IRMD836

iMOTION™ µIPM™

Motor Drive Reference Board For Low Power Applications

Description

IRMD836 is a reference board including a three-phase module for motor drive application. The kit features and demonstrates International Rectifier's intelligent power module (IPM) technology in an innovative PQFN package.

Features

µIPM™ - Intelligent Power Module (IPM)

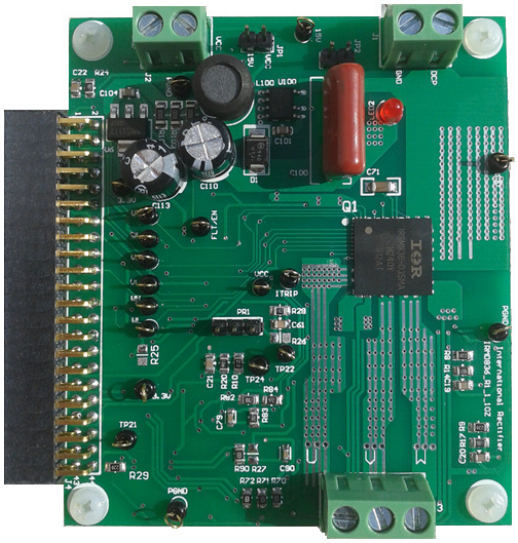
- Low RDS(on) Trench MOSFETs (250V or 500V)
- Integrated gate drivers and bootstrap functionality
- Overcurrent and under-voltage lockout protection
- Fault diagnostic output
- Optimized dV/dt for loss and EMI trade offs
- IPM Isolation 1500VRMS min

Product Summary

- FR4 based 1oz copper two-layer PCB
- 20 – 100W motor power range (Note1)
- Possibility to easy change between 3 Leg shunt to single shunt configuration
- Compatible with the following µIPM modules:

IRSM836-024MA	2A / 2.2Ω, 250V
IRSM836-044MA	4A / 1.1Ω, 250V
IRSM836-025MA	2A / 4Ω, 500V
IRSM836-035MA	3A / 2.2Ω, 500V

Note1: Determined by rating of mounted µIPM



70 x 87mm

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Safety Precautions

In addition to the precautions listed throughout this manual, please read and understand the following statements regarding hazards associated with development system.



ATTENTION: The **ground potential** of the IRMD836 system is biased to a negative DC bus voltage potential. When measuring voltage waveform by oscilloscope, the scope ground needs to be isolated. Failure to do so may result in personal injury or death. Darkened display LEDs is not an indication that capacitors have discharged to safe voltage levels.



ATTENTION: Only personnel familiar with the drive and associated machinery should plan or implement the installation, start-up, and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.



ATTENTION: The surface temperatures of the drive may become hot, which may cause injury.



ATTENTION: IRMD836 system contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference applicable ESD protection handbook and guideline.



ATTENTION: An incorrectly applied or installed drive can result in component damage or reduction in product life. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.

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ATTENTION: Remove and lock out power from the drive before you disconnect or reconnect wires or perform service. Wait three minutes after removing power to discharge the bus voltage. Do not attempt to service the drive until bus voltage has discharged to zero. Failure to do so may result in bodily injury or death.



ATTENTION: Do not connect power factor correction capacitors to output terminals U, V, and W. Doing so may result in equipment damage or bodily injury.

