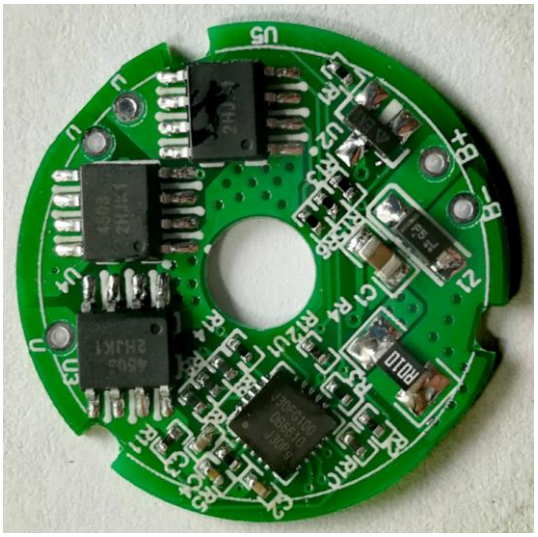
Subject **OB6610 Demo Board Manual**	Board Model: OB6610_SO8_1836 Doc. No.: OB_DOC_DBM_A_661000
	**Key Feature:** • Sensorless motor control • Continuous average current: 3.0A • High speed motor support • Motor start fast, stuck restart • High precision and wide range speed control • UVP/OCP support • Fast phase to phase SCP • Small PCB size, simple BOM and assemble conveniently

Revision history：

Revise Date	Version	Reason/Issue
2018-11-06	00	First Issue

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1. System Electrical Specification

1.1 Input Characteristic

■ DC input voltage rating	1s Li-ion battery of 3.7V
■ DC input voltage	2.8V to 4.2V

1.2 System parameters

■ PWM frequency	25 KHz
■ MCU supply voltage	2.8V to 4.2V
■ Current sampling resistance	15mΩ±1%
■ Gate driver supply voltage	2.8V to 4.2V
■ Max of MOSFET drain source voltage value	30.0V

1.3 Output characteristic

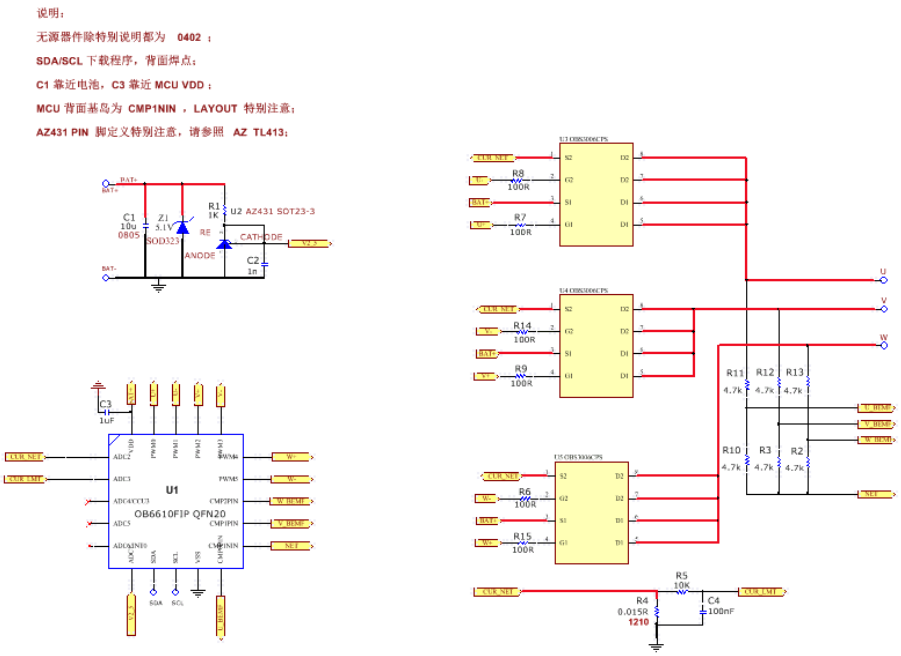
■ Over average current	5.0A 3S
■ Phase to phase shortcuit average current	8.0A 40mS
■ Restart times	3 times 1S interval
■ Maximum of PWM duty	100%
■ Minimum of PWM duty	13%

1.4 Environmental

■ Operating Ambient Temperature	-20 ℃ ~ 45 ℃
■ Storage Temperature	-40 ℃ ~ 100 ℃
■ Storage Humidity	0 ~ 95% R.H.

