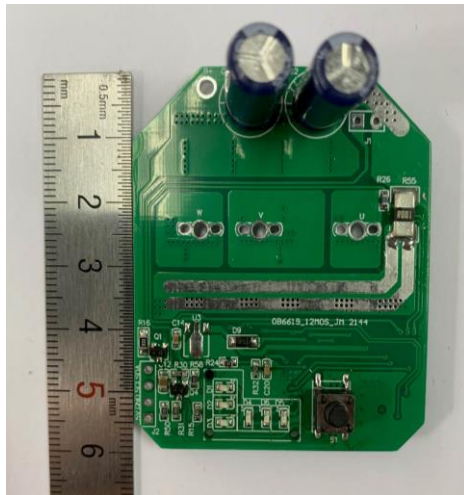


Subject
OB6619 Demo Board Manual

Board Model: OB6619_12MOS_JM_2144

Doc. No.: OB_DOC_DBM_C_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

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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 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 $5V \pm 1\%$
- 5V supply current 100mA
- Current sampling resistance $1m\Omega$
- Current sampling amplification 16
- Current sampling amplifier offset Self-calibration
- Gate driver supply voltage 12V
- Max of MOSFET drain source voltage value 38V
- MOSFET thermal sensor precision 1%

1.3 Output characteristic

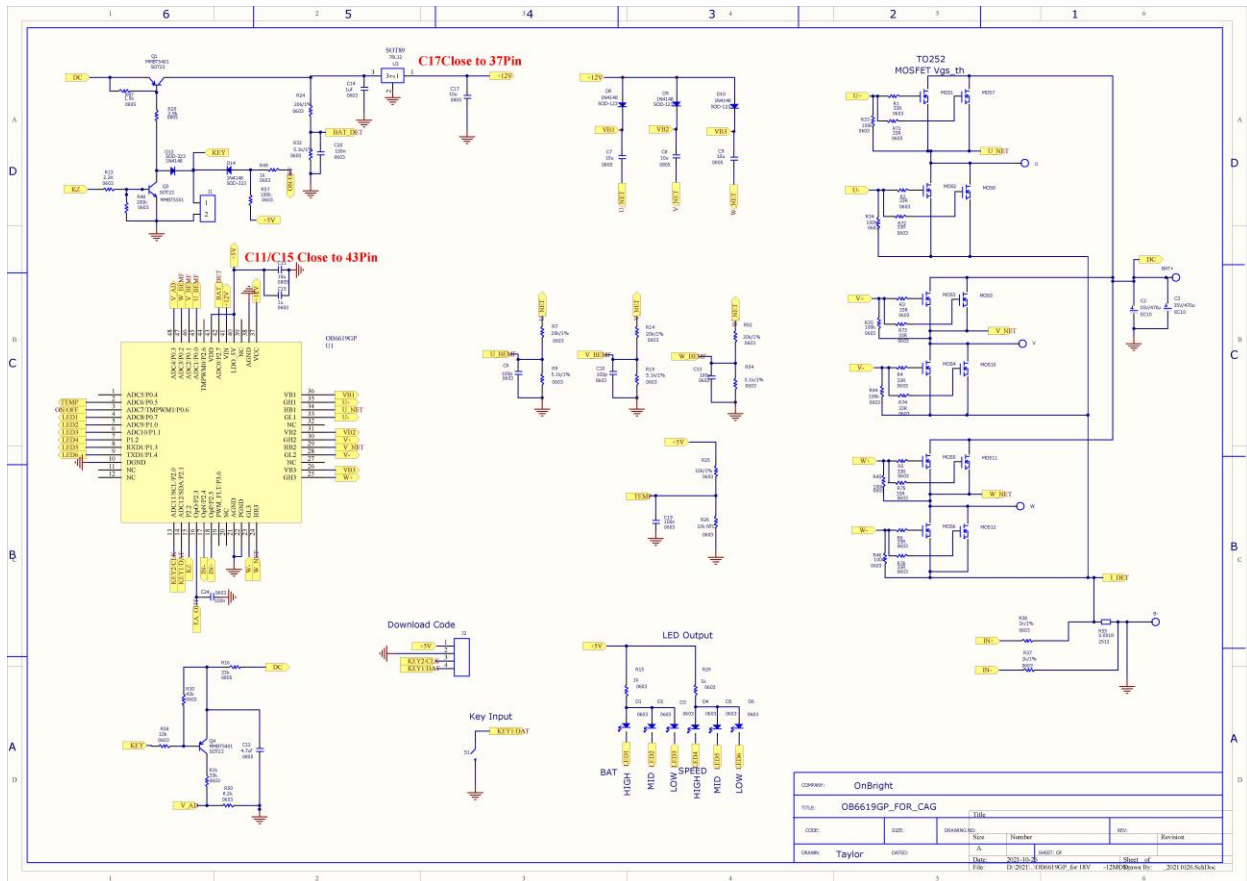
- Phase current limitation 100A
- Bus current limitation 40A
- Maximum of PWM duty 100%
- Minimum of PWM duty 20%

