

Subject
OB2113 Demo Board Manual

Board Model:AD5.0V3.1A2113.00

Doc. No.: OB_DOC_DBM_211300



Key features:

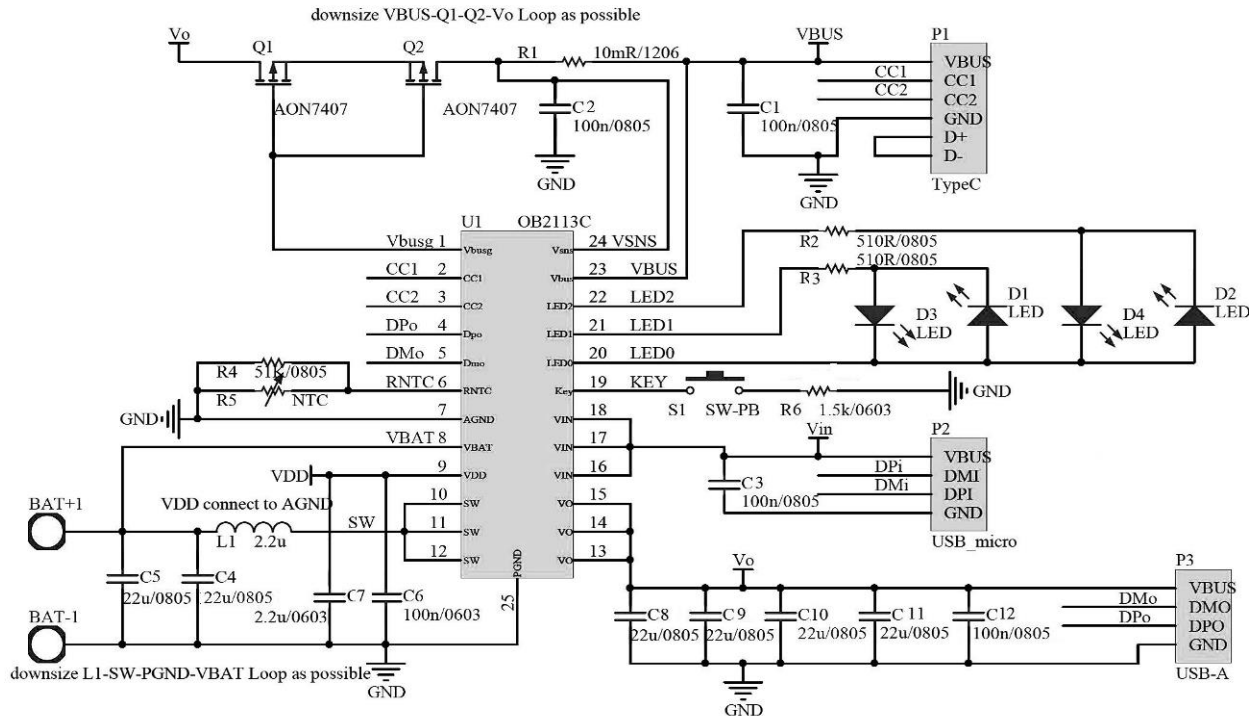
- Integrated Buck, Boost, and power bridge in one SOC
- Up to 3.1A charging current for Type-C input supply, and 2.4A charging current for Micro-B input supply
- Up to 5V/3.1A discharging current at USB-A or Type-C ports
- Adaptive power distribution at path-through mode
- Support Apple and Samsung equipment detection
- Input BC1.2 charge detection, compatible host USB charging
- Support 4-LED battery power indication
- Very low sleep mode power consumption (typical 30uA)
- Support trickle current charging function when battery is over discharged
- Comprehensive protections: input OVP, output OVP, output SCP, battery OVP, battery UVP, battery OTP, OCP

Revision History

Revise Date	Version	Reason/Issue
2020-03-31	00	First issue

1. Board Information

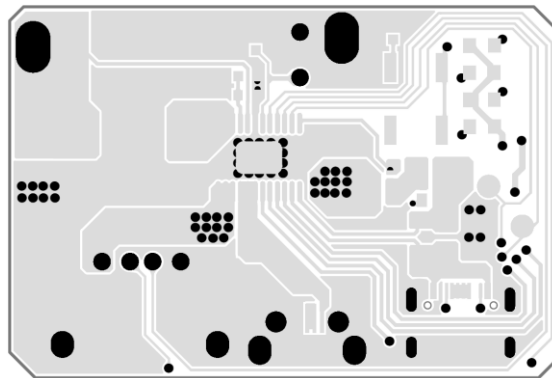
1.1. Board schematic



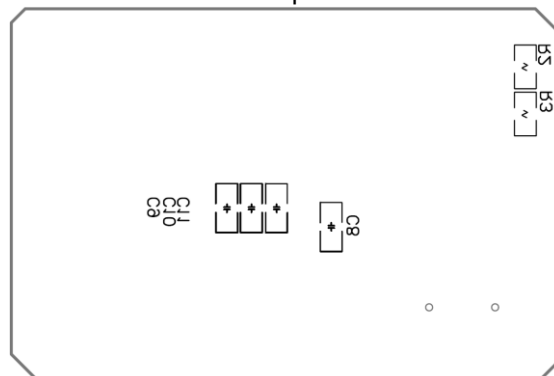
1.2. Component list

No.	Position	Description	Quantity
1	R1	SMD RES 0R01 /1% /1206	1
2	R2,R3	SMD RES 510R /5% /0805	2
3	R4	SMD RES 51K /1% /0603	1
4	R5	NTC,50K@25°C RNTC5D4.0MM	NC
5	R6	SMD RES 1.5K /5% /0603	1
6	C1,C2,C3,C12	SMD CAP 100nF /25V 0805	4
7	C4,C5,C8,C9,C10,C11	SMD CAP 22uF /25V 0805	6
8	C6	SMD CAP 100nF /25V 0603	1
9	C7	SMD CAP 2.2uF /25V 0603	1
10	Q1,Q2	SMD P-MOS AON7407 / DFN3*3	2
11	L1	SMD inductor SHC1004-2R2M 2.2uH	1
12	D1,D2,D3,D4	SMD LED /0805	4
13	S1	SMD 按键开关	1
14	U1	OB2113 / TSSOP-24	1
15	P1	SMD TYPE_C	1
16	P2	SMD MICRO_USB	1
17	P3	SMD USB_HOST	1
18	PCB	OB2113 2011D	1
19	Total		30