2. Board Information

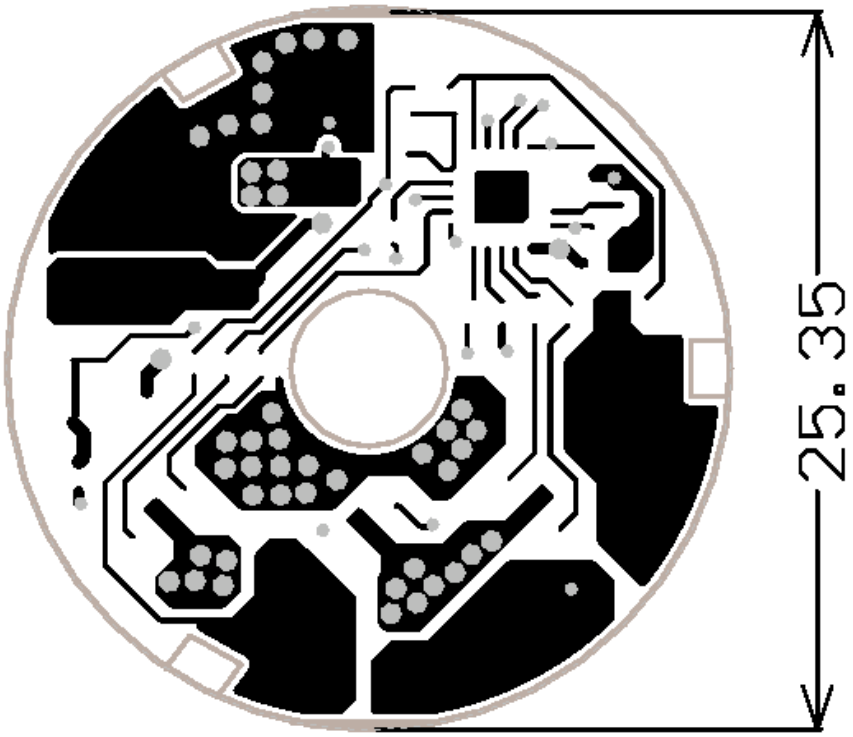
2.1 Schematic



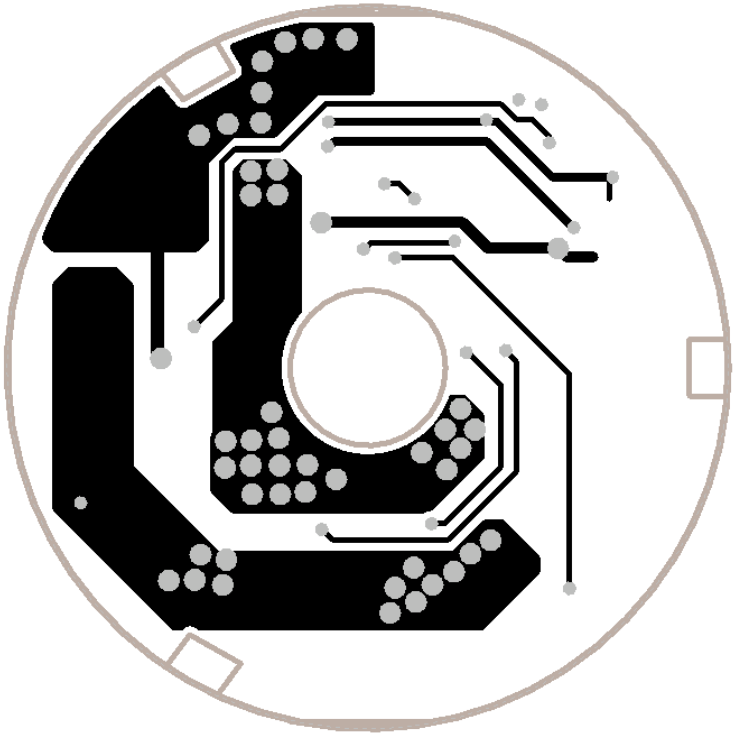
2.1.1 Bill of material

Designator	Package	Description	QTY
C1	C0805	Capacitor,ceramic,10uF/25V	1
Z1	SOD323	Zener,5.1V	1
C2	C0402	Capacitor,ceramic,1nF/25V	1
C3	C0402	Capacitor,ceramic,1uF/25V	1
C4	C0402	Capacitor,ceramic,100nF/25V	1
R1	R0402	Resistor,chip,1K,1%	1
R2, R3, R10, R11, R12, R13	R0402	Resistor,chip,4.7K,1%	6
R4	R1210	Resistor,chip,0.015R,1%	1
R5	R0402	Resistor,chip,10K,1%	1
R6, R7, R8, R9, R14, R15	R0402	Resistor,chip,100R,1%	6
U1	QFN20	OB6610FIP	1
U2	SOT23-3	AZ431	1
U3, U4, U5	SOP-8	OBS3006CPS	3
PCB	26mm*26mm	1OZ，thickness 1.0mm	1