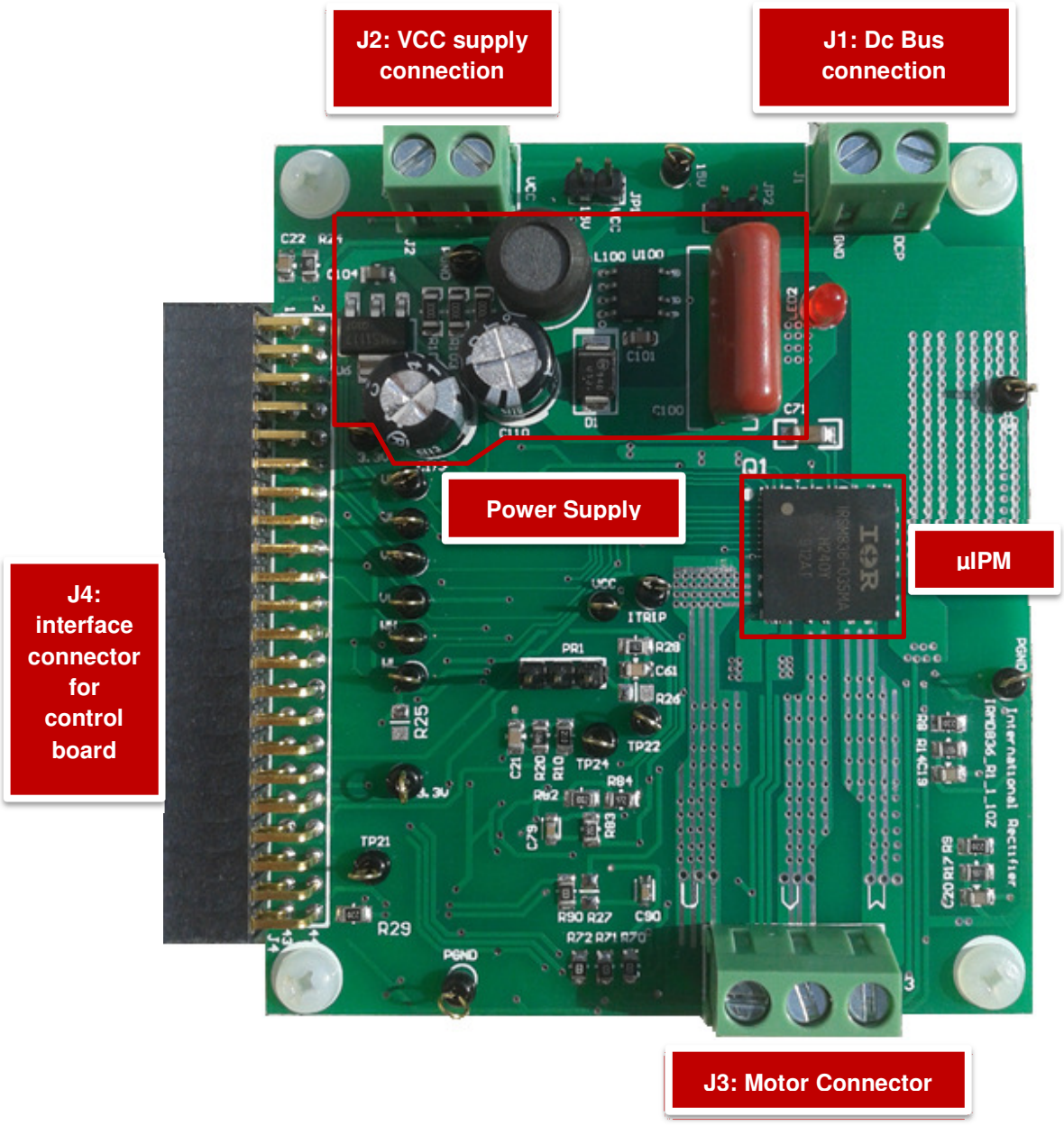


ATTENTION: Debris When Unpacking
IRMD836 system is shipped with packing materials that need to be removed prior to installation. Failure to remove all debris and packing materials which are unnecessary for system installation may result in overheating or abnormal operating condition.

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Hardware Description

A top view of the IRMD836 board is shown below.



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PCB

The 70 x 80mm board has two layers with 1oz (~35µm) copper each.

Isolation Boundary

Note that the ground potential of the IRMD836 system is biased to a negative DC bus voltage potential. The user should keep in mind that most parts of the hardware have negative DC bus ground and it may be necessary to isolate the scope when waveforms are measured. Refer to the IRMD836 schematics for more information.

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Connector definition

J1 – Dc Bus connection

Pin	Name	Description
1	GND	Connected to ground
2	DCP	Connected to Dc Bus positive voltage

J2 – Vcc supply connection

Pin	Name	Description
1	VCC	Connected to positive supply voltage to feed the uIPM – use only removing jumper JP1 (Note2)
2	GND	Connected to ground

Note2: in order to feed the uIPMs with the 15V supply generated on the board, pins 1 and 2 of jumper JP1 must be shorted and no external supply has to be connected to Vcc

J3 – Motor connector

Pin	Name	Description
U	Phase U voltage	Connected to motor phase U
V	Phase V voltage	Connected to motor phase V
W	Phase W voltage	Connected to motor phase W

J4 – Interface connector for control board

Pin	Name	Description
1	PWMUH	PWM input signal for phase U high side Mosfet, active high
2	GND	Ground
2	PWMUL	PWM input signal for phase U low side Mosfet, active high
4	GND	Ground

