

**Subject**  
**OB6617 Demo Board Manual**

Board Model: OB6617\_1742\_Protel  
Doc. No.: OB\_DOC\_DBM\_B\_661700



**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 with hall sensor feedback
- Step-less speed regulation
- Forward/Reverse selection
- 10% 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
2017-11-06	00	First Issue

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# 1. System Electrical Specification

## 1.1 Input Characteristic

- DC input voltage rating 3~5 cells Li-Iron battery of 3.7V
- DC input voltage 7V 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 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 @ 3 cells battery  
12V @ 5 cells battery
- Max of MOSFET drain source voltage value 30V
- MOSFET thermal sensor precision 1%

## 1.3 Output characteristic

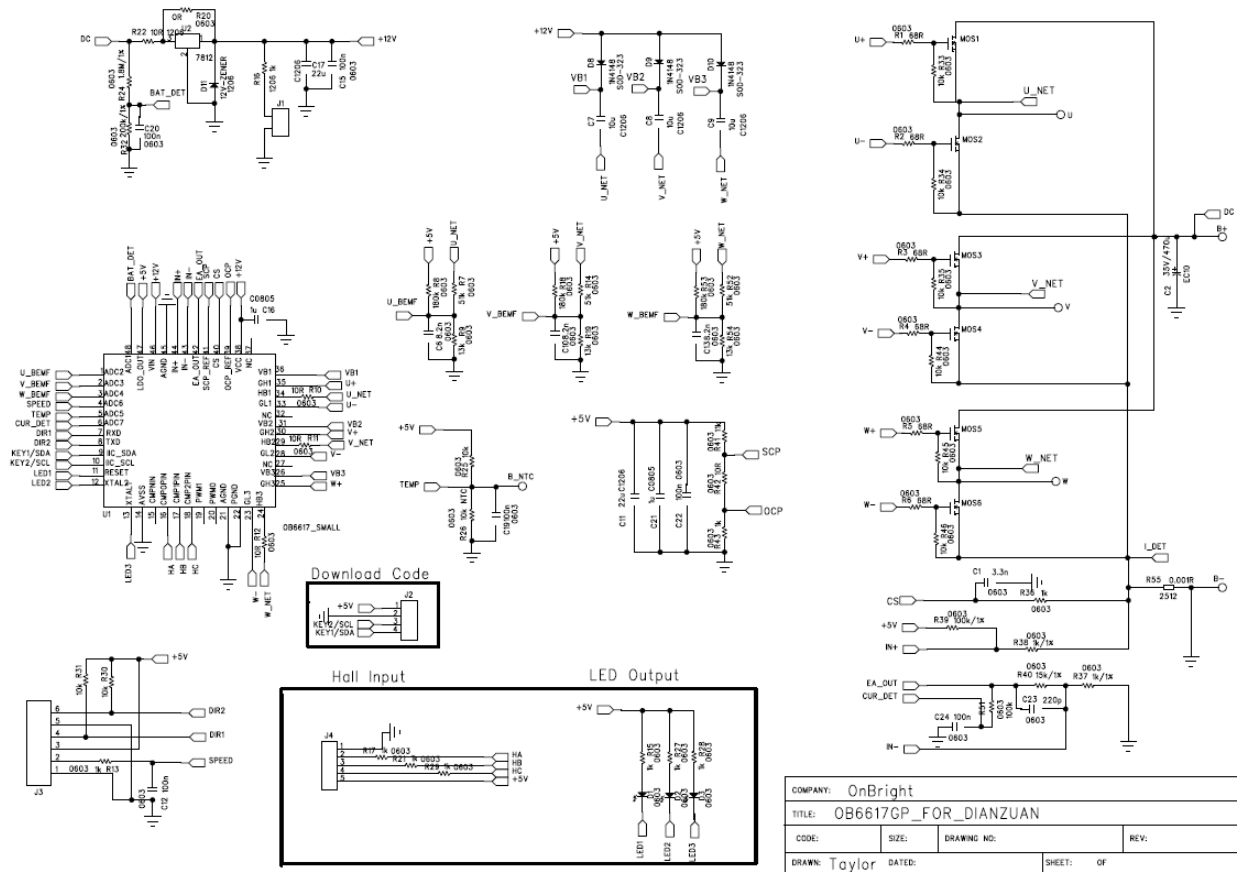
- Phase current limitation 70A
- Maximum of PWM duty 100%
- Minimum of PWM duty 10%