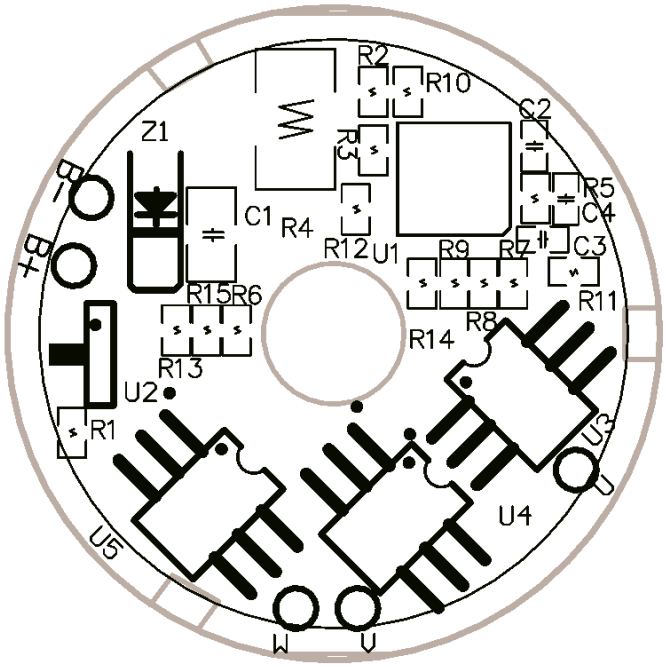
2.2 PCB Gerber File



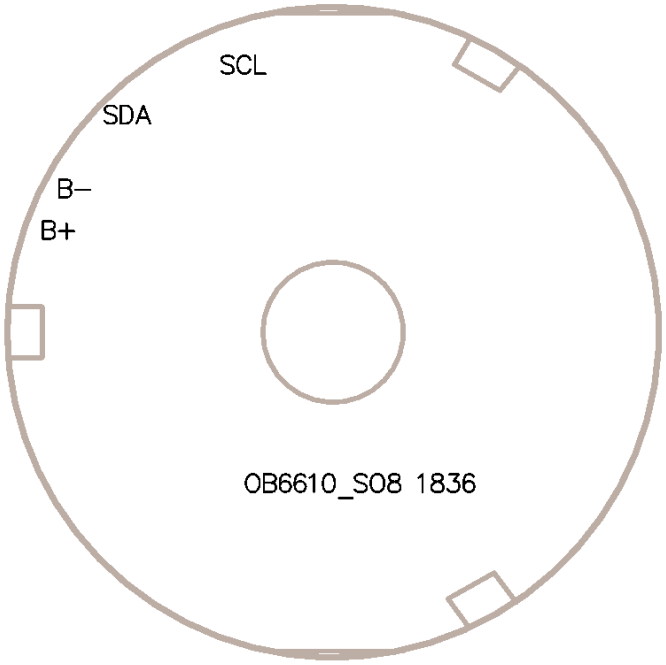
Top Layer



Bottom Layer

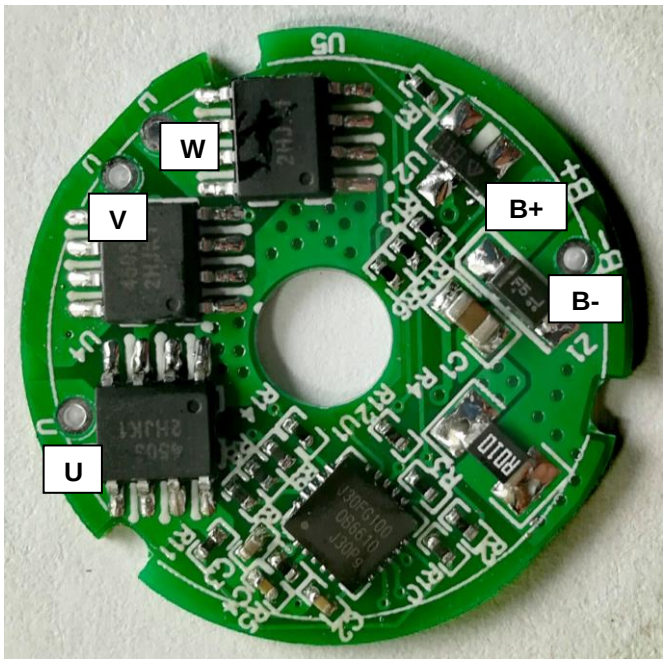


Silkscreen Top Layer



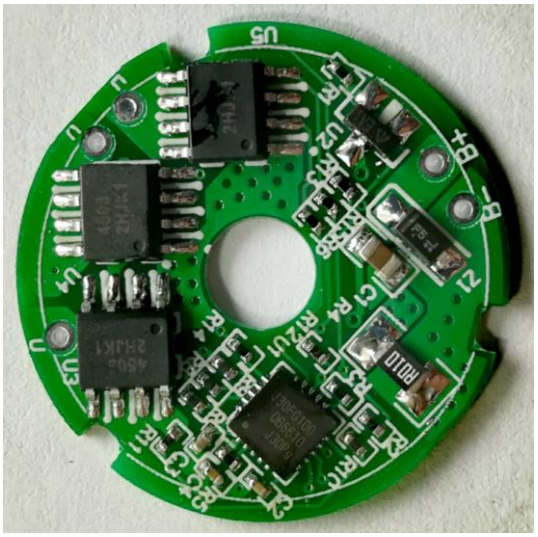
Silkscreen Bottom Layer

2.3 Interface Function Description



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

2.4 BLDC Controller Board Snapshot



3. Performance Evaluation

This session presents the test results of OB6610 3.7V/3.0A electronic trimmer 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℃

No	Parameter	Symbol	Min	Type	Max	Unit	Corresponding Fig.
1	MCU supply(Gate driver supply)	V_{bat}	2.8	3.7	4.2	V	Fig.1,Fig.2
2	Battery UVP	V_{bus_UVLO}		2.8		V	Fig.3
3	MOSFET gate voltage	V_{gs}	1.0	1.6	3.0	V	Fig.4
4	Highside MOSFET rise time	T_{r_h}		345.8		ns	Fig.4
5	Highside MOSFET fall time	T_{f_h}		373.9		ns	Fig.4
6	Lowside MOSFET rise time	T_{r_l}		195.9		ns	Fig.4
7	Lowside MOSFET fall time	T_{f_l}		181.0		ns	Fig.4
8	Bus supply voltage spike	V_{spike}		1.0		V	Fig.5
9	PWM frequency	f_{PWM}		25.0		kHz	Fig.6
10	Motor stuck protect time	T_{STP}		66.7		ms	Fig.11

Test Equipments

Item	Module
Battery	1 cell Li-Iron, 2600mAH
DC source	GWINSTEK GPS-3303C
Oscilloscope	LeCroy 4024
Current meter	/
Differential probe	/
Thermo meter	DT-847U
Digital multimeter	FLUKE 15B+

