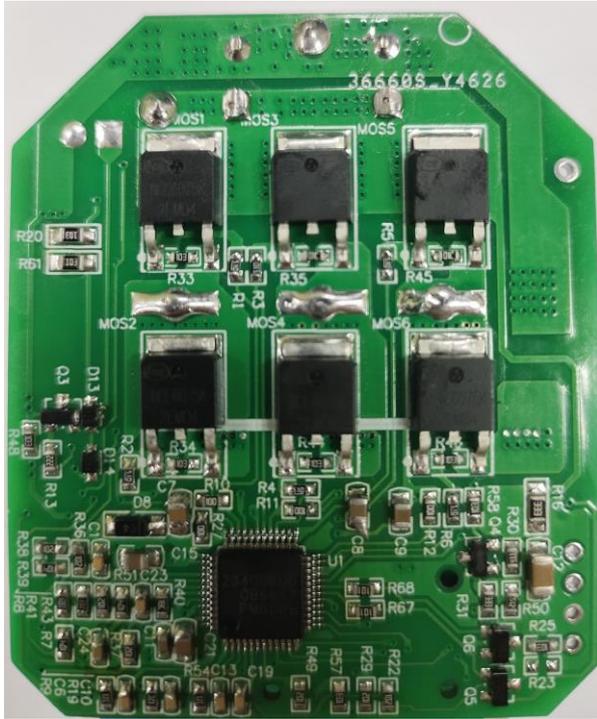


Subject
OB6617P Demo Board Manual

Board Model: OB6617_6MOS_36V_JM 2103

Doc. No.: OB_DOC_DBM_A_6617P00



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
2021-04-06	00	First Issue

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1. System Electrical Specification

1.1 Input Characteristic

- DC input voltage rating 10 cells Li-Iron battery of 3.7V
- DC input voltage 30V to 42V
- 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 12V
- Max of MOSFET drain source voltage value 60V
- MOSFET thermal sensor precision 1%

1.3 Output characteristic

- Phase current limitation 45A
- 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.

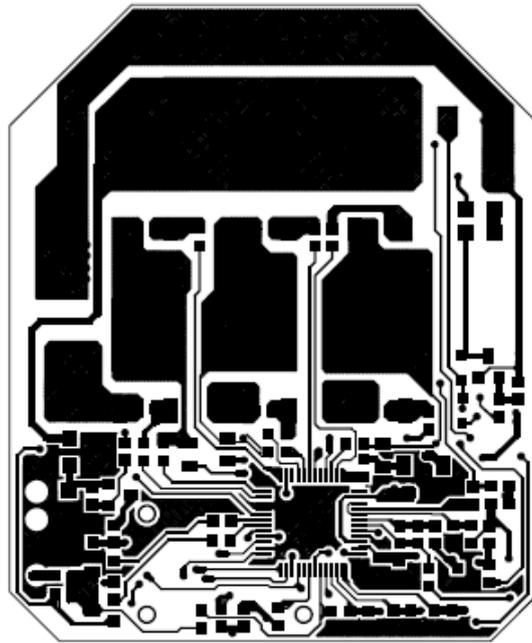
Bill of material

Position	Description	Package	QTY
C1	Capacitor,ceramic,3.3nf/25V,X7R,10%	0603	1
C2, C3	Capacitor, aluminum electrolytic, 470uf/50V, -40/105°C	EC10	2
C6, C10, C13	Capacitor,ceramic,100pf/25V,X7R,10%	0603	3
C7,C8, C9, C15, C17, C21	Capacitor,ceramic,10uf/25V,X7R,10%	0805	6
C18	Capacitor,ceramic,10uf/50V,X7R,10%	1206	1
C12	Capacitor,ceramic,4.7uf/50V,X7R,10%	1206	1
C11	Capacitor,ceramic,1uf/25V,X7R,10%	0603	1
C19,C14	Capacitor,ceramic,1nf/25V,X7R,10%	0603	2
C23	Capacitor,ceramic,220pf/25V,X7R,10%	0603	1
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	NCE6075K	TO252	6
Q1, Q4	PNP,MMBT5401	SOT23	2
Q5,Q6	NPN,7002K	SOT23	2
Q3	NPN,MMBT5551	SOT23	1
R1,R2,R3,R4,R5,R6	Resistor,chip,51R,5%	0603	6
R7, R14, R52	Resistor,chip,100K,1%	0603	3
R9, R19, R54	Resistor,chip,13K,1%	0603	3
R8, R18, R53	Resistor,chip,180k,1%	0603	3
R25, R33, R34, R35, R44,R45,R46, R48, R57, R58,R21	Resistor,chip,10k,5%	0603	11
R10, R11, R12,R27,R28,R42,R56	Resistor,chip,10R,5%	0603	7
R13	Resistor,chip,2.2k,5%	0603	1
R17	Resistor,chip,2k,5%	0603	1
R15,R29, R36, R43,R49,R22	Resistor,chip,1k,5%	0603	6
R16	Resistor,chip,33k,5%	0805	1
R31	Resistor,chip,33k,5%	0603	1
R20,R61	Resistor,chip,10k,5%	0805	2
R24	Resistor,chip,18k,1%	0603	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
R67,R68	Resistor,chip,100R,5%	0603	2
R47	Resistor,chip,5.1k,5%	0805	1
R50	Resistor,chip,3.6k,5%	0603	1

