

**Subject**  
**OB6619 Demo Board Manual**

Board Model: OB6619\_12MOS\_DC\_2144

Doc. No.: OB\_DOC\_DBM\_B\_661900


**Key Feature:**

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

**Revision history:**

Revise Date	Version	Reason/Issue
2021-11-17	00	First Issue

## 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 Garber File .....	6
2.4	Heat-sink Three View Drawing .....	7
2.5	Connector Function Description .....	8
2.6	BLDC Controller Board Snapshot .....	9
3.	Performance Evaluation.....	10
3.1	Bus Current With MOSFET NTC Temperature .....	11
3.1.1	Load Temperature .....	11
3.1.2	Low Temperature .....	11
3.2	Voltage Test .....	11
3.2.1	Gate Driver & MCU Supply Power ON/OFF .....	11
3.2.2	Battery under voltage lockout .....	12
3.2.3	MOSFET Vgs .....	12
3.2.4	MOSFET Vds .....	13
3.3	PWM Test .....	13
3.3.1	PWM Frequency .....	13
3.3.2	Speed Regulator .....	14
3.3.3	PWM Initial duty .....	14
3.3.4	PWM Duty ON.....	15
3.4	Current sampling .....	15
3.5	Motor Short Circuit Protection .....	16
3.5.1	U-V phase short circuit.....	16
3.5.2	U-W phase short circuit.....	16
3.5.3	V-W phase short circuit .....	17
3.6	Dead Time .....	17

## Figures Index

Fig. 1	Measured gate driver and MCU supply voltage @ battery=18V .....	11
Fig. 2	Measured gate driver and MCU supply voltage @ battery=18V .....	11
Fig. 3	Measured UVW output voltage @ battery=13.5V .....	12
Fig. 4	Measured U phase voltage and highside MOSFET Vgs rise time @ battery=18V .....	12
Fig. 5	Measured U phase voltage and highside MOSFET Vgs fall time @ battery=18V .....	12
Fig. 6	Measured U phase voltage and lowside MOSFET Vgs rise time @ battery=18V.....	12
Fig. 7	Measured U phase voltage and lowside MOSFET Vgs fall time @ battery=18V.....	12
Fig. 8	Measured U phase voltage and highside and lowside MOSFET Vds @ battery=21V .....	13
Fig. 9	Measured U phase voltage and highside and lowside MOSFET Vgs.....	13
Fig. 10	Measured U-phase and throttle voltage .....	14
Fig. 11	Measured U phase voltage and highside and lowside MOSFET Vgs .....	14
Fig. 12	Measured UVW phase voltage .....	15
Fig. 13	Measured U phase voltage, U phase current and EA out .....	15
Fig. 14	Measured U-phase voltage, V-phase voltage, IO-trigger, phase current @ battery .....	16
Fig. 15	Measured U-phase voltage, W-phase voltage, IO-trigger, phase current @ battery .....	16
Fig. 16	Measured V-phase voltage, W-phase voltage, IO-trigger, phase current @ battery.....	17
Fig. 17	Measured highside and lowside MOSFET Vgs.....	17

# 1. System Electrical Specification

## 1.1 Input Characteristic

▪ DC input voltage rating	5 cells Li-Iron battery of 3.7V
▪ DC input voltage	13.5V to 25V
▪ Handle working voltage	0 to 5V
▪ Hall sensor working voltage	0 to 5V
▪ Motor steering signal type	Differential signal

## 1.2 System parameters

▪ PWM frequency	20 KHz
▪ MCU supply voltage	5V±1%
▪ 5V supply current	100mA
▪ Current sampling resistance	1mΩ
▪ Current sampling amplification	16
▪ Current sampling amplifier offset	Self-calibration
▪ Gate driver supply voltage	12V
▪ Max of MOSFET drain source voltage value	27V
▪ MOSFET thermal sensor precision	1%

