND
R9027
100R
A2=Q3001
RLY_DRV
Q7009
2N7002
A2=R3004
C3007
100p/50V
R9028
10K/0603
12V
12VBSm_GND

M3002
M-M4-6.6PTH-PAD8_SPACER_EVPS
Mounting Hole M4
M3003
M-M4-6.6PTH-PAD8_SPACER_EVPS
Mounting Hole M4

M3000
Mounting Hole M4
M-M4FIX-4.5PTH-PAD9_EVPS_SGP
M3001
Mounting Hole M4
M-M4FIX-4.5PTH-PAD9_EVPS_SGP
M3004
Mounting Hole M4
M-M4FIX-4.5PTH-PAD9_EVPS_SGP

Title	LITE-ON SINGAPORE	S3
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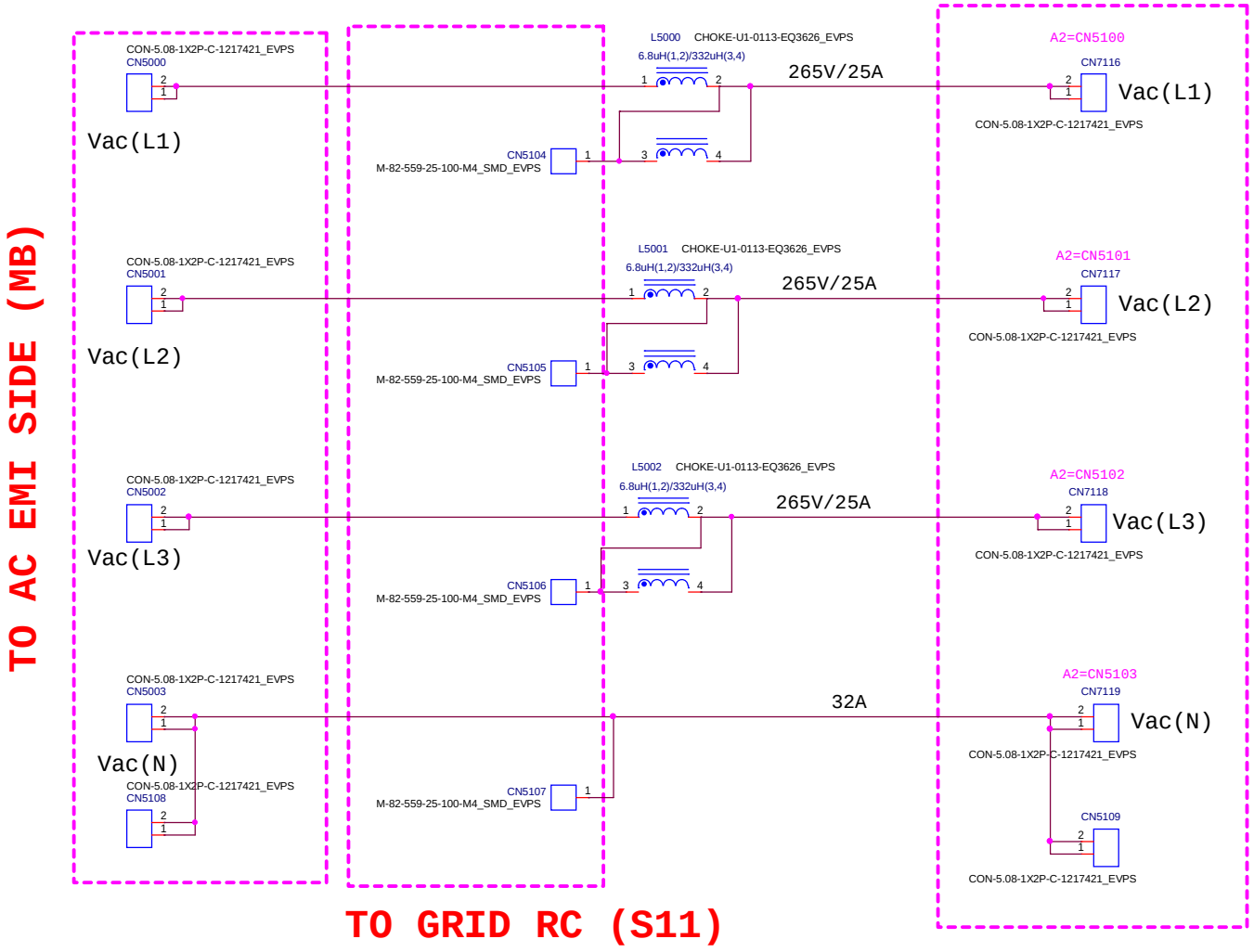

M6000
Mounting Hole M4
M-M4-6.6PTH-PAD8_SPACER_EVPS

M6001
Mounting Hole M4
M-M4-SCREW_CIPS

M6002
Mounting Hole M4
M-M4-SCREW_CIPS

M6006
Mounting Hole M4
M-82-559-25-100-M4_SMD_EVPS

M6003
Mounting Hole M4
M-M4-6.6PTH-PAD8_SPACER_EVPS

M6004
Mounting Hole M4
M-M4-SCREW_CIPS

M6005
Mounting Hole M4
M-M4-SCREW_CIPS

M6007
Mounting Hole M4
M-82-559-25-100-M4_SMD_EVPS

LITE-ON SINGAPORE		S4
Title: 01 PFC Choke		
Size: A3	Document Number: <Doc>	Rev: A2
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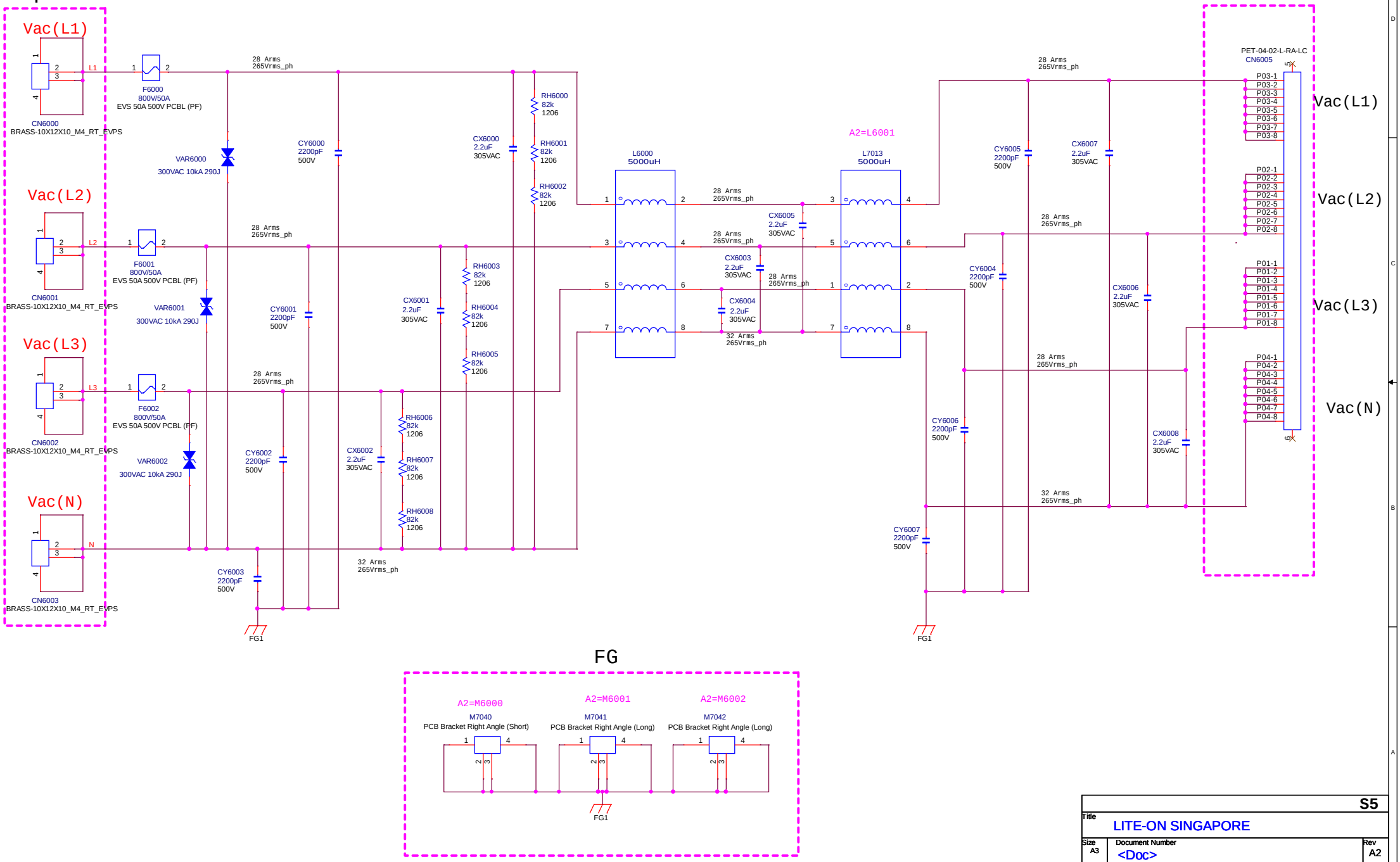
AC EMI BOARD (11kW OBC)

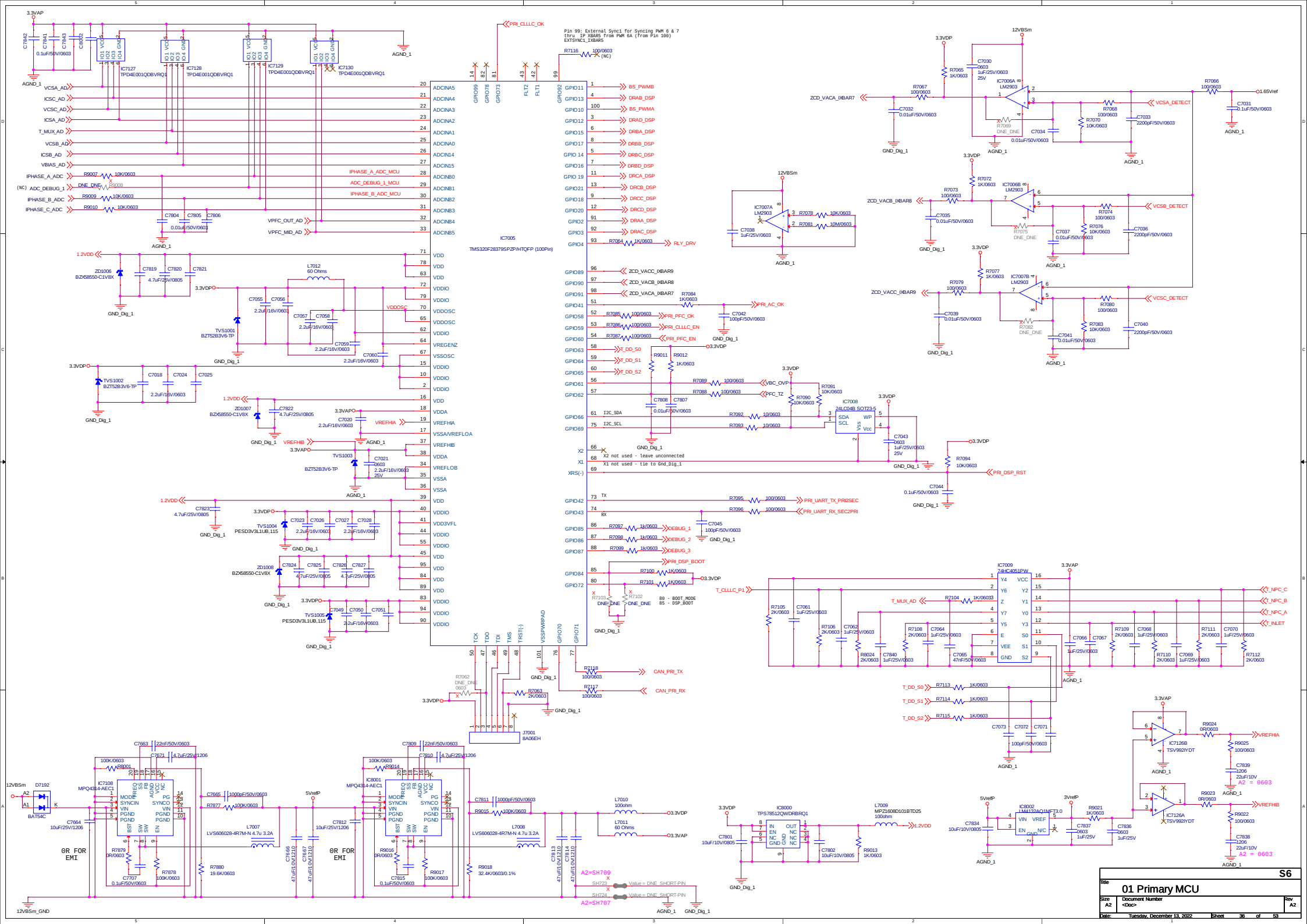
Vac input from external
3 phase 5 wire

TO PFC LCL BOARD



FG

			S5
Title	LITE-ON SINGAPORE		
Size A3	Document Number <Doc>		Rev A2
Date: Tuesday, December 13, 2022	Sheet 35 of 53		