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



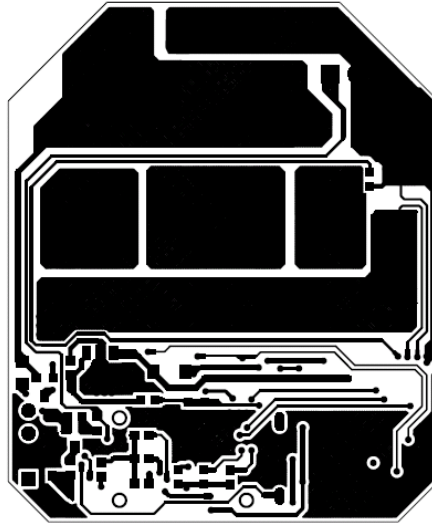
2.2 Bill of material

Position	Description	Package	QTY
C2, C3	Capacitor,aluminum electrolytic,470uf/35V,-40/105℃	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	Capacitor,ceramic,4.7uf/25V,X7R,10%	0805	1
C14,C15	Capacitor,ceramic,1uf/25V,X7R,10%	0603	2
C19, C20, C24	Capacitor,ceramic,100nf/25V,X7R,10%	0603	3
D1, D2, D3, D4, D5, D6	LED,Green	0603	6
D8, D9, D10, D13, D14	1N4148	SOD-323	5
MOS1, MOS2, MOS3, MOS4, MOS5, MOS6, MOS7, MOS8, MOS9, MOS10, MOS11, MOS12	NCE3080K	TO-252	12
U1	OB6619GQP	LQFP48	1
Q1,Q4	PNP,MMBT5401	SOT-23	2
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
R13	Resistor,chip,2.2k,5%	0603	1
R15, R29, R49	Resistor,chip,1k,5%	0603	3
R16, R31	Resistor,chip,33k,5%	0603	2
R20	Resistor,chip,3.9k,5%	0805	1
R25	Resistor,chip,10k,1%	0603	1
R26	10k,NTC TSM1A103^34D,B=3950	0603	1
R30	Resistor,chip,43k,5%	0603	1
R33, R34, R35, R44, R45, R46, R48, R57	Resistor,chip,100k,5%	0603	8
R37, R38	Resistor,chip,1k,1%	0603	2
R47	Resistor,chip,1.5k,5%	0805	1
R50	Resistor,chip,8.2k,5%	0603	1
R55	Resistor,chip,1mR,1%	2512	1
R58	Resistor,chip,10k,5%	0603	1
S1	SWITCH	6*6	1
U3	78L12	SOT-89	1

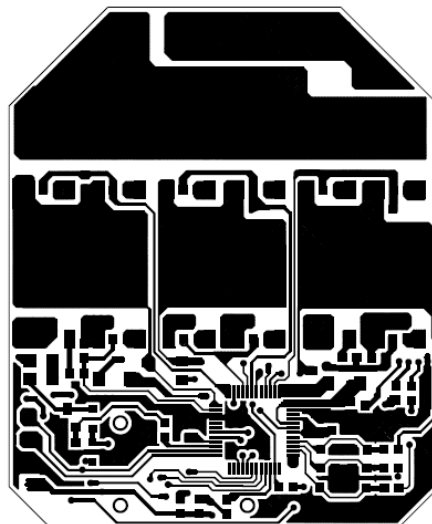
NOTE:

6 管方案: MOS7,MOS8,MOS9,MOS10,MOS11,MOS12,R71,R72,R73,R74,R75,R76 去除;
Mosfet 规格建议使用 30V/130A。

