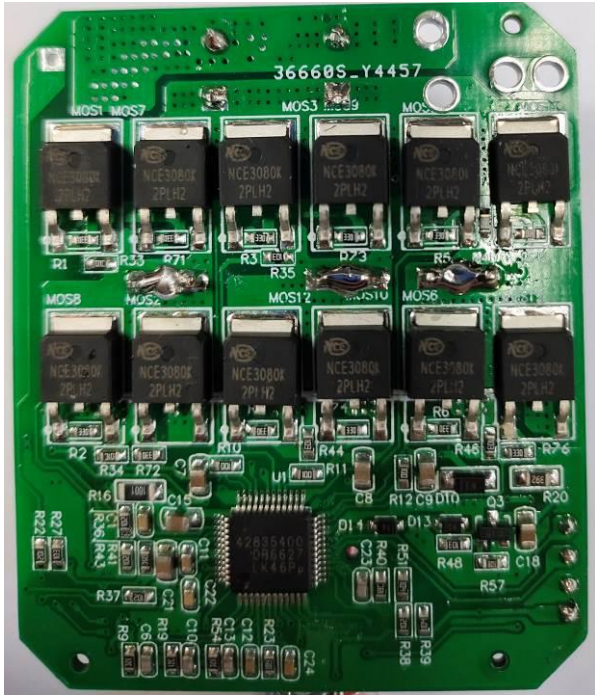


**Subject**  
**OB6627L Demo Board Manual**

Board Model: OB6627\_12MOS\_DC 2047  
 Doc. No.: OB\_DOC\_DBM\_D\_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

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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  $1m\Omega$
- 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 35.7V
- MOSFET thermal sensor precision 1%

## 1.3 Output characteristic

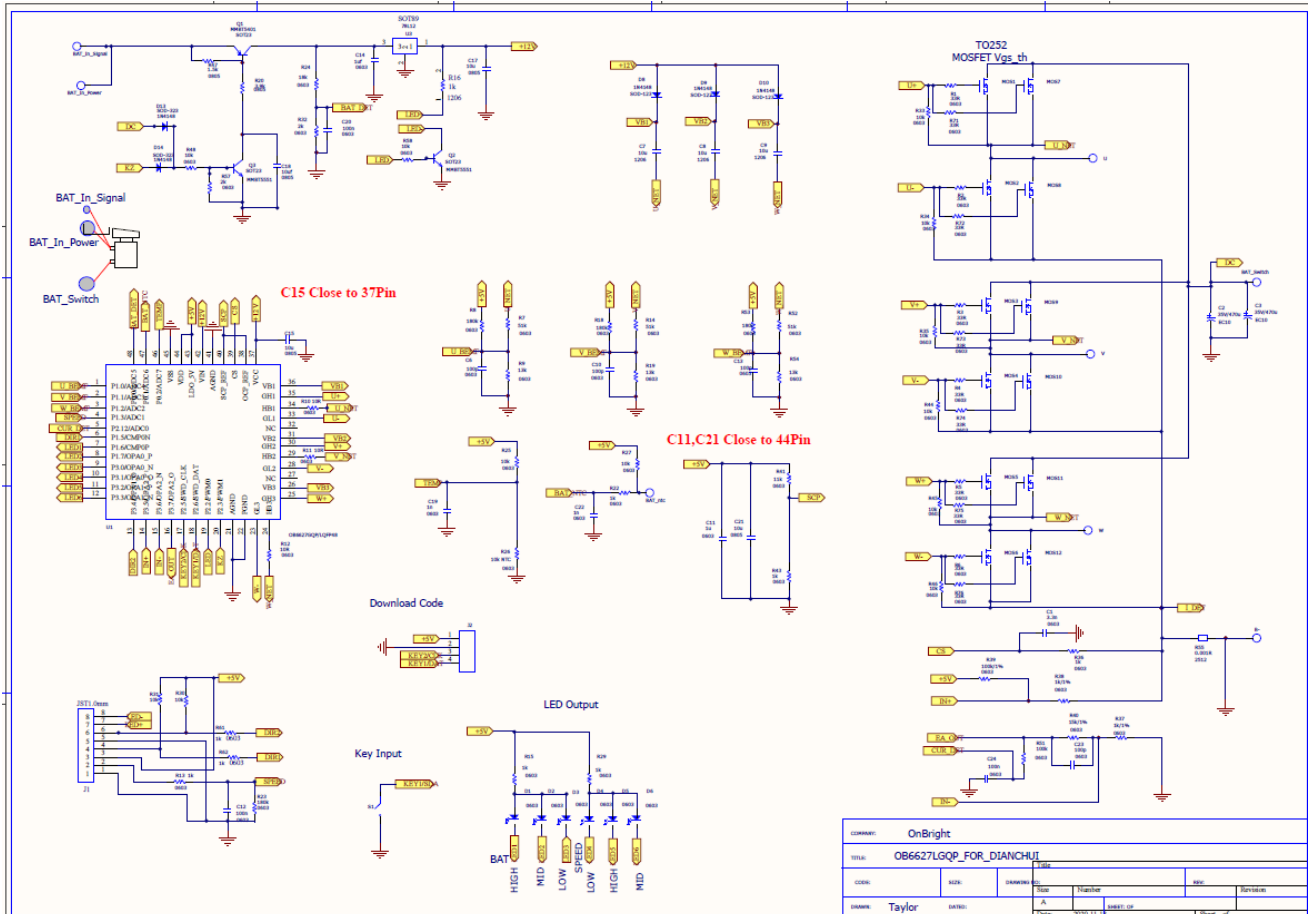
- Phase current 80A
- Phase current overcurrent protection delay 8ms
- Non-Full speed instantaneous current protection 80A
- Non-Full speed instantaneous current protection delay 8ms
- Secondary phase current protection 100A
- Secondary phase current protection delay 100us
- Maximum of PWM duty 100%
- Minimum of PWM duty 21%

## 1.4 Environmental

- Operating Ambient Temperature  $-20^{\circ}\text{C}$  to  $60^{\circ}\text{C}$
- Storage Temperature  $-40^{\circ}\text{C}$  to  $100^{\circ}\text{C}$
- Storage Humidity 0% to 95% R.H.

