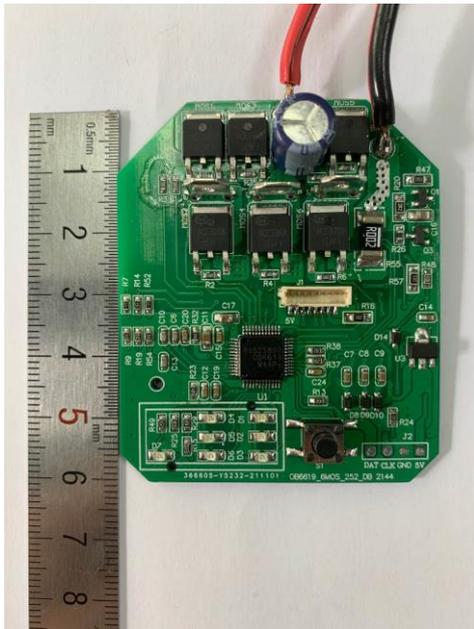


**Subject**  
**OB6619 Demo Board Manual**

Board Model: OB6619\_6MOS\_252\_DB\_2144

Doc. No.: OB\_DOC\_DBM\_A\_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 stop
- Automatic power off with time delay
- MOSFET temperature sensing and thermal protection.
- Low levels battery under voltage protection
- Battery residual capacity display
- PCB size small, and assemble conveniently

**Revision history:**

Revise Date	Version	Reason/Issue
2021-11-19	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 Gerber 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	Wrench Test.....	17
3.6.1	Phase Voltage & Current waveforms in 30A system .....	17
3.6.2	Phase Voltage & Current waveforms in 34A system .....	18

## 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=14.8V .....	12
Fig. 4	Measured highside and lowside MOSFET Vgs.....	12
Fig. 5	Measured highside and lowside MOSFET Vds.....	13
Fig. 6	Measured highside and lowside MOSFET Vgs.....	13
Fig. 7	Measured U-phase and throttle voltage .....	14
Fig. 8	Measured highside and lowside MOSFET Vgs.....	14
Fig. 9	Measured UVW phase voltage.....	15
Fig. 10	Measured U phase voltage,U phase current and EA out.....	15
Fig. 11	Measured U-phase voltage, V-phase voltage, Bus voltage, phase current @ battery.....	16
Fig. 12	Measured U-phase voltage, W-phase voltage, Bus voltage, phase current @ battery .....	16
Fig. 13	Measured V-phase voltage, W-phase voltage, Bus voltage, phase current @ battery.....	17
Fig. 14	Measured V-phase voltage, V-phase voltage, W-phase voltage, phase current @.....	17
Fig. 15	Measured V-phase voltage, V-phase voltage, W-phase voltage, phase current @.....	18

# 1. System Electrical Specification

## 1.1 Input Characteristic

- DC input voltage rating 5 cells Li-Iron battery of 3.7V
- DC input voltage 13.8V 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  $5V \pm 1\%$
- 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 35V
- MOSFET thermal sensor precision 1%

## 1.3 Output characteristic

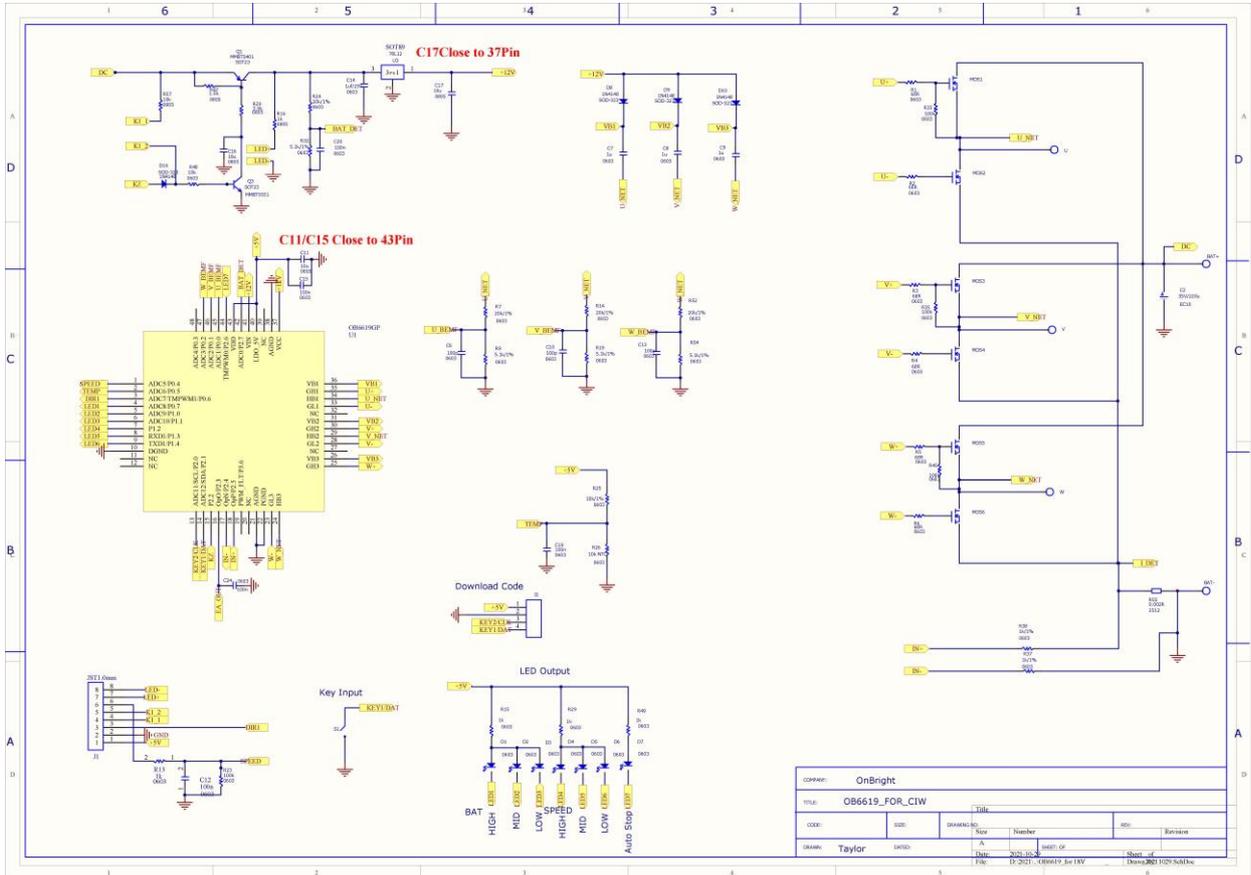
- Phase current limitation 80A
- Maximum of PWM duty 100%
- Minimum of PWM duty 20%