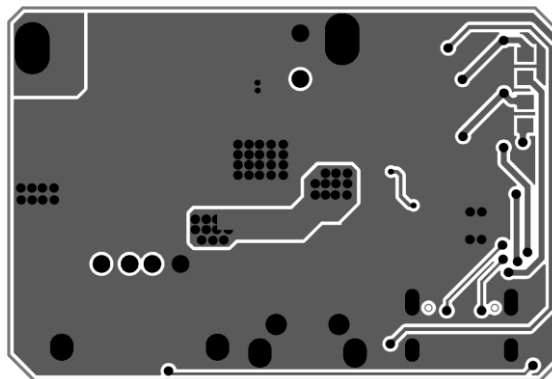
1.3.PCB Gerber File



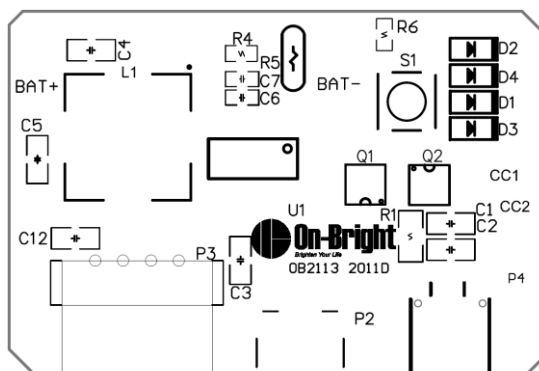
Top



Bottom

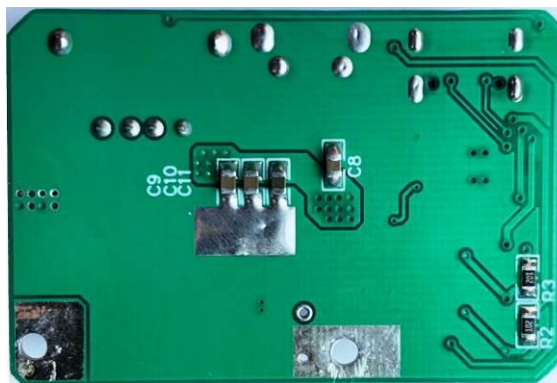
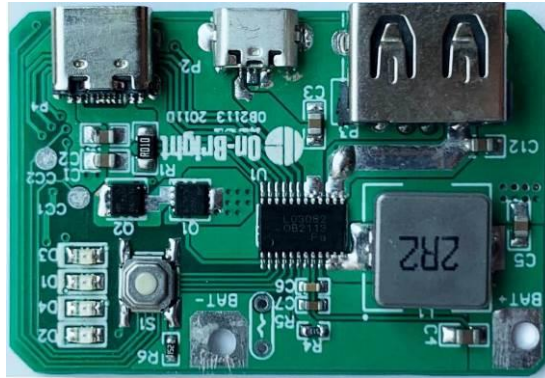


Bottom



Silkscreen Top

1.4. Snapshot



2. Converter Specification

2.1. Input Characteristics

- Buck input voltage range 4.5-5. 5Vdc
- Boost input voltage range 3.0-4.2Vdc (V_{BAT})

2.2. Output Characteristics

- Buck output voltage & current 3.0-4.2V/3.1A (Type_c input)
- Boost output voltage & current 5.0V/3.1A
- Operating frequency 600KHz

2.3. Performance Function

- Standby Power < 50uA@4.2V battery voltage
- Efficiency >87%
- Ripple & Noise <200mV

2.4. Protection Function

- Input Over Voltage Protection Shut down with auto-restart
- Output OVP Shut down with auto-restart
- Battery OVP / OTP/ OCP Shut down with auto-restart
- Output SCP / Battery UVP Shut down

3. Performance Evaluation

3.1. Standby Power

V_{BAT}	I_{BAT} (uA)	Spec	Remark
3.0Vdc	24.5	<50uA	Pass
3.3Vdc	26.3		Pass
3.6Vdc	28.2		Pass
3.9Vdc	29.8		Pass
4.2Vdc	31.8		Pass

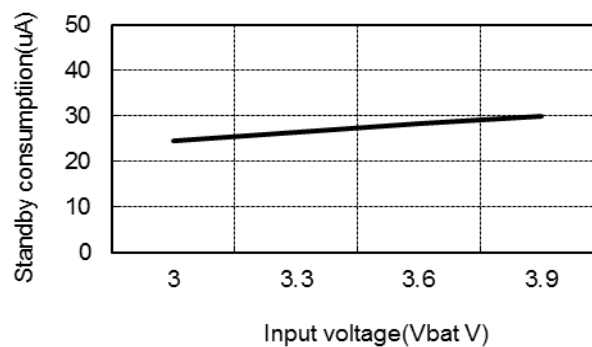


Figure 1. Standby input current

3.2. Efficiency

3.2.1 Buck CC mode

Micro Vin

	V_{BAT} (Vdc)	CC@ Vin=5V (%)	Spec	Remark
Buck CC	3.0	90.31	>89%	Pass
	3.3	91.25		Pass
	3.6	92.09		Pass
	3.9	92.81		Pass
	4.2	93.28		Pass

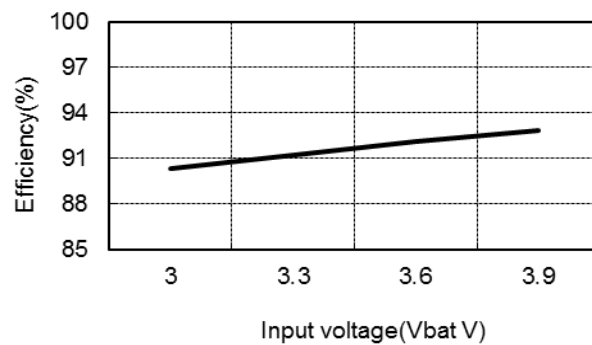


Figure 2. Efficiency @Buck CC mode

Type C Vin

	V _{BAT} (Vdc)	CC@ Vin=5V (%)	Spec	Remark
Buck CC	3.0	89.47	>89%	Pass
	3.3	90.32		Pass
	3.6	91.26		Pass
	3.9	92.03		Pass
	4.2	92.38		Pass

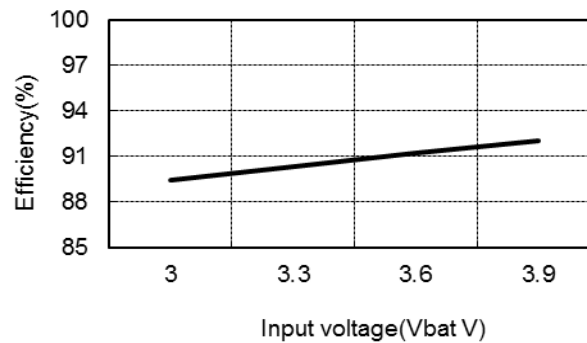


Figure 3. Efficiency @Buck CC mode

3.2.2 Buck CV mode
Micro Vin

	Load (A)	CV@ Vin=5V (%)	Spec	Remark
Buck CV	0.7	94.59	>90%	Pass
	1.4	94.73		Pass
	2.1	94.02		Pass
	2.7	93.24		Pass

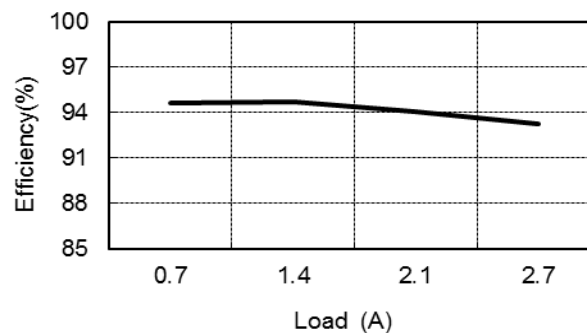


Figure 4. Efficiency @Buck CV mode

Type C Vin

	Load (A)	CV@ Vin=5V (%)	Spec	Remark
Buck CV	0.8	94.39	>90%	Pass
	1.6	94.48		Pass
	2.4	93.66		Pass
	3.2	92.74		Pass

