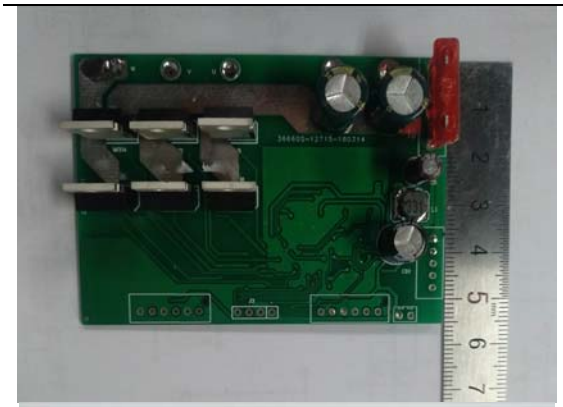
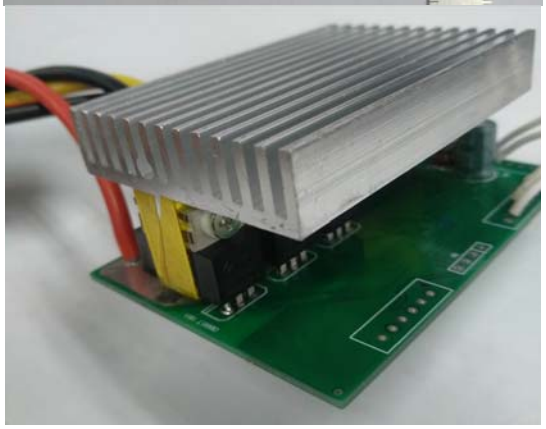
Subject

OB6617 Demo Board Manual

Board Model: OB6617_6MOS_1823

Doc. No.: OB_DOC_DBM_C_661700





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
- 16% duty start, and motor fast sop
- Automatic power off with time delay
- MOSFET temperature sensing and thermal protection.
- Tow levels battery under voltage protection
- Battery residual capacity display
- PCB size small, and assemble conveniently

Revision history：

Revise Date	Version	Reason/Issue
2018-06-21	00	First Issue

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1. System Electrical Specification

1.1 Input Characteristic

DC input voltage rating	10 cells Li-Iron battery of 3.7V
DC input voltage	28V to 45V
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	25.4 KHz
MCU supply voltage	5V±1%
5V supply current	100mA
Current sampling resistance	2mΩ
Current sampling amplification	16
Current sampling amplifier offset	Self-calibration
Gate driver supply voltage	12V
Max of MOSFET drain source voltage value	60V
MOSFET thermal sensor precision	1%

1.3 Output characteristic

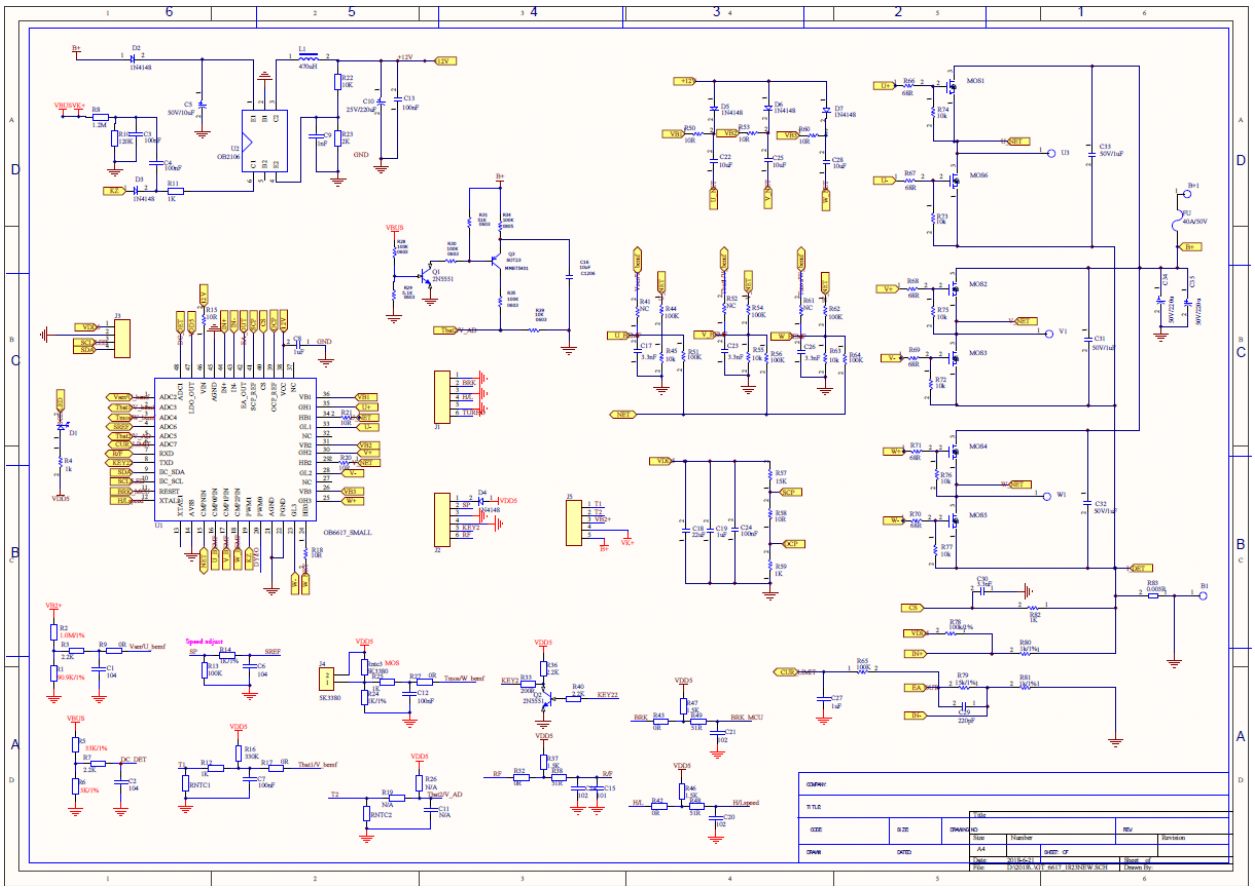
Phase current limitation	50A
Maximum of PWM duty	100%
Minimum of PWM duty	16%

1.4 Environmental

Operating Ambient Temperature	-20℃ to 60℃
Storage Temperature	-40 ℃ to 100 ℃
Storage Humidity	0% to 95% R.H.