## 2. Board Information

### 2.1 Schematic

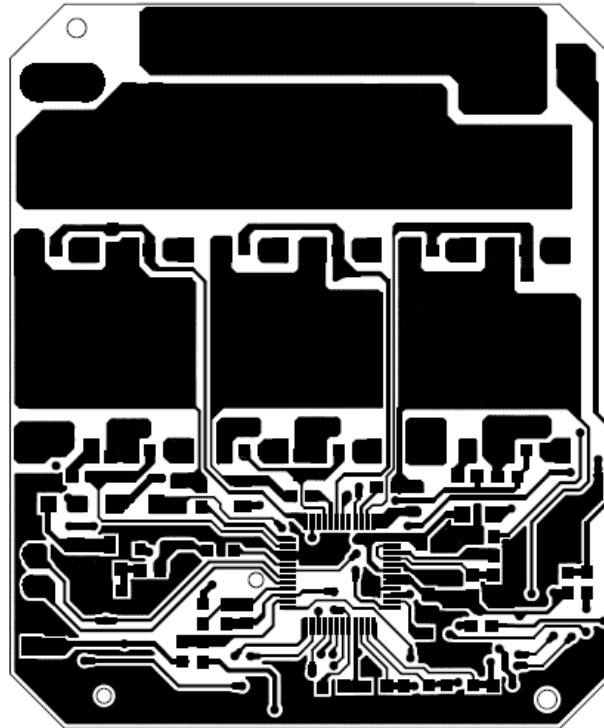


## 2.2 Bill of material

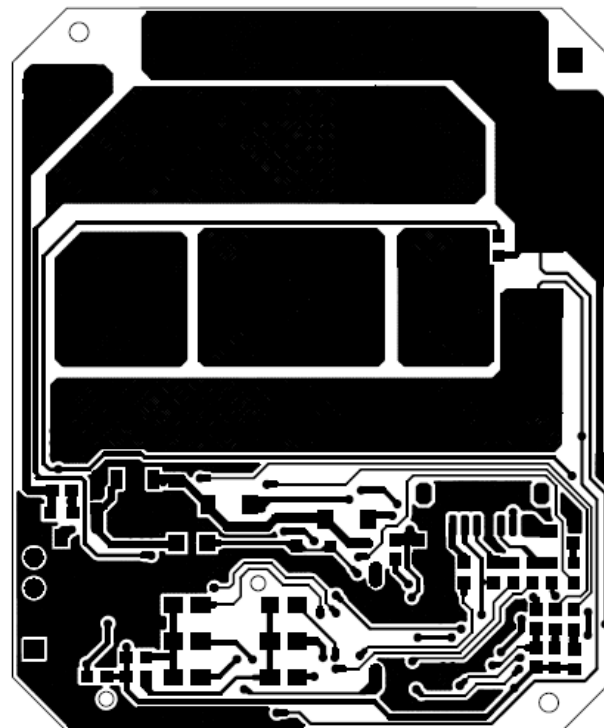
Position	Description	Package	QTY
C1	Capacitor,ceramic,3.3nf/25V,X7R,10%	0603	1
C2, C3	Capacitor, aluminum electrolytic, 470uf/35V, -40/105°C	EC10	2
C7,C8, C9, C15, C17, C18,C21	Capacitor,ceramic,10uf/25V,X7R,10%	0805	7
C11,C14	Capacitor,ceramic,1uf/25V,X7R,10%	0603	2
C19,C22	Capacitor,ceramic,1nf/25V,X7R,10%	0603	2
C6, C10, C13,C23	Capacitor,ceramic,100pf/25V,X7R,10%	0603	4
C12,C20, C24	Capacitor,ceramic,100nf/25V,X7R,10%	0603	3
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,MO S6,MOS7,MOS8,MOS9,MOS10, MOS11, MOS12	Power MOS,NCE3080K (30V 80A)	TO252	12
Q1	PNP,MMBT5401	SOT23	1
Q2,Q3	NPN,MMBT5551	SOT23	2
R1,R2,R3,R4,R5,R6,R71,R72, R73, R74,R75, 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, R23,R53	Resistor,chip,180k,1%	0603	4
R25, R27,R30,R31,R33, R34, R35, R44,R45,R46, R48,R58	Resistor,chip,10k,5%	0603	12
R10, R11, R12	Resistor,chip,10R,5%	0603	3
R13,R15,R22,R29, R36, R43,R61,R62	Resistor,chip,1k,5%	0603	8
R20	Resistor,chip,3.9k,5%	0805	1
R24	Resistor,chip,18k,1%	0603	1
R26	NTC,TSM1A103-34D,10K,B=3950,1%	0603	1
R32,R57	Resistor,chip,2k,1%	0603	2
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%	0805	1
R16	Resistor,chip,1k,5%	1206	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

