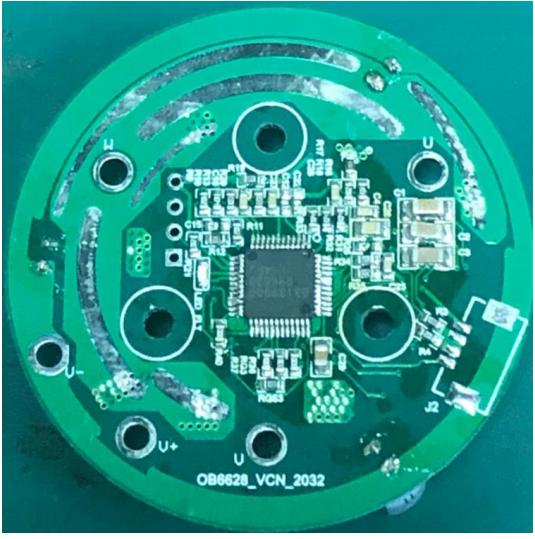


<b>Subject</b> <b>OB6628 Demo Board Manual</b>	Board Model: OB6628GP_VCN_2032 Upper Model: MotorFigure_3-1002_VCN6628GP_DEMO_Setup Doc. No.: OB_DOC_DBM_A_662800
	<b>Key Feature:</b> <ul style="list-style-type: none"><li>• Single chip BLDC controller solution</li><li>• High integration of MCU, pre-driver, high speed rail-to-rail operation amplifier, high precision LDO, current protection comparator.</li><li>• Six-step BLDC control without sensors</li><li>• MOSFET temperature sensing and thermal protection.</li><li>• Two levels battery under voltage protection</li><li>• Constant power control.</li></ul>

**Revision history:**

Revise Date	Version	Reason/Issue
2021-02-05	00	First Issue

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# 1. System Electrical Specification

## 1.1 Input Characteristic

- |                           |                          |
|---------------------------|--------------------------|
| ▪ DC input voltage rating | 6-7cells Li-Iron battery |
| ▪ DC input voltage        | 17V to 32V               |

## 1.2 System parameters

- |  |                       |
|--|-----------------------|
| ▪ PWM frequency                            | 8KHz-16KHZ            |
| ▪ MCU supply voltage                       | 5V ± 2%               |
| ▪ 5V supply current                        | 100mA                 |
| ▪ ADC_REF                                  | ± 1%                  |
| ▪ Current sampling resistance              | 2mΩ                   |
| ▪ Current sampling amplification           | 21                    |
| ▪ Current sampling amplifier offset        | Self-calibration      |
| ▪ Gate driver supply voltage               | 12V @ 6 cells battery |
| ▪ Max of MOSFET drain source voltage value | 40V                   |