IC7005
TMS320F28379SPZP/HTQFP (100Pin)
Pin 99: External Sync1 for Syncing PWM 6 & 7 thru IP XBARS from PWM 6A (from Pin 100)
EXTSYNC1_IXBARS
ADCINA5
ADCINA4
ADCINA3
ADCINA2
ADCINA1
ADCINA0
ADCIN14
ADCIN15
ADCINB0
ADCINB1
ADCINB2
ADCINB3
ADCINB4
ADCINB5
GPIO11 BS_PWMB
GPIO13 DRAB_DSP
GPIO10 BS_PWMA
GPIO12 DRAD_DSP
GPIO15 DRBA_DSP
GPIO17 DRBB_DSP
GPIO 14 DRBC_DSP
GPIO16 DRBD_DSP
GPIO 19 DRCA_DSP
GPIO21 DRCB_DSP
GPIO18 DRCC_DSP
GPIO20 DRCD_DSP
GPIO2 DRAA_DSP
GPIO3 DRAC_DSP
GPIO4 RLY_DRV
GPIO89 ZCD_VACC_IXBAR9
GPIO90 ZCD_VACB_IXBAR8
GPIO91 ZCD_VACA_IXBAR7
GPIO41 PRI_AC_OK
GPIO58 PRI_PFC_OK
GPIO59 PRI_CLLLC_EN
GPIO60 PRI_PFC_EN
GPIO63 T_DD_S0
GPIO64 T_DD_S1
GPIO65 T_DD_S2
GPIO61 VBC_OVP
GPIO62 PFC_TZ
GPIO66 I2C_SDA
GPIO69 I2C_SCL
GPIO42 PRI_UART_TX_PRI2SEC
GPIO43 PRI_UART_RX_SEC2PRI
GPIO85 DEBUG_1
GPIO86 DEBUG_2
GPIO87 DEBUG_3
GPIO84 PRI_DSP_BOOT
GPIO72
80 - BOOT_MODE
85 - DSP_BOOT
TCK
TDO
TDI
TMS
TRST(-)
VSSPWRPAD
GPIO70
GPIO71
CAN_PRI_TX
CAN_PRI_RX
PRI_DSP_RST
IPHASE_A_ADC_MCU
ADC_DEBUG_1_MCU
IPHASE_B_ADC_MCU
VPFC_OUT_AD
VPFC_MID_AD
IC7127 TPD4E001QDBVRQ1
IC7128 TPD4E001QDBVRQ1
IC7129 TPD4E001QDBVRQ1
IC7130 TPD4E001QDBVRQ1
IC7007A LM2903
IC7006A LM2903
IC7006B LM2903
IC7007B LM2903
IC7008 24LC04B SOT23-5
IC7009 74HC4051PW
IC8000 TPS78512QWDRBRQ1
IC8001 MPQ4314-AEC1
IC8002 LM4132AQ1MF3.0
IC7126A TSV992IYDT
IC7126B TSV992IYDT
IC7108 MPQ4314-AEC1
J7001 8A06EH
D7192 BAT54C
ZD1006 BZX58550-C1V8X
ZD1007 BZX58550-C1V8X
ZD1008 BZX58550-C1V8X
TVS1001 BZT52B3V6-TP
TVS1002 BZT52B3V6-TP
TVS1003 BZT52B3V6-TP
TVS1004 PESD3V3L1UB,115
TVS1005 PESD3V3L1UB,115
L7012 60 Ohms
L7011 60 Ohms
L7010 100ohm
L7009 MPZ1608D101BTD25 100ohm
L7007 LVS606028-4R7M-N 4.7u 3.2A
L7008 LVS606028-4R7M-N 4.7u 3.2A
0R FOR EMI
0R FOR EMI
A2=SH709
A2=SH707
SH723 Value = DNE_SHORT-PIN
SH724 Value = DNE_SHORT-PIN
A2 = 0603
A2 = 0603
3.3VAP
3.3VDP
1.2VDD
12VBSm
5VrefP
3VrefP
1.65Vref
AGND_1
GND_Dig_1
12VBSm_GND
VCSA_AD
VCSC_AD
VCSB_AD
ICSA_AD
ICSC_AD
ICSB_AD
T_MUX_AD
VBIAS_AD
IPHASE_A_ADC
ADC_DEBUG_1
IPHASE_B_ADC
IPHASE_C_ADC
ZCD_VACA_IXBAR7
ZCD_VACB_IXBAR8
ZCD_VACC_IXBAR9
VCSA_DETECT
VCSB_DETECT
VCSC_DETECT
T_CLLLC_P1
T_NPC_C
T_NPC_B
T_NPC_A
T_INLET
T_DD_S0
T_DD_S1
T_DD_S2
X2 not used - leave unconnected
X1 not used - tie to Gnd_Dig_1
DNE_DNE
S6
01 Primary MCU
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<Doc>
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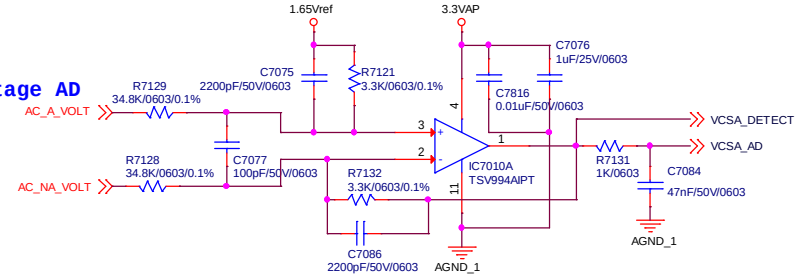
VCSA_AD=1.65V+0.001798*VLL

VCSA_AD=2.44 @442Vpk (313Vrms)

VCSA_AD=2.616 @537Vpk(380Vrms)

VCSA_AD=2.87 @678Vpk (480Vrms)