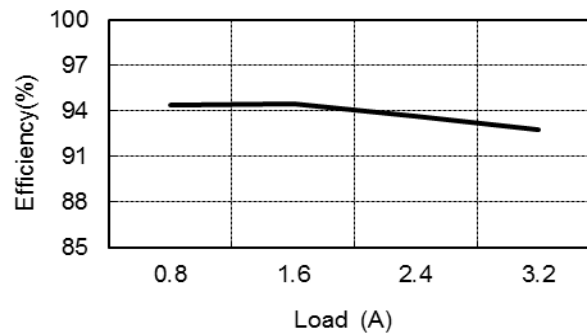


Figure 5. Efficiency @Buck CV mode

3.2.3 Boost CV mode USB A Vo

	Load (A)	CV@ $V_{BAT}=3V$ (%)	Spec	Remark
Boost CV	0.775	94.64	>87%	Pass
	1.550	93.39		Pass
	2.325	91.40		Pass
	3.100	88.81		Pass

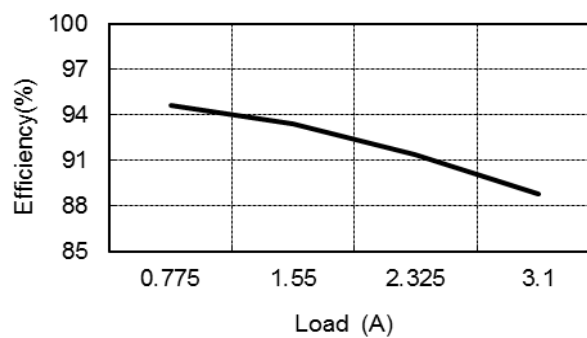


Figure 6. Efficiency @Boost CV mode

	Load (A)	CV@ $V_{BAT}=3.6V$ (%)	Spec	Remark
Boost CV	0.775	94.96	>87%	Pass
	1.550	94.57		Pass
	2.325	93.34		Pass
	3.100	91.98		Pass

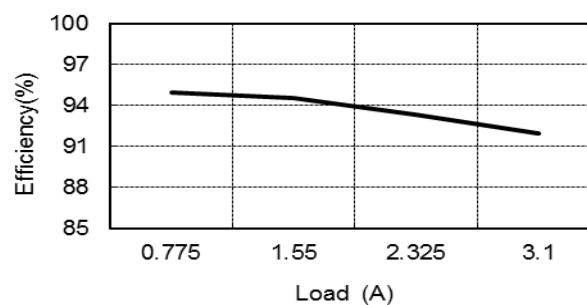


Figure 7. Efficiency @Boost CV mode

	Load (A)	CV@ V _{BAT} =4.2V (%)	Spec	Remark
Boost CV	0.775	96.11	>87%	Pass
	1.550	95.72		Pass
	2.325	94.87		Pass
	3.100	93.80		Pass

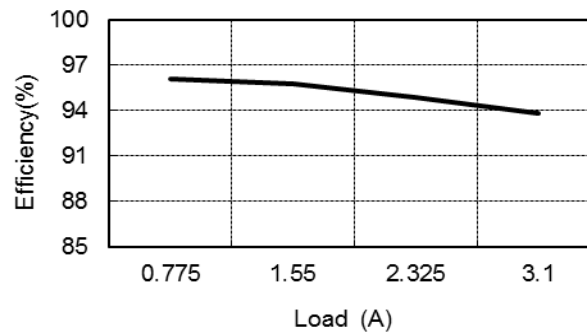


Figure 8. Efficiency @Boost CV mode

Type C Vo

	Load (A)	CV@ V _{BAT} =3V (%)	Spec	Remark
Boost CV	0.775	93.61	>87%	Pass
	1.550	92.23		Pass
	2.325	89.87		Pass
	3.100	87.15		Pass

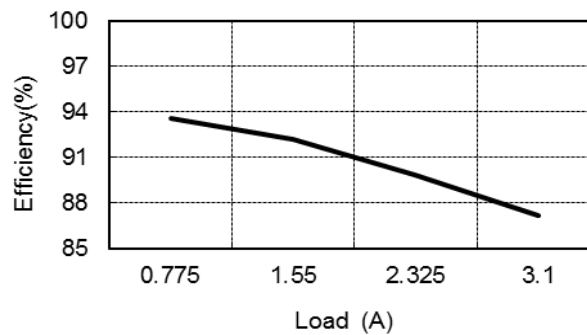


Figure 9. Efficiency @Boost CV mode

	Load (A)	CV@ V _{BAT} =3.6V (%)	Spec	Remark
Boost CV	0.775	94.54	>87%	Pass
	1.550	93.76		Pass
	2.325	92.05		Pass
	3.100	90.03		Pass

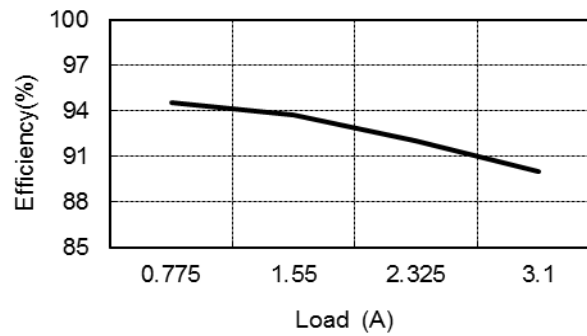


Figure 10. Efficiency @Boost CV mode

	Load (A)	CV@ $V_{BAT}=4.2V$ (%)	Spec	Remark
Boost CV	0.775	94.51	>90%	Pass
	1.550	95.01		Pass
	2.325	94.38		Pass
	3.100	93.51		Pass

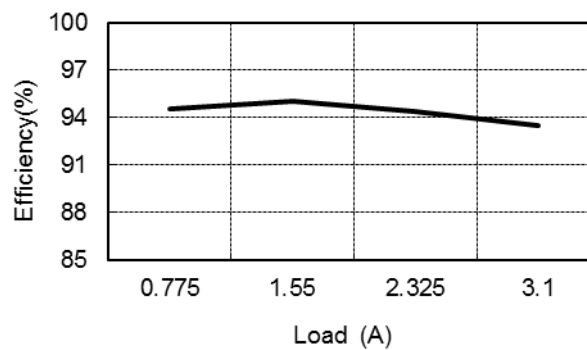


Figure 11. Efficiency @Boost CV mode

Path buck CV Mode

	Load (A)	CV@ $V_{in}=5V$ (%)	Spec	Remark
Boost CV	0.775	96.40	>90%	Pass
	1.550	97.46		Pass
	2.325	97.46		Pass
	3.100	97.17		Pass