## 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

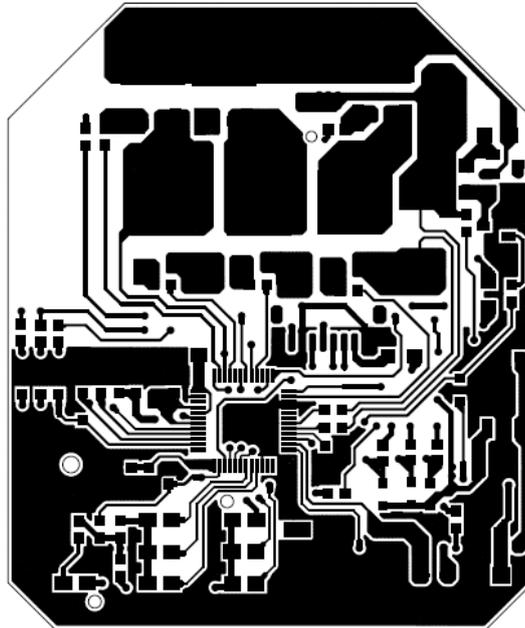
### 2.1 Schematic



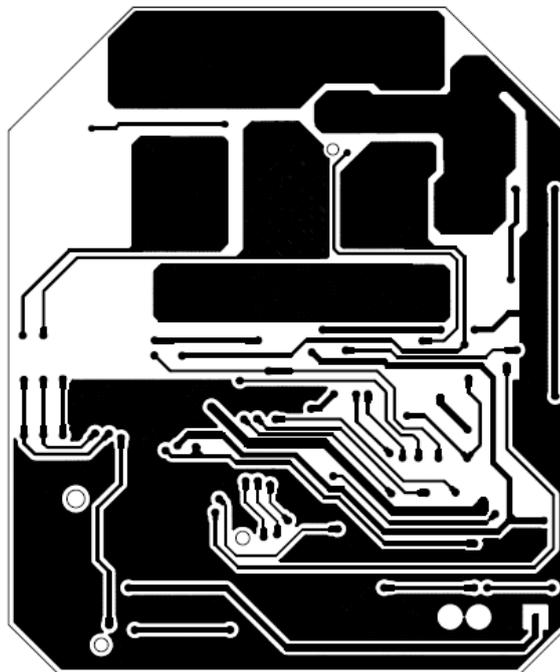
## 2.2 Bill of material

Position	Description	Package	QTY
C16,C11,C17	Capacitor,ceramic,10uf/25V,X7R,10%	0805	3
C12, C15,C19, C20, C24	Capacitor,ceramic,100nf/25V,X7R,10%	0603	5
C6,C10,C13	Capacitor,ceramic,100pf/25V,X7R,10%	0603	3
C7,C8,C9,C14	Capacitor,ceramic,1uf/25V,X7R,10%	0603	4
C2	Capacitor,aluminum electrolytic,220uf/35V,-40/105°C	EC10	1
R57	Resistor,chip,10k,5%	0805	1
R48	Resistor,chip,10k,5%	0603	1
R47	Resistor,chip,1.5k,5%	0805	1
R16	Resistor,chip,1k,5%	0805	1
R24,R7,R14,R52	Resistor,chip,20k,1%	0603	4
R32,R9,R19,R54	Resistor,chip,5.1k,1%	0603	4
R20	Resistor,chip,3.9k,5%	0805	1
R13,R15,R29,R49	Resistor,chip,1k,5%	0603	4
R26	10k,NTC TSM1A103^34D,B=3950	0603	1
R25	Resistor,chip,10k,1%	0603	1
R1,R2,R3,R4,R5,R6	Resistor,chip,68R,5%	0603	6
R23,R33,R35,R45	Resistor,chip,100k,5%	0603	4
R37,R38	Resistor,chip,1k,1%	0603	2
R55	Resistor,chip,2mR,1%	2512	1
D14,D8,D9,D10	1N4148	SOD-323	4
D1,D2,D3,D4,D6,D7	LED, Green	0603	6
D5	NC		
MOS1,MOS2,MOS3, MOS4,MOS5,MOS6	NCE3080K	TO-252	6
Q1	PNP,MMBT5401	SOT-23	1
Q3	NPN,MMBT5551	SOT-23	1
U3	78L12	SOT-89	1
U1	OB6619GQP	LQFP48	1
J1	1mm,8pin Connector		1
S1	SWITCH	6*6	1

