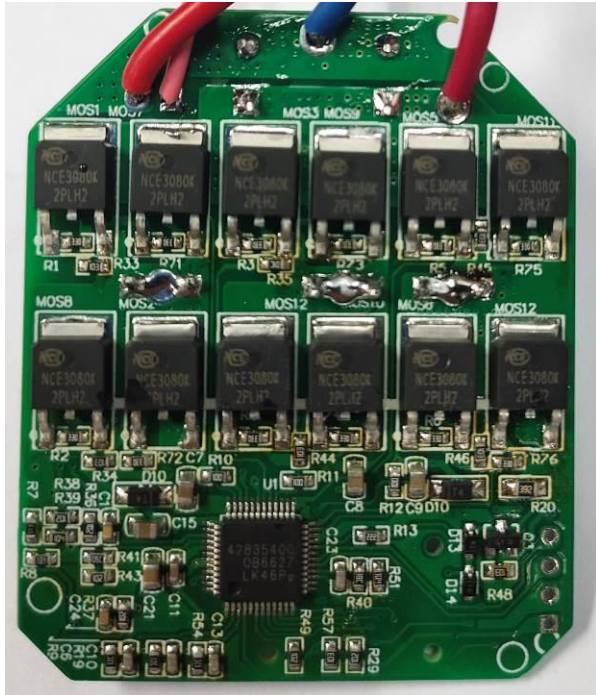


Subject
OB6627L Demo Board Manual

Board Model: OB6627_12MOS_JM_2046

Doc. No.: OB_DOC_DBM_B_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
- 21 % 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

Contents Index

1.	System Electrical Specification	3
1.1	Input Characteristic.....	3
1.2	System parameters	3
1.3	Output characteristic.....	3
1.4	Environmental.....	3
2.	Board Information	4
2.1	Schematic.....	4
2.2	Bill of material	5
2.3	PCB Gerber File	6
2.4	Connector Function Description	8
2.5	BLDC Controller Board Snapshot	9
3.	Performance Evaluation.....	10
3.1	Voltage Test	10
3.1.1	Gate Driver & MCU Supply Power ON/OFF	10
3.2	MOSFET.....	11
3.2.1	Vgs Rise/Fall Edge Time.....	11
3.2.2	Vds Strike Voltage @ Bus = 22V.....	14
3.3	Current Sensing.....	15
3.4	Motor Short Circuit Protection	15
3.4.1	U-V phase short circuit(Static short circuit)	15
3.4.2	V-W phase short circuit(Static short circuit)	16
3.4.3	U-W phase short circuit(Static short circuit)	16
3.4.4	U-V phase short circuit(Dynamic short circuit).....	16
3.4.5	V-W phase short circuit(Dynamic short circuit)	17
3.4.6	U-W phase short circuit(Dynamic short circuit).....	17
3.5	Temperature Test.....	18
3.5.1	Temperature Measure	18
3.6	Reliability	18
3.6.1	Low Temperature Reliability	18
3.6.2	High Temperature Reliability	18

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 $1m\Omega$
- 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 33.34V
- MOSFET thermal sensor precision 1%

1.3 Output characteristic

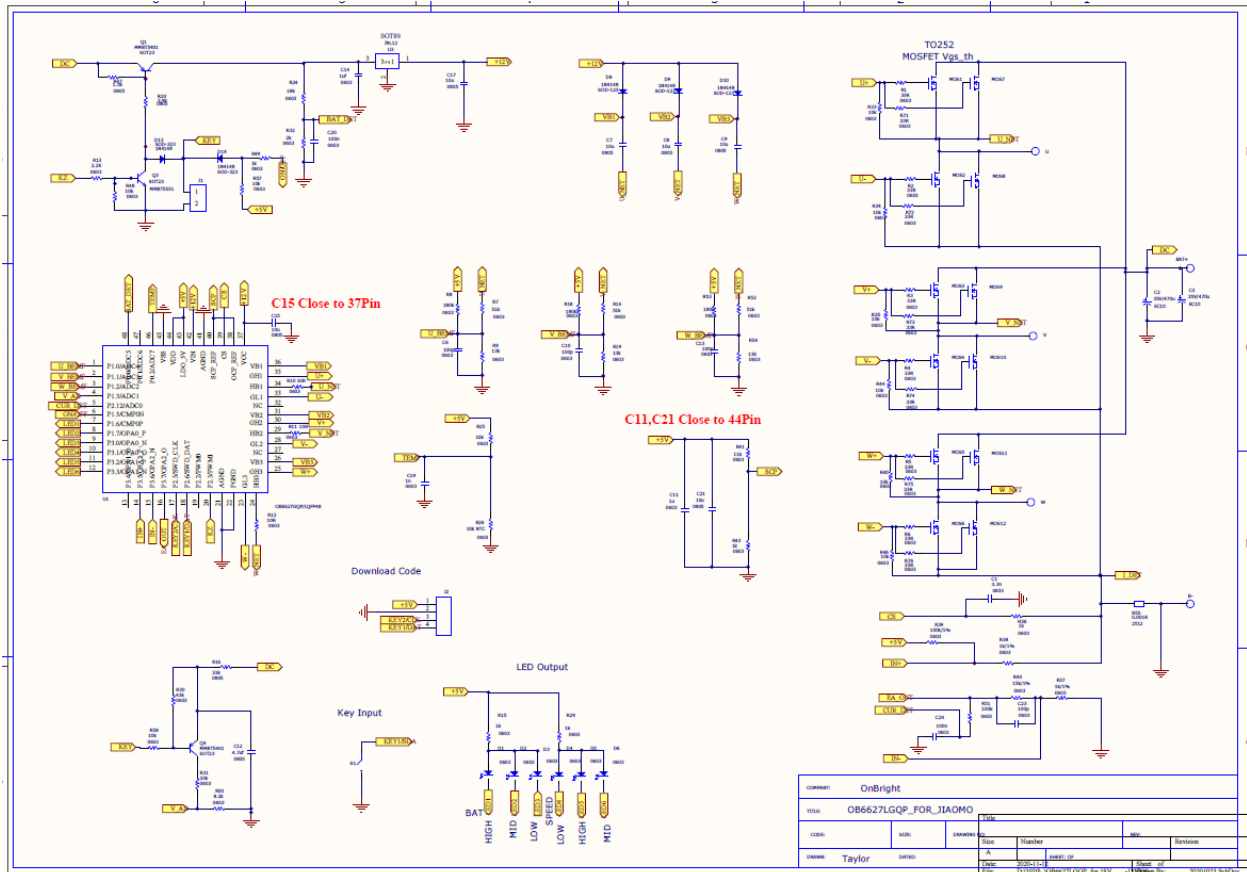
- High-grade one-level overcurrent protection 60A
- Low-grade one-level overcurrent protection 60A
- Bus primary overcurrent protection delay 1s
- Secondary overcurrent protection of bus 70A
- Bus secondary overcurrent protection delay 300ms
- Phase current limitation 100A
- Maximum of PWM duty 100%
- Minimum of PWM duty 21%