## 1.3 Output characteristic

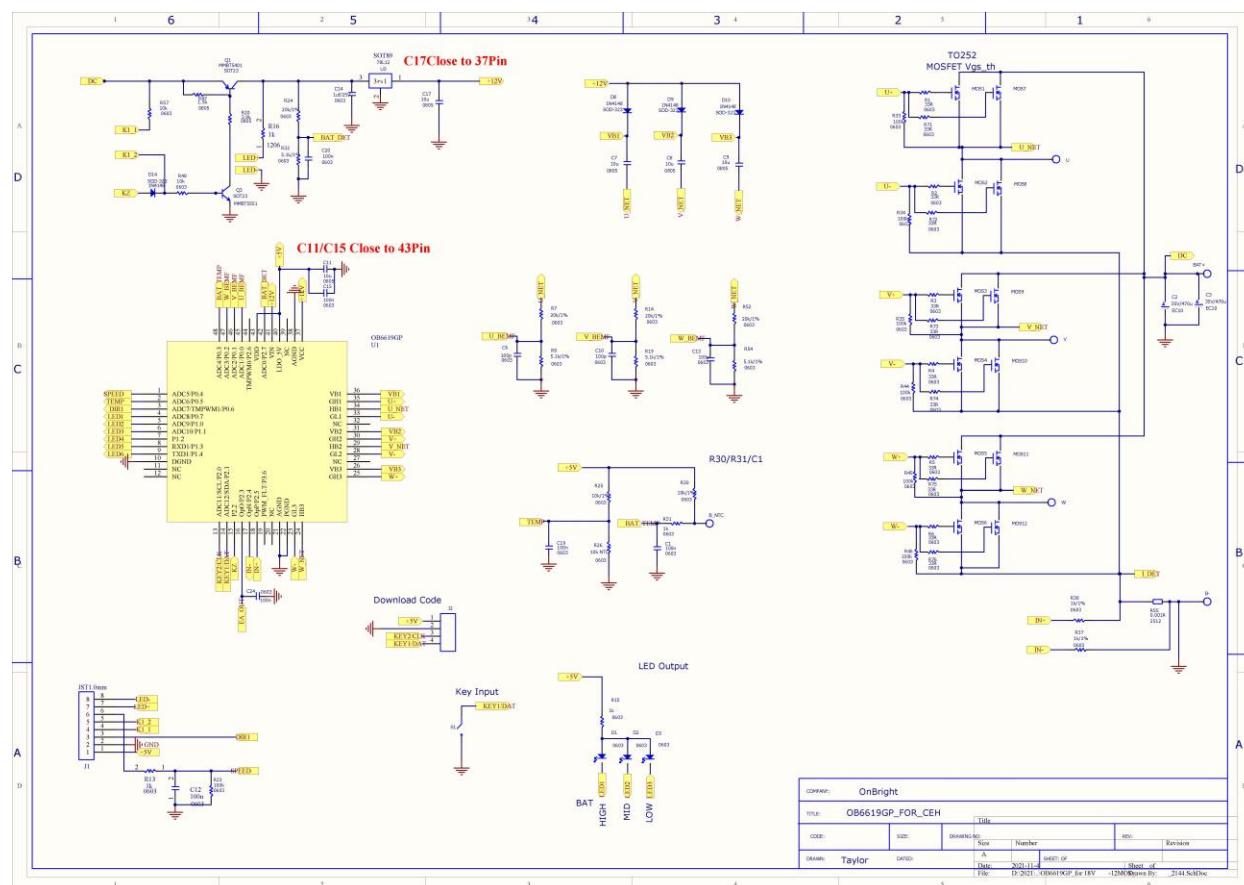
▪ Phase current limitation	100A
▪ Bus current limitation	50A
▪ Maximum of PWM duty	100%
▪ Minimum of PWM duty	20%

## 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

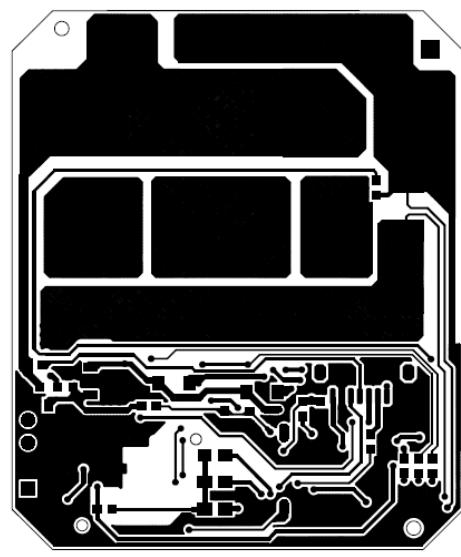
### 2.1 Schematic



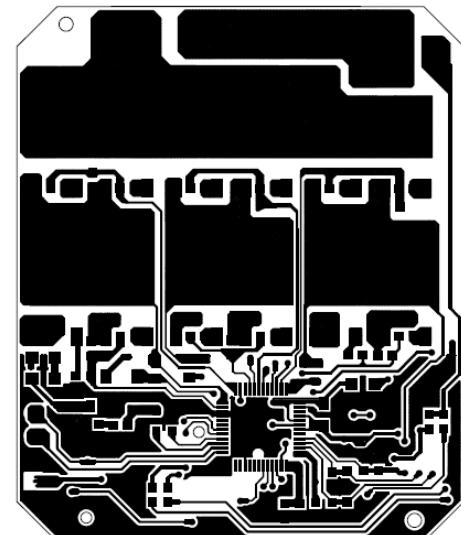
## 2.2 Bill of material

Position	Description	Package	QTY
C1, C19, C20, C24	Capacitor,ceramic,100nf/25V,X7R,10%	0603	4
C2, C3	Capacitor,aluminum electrolytic,470uf/35V,-40/105°C	EC10	2
C6, C10, C13	Capacitor,ceramic,100pf/25V,X7R,10%	0603	3
C7, C8, C9, C11, C17	Capacitor,ceramic,10uf/25V,X7R,10%	0805	5
C12,C15	Capacitor,ceramic,100nf/25V,X7R,10%	0603	2
C14	Capacitor,ceramic,1uf/25V,X7R,10%	0603	1
D1, D2, D3	LED,Green	0603	3
D8, D9, D10, D14	1N4148	SOD-323	4
J1	1mm,8pin Connector		1
MOS1, MOS2, MOS3, MOS4, MOS5, MOS6, MOS7, MOS8, MOS9, MOS10, MOS11, MOS12	NCE3080K	TO-252	12
U1	OB6619GQP	LQFP48	1
Q1	PNP,MMBT5401	SOT-23	1
Q3	NPN,MMBT5551	SOT-23	1
R1, R2, R3, R4, R5, R6, R71, R72, R73, R74, R75, R76	Resistor,chip,33R,5%	0603	12
R7, R14, R24, R52	Resistor,chip,20k,1%	0603	4
R9, R19, R32, R54	Resistor,chip,5.1k,1%	0603	4
R16	Resistor,chip,1k,5%	0805	1
R13, R15, R31	Resistor,chip,1k,5%	0603	3
R20	Resistor,chip,3.9k,5%	0805	1
R23, R33, R34, R35, R44, R45, R46	Resistor,chip,100k,5%	0603	7
R25, R30	Resistor,chip,10k,1%	0603	2
R26	10k,NTC TSM1A103^34D,B=3950	0603	1
R37, R38	Resistor,chip,1k,1%	0603	2
R47	Resistor,chip,1.5k,5%	0805	1
R48, R57	Resistor,chip,10k,5%	0603	2
R55	Resistor,chip,1mR,1%	2512	1
S1	SWITCH	6*6	1
U3	78L12	SOT-89	1