3.1 Voltage Test

3.1.1 MCU Supply(Gate Driver) Power ON/OFF & Vref Output

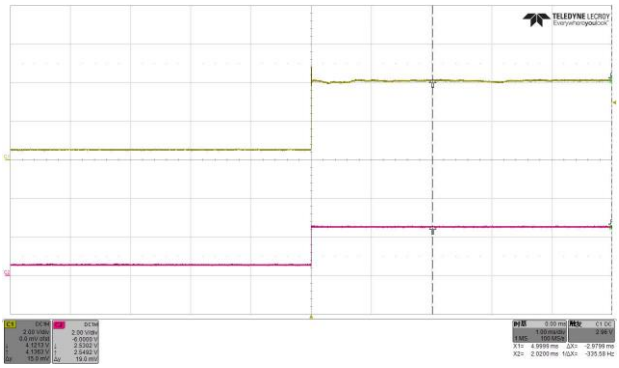


Fig. 1 Measured MCU supply voltage and 2.5V reference voltage @ battery=4.0V

CH1:V_{BAT} CH2:V_{REF}

单节锂电接入，MCU 供电和 2.5V 采样参考电压输出正常波形

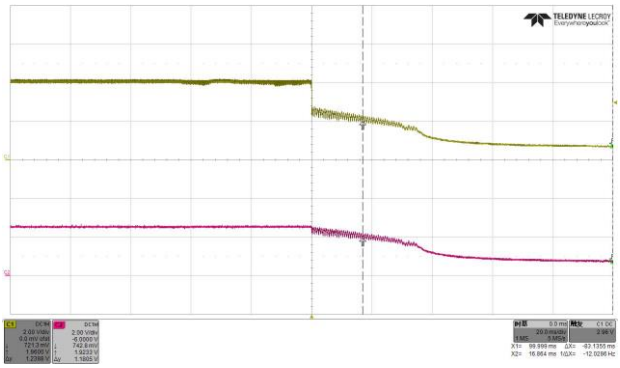


Fig. 2 Measured MCU supply voltage and 2.5V reference voltage @ battery=4.0V

CH1:V_{BAT} CH2:V_{REF}

单节锂电移除，MCU 供电和 2.5V 采样参考电压输出正常波形

3.1.2 V_{bus} under voltage lockout

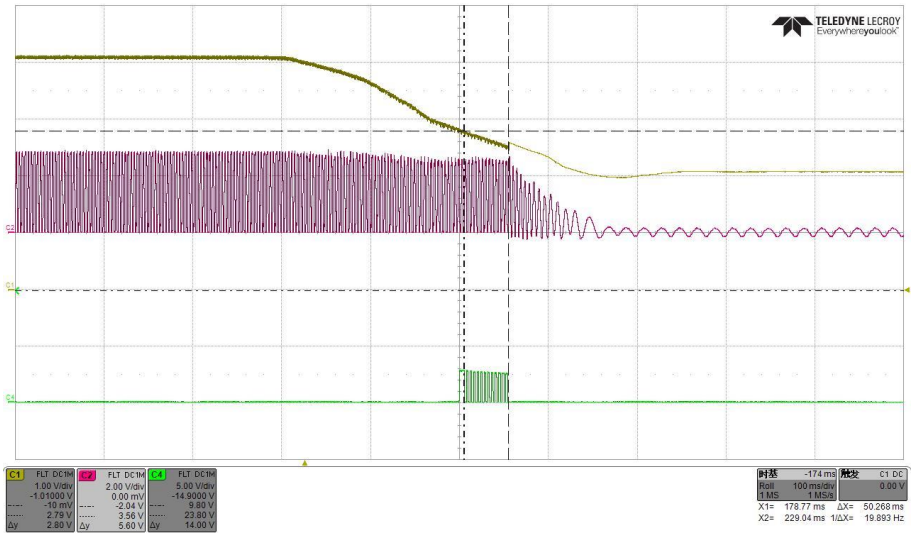


Fig. 3 Measured DC source voltage and U phase voltage @ V_{bus}=4.2V

CH1:V_{BAT} CH2:V_{MTR_PHS} CH4:2.8V UVP debounce counter

MCU 供电缓慢下降，欠压保护延时触发正常波形

3.1.3 MOSFET $V_{gs}/T_{r\_h}/T_{r\_l}/T_{f\_h}/T_{f\_l}$

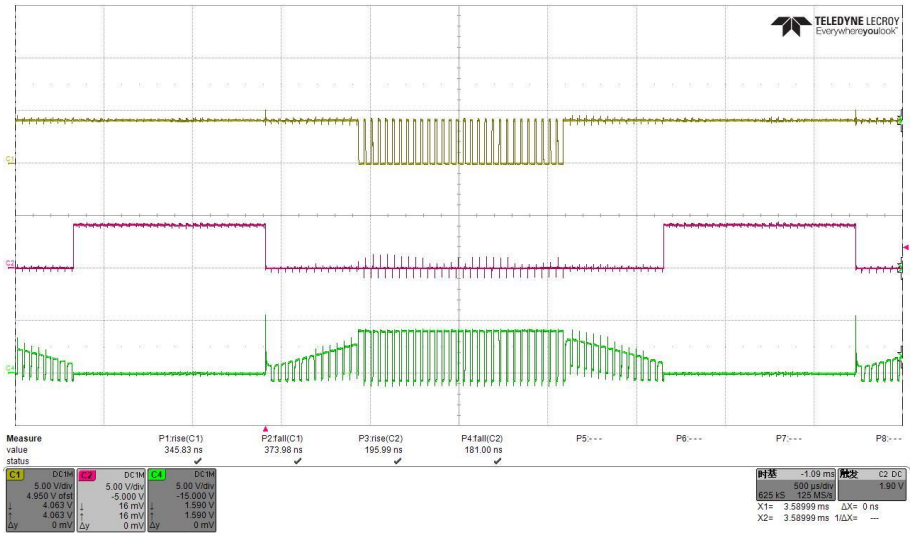


Fig. 4 Measured phase U highside and lowside MOSFET $V_{gs}/T_{r\_h}/T_{r\_l}/T_{f\_h}/T_{f\_l}$