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



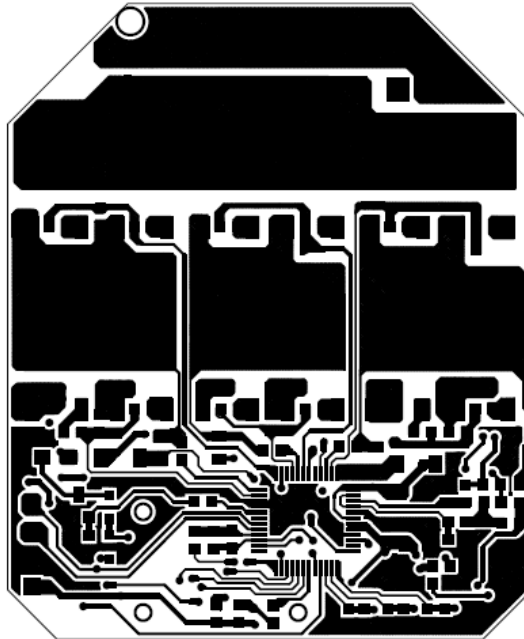
2.2 Bill of material

Position	Description	Package	QTY
C1	Capacitor,ceramic,3.3nf/25V,X7R,10%	0603	1
C2, C3	Capacitor, aluminum electrolytic, 470uf/35V, -40/105°C	EC10	2
C7,C8, C9, C15, C17, C21	Capacitor,ceramic,10uf/25V,X7R,10%	0805	6
C12	Capacitor,ceramic,4.7uf/25V,X7R,10%	0805	1
C11,C14	Capacitor,ceramic,1uf/25V,X7R,10%	0603	2
C19	Capacitor,ceramic,1nf/25V,X7R,10%	0603	1
C6, C10, C13,C23	Capacitor,ceramic,100pf/25V,X7R,10%	0603	4
C20, C24	Capacitor,ceramic,100nf/25V,X7R,10%	0603	2
D1, D2, D3, D4, D5, D6	LED, Green	0603	6
D8, D9, D10	1N4148	SOD-123	3
D13, D14	1N4148	SOD-323	2
MOS1,MOS2,MOS3,MOS4,MOS5,MOS6, MOS7,MOS8,MOS9,MOS10,MOS11,MOS 12	Power MOS,NCE3080K (30V 80A)	TO252	12
Q1, Q4	PNP,MMBT5401	SOT23	2
Q3	NPN,MMBT5551	SOT23	1
R1,R2,R3,R4,R5,R6,R71,R72,R73,R74,R7 5, R76	Resistor,chip,33R,5%	0603	12
R7, R14, R52	Resistor,chip,51K,1%	0603	3
R9, R19, R54	Resistor,chip,13K,1%	0603	3
R56	Resistor,chip,51K,5%	0603	1
R8, R18, R53	Resistor,chip,180k,1%	0603	3
R25, R33, R34, R35, R44,R45,R46, R48, R57, R58	Resistor,chip,10k,5%	0603	10
R10, R11, R12	Resistor,chip,10R,5%	0603	3
R13	Resistor,chip,2.2k,5%	0603	1
R15,,R29, R36, R43,R49	Resistor,chip,1k,5%	0603	5
R16	Resistor,chip,33k,5%	0805	1
R31	Resistor,chip,33k,5%	0603	1
R20	Resistor,chip,3.9k,5%	0805	1
R24	Resistor,chip,18k,1%	0805	1
R26	NTC,TSM1A103-34D,10K,B=3950,1%	0603	1
R30	Resistor,chip,43k,5%	0603	1
R32	Resistor,chip,2k,1%	0603	1
R37, R38	Resistor,chip,1k,1%	0603	2
R39,R51	Resistor,chip,100k,1%	0603	2
R40	Resistor,chip,15k,1%	0603	1
R41	Resistor,chip,11k,5%	0603	1
R47	Resistor,chip,1.5k,5%	0603	1
R50	Resistor,chip,8.2k,5%	0603	1
R55	Resistor,chip,1mR,1%,3W	2512	1
S1	Key,6mm*7mm,auto-release	SWPB	1