2.3 PCB Garber File

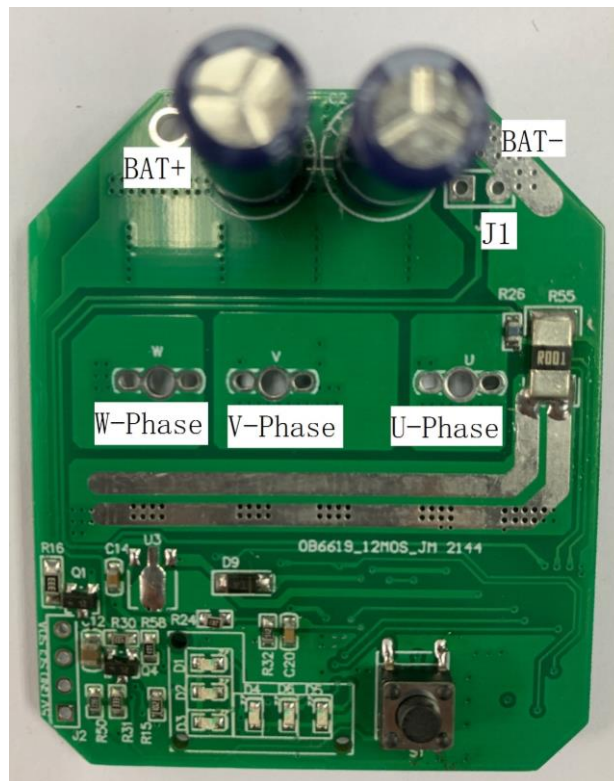


Top Layer



Bottom Layer

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

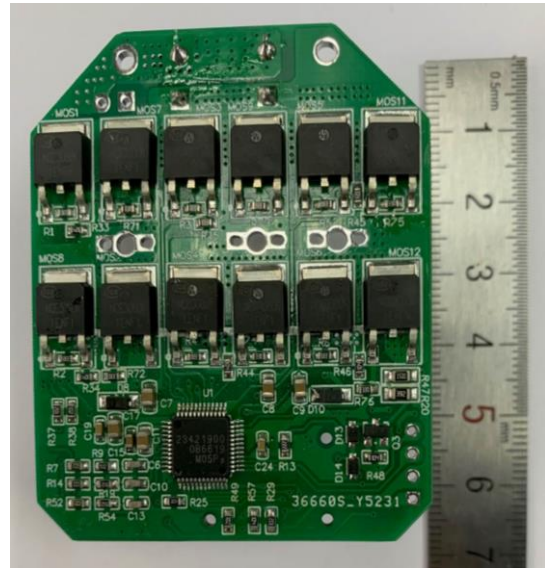
J1- 2pin connector

Pin Num	Description	Voltage Range
1	ON/OFF signal supply	0~5V
2	GND	0V

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 OB6619GP 18V/40A Angle Grinder 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 _{bus_UVLO}	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 _{gs}		12		V	Fig.4
5	Highside MOSFET Rise time	Tr _h		455		ns	Fig.4
6	Highside MOSFET Fall time	Tf _h		421		ns	Fig.5
7	Lowside MOSFET Rise time	Tr _l		428		ns	Fig.6
8	Lowside MOSFET Fall time	Tf _l		422		ns	Fig.7
9	Vds Peak voltage	V _{ds}			30.2	V	Fig.8
10	PWM frequency	f _{PWM}		20		kHz	Fig.9
11	PWM duty	Duty	20		100	%	Fig.10, Fig.11
12	Current amplify coefficient			16			Fig.12
13	MOSFET current shutdown time in MOTOR short circuit				10	us	Fig.13, Fig.14, Fig.15
14	MOSFET Vds in MOTOR short circuit	V _{ds}			38	V	Fig.13, Fig.14, Fig.15
15	Dead Time			1.4		us	Fig.16
16	Abnormal Power On Protect(先上电再按调速)差值			530		mv	Fig.17
17	Abnormal Power On Protect(先按调速后上电)差值			180		mv	Fig.18

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	26.6	26.4	26.8	26.6	26.4
5min	40.2	44.2	41.7	45.1	38.8
10min	42.3	46.8	43.9	47.4	40.9
20min	43.3	49.0	44.7	48.9	42.1
30min	44.2	48.2	44.4	49.0	42.2
1h	44.1	48.3	44.4	48.1	42.1

Note: 电源电压 20V, 负载电流 12.7A, 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