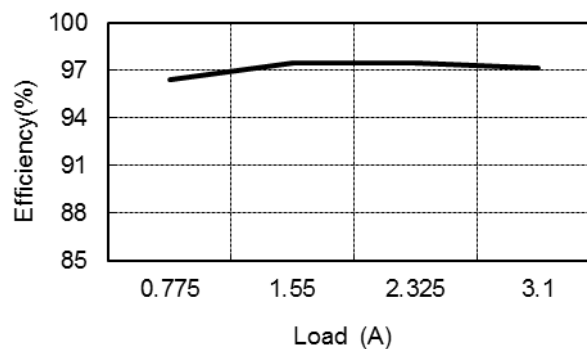


Figure 12. Efficiency @path buck CV mode

3.3. Output Voltage & Current

3.3.1 Buck CV mode

Micro Vin

Buck CV@ Vin=5V													
I _{out} (A)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2.0	2.2	2.4
V _{BAT} (V)	4.209	4.194	4.194	4.189	4.177	4.174	4.170	4.166	4.163	4.162	4.161	4.160	4.159

Buck CC@ Vin=5V								
V _{BAT} (V)	4.156	4.0	3.8	3.6	3.4	3.2	3.0	2.8
I _{in} (A)	2.408	2.412	2.415	2.422	2.429	2.437	2.445	2.451

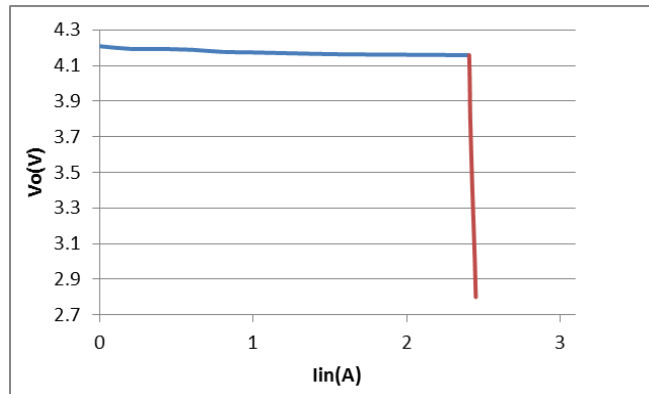


Figure 13. I-V curve@ Buck mode

Type C Vin

Buck CV@ V _{in} =5V											
Load (A)	0A	0.2A	0.4A	0.6A	0.8A	1A	1.2A	1.4A	1.6A	1.8A	2.0A
V _{out} (V)	4.207	4.187	4.195	4.194	4.186	4.185	4.184	4.183	4.184	4.183	4.183

Buck CV@ V _{in} =5V											
Load (A)	2.2A	2.4A	2.6A	2.8A	3.0A						
V _{out} (V)	4.182	4.180	4.180	4.179	4.179						

Buck CC@ Vin=5V									
V _{BAT} (V)	4.179	4.0	3.8	3.6	3.4	3.2	3.0	2.8	
I _{in} (A)	2.978	2.978	2.982	2.986	2.991	2.996	3.001	3.012	

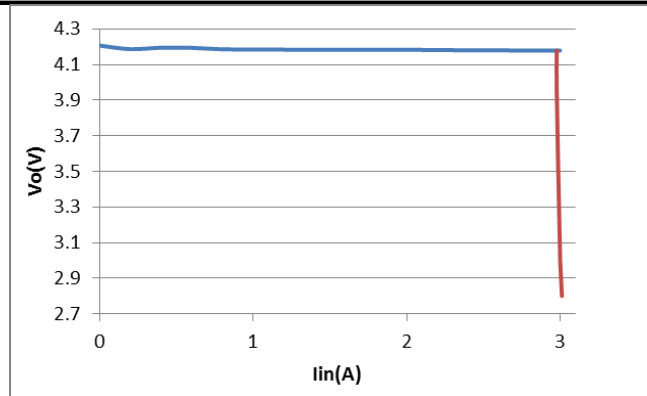


Figure 14. I-V curve@ Buck mode

3.3.2 Boost CV mode

USB A Vo

	Boost CV@ $V_{BAT}=4.2V$										
Load (A)	0A	0.2A	0.4A	0.6A	0.8A	1A	1.2A	1.4A	1.6A	1.8A	2.0A
Vout (V)	5.117	5.096	5.095	5.090	5.084	5.077	5.070	5.064	5.057	5.050	5.045

	Boost CV@ $V_{BAT}=4.2V$										
Load (A)	2.2A	2.4A	2.6A	2.8A	3.0A	3.1A					
Vout (V)	5.040	5.037	5.033	5.031	5.028	5.027					

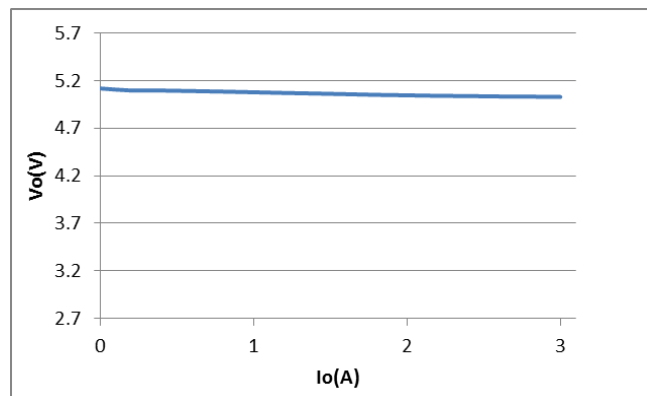


Figure 15. I-V curve@ boost mode

Type C Vo

	Boost CV@ $V_{BAT}=4.2V$										
Load (A)	0A	0.2A	0.4A	0.6A	0.8A	1A	1.2A	1.4A	1.6A	1.8A	2.0A
Vout (V)	5.121	5.096	5.088	5.078	5.068	5.057	5.045	5.032	5.021	5.010	4.999

	Boost CV@ $V_{BAT}=4.2V$										
Load (A)	2.2A	2.4A	2.6A	2.8A	3.0A						
Vout (V)	4.989	4.980	4.970	4.960	4.949						

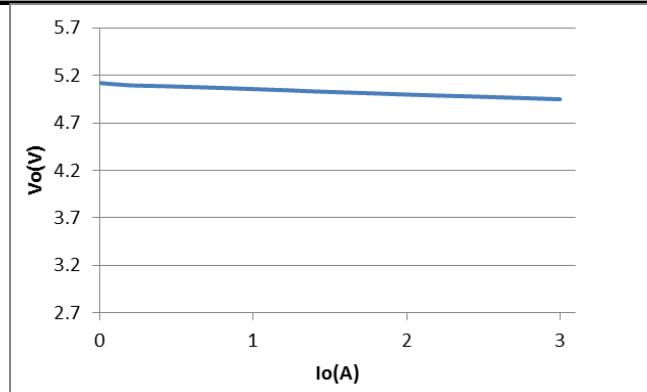


Figure 16. Load regulation @Boost CV mode

3.4. Boost BAT UVP (Figure 17)

UVP	Test Result (V)	Spec	Remark
V_{BAT}	2.797	2.8V	Pass

3.5. Boost Output Voltage OVP (Figure 18)

OVP	Test Result (V)	Spec	Remark
V_{out}	6.48	6.5V	Pass

3.6. Ripple & Noise (Figure 19-28)

USB A Vo

V_{BAT} (V)	No load (mV)	Full load (mV)	Spec	Remark
3.0	60	146	<150mV	Pass
3.3	63	126		Pass
3.6	63	116		Pass
3.9	61	106		Pass
4.2	60	93		Pass