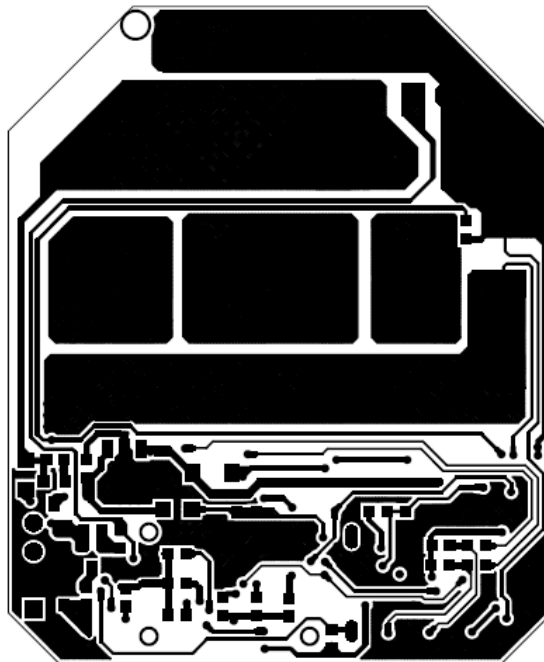
U1	OB6627LGQP	LQFP48	1
U3	78L12	SOT89	1

Note1: BOM is used in 5 cells battery

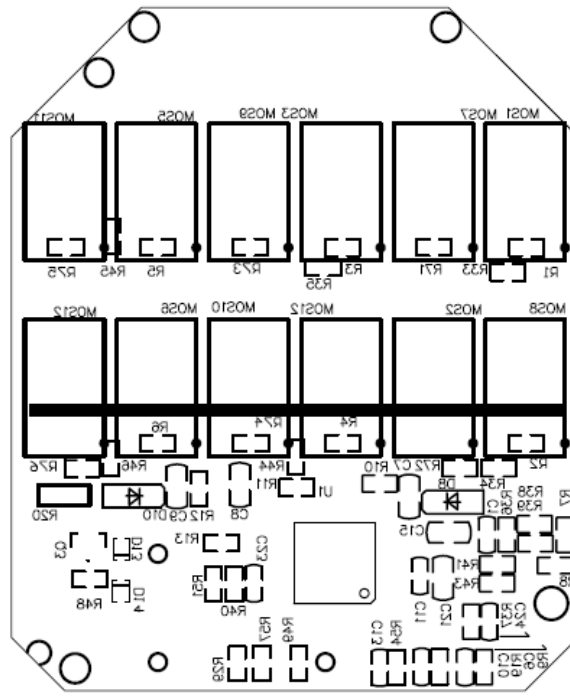
2.3 PCB Garber File



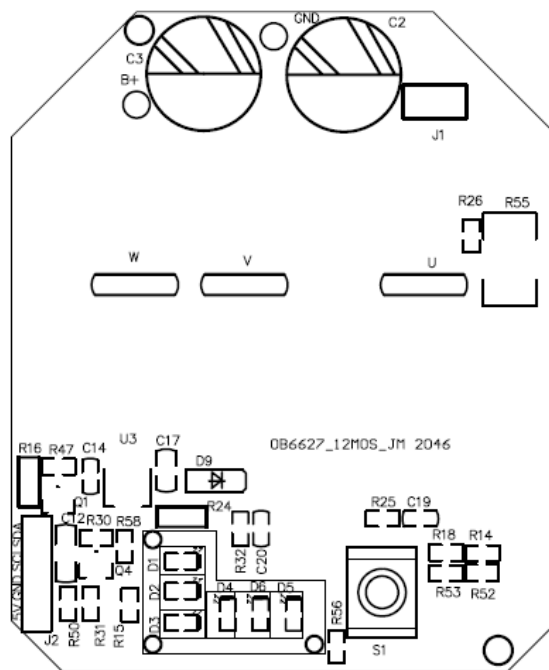
Top Layer



Bottom Layer

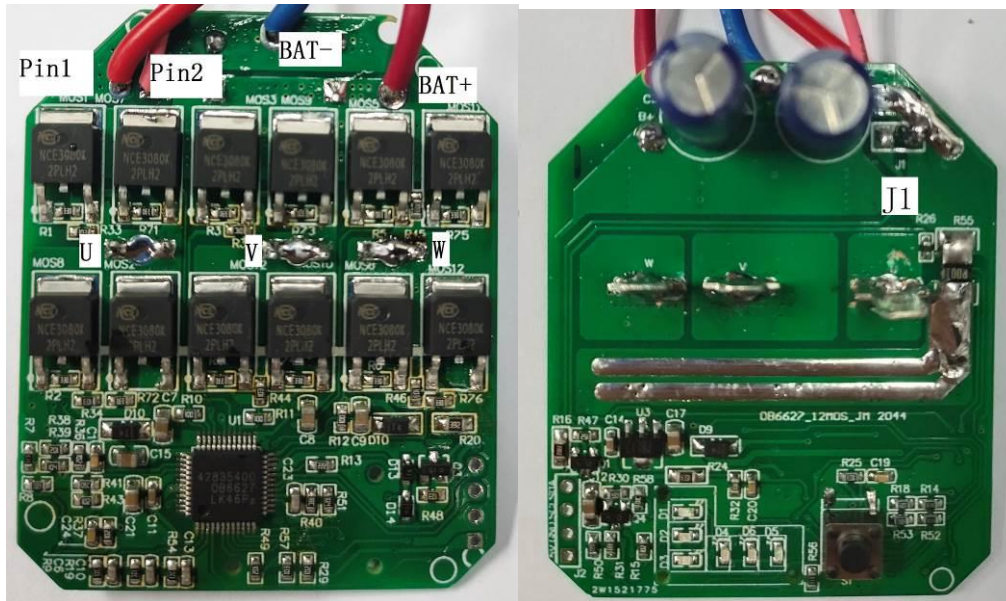


Silkscreen Top



Silkscreen Bottom

2.4 Connector Function Description

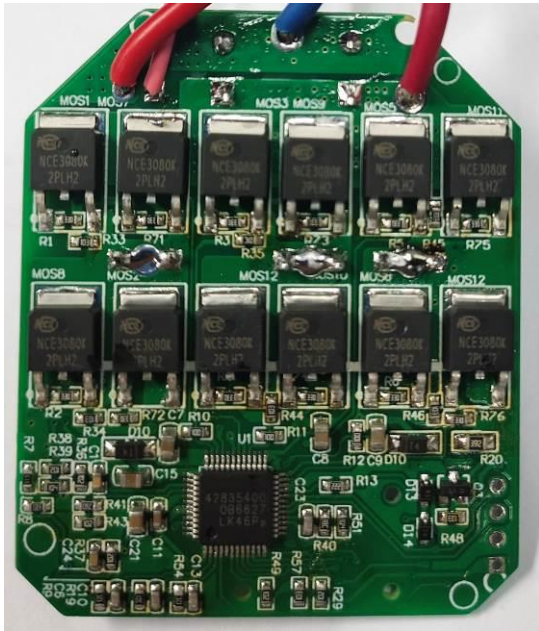


Name	Description
BAT+	Battery input, Bus+
BAT-	Battery input, GND
U	Motor U phase output
V	Motor V phase output
W	Motor W phase output

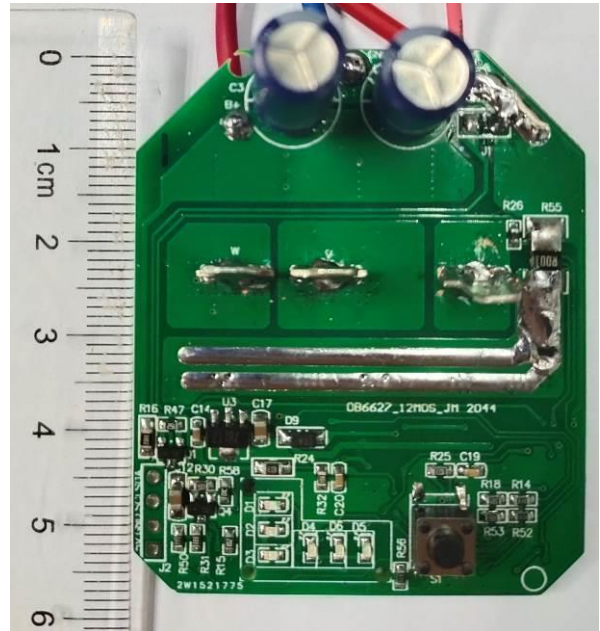
J1- 2pin connector

Pin Num	Description
Pin1	GND
Pin2	KEY

2.5 BLDC Controller Board Snapshot



Top



Bottom

3. Performance Evaluation