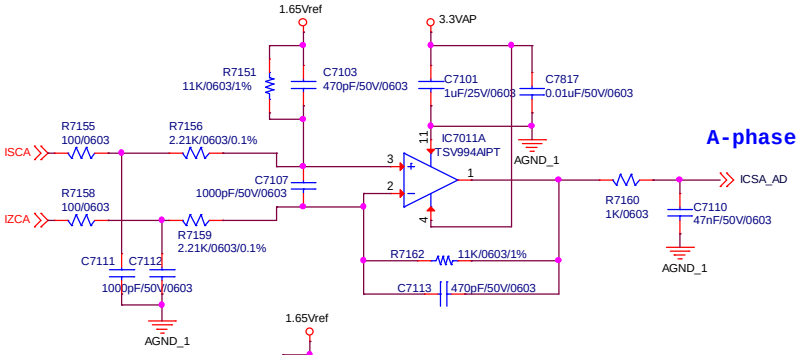
A-phase Voltage AD



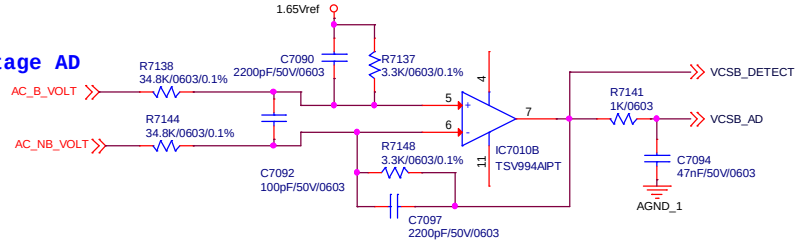
ICSA_AD=1.65V+0.0195*Ipk

VCSA_AD=3 @70Apk

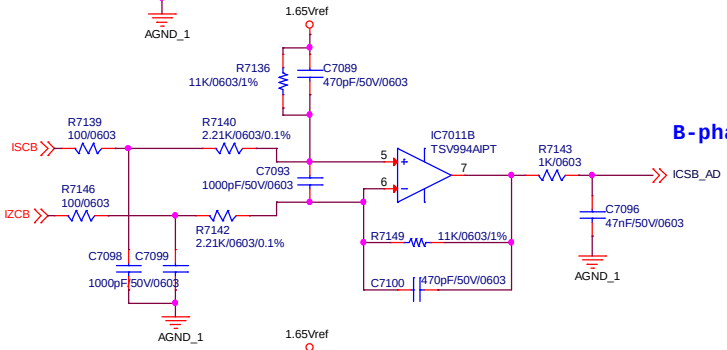
A-phase Current AD



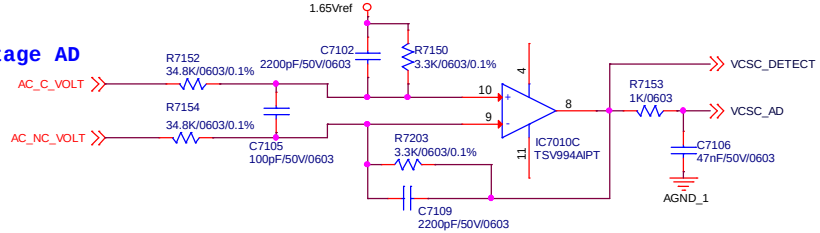
B-phase Voltage AD



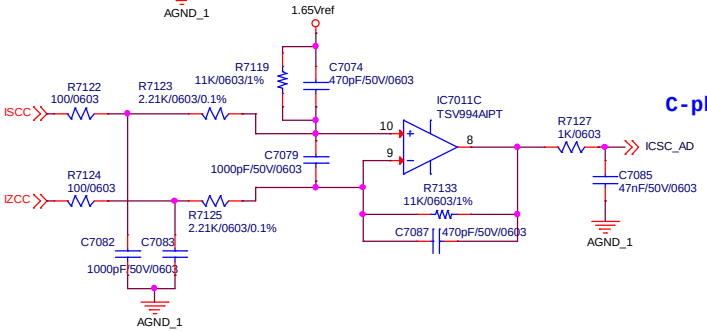
B-phase Current AD

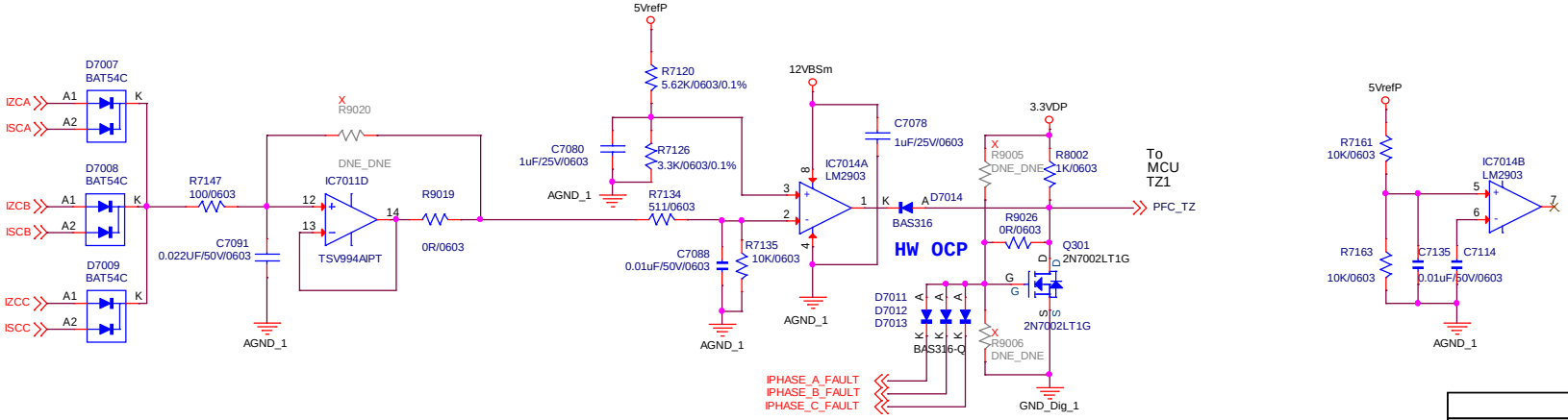


C-phase Voltage AD



C-phase Current AD





		S6
Title	02 Primary MCU AC Sense	
Size A3	Document Number <Doc>	Rev A2
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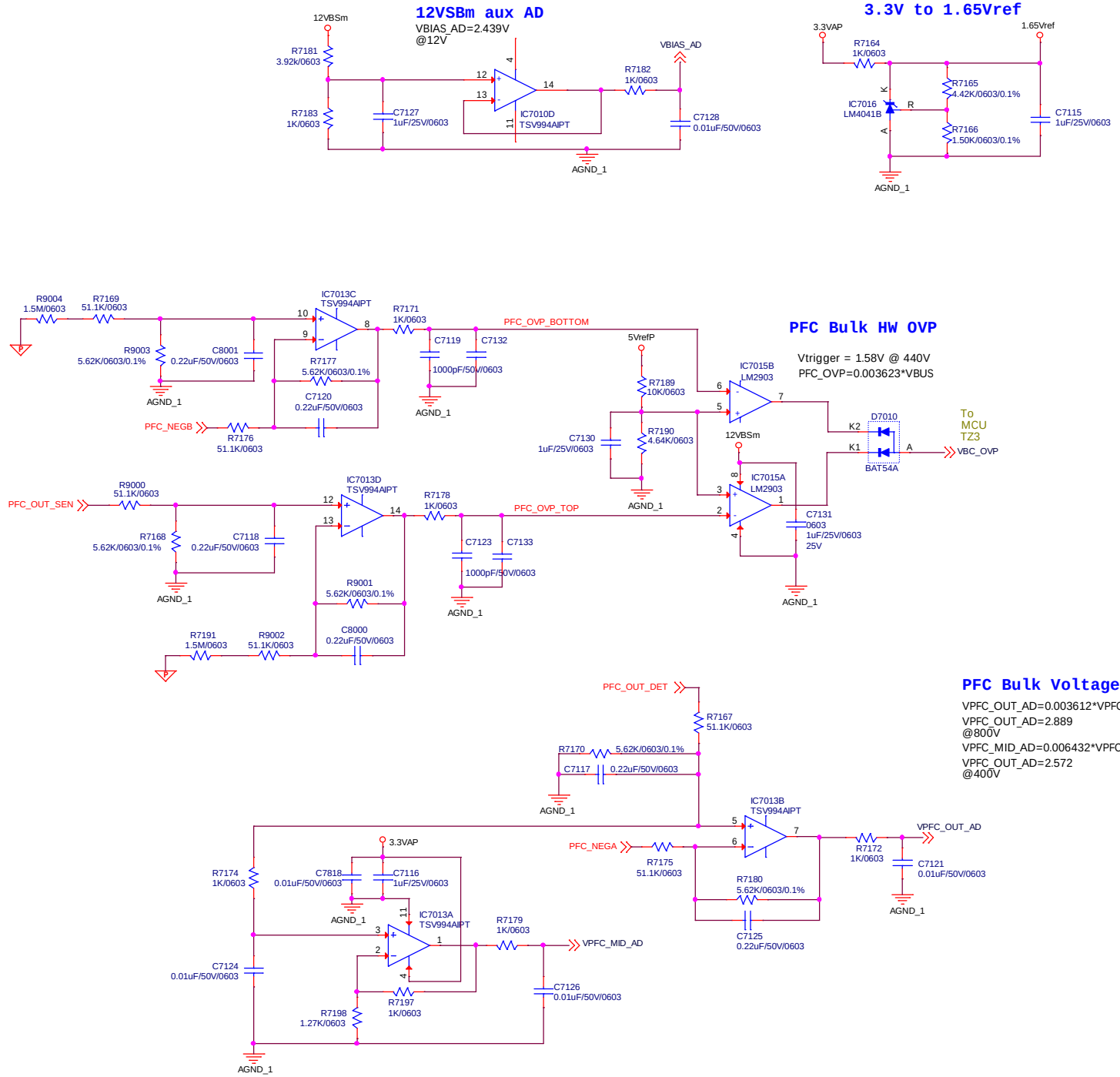

		S6
Title	03 Primary MCU Bulk Sense	
Size A3	Document Number <Doc>	Rev A2
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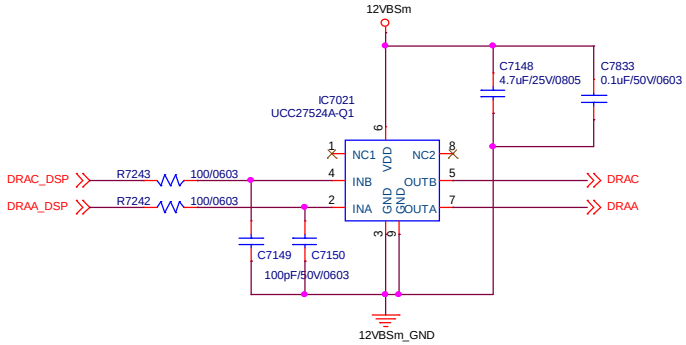
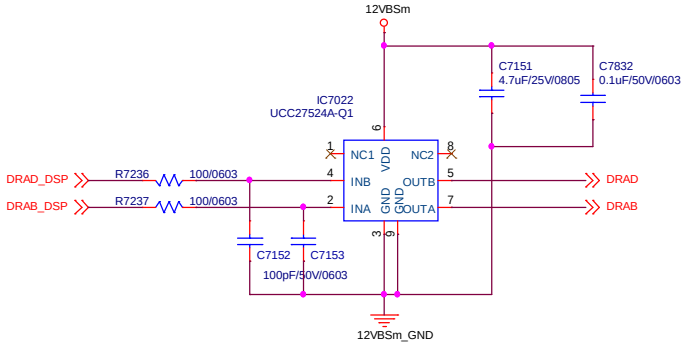