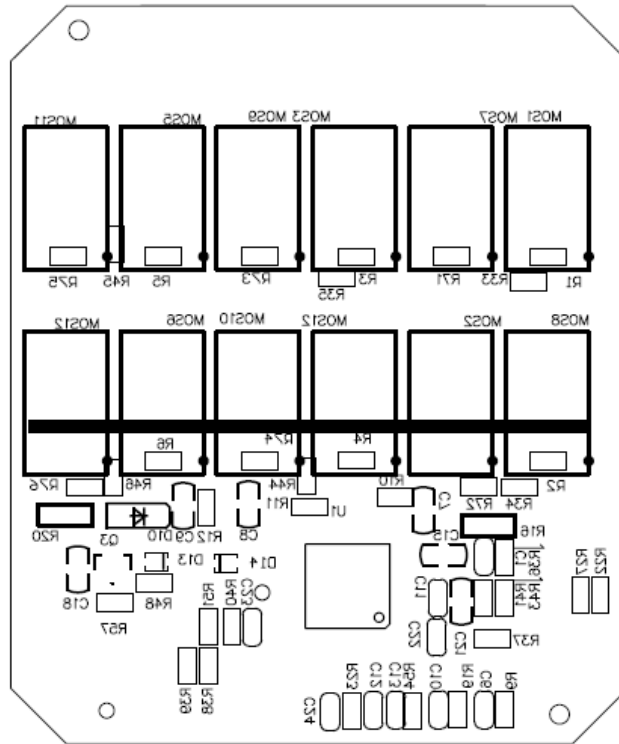
## 2.3 PCB Garber File



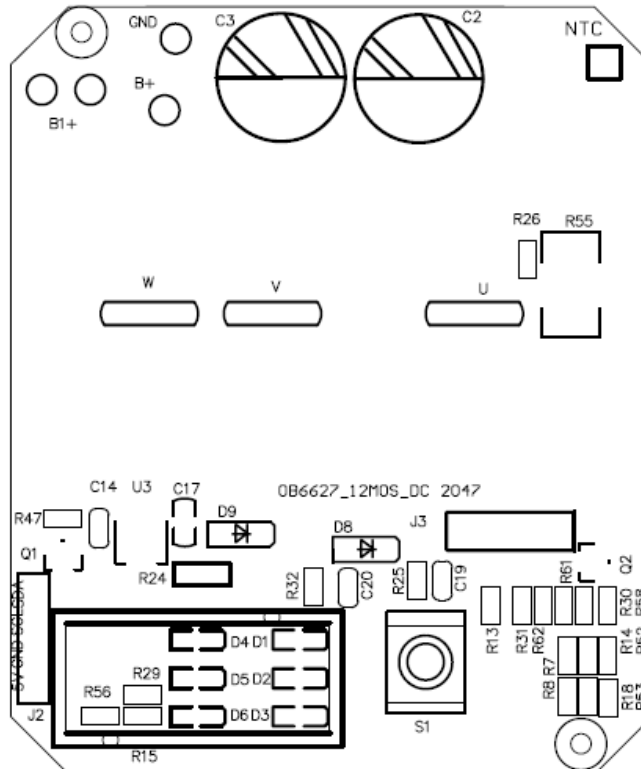
Top Layer



Bottom Layer

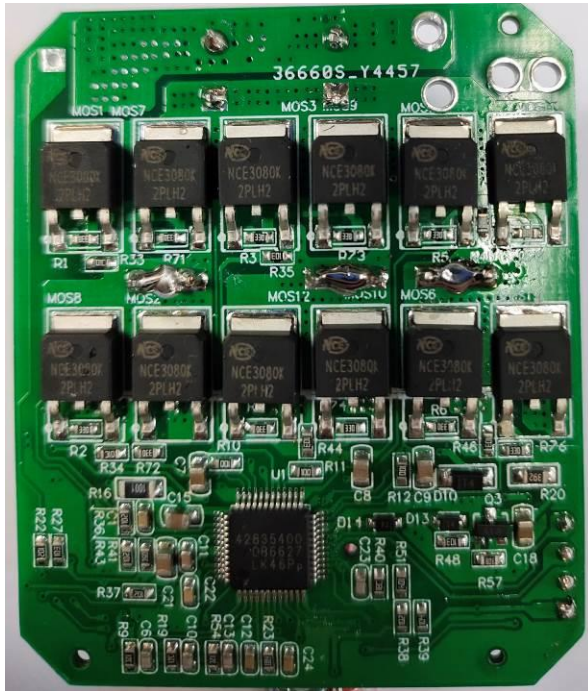


Silkscreen Top

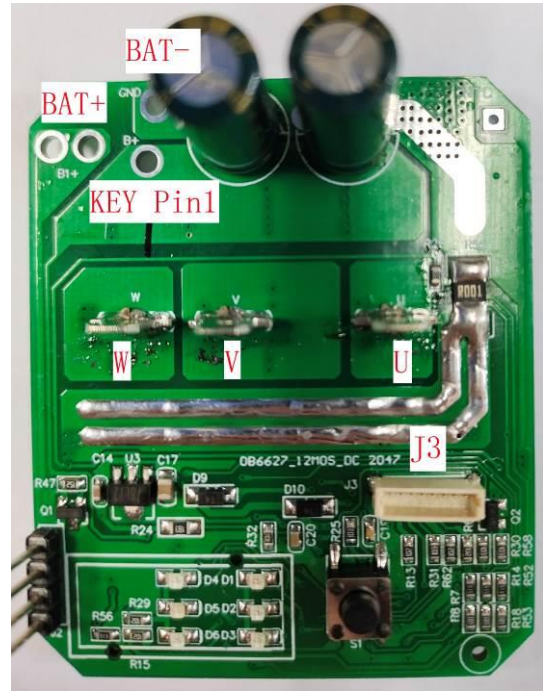


Silkscreen Bottom

## 2.4 Connector Function Description



Top



Bottom

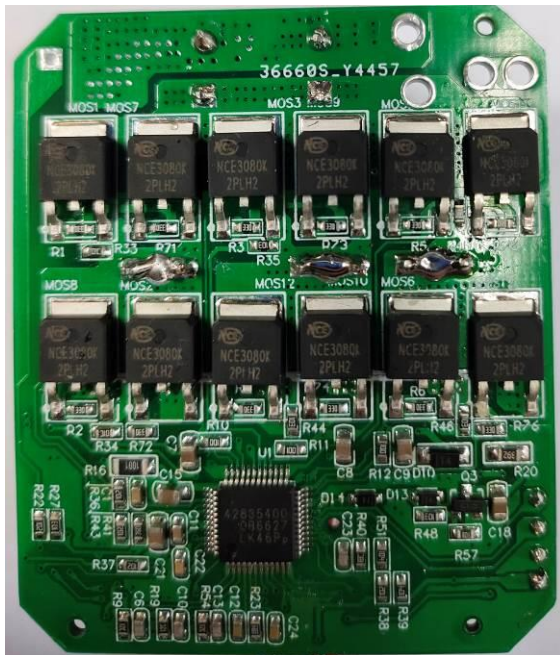
Name	Description
BAT+	Battery input, Bus+
BAT-	Battery input, GND
KEY Pin1	Current output port of Flow current switch
U	Motor U phase output
V	Motor V phase output
W	Motor W phase output

J3- 8pin connector

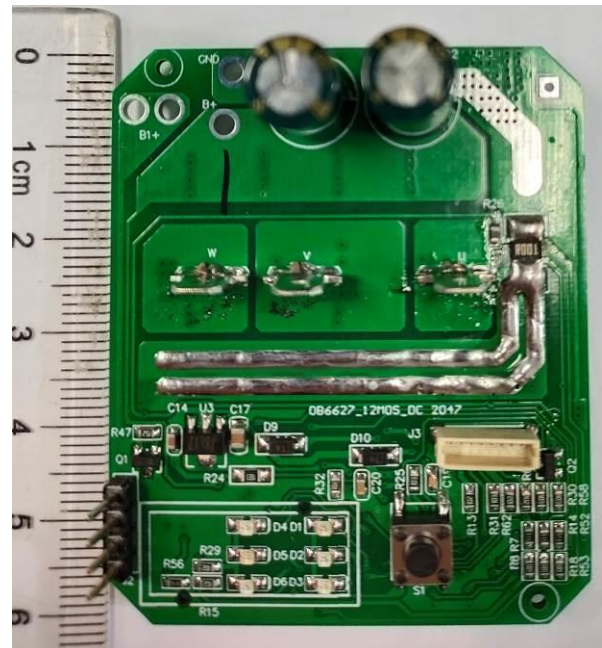
Pin Num	Description	Voltage Range
1	GND	0
2	Speed signal input	0~5V
3	Speed signal supply	5V
4	Motor Direction Control1	0~5V
5	GND	0
6	Motor Direction Control2	0~5V
7	LED+	0~12V