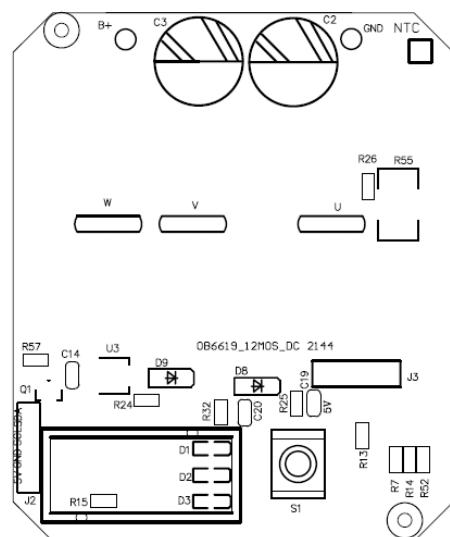
## 2.3 PCB Garber File



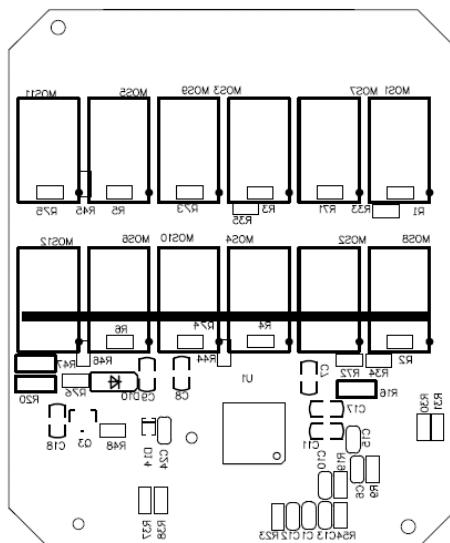
Top Layer



Bottom Layer



## Silkscreen Top Layer

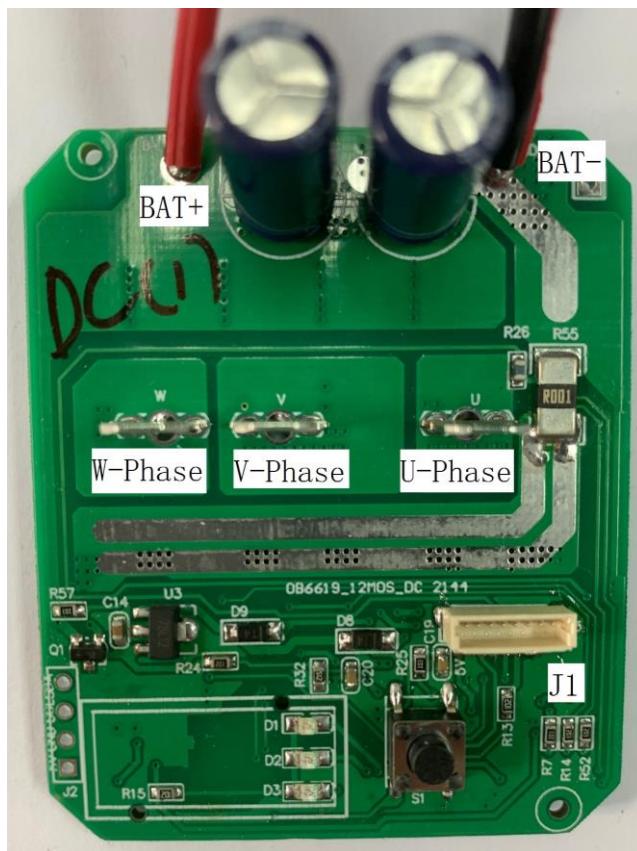


## Silkscreen Bottom Layer

## 2.4 Heat-sink Three View Drawing

N/A

## 2.5 Connector Function Description



HoleName	Description
BAT+	Battery input, Bus+
BAT-	Battery input, GND
U_Phase	Motor U phase output
V_Phase	Motor V phase output
W_Phase	Motor W phase output

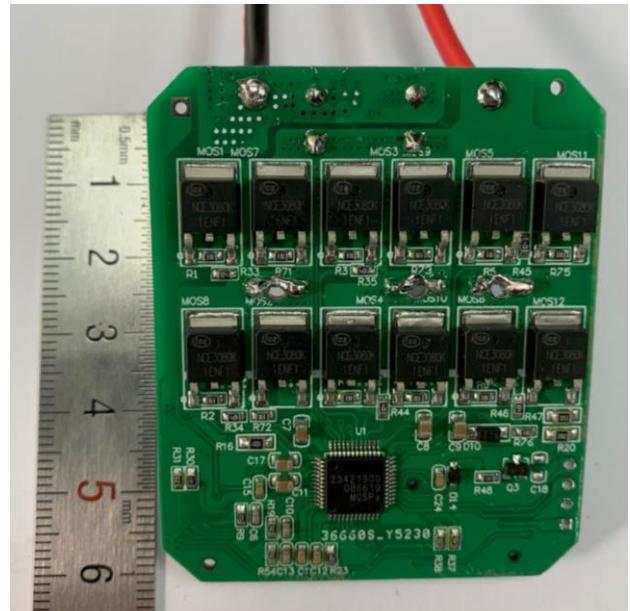
J1- 8pin connector

Pin Num	Description	Voltage Range
1	Speed signal supply	5V
2	GND	0V
3	Turn direction signal	0~5V
4	Motor steering signal 1	0~5V
5	Motor steering signal 2	0~5V
6	Speed signal input	0~5V
7	Working LED anode	13.5V~22V
8	Working LED cathode	13.5V~22V

J2- 4pin connector

Pin Num	Description	Voltage Range
1	5V supply	5V
2	GND	0V
3	SCL	0~5V
4	SDA	0~5V

## 2.6 BLDC Controller Board Snapshot



### 3. Performance Evaluation

This session presents the test results of OB6619GQP 18V/50A electric Hammer controller demo. Results on inrush current and safety test are not included and will be added when they become available.