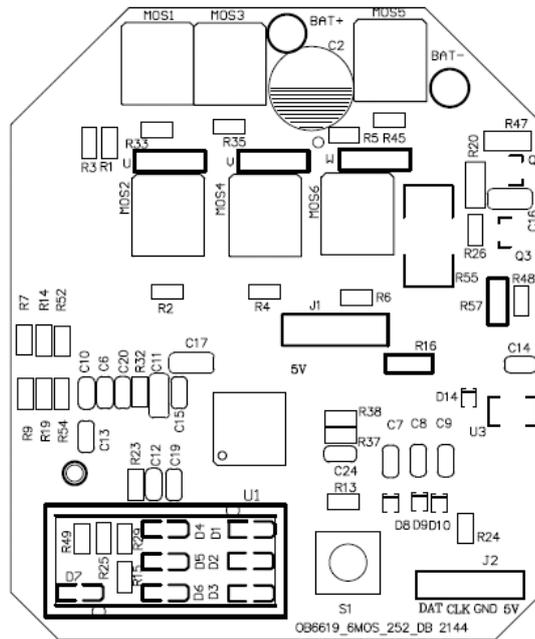
## 2.3 PCB Garber File



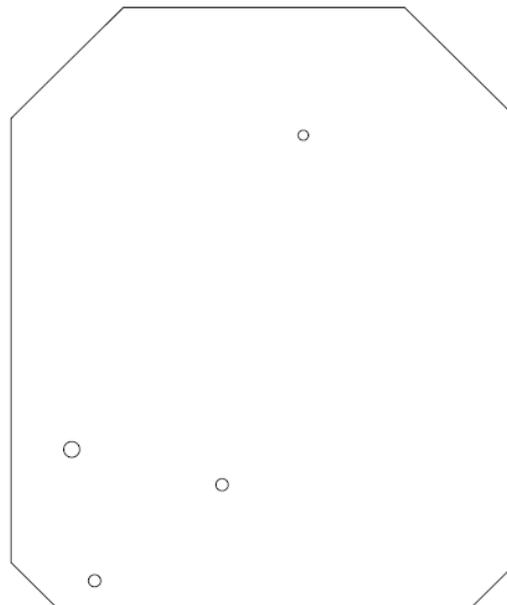
Top Layer



Bottom Layer



Silkscreen Top Layer

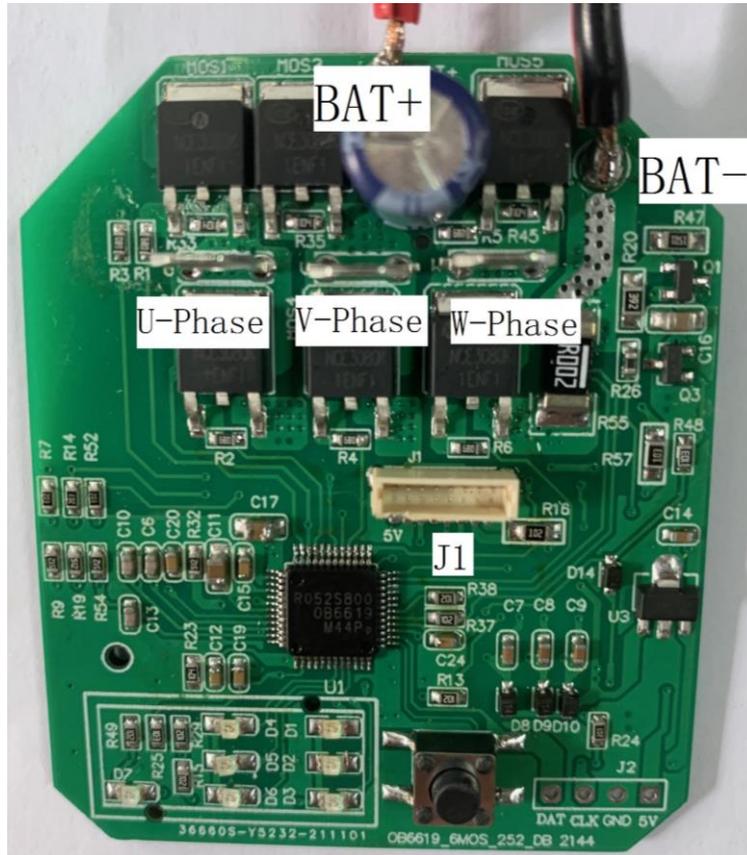


Silkscreen Bottom Layer

## 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

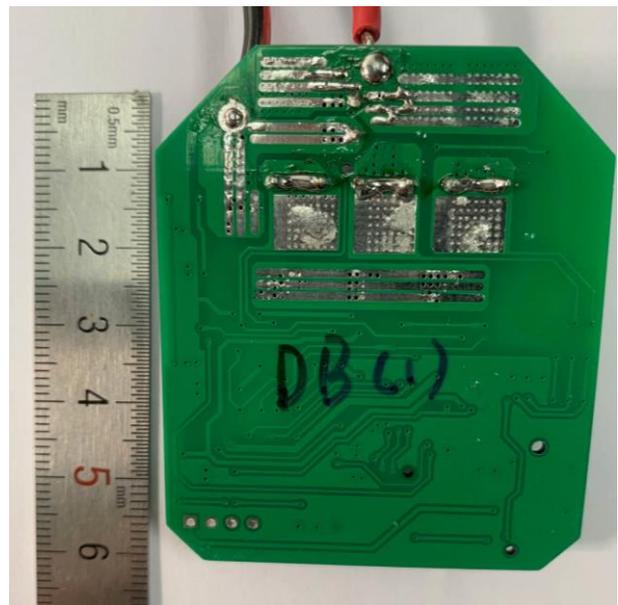
J1- 8pin connector

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/20A electric wrench 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>	14.5			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	Tr <sub>h</sub>		656		ns	Fig.4
6	Highside MOSFET Fall time	Tf <sub>h</sub>		834		ns	Fig.4
7	Lowside MOSFET Rise time	Tr <sub>l</sub>		625		ns	Fig.4
8	Lowside MOSFET Fall time	Tf <sub>l</sub>		714		ns	Fig.4
9	Vds Peak voltage	V <sub>ds</sub>			35.2	V	Fig.5
10	PWM frequency	f <sub>PWM</sub>		20		kHz	Fig.6
11	Throttle voltage	V <sub>throttle</sub>	1		4	V	Fig.7
12	PWM duty	Duty	20		100	%	Fig.8, Fig.9
13	Current amplify coefficient			16			Fig.10
14	MOSFET current shutdown time in MOTOR short circuit				10	us	Fig.11, Fig.12, Fig.13
15	MOSFET Vds in MOTOR short circuit	V <sub>ds</sub>			33.9	V	Fig.11, Fig.12, Fig.13
16	Tripping Phase current of complete machine @ battery voltage = 22V				70	A	Fig.14, Fig.15

#### 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)	电解 (°C)	采样电阻 (°C)	OB6619 (°C)
0min	26.8	26.8	26.8	26.7	26.5
5min	62.6	60.8	55.9	72.7	42.2
10min	72.7	69.8	69.1	77.9	47.7
15min	73.6	71.7	70.6	81.7	47.8
20min	72.4	69.8	70.2	81.2	48.1
30min	70.4	68.1	67.6	79.4	46.9
1h	73.5	69.7	71.2	81.4	47.5

Note: 电源电压 20.59V, 负载电流 12.9A, 无散热器, 环境温度 27°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