CH1:V_{GH} CH2:V_{GL} CH4:V_{MTR_PHS}

MCU 供电缓慢下降，欠压保护延时触发正常波形

3.1.4 V_{bat} Spike Voltage

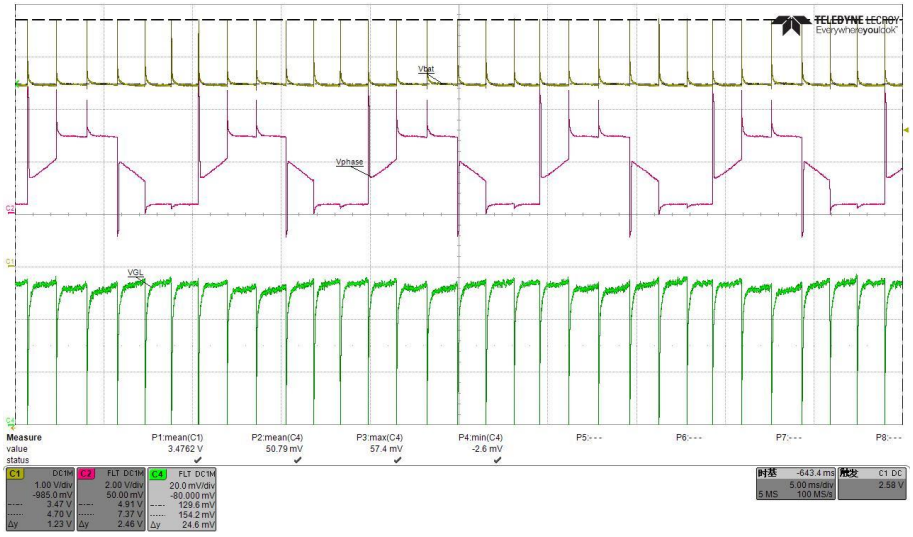


Fig. 5 Measured V_{bat} / U phase voltage and R_{cs} voltage

CH1:V_{BAT} CH2:V_{MTR_PHS} CH4:I_{CS}

100%占空比运行，电池电压尖峰波形

3.2 PWM Test

3.2.1 PWM Frequency

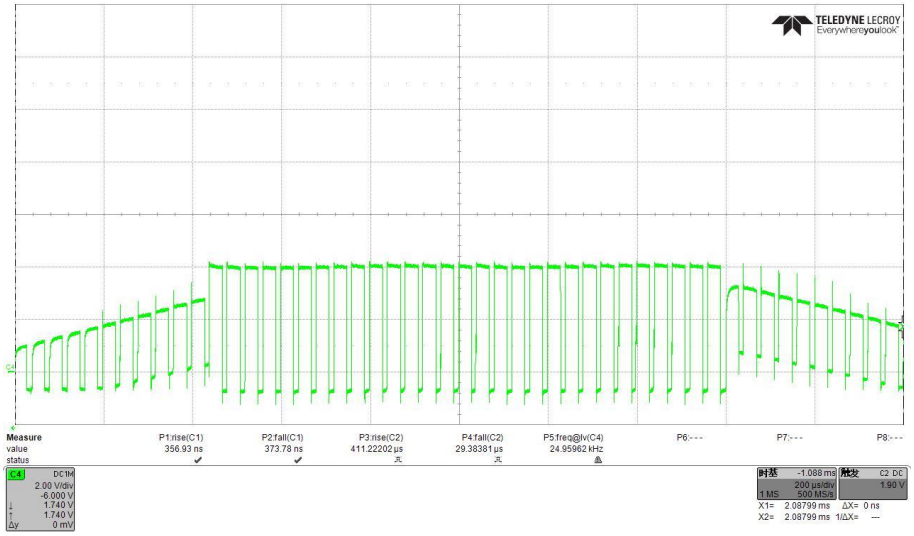


Fig. 6 Measured phase U voltage rising edge period