This session presents the test results of OB6627L 18V45A Angle Grinder 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		0.405		us
6	Highside MOSFET Fall time	Tf _h		0.666		us
7	Lowside MOSFET Rise time	Tr _l		0.430		us
8	Lowside MOSFET Fall time	Tf _l		0.472		us
9	PWM frequency	f _{PWM}		20		kHz
10	PWM duty	Duty	21		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

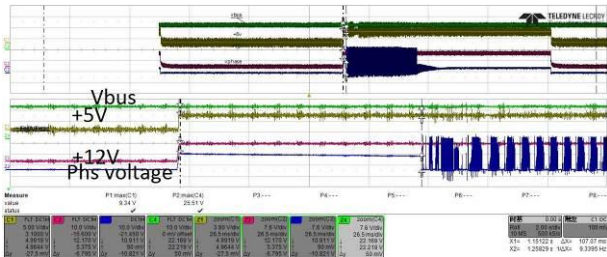


Fig. 1 Measured bus voltage, VCC=12V, LDO=5V @ bus=22V
Power On Time = 107ms

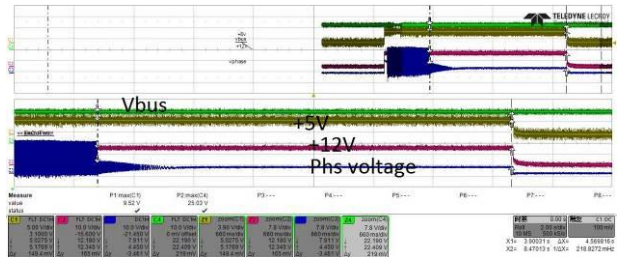


Fig. 2 Measured bus voltage, VCC=12V, LDO=5V @ bus=22V
Power Off Time = 4.6s

3.2 MOSFET

3.2.1 Vgs Rise/Fall Edge Time

	GH1	GH2	GH3	GL1	GL2	GL3
tr/us	0.405	0.418	0.425	0.43	0.435	0.444
tf/us	0.666	0.664	0.656	0.472	0.415	0.443