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5	PWMVH	PWM input signal for phase V high side Mosfet, active high
6	3.3V	On board 3.3V supply
7	PWMVL	PWM input signal for phase V low side Mosfet, active high
8	3.3V	On board 3.3V supply
9	PWMWH	PWM input signal for phase W high side Mosfet, active high
10	I_U	Leg U shunt voltage in 3 leg shunt configuration / shunt voltage in single shunt configuration
11	PWMW	PWM input signal for phase W low side Mosfet, active high
12	GND	Ground
13	FLT/EN	Input/Output signal – active low
14	DCPCONN	DcBus positive voltage, available on Pin14 only if jumper JP2 is inserted (Note3)
15	GND	Ground
16	N.C.	Not Connected
17	N.C.	Not Connected
18	GND	Ground
19	N.C.	Not Connected
20	DCP_FB	DcBus positive voltage, scaled in 0-3.3V range by a voltage divider
21	N.C.	Not Connected
22	N.C.	Not Connected
23	GND	Ground
24	3.3V	On board 3.3V supply
25	N.C.	Not Connected
26	GND	Ground

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27	N.C.	Not Connected
28	GND	Ground
29	V TRIP	Current comparator input signal for I_TRIP generation
30	GND	Ground
31	ITRIP	Input signal from current comparator – active high
32	N.C.	Not Connected
33	USENSE	Phase U voltage value scaled in 0-3.3V range by a voltage divider
34	VSENSE	Phase V voltage value scaled in 0-3.3V range by a voltage divider
35	WSENSE	Phase W voltage value scaled in 0-3.3V range by a voltage divider
36	3.3V	On board 3.3V supply
37	I_V	Leg V shunt voltage in 3 leg shunt configuration
38	GND	Ground
39	N.C.	Not Connected
40	GND	Ground
41	I_W	Leg W shunt voltage in 3 leg shunt configuration
42	GND	Ground
43	COMP_OUT	Comparator output for phase current shaping
44	DIG_VTH	Digital input signal for threshold generation on current shaping comparator

Note3: in order to have the DC bus positive voltage on Pin14, pins 1 and 2 of jumper JP2 must be shorted. Please consider this is a high voltage pin (up to 250V/500V, depending on rating of mounted uIPM

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Specifications

Parameters	Values	Conditions
Output Power		
Watts (Note4)	90W 100W 60W 95W	IRSM836-025MA IRSM836-035MA IRMS836-024MA IRMS836-044MA
Current (Note4)	360mA* 420mA* 470mA* 750mA*	IRSM836-025MA IRSM836-035MA IRMS836-024MA IRMS836-044MA
		*rms, Fc=16kHz, 2-phase PWM, ΔTca=70C, Ta=25C
DC bus voltage		
Maximum DC bus voltage	400V 200V	With 500V modules mounted With 250V modules mounted
Minimum DC bus voltage	40V**	**Only if on board generated 15V supply is used.
Current feedback		
Current sensing device RS1,RS2,RS3	0.5 Ω	Three leg shunt configuration is set. To implement single shunt, RS2 and RS3 has to be removed, while R99 and R98 resistors (0 Ω) has to be inserted
Protection		
Output current trip level	1.2Apk	Configure by changing shunt resistors, R82 and/or R83 as indicated on schematics
Critical over voltage trip	380V	
Over voltage trip	360V	
Under voltage trip	120V	
Power Device		
IRSM836-0xyMA	36L µIPM	x = DC current rating y = 4 for 250V, y = 5 for 500V
On board power supply		
15V	15V+/-5%, Max 20mA	Used for µIPM gate drive power
3.3V	3.3V+/-5%, Max 50mA	Used for interface signal with control board and alarm signals as I_TRIP, FLT/EN
PCB		
Material	FR4, 1.6mm thickness Copper thickness=1oz (35um)	
Dimension	70mm x 80mm	
System environment		
Ambient temperature	0 to 70°C	95% RH max. (Non-condensing)

Note4: please refer to IRSM836_xyMA datasheet for data about maximum current and power, changing Fc, modulation, ΔTca, use of a heat sink.