## 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

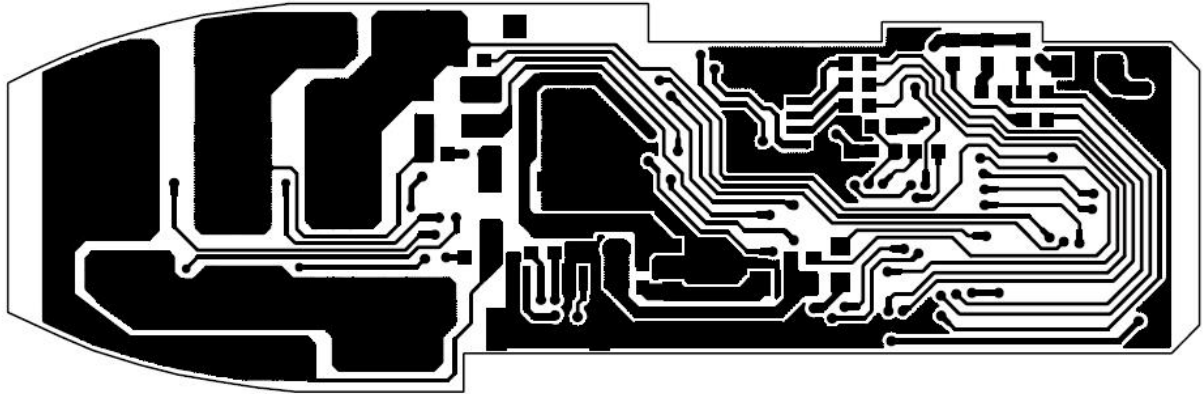
Position	Description	Package	QTY
C2	Capacitor, aluminum electrolytic, 470uf/35V, -40/105°C	EC8	1
C1	Capacitor, ceramic, 3.3nf/25V, X7R, 10%	0603	1
C6, C10, C13	Capacitor, ceramic, 8.2nf/25V, X7R, 10%	0603	3
C12, C15, C19, C20, C22, C24	Capacitor, ceramic, 100nf/25V, X7R, 10%	0603	6
C23	Capacitor, ceramic, 220pf/25V, X7R, 10%	0603	1
C16, C21	Capacitor, ceramic, 1uf/25V, X7R, 10%	0805	2
C7, C8, C9	Capacitor, ceramic, 10uf/25V, X7R, 10%	1206	3
C11, C17	Capacitor, ceramic, 22uf/25V, X7R, 10%	1206	2
D8, D9, D10	T4, 1N4148	SOD323	5
D11	1N4106, 12V Zener	1206	1
D1	LED, Red	0603	1
D2	LED, Yellow	0603	1
D3	LED, Green	0603	1
MOS1, MOS2, MOS3, MOS4, MOS5, MOS6	Power MOS, MDU1511	DFN5*6	6
U1	OB6617GP	LQFP48	1
U2	78L12	SOT89	1
R32	Resistor, chip, 200k, 1%	0603	1
R24	Resistor, chip, 1.8M, 1%	0603	1
R39	Resistor, chip, 100k, 1%	0603	1
R40	Resistor, chip, 15k, 1%	0603	1
R37, R38	Resistor, chip, 1k, 1%	0603	2
R20	Resistor, chip, 0R, 5%	0603	1
R10, R11, R12, R42	Resistor, chip, 10R, 5%	0603	4
R1, R2, R3, R4, R5, R6	Resistor, chip, 68R, 5%	0603	6
R25, R30, R31, R33, R34, R35, R44, R45, R46	Resistor, chip, 10k, 5%	0603	9
R41	Resistor, chip, 11k, 5%	0603	1
R13, R15, R17, R21, R27, R28, R29, R36, R43	Resistor, chip, 1k, 5%	0603	9
R51	Resistor, chip, 100k, 5%	0603	1
R8, R18, R53	Resistor, chip, 180k, 5%	0603	3
R7, R14, R52	Resistor, chip, 51k, 5%	0603	3
R9, R19, R54	Resistor, chip, 13k, 5%	0603	3
R26	10k, NTC TSM1A103^34D, B=3435	0603	1
R22	Resistor, chip, 10R, 5%	1206	1
R16	Resistor, chip, 1k, 5%	1206	1
R55	Resistor, chip, 1mR, 1%	2512	1