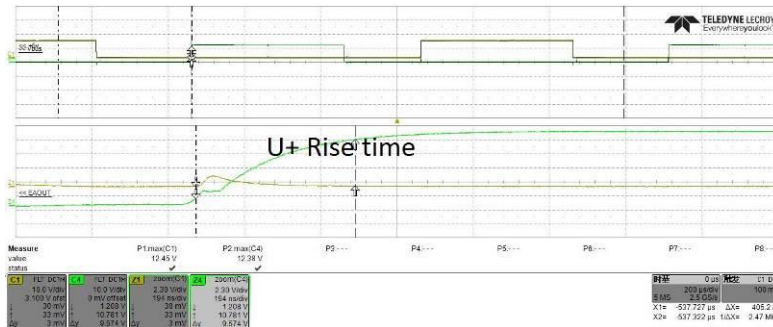


Fig. 3 Measured U-Phase highside Rise MOSFET Vgs @ bus = 18V

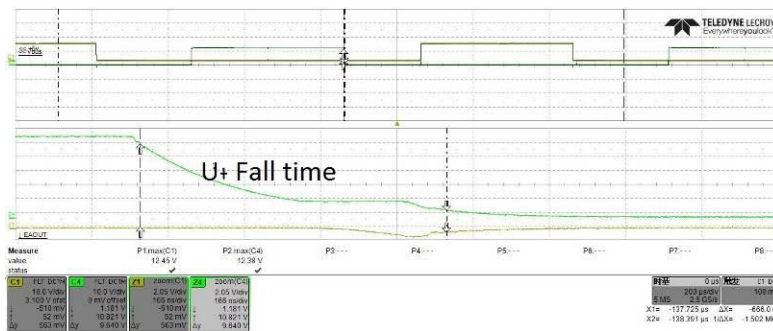


Fig. 4 Measured U-Phase highside Fall MOSFET Vgs @ bus = 18V

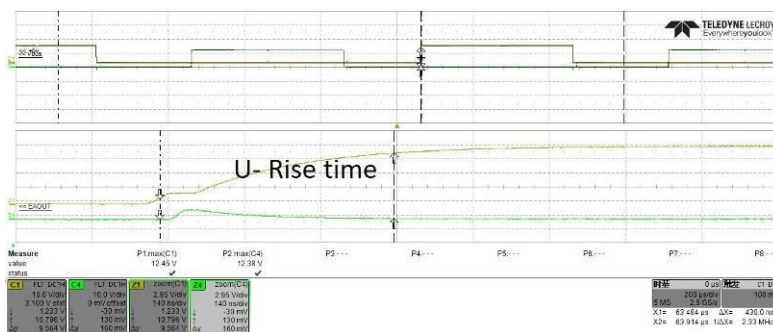


Fig. 5 Measured U-Phase lowside Rise MOSFET Vgs @ bus = 18V

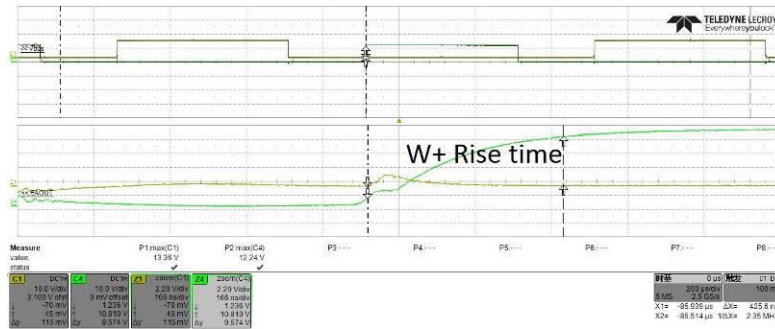


Fig. 11 Measured W-Phase highside Rise MOSFET Vgs @ bus = 18V

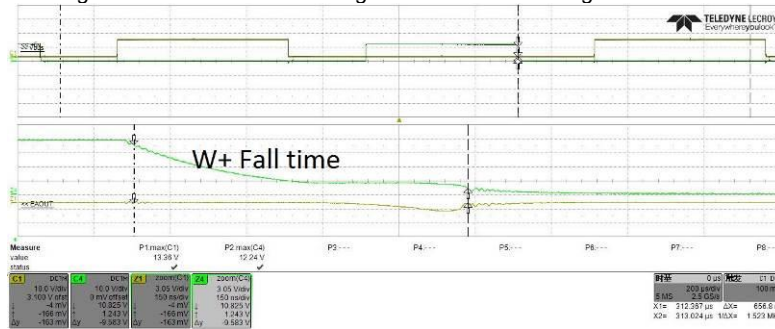


Fig. 12 Measured W-Phase highside Fall MOSFET Vgs @ bus = 18V

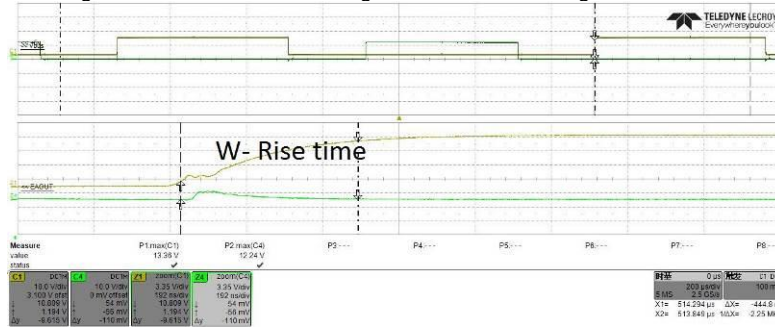


Fig. 13 Measured W-Phase lowside Rise MOSFET Vgs @ bus = 18V