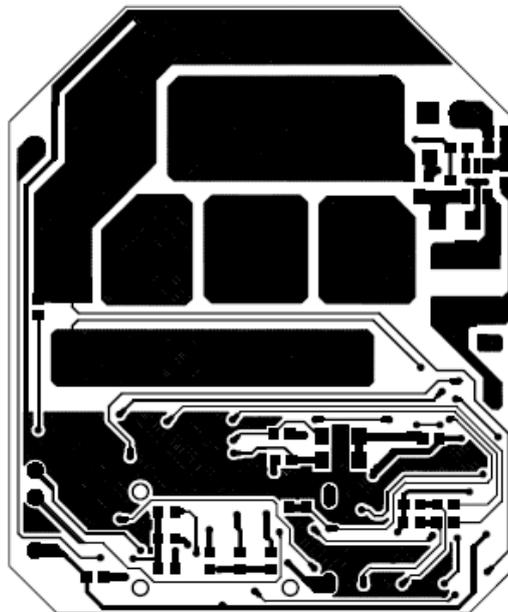
L1	CD54-471KC	CHOKES-D128C	1
R55	Resistor,chip,2mR,1%,3W	2512	1
S1	Key,6mm*7mm,auto-release	SWPB	1
U1	OB6617P	LQFP48	1
U2	OB2107	SOT23-6	1