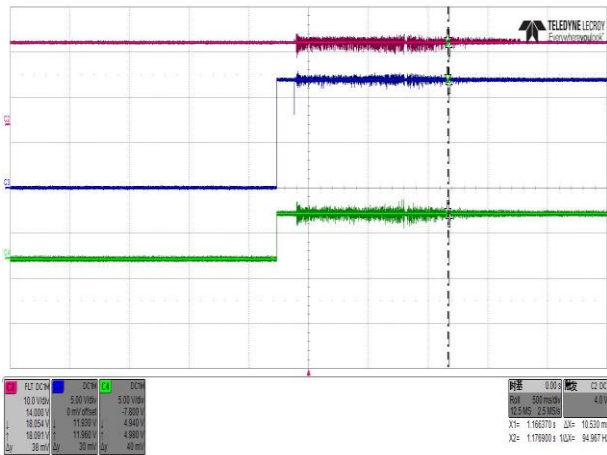


Fig. 1 Measured gate driver and MCU supply voltage @ battery=18V

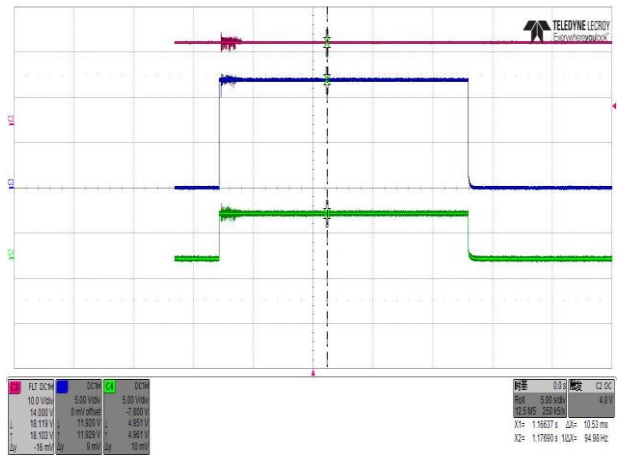


Fig. 2 Measured gate driver and MCU supply voltage @ battery=18V

3.2.2 Battery under voltage lockout

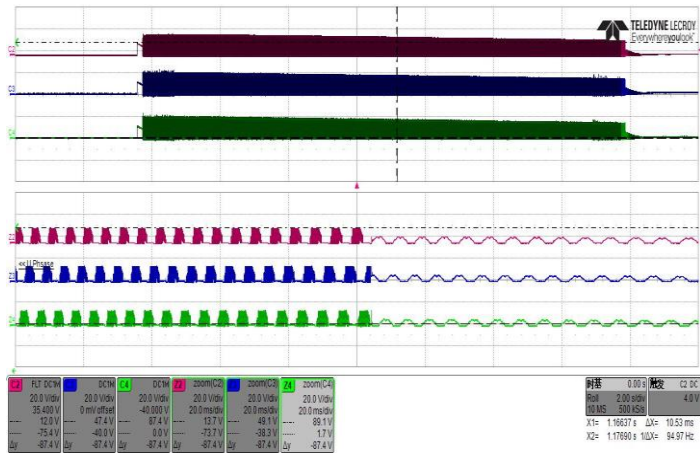


Fig. 3 Measured UVW output voltage @ battery=13.5V

3.2.3 MOSFET Vgs

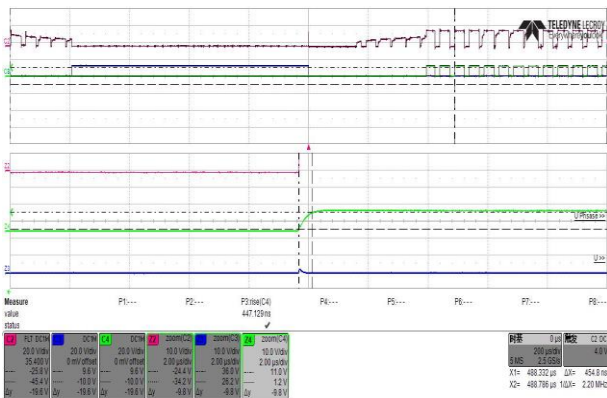


Fig. 4 Measured U phase voltage and highside MOSFET Vgs rise time @ battery=18V