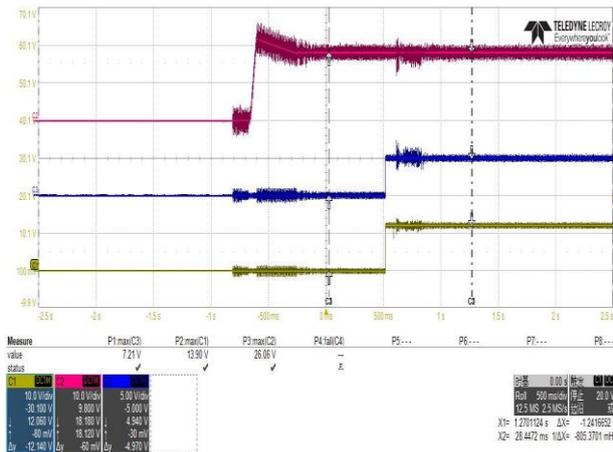


Fig. 1 Measured gate driver and MCU supply voltage @ battery=18V

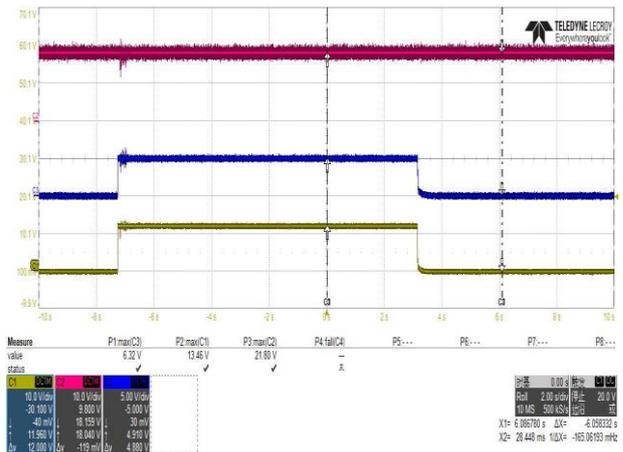


Fig. 2 Measured gate driver and MCU supply voltage @ battery=18V

### 3.2.2 Battery under voltage lockout

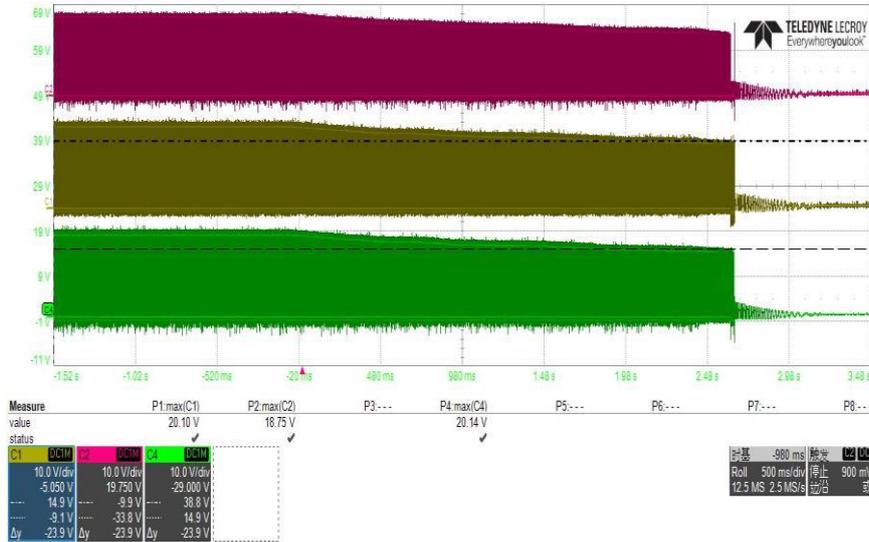


Fig. 3 Measured UVW output voltage @ battery=14.8V

### 3.2.3 MOSFET Vgs

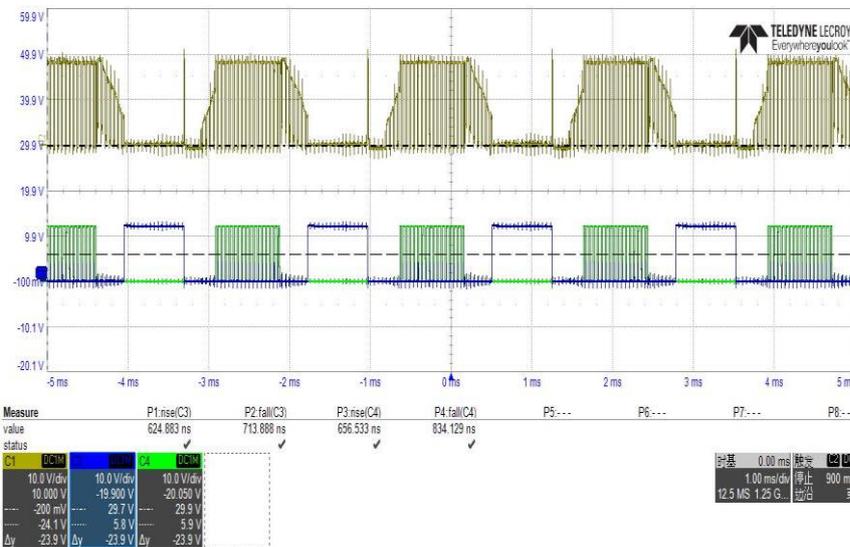