Note1: BOM is used in 10 cells battery

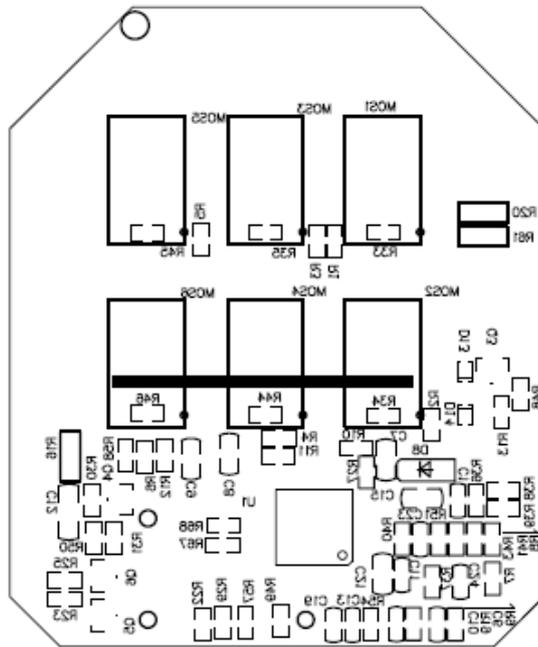
2.2 PCB Garber File



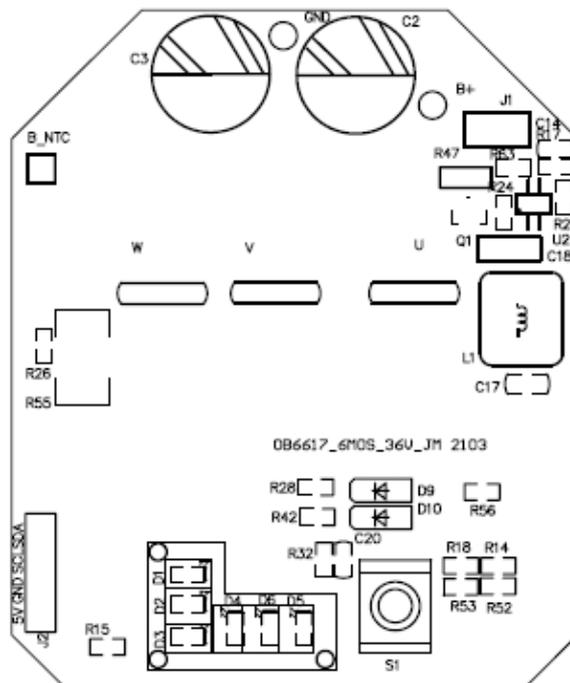
Top Layer



Bottom Layer

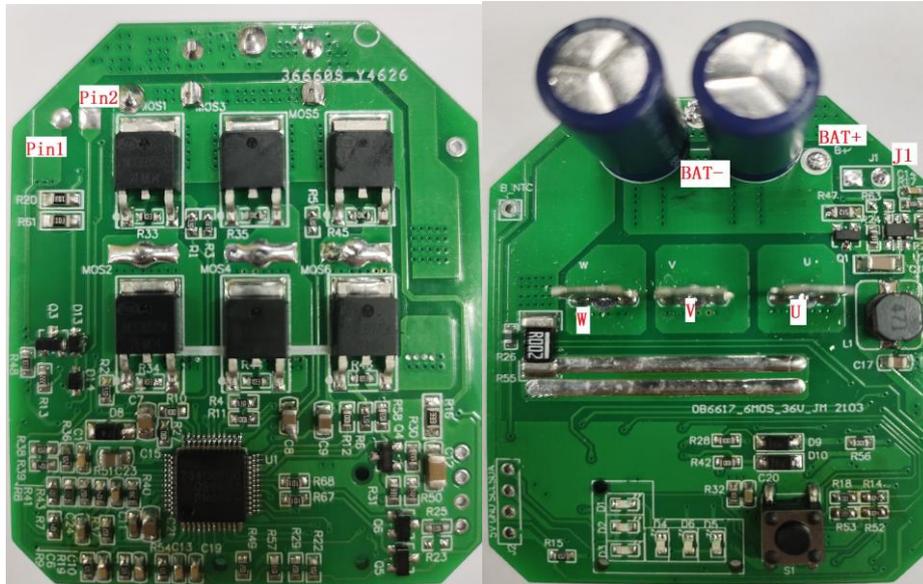


Silkscreen Top



Silkscreen Bottom

2.3 Connector Function Description

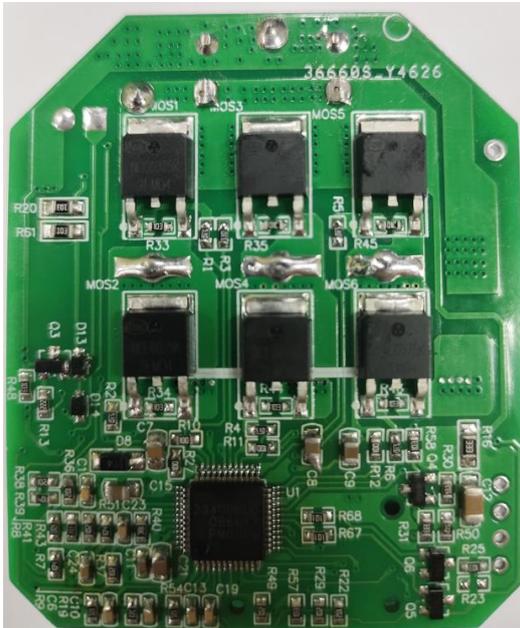


Name	Description
BAT+	Battery input, Bus+
BAT-	Battery input, GND
U	Motor U phase output
V	Motor V phase output
W	Motor W phase output

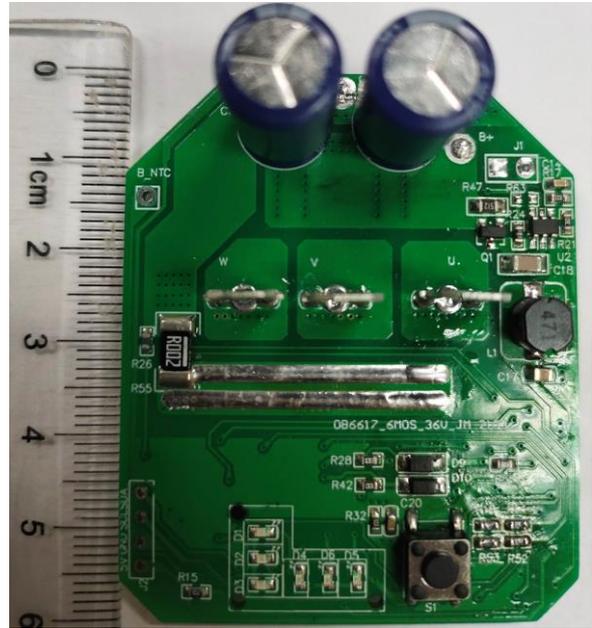
J1- 2pin connector

Pin Num	Description
Pin1	GND
Pin2	KEY

2.4 BLDC Controller Board Snapshot



Top



Bottom

3. Performance Evaluation

This session presents the test results of OB6627P 36V24A Angle Grinder Controller demo. TA=25°C

No	Parameter	Symbol	Min	Type	Max	Unit
1	Battery UVP	V _{bus_UVLO}		30.0		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		0.823		us
6	Highside MOSFET Fall time	Tf _h		0.84		us
7	Lowside MOSFET Rise time	Tr _l		0.672		us
8	Lowside MOSFET Fall time	Tf _l		0.699		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			60.0		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