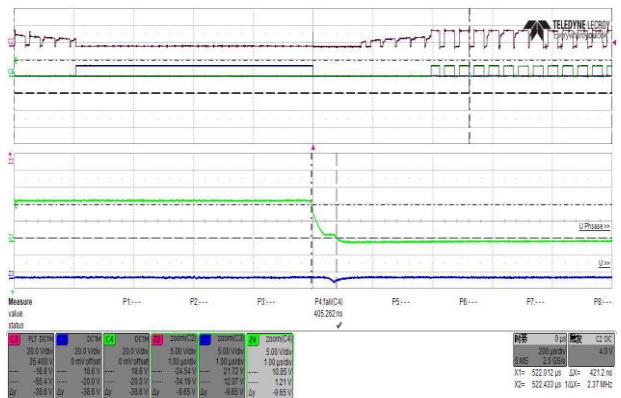


Fig. 5 Measured U phase voltage and highside MOSFET Vgs fall time @ battery=18V

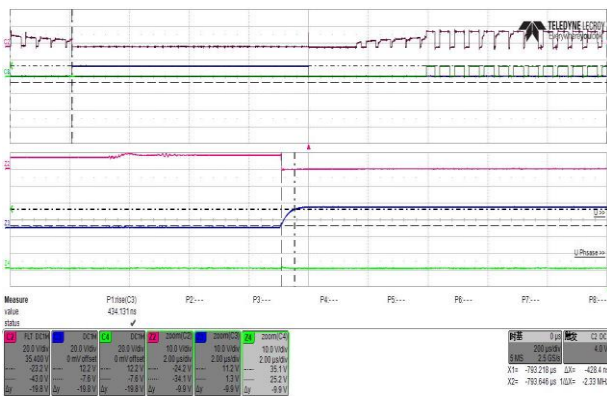


Fig. 6 Measured U phase voltage and lowside MOSFET Vgs rise time @ battery=18V

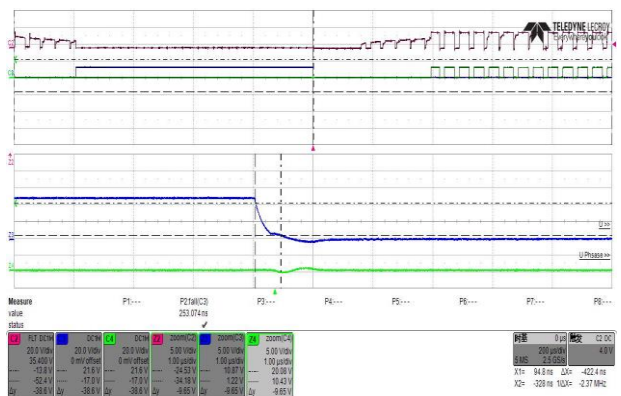


Fig. 7 Measured U phase voltage and lowside MOSFET Vgs fall time @ battery=18V

3.2.4 MOSFET Vds

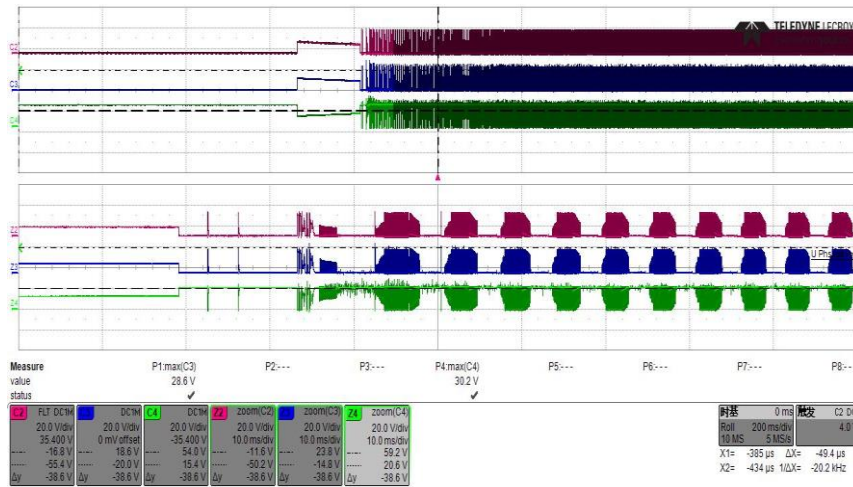


Fig. 8 Measured U phase voltage and highside and lowside MOSFET Vds @ battery=21V