Overall, the module meets design specifications.

TA=25°C

No	Parameter	Symbol	Min	Type	Max	Unit	Corresponding Fig.
1	Battery UVP	V <sub>bus_UVLO</sub>	13.5			V	Fig.3
2	MCU supply	LDO_5V	4.9	5	5.1	V	Fig.1, Fig.2
3	Gate driver supply	LDO_12V		12		V	Fig.1, Fig.2
4	MOSFET gate voltage	V <sub>gs</sub>		12		V	Fig.4
5	Highside MOSFET Rise time	T <sub>r_h</sub>		487		ns	Fig.4
6	Highside MOSFET Fall time	T <sub>f_h</sub>		745		ns	Fig.5
7	Lowside MOSFET Rise time	T <sub>r_l</sub>		490		ns	Fig.6
8	Lowside MOSFET Fall time	T <sub>f_l</sub>		444		ns	Fig.7
9	V <sub>ds</sub> Peak voltage	V <sub>ds</sub>			27.6	V	Fig.8
10	PWM frequency	f <sub>PWM</sub>		20		kHz	Fig.9
11	Throttle voltage	V <sub>throttle</sub>	1		4	V	Fig.10
12	PWM duty	Duty	20		100	%	Fig.11, Fig.12
13	Current amplify coefficient			16			Fig.13
14	MOSFET current shutdown time in MOTOR short circuit				10	us	Fig.14, Fig.15, Fig.16
15	MOSFET V <sub>ds</sub> in MOTOR short circuit	V <sub>ds</sub>			24	V	Fig.14, Fig.15, Fig.16
16	Dead Time			1.4		us	Fig.17

#### Test Equipments

Item	Module
DC source	LW12050KD
Oscilloscope	LeCroy wavesurfer424
Current meter	Tek TCPA300
Differential probe	CATIII
Multi-meter	VC9808

### 3.1 Bus Current With MOSFET NTC Temperature

#### 3.1.1 Load Temperature

	上桥 Mos (°C)	下桥 Mos (°C)	OB6619 (°C)	采样电阻 (°C)	电解 (°C)
0min	25.6	26.1	26.2	25.8	26.1
5min	47.6	53.1	48.5	58.0	38.7
10min	49.8	55.9	51.3	60.7	40.6
20min	48.8	56.0	48.7	61.1	40.9
30min	46.5	52.2	45.0	59.5	41.2
1h	47.3	53.4	45.9	60.6	42.3