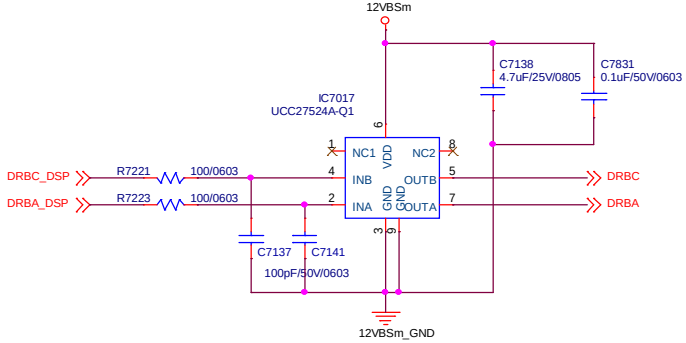
A2=CN7092

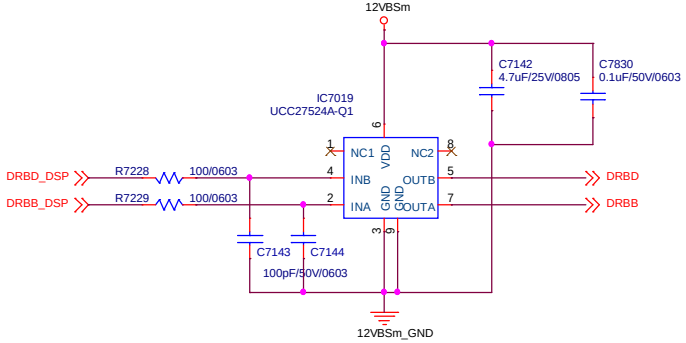
CN7120

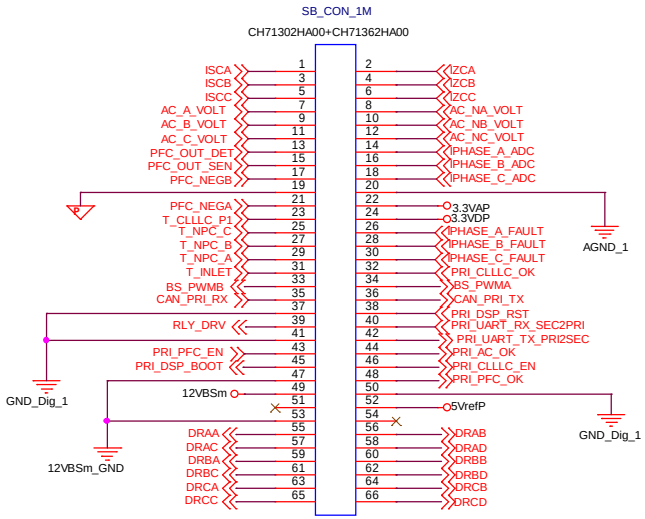
Pri_MCU_support

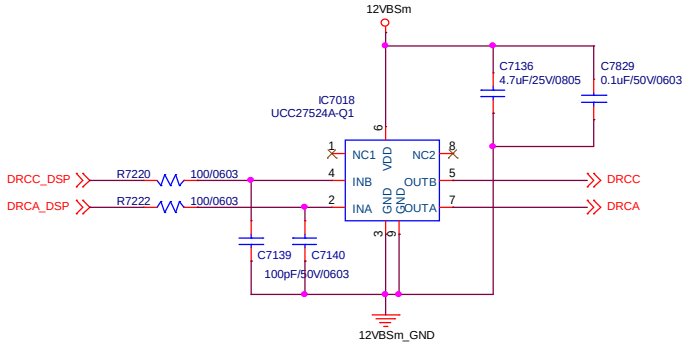
M-B2B-10113-RA-S6_EVPS_SGP

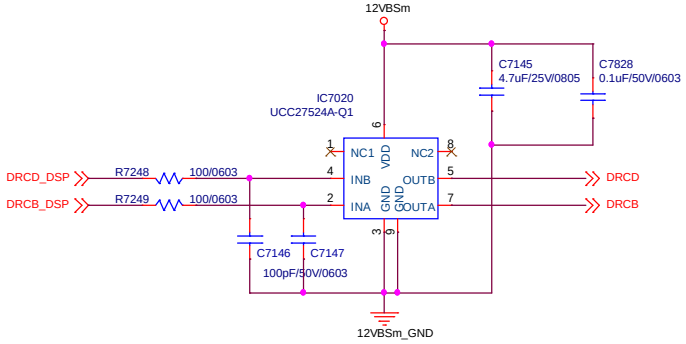
TIN finger











		S6
Title	04 PFC 12V Driver	
Size A3	Document Number <Doc>	Rev A2
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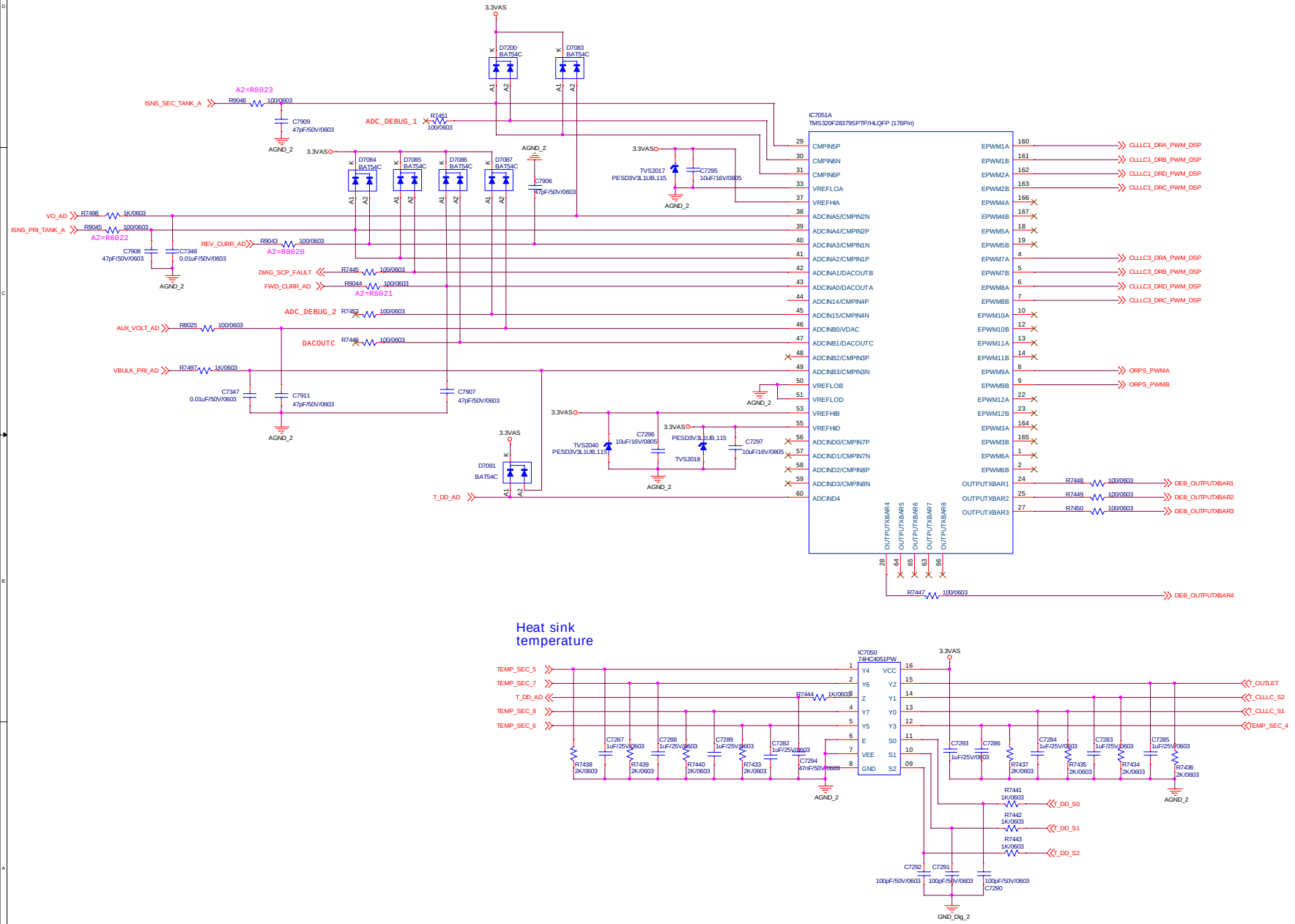
SECONDARY MCU

TMS320F28379S/LQFP176_a



Heat sink temperature

			S7
Title	01 Secondary MCU Signals		
Size A2	Document Number		Rev A2
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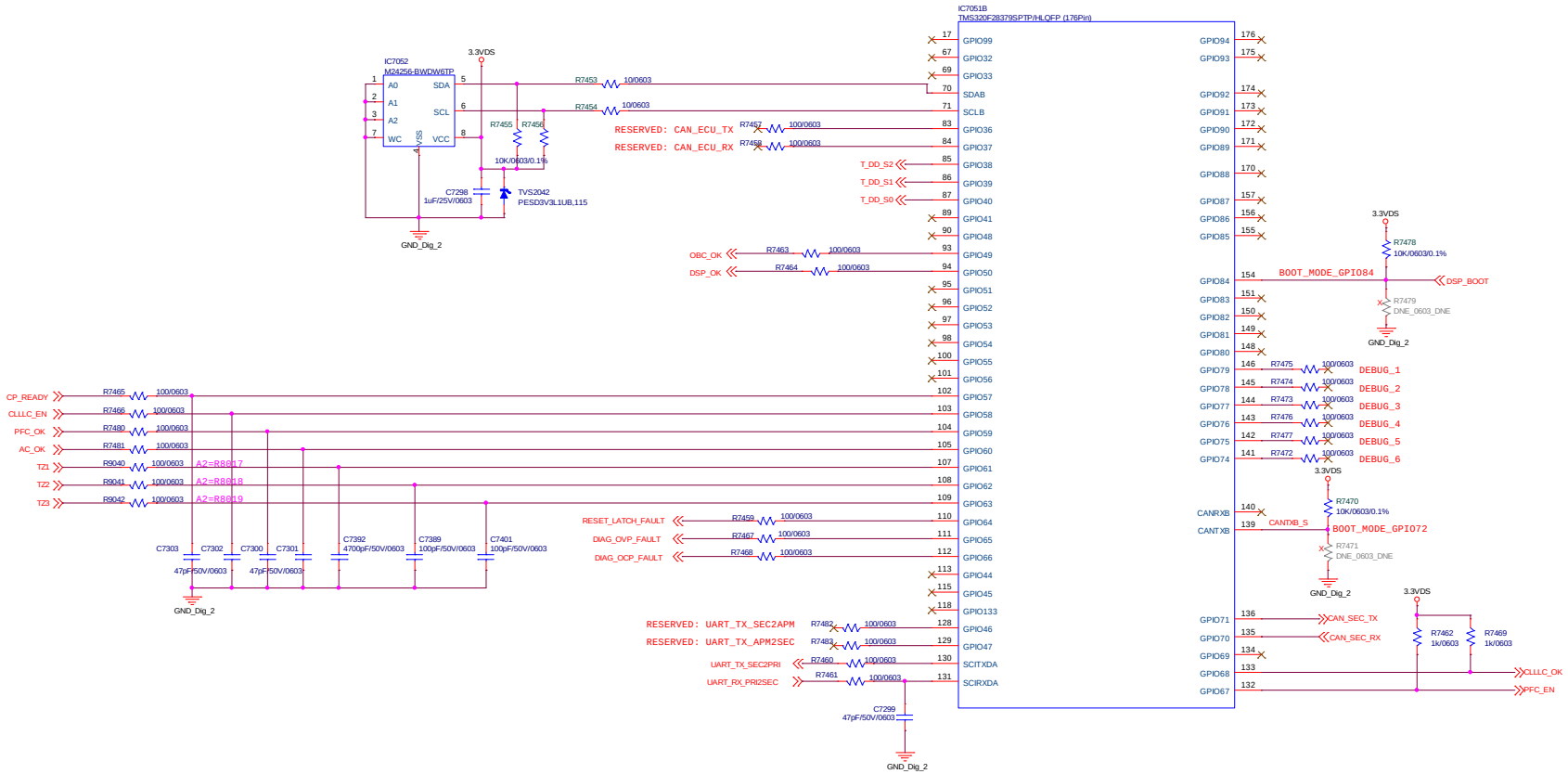
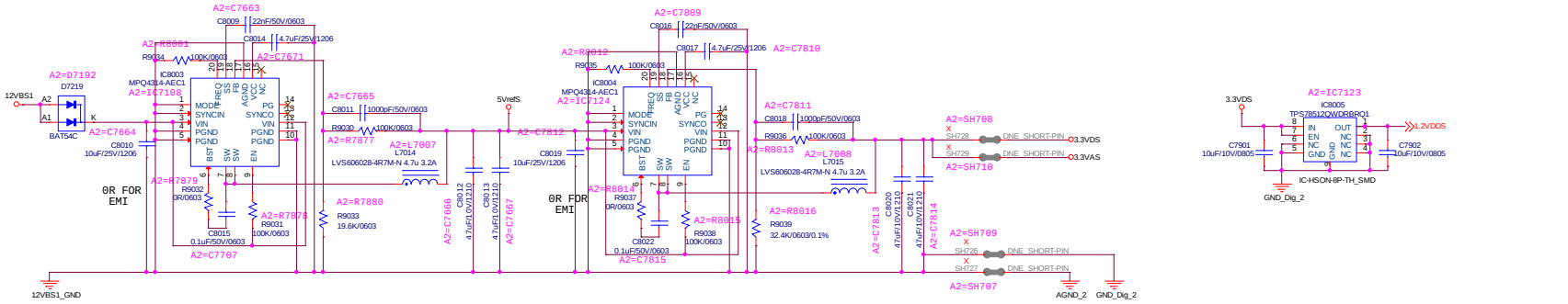
SECONDARY MCU

TMS320F28379S/LQFP176_b



SECONDARY BIAS SUPPLY



			S7
Title	02 Secondary MCU Signals		
Size A2	Document Number		Rev A2
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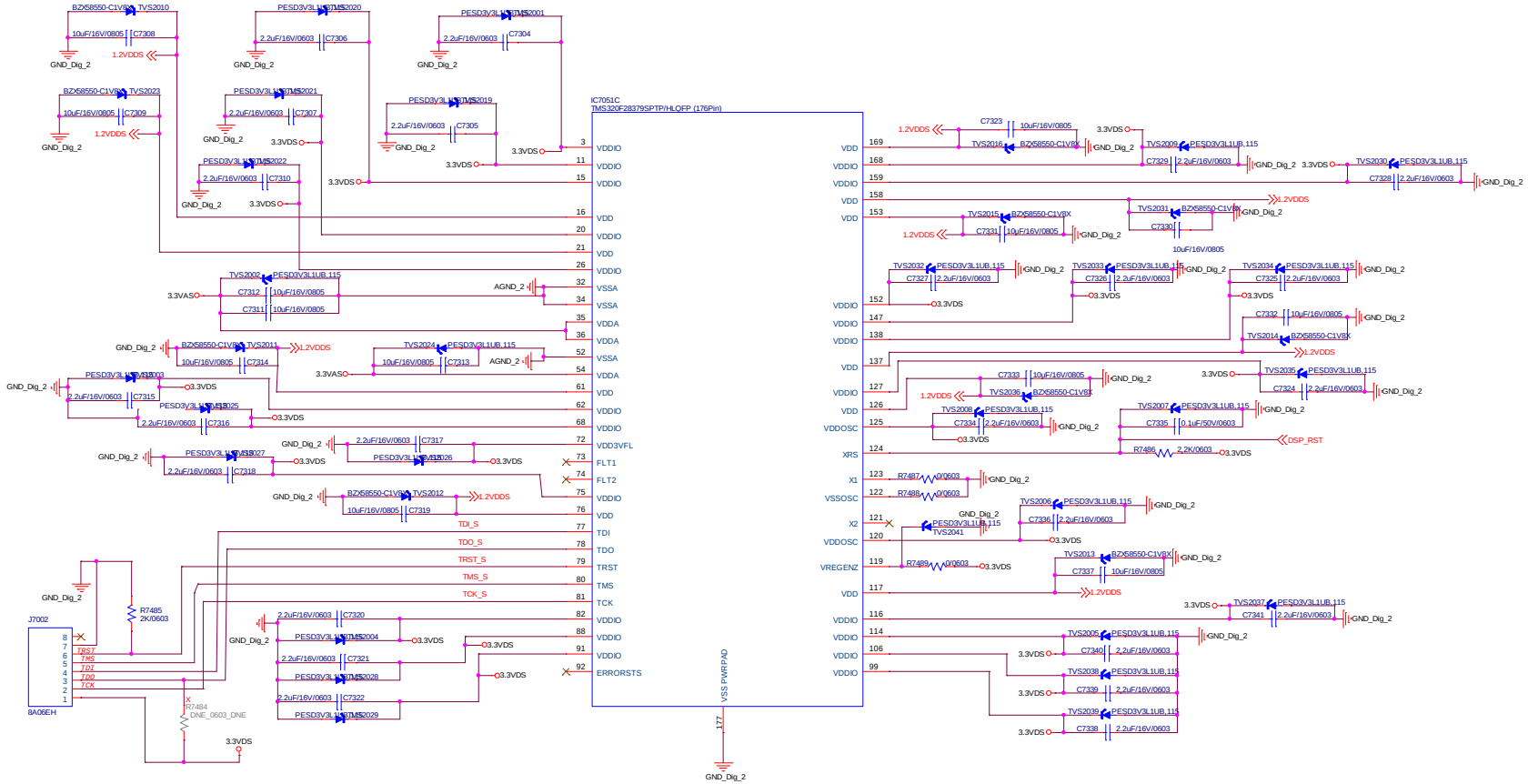
SECONDARY MCU