8	LED-	0~12V



## 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	Vgs		12.0		V
5	Highside MOSFET Rise time	Tr_h		0.427		us
6	Highside MOSFET Fall time	Tf_h		0.671		us
7	Lowside MOSFET Rise time	Tr_l		0.440		us
8	Lowside MOSFET Fall time	Tf_l		0.502		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 Vds 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

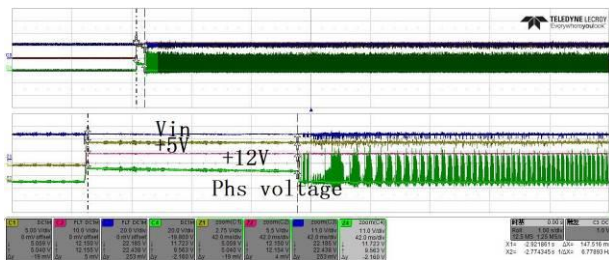


Fig. 1 Measured bus voltage, VCC=12V, LDO=5V @ bus=22V  
Power On Time = 147ms

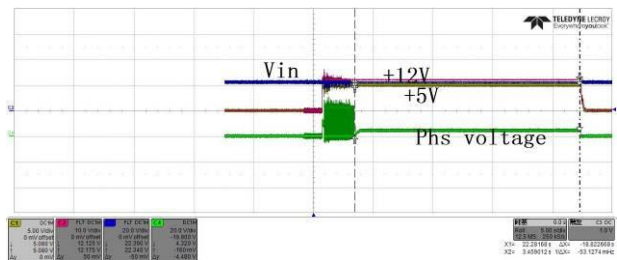


Fig. 2 Measured bus voltage, VCC=12V, LDO=5V @ bus=22V  
Power Off Time = 18.8s

## 3.2 MOSFET

### 3.2.1 Vgs Rise/Fall Edge Time

	GH1	GH2	GH3	GL1	GL2	GL3
tr/us	0.427	0.426	0.423	0.440	0.462	0.476
tf/us	0.671	0.706	0.697	0.502	0.495	0.482