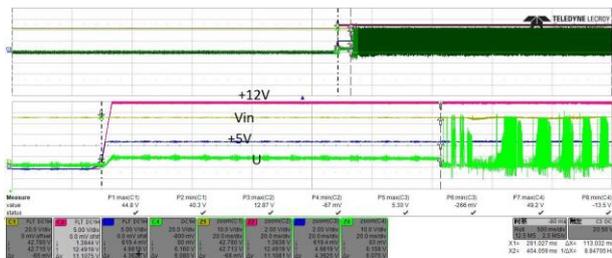


Fig. 1 Measured bus voltage, VCC=12V, LDO=5V @ bus=42V
Power On Time = 113ms

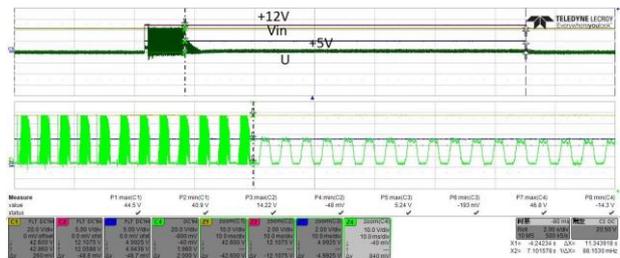


Fig. 2 Measured bus voltage, VCC=12V, LDO=5V @ bus=42V
Power Off Time = 11.34s

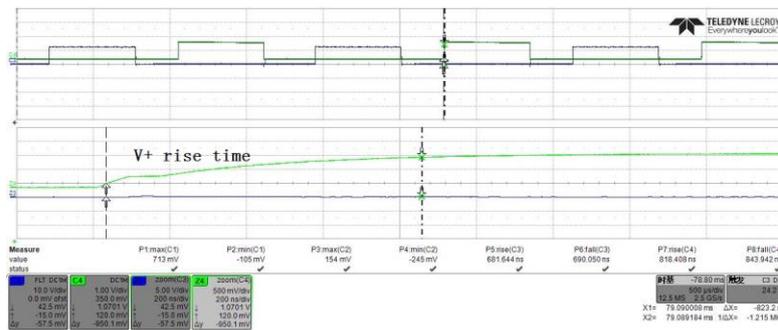


Fig. 7 Measured V-Phase highside Rise MOSFET Vgs @ bus = 42V

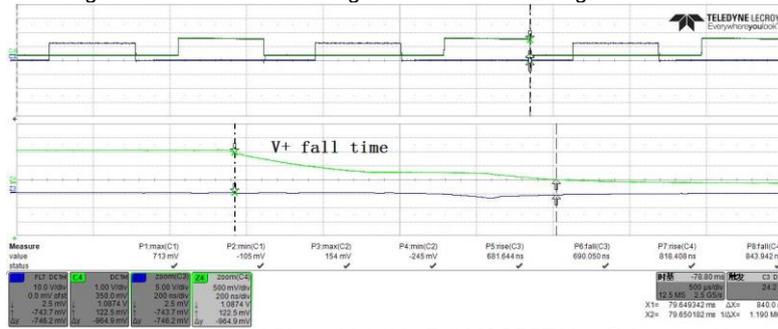


Fig. 8 Measured V-Phase highside Fall MOSFET Vgs @ bus = 42V

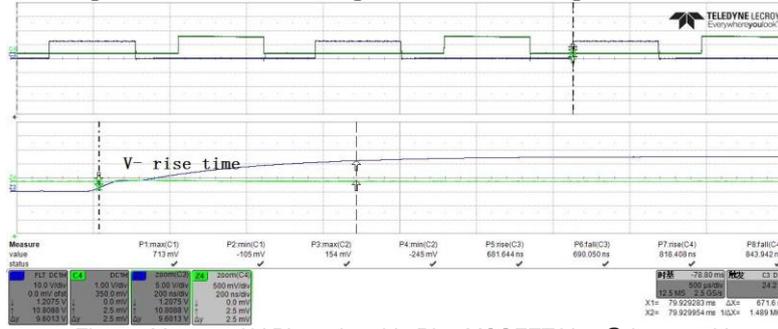


Fig. 9 Measured V-Phase lowside Rise MOSFET Vgs @ bus = 42V

