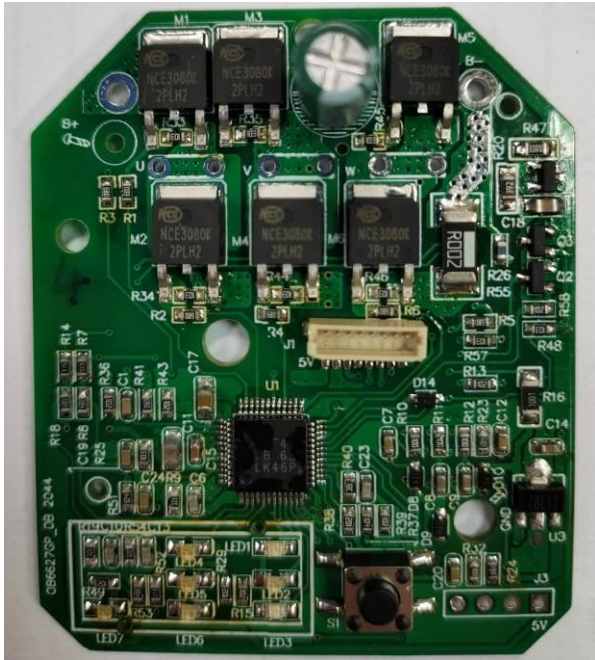


Subject
OB6627L Demo Board Manual

Board Model: OB6627GP_DB 2044
Doc. No.: OB_DOC_DBM_C_6627L01



Key Feature:

- Single chip BLDC controller solution
- High integration of MCU, pre-driver, high speed rail-to-rail operation amplifier, high precision LDO, current protection comparator.
- Six-step BLDC control
- Forward/Reverse selection
- 20% duty start, and motor fast stop
- Automatic power off with time delay
- MOSFET temperature sensing and thermal protection.
- Two levels battery under voltage protection
- Battery residual capacity display
- PCB size small, and assemble conveniently

Revision history:

Revise Date	Version	Reason/Issue
2020-12-04	00	First Issue
2021-01-13	01	Updated BOM list, Schematic

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1. System Electrical Specification

1.1 Input Characteristic

- DC input voltage rating 5 cells Li-Iron battery of 3.7V
- DC input voltage 14V to 25V
- Handle working voltage 0 to 5V

1.2 System parameters

- PWM frequency 20KHz
- MCU supply voltage $5V \pm 2\%$
- 5V supply current 100mA
- Current sampling resistance $2m\Omega$
- Current sampling amplification 16
- Current sampling amplifier offset Self-calibration
- Gate driver supply voltage Battery voltage 18V @ 5 cells battery
- Max of MOSFET drain source voltage value 32.88V
- MOSFET thermal sensor precision 1%

1.3 Output characteristic

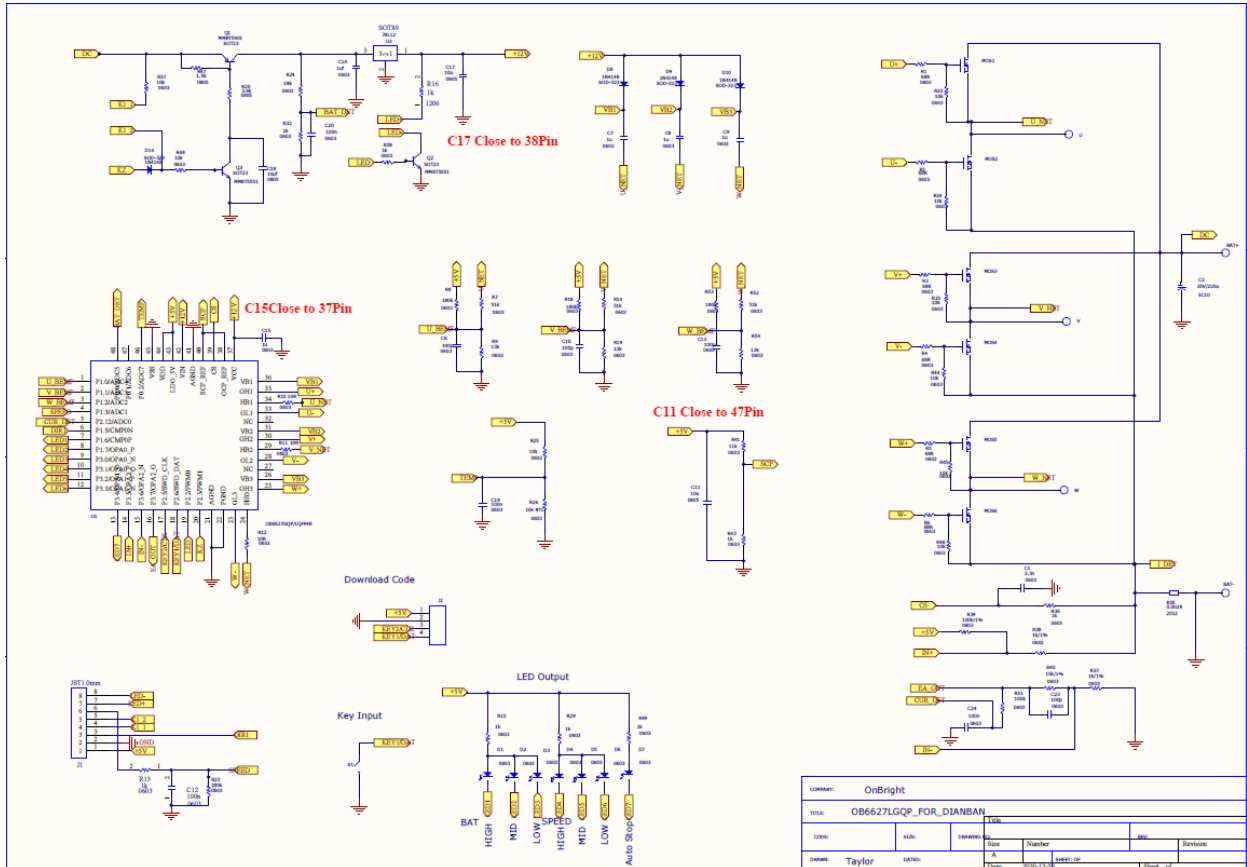
- Phase current limitation 70A
- Forward bus current 25A
- Reverse bus current 25A
- Maximum of PWM duty 100%
- Minimum of PWM duty 20%

1.4 Environmental

- Operating Ambient Temperature -20°C to 60°C
- Storage Temperature -40°C to 100°C
- Storage Humidity 0% to 95% R.H.