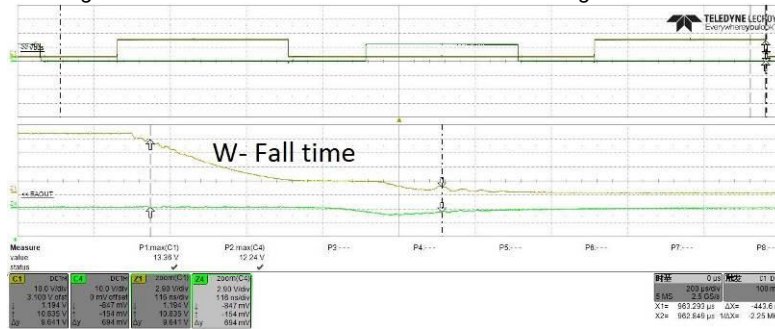


Fig. 14 Measured W-Phase lowside Fall MOSFET Vgs @ bus = 18V

3.2.2 Vds Strike Voltage @ Bus = 22V

	U+	V+	W+
Vds / V	29.64	30.94	33.34
	U-	V-	W-
Vds / V	31.30	30.68	31.44

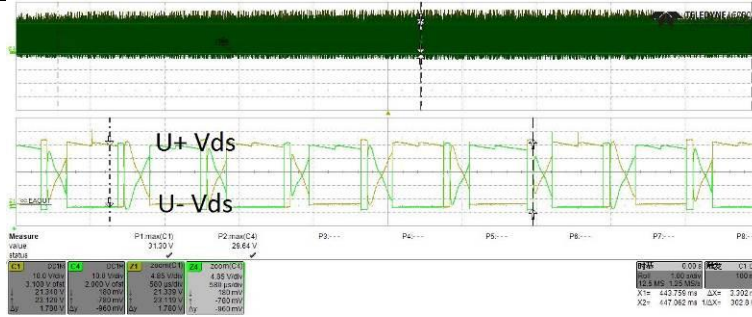


Fig. 15 Measured U+(Green), U-(Yellow) MOSFET Vds strike voltage @ bus = 22V

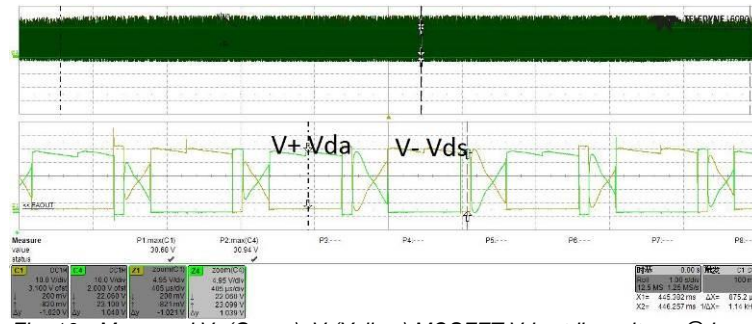


Fig. 16 Measured V+(Green), V-(Yellow) MOSFET Vds strike voltage @ bus = 22V

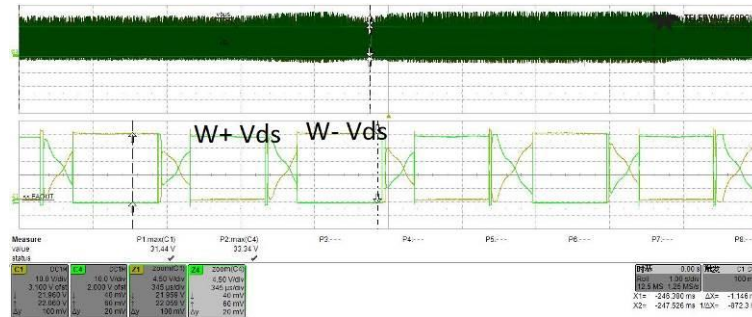


Fig. 17 Measured W+(Green), W-(Yellow) MOSFET Vds strike voltage @ bus = 22V