2. Board Information

2.1 Schematic

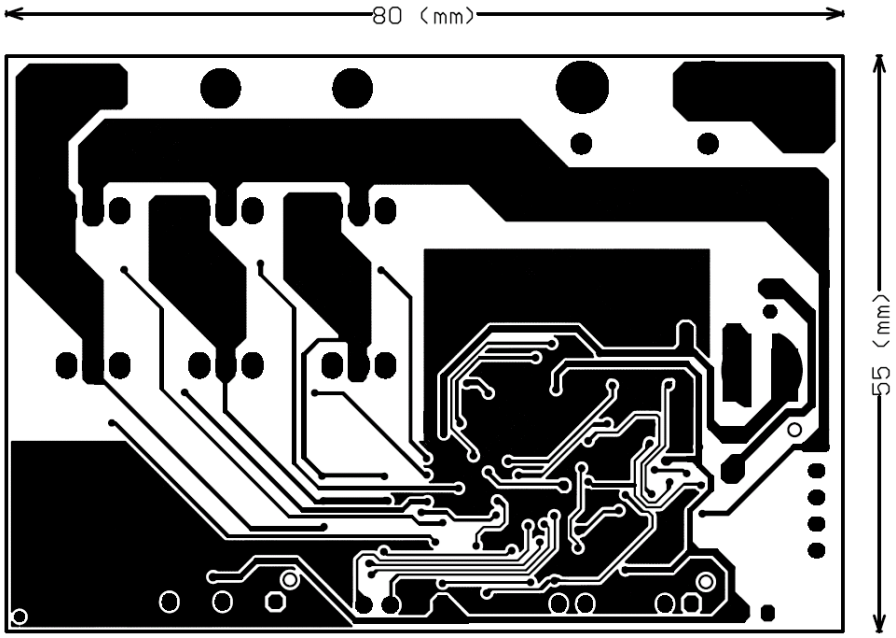


2.2 Bill of material

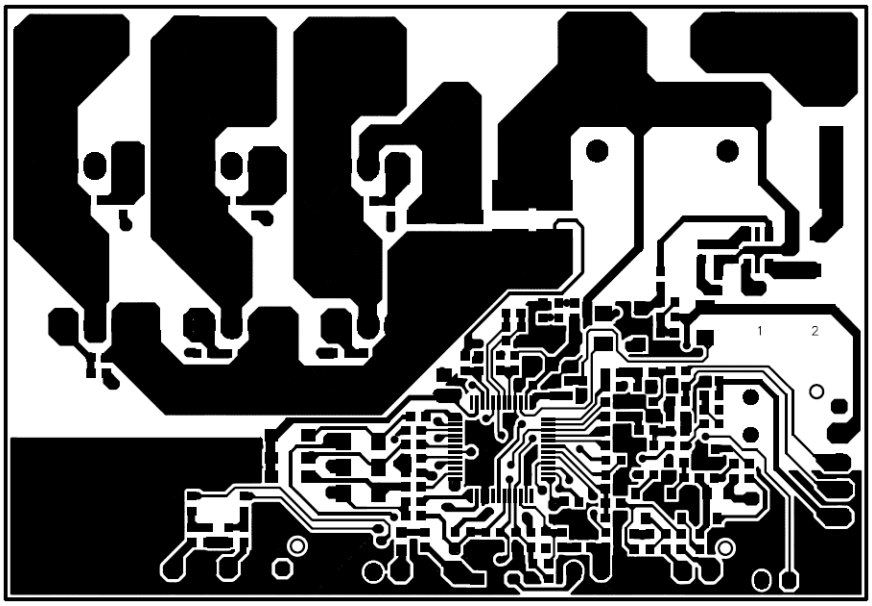
Position	Description	Package	QTY
C2,C3,C6, C13, C24	Capacitor,ceramic,100nf/50V,X7R,10%	0603	5
C16,C22,C25,C28	Capacitor,ceramic,10uf/50V,X7R,10%	1206	4
C17,C23,C26,C30	Capacitor,ceramic,3.3nf/25V,X7R,10%	0603	4
C31,C32,C33	Capacitor,ceramic,1uf/50V,X7R,10%	1206	3
C1,C7,C11,C12,C14,C15,C20,C21	NA		
C4	Capacitor,ceramic,150nf/50V,X7R,10%	0603	1
C18	Capacitor,ceramic,22uf/50V,X7R,10%	1206	1
C27	Capacitor,ceramic,1uf/25V,X7R,10%	0603	1
C5	Capacitor, aluminum electrolytic,10uf/50V,-40/105℃	EC5	1
C9	Capacitor,ceramic,1nf/50V,X7R,10%	0603	1
C8,C19	Capacitor,ceramic,1uf/50V,X7R,10%	0805	2
C29	Capacitor,ceramic,220pf/25V,X7R,10%	0603	1
C34,C35	Capacitor, aluminum electrolytic,220uf/50V,-40/105℃	EC10	2
C10	Capacitor, aluminum electrolytic,220uf/25V,-40/105℃	EC8	1
D1	LED, Green	0603	1
D2,D3,D4,D5,D6,D7	1N4148	SOD-123	6
FU	40A/50V 保险丝	FUSe4	1
L1	330uH	CD32-331K	1
MOS1,MOS2,MOS3,MOS4,MOS5, MOS6	HY3007	TO-220A	6
RNTC1	NA	0603	
RNTC2	NA	0603	
RNTC3	NA	0603	
Q1	NPN,MMBT5551	SOT-23	1
Q2	NA		
Q3	PNP,MMBT5401	SOT-23	1
R7	Resistor,chip,2.2k,1%	0603	1
R4,R11,R14	Resistor,chip,1k,5%	0603	3
R59,R80,R81,R82	Resistor,chip,1k,1%	0603	4
R5	Resistor,chip,33k,1%	1206	1
R6	Resistor,chip,3k,1%	0603	1
R8	Resistor,chip,1.2M,1%	0603	1
R10	Resistor,chip,120k,1%	0603	1
R29	Resistor,chip,5.1k,5%	0603	1

R13,R28,R30,R34,R35,R44,R51,R54,R56,R62,R64	Resistor,chip,100k,5%	0603	11
R31	Resistor,chip,51k,5%	0603	1
R22,R39,R45,R55,R63,R72,R73,R74,R75,R76,R77	Resistor,chip,10k,5%	0603	11
R1,R2,R3,R9,R12,R16,R17,R19,R24,R25,R27,R26,R32,R33,R36,R37,R38,R40,R41,R42,R43,R46,R47,R48,R49,R52,R61	NA		
R15	Resistor,chip,10R,5%	1206	1
R58	Resistor,chip,10R,1%	0603	1
R18,R20,R21,R50,R53,R60	Resistor,chip,10R,5%	0603	6
R23	Resistor,chip,2k,5%	0603	1
R65,R78	Resistor,chip,100k,1%	0603	2
R57,R79	Resistor,chip,15k,1%	0603	2
R66,R67,R68,R69,R70,R71	Resistor,chip,68R,5%	0603	6
RS1	Resistor,chip,2mR,1%	2512	1
RS2	NA	2512	
U1	OB6617GP	LQFP48	1
U2	OB2106	US-6P-PCB	1
J1	2.54mm,6pin Connector（NA）		
J2	2.54mm,6pin Connector		1
J3	2.54mm,4pin Connector（NA）		
J4	2.54mm,2pin Connector（NA）		
J5	2.54mm,5pin Connector		1