J3	JST SH1.0mm,6pin Connector		1
J4	JST SH1.0mm,5pin Connector		1
J1	3mm 直插 LED, White		1

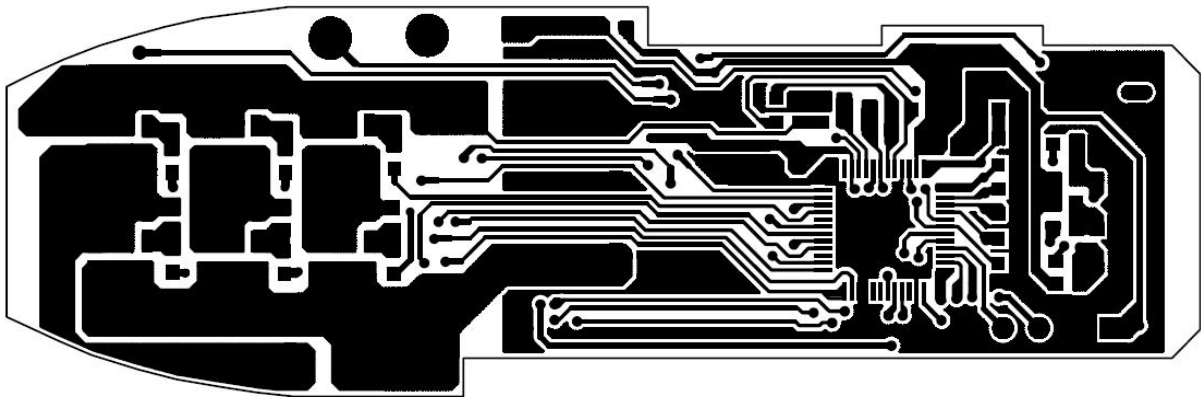
Note: R20 is used to connect 12V to Bus.