3.3 Current Sensing

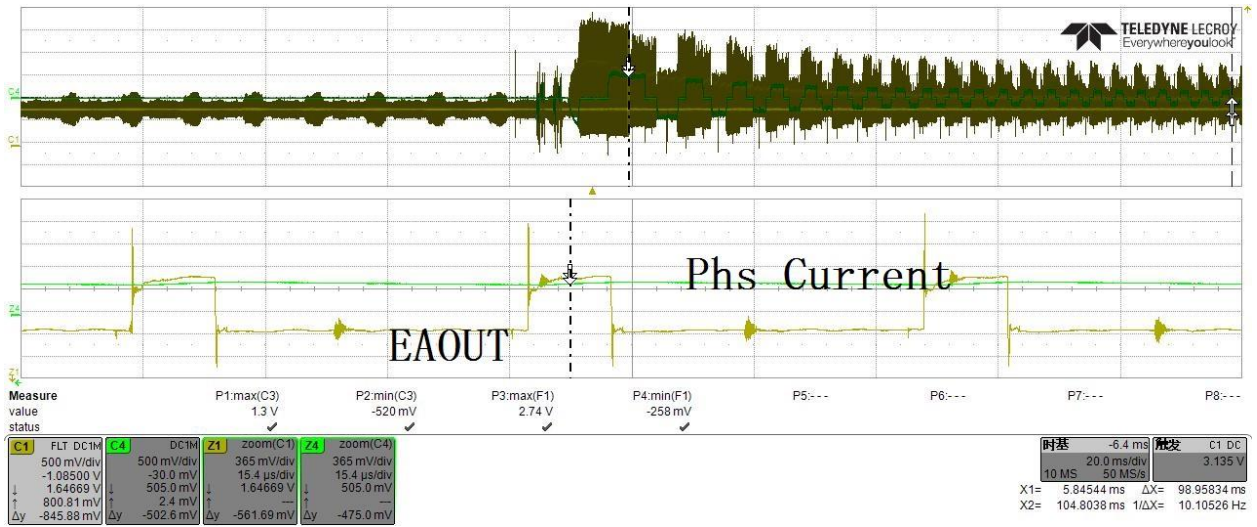


Fig.18 Measured Amplifier output(Yellow), pha-current(Green) @ bus = 22V

3.4 Motor Short Circuit Protection

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

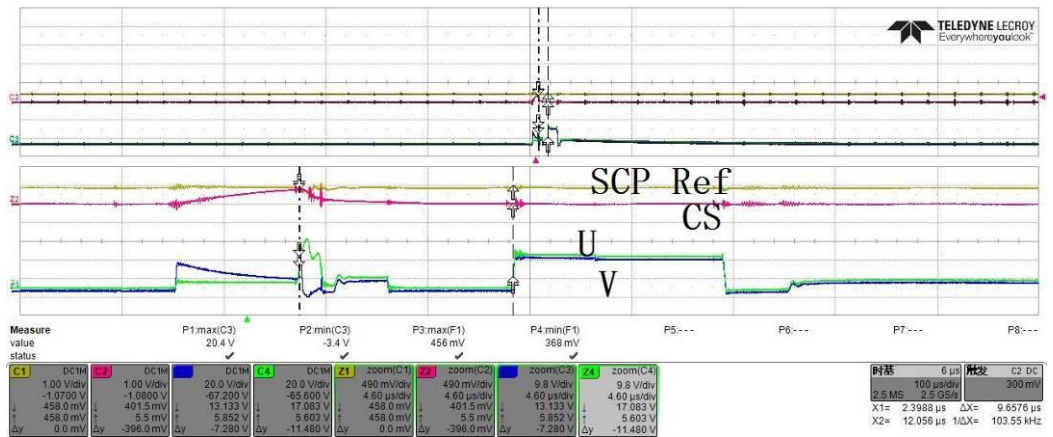


Fig. 19 Measured U(C4 Green)/V(C3 Blue)-phase voltage, SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 18V

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

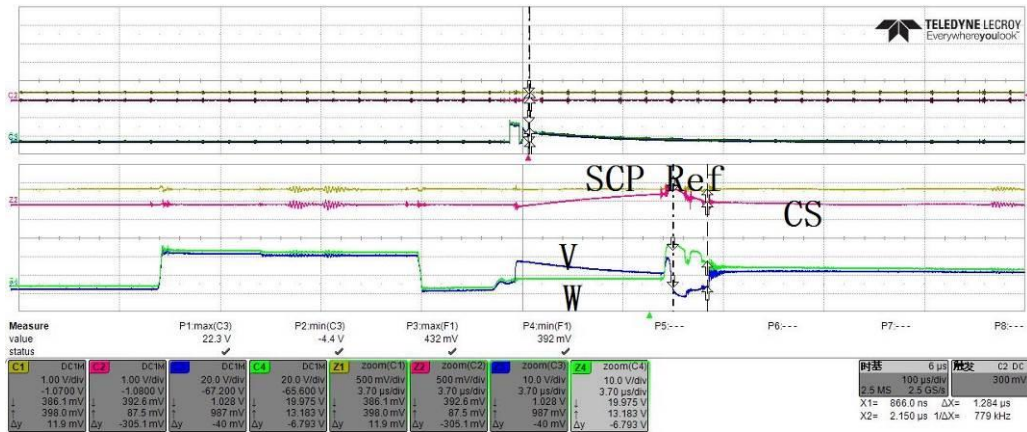


Fig. 20 Measured W(C4 Green)/V(C3 Blue)-phase voltage, SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 18V