Type C Vo

V_{BAT} (V)	No load (mV)	Full load (mV)	Spec	Remark
3.0	50	141	<150mV	Pass
3.3	48	131		Pass
3.6	48	115		Pass
3.9	48	100		Pass
4.2	50	83		Pass

Path buck Vo

V_{in} (V)	No load (mV)	Full load (mV)	Spec	Remark
5.0	63	68	<150mV	Pass

3.7. Waveforms

3.7.1 Vbat UVP & Vo OVP waveform

Figure 17: Boost mode, $V_{BAT}=4.2V$ 开始降低, 直到触发 UVP

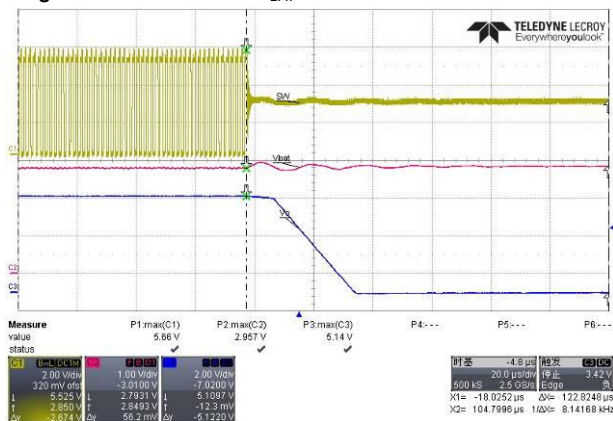
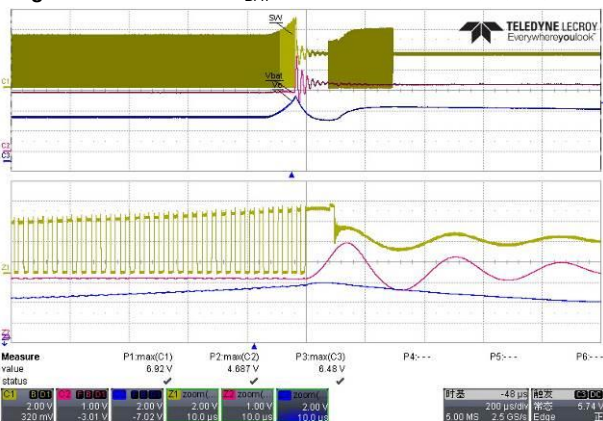


Figure 18: Boost mode, $V_{BAT}=4.2V$, CC 切换 CV 过程中触发 OVP



3.7.2 Ripple & Noise

USB A Vo

Figure 19: Boost mode, $V_{BAT}=3.0V$, no-load

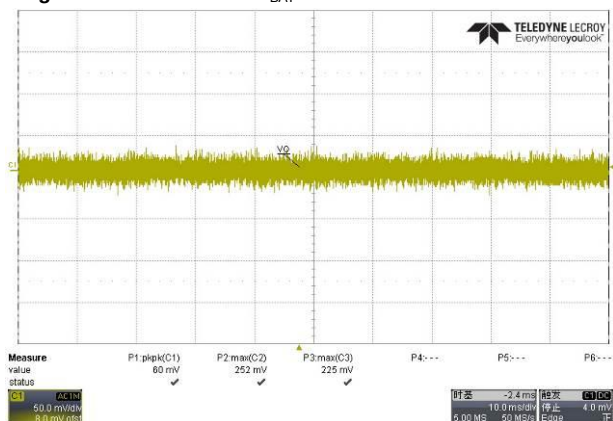


Figure 20: Boost mode, $V_{BAT}=3.0V$, full load

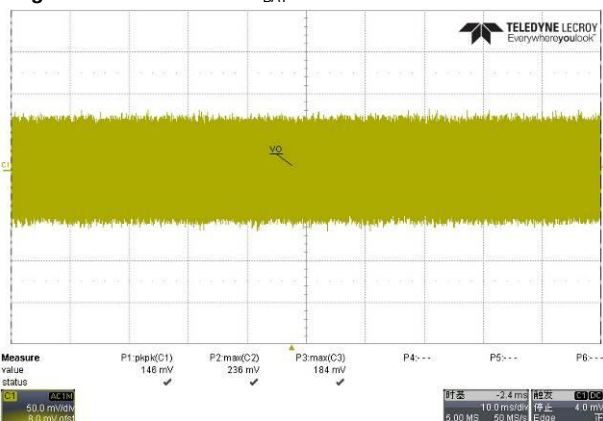
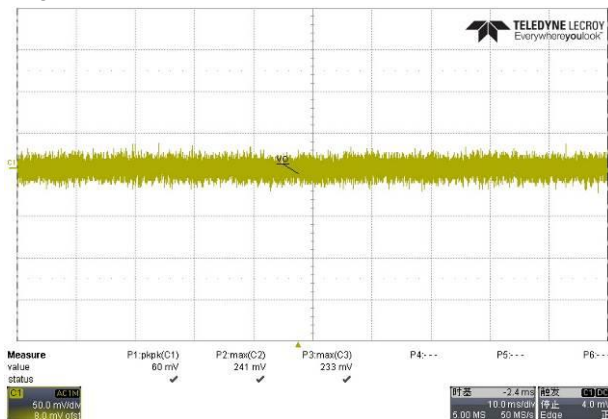
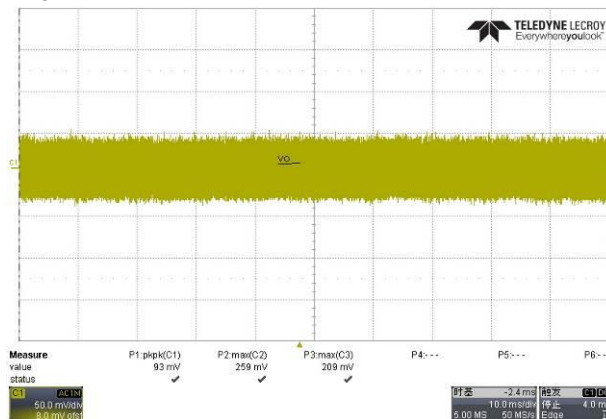
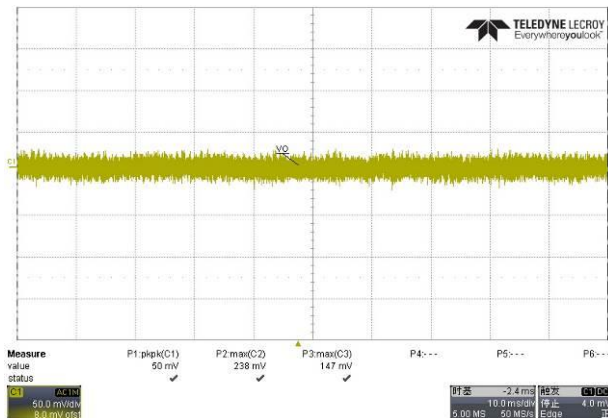
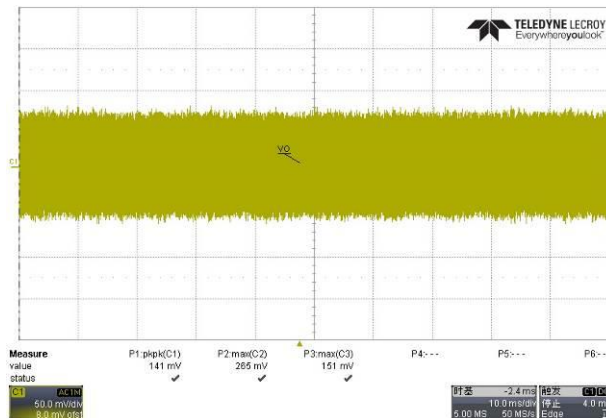
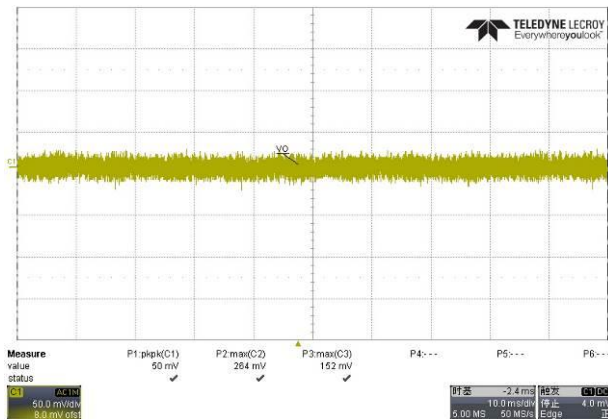
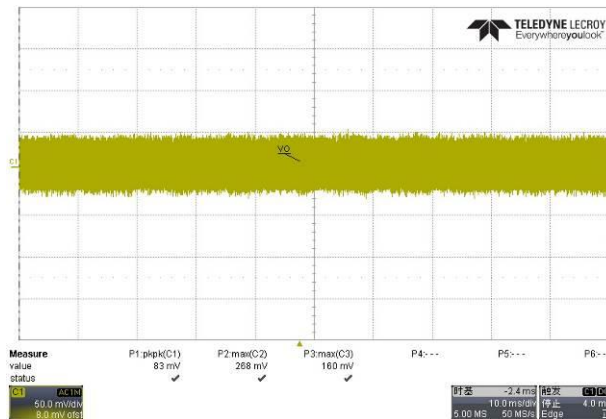