Note: 电源电压 20V, 负载电流 12.9A, 无散热器, 环境温度 26°C, 30min 后达热平衡

#### 3.1.2 Low Temperature

Setup: TA = -40°C, Bus Voltage = 20V, Time=16h

Result: Pass

### 3.2 Voltage Test

#### 3.2.1 Gate Driver & MCU Supply Power ON/OFF

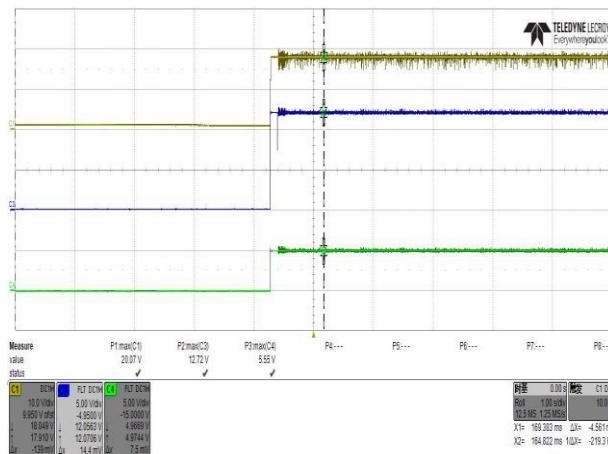


Fig. 1 Measured gate driver and MCU supply voltage @ battery=18V

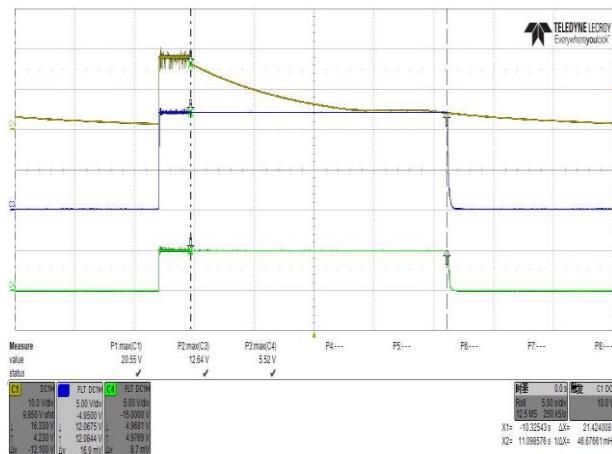


Fig. 2 Measured gate driver and MCU supply voltage @ battery=18V

### 3.2.2 Battery under voltage lockout

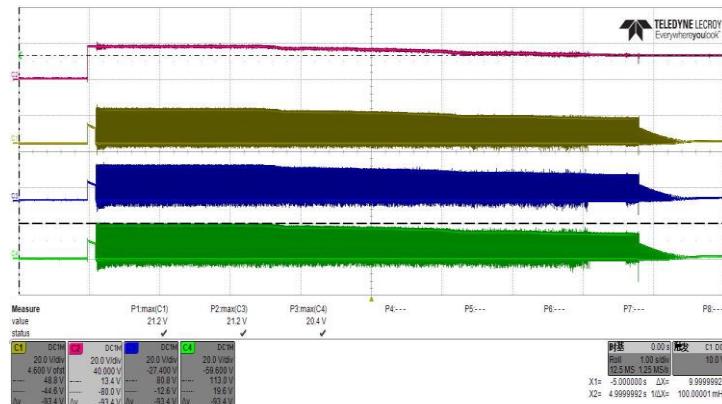


Fig. 3 Measured UVW output voltage @ battery=13.5V

### 3.2.3 MOSFET Vgs

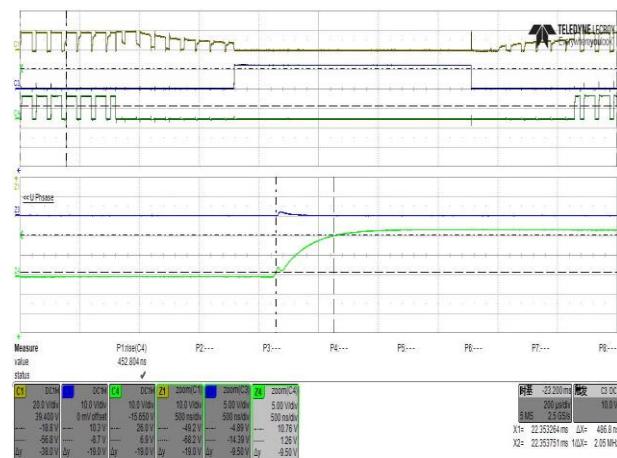


Fig. 4 Measured U phase voltage and highside MOSFET Vgs rise time @ battery=18V

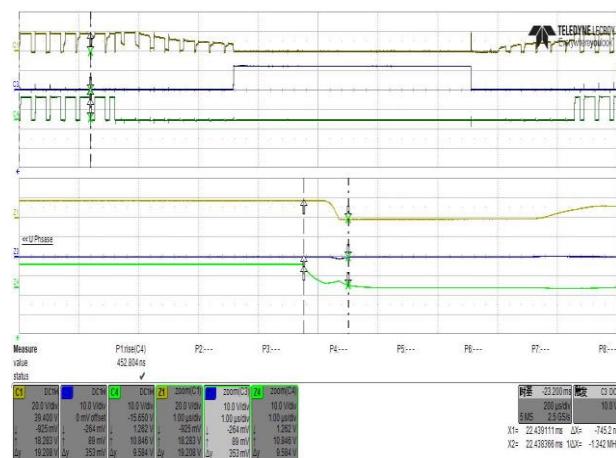


Fig. 5 Measured U phase voltage and highside MOSFET Vgs fall time @ battery=18V

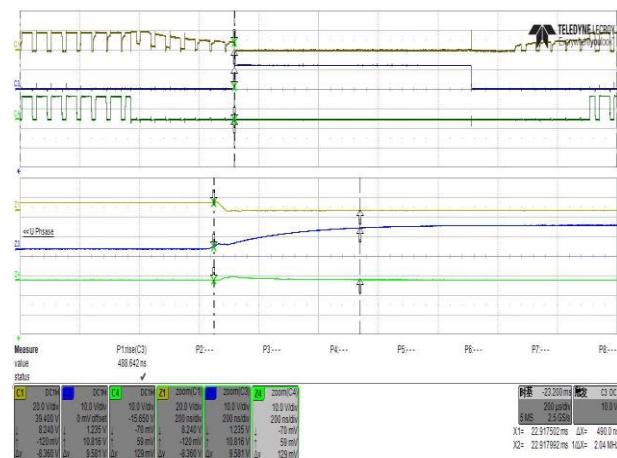


Fig. 6 Measured U phase voltage and lowside MOSFET Vgs rise time @ battery=18V

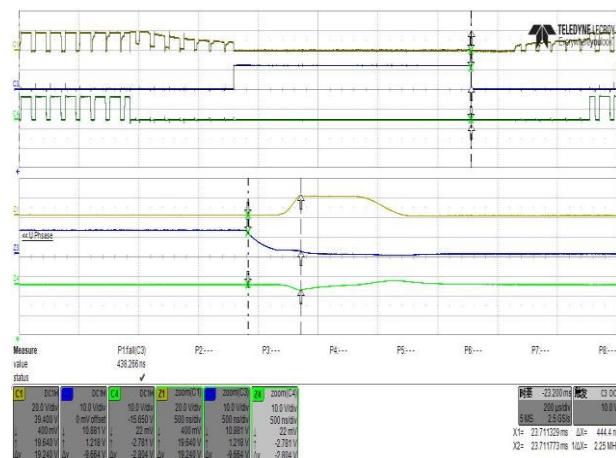


Fig. 7 Measured U phase voltage and lowside MOSFET Vgs fall time @ battery=18V

### 3.2.4 MOSFET Vds

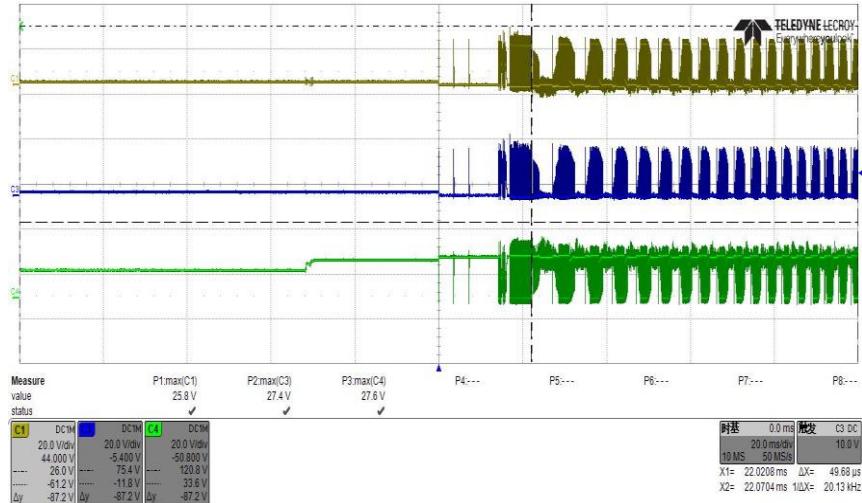


Fig. 8 Measured U phase voltage and highside and lowside MOSFET Vds @ battery=21V