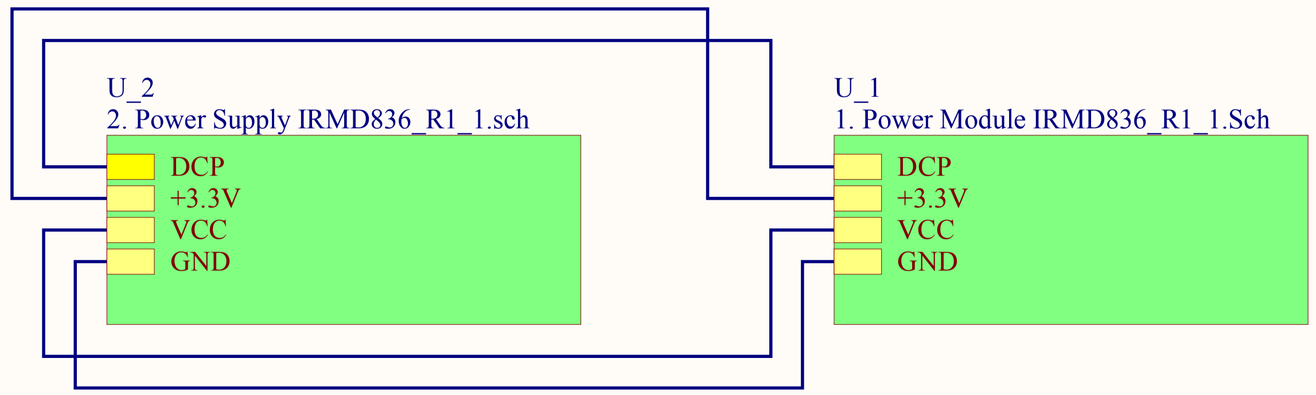
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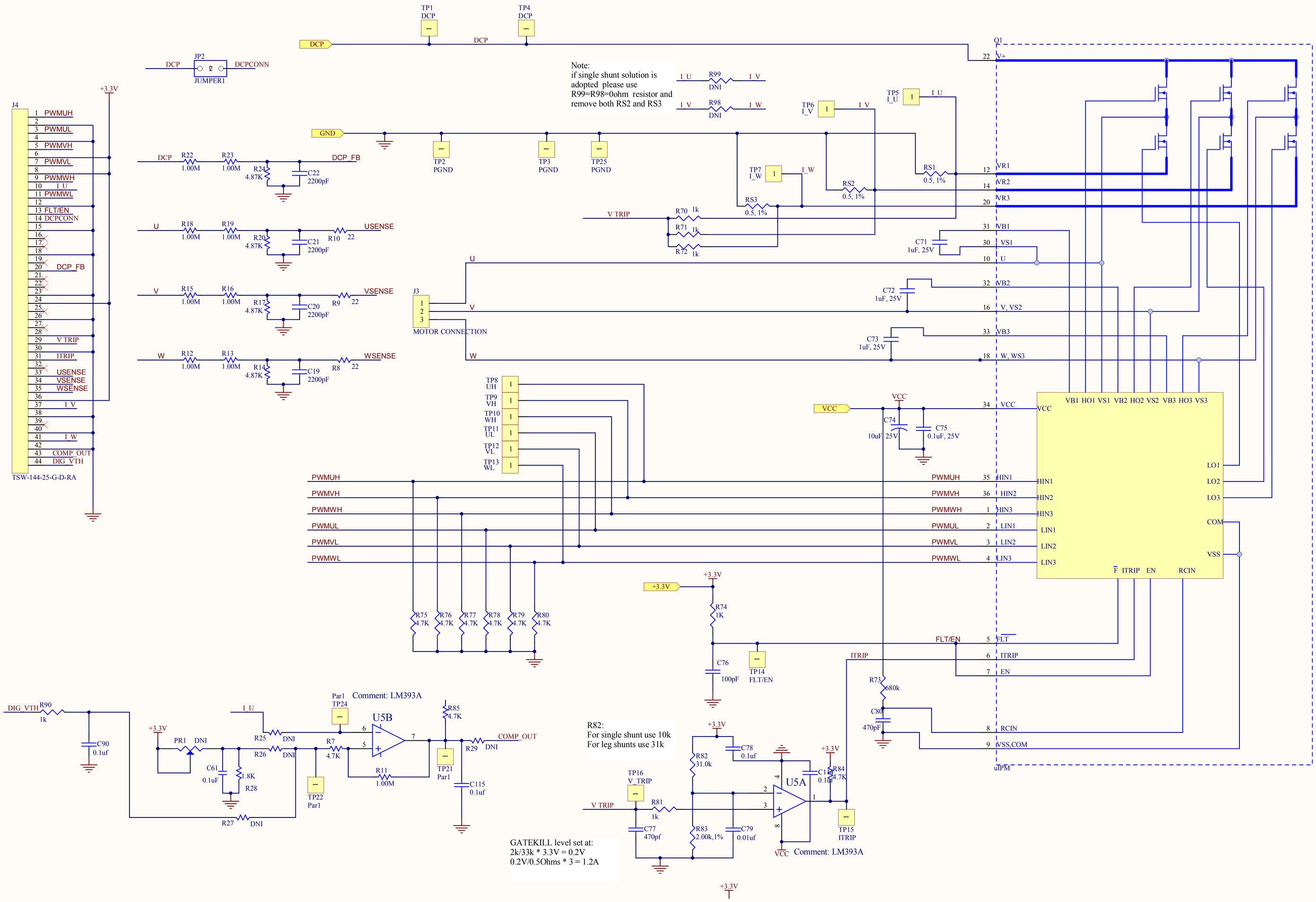
Revision History