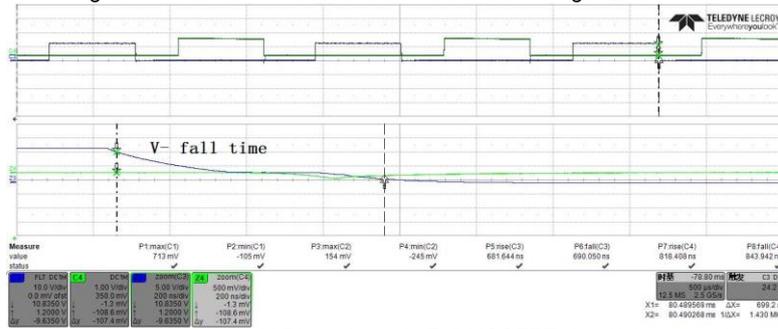


Fig. 10 Measured V-Phase lowside Fall MOSFET Vgs @ bus = 42V

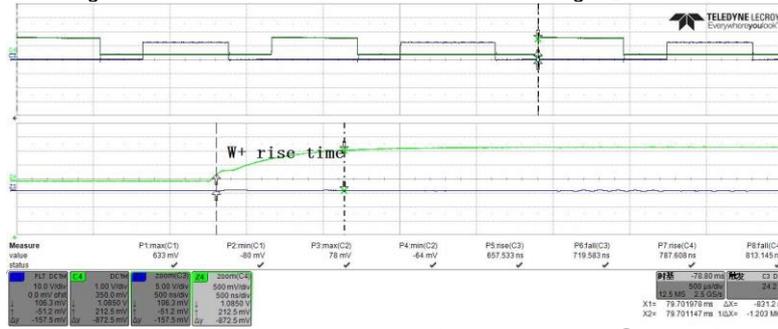


Fig. 11 Measured W-Phase highside Rise MOSFET Vgs @ bus = 42V

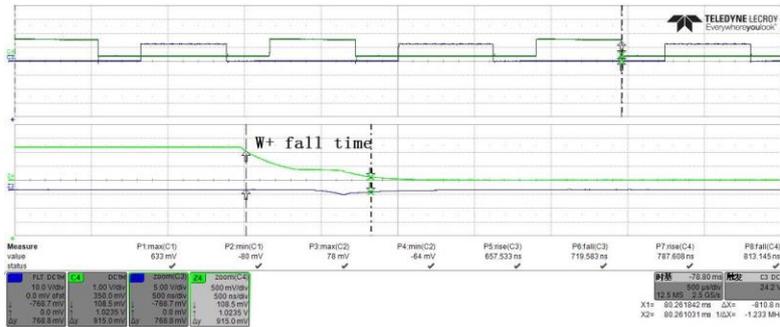


Fig. 12 Measured W-Phase highside Fall MOSFET Vgs @ bus = 42V

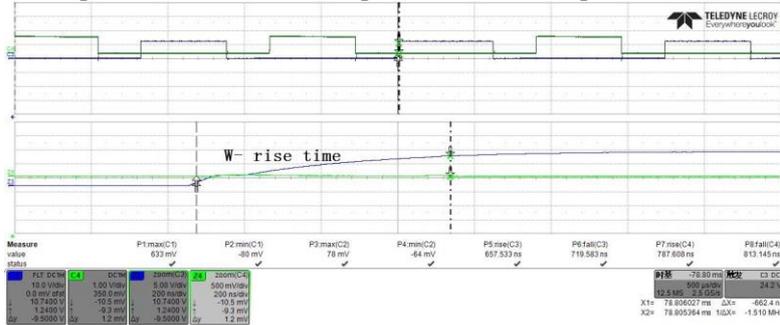


Fig. 13 Measured W-Phase lowside Rise MOSFET Vgs @ bus = 42V

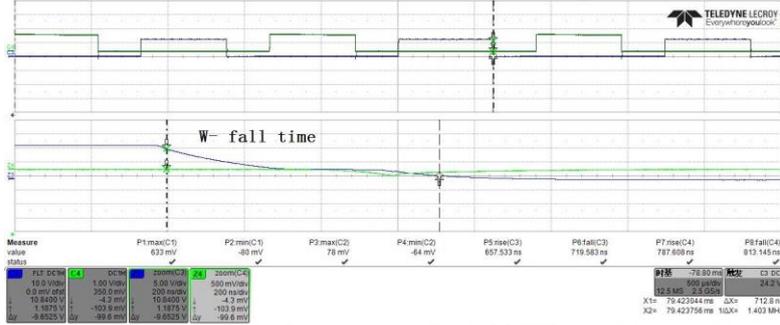


Fig. 14 Measured W-Phase lowside Fall MOSFET Vgs @ bus = 42V

3.2.2 Vds Strike Voltage @ Bus = 42V