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

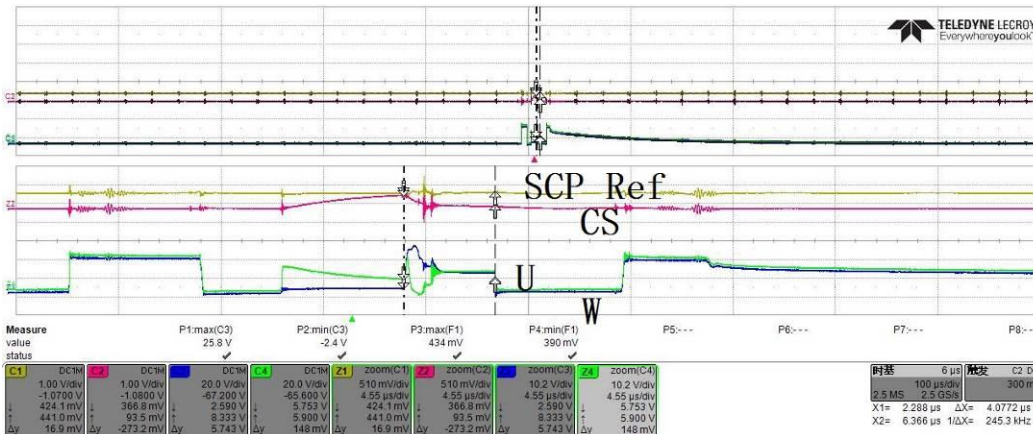


Fig. 21 Measured U(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 18V

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

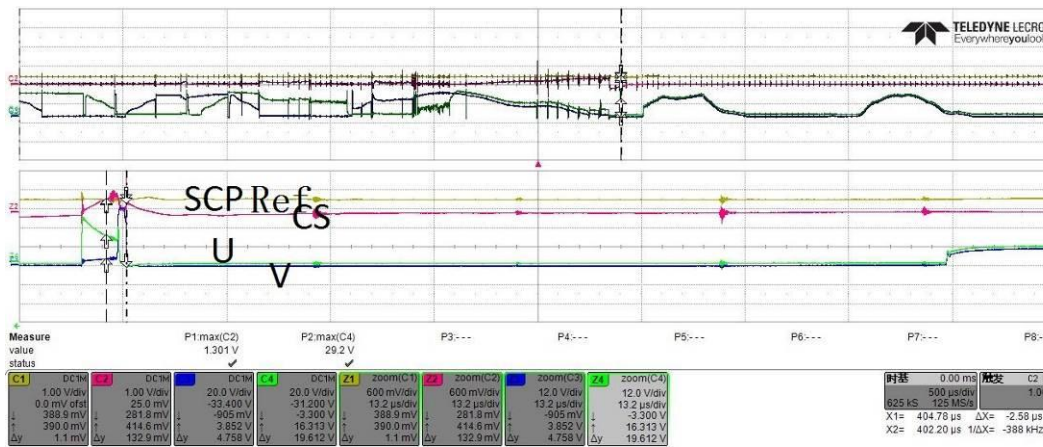


Fig. 22 Measured U(C4 Green)/V(C3 Blue)-phase voltage, SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 22V

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

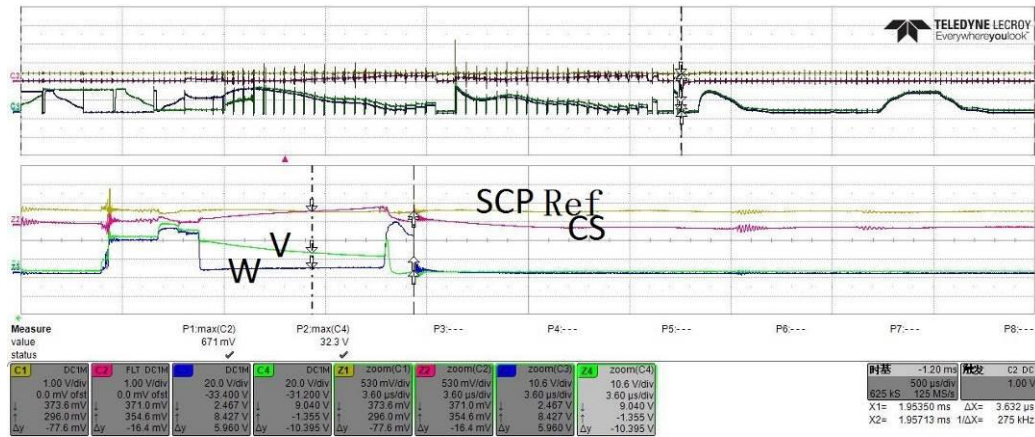


Fig. 23 Measured V(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 22V

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

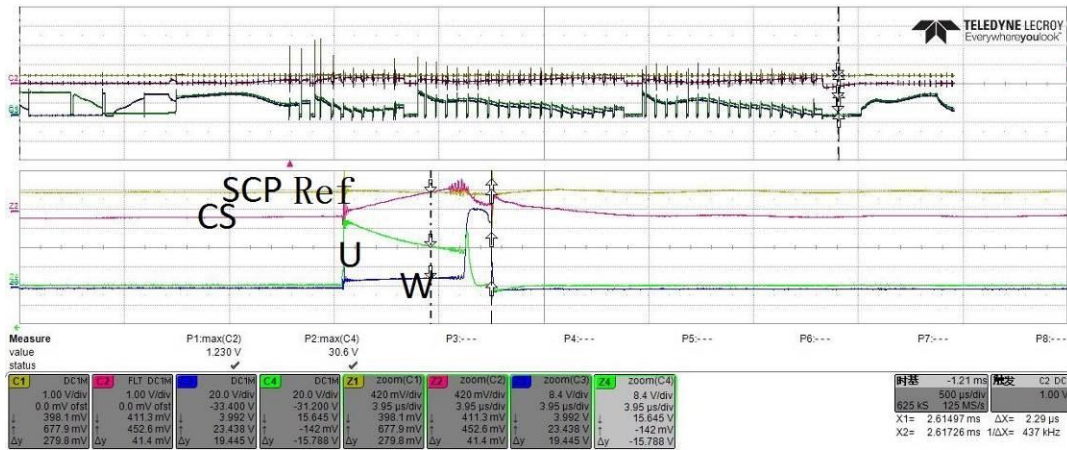


Fig. 24 Measured U(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 22V

3.5 Temperature Test

3.5.1 Temperature Measure

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

	MOS1	MOS3	MOS5	MOS8	MOS10	MOS12	NTC
30min	67.1	67.2	67.6	69.3	69.1	67.6	69.9
60min	67.0	67.1	67.6	67.3	69.1	67.7	69.3
90min	66.7	66.7	67.6	67.2	68.9	68.7	69.3
120min	66.6	66.7	67.6	67.1	68.5	68.7	69.2

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

Disclaimer

On-Bright Electronics reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its documents, products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

This document is under copy right protection. None of any part of document could be reproduced, modified without prior written approval from On-Bright Electronics.