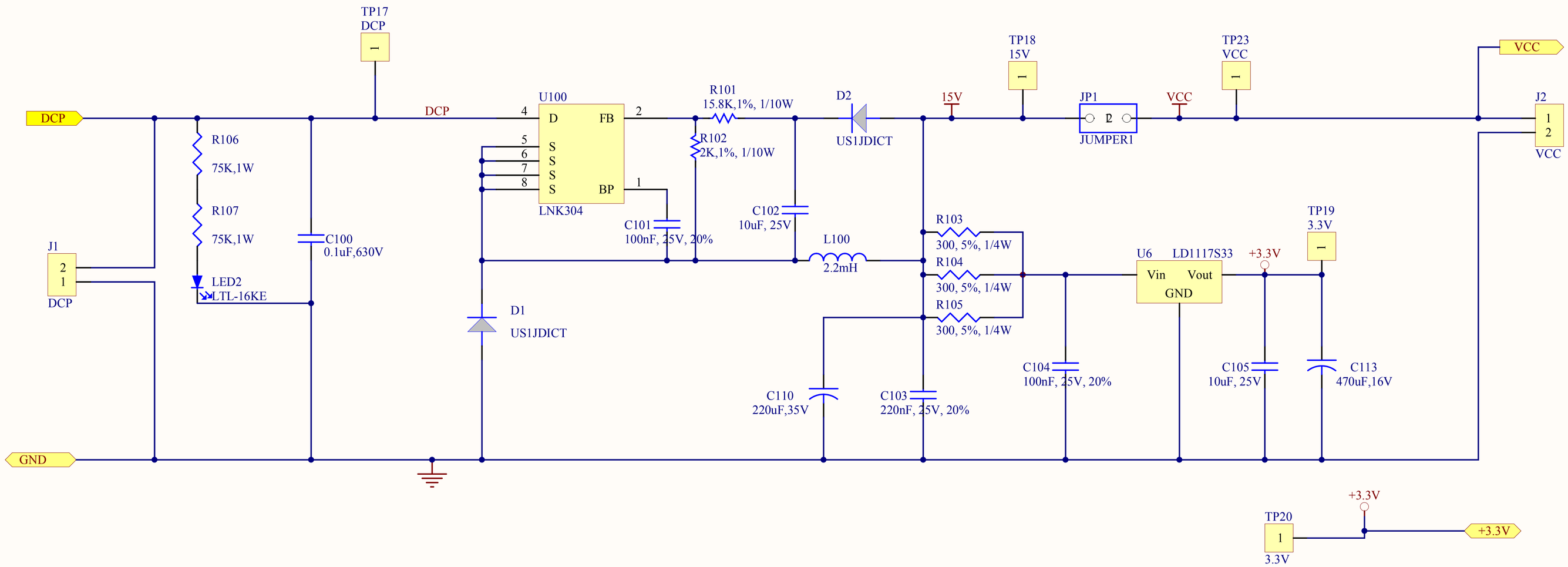
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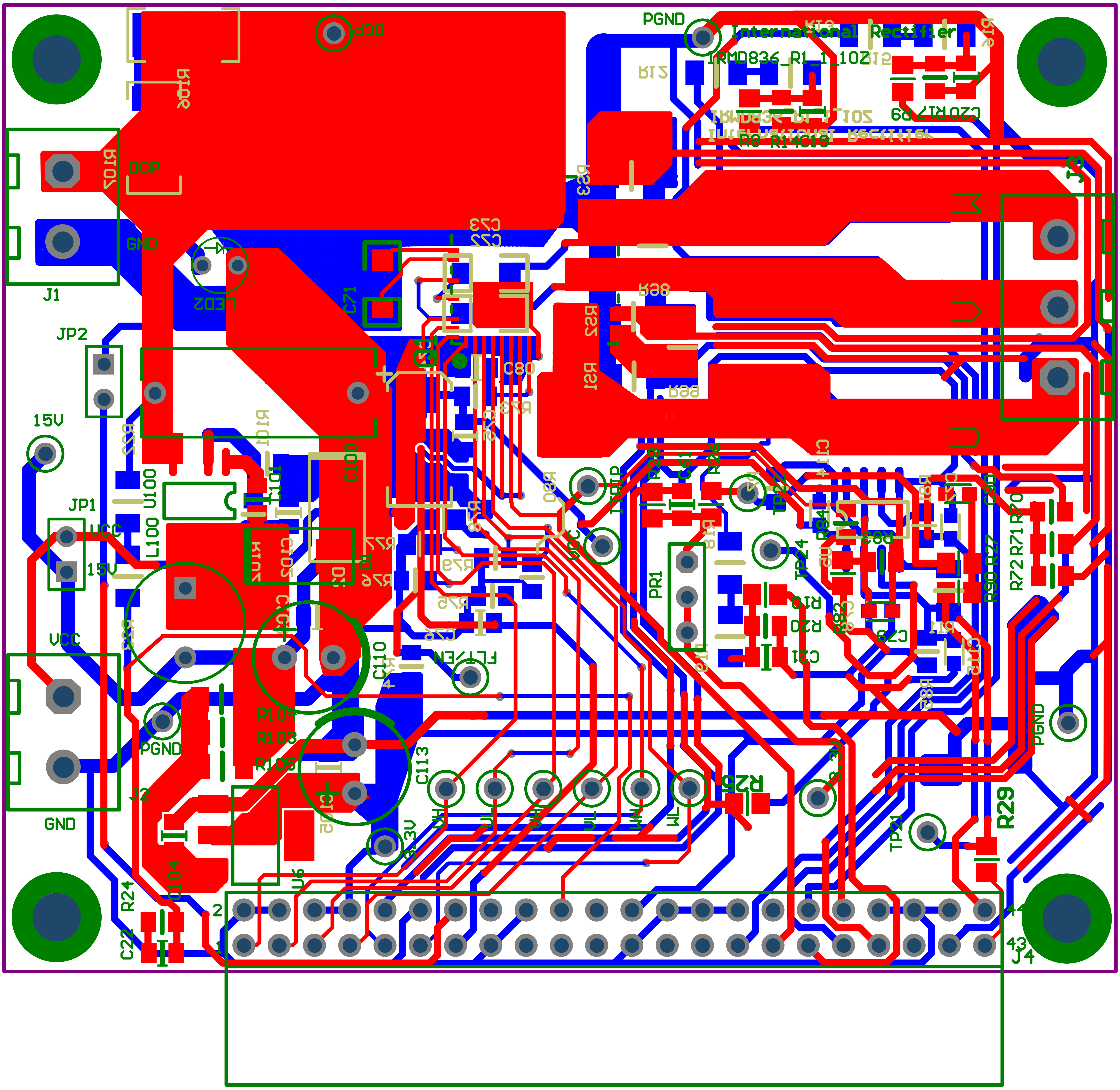
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U_2
2. Power Supply IRMD836_R1_1.sch
DCP
+3.3V
VCC
GND
U_1
1. Power Module IRMD836_R1_1.Sch
DCP
+3.3V
VCC
GND