	U-	V-	W-
Vds / V	62.1	57.6	54.6

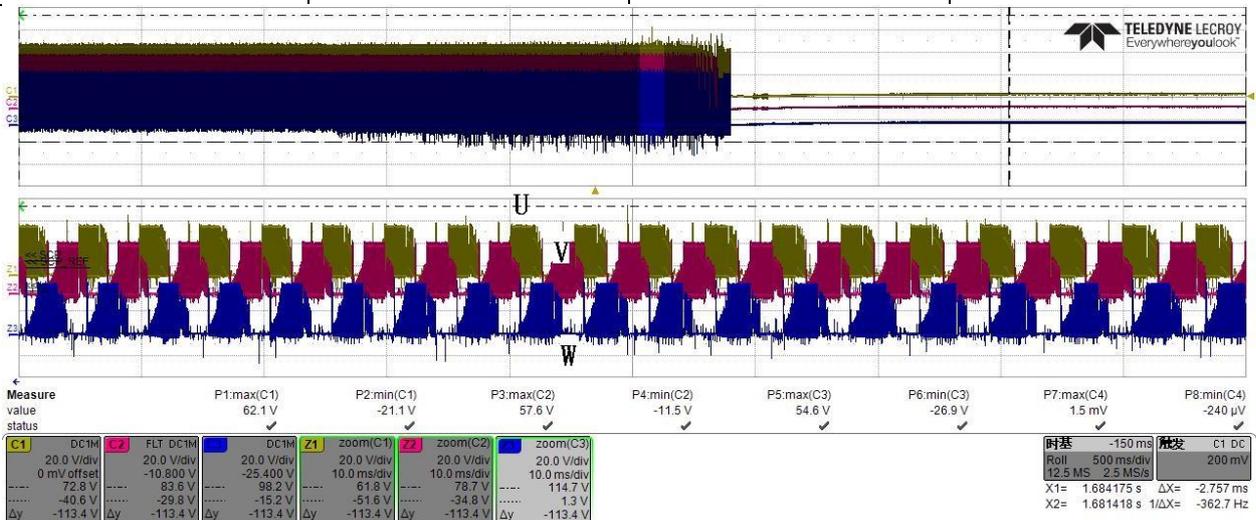


Fig. 15 Measured U- (Yellow), V-(Red), W-(Blue) MOSFET Vds strike voltage @ bus = 42V

3.3 Current Sensing

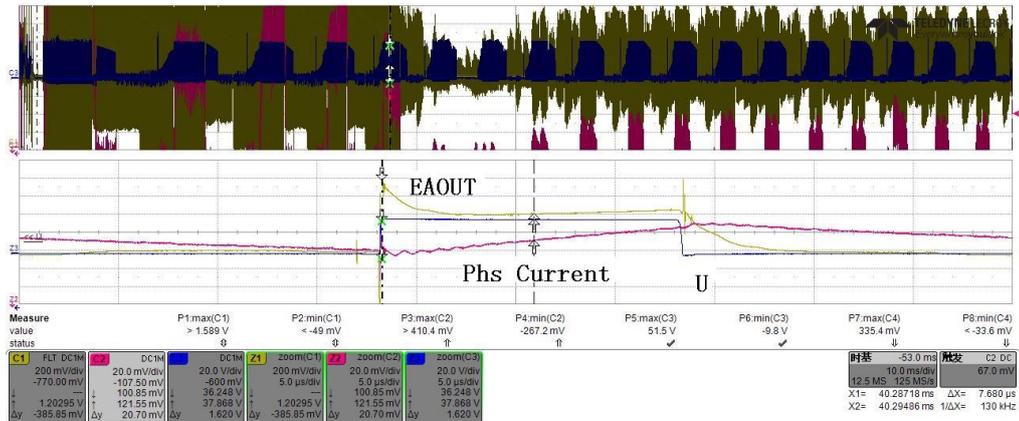


Fig. 16 Measured Amplifier output(Yellow), pha-current(Red) @ bus = 42V

3.4 Motor Short Circuit Protection

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

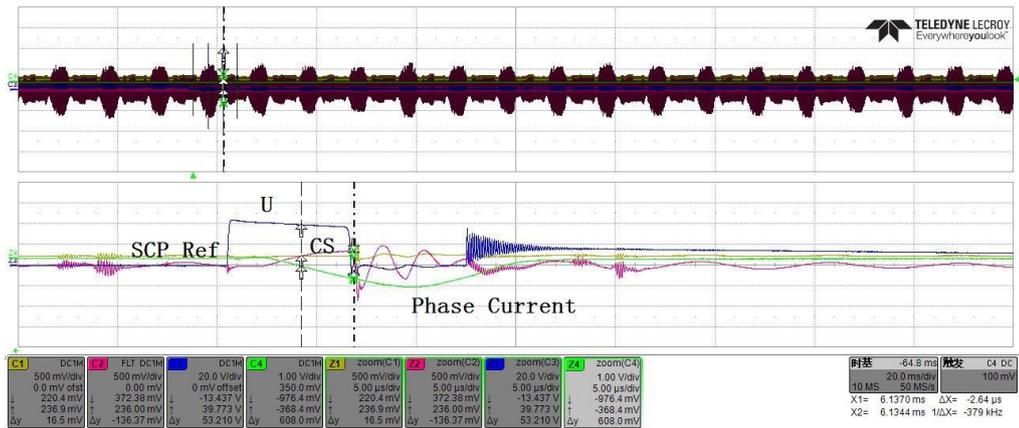


Fig. 17 Measured Phs Current(C4 Green), U phase voltage (C3 Blue), SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 42V