2.3 PCB Garber File



Top Layer



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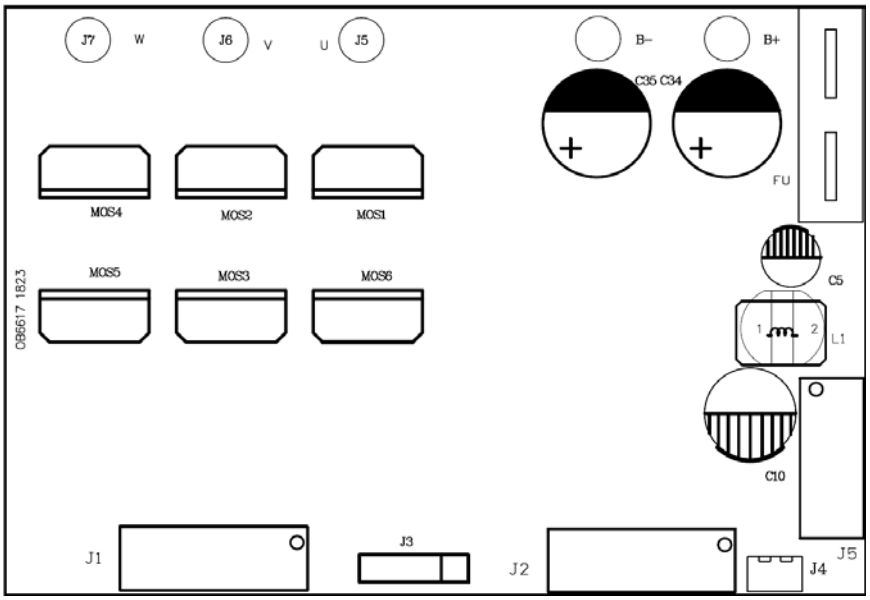
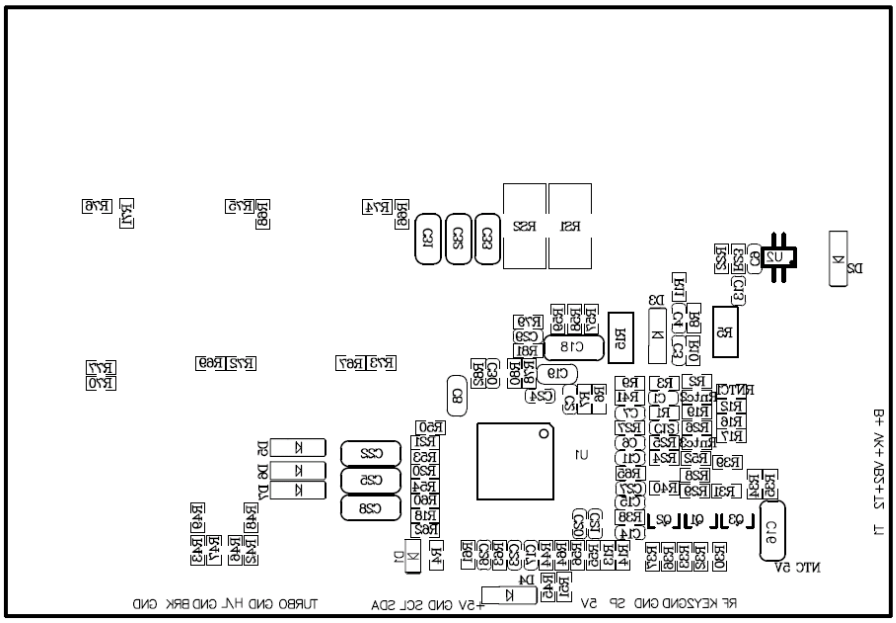