2. Board Information

2.1 Schematic

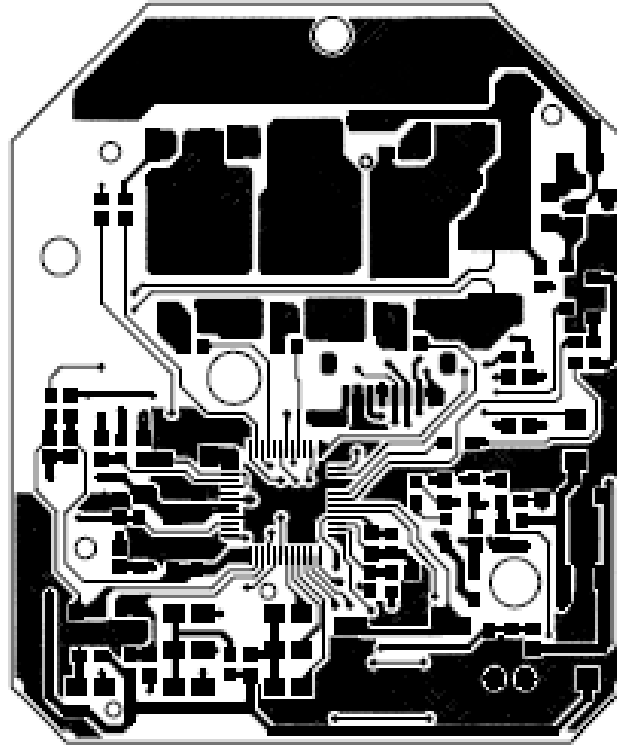


2.2 Bill of material

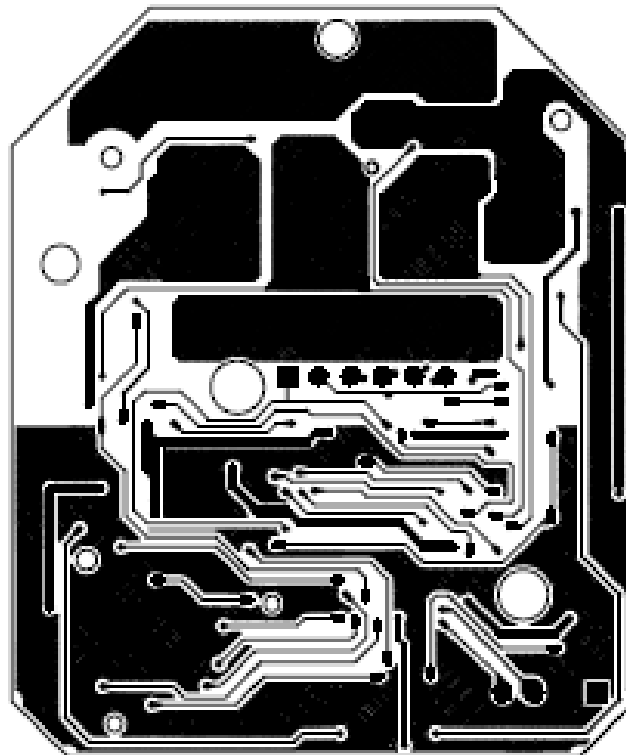
Position	Description	Package	QTY
C2	Capacitor,aluminum electrolytic,220uf/35V,-40/105°C	EC8	1
C1	Capacitor,ceramic,3.3nf/25V,X7R,10%	0603	1
C12,C19,C20,C24	Capacitor,ceramic,100nf/25V,X7R,10%	0603	4
C6,C10,C13,C23	Capacitor,ceramic,100pf/25V,X7R,10%	0603	4
C7,C8,C9,C14,C15	Capacitor,ceramic,1uf/25V,X7R,10%	0603	5
C11,C17,C18	Capacitor,ceramic,10uf/25V,X7R,10%	0805	3
D8,D9,D10,D14	1N4148	SOD323	4
D1,D2,D3,D4,D6,D7	LED,Green	0603	6
MOS1,MOS2,MOS3,MOS4,MOS5,MOS6	Power MOS,NCE3080K (30V 80A)	TO252	6
Q1	PNP,MMBT5401	SOT23	1
Q2,Q3	NPN,MMBT5551	SOT23	2
U1	OB6627LGQP	LQFP48	1
U3	78L12	SOT89	1
R32	Resistor,chip,2k,1%	0603	1
R24	Resistor,chip,18k,1%	0603	1
R39	Resistor,chip,100k,1%	0603	1
R40	Resistor,chip,15k,1%	0603	1
R37,R38	Resistor,chip,1k,1%	0603	2
R8,R18,R23,R53	Resistor,chip,180k,1%	0603	4
R7,R14,R52	Resistor,chip,51k,1%	0603	3
R9,R19,R54	Resistor,chip,13k,1%	0603	3
R10,R11,R12	Resistor,chip,10R,5%	0603	3
R1,R2,R3,R4,R5,R6	Resistor,chip,68R,5%	0603	6
R25,R33,R34,R35,R44,R45,R46,R48,R57	Resistor,chip,10k,5%	0603	9
R41	Resistor,chip,11k,5%	0603	1
R13,R15,R29,R36,R43,R49,R58	Resistor,chip,1k,5%	0603	7
R51	Resistor,chip,100k,5%	0603	1
R26	10k,NTC,3950	0603	1
R47	Resistor,chip,1.5k,5%	0805	1
R20	Resistor,chip,3.9k,5%	0805	1
R16	Resistor,chip,1k,5%	1206	1
R55	Resistor,chip,2mR,1%	2512	1
J1	JST SH1.0mm,8pin Connector		1
S1	SWITCH	6*6	1