	Soldered	NC
3 Cells Li-Iron Battery	R20	U2
5 Cells Li-Iron Battery	U2	R20

## 2.3 PCB Garber File



Top Layer

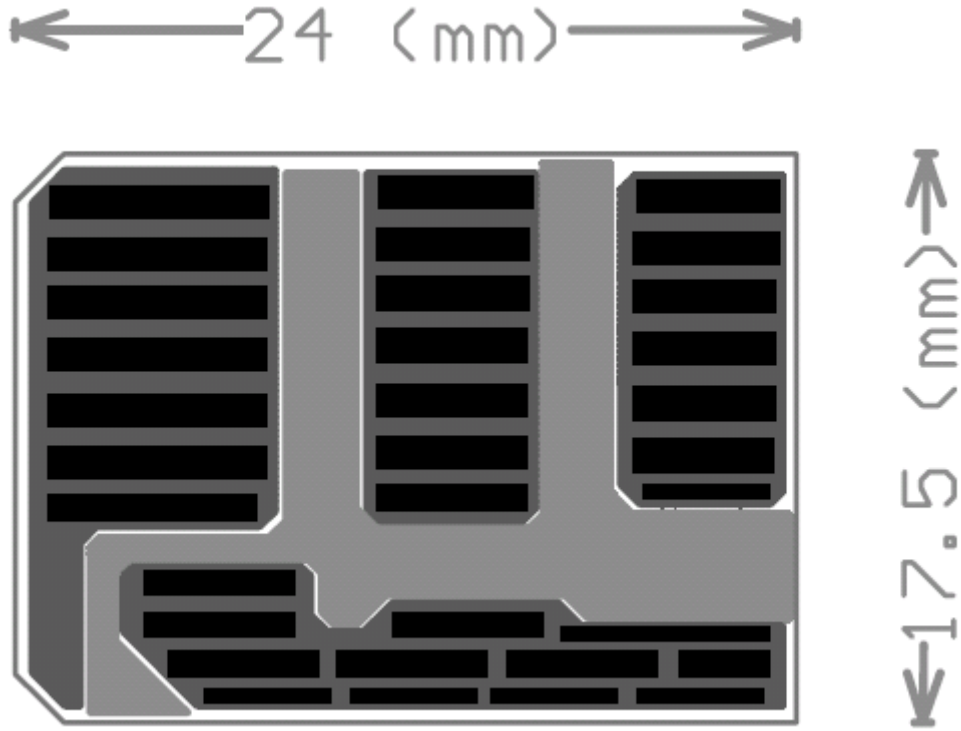


Bottom Layer

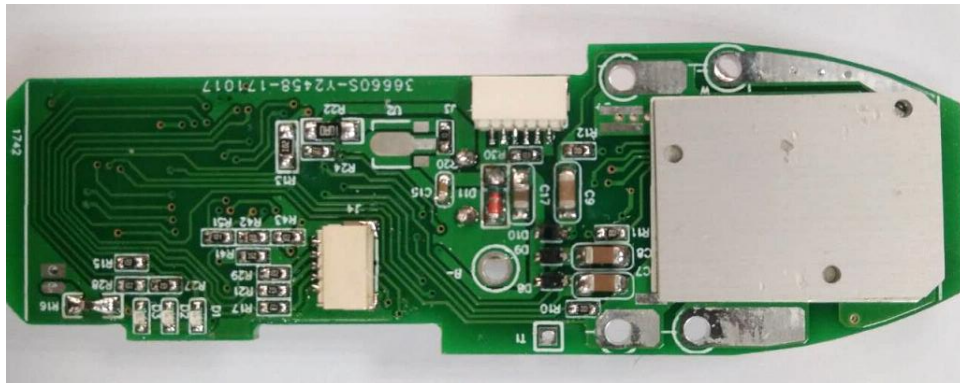




## 2.4 Heat-sink Three View Drawing



## 2.5 Connector Function Description



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

### J1- 2pin connector

Pin Num	Description	Voltage Range
1	Working LED Anode	12V
2	Working LED Cathode	12V

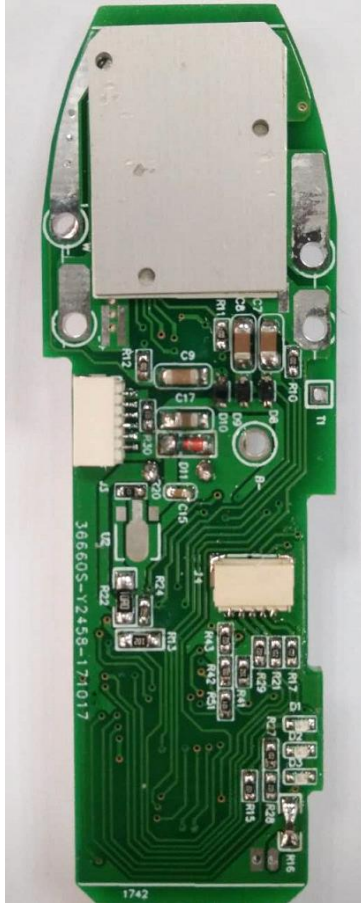
### J3- 6pin connector

Pin Num	Description	Voltage Range
1	GND	0
2	Speed signal input	0~5V
3	Speed signal supply	5V
4	Motor steering signal 1	0~5V
5	GND	0
6	Motor steering signal 2	0~5V

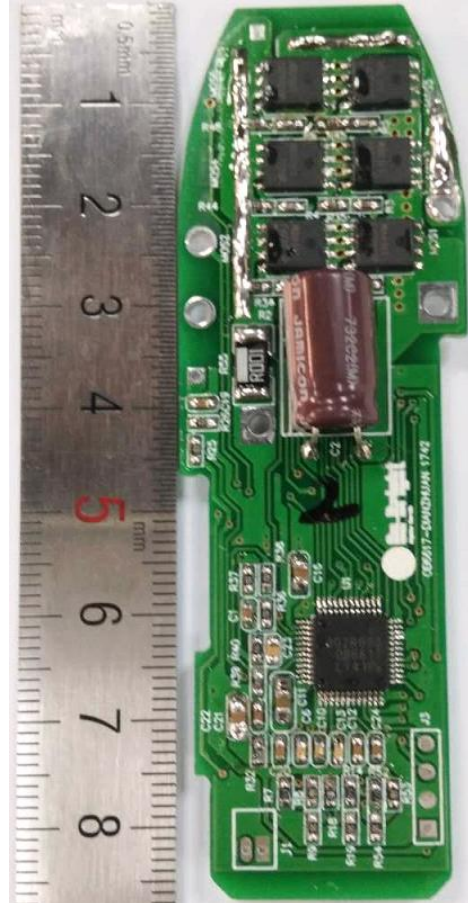
### J4-5pin connector

Pin Num	Description	Voltage Range
1	GND	0
2	1 <sup>st</sup> hall sensor signal	0~5V
3	2 <sup>nd</sup> hall sensor signal	0~5V
4	3 <sup>rd</sup> hall sensor signal	0~5V
5	Motor hall sensor supply	5V