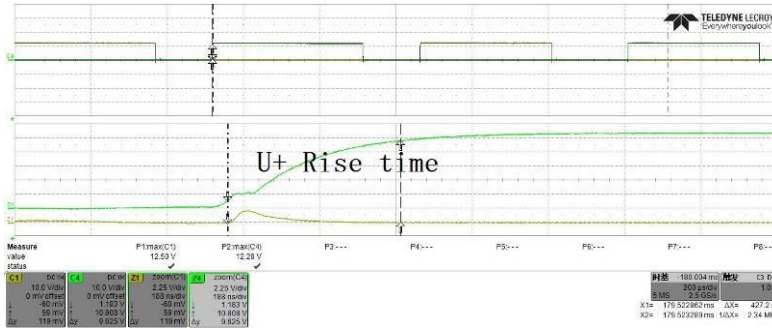


Fig. 3 Measured U-Phase highside Rise MOSFET Vgs @ bus = 18V

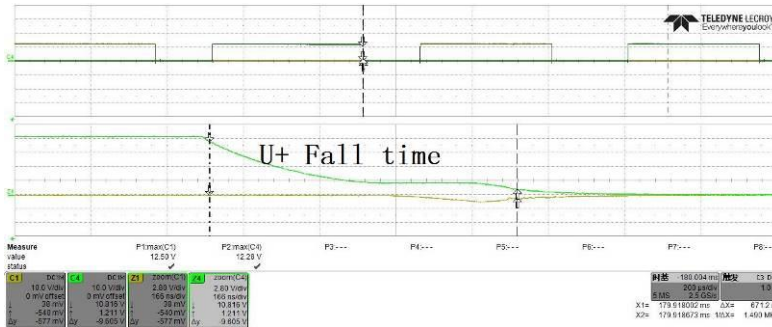


Fig. 4 Measured U-Phase highside Fall MOSFET Vgs @ bus = 18V

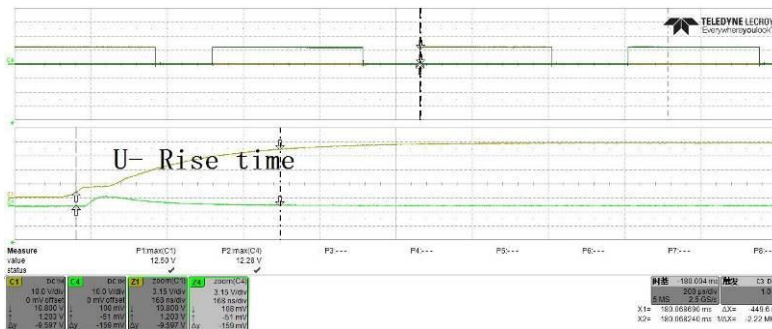


Fig. 5 Measured U-Phase lowside Rise MOSFET Vgs @ bus = 18V



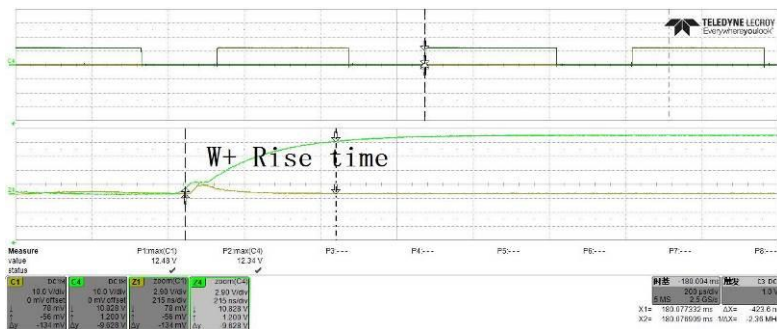


Fig. 11 Measured W-Phase highside Rise MOSFET Vgs @ bus = 18V

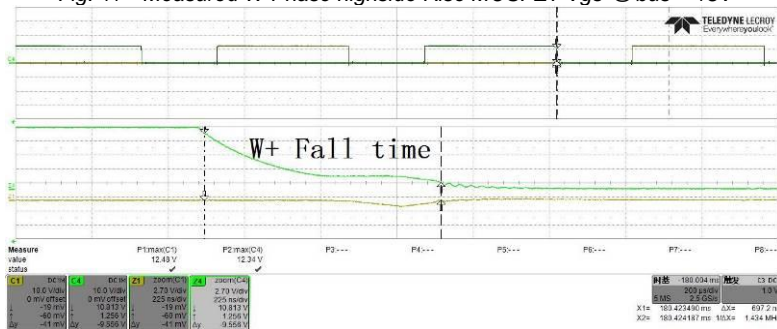


Fig. 12 Measured W-Phase highside Fall MOSFET Vgs @ bus = 18V

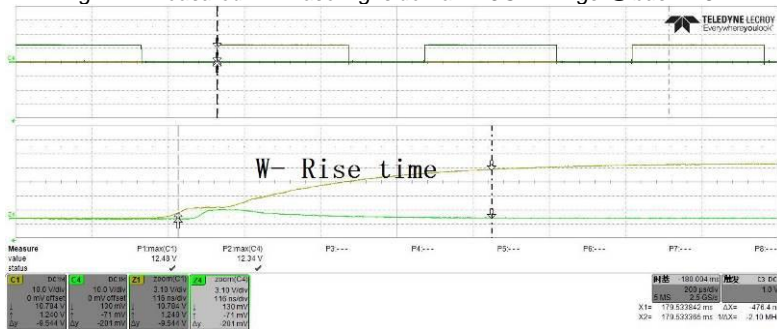


Fig. 13 Measured W-Phase lowside Rise MOSFET Vgs @ bus = 18V

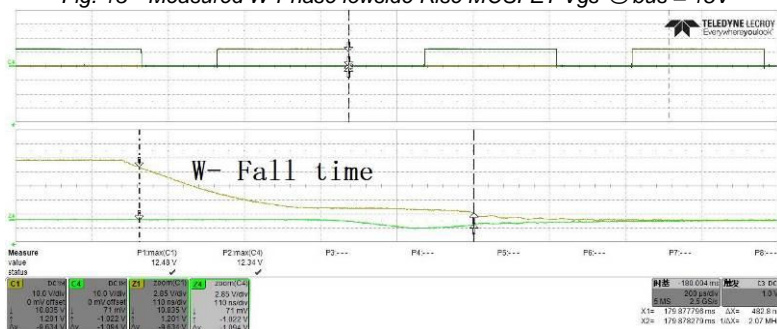


Fig. 14 Measured W-Phase lowside Fall MOSFET Vgs @ bus = 18V

### 3.2.2 Vds Strike Voltage @ Bus = 22V

	U+	V+	W+
Vds / V	34.86	34.6	35.7