Figure 21: Boost mode, $V_{BAT}=4.2V$, no-load

 CH1: V_O
Figure 22: Boost mode, $V_{BAT}=4.2V$, full load

 CH1: V_O

Type C V_O

Figure 23: Boost mode, $V_{BAT}=3.0V$, no-load

 CH1: V_O
Figure 24: Boost mode, $V_{BAT}=3.0V$, full load

 CH1: V_O
Figure 25: Boost mode, $V_{BAT}=3.0V$, no-load

 CH1: V_O
Figure 26: Boost mode, $V_{BAT}=3.0V$, full load

 CH1: V_O

Path BUCK Vo

Figure 27: Boost mode, $V_{in}=5.0V$, no-load

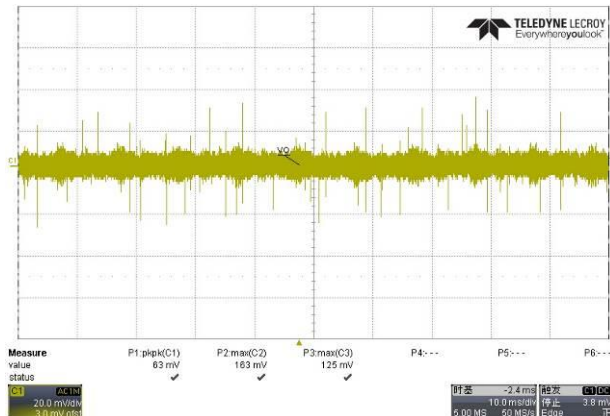
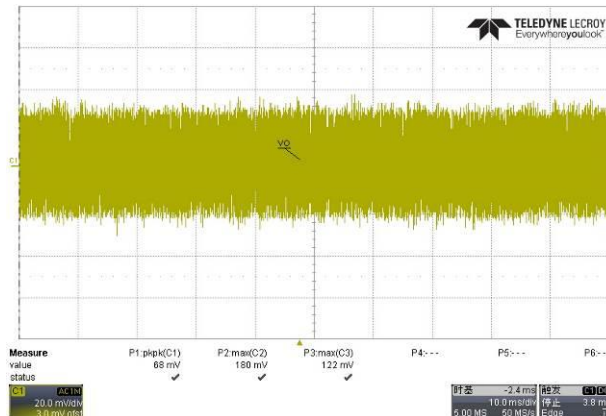


Figure 28: Boost mode, $V_{in}=5.0V$, full load



3.7.3 BUCK CC Mode

Type C Vin

Figure 29: Buck CC mode, $V_{in}=5V$, start at full load

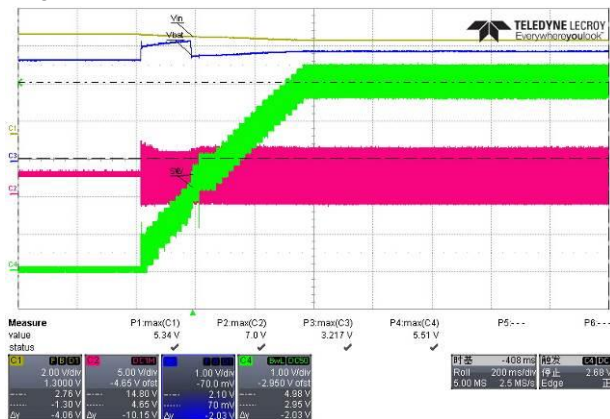
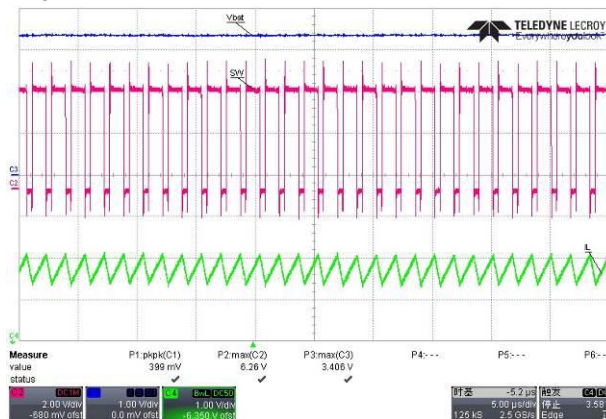