## 1.3 Output characteristic

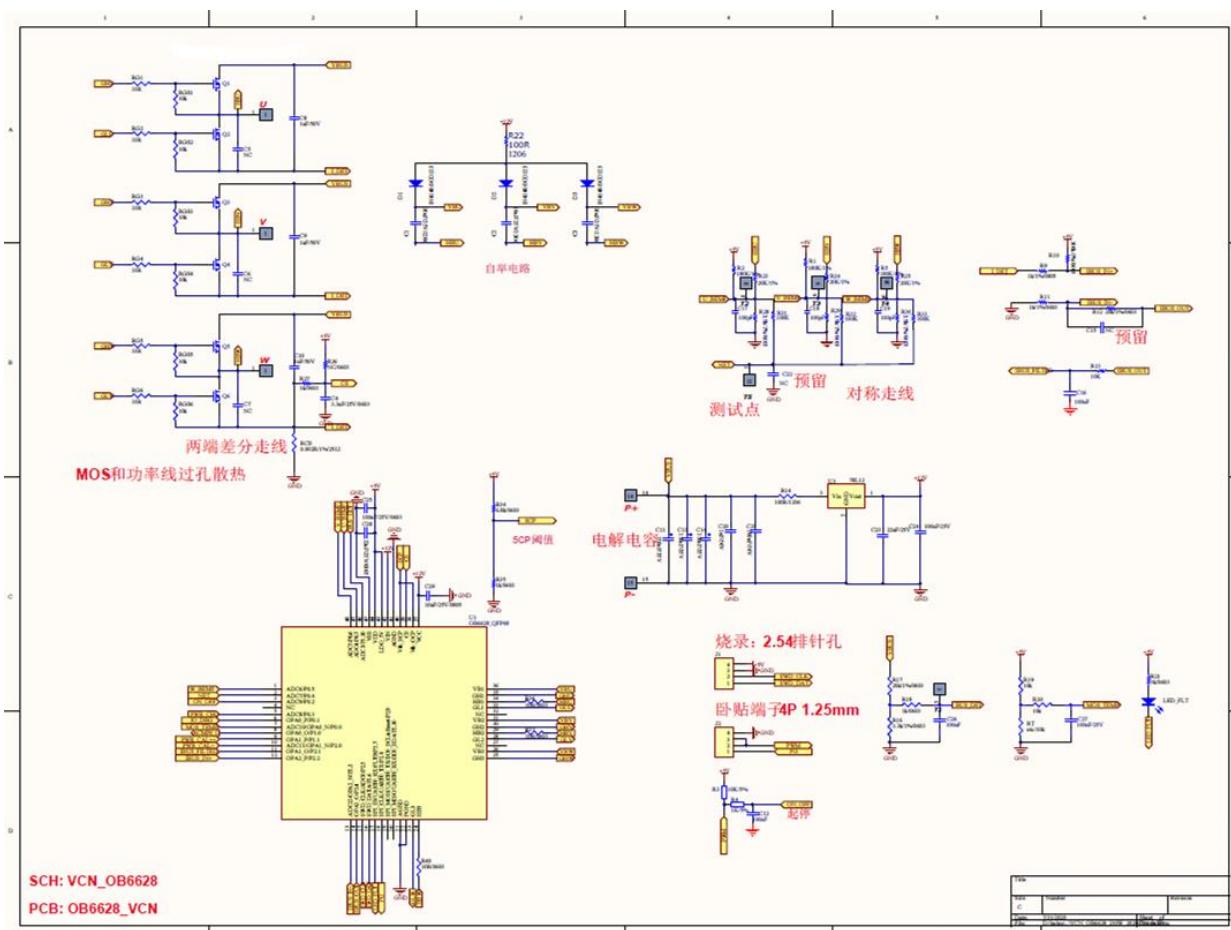
- |                             |      |
|-----------------------------|------|
| ▪ Maximum of Constant power | 230W |
| ▪ Maximum of PWM duty       | 100% |
| ▪ Minimum of PWM duty       | 2%   |