	U-	V-	W-
Vds / V	31.01	31.2	35.3

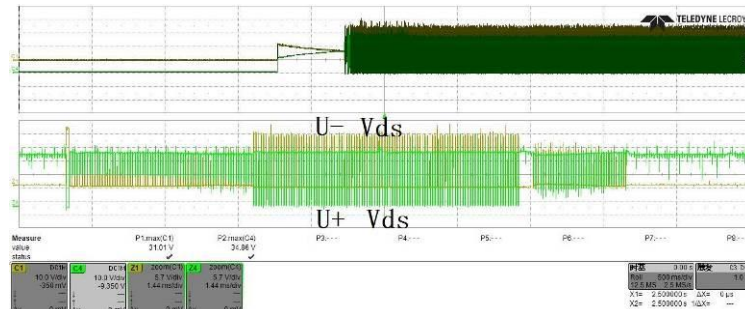


Fig. 15 Measured U+(Red), U-(Green) MOSFET Vds strike voltage @ bus = 22V

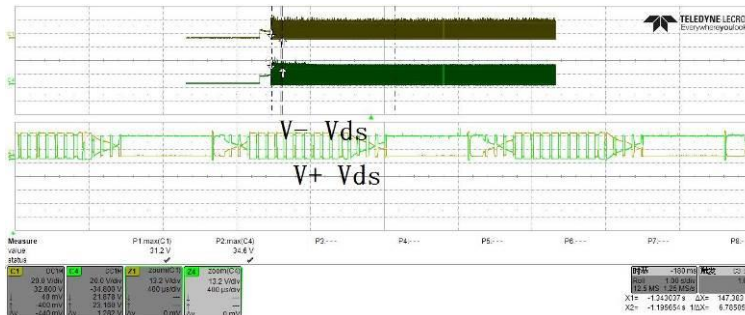


Fig. 16 Measured V+( Red), V-( Green) MOSFET Vds strike voltage @ bus = 22V

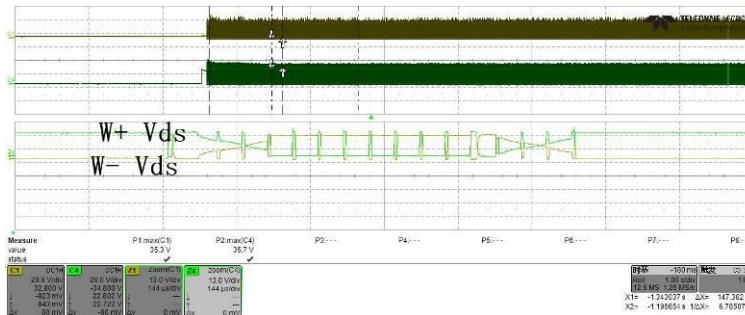


Fig. 17 Measured W+( Red), W-( Green) MOSFET Vds strike voltage @ bus = 22V

### 3.3 Current Sensing

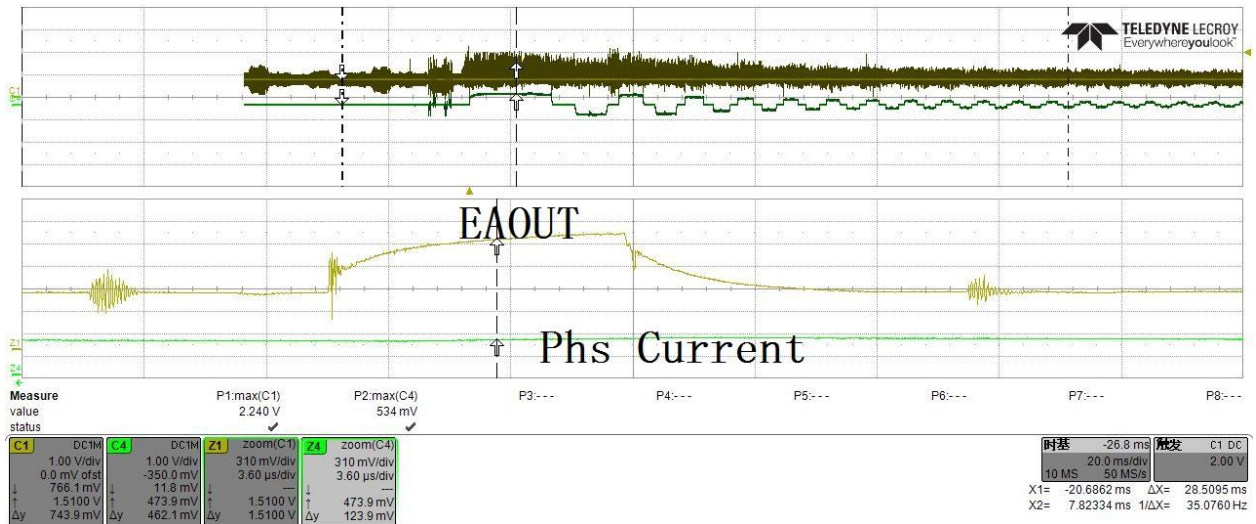


Fig. 18 Measured Amplifier output (Yellow), pha-current (Green) @ bus = 22V

### 3.4 Motor Short Circuit Protection

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

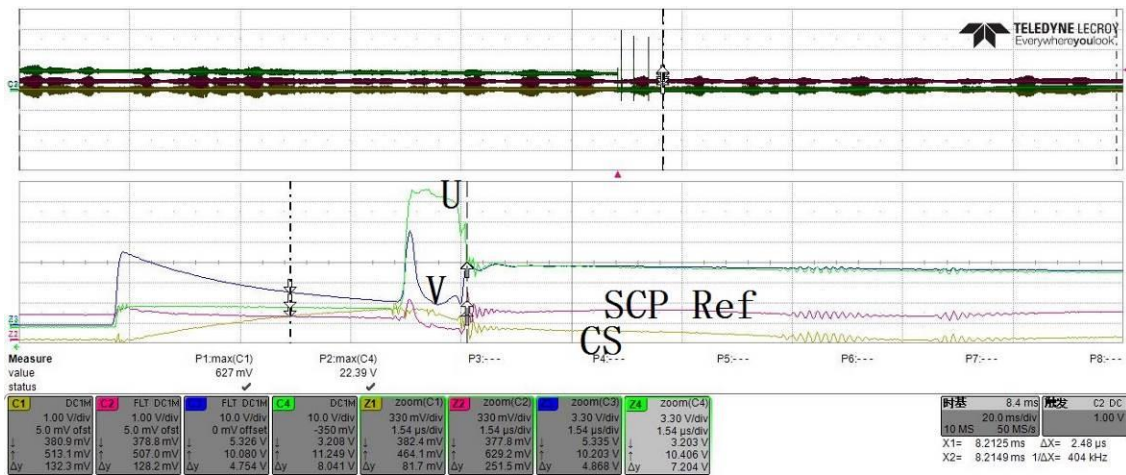


Fig. 19 Measured U (C4 Green) / V (C3 Blue) - phase voltage, SCP voltage (C2 Red), Rcs voltage (C1 Yellow) @ battery voltage = 18V