Note1: BOM is used in 5 cells battery

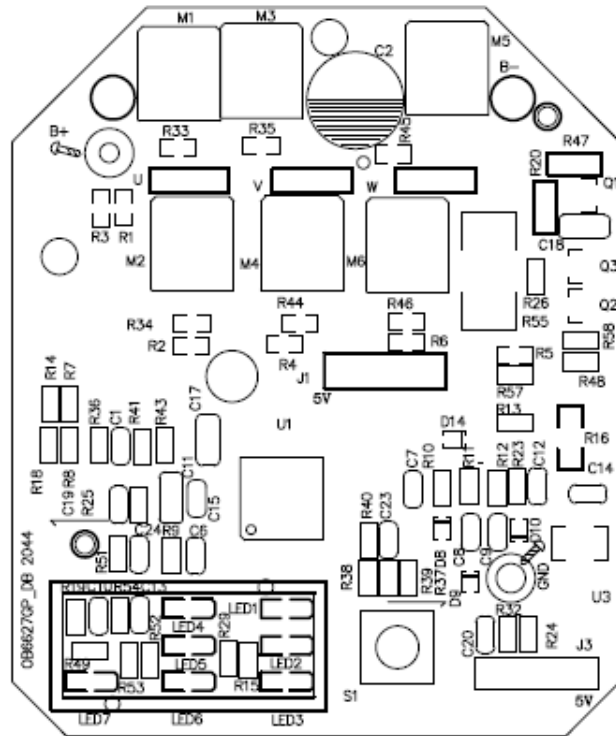
2.3 PCB Garber File



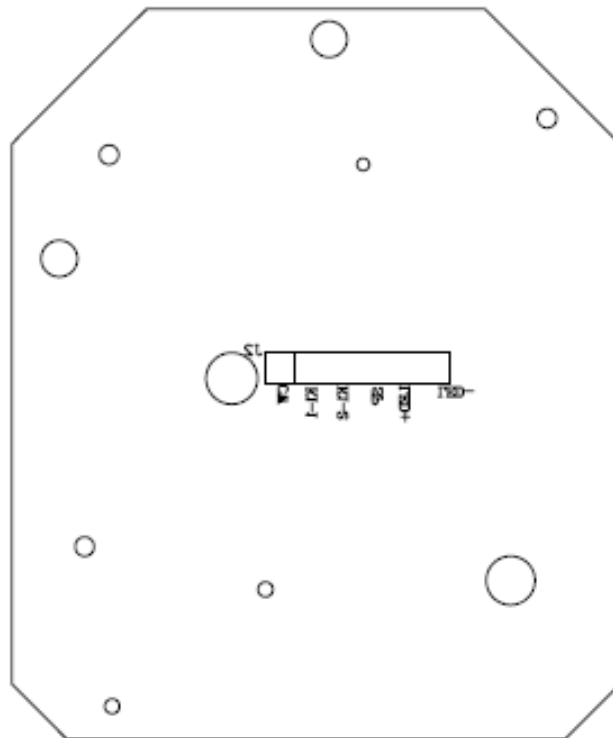
Top Layer



Bottom Layer

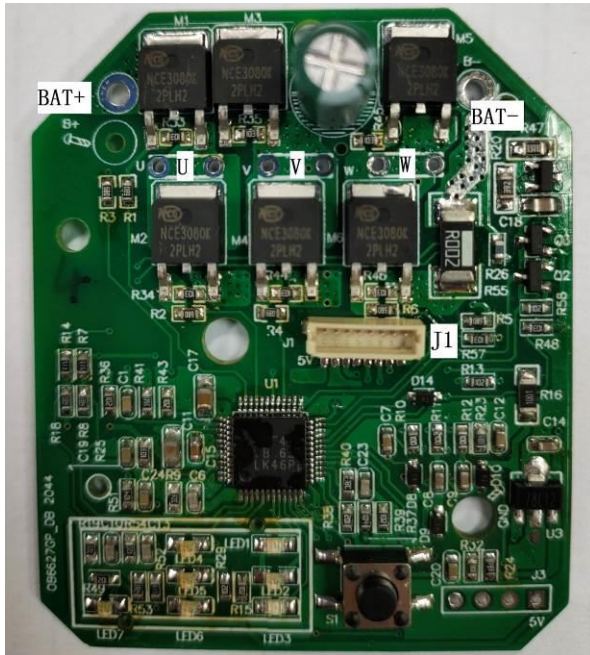


Silkscreen Top

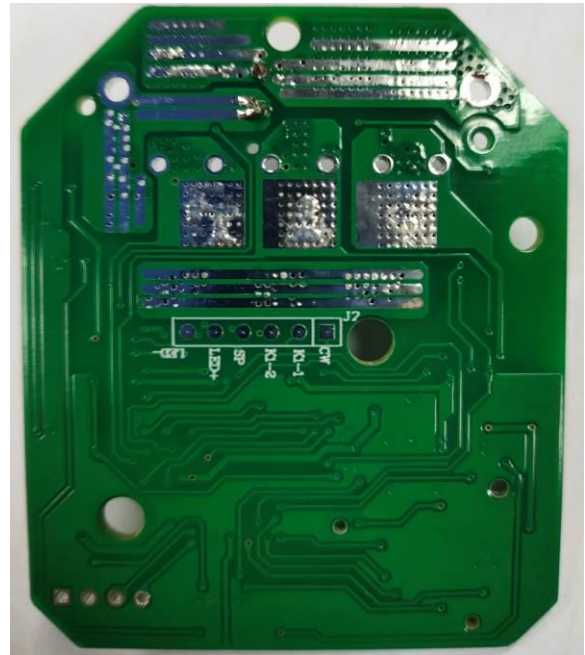


Silkscreen Bottom

2.4 Connector Function Description



Top



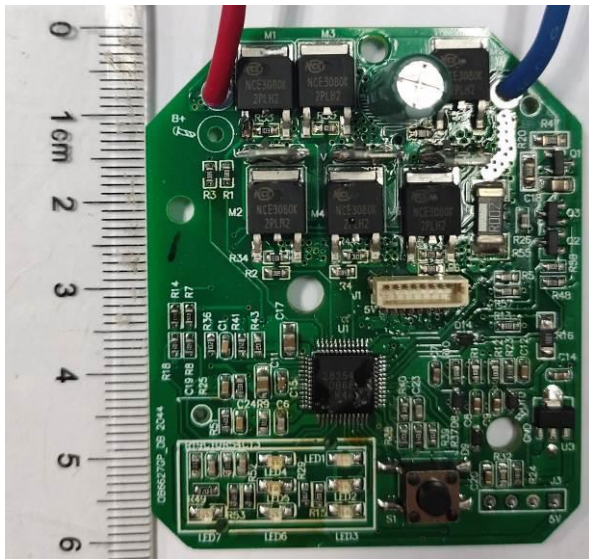
Bottom

Name	Description
B+	Battery input, Bus+
B-	Battery input, GND
U	Motor U phase output
V	Motor V phase output
W	Motor W phase output

J1- 8pin connector

Pin Num	Description	Voltage Range
1	Speed signal supply	5V
2	GND	0
3	Motor Direction Control	0~5V
4	Motor steering signal 1	0~5V
5	Motor steering signal 2	0~5V
6	Speed signal input	0~5V
7	LED+	0~12V
8	LED-	0~12V

2.5 BLDC Controller Board Snapshot



Top



Bottom

3. Performance Evaluation

This session presents the test results of OB6627L 18V25A Electric Wrench Controller demo. TA=25°C

No	Parameter	Symbol	Min	Type	Max	Unit
1	Battery UVP	V _{bus_UVLO}		14.0		V
2	MCU supply	LDO_5V	4.9	5.0	5.1	V