## 3.3 PWM Test

### 3.3.1 PWM Frequency

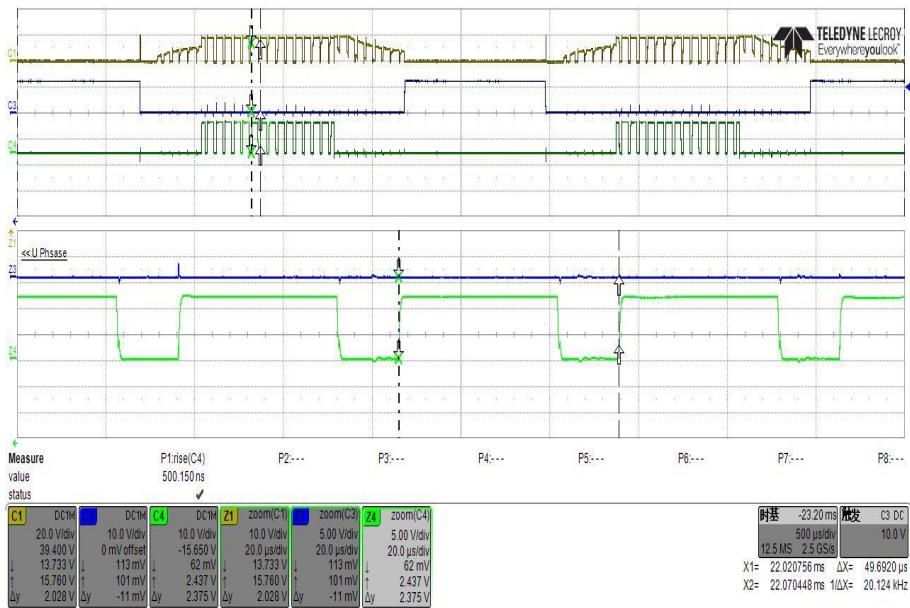


Fig. 9 Measured U phase voltage and highside and lowside MOSFET Vgs

### 3.3.2 Speed Regulator

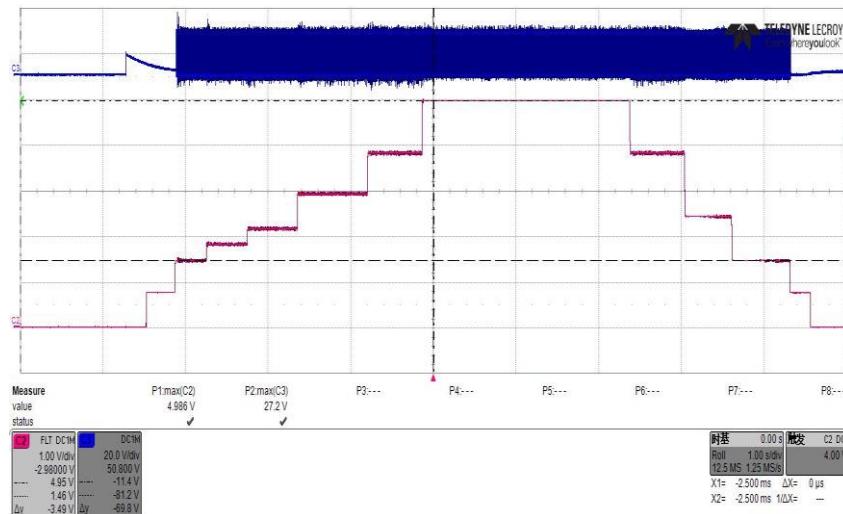


Fig. 10 Measured U-phase and throttle voltage

### 3.3.3 PWM Initial duty

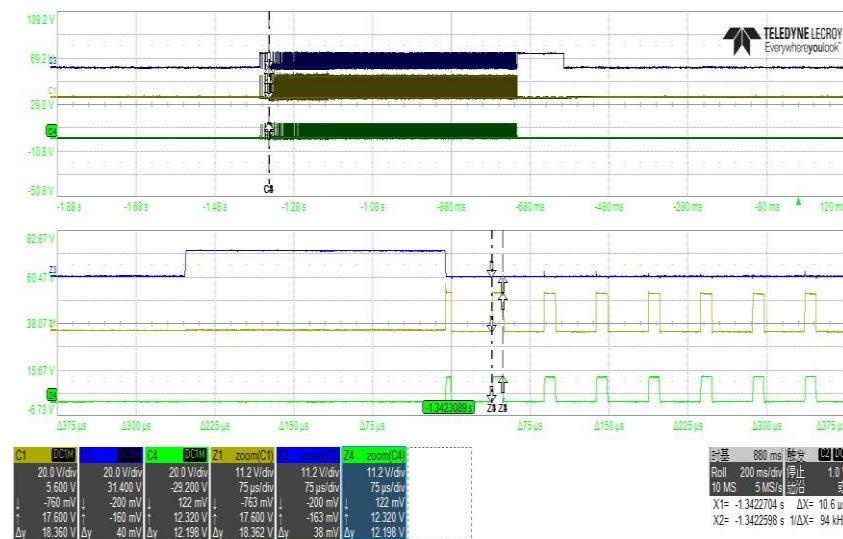


Fig. 11 Measured U phase voltage and highside and lowside MOSFET Vgs