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

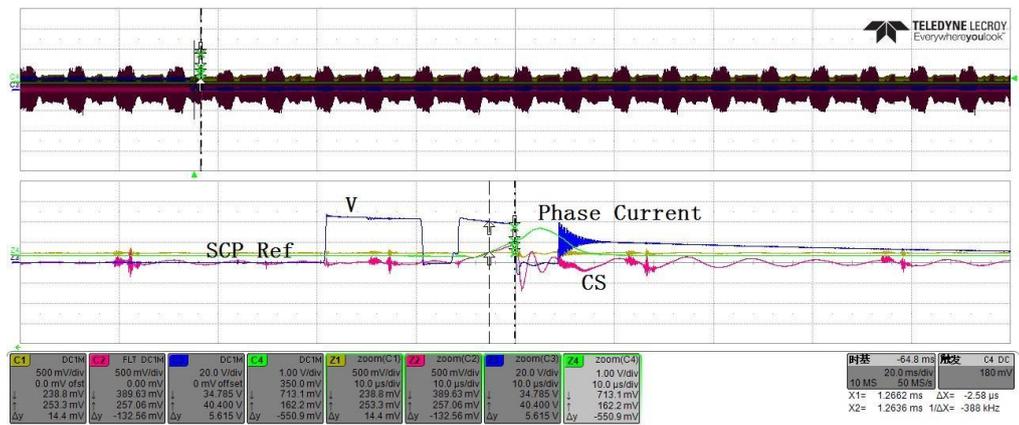


Fig. 18 Measured Phs Current(C4 Green), V phase voltage (C3 Blue), SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 42V

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

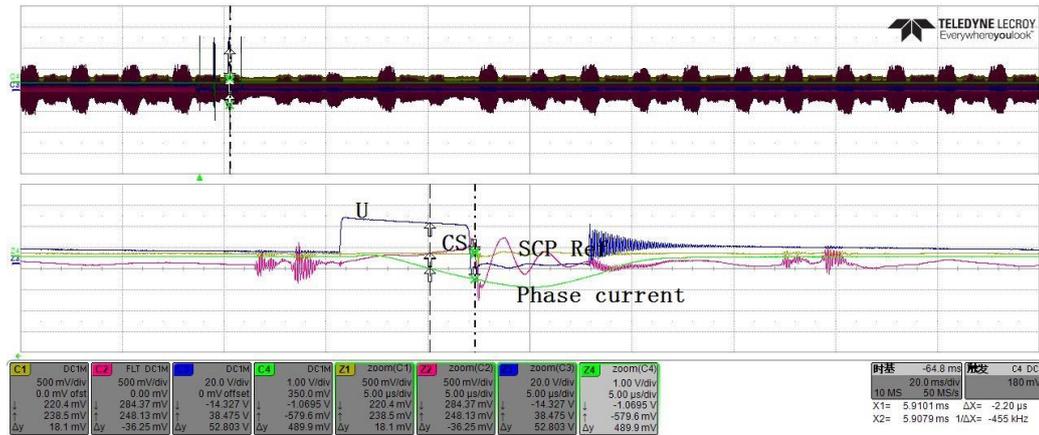


Fig. 19 Measured Phs Current(C4 Green), U phase voltage (C3 Blue), SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 42V

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

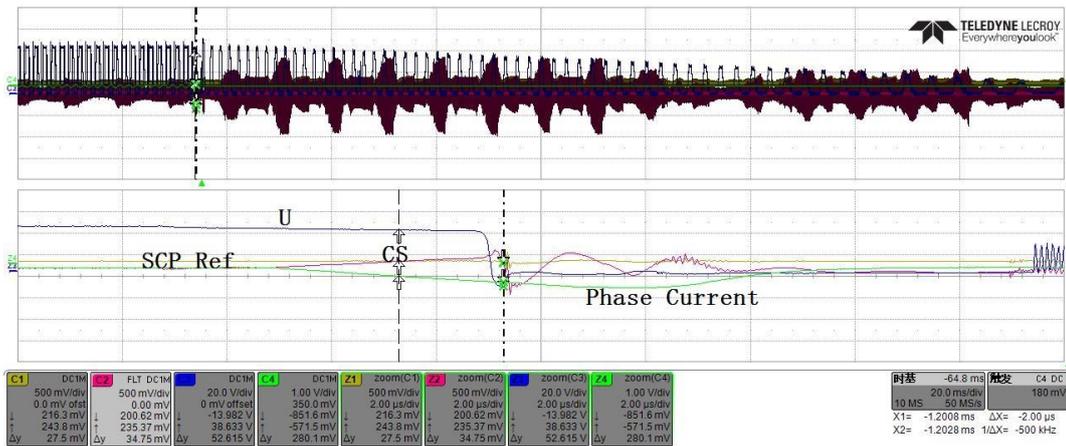


Fig. 20 Measured Phs Current(C4 Green), U phase voltage (C3 Blue), SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 42V