Silkscreen Top Layer

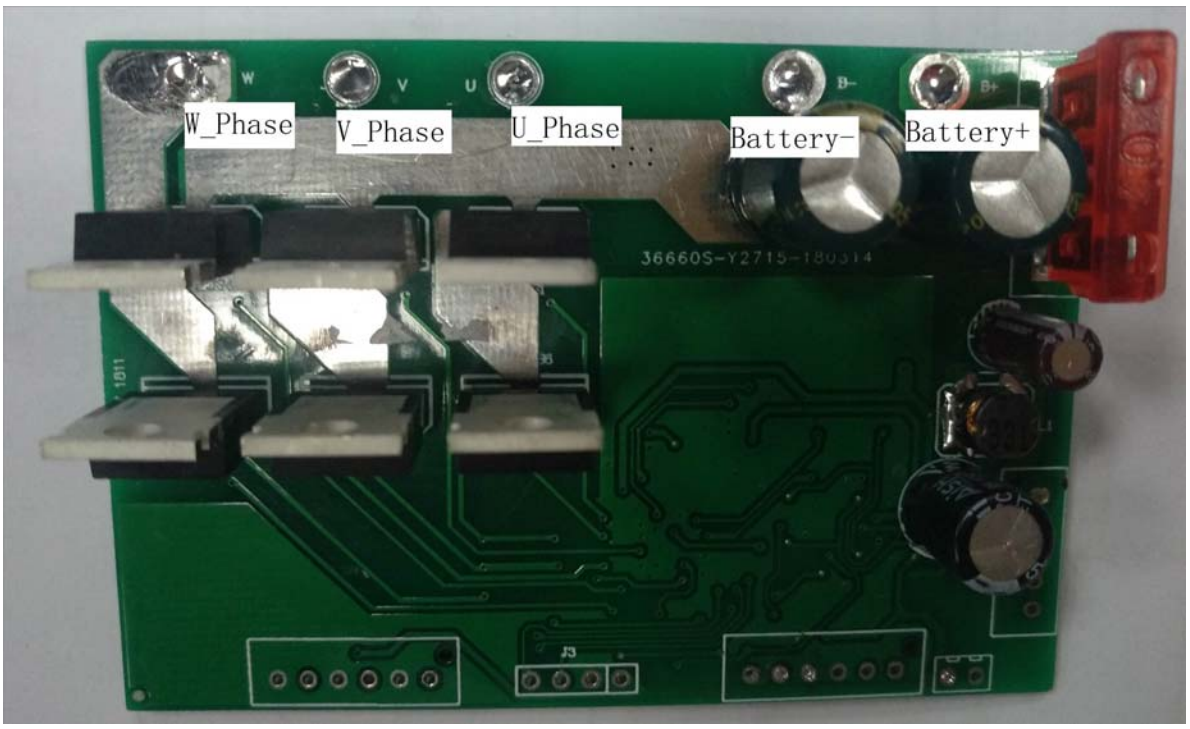


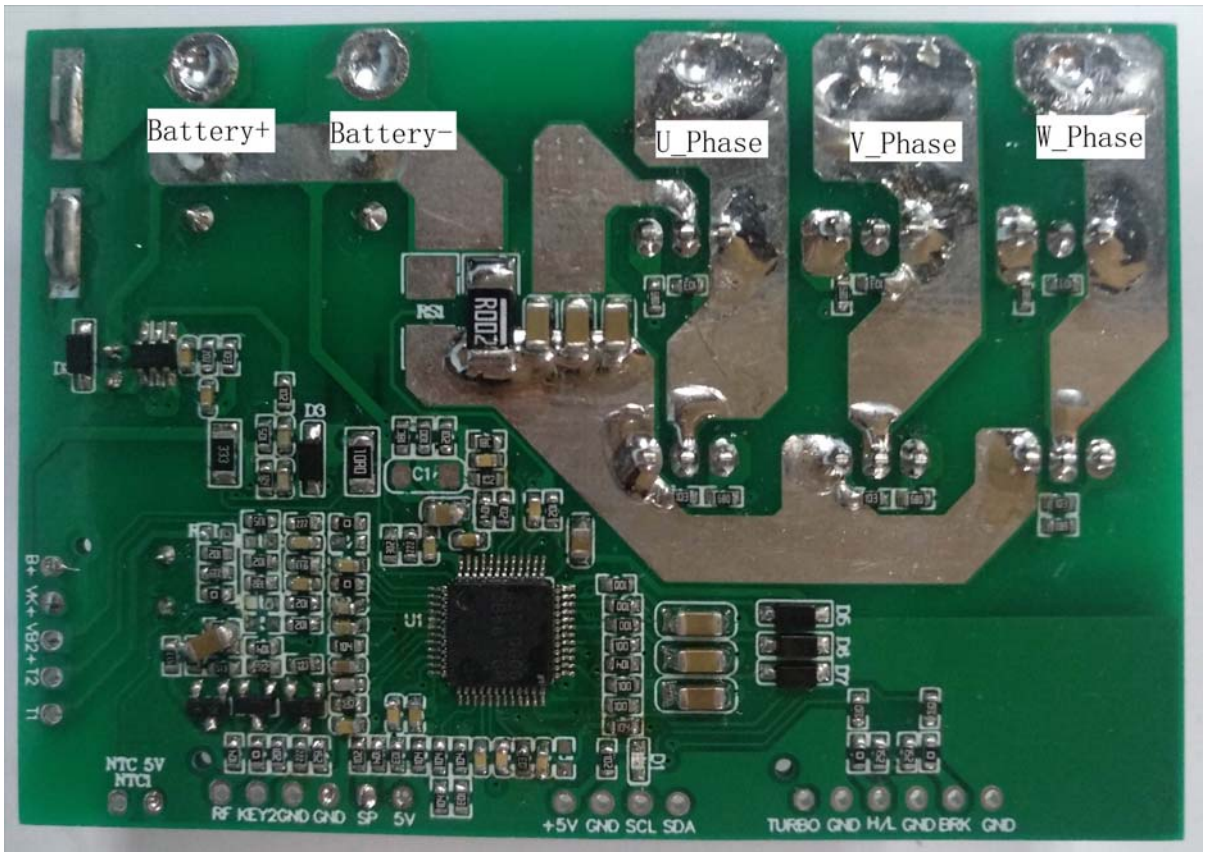
Silkscreen Bottom Layer

2.4 Heat-sink Three View Drawing

N/A

2.5 Connector Function Description





HoleName	Description
Battery+	Battery input, Bus+
Battery-	Battery input, GND
U_Pha	Motor U phase output
V_Pha	Motor V phase output
W_Pha	Motor W phase output

J1- 6pin connector

Pin Num	Description	Voltage Range
1	GND	0V
2	BRK	0~5V
3	GND	0V
4	H/L(3 速)	0~5V
5	GND	0V
6	TURBO（预留）	0~5V

J2- 6pin connector

Pin Num	Description	Voltage Range
1	Speed signal supply	5V
2	Speed signal input	0~5V
3	GND	0V
4	GND	0V
5	KEY2(预留开关)	0~5V
6	RF(预留 IO)	0~5V

J3- 4pin connector

Pin Num	Description	Voltage Range
1	5V supply	5V
2	GND	0V
3	SCL	0~5V
4	SDA	0~5V

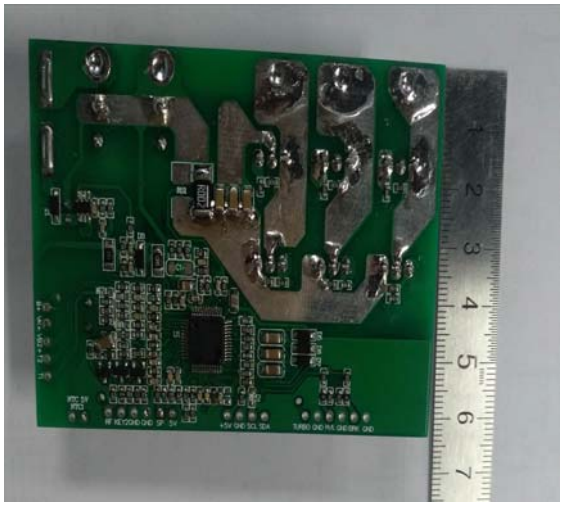
J4- 2pin connector

Pin Num	Description	Voltage Range
1	5V supply	5V
2	MOS temperature signal	0~5V

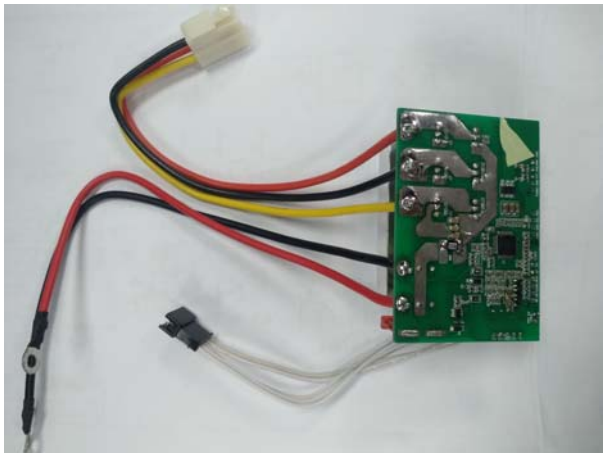
J5- 5pin connector

Pin Num	Description	Voltage Range
1	T1(battery1 temperature signal 预留)	0~5V
2	T2(battery2 temperature signal 预留)	0~5V
3	VB2+(预留半压检测)	28~45V
4	VK+(MCU supply switch)	28~45V
5	B+(connect to VK+)	28~45V