## 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

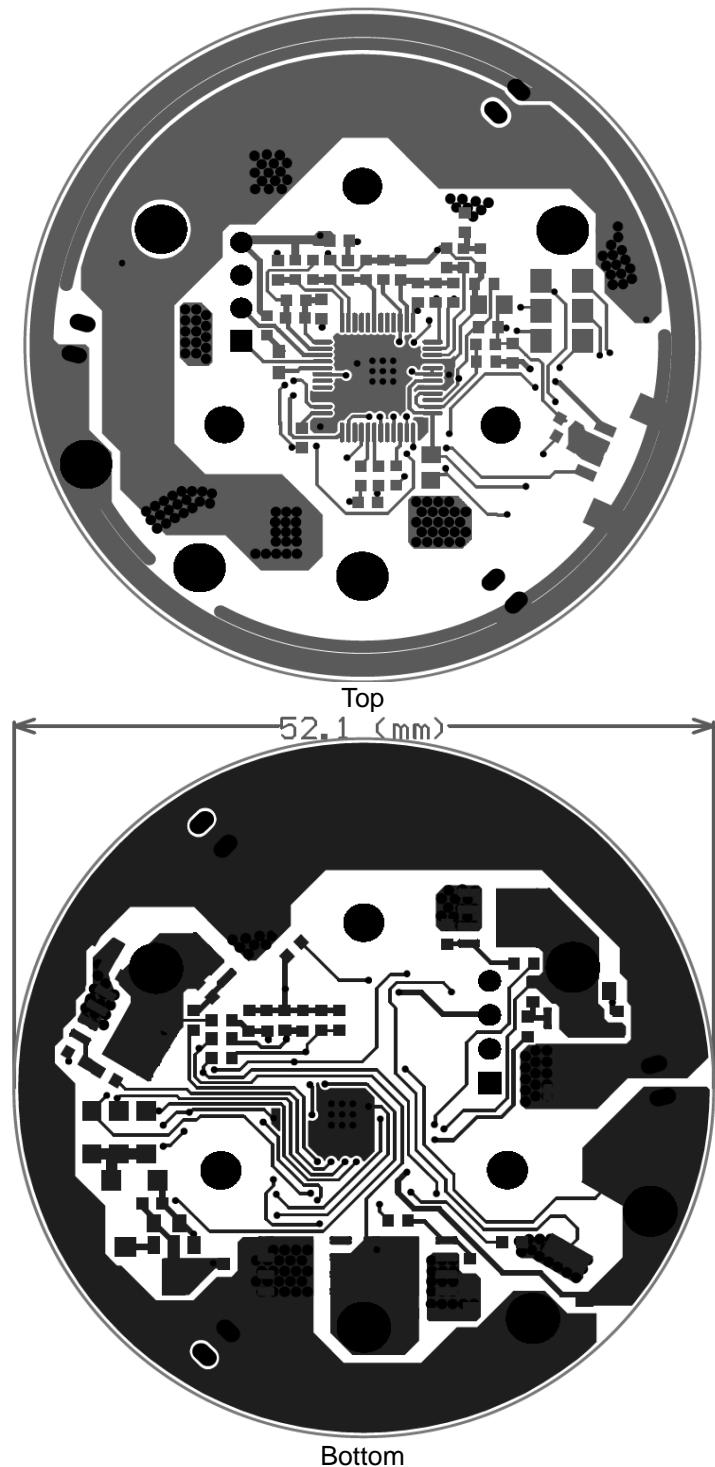
### 2.1 Schematic

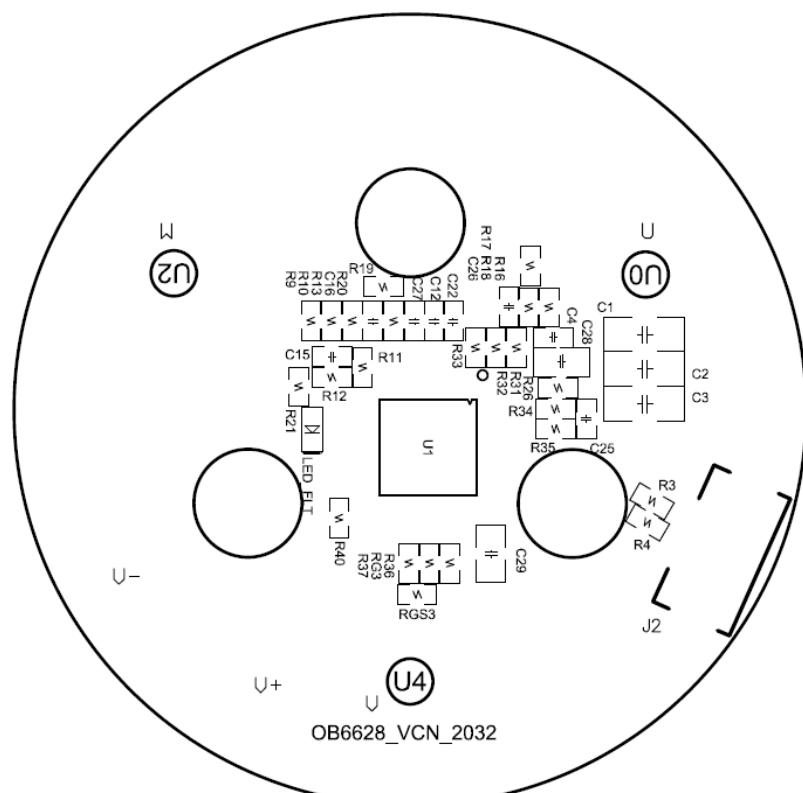


## 2.2 Bill of material

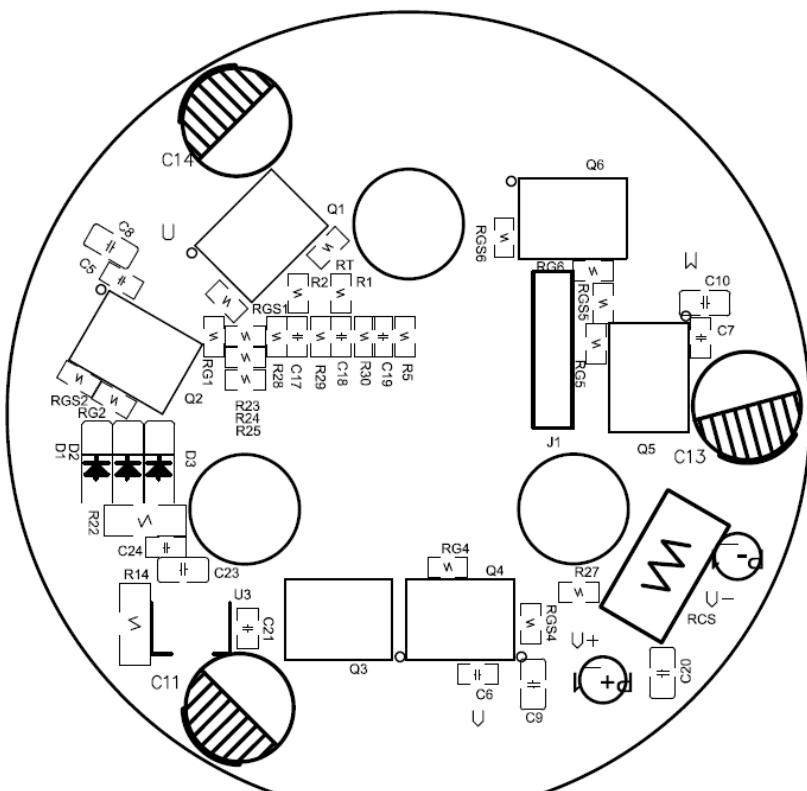
Designator	Comment	Footprint	Quantity
C1, C2, C3	10uF/25V/1206	C1206	3
C4	3.3nF/25V/0603	C0603	1
C8, C9, C10, C20	1uF/50V	C0805	4
C11, C13, C14	220uF/35V	CAP10*16	3
C17, C18, C19	100pF	C0603	3
C21	100nF/50V	C0603	1
C24, C27, C16,C25, C26	100nF/25V	C0603	5
C23,C28 C29	10uF/25V/0805	C0805	3
D1, D2, D3	1N4148/SOD123	D-SOD123	3
LED_FLT	RED/0603	LED-0603	1
Q1, Q2, Q3, Q4, Q5, Q6	NCEP40T13	PQFN5X6	6
R12, R17, R23, R24, R25	20K/1%	R0603	5
R3, R13 R19,R20	10K/5%	R0603	4
R4 R9 R11,R18, R27, R35	1k/1%	R0603	6
R10, R31, R32, R33, RGS1, RGS2, RGS3, RGS4, RGS5, RGS6	100k/1%/0603	R0603	10
R14,R22	100R/1206	R1206	2
R16	3.3k/1%/0603	R0603	1
R21	3k/0603	R0603	1
R28, R29, R30	3.9K/1%	R0603	3
R34	6.8k/0603	R0603	1
R36, R37, R40	10R/0603	R0603	3
RCS	0.002R/1%/2512	R2512	1
RG1, RG2, RG3, RG4, RG5, RG6	33R	R0603	6
R1,R2,R5	180K	R0603	3
RT	ntc/10K	R0603	1
U1	OB6628_QFP48	QFP48	1
U3	78L12	SOT89	1