Fig. 4 Measured highside and lowside MOSFET Vgs

### 3.2.4 MOSFET Vds

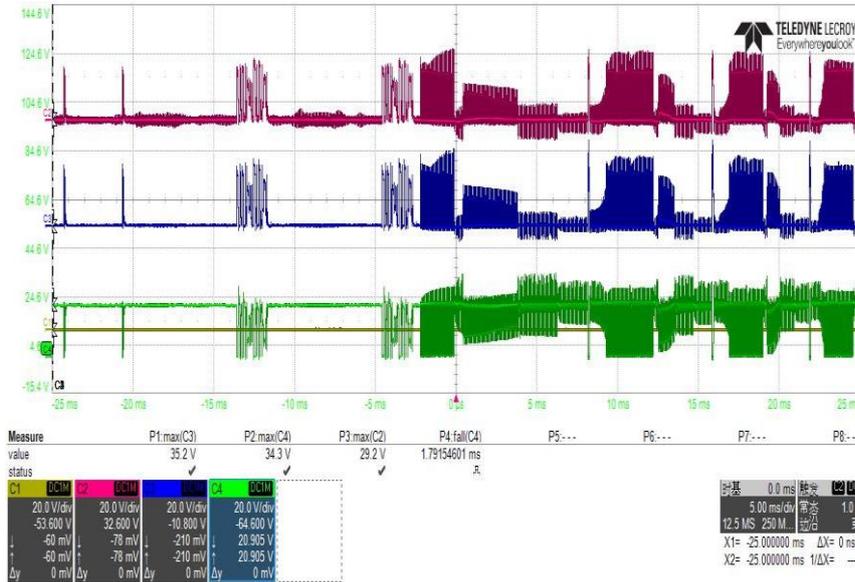


Fig. 5 Measured highside and lowside MOSFET Vds

## 3.3 PWM Test

### 3.3.1 PWM Frequency

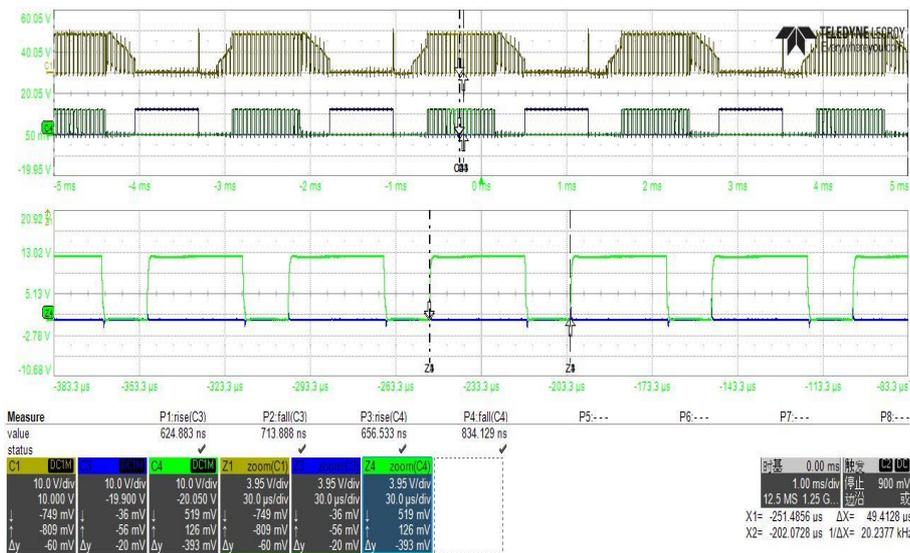


Fig. 6 Measured highside and lowside MOSFET Vgs

### 3.3.2 Speed Regulator

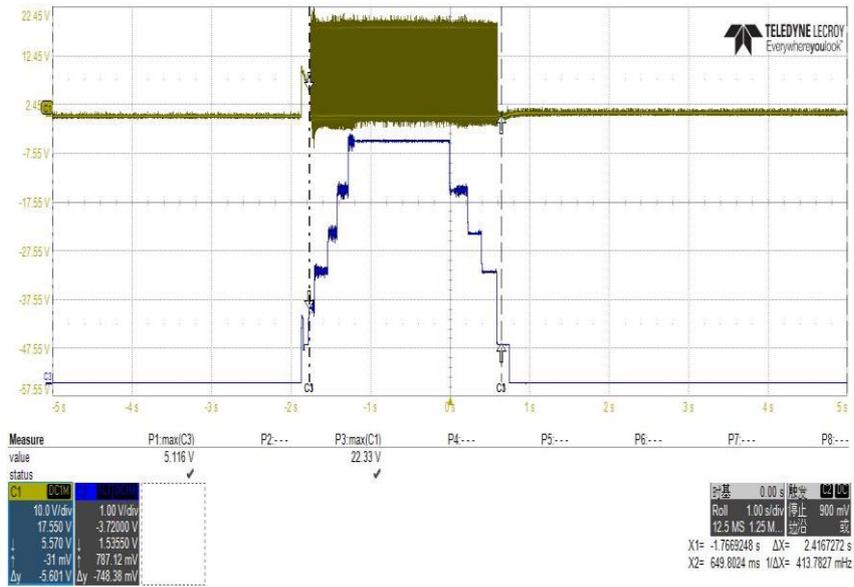