## 2.6 BLDC Controller Board Snapshot



Top



Bottom

### 3. Performance Evaluation

This session presents the test results of OB6617GP 18V/30A 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
1	Battery UVP	$V_{bus\_UVLO}$		6		V
2	MCU supply	LDO_5V	4.9	5	5.1	V
3	Gate driver supply	LDO_12V		12		V
4	MOSFET gate voltage	Vgs		12		V
5	Highside MOSFET Rise time	Tr_h		0.85		us
6	Highside MOSFET Fall time	Tf_h		1.04		us
7	Highside MOSFET Rise time	Tr_l		1.14		us
8	Highside MOSFET Fall time	Tf_l		0.76		us
9	PWM frequency	$f_{PWM}$		20		KHz
10	PWM duty	Duty	10		100	%
11	Throttle voltage	$V_{throttle}$	0.8		4	V
12	Six step control logic					
13	Current amplify coefficient			16		
14	MOSFET current shutdown time in MOTOR short circuit				10	us
15	MOSFET Vds in MOTOR short circuit				20	V

#### Test Equipments

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

### 3.1 Voltage Test

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

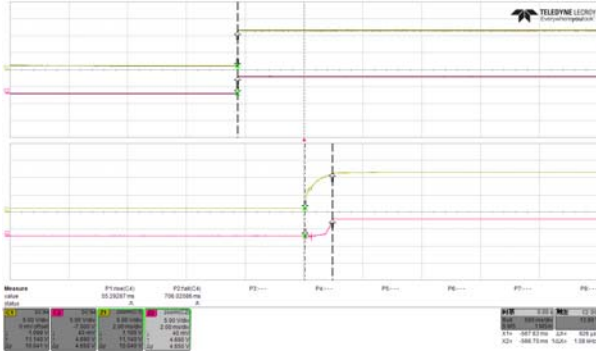


Fig. 1 Measured bus voltage and LDO-5V @ bus=12V

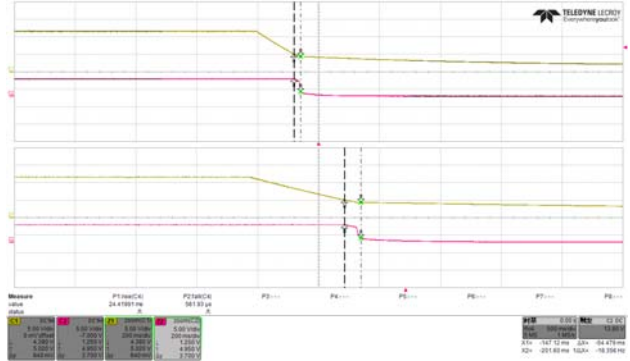


Fig. 2 Measured bus voltage and LDO-5V @ bus=12V

#### 3.1.2 OB6617L Under Voltage Lockout ON/OFF

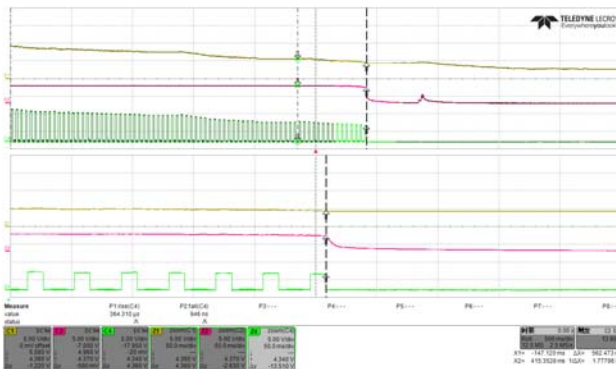


Fig. 3 Measured OB6617L supply voltage , LDO-5V, low-side Gate Driver @ bus = 4.37V