CH4:I_{MTR_PHS}

25.0KHz PWM 频率波形

3.2.2 Power On

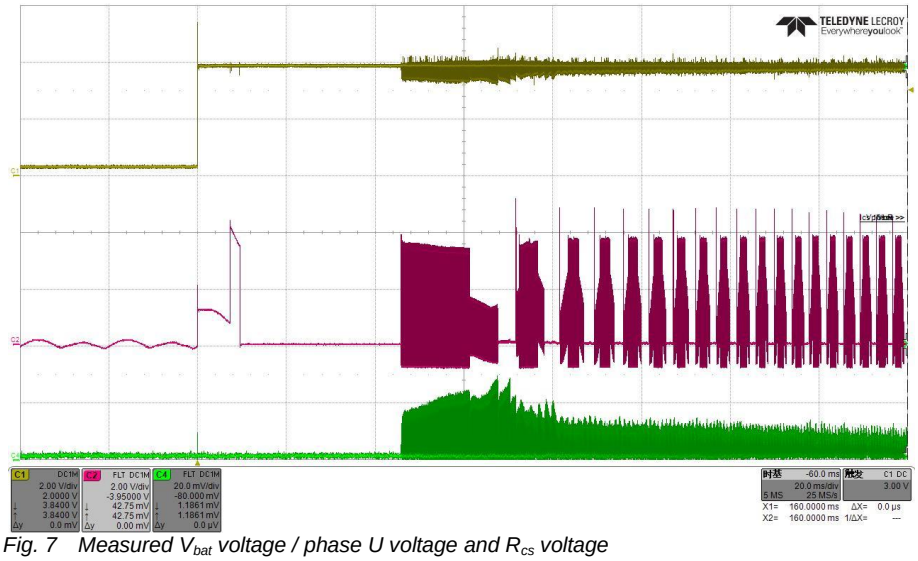


Fig. 7 Measured V_{bat} voltage / phase U voltage and R_{cs} voltage

CH1:V_{BAT} CH2:V_{MTR_PHS} CH4:I_{CS}

电机起动相电压和相电流波形

3.2.3 Power Off

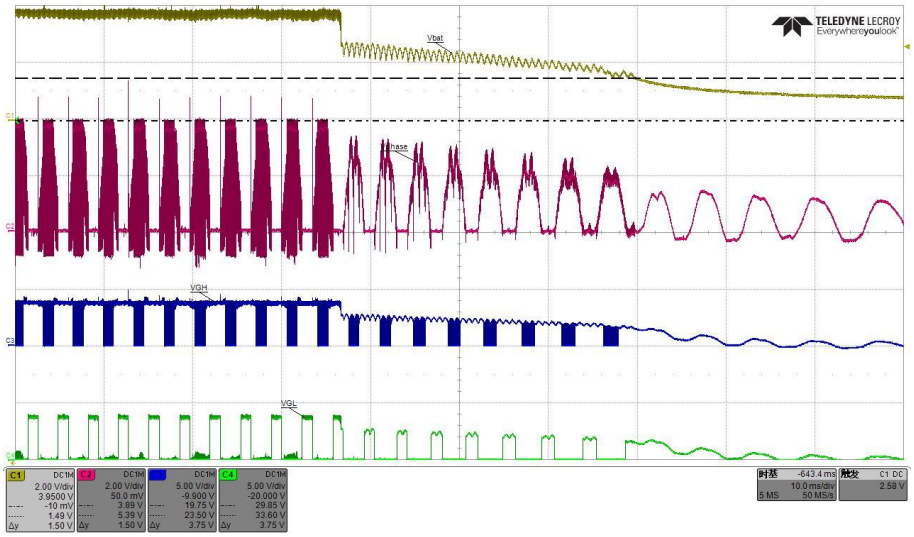


Fig. 8 Measured V_{bat} voltage / phase U voltage and highside / lowside gate drive voltage