J4
1 PWMUH
3 PWMUL
5 PWMVH
7 PWMVL
9 PWMWH
10 I_U
11 PWMWL
13 FLT/EN
14 DCPCONN
20 DCP_FB
29 V TRIP
31 ITRIP
33 USENSE
34 VSENSE
35 WSENSE
37 I_V
41 I_W
43 COMP_OUT
44 DIG_VTH
TSW-144-25-G-D-RA
+3.3V
JP2
DCP
DCPCONN
JUMPER1
TP1 DCP
TP4 DCP
GND
TP2 PGND
TP3 PGND
TP25 PGND
Note:
if single shunt solution is adopted please use R99=R98=0ohm resistor and remove both RS2 and RS3
I_U R99 I_V DNI
I_V R98 I_W DNI
TP6 I_V
TP5 I_U
TP7 I_W
RS1 0.5, 1%
RS2 0.5, 1%
RS3 0.5, 1%
V TRIP
R70 1k
R71 1k
R72 1k
C71 1uF, 25V
C72 1uF, 25V
C73 1uF, 25V
J3
MOTOR CONNECTION
U
V
W
DCP R22 1.00M R23 1.00M R24 4.87K C22 2200pF DCP_FB
U R18 1.00M R19 1.00M R20 4.87K C21 2200pF R10 22 USENSE
V R15 1.00M R16 1.00M R17 4.87K C20 2200pF R9 22 VSENSE
W R12 1.00M R13 1.00M R14 4.87K C19 2200pF R8 22 WSENSE
TP8 UH
TP9 VH
TP10 WH
TP11 UL
TP12 VL
TP13 WL
PWMUH
PWMVH
PWMWH
PWMUL
PWMVL
PWMWL
R75 4.7K
R76 4.7K
R77 4.7K
R78 4.7K
R79 4.7K
R80 4.7K
Q1
22 V+
12 VR1
14 VR2
20 VR3
31 VB1
30 VS1
10 U
32 VB2
16 V, VS2
33 VB3
18 W, WS3
34 VCC
35 HIN1
36 HIN2
1 HIN3
2 LIN1
3 LIN2
4 LIN3
5 FLT
6 ITRIP
7 EN
8 RCIN
9 VSS,COM
VB1 HO1 VS1 VB2 HO2 VS2 VB3 HO3 VS3
LO1
LO2
LO3
COM
VSS
F ITRIP EN RCIN
uIPM
VCC
C74 10uF 25V
C75 0.1uF, 25V
+3.3V
R74 1K
C76 100pF
TP14 FLT/EN
FLT/EN
ITRIP
R73 680k
C80 470pF
DIG_VTH R90 1k
C90 0.1uf
Par1 TP24
Comment: LM393A
U5B
R85 4.7K
COMP_OUT
R29 DNI
TP21 Par1
C115 0.1uf
I_U
R25 DNI
R26 DNI
R7 4.7K
R11 1.00M
PR1 DNI
C61 0.1uF
R28 1.8K
TP22 Par1
R27 DNI
R82: For single shunt use 10k For leg shunts use 31k
TP16 V_TRIP
R81 1k
C77 470pf
R82 31.0k
R83 2.00k,1%
C79 0.01uf
C78 0.1uf
U5A
C81 0.1uf
R84 4.7K
TP15 ITRIP
Comment: LM393A
GATEKILL level set at:
2k/33k * 3.3V = 0.2V
0.2V/0.5Ohms * 3 = 1.2A