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

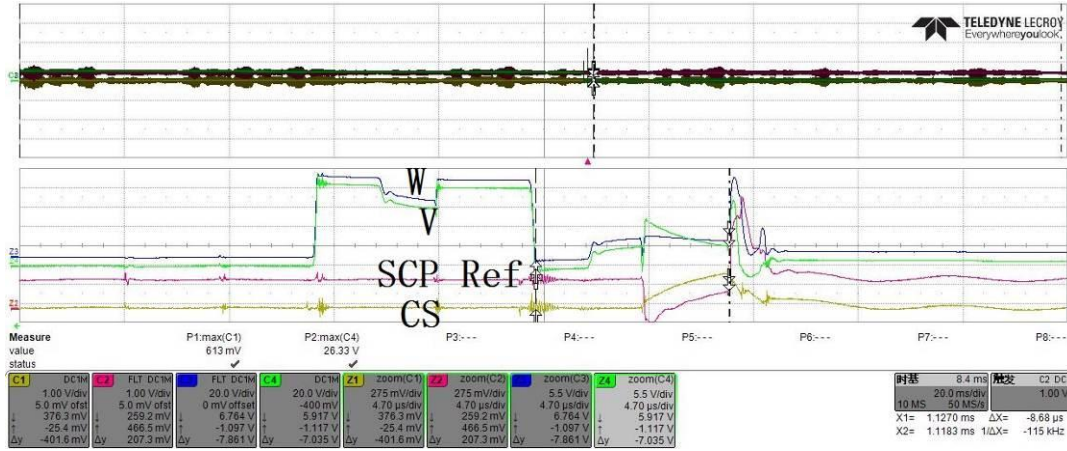


Fig. 20 Measured V(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage =18V

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

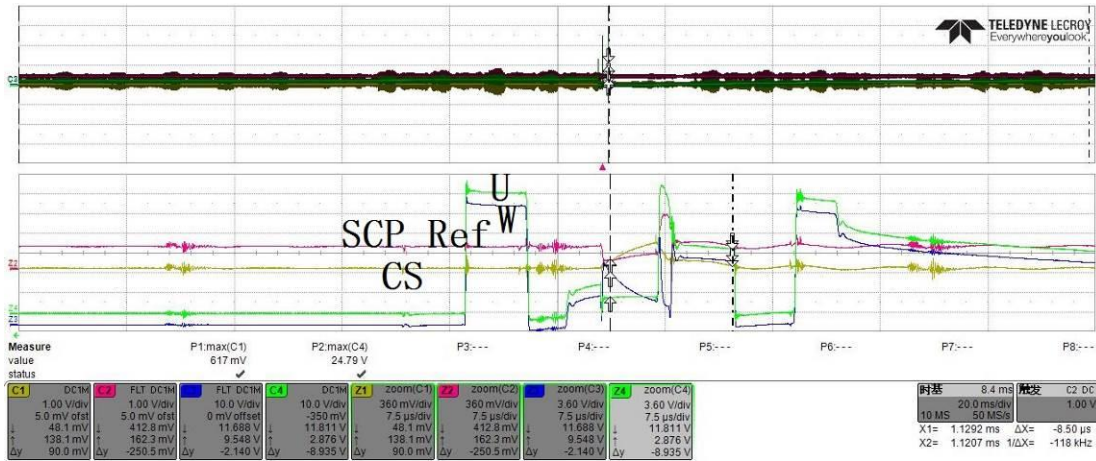


Fig. 21 Measured U(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage =18V

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

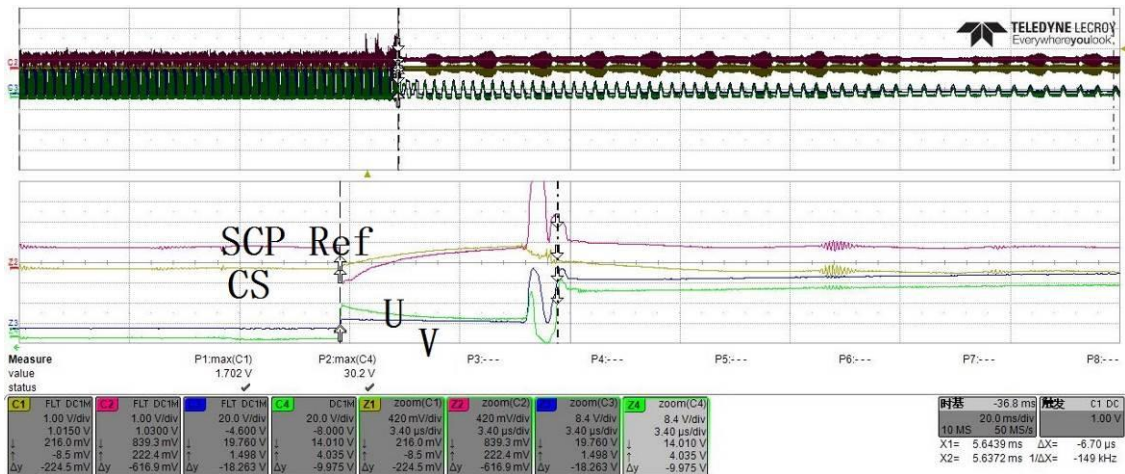


Fig. 22 Measured U(C4 Green)/V(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage =22V



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

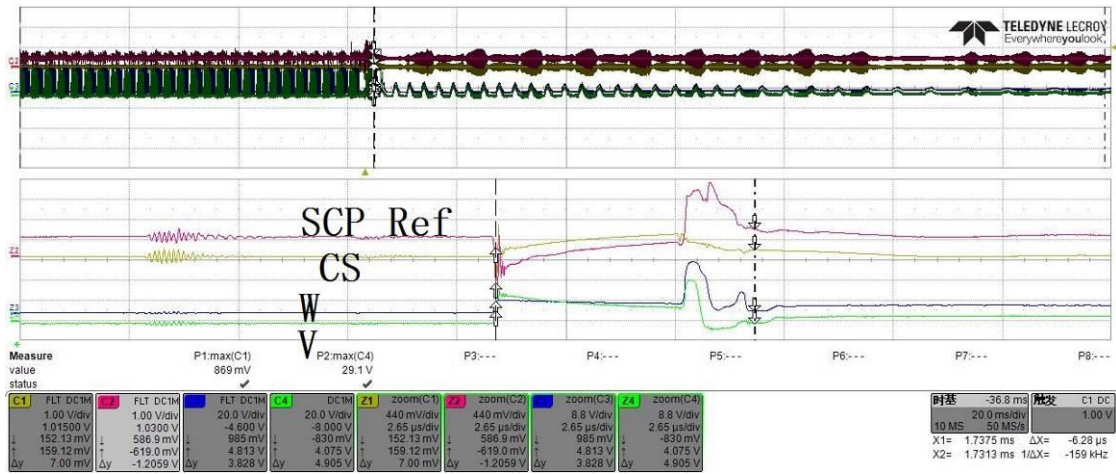


Fig. 23 Measured V(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage =22V