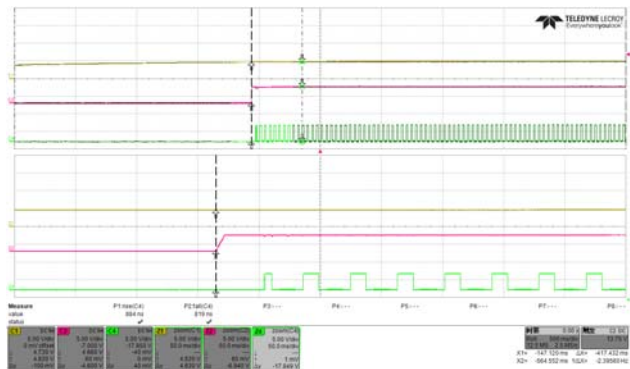


Fig. 4 Measured OB6617L supply voltage , LDO-5V, low-side Gate Driver @ bus = 4.63V

#### 3.1.3 Battery Under Voltage Lockout

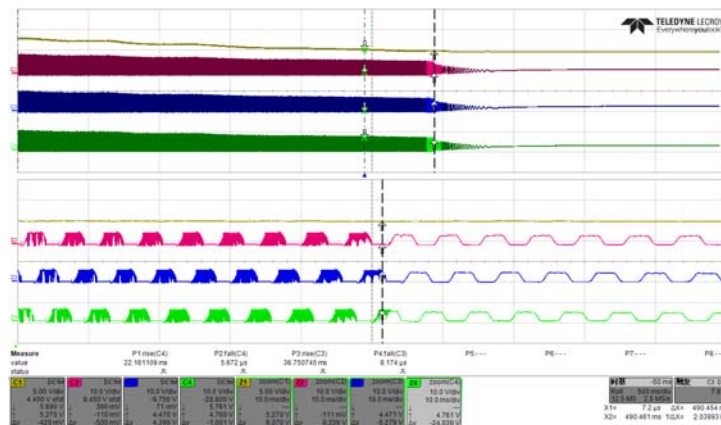


Fig. 5 Measured Bus voltage and UVW output voltage @ bus = 6V

## 3.2 MOSFET Vgs

### 3.2.1 Gate Driver Voltage

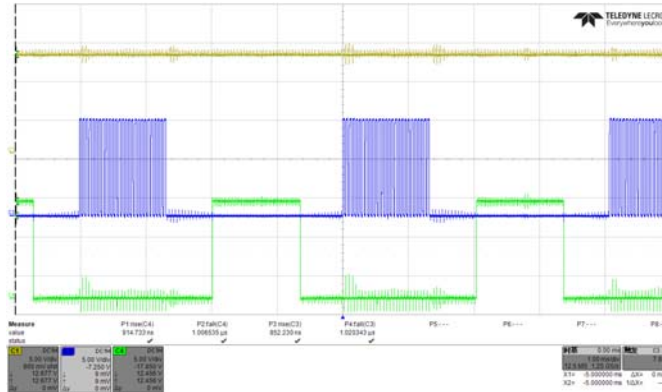


Fig. 6 Measured highside and lowside MOSFET Vgs @ bus = 12.5V

### 3.2.2 Gate Driver Rise/Fall Edge Time

	GH1	GH2	GH3	GL1	GL2	GL3
Tr/us	0.85	0.87	0.85	1.13	1.15	1.17
Tf/us	1.04	1.04	1.02	0.744	0.76	0.74