## 2.3 PCB Garber File



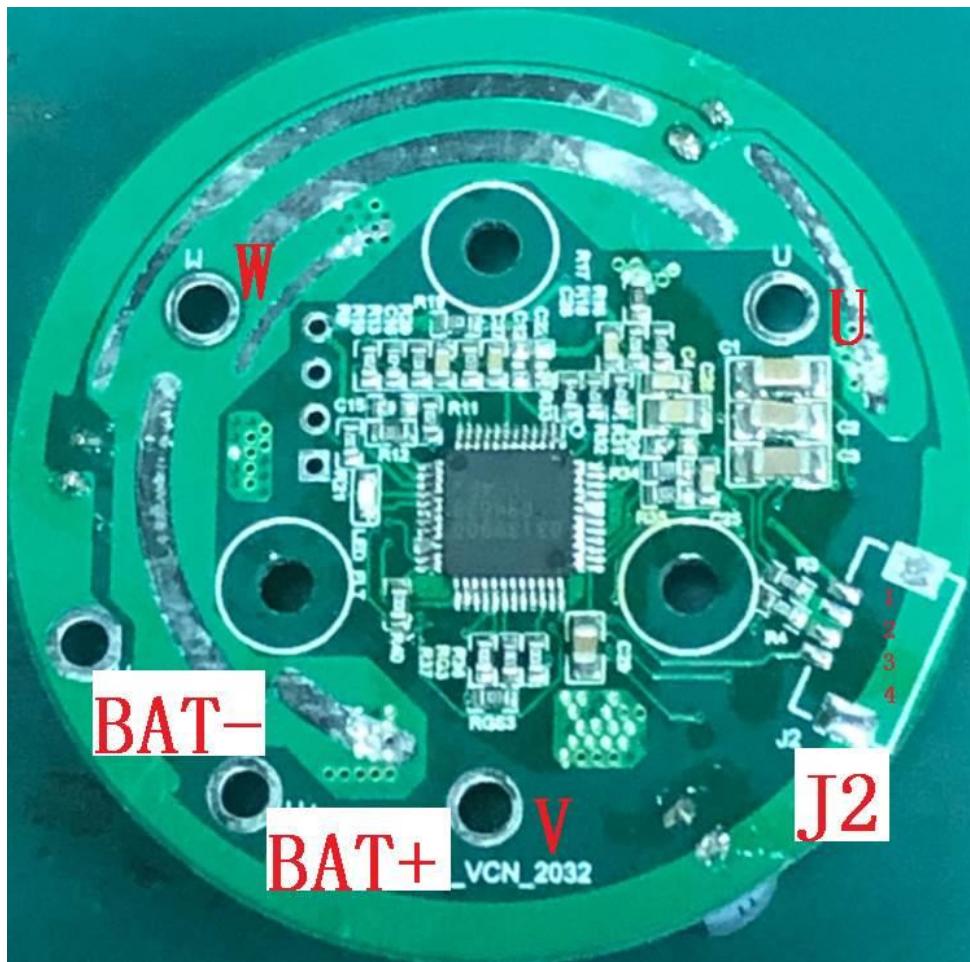


TOP



BOTTOM

## 2.4 Connector Function Description

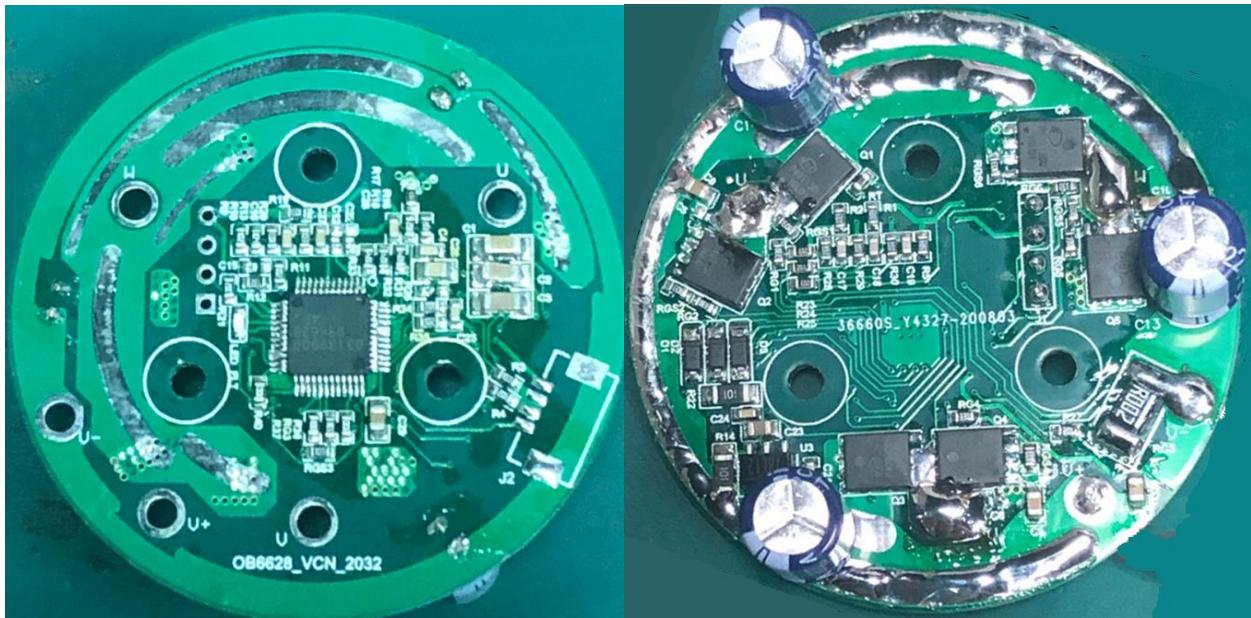


Name	Description
BAT+	Battery input, Bus+
BAT-	Battery input, GND
U	Motor U phase output
V	Motor V phase output
W	Motor W phase output

J2- 4pin connector

Pin Num	Description	Voltage Range
1	GND	0V
2	PWM 调速输入 (推荐 100Hz-1KHz)	0-5V
3		
4	FG	-

## 2.5 BLDC Controller Board Snapshot



Top

Bottom

### 3. Performance Evaluation

This session presents the test results of OB6627GP 18V/25A electric drill controller demo. TA=25°C

No	Parameter	Symbol	Min	Type	Max	Unit
1	MCU supply	LDO_5V	4.9	5	5.1	V
2	Gate driver supply	LDO_12V		12		V
3	MOSFET gate voltage	Vgs		12		V
4	Highside MOSFET Rise time	Tr_h		0.472		us
5	Highside MOSFET Fall time	Tf_h		0.631		us
6	Lowside MOSFET Rise time	Tr_l		0.435		us
7	Lowside MOSFET Fall time	Tf_l		0.517		us
8	PWM frequency	f_PWM	8	16		kHz
9	Current amplify coefficient			21		
10	MOSFET Vds @230W @BAT Voltage 24.66V	Vds			27.27	V
11	Dead Time	DT_F		1.036		us
		DT_R		0.58		us