3	Gate driver supply	LDO_12V		12.0		V
4	MOSFET gate voltage	V _{gs}		12.0		V
5	Highside MOSFET Rise time	Tr _h		0.660		us
6	Highside MOSFET Fall time	Tf _h		0.900		us
7	Lowside MOSFET Rise time	Tr _l		0.639		us
8	Lowside MOSFET Fall time	Tf _l		0.774		us
9	PWM frequency	f _{PWM}		20		kHz
10	PWM duty	Duty	20		100	%
11	Current amplify coefficient			16		
12	MOSFET current shutdown time in MOTOR short circuit				10	us
13	MOSFET V _{ds} in MOTOR short circuit			30		V

Test Equipments

Item	Module
DC source	LW12050KD
Oscilloscope	LeCroy HDO420
Current meter	Tek TCPA300
Differential probe	CATIII
Multi-meter	VC9808

3.1 Voltage Test

3.1.1 Gate Driver & MCU Supply Power ON/OFF

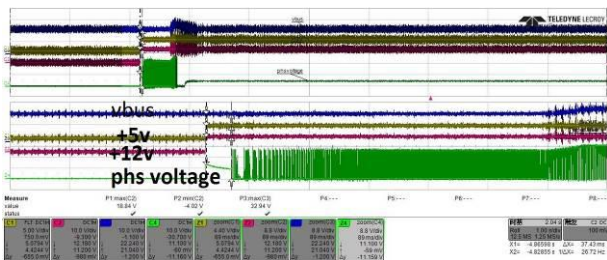


Fig. 1 Measured bus voltage, VCC=12V, LDO=5V @ bus=22V
Power On Time = 107ms

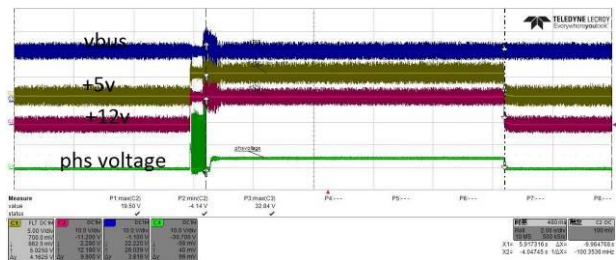


Fig. 2 Measured bus voltage, VCC=12V, LDO=5V @ bus=22V
Power Off Time = 4.6s

3.2 MOSFET

3.2.1 Vgs Rise/Fall Edge Time

	GH1	GH2	GH3	GL1	GL2	GL3
tr/us	0.660	0.651	0.634	0.639	0.642	0.658
tf/us	0.911	0.887	0.9	0.774	0.758	0.730