TP17
DCP
DCP
U100
D
FB
S
S
S
S
BP
LNK304
R101
15.8K,1%, 1/10W
R102
2K,1%, 1/10W
C101
100nF, 25V, 20%
D2
US1JDICT
15V
TP18
15V
JP1
JUMPER1
VCC
TP23
VCC
VCC
J2
VCC
R106
75K,1W
R107
75K,1W
LED2
LTL-16KE
C100
0.1uF,630V
J1
DCP
C102
10uF, 25V
L100
2.2mH
R103
300, 5%, 1/4W
R104
300, 5%, 1/4W
R105
300, 5%, 1/4W
U6
LD1117S33
Vin
Vout
GND
+3.3V
TP19
3.3V
D1
US1JDICT
C110
220uF,35V
C103
220nF, 25V, 20%
C104
100nF, 25V, 20%
C105
10uF, 25V
C113
470uF,16V
GND
TP20
3.3V
+3.3V
+3.3V


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IRMD836_R1_1_10Z
PGND
DCP
GND
J1
JP2
15V
JP1
VCC
J2
LED2
C71
C80
R29
R25
TP21
TP22
TP24
PR1
ITRIP
FLT/EN
3.3V
UH
UL
VH
VL
WH
WL
J3
J4
U100
L100
C100
C101
C102
C104
C110
C113
C22
R24
R104
R103
R105
U6
C61
R28
R26
R10
R20
C21
C29
R84
R27
R90
R70
R71
R72
C90
R8
R14
C19
C20
R17
R9
1
2
43
44