3.3 PWM Test

3.3.1 PWM Frequency

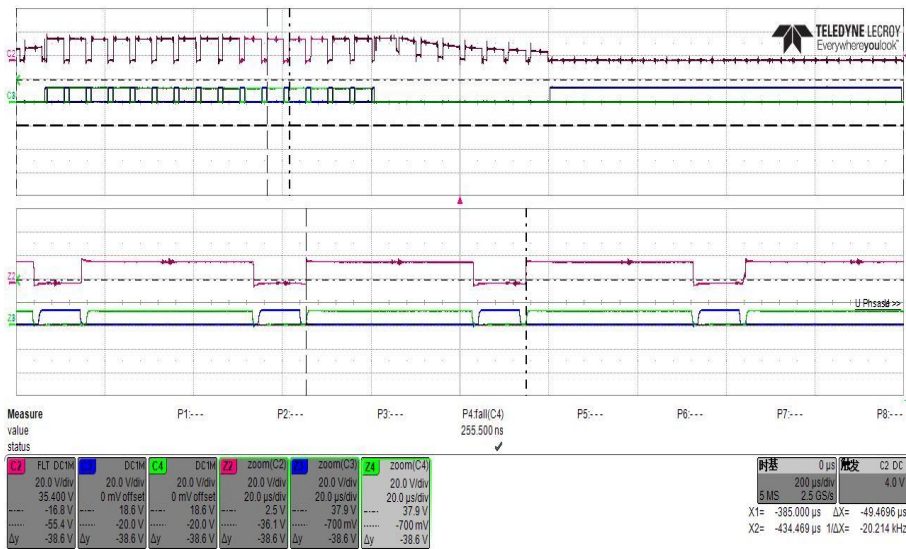


Fig. 9 Measured U phase voltage and highside and lowside MOSFET Vgs

3.3.2 PWM Initial duty

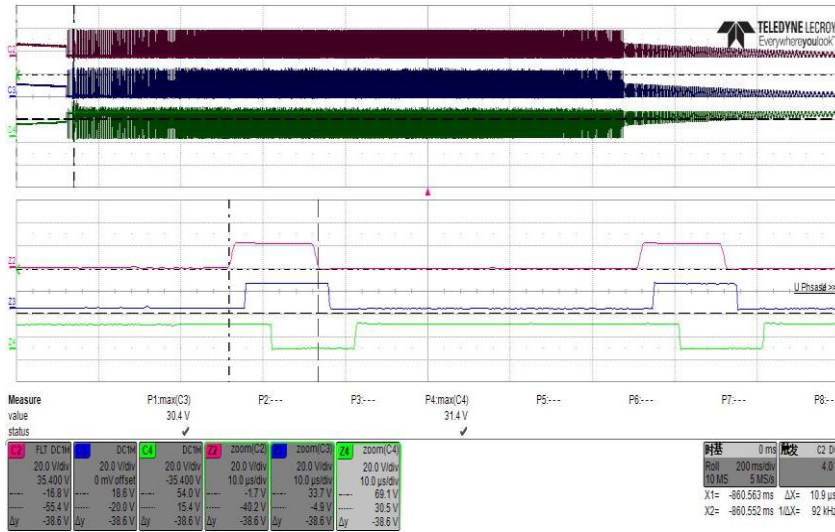


Fig. 10 Measured U phase voltage and highside and lowside MOSFET Vgs

3.3.3 PWM Duty ON

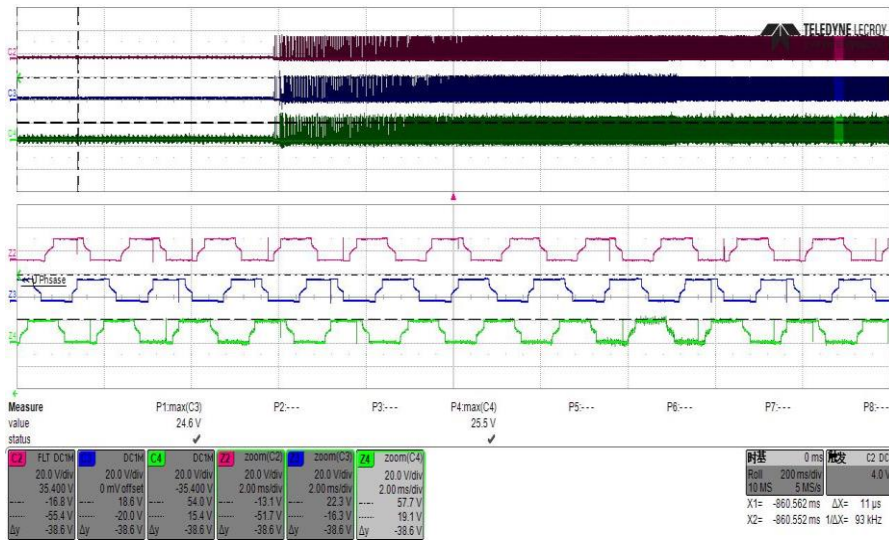


Fig. 11 Measured UVW phase voltage

3.4 Current sampling

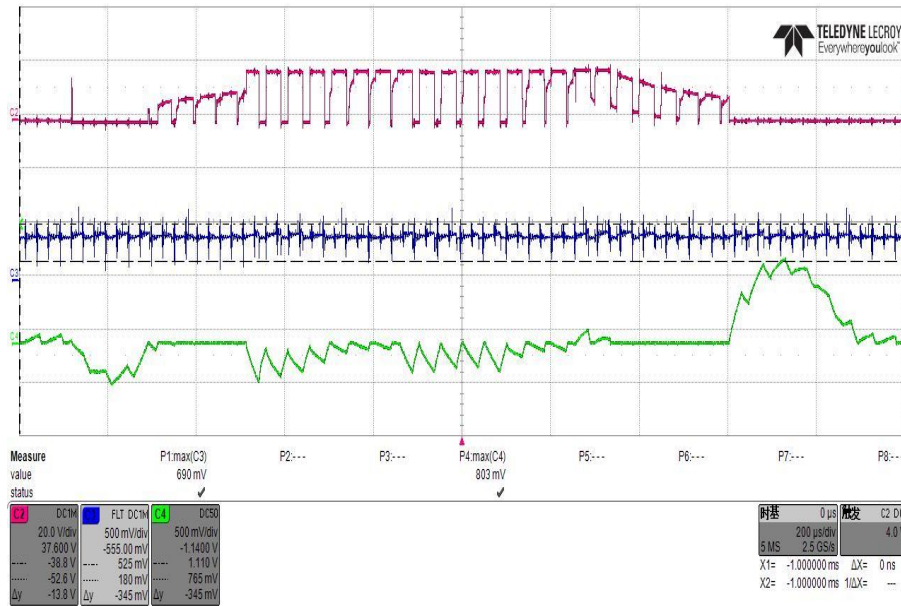