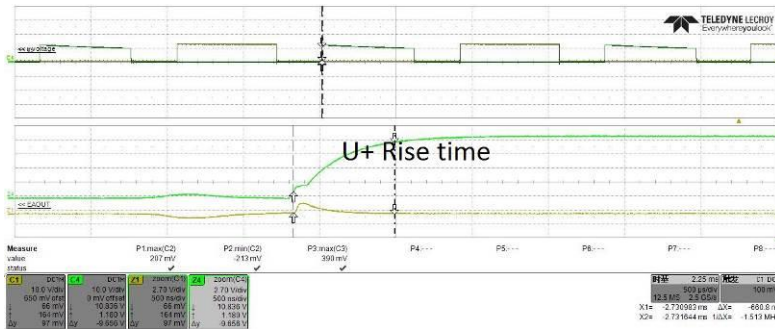


Fig. 3 Measured U-Phase highside Rise MOSFET Vgs @ bus = 18V

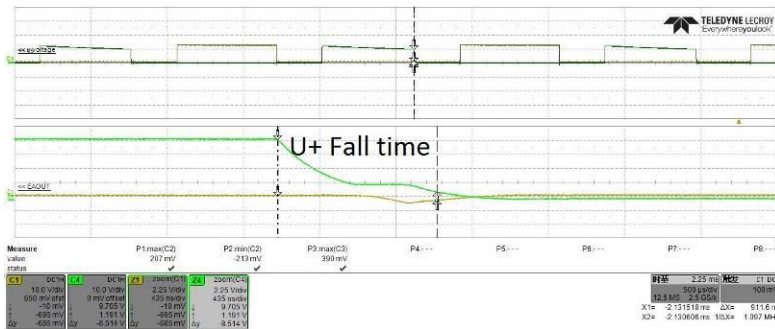


Fig. 4 Measured U-Phase highside Fall MOSFET Vgs @ bus = 18V

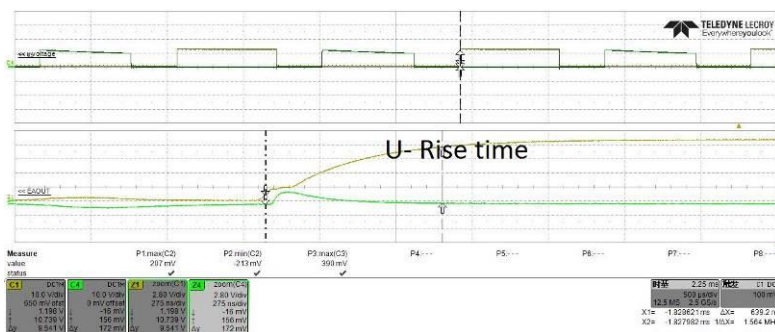


Fig. 5 Measured U-Phase lowside Rise MOSFET Vgs @ bus = 18V

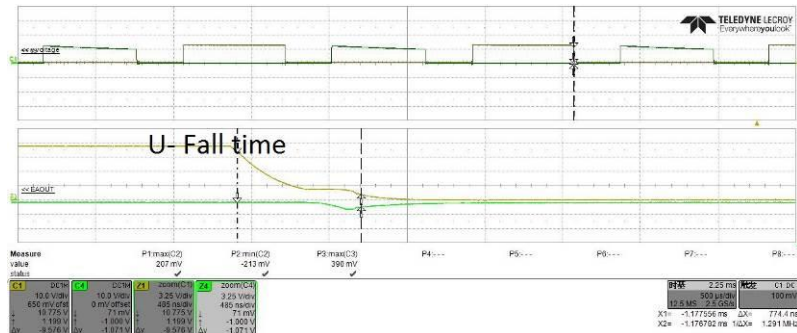


Fig. 6 Measured U-Phase lowside Fall MOSFET Vgs @ bus = 18V

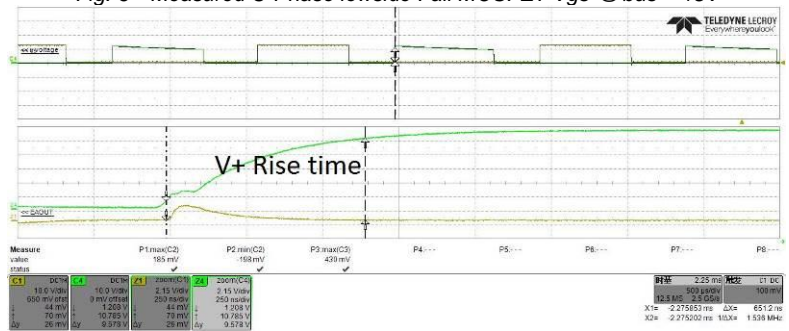


Fig. 7 Measured V-Phase highside Rise MOSFET Vgs @ bus = 18V

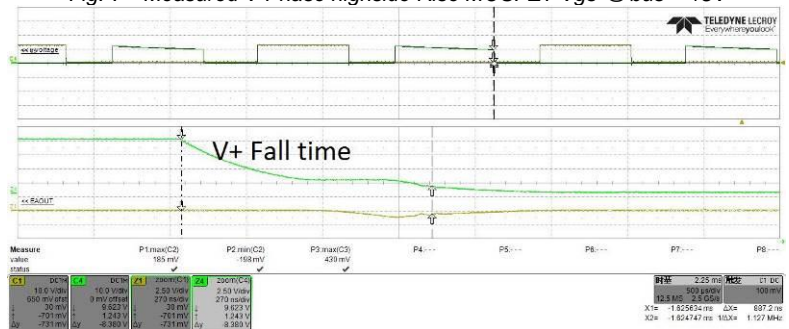


Fig. 8 Measured V-Phase highside Fall MOSFET Vgs @ bus = 18V

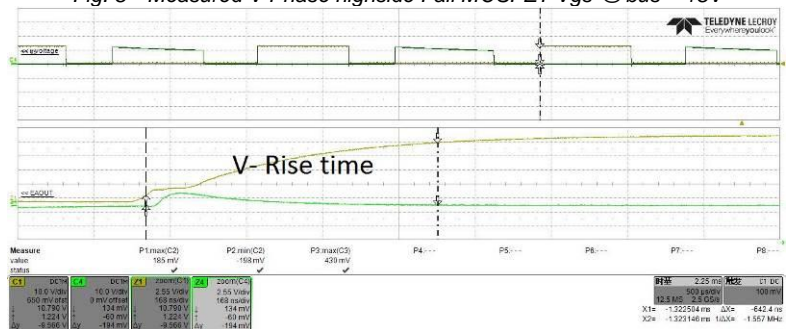