Figure 30: Buck CC mode, $V_{in}=5V$, normal at full load



Micro Vin

Figure 31: Buck CC mode, $V_{in}=5V$, start at full load

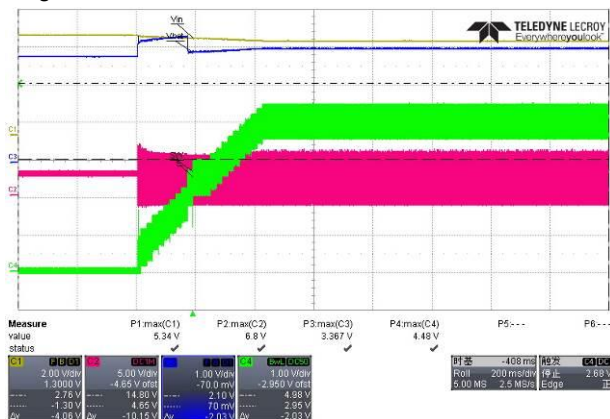
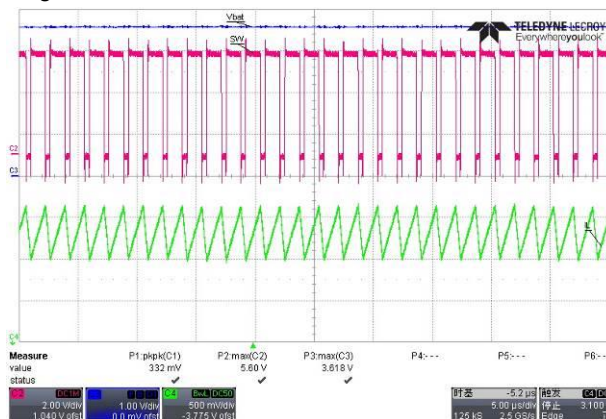


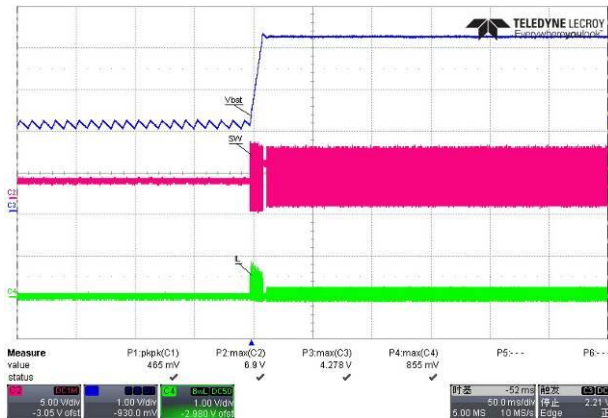
Figure 32: Buck CC mode, $V_{in}=5V$, normal at full load



3.7.4 Buck CV mode

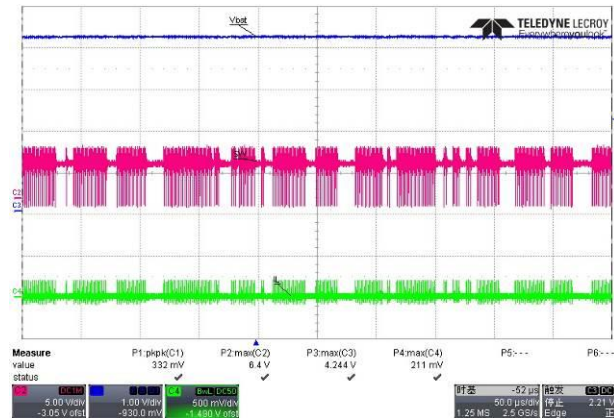
Micro Vin

Figure 33: Buck CV mode, $V_{in}=5V$, start at light load



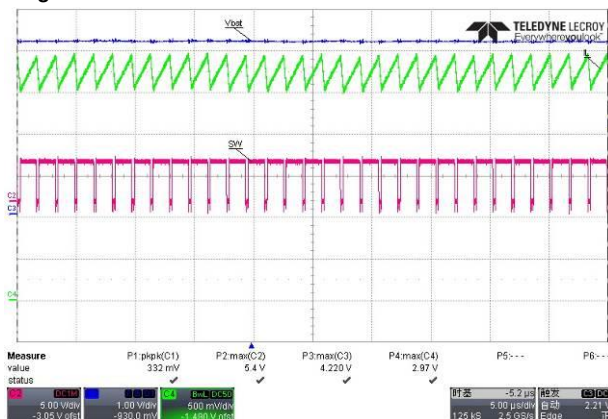
CH2: sw CH3:Vbat CH4:IL
 设定 $I_{OUT}=0.02A$, 轻载启动波形

Figure 34: Buck CV mode, $V_{in}=5V$, normal at light load



CH2: sw CH3:Vbat CH4:IL
 设定 $I_{OUT}=0.02A$, 轻载正常工作波形

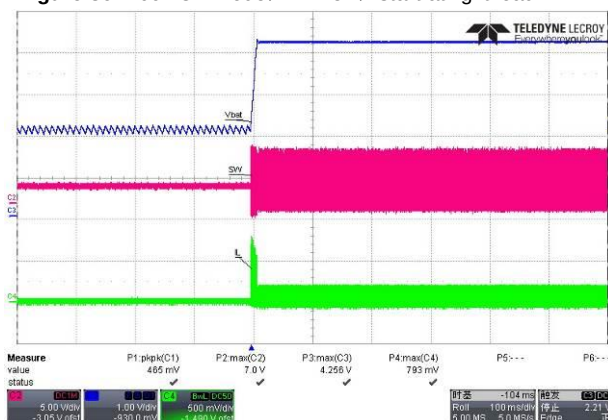
Figure 35: Buck CV mode, $V_{in}=5V$, normal at full load



CH2: sw CH3:Vbat CH4:IL
 设定 $I_{OUT}=3.1A$, 满载启动波形

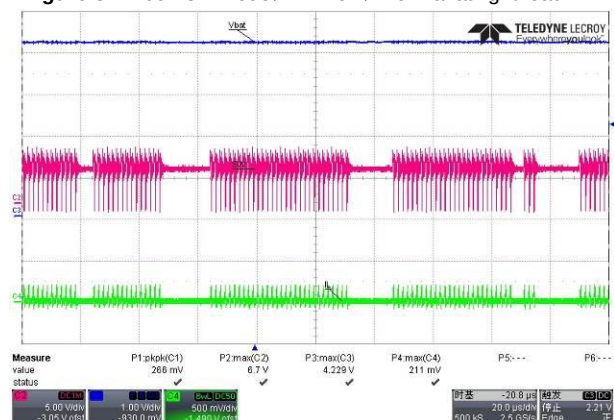
Type C Vin

Figure 36: Buck CV mode, $V_{in}=5V$, start at light load



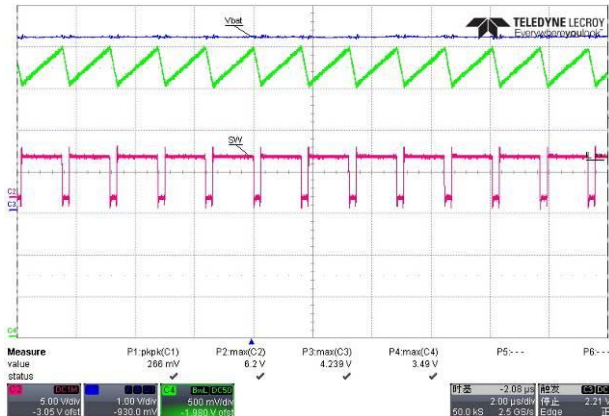
CH2: sw CH3:Vbat CH4:IL
 设定 $I_{OUT}=0.02A$, 轻载启动波形