#### ***Test Equipments***

Item	Module
DC source	LW12050KD
Oscilloscope	LeCroy HDO4024
Current meter	Tek TCPA300
Differential probe	CATIII
Multi-meter	VC9808

## 3.1 Voltage Test

### 3.1.1 Supply Power ON/OFF

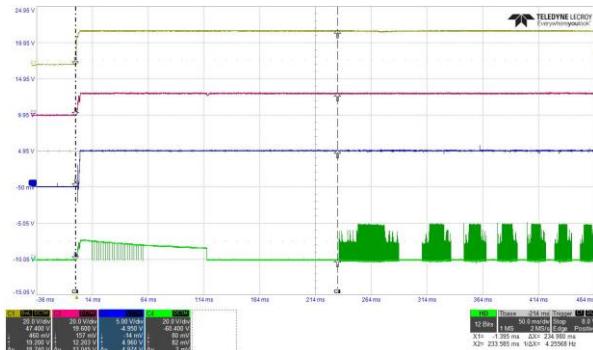


Fig. 1 Measured bus voltage ,VCC=12V, LDO=5V @ bus=19V ; Power On Time = 200ms

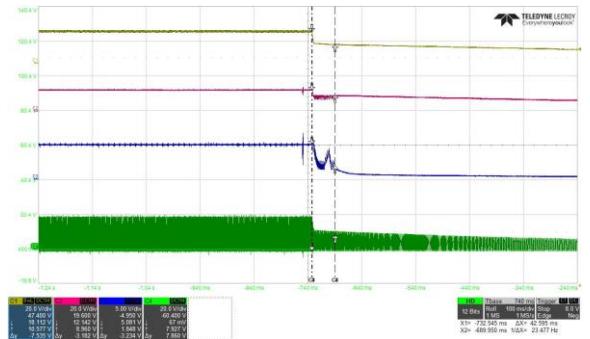


Fig. 2 Measured bus voltage ,VCC=12V, LDO=5V @ bus=19V ; Power Off Time = 42ms

## 3.2 MOSFET

### 3.2.1 Vgs Rise/Fall Edge Time

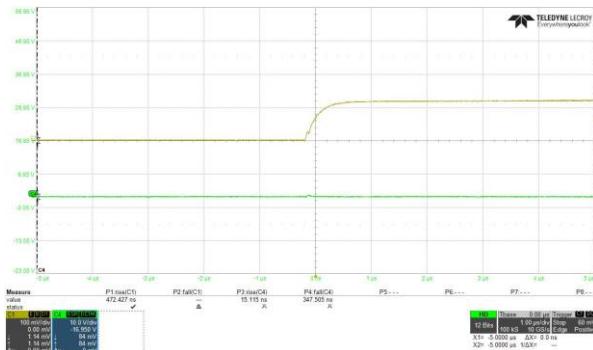


Fig. 3 Measured U-Phase highside(Yellow) and lowside(Green) MOSFET Vgs @ bus = 23V

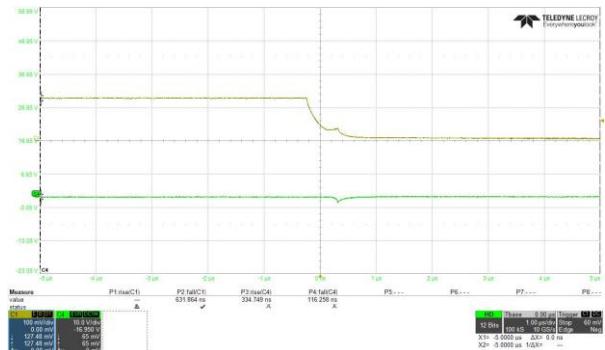


Fig. 4 Measured V-Phase highside(Yellow) and lowside(Green) MOSFET Vgs @ bus = 23V

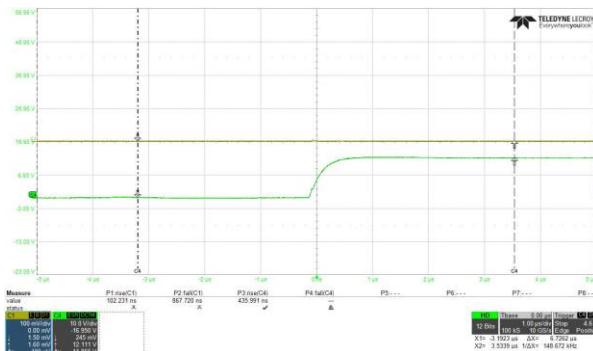


Fig. 5 Measured W-Phase highside(Yellow) and lowside(Green) MOSFET Vgs @ bus = 23V