Fig. 9 Measured V-Phase lowside Rise MOSFET Vgs @ bus = 18V

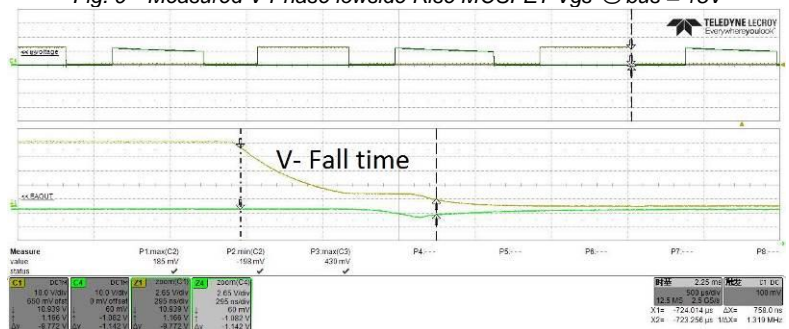


Fig. 10 Measured V-Phase lowside Fall MOSFET Vgs @ bus = 18V

3.2.2 Vds Strike Voltage @ Bus = 22V

	U+	V+	W+
Vds / V	29.22	30.00	29.16
	U-	V-	W-
Vds / V	30.64	32.00	32.88

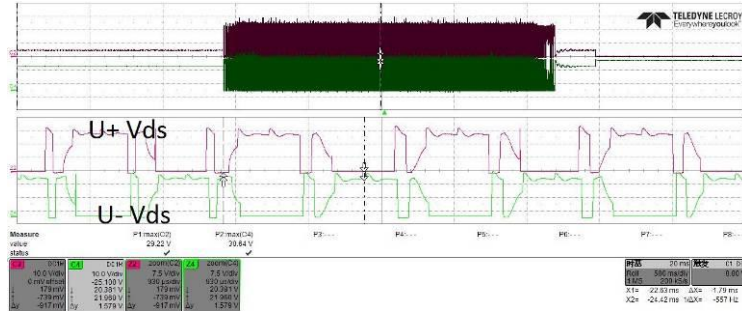


Fig. 15 Measured U+(Red), U-(Green) MOSFET Vds strike voltage @ bus = 22V

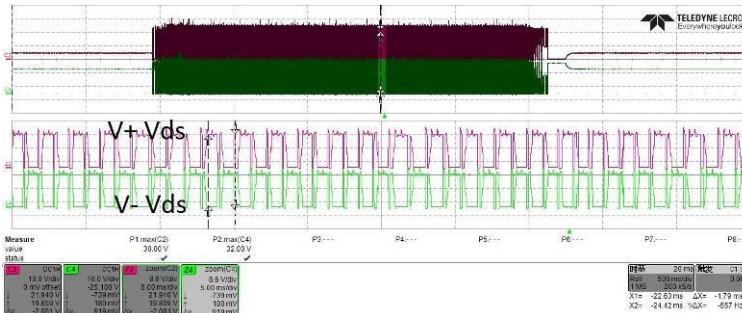


Fig. 16 Measured V+(Red), V-(Green) MOSFET Vds strike voltage @ bus = 22V

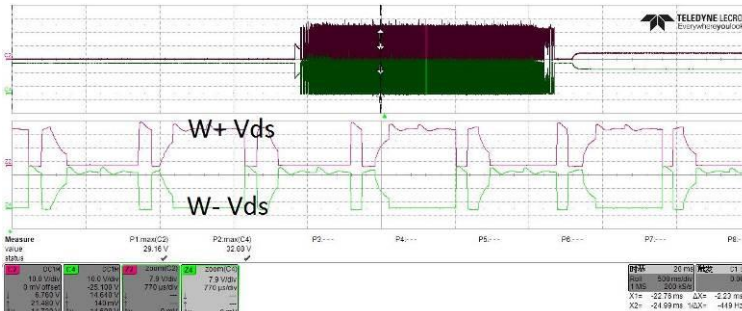


Fig. 17 Measured W+(Red), W-(Green) MOSFET Vds strike voltage @ bus = 22V

3.3 Current Sensing

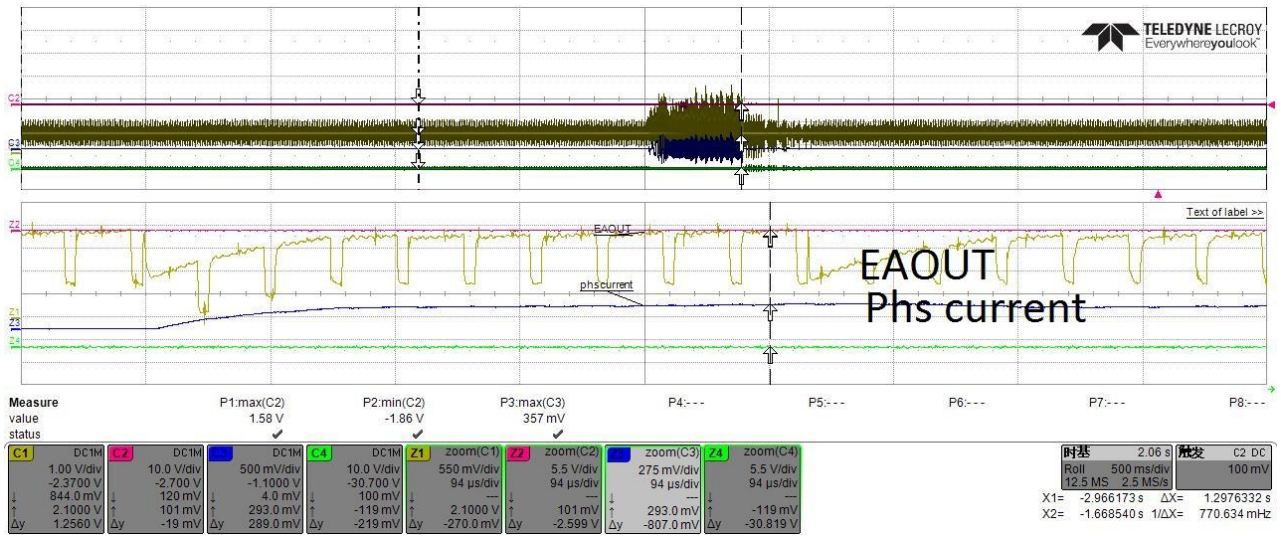