Fig. 12 Measured U phase voltage, U phase current and EA out

3.5 Motor Short Circuit Protection

3.5.1 U-V phase short circuit

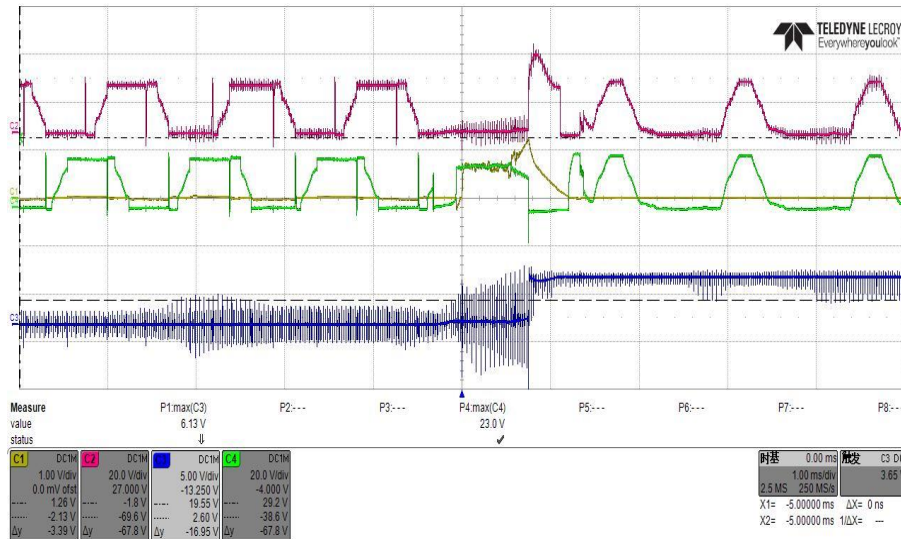


Fig. 13 Measured U-phase voltage, V-phase voltage, IO-trigger, phase current @ battery voltage = 21V

3.5.2 U-W phase short circuit

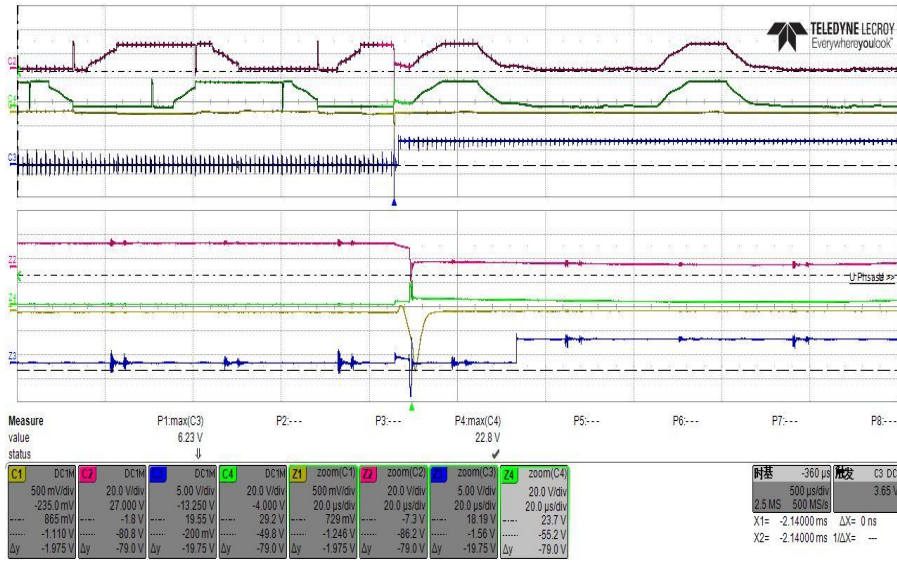


Fig. 14 Measured U-phase voltage, W-phase voltage, IO-trigger, phase current @ battery voltage = 21V