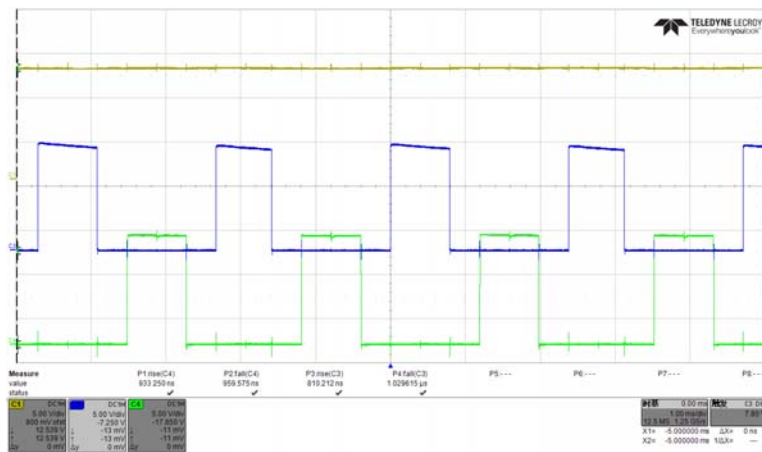


Fig. 7 Measured highside and lowside MOSFET Vgs @ bus = 12.5V



### 3.3 PWM

#### 3.3.1 PWM Frequency

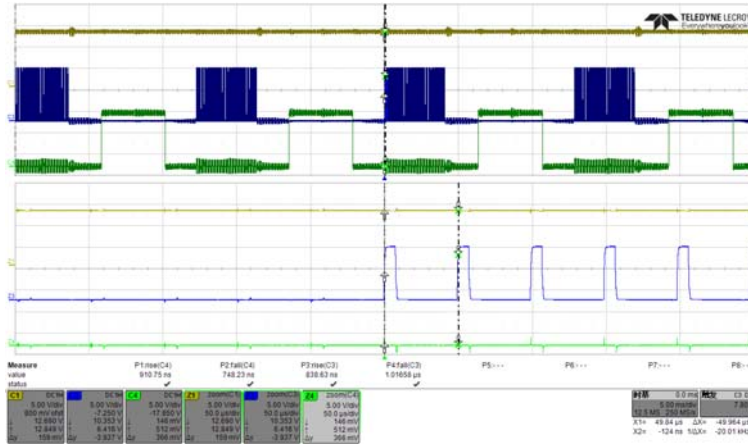


Fig. 8 Measured high-side gate driver PWM frequency

#### 3.3.2 Speed Regulator

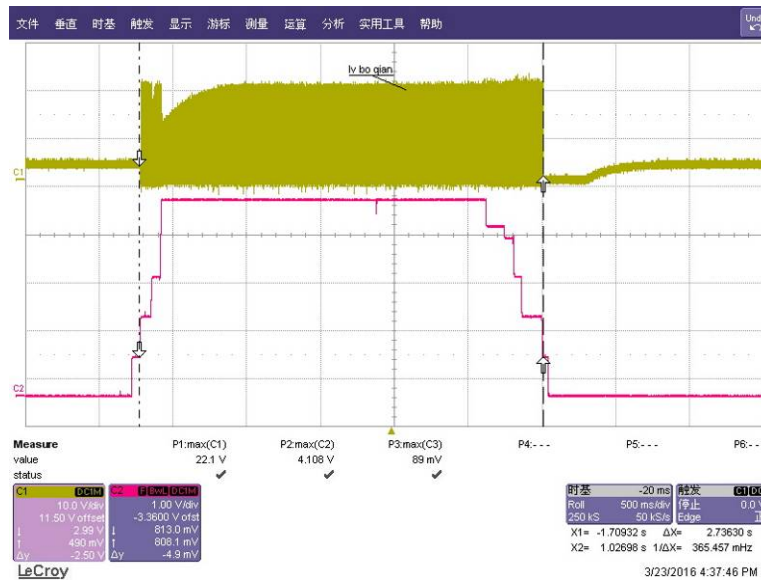


Fig. 9 Measured U-phase and throttle voltage

### 3.3.3 PWM Minimum Duty

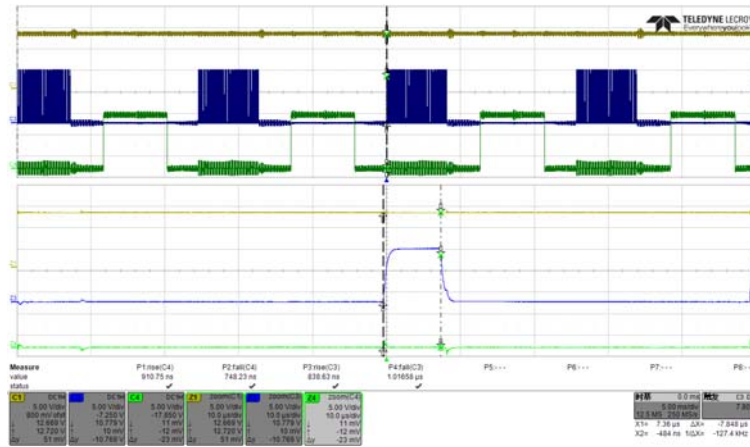


Fig. 10 Measured high-side gate driver PWM minimum duty