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

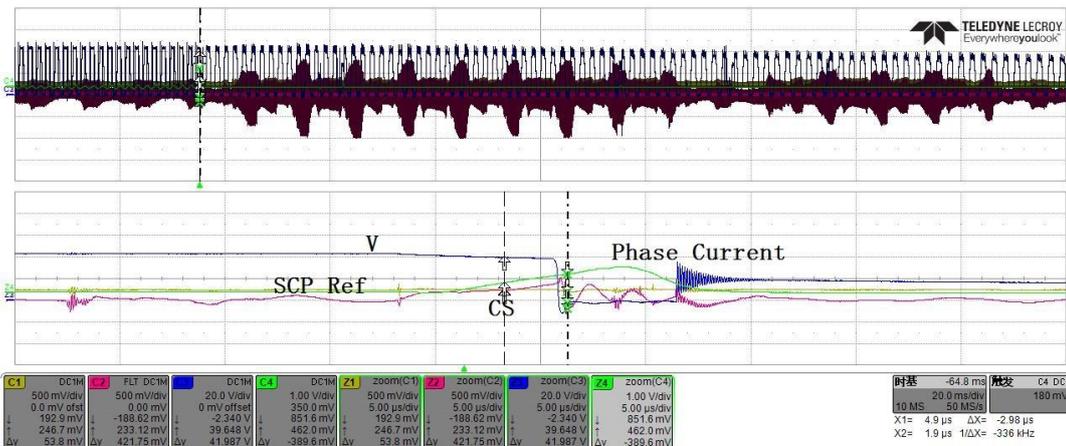


Fig. 21 Measured Phs Current(C4 Green), V phase voltage (C3 Blue), SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 42V

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

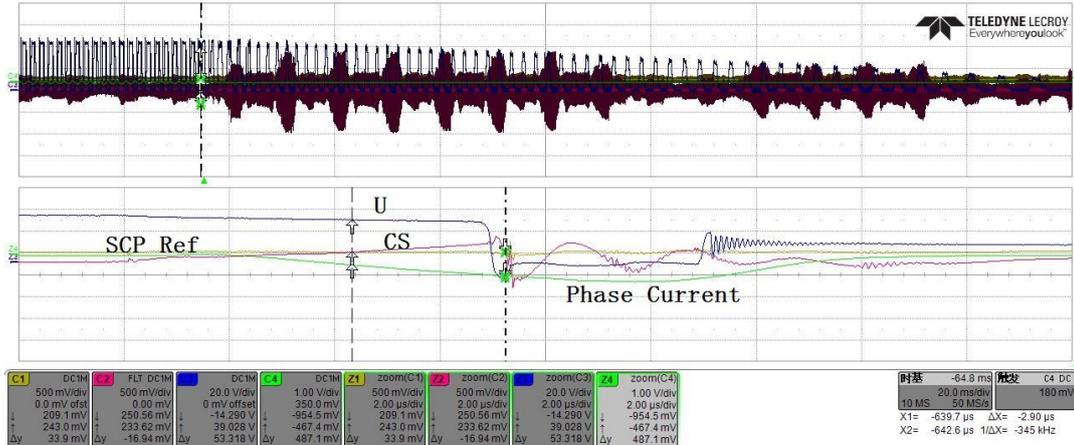


Fig. 22 Measured Phs Current(C4 Green), U phase voltage (C3 Blue), SCP voltage(C1 Yellow), Rcs voltage(C2 Red) @ battery voltage = 42V

3.5 Load Test

3.5.1 Temperature Measure

Setup: Temperature Protect: 85°C, Bus Voltage = 42V

时间/S	MOS1	MOS4	MOS2	MOS5	MOS3	MOS6	NTC	电容
0	27.5	27.6	27.4	26.8	27.4	26.5	26.3	27.3
18	30.7	31.0	30.8	32.4	32.5	33.2	26.8	30.0
36	71.7	60.8	69.1	67.0	71.2	72.3	42.5	32.6
54	81.5	68.5	81.2	76.5	87.3	80.3	56.4	36.8
72	78.7	71.6	80.4	80.2	85.7	78.0	61.2	40.8
85	100.3	84.1	94.1	97.2	103.3	99.3	70.0	45.3

3.6 Reliability

3.6.1 Low Temperature Reliability

Setup: TA = -40°C, Bus Voltage = 42V

Result: Pass

3.6.2 High Temperature Reliability

Setup : Bus voltage = 42V, Bus Current =3.1 A, TA =90°C

时间/min	MOS1	MOS4	MOS2	MOS5	MOS3	MOS6	NTC	电容
30	98.8	99.8	100.3	100.4	101.3	100.4	72.5	96.4
60	99.5	100.5	99.2	101.3	102.3	101	72.4	96.8
90	99.5	102	99.8	102.5	103.8	101.7	73.5	97.5
120	99.5	102.1	99.7	102.5	103.8	101.7	73.5	97.5

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