CH1:V_{BAT} CH2:V_{MTR_PHS} CH3:V_{GH} CH4:V_{GL}

电池掉电过程电机相电压和上下管驱动波形

3.3 Current sampling

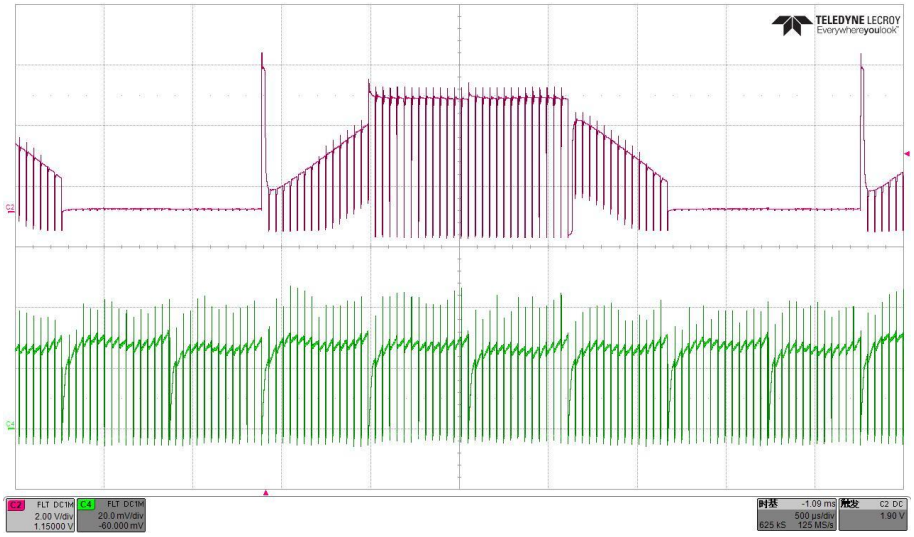


Fig. 9 Measured phase U voltage and R_{cs} voltage

CH2:V_{MTR_PHS} CH4:I_{CS}

电机驱动时电机相电压和电流采样电阻两端电压波形

3.4 Over Average Current Protect

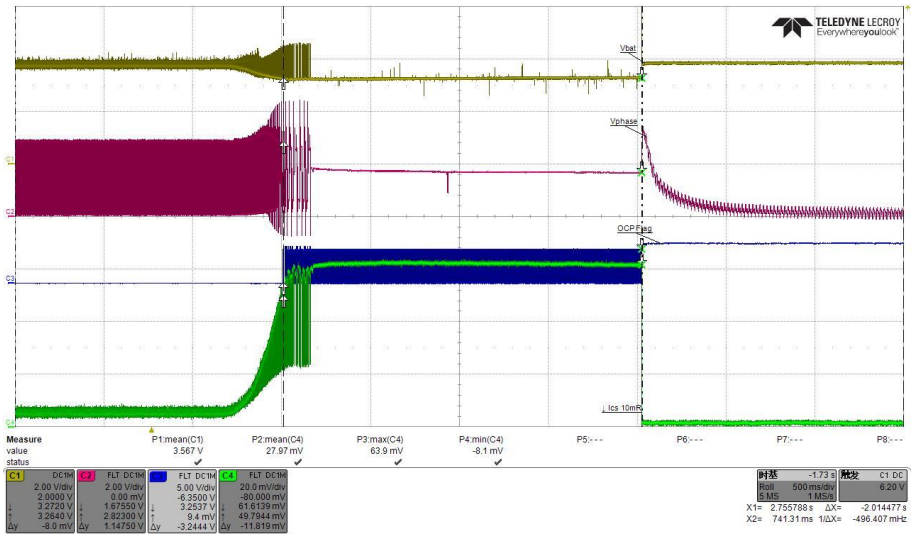


Fig. 10 Measured V_{bat} / phase U voltage/OCP debounce toggle counter and R_{cs} voltage

CH1:V_{BAT} CH2:V_{MTR_PHS} CH3:OCP debounce counter CH4:I_{CS}

电机慢速捏停过程电机相电流和过流保护波形

3.5 Motor Stuck Protect

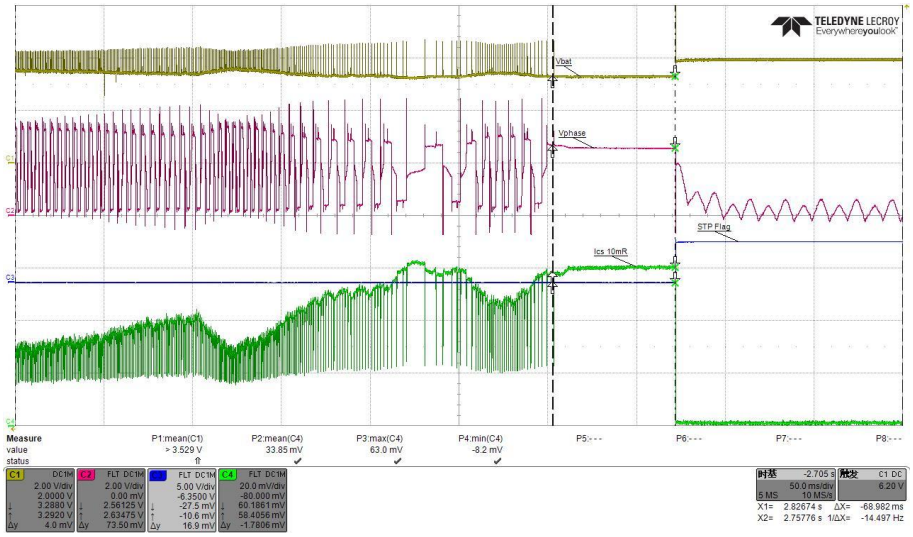


Fig. 11 Measured V_{bat} /phase U voltage/motor stuck protect flag and R_{cs} voltage