2.6 BLDC Controller Board Snapshot

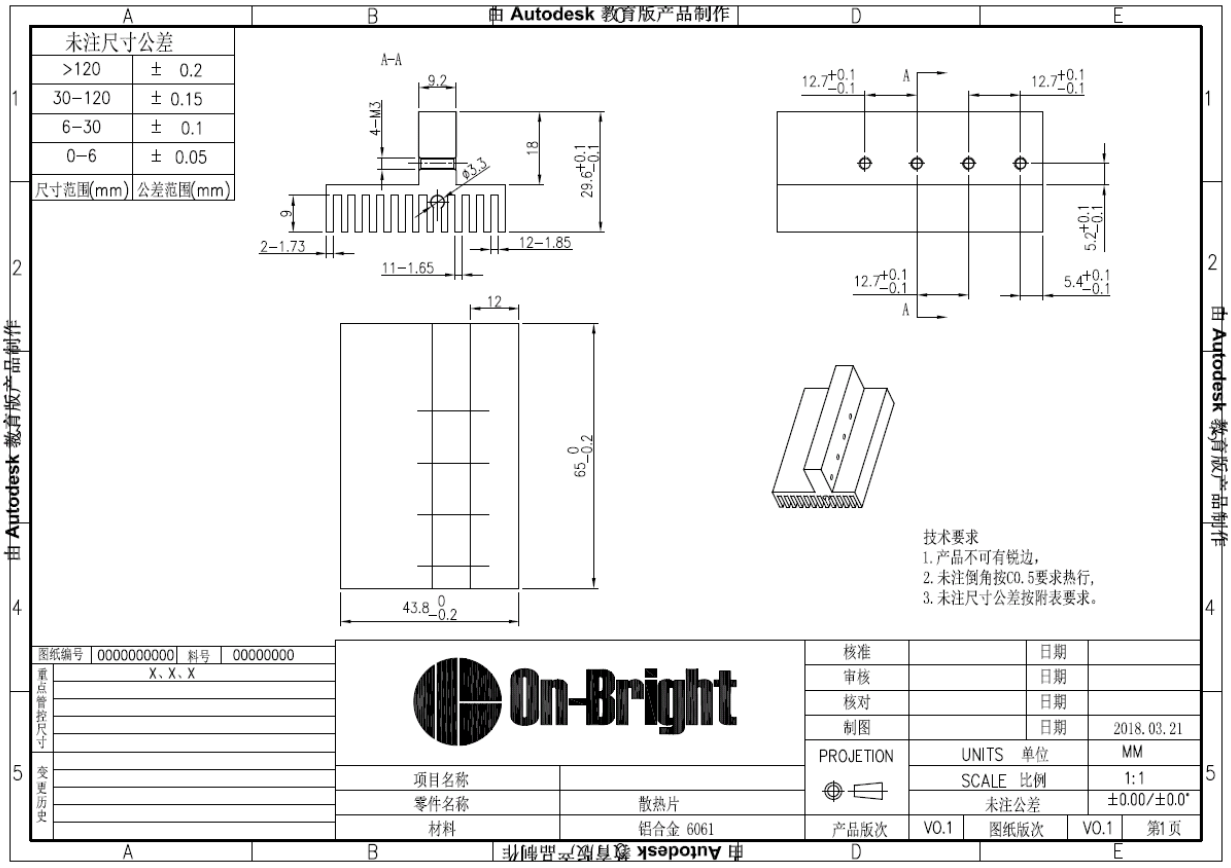


2.7 Fuction Line Length



功能线五根	VK+,B+,SP,+5V,GND	15CM
电机线	U,V,W	20CM
电源线	B+,B-	25CM

2.8 散热器外观尺寸封装图



3. Performance Evaluation

This session presents the test results of OB6617GP 36V/22A 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℃

No	Parameter	Symbol	Min	Type	Max	Unit	Corresponding Fig.
1	Battery UVP	V_{bus_UVLO}	28			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	Vgs		12		V	Fig.4
5	Highside MOSFET Rise time	Tr_h		1.12		us	Fig.4
6	Highside MOSFET Fall time	Tf_h		1.27		us	Fig.4
7	Lowside MOSFET Rise time	Tr_l		1.02		us	Fig.4
8	Lowside MOSFET Fall time	Tf_l		1.06		us	Fig.4
9	PWM frequency	f_{PWM}		25.5		kHz	Fig.5
10	PWM duty	Duty	16		100	%	Fig.7
11	Throttle voltage	$V_{throttle}$	1.5		3.5	V	Fig.6
13	Current amplify coefficient			16			Fig.9
16	MOSFET current shutdown time in MOTOR short circuit				10	us	Fig.10,Fig.11,Fig.12
17	MOSFET Vds in MOTOR short circuit				44	V	Fig.10,Fig.11,Fig.12
18	Wait Electric Brake Time	T_{BRK}		2		S	Fig.13
19	Electric Flying Car Protect(先按调速再上电)	V_{Tbat2/V_AD}		1.2		V	Fig.14
20	Electric Flying Car Protect(先上电再按调速)	V_{Tbat2/V_AD}		2.5		V	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 Temperature