TMS320F28379S/LQFP176_c



			S7
Title	03 Secondary MCU Power		
Size A2	Document Number		Rev A2
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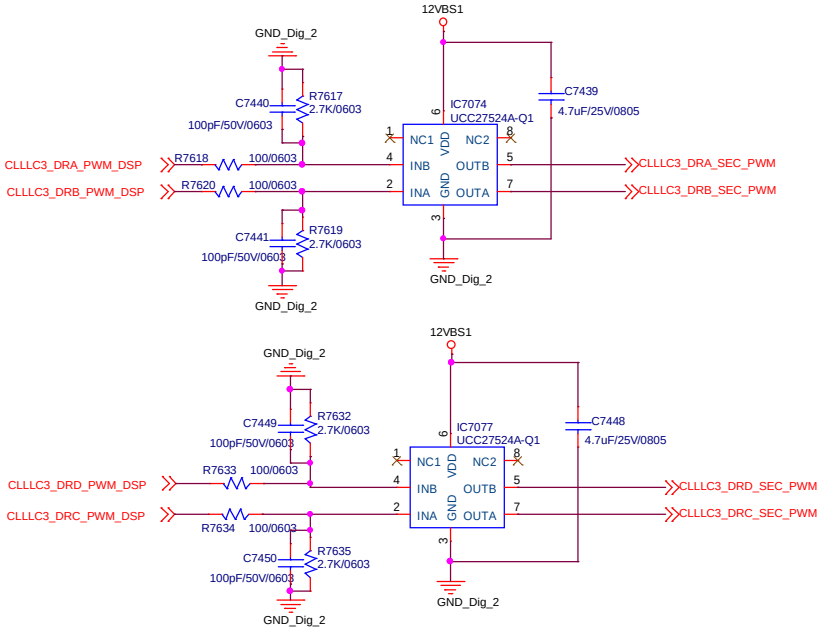
CLLLC_A SEC PWM driver



A2=CN7092

TIN finger

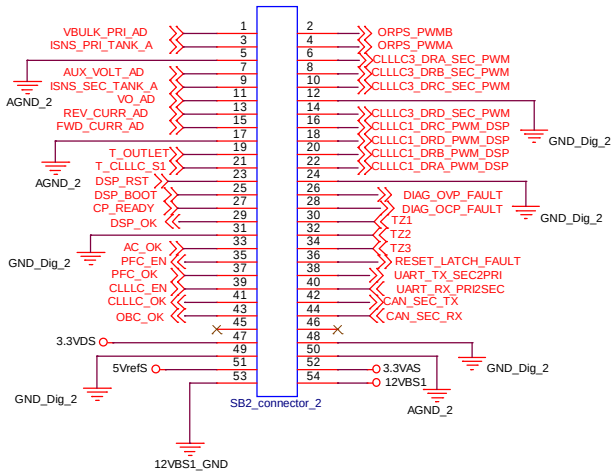
CN7121

Pri_MCU_support

M-B2B-10113-RA-S2_EVPS

A2=SB_CON_2

SB_CON_2A



TO MB

			S7
Title	04 Secondary_12V_DRIVER		
Size A3	Document Number		Rev A2
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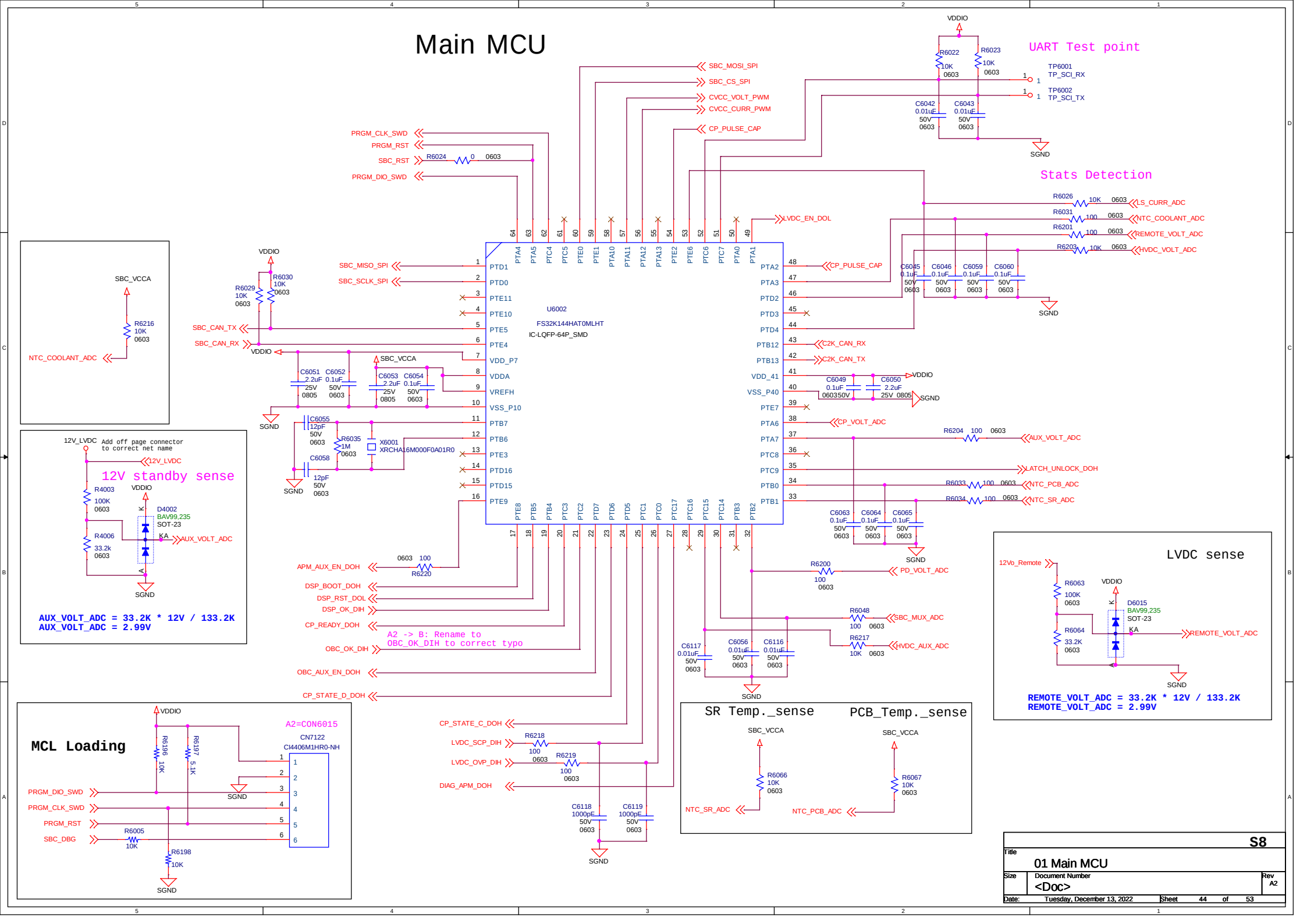
Main MCU



Title	01 Main MCU
Size	
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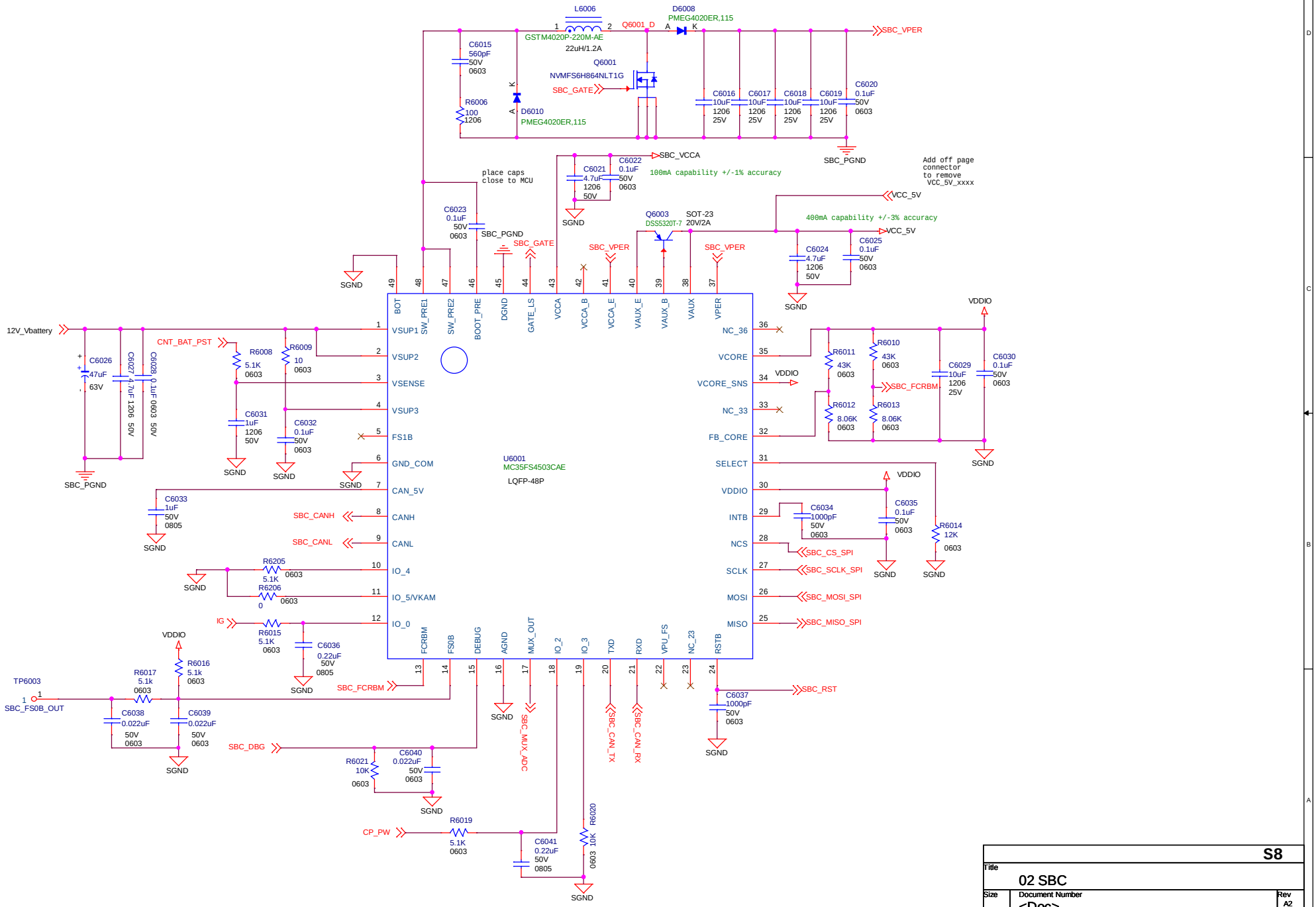
S8