Fig. 18 Measured Amplifier output(Yellow), pha-current(Green) @ bus = 22V

3.4 Motor Short Circuit Protection

3.4.1 U-V phase short circuit(Static short circuit)

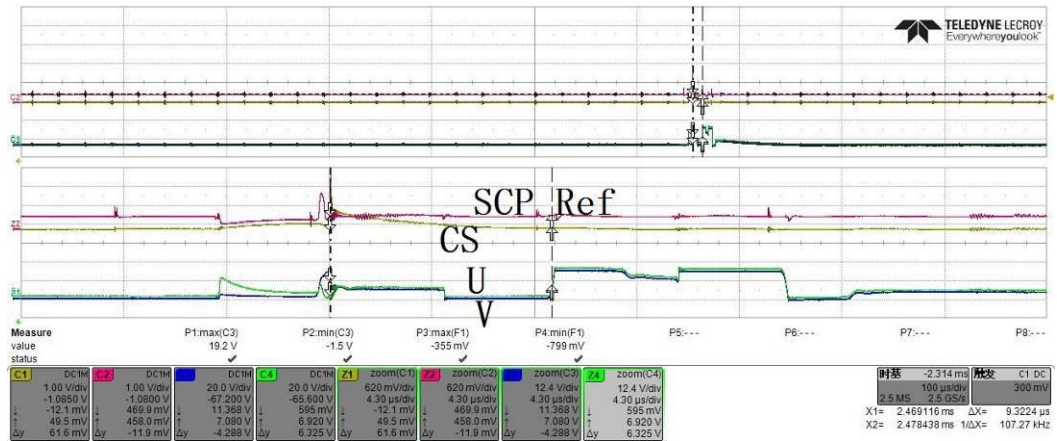


Fig. 19 Measured U(C4 Green)/V(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage = 18V

3.4.2 V-W phase short circuit(Static short circuit)

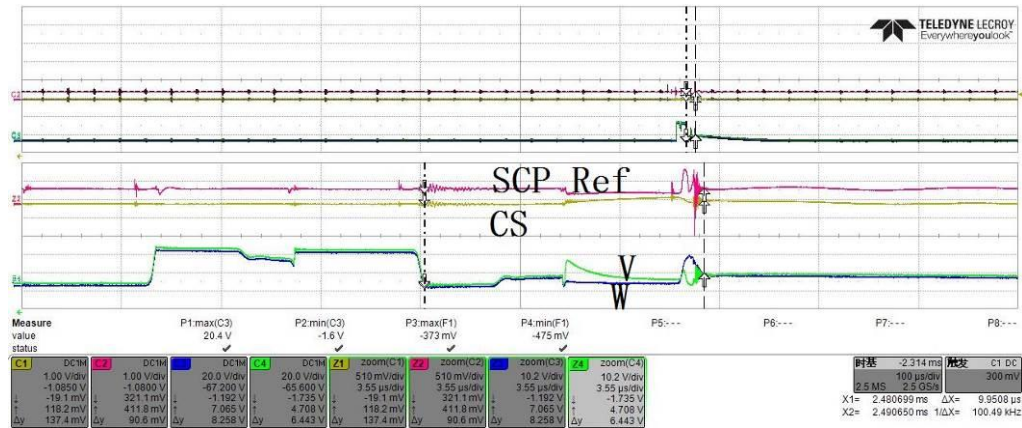


Fig. 20 Measured V(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage = 18V

3.4.3 U-W phase short circuit(Static short circuit)

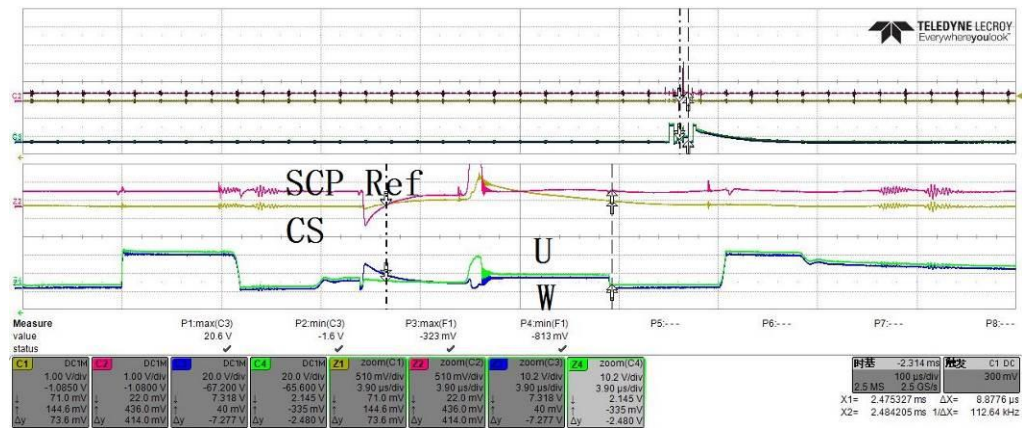


Fig. 21 Measured U(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage = 18V