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

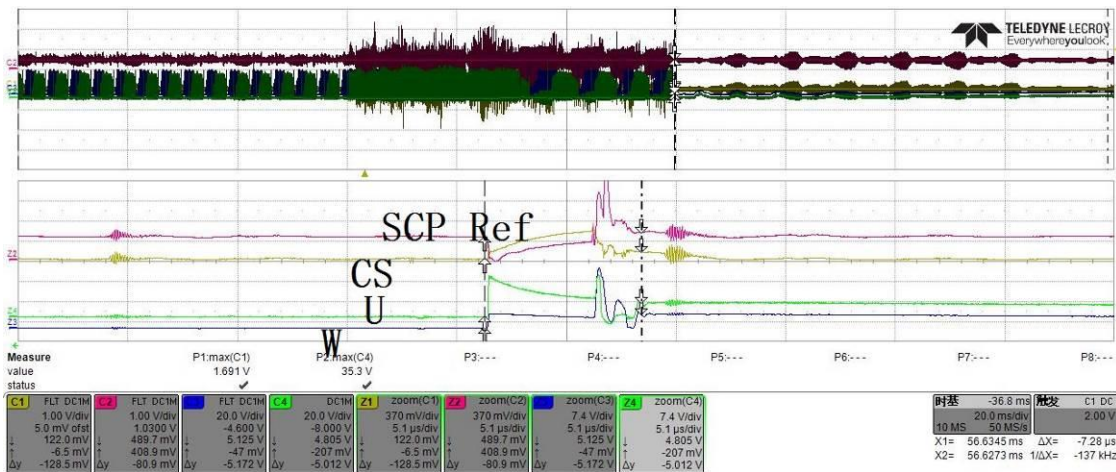


Fig. 24 Measured U(C4 Green)/W(C3 Blue)-phase voltage, SCP voltage(C2 Red), Rcs voltage(C1 Yellow) @ battery voltage =22V

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## 3.5 Temperature Test

### 3.5.1 Temperature Measure

Setup : Bus voltage = 20.2V, Bus Current = 10.2A, TA = 60°C

	MOS1	MOS2	MOS3	MOS4	MOS5	MOS6	NTC
30min	75.9	73.9	73.2	75.3	76.9	75.5	76
60min	76.9	74.9	74	76.1	77.9	76.5	77
90min	76.8	74.9	74.1	76.1	77.9	76.4	77.1
120min	76.8	75	74.2	76.1	78	76.5	77

## 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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