L6006
GSTM4020P-220M-AE
22uH/1.2A
D6008
PMEG4020ER,115
Q6001
NVMFS6H864NLT1G
SBC_GATE
SBC_VPER
C6015
560pF
50V
0603
R6006
100
1206
D6010
PMEG4020ER,115
C6016
10uF
1206
25V
C6017
10uF
1206
25V
C6018
10uF
1206
25V
C6019
10uF
1206
25V
C6020
0.1uF
50V
0603
SBC_PGND
SBC_VCCA
C6021
4.7uF
1206
50V
C6022
0.1uF
50V
0603
100mA capability +/-1% accuracy
place caps
close to MCU
C6023
0.1uF
50V
0603
Add off page
connector
to remove
VCC_5V_xxxx
VCC_5V
Q6003
DSS5320T-7
SOT-23
20V/2A
400mA capability +/-3% accuracy
C6024
4.7uF
1206
50V
C6025
0.1uF
50V
0603
SGND
12V_Vbattery
CNT_BAT_PST
C6026
47uF
63V
C6027
4.7uF 1206 50V
C6028
0.1uF 0603 50V
R6008
5.1K
0603
R6009
10
0603
C6031
1uF
1206
50V
C6032
0.1uF
50V
0603
U6001
MC35FS4503CAE
LQFP-48P
BOT
SW_PRE1
SW_PRE2
BOOT_PRE
DGND
GATE_LS
VCCA
VCCA_B
VCCA_E
VAUX_E
VAUX_B
VAUX
VPER
VSUP1
VSUP2
VSENSE
VSUP3
FS1B
GND_COM
CAN_5V
CANH
CANL
IO_4
IO_5/VKAM
IO_0
NC_36
VCORE
VCORE_SNS
NC_33
FB_CORE
SELECT
VDDIO
INTB
NCS
SCLK
MOSI
MISO
FCRBM
FS0B
DEBUG
AGND
MUX_OUT
IO_2
IO_3
TXD
RXD
VPU_FS
NC_23
RSTB
R6011
43K
0603
R6010
43K
0603
R6012
8.06K
0603
R6013
8.06K
0603
SBC_FCRBM
C6029
10uF
1206
25V
C6030
0.1uF
50V
0603
C6033
1uF
50V
0805
SBC_CANH
SBC_CANL
C6034
1000pF
50V
0603
C6035
0.1uF
50V
0603
R6014
12K
0603
SBC_CS_SPI
SBC_SCLK_SPI
SBC_MOSI_SPI
SBC_MISO_SPI
R6205
5.1K
0603
R6206
0
0603
IG
R6015
5.1K
0603
C6036
0.22uF
50V
0805
TP6003
SBC_FS0B_OUT
R6016
5.1k
0603
R6017
5.1k
0603
C6038
0.022uF
50V
0603
C6039
0.022uF
50V
0603
SBC_RST
C6037
1000pF
50V
0603
SBC_DBG
R6021
10K
0603
C6040
0.022uF
50V
0603
SBC_MUX_ADC
SBC_CAN_TX
SBC_CAN_RX
CP_PW
R6019
5.1K
0603
C6041
0.22uF
50V
0805
R6020
10K
0603
S8
Title
02 SBC
Size
Document Number
<Doc>
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45
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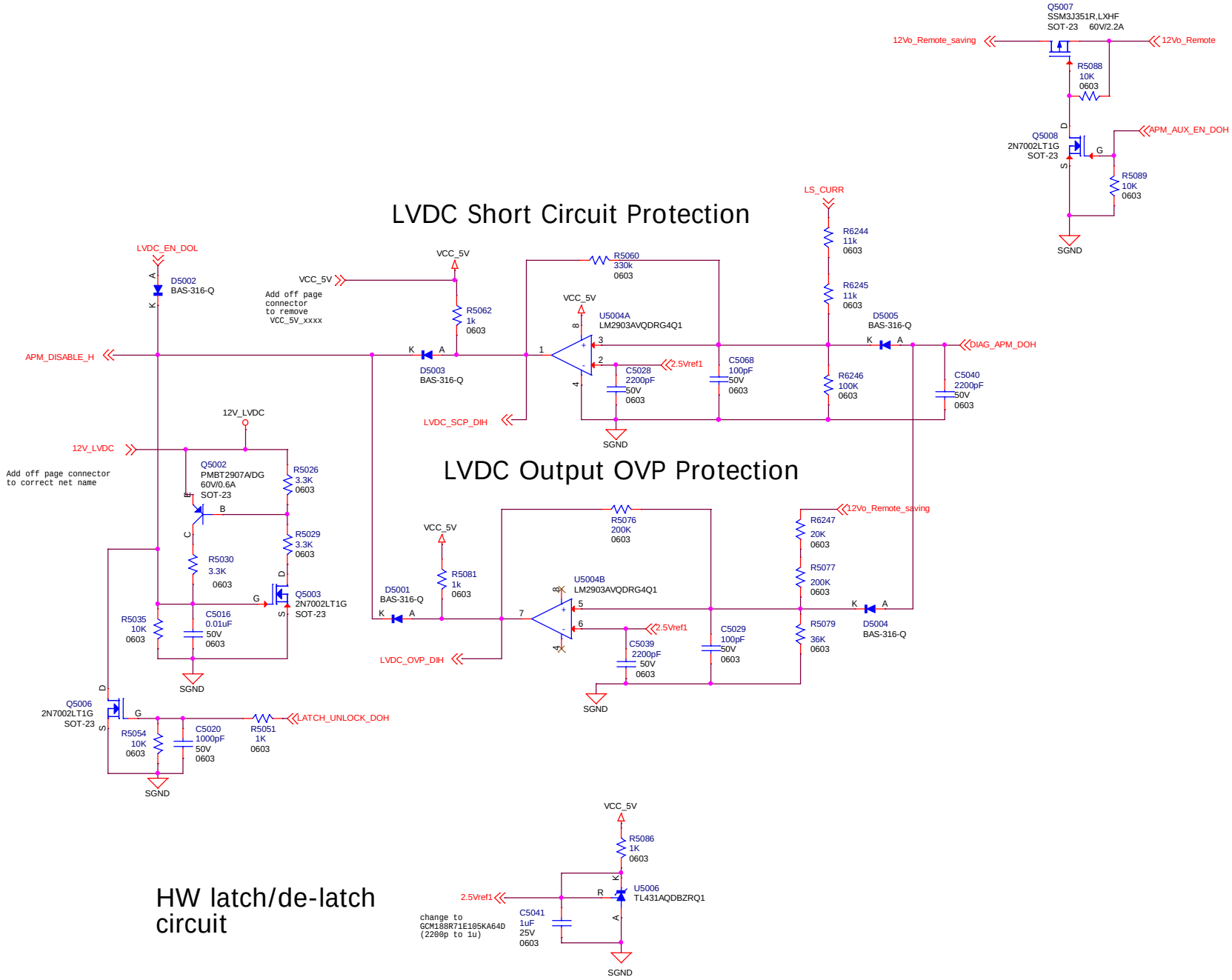

		S8
Title	03 LVDC Protection	
Size	Document Number <Doc>	Rev A2
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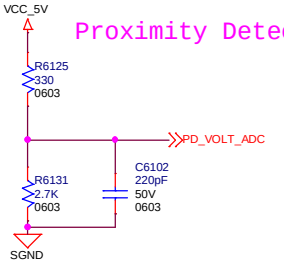
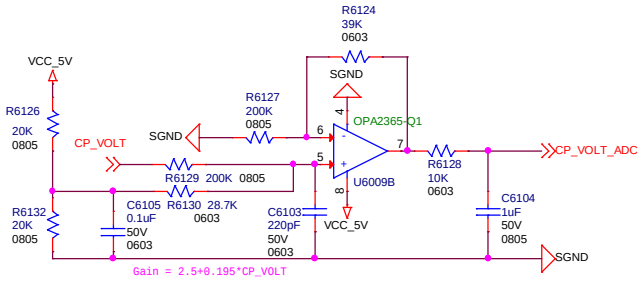
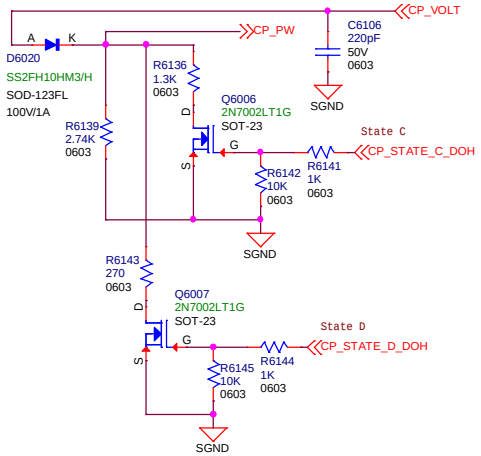
Control Pilot Peak Voltage Measurement