CH1:V_{BAT} CH2:V_{MTR_PHS} CH3:OCP debounce counter CH4:I_{CS}

电机快速捏停过程电机相电流和卡机保护波形

3.6 Motor Short Circuit Protection

3.6.1 U-V phase short circuit

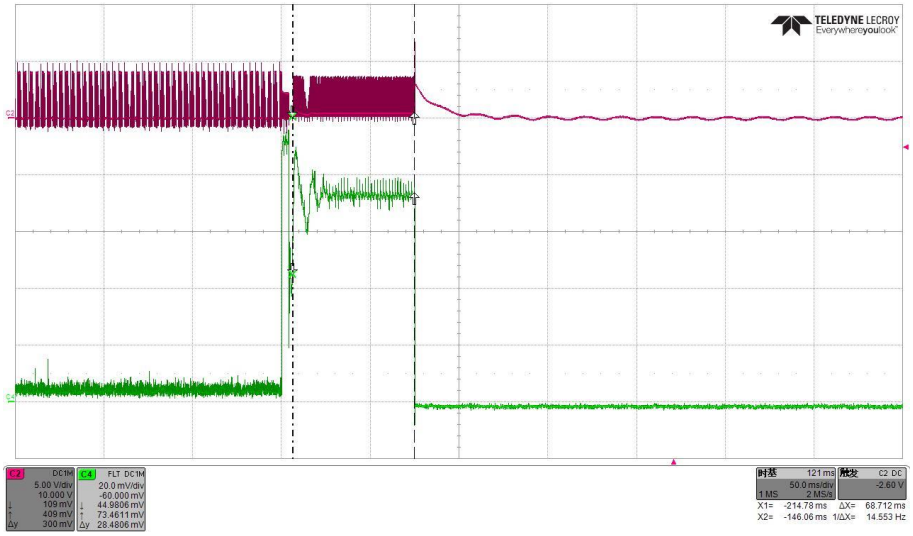


Fig. 12 Measured phase U voltage and R_{cs} voltage @ battery voltage = 4.0V

CH2:V_{MTR_PHS} CH4:I_{CS}

U-V 相间短路时电流采样电阻两端电压和短路保护波形

3.6.2 U-W phase short circuit

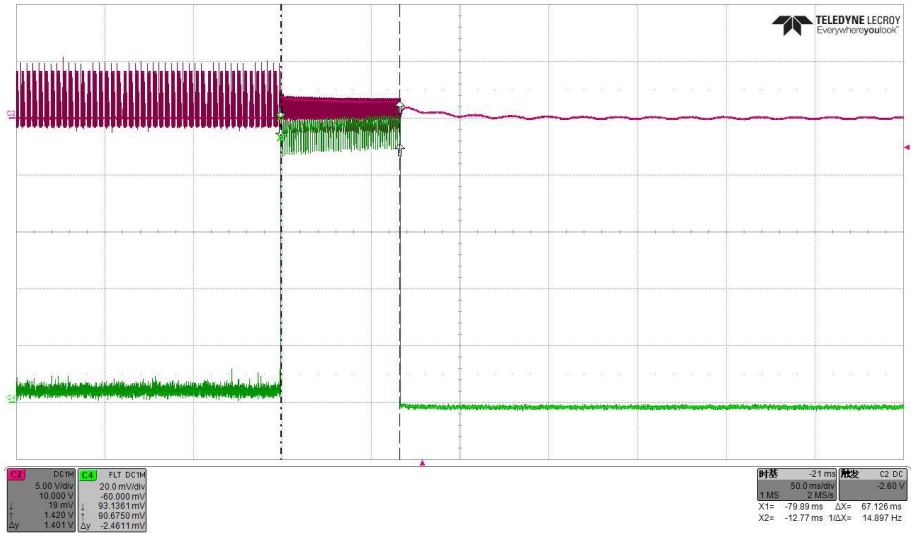


Fig. 13 Measured phase U voltage and R_{cs} voltage @ battery voltage = 4.0V

CH2:V_{MTR_PHS} CH4:I_{CS}

U-W 相间短路时电流采样电阻两端电压和短路保护波形

3.6.3 V-W phase short circuit

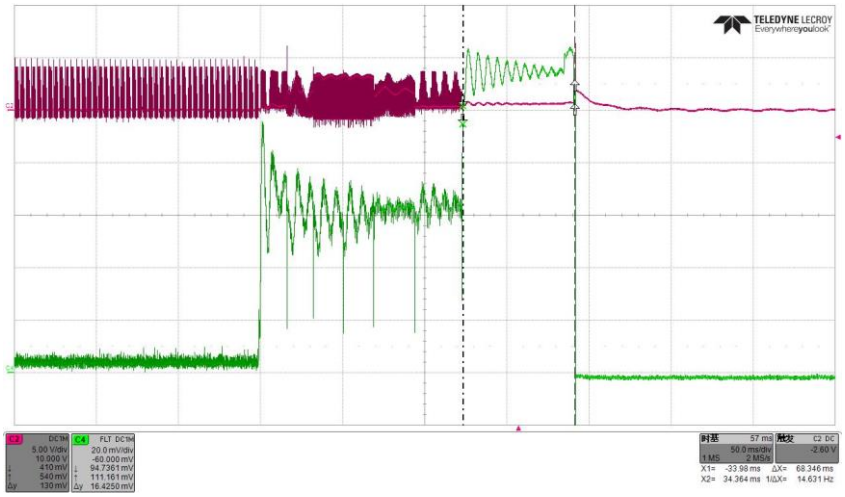


Fig. 14 Measured phase U voltage and R_{cs} voltage @ battery voltage = 4.0V

CH2:V_{MTR_PHS} CH4:I_{CS}

V-W 相间短路时电流采样电阻两端电压和短路保护波形

3.7 Mosfet Temperature Rise

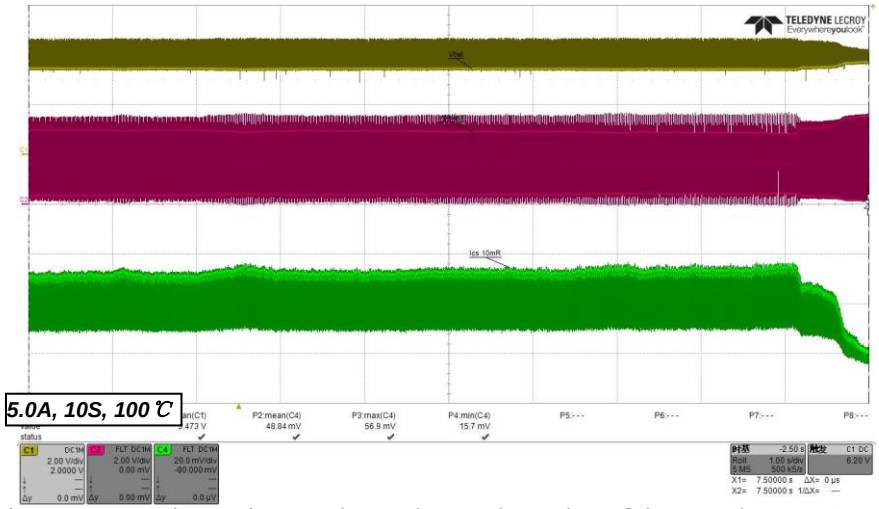


Fig. 15 Measured Bus voltage, U-phase voltage and R_{cs} voltage @ battery voltage = 4.0V

CH1:V_{BAT} CH2:V_{MTR_PHS} CH4:I_{CS}

室温 25℃下 5.0A 平均电流持续工作 10S，最高温度 MOS 约为 100℃

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