3.5.3 V-W phase short circuit

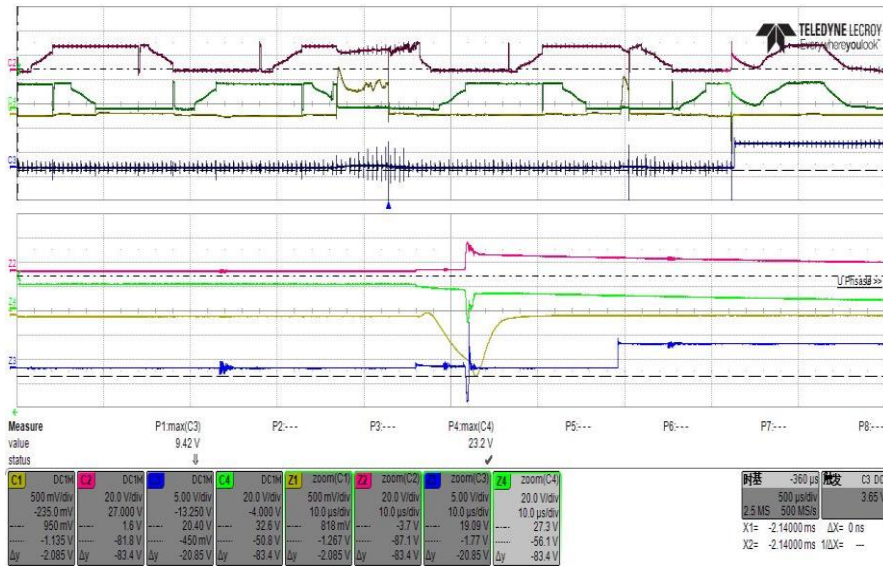


Fig. 15 Measured V-phase voltage, W-phase voltage, IO-trigger, phase current @ battery voltage = 21V

3.6 Dead Time

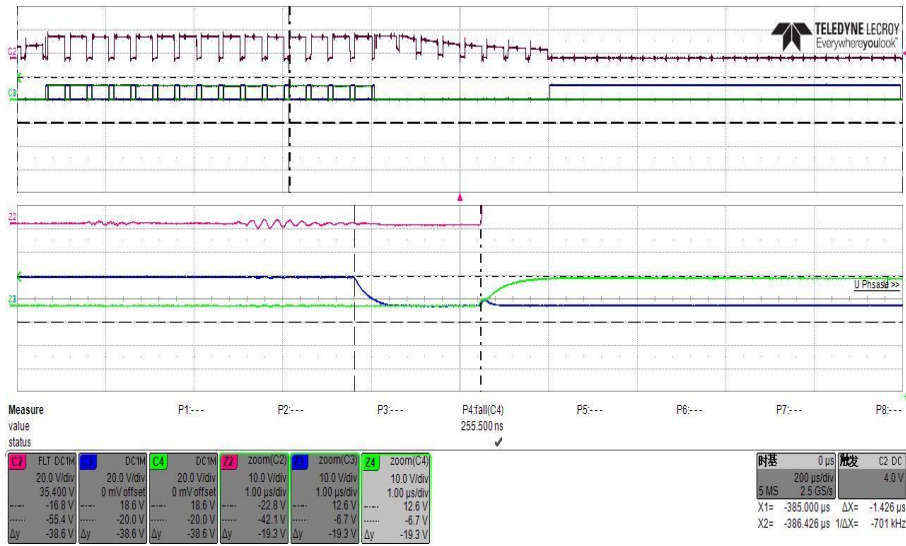


Fig. 16 Measured U phase voltage and highside and lowside MOSFET Vgs

3.7 Abnormal Power On Protect

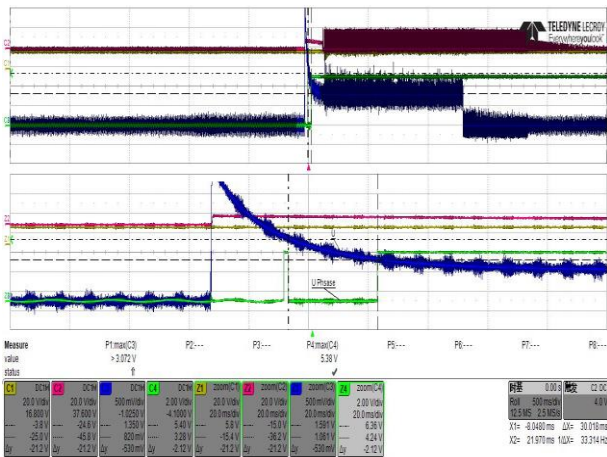


Fig. 17 Measured IV_AD(先上电再按调速)

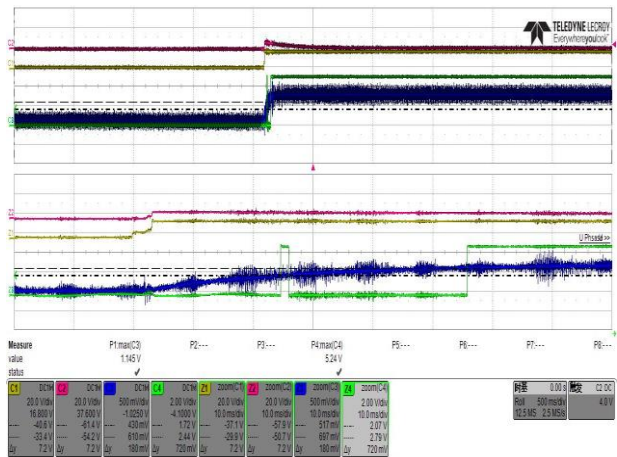


Fig. 18 Measured V_AD(先按调速再上电)

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