Proximity Detection circuit

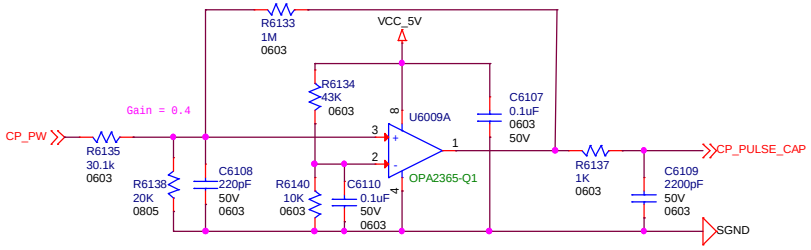




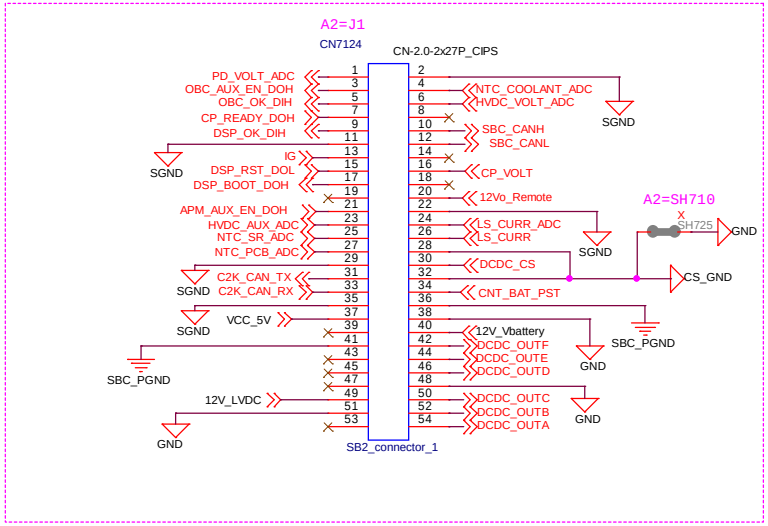
Control pilot circuit

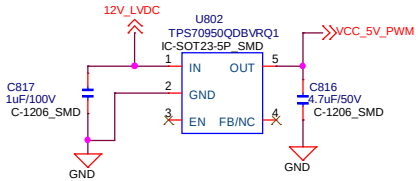


Control Pilot Frequency Measurement



TO APM MAIN BOARD





TIN finger
A2=CN7092
CN7123
Pri_MCU_support
M-B2B-I0113-RA-S2_EVPS

		S8
Title	04 Control Pilot	
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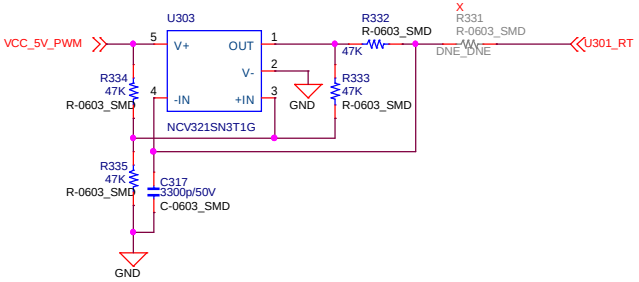
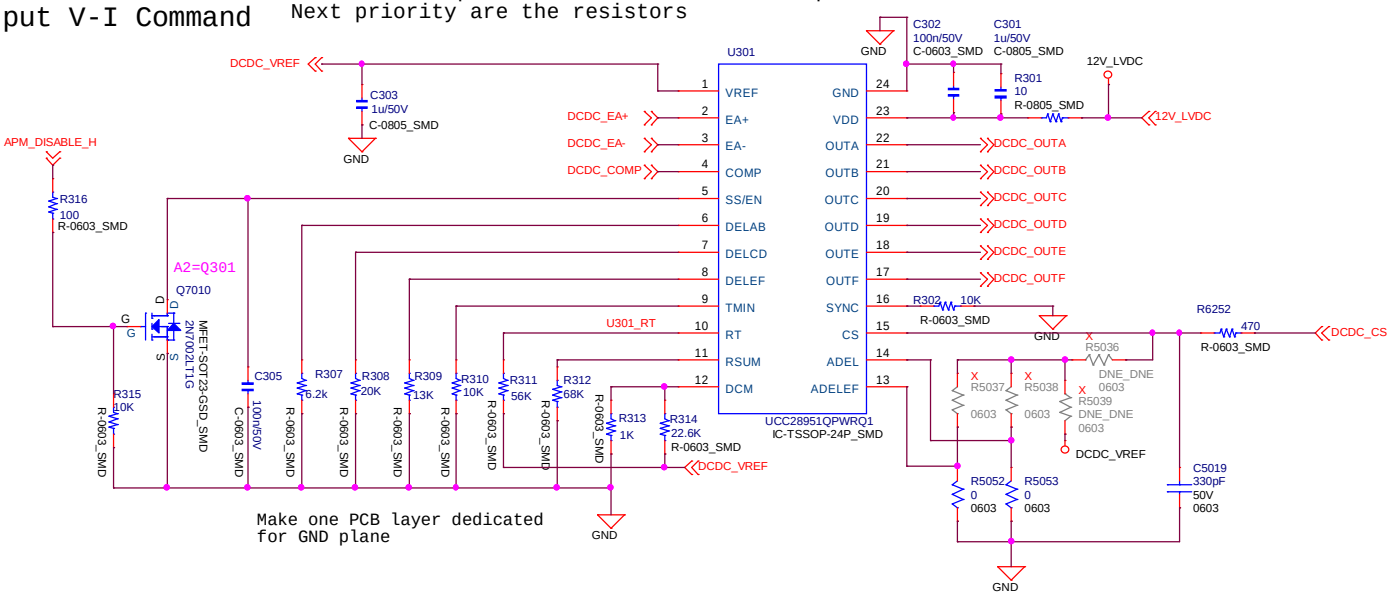
DITHERING

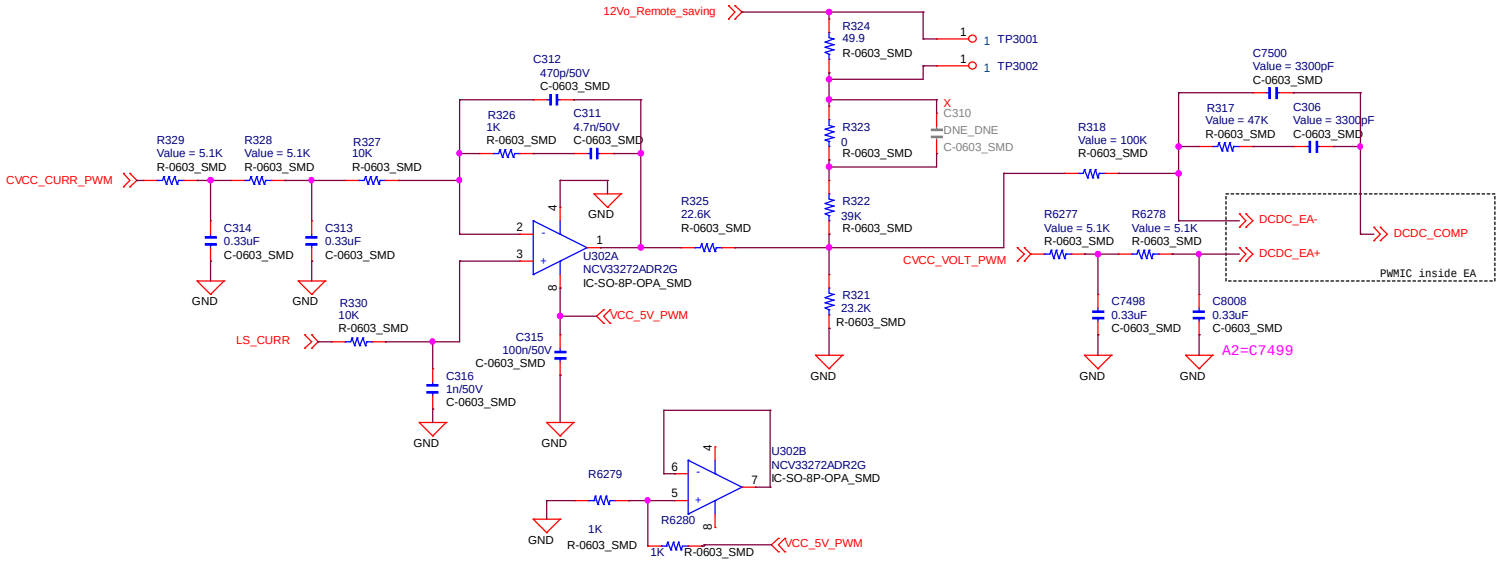


Output V-I Command

Prioritize capacitors to be closed to IC pin
Next priority are the resistors



Make one PCB layer dedicated
for GND plane



IC change to 36V rating
Note: A/B - single package

		S8
Title	05 PSFB PWM IC	
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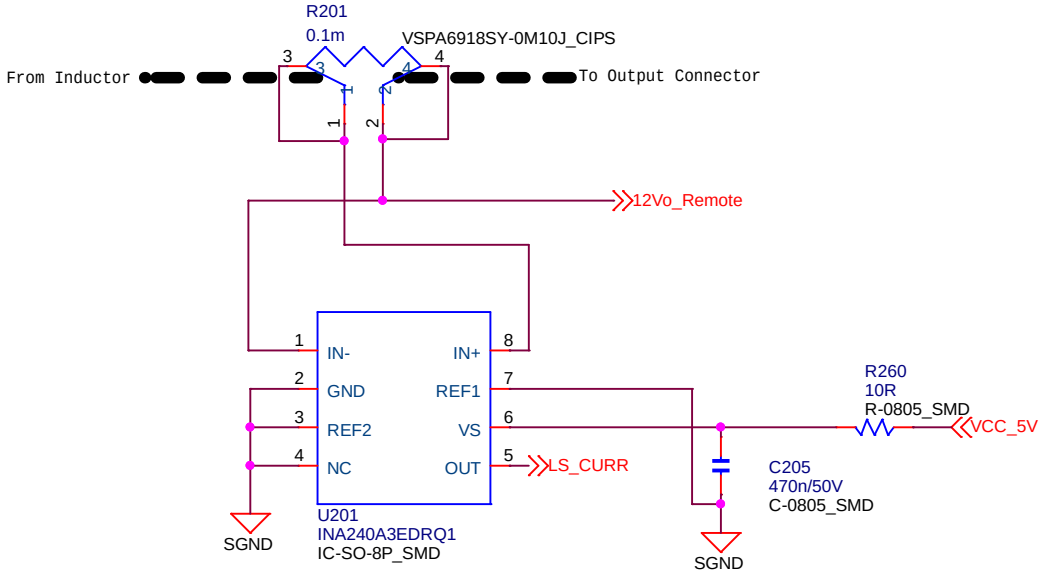
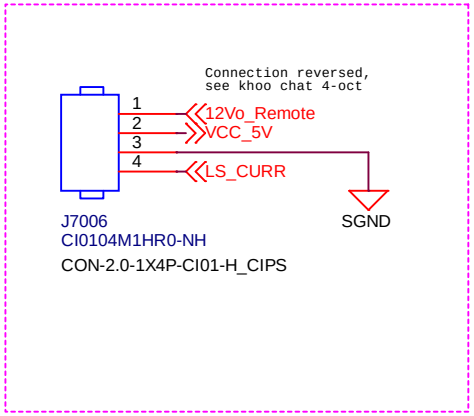
IOUT = 3600/13.8
IOUT = 260.87A
IOUT_OCP = 320A
VOUT (U22) = 320 * (0.1m) * 100V/V = 3.2V



LV Current sensor connector



		S9
Title	01 LV Current Sensor	
Size	Document Number <Doc>	Rev A2
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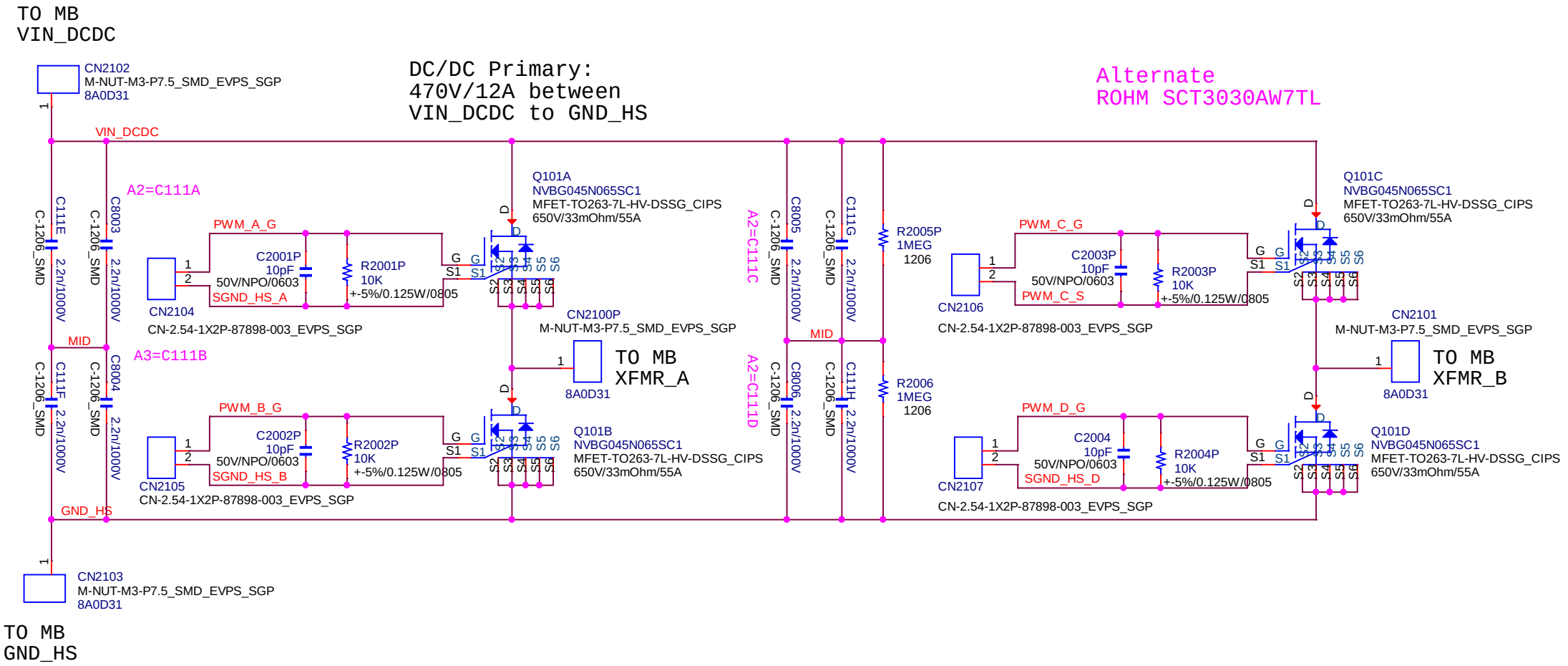
APM PSFB BOARD