	Time	散热器(℃)	Mos(℃)	Current(A)
1	30min	54.8	73.1	20.8
2	30min	58.8	75.2	21.1

3.2 Voltage Test

3.2.1 Gate Driver & MCU Supply Power ON/OFF

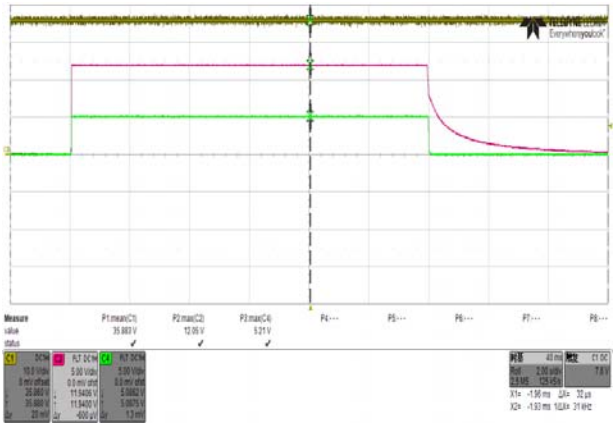


Fig. 1 Measured gate driver and MCU supply voltage @ battery=36V

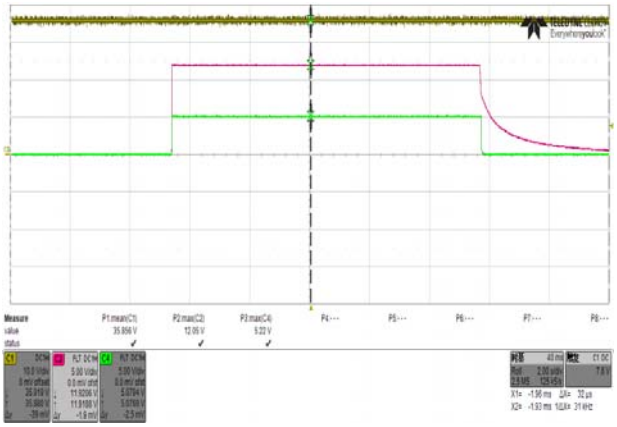


Fig. 2 Measured gated river and MCU supply voltage @ battery=36V

3.2.2 Battery under voltage lockout

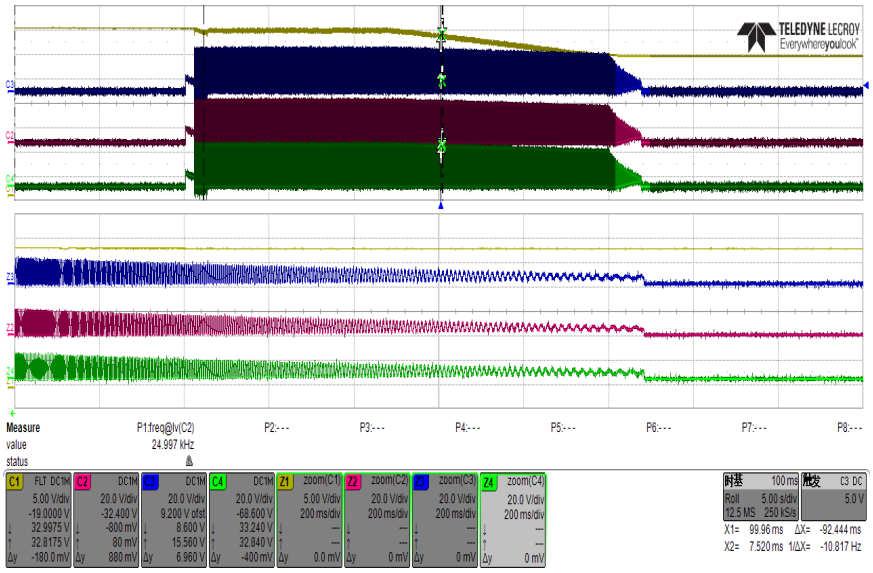


Fig. 3 Measured Vbus and UVW output voltage @ battery=28V

3.2.3 MOSFET Vgs

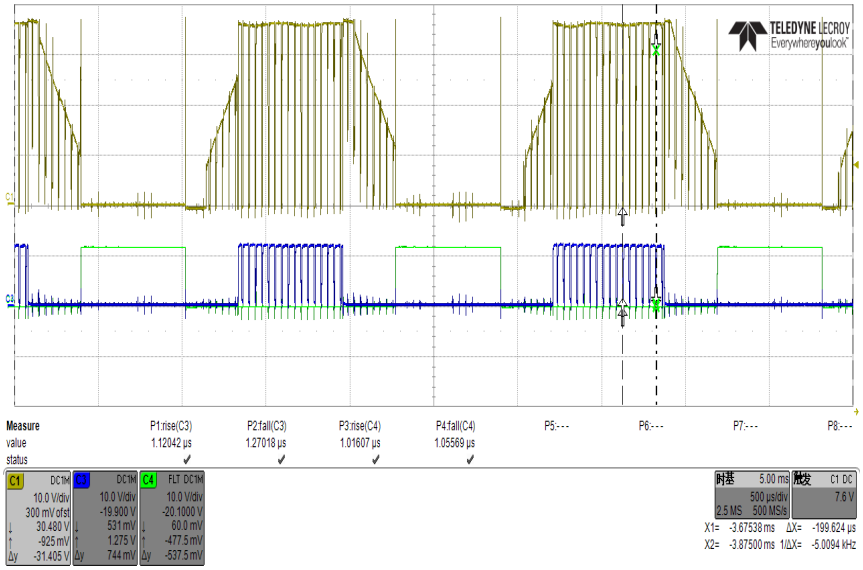


Fig. 4 Measured highside and lowside MOSFET Vgs

3.3 PWM Test

3.3.1 PWM Frequency

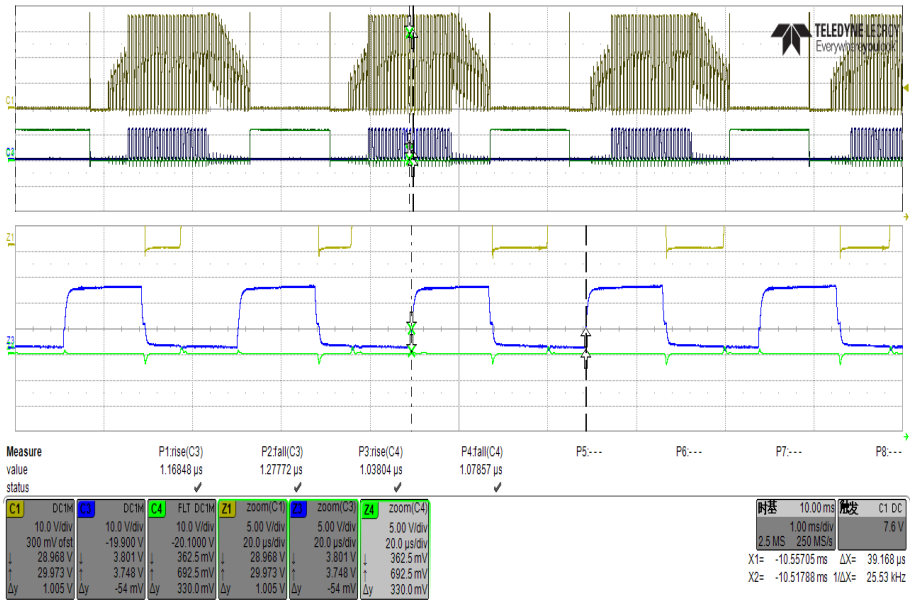