### 3.3.4 PWM Duty ON

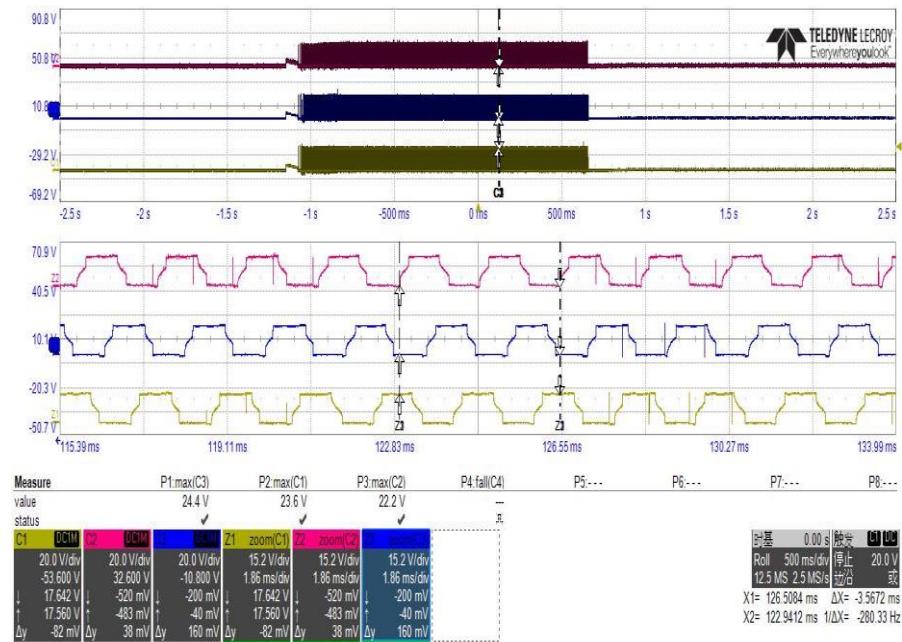


Fig. 12 Measured UVW phase voltage

## 3.4 Current sampling

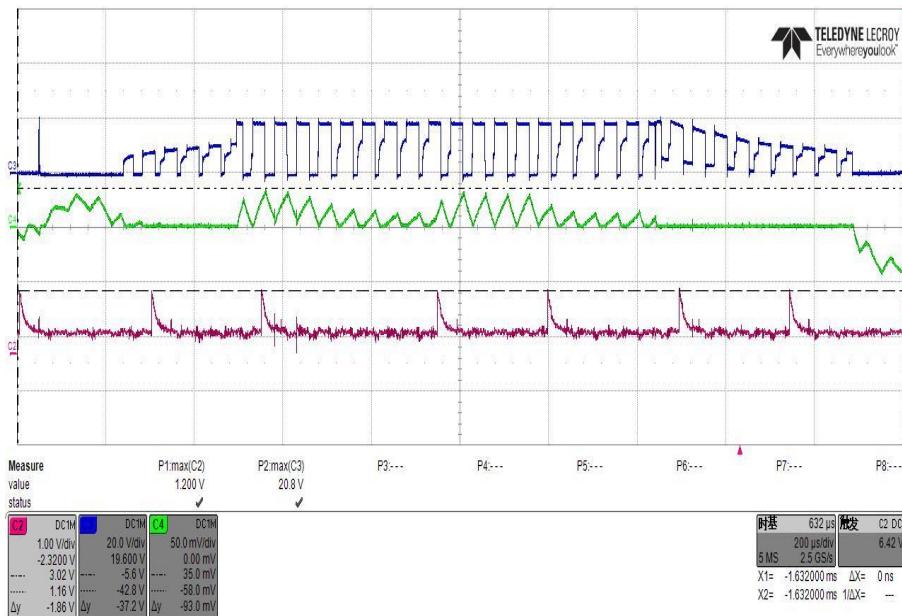


Fig. 13 Measured U phase voltage, U phase current and EA out

## 3.5 Motor Short Circuit Protection

### 3.5.1 U-V phase short circuit

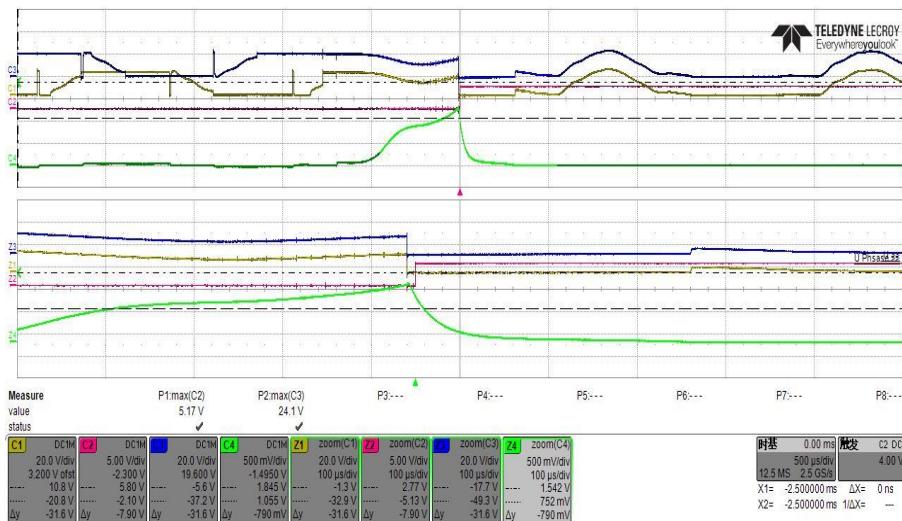


Fig. 14 Measured U-phase voltage, V-phase voltage, IO-trigger, phase current @ battery voltage = 21V