Fig. 7 Measured U-phase and throttle voltage

### 3.3.3 PWM Initial duty



Fig. 8 Measured highside and lowside MOSFET Vgs

### 3.3.4 PWM Duty ON

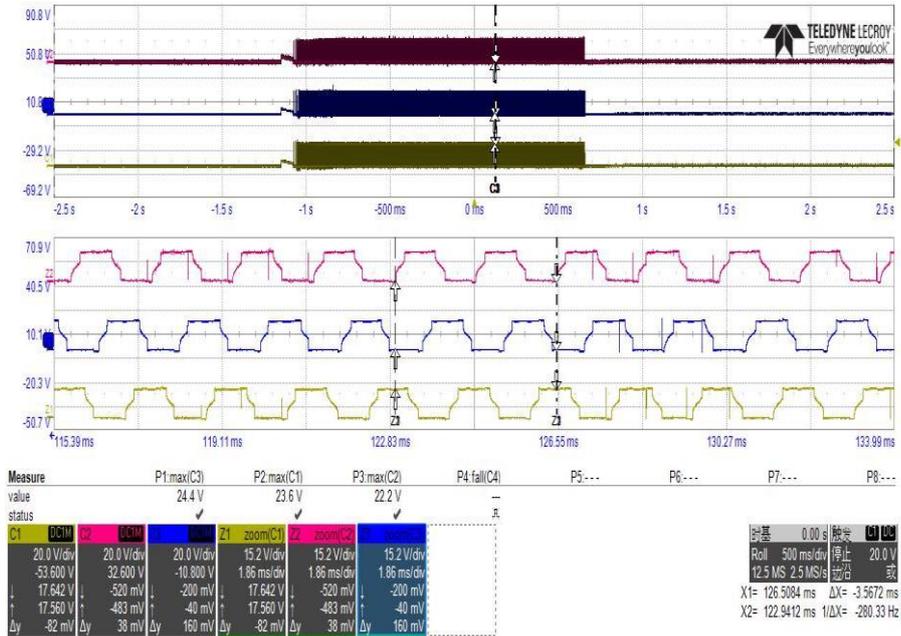


Fig. 9 Measured UVW phase voltage

### 3.4 Current sampling

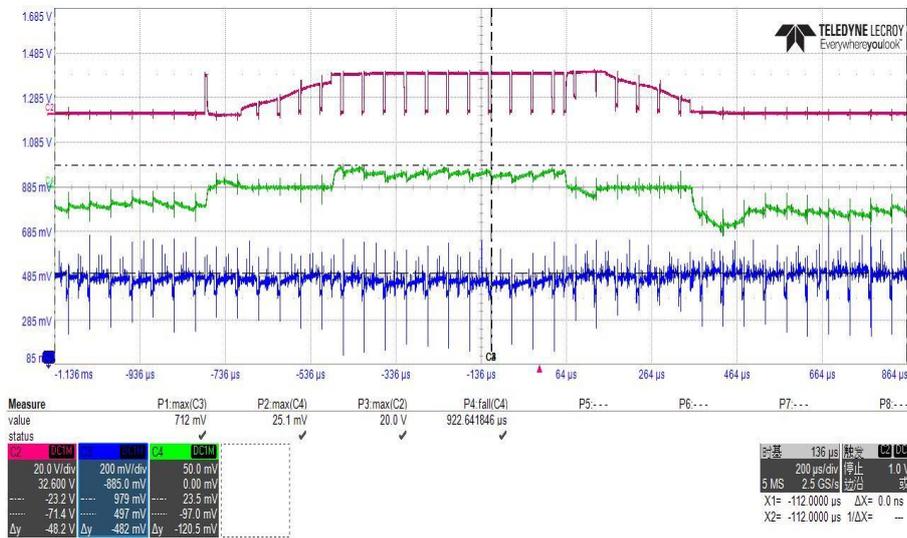


Fig. 10 Measured U phase voltage, U phase current and EA out