Fig. 5 Measured highside and lowside MOSFET Vgs

3.3.2 Speed Regulator

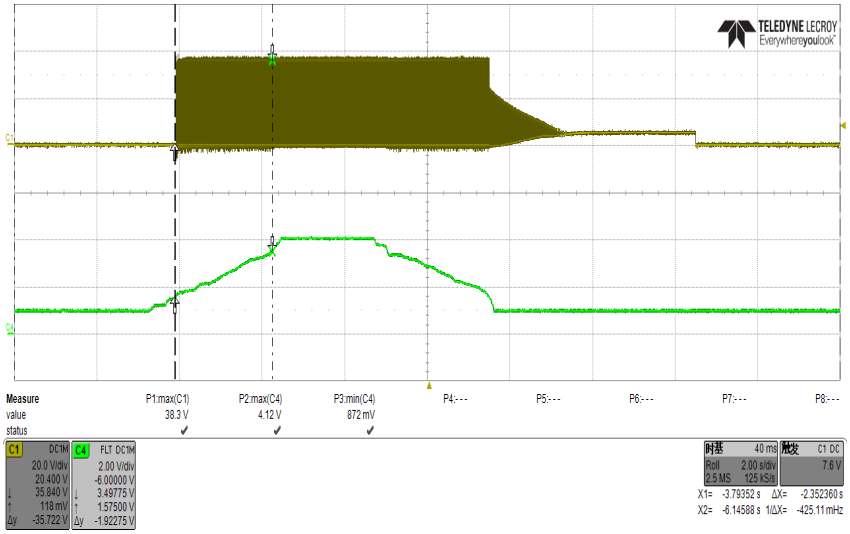


Fig. 6 Measured U-phase and throttle voltage

3.3.3 PWM Initial duty

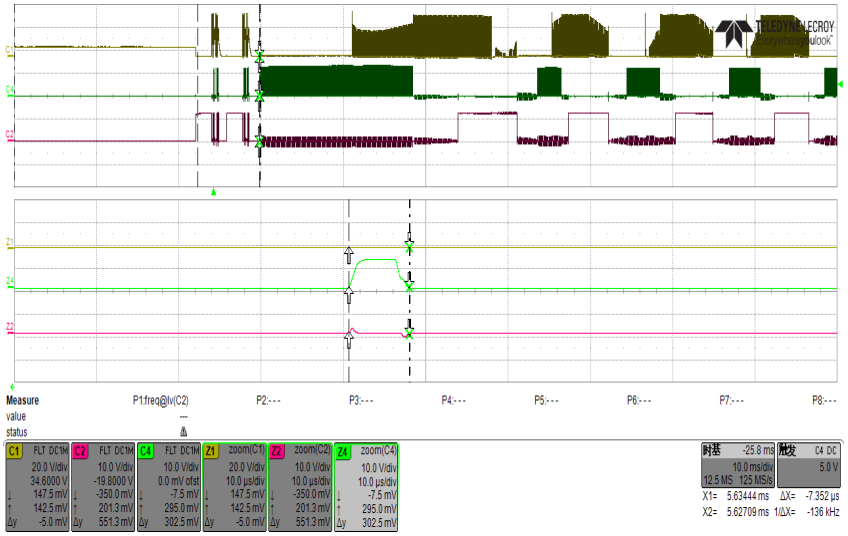


Fig. 7 Measured highside and lowside MOSFET Vgs

3.3.4 PWM Duty ON

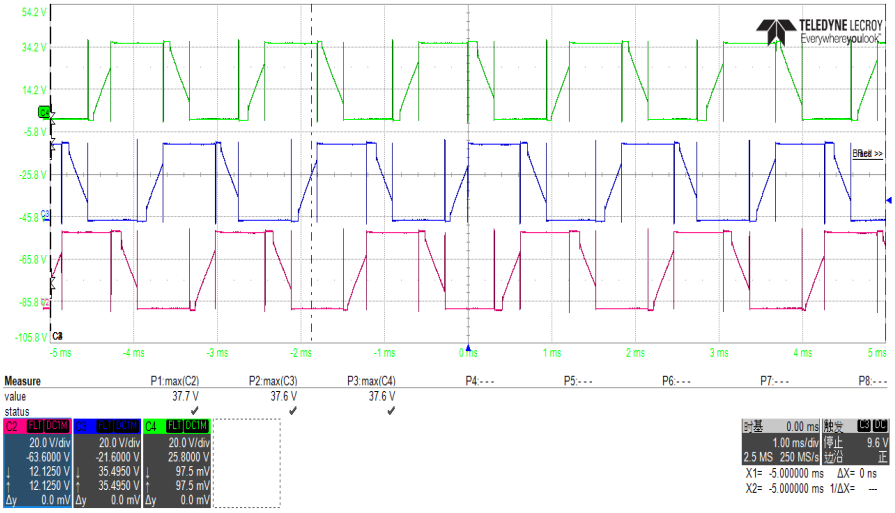


Fig. 8 Measured UVW phase voltage

3.4 Current sampling

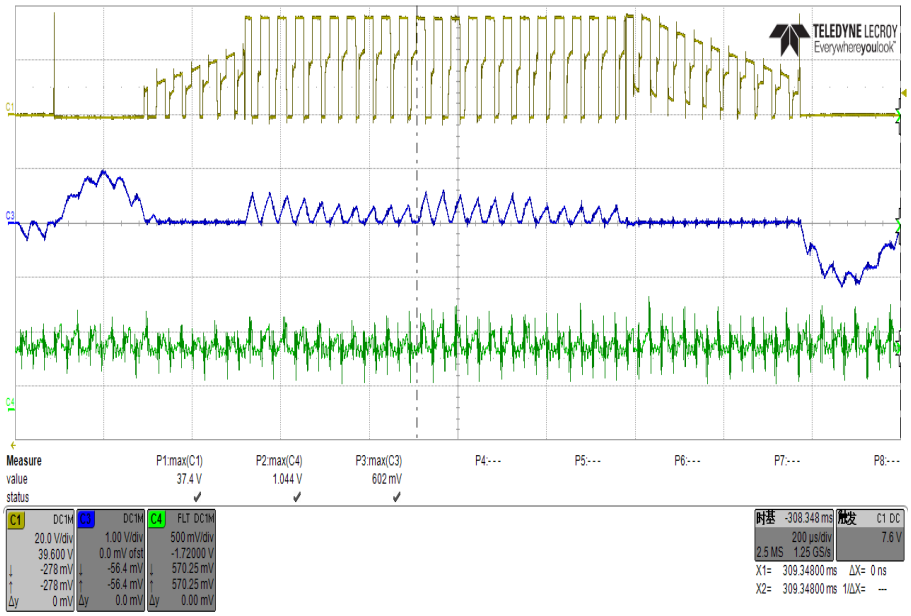


Fig. 9 Measured U phase voltage,U phase current and EA out

3.5 Motor Short Circuit Protection

3.5.1 U-V phase short circuit

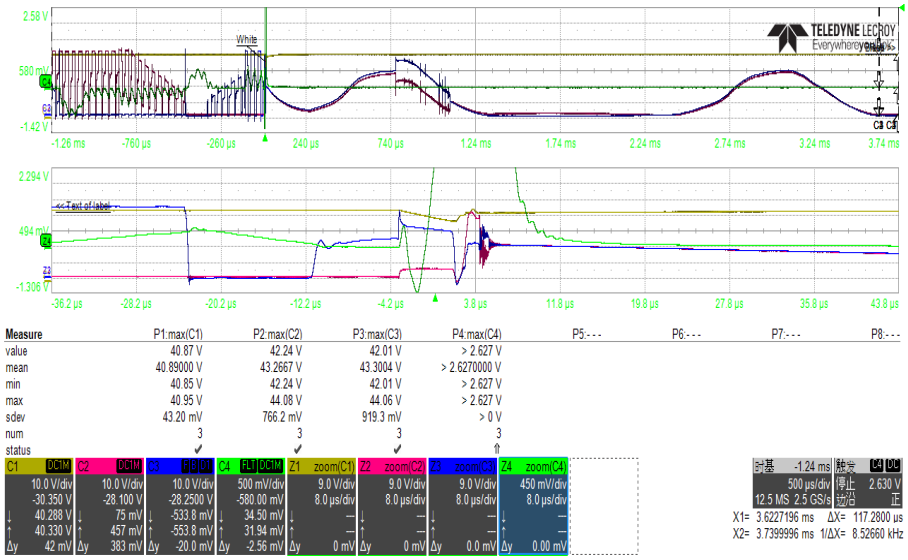


Fig. 10 Measured U-phase voltage, V-phase voltage, Bus voltage, phase current @ battery voltage = 40V