### 3.5.2 U-W phase short circuit

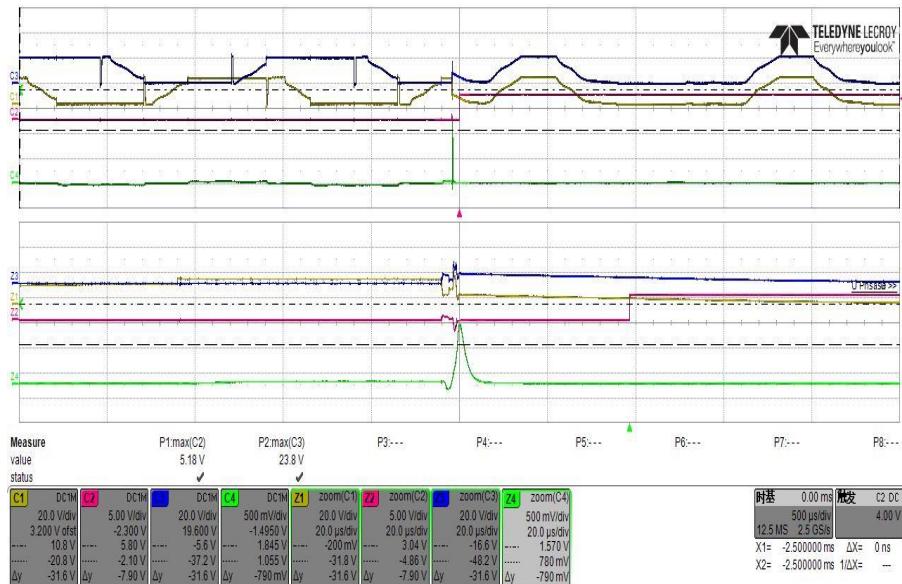


Fig. 15 Measured U-phase voltage, W-phase voltage, IO-trigger, phase current @ battery voltage = 21V

### 3.5.3 V-W phase short circuit

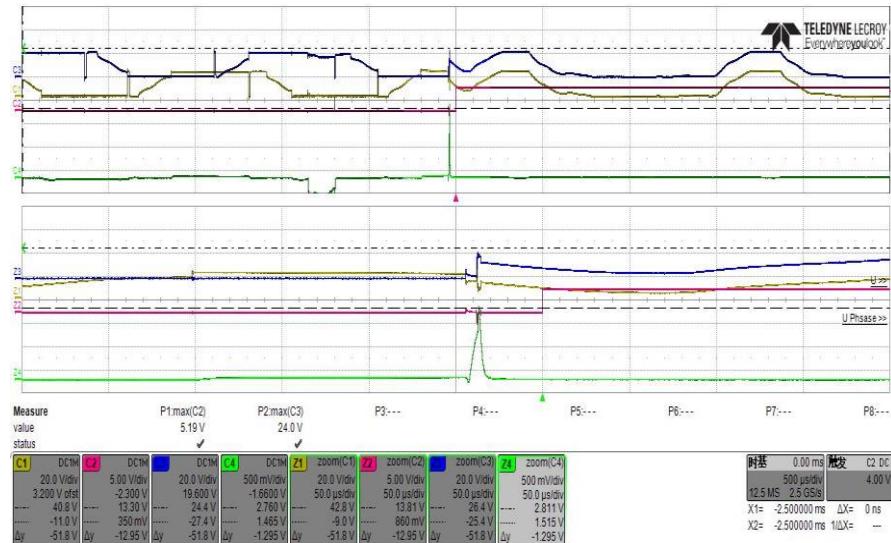


Fig. 16 Measured V-phase voltage, W-phase voltage, IO-trigger, phase current @ battery voltage = 21V

### 3.6 Dead Time

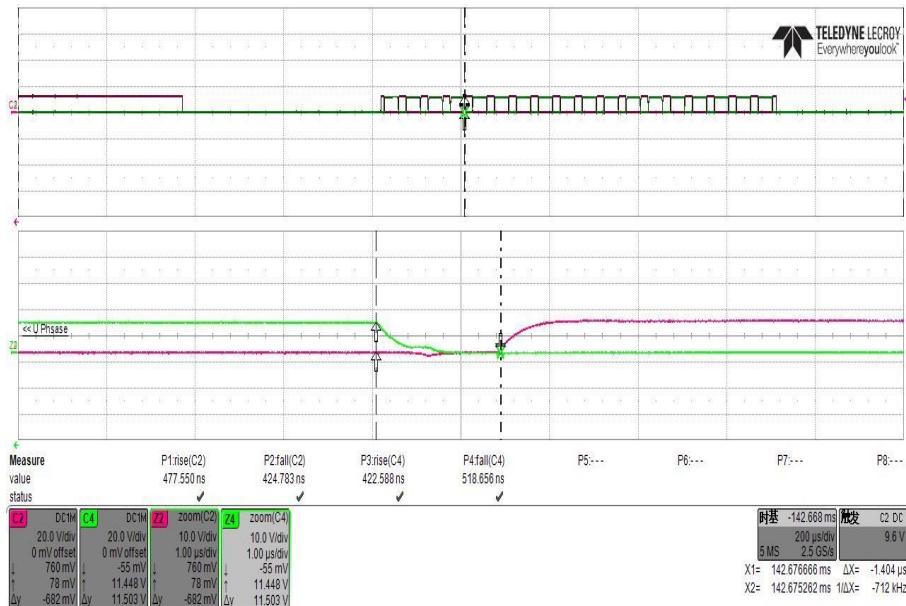


Fig. 17 Measured highside and lowside MOSFET Vgs

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