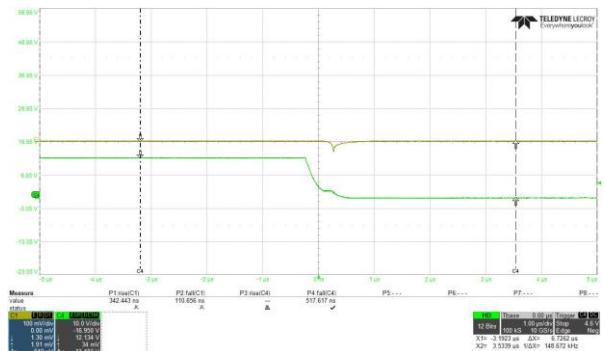


Fig. 6 Measured W-Phase highside(Yellow) and lowside(Green) MOSFET Vgs @ bus = 23V

### 3.2.2 Vds Strike Voltage @ Bus = 25V, Power=230W

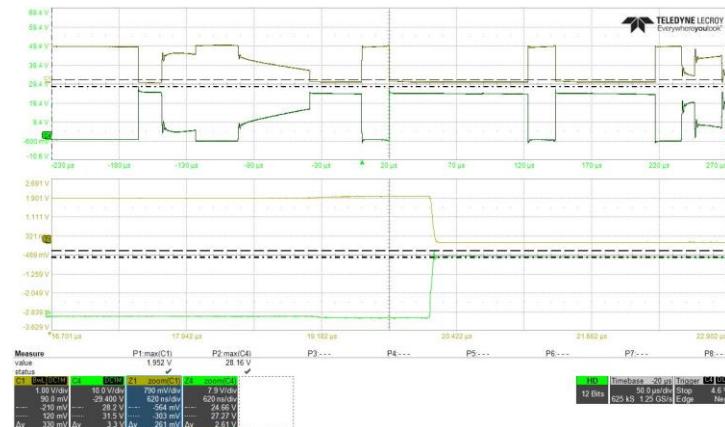


Fig. 7 Measured HighSide(Yellow), LowSide(Green),MOSFET Vds strike voltage @ bus = 25V

### 3.2.3 Dead Time

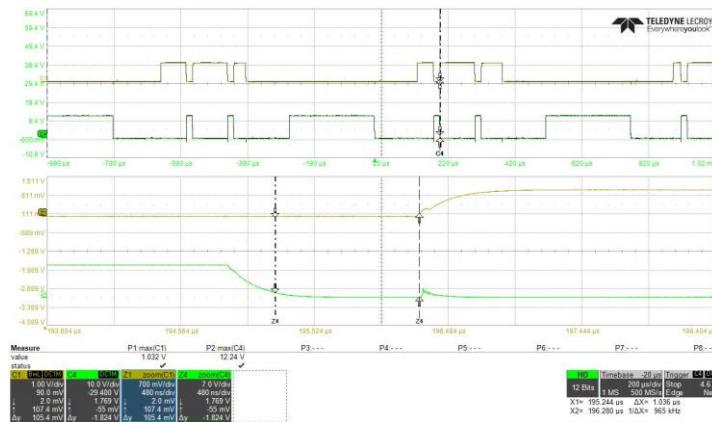


Fig. 8 HighSide Vgs(Yellow), LowSide Vgs(Green)

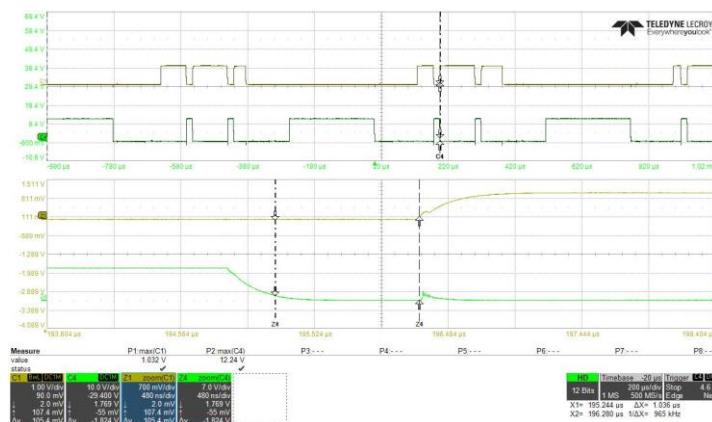


Fig. 9 HighSide Vgs(Yellow), LowSide Vgs(Green)