### 3.5 Motor Short Circuit Protection

#### 3.5.1 U-V phase short circuit

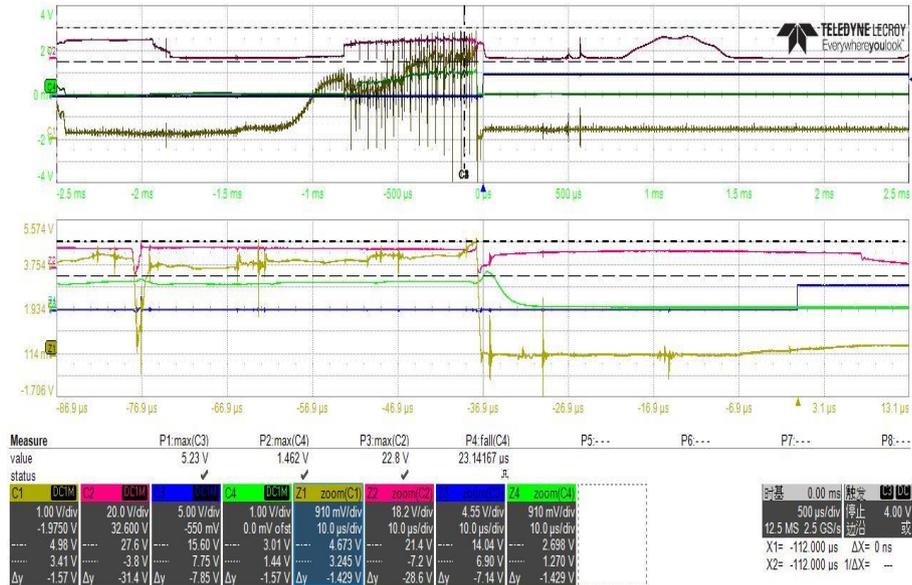


Fig. 11 Measured U-phase voltage, V-phase voltage, Bus voltage, phase current @ battery voltage = 21V

#### 3.5.2 U-W phase short circuit

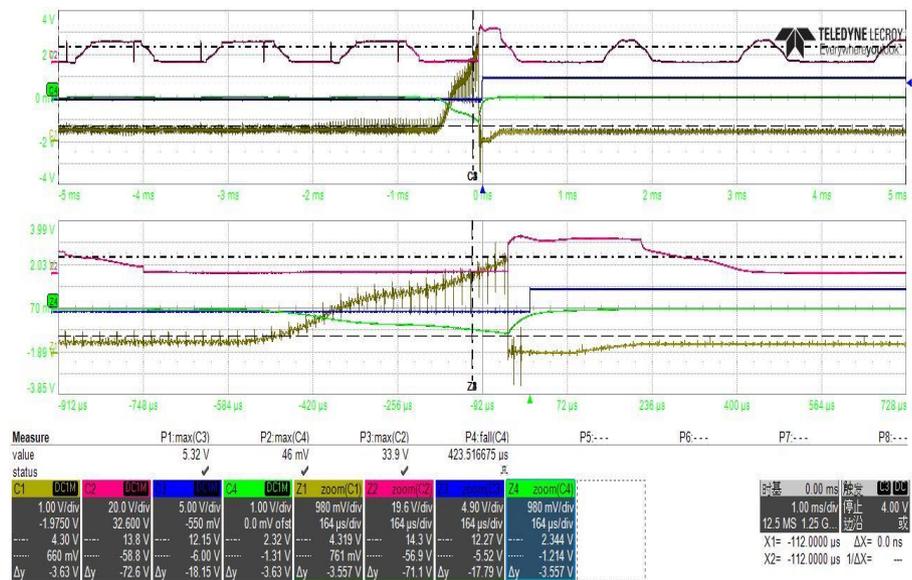


Fig. 12 Measured U-phase voltage, W-phase voltage, Bus voltage, phase current @ battery voltage = 21V