3.4.4 U-V phase short circuit(Dynamic short circuit)

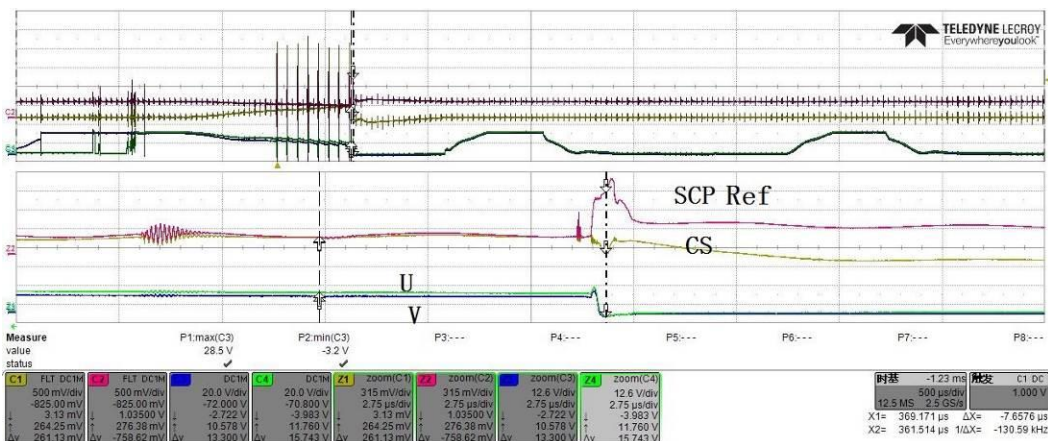


Fig. 22 Measured U(C4 Green)/V(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage = 22V

3.4.5 V-W phase short circuit(Dynamic short circuit)

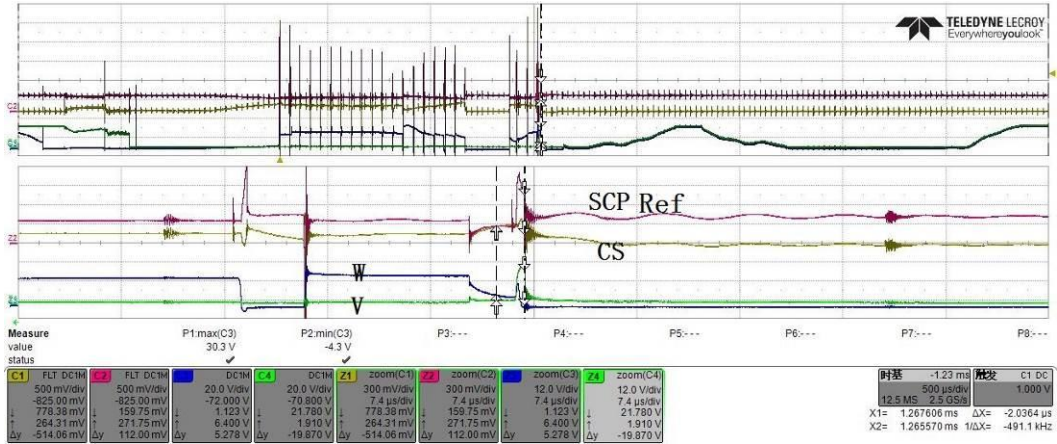


Fig. 23 Measured V(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage = 22V

3.4.6 U-W phase short circuit(Dynamic short circuit)

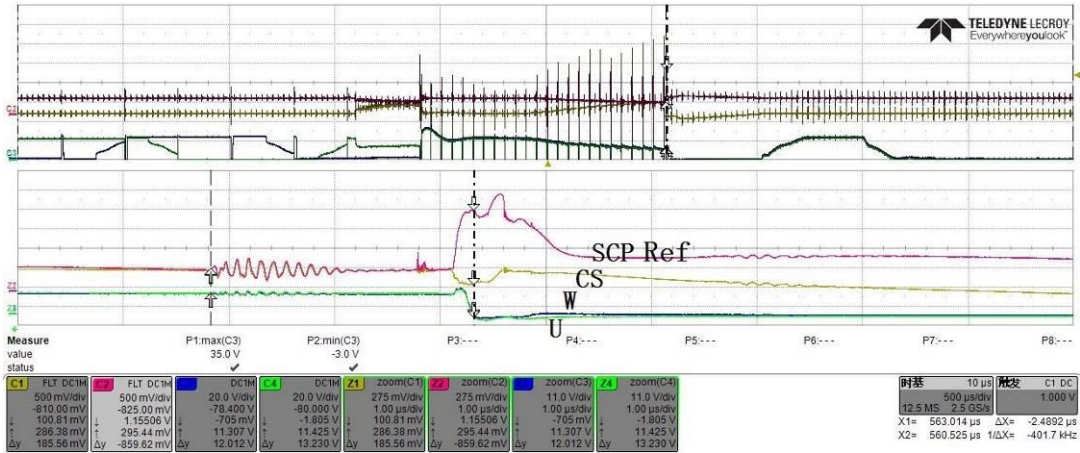


Fig. 24 Measured U(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage = 22V

3.5 Temperature Test

3.5.1 Temperature Measure

Setup : Bus voltage = 20.2V, Bus Current = 10.7A, TA = 60°C

	MOS1	MOS2	MOS3	MOS4	MOS5	MOS6	NTC
30min	76	76.4	79.4	71.9	75.7	78.4	79.3
60min	75.6	76	79.2	71.6	75.3	77.9	78.9
90min	75.6	76	79	71.6	75.4	78	78.9
120min	75.7	76	79.1	71.6	75.3	78.1	78.8

3.6 Reliability

3.6.1 Low Temperature Reliability

Setup: TA = -40°C, Bus Voltage = 18V

Result: Pass

3.6.2 High Temperature Reliability

Setup: TA = 60°C, Bus Voltage = 20.2V

Result: Pass

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