		S10
Title	01 APM PSFB Primary	
Size	Document Number	Rev A2
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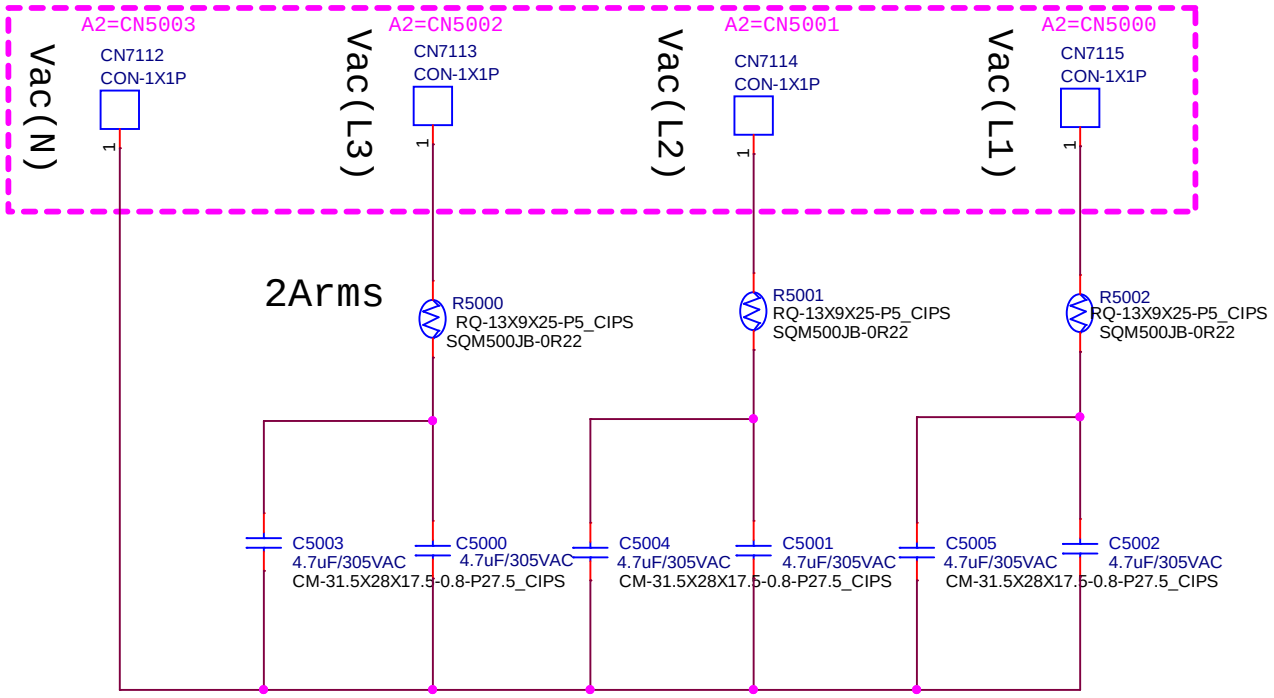
TO PFC CHOKE BOARD (S4)



A2=M6000
M7032
Mounting Hole M4
M4L8 Screw Torx

A2=M6001
M7033
Mounting Hole M4
M4L8 Screw Torx

A2=M6002
M7034
Mounting Hole M4
M4L8 Screw Torx

A2=M6003
M7035
Mounting Hole M4
M4L8 Screw Torx

LITE-ON SINGAPORE		
Title: 01 Grid RC Filter		
Size: A4	Document Number: <Doc>	Rev: A2
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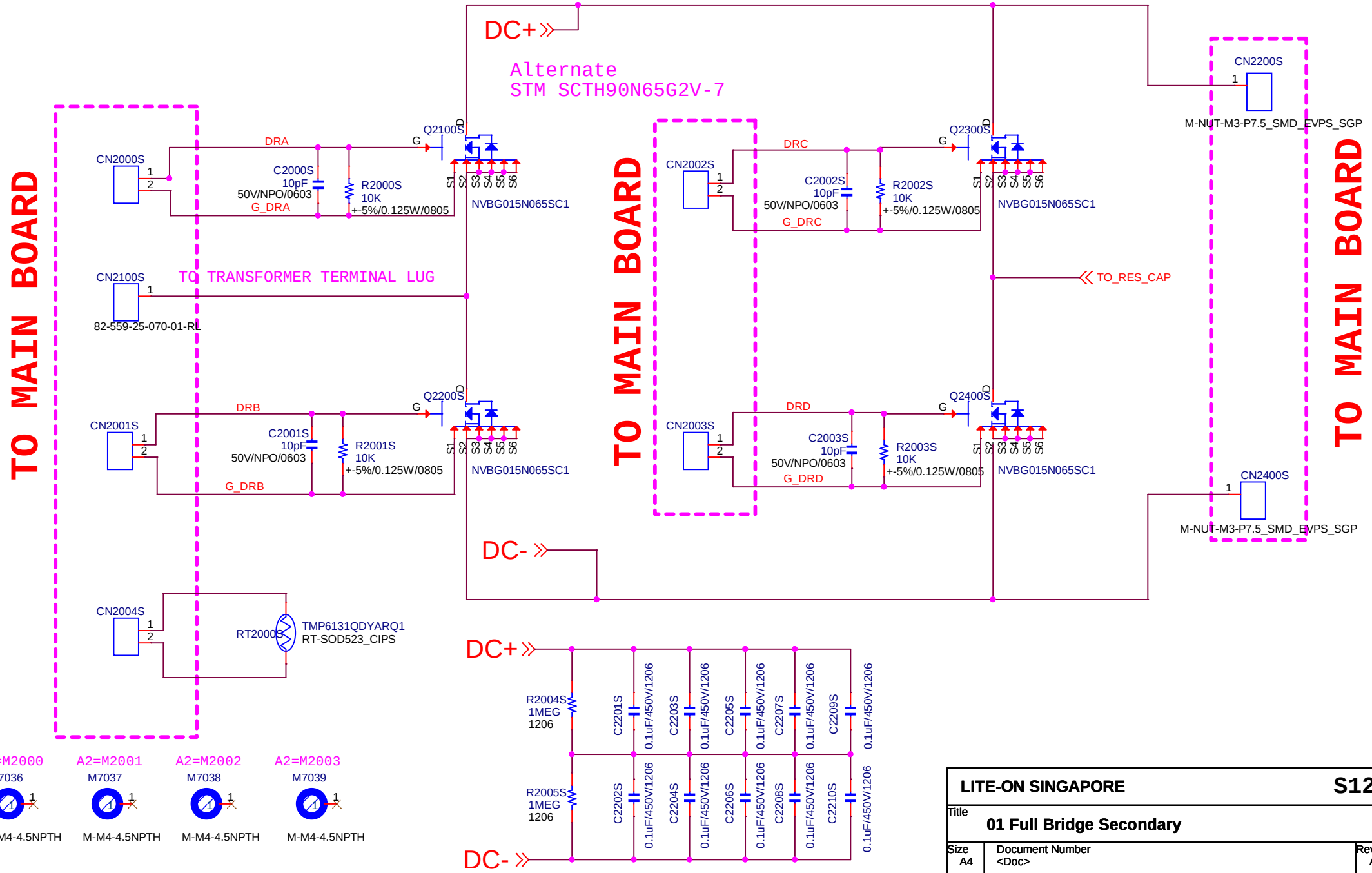
FULL BRIDGE BOARD - SEC (11kW OBC)



LITE-ON SINGAPORE		S12
Title: 01 Full Bridge Secondary		
Size: A4	Document Number: <Doc>	Rev: A2
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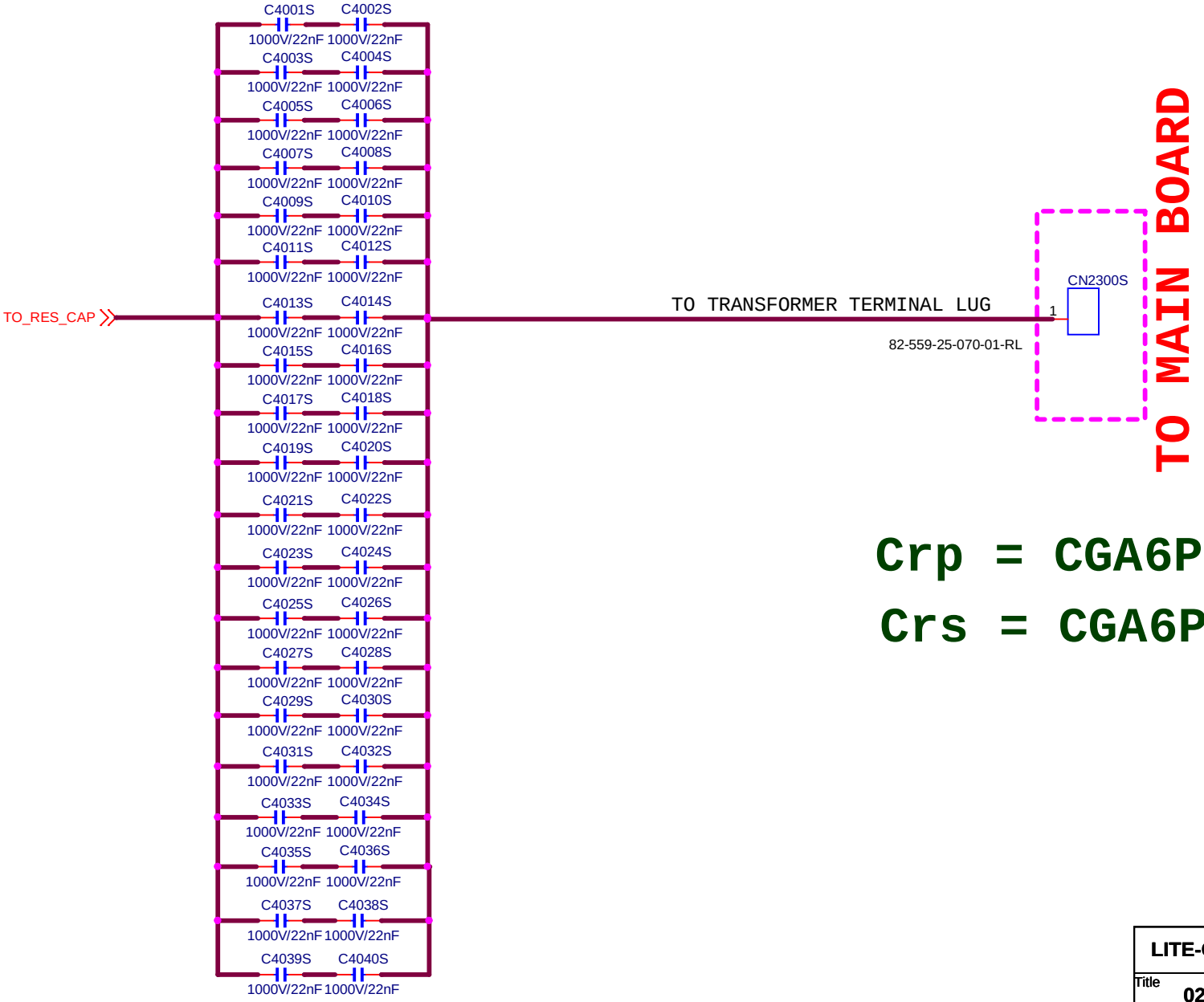
Crp = 135nF = (15nF/2)*18 - 36pc - 2 series, 18 parallel
Crs = 220nF = (22nF/2)*20 - 40pc - 2 series, 20 parallel



Crp = CGA6P1C0G3A153J250AC
Crs = CGA6P1C0G3A223J250AC

LITE-ON SINGAPORE		S12
Title: 02 Res Caps Secondary		
Size: A4	Document Number: <Doc>	Rev: A2
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