### 3.3.4 PWM Maximum Duty

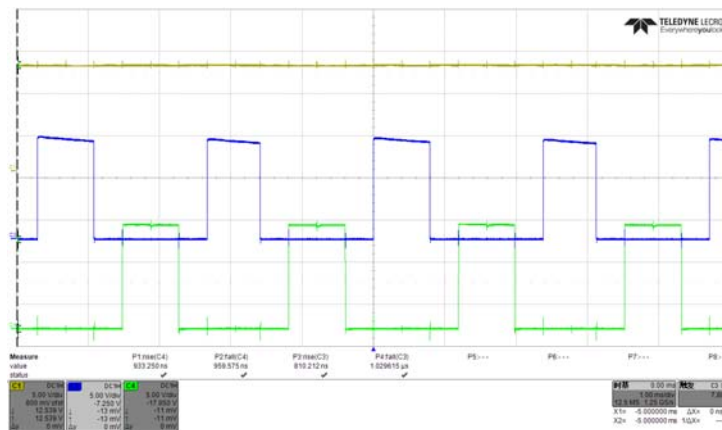


Fig. 11 Measured high-side gate driver PWM minimum duty



### 3.4 Motor Short Circuit Protection

#### 3.4.1 Phase Short Circuit Protection Time

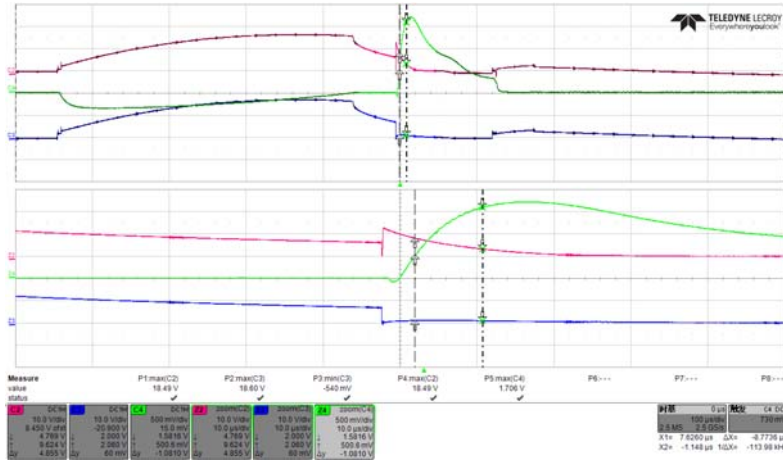


Fig. 12 Measured short circuit protection time @ bus = 12.5V

#### 3.4.2 MOSFET Vds @ Short Circuit Protection

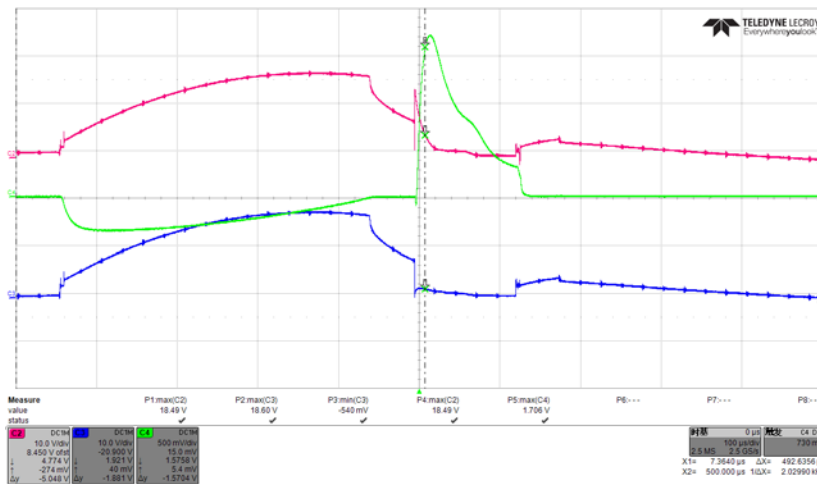


Fig. 13 Measured phase voltage @bus=12.5V

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