### 3.3 Current Sensing

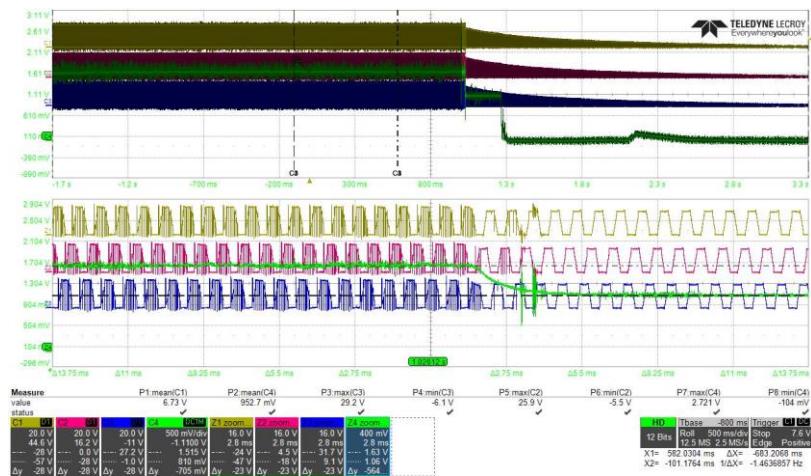


Fig. 10 u/v/wPhase(Yellow, Red, Blue), bus-current(CURRENT\_SENSE\_AVG, Green), @ bus = 23V, Power=230W

### 3.4 PWM Frequency

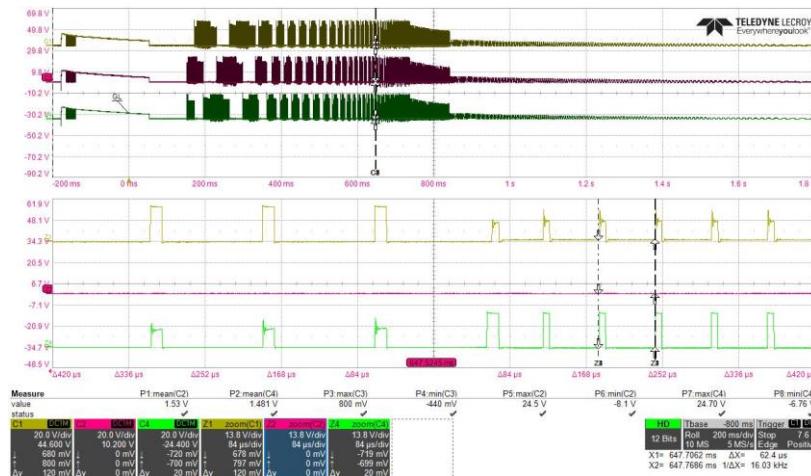


Fig. 11 u/v/wPhase(Yellow, Red, Green), @ bus = 23V

### 3.5 Temperature Test

#### 3.5.1 High Temperature Endurance Test

The whole machine is put into high temperature box, 23V, 230W 2Hours, Unit: °C

	1	2	3	4	5	6	7	8	Temperature
MOSU+	MOSU-	MOSV+	MOSV-	MOSW+	MOSW-	OB6628	Motor Winding		
1min	62.4	62	61.9	63.6	61.2	64.7	63.8	64.1	60°C
30min	81.3	81.1	81.7	80.4	81.9	81.6	79	91.7	65°C

### 3.5.2 Blocking Hole Protection Test

At room temperature, 23V, 230W, Uint: °C

	3	4	5	6	7	8	Temperature
	MOSV+	MOSV-	MOSW+	MOSW-	OB6628	Motor Winding	
3S	42.1	54	40.6	56.3	41.9	57	25°C

Actual measurement: Blocking hole, the temperature of machine part is much higher than the controller.

The plugging time should not be too long.

### 3.5.3 Low Temperature Test

The whole machine is put into high temperature box, Set temperture-40°C

The temperature of MOSFET, OB6628, Motor Winding	The whole machine	The controller
-15°C	Starting Success	Starting Success
-20°C	Starting Success	Starting Success
-25°C	Starting Success	Starting Success
-30°C	Fail	Starting Success
-33°C	Fail	Starting Success

Vacuum cleaners are recommended to operate at temperature greater than -25°C;

### 3.6 SCP Test

Condition	Setup	Result
TA=25°C	Vin=25V Phase of UV Short Circuit 10 次 Phase of VW Short Circuit 10 次 Phase of UW Short Circuit 10 次	Pass

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