### 3.5.3 V-W phase short circuit

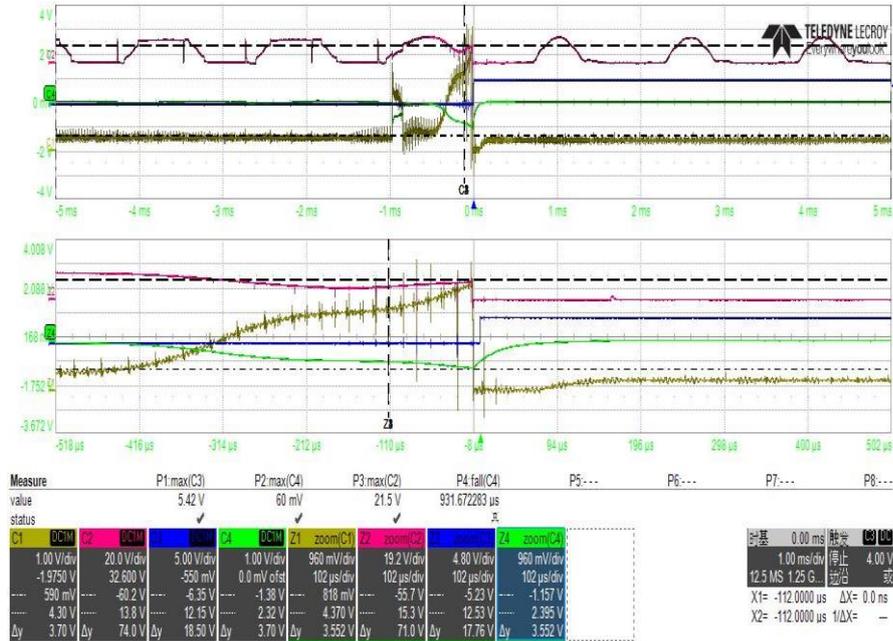


Fig. 13 Measured V-phase voltage, W-phase voltage, Bus voltage, phase current @ battery voltage = 21V

## 3.6 Wrench Test

### 3.6.1 Phase Voltage & Current waveforms in 30A system

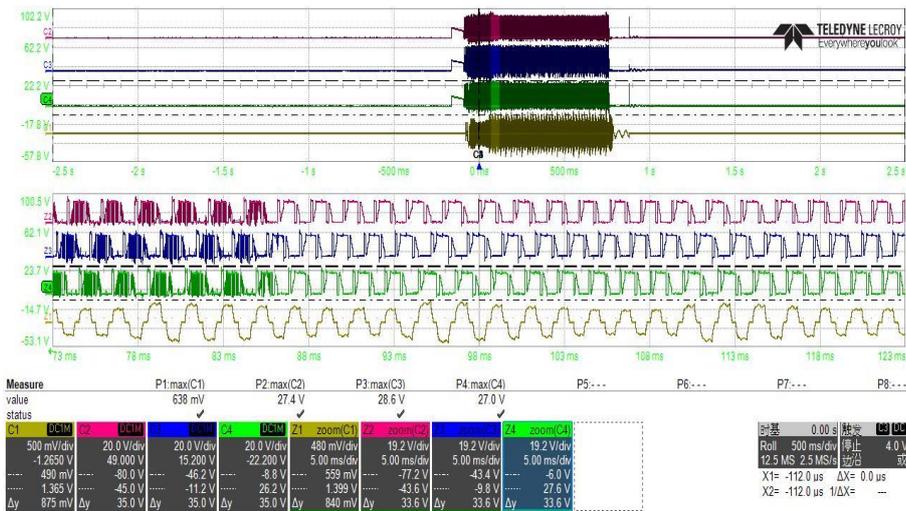


Fig. 14 Measured V-phase voltage, V-phase voltage, W-phase voltage, phase current @ battery voltage = 22V

### 3.6.2 Phase Voltage & Current waveforms in 3A system

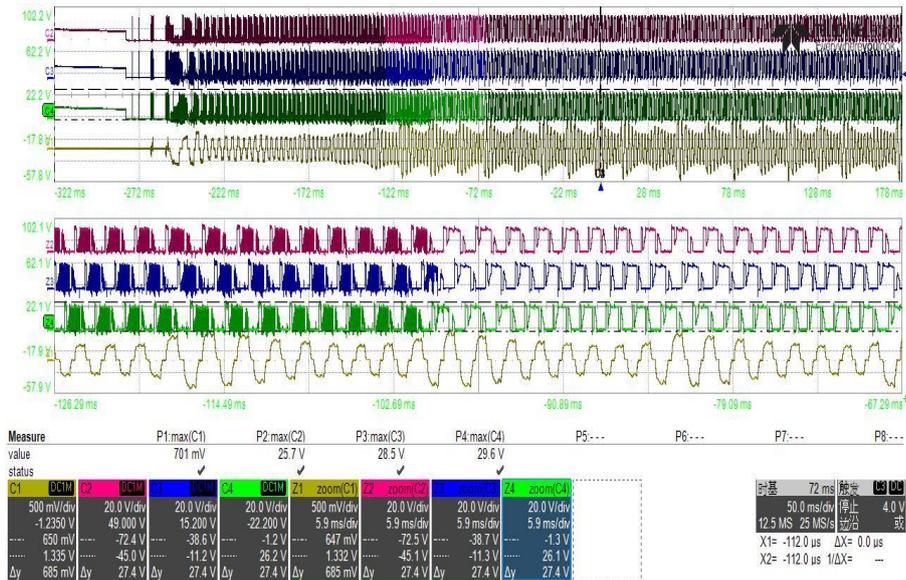


Fig. 15 Measured V-phase voltage, V-phase voltage, W-phase voltage, phase current @ battery voltage = 22V

### 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.