3.5.2 U-W phase short circuit

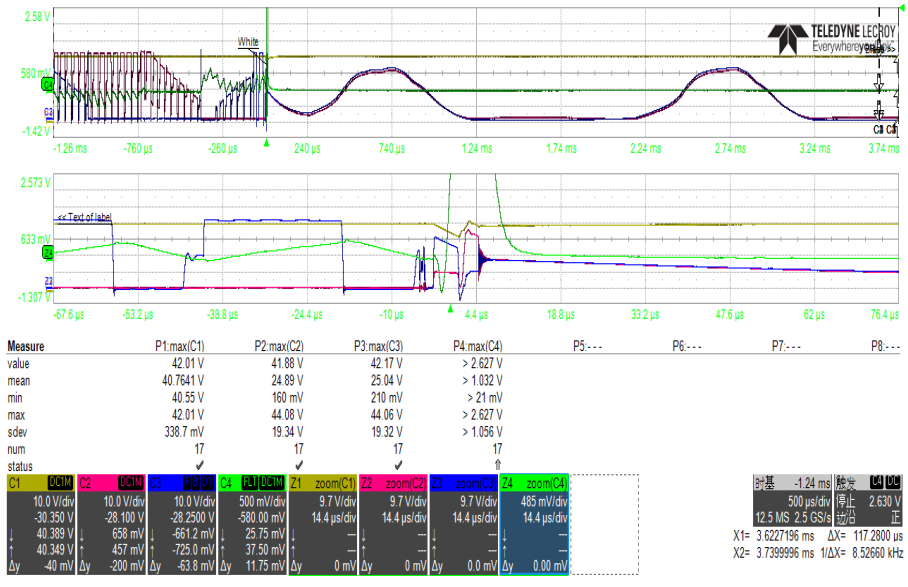


Fig. 9 Measured U-phase voltage, W-phase voltage, Bus voltage, phase current @ battery voltage = 40V

3.5.3 V-W phase short circuit

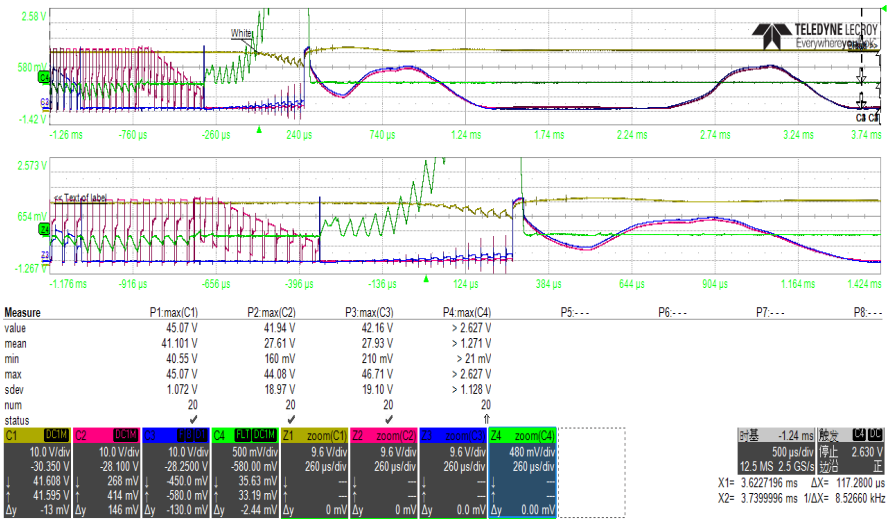


Fig. 10 Measured V-phase voltage, W-phase voltage, Bus voltage, phase current @ battery voltage = 40V

3.5.4 Wait Electric Brake Time

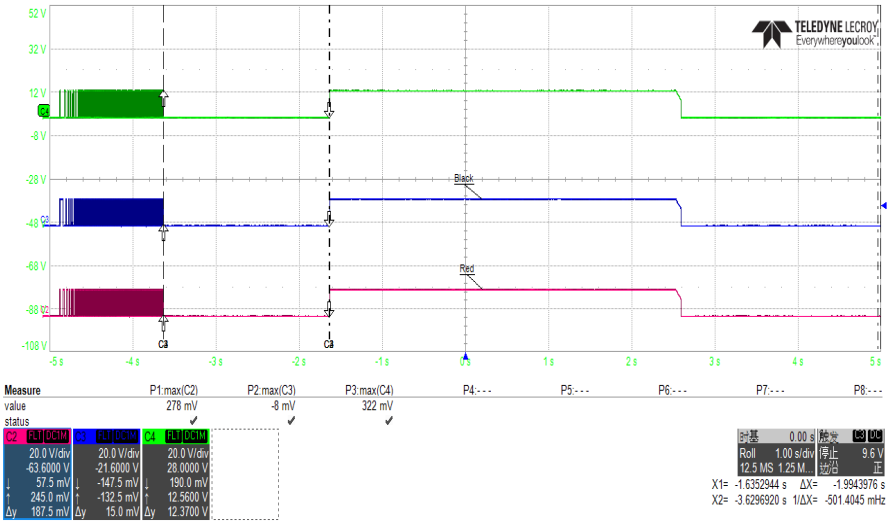


Fig. 11 Measured U-Vgs, V-Vgs, W-Vgs

3.5.5 Electric Flying Car Protect

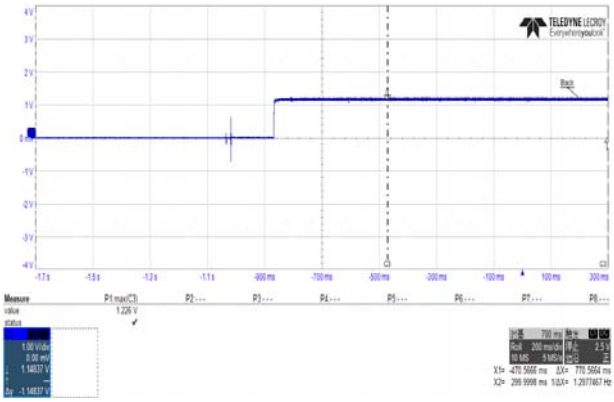


Fig. 12 Measured Tbat2/V_AD(先按调速再上电)

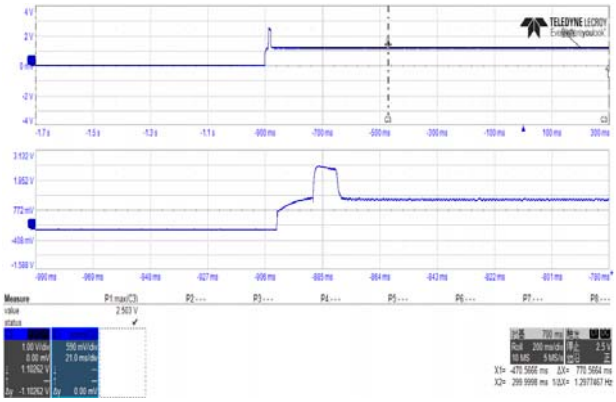


Fig. 13 Measured Tbat2/V_AD(先上电再按调速)

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