Figure 37: Buck CV mode, $V_{in}=5V$, normal at light load



CH2: sw CH3:Vbat CH4:IL
 设定 $I_{OUT}=0.02A$, 轻载正常工作波形

Figure 38: Buck CV mode, $V_{in}=5V$, normal at full load



3.7.5 Boost CV mode

Type C Vo

Figure 39: Boost mode, $V_{BAT}=4.2V$, start at no-load

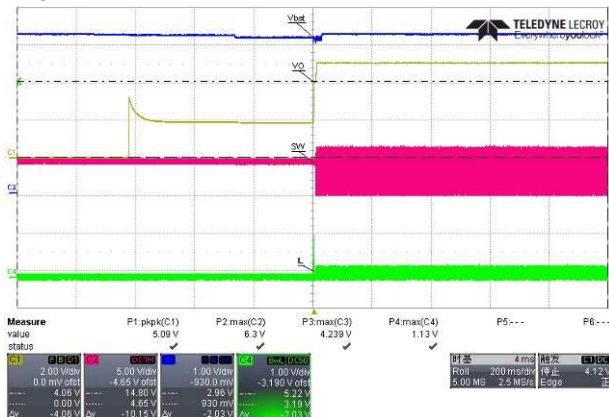


Figure 40: Boost mode, $V_{BAT}=4.2V$, normal at no-load

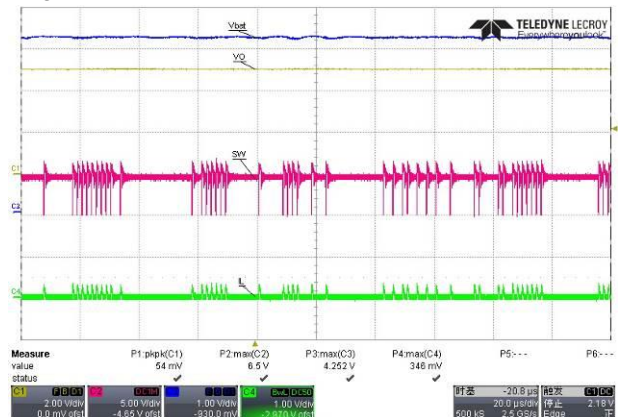


Figure 41: Boost mode, $V_{BAT}=4.2V$, start at full load

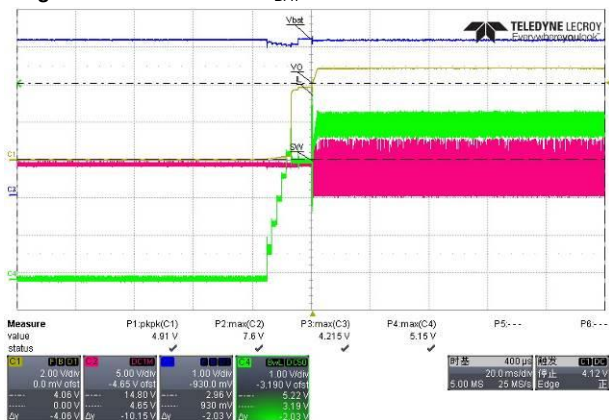
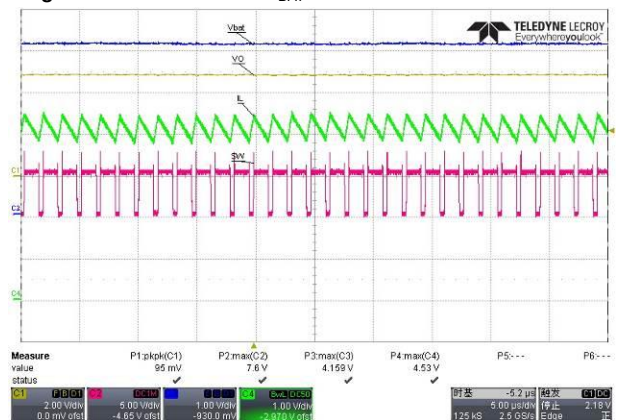
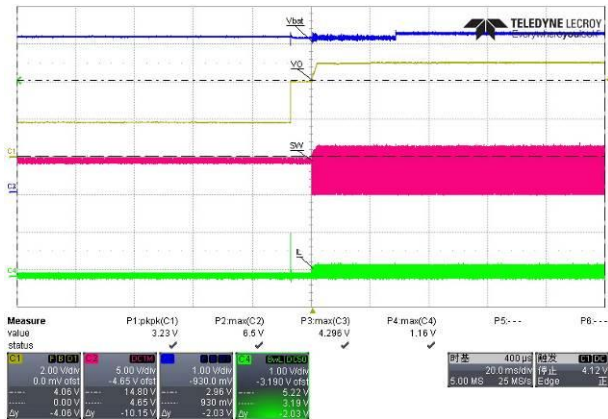
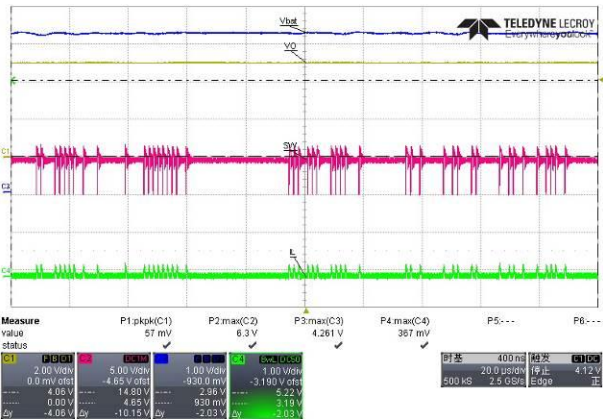


Figure 42: Boost mode, $V_{BAT}=4.2V$, normal at full load

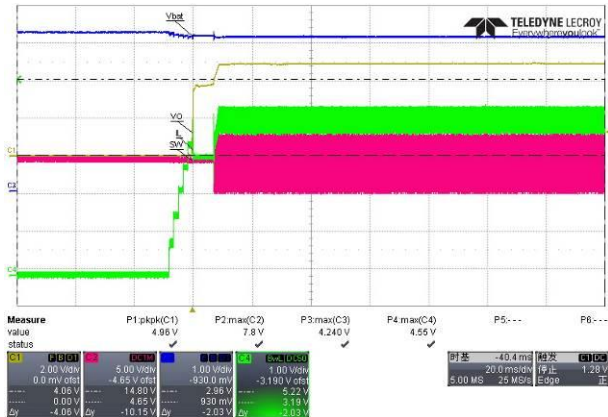


USB A Vo
Figure 43: Boost mode, $V_{BAT}=4.2V$, start at no-load


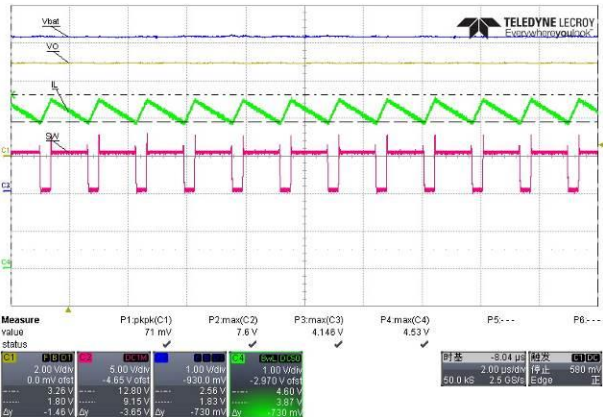
CH1: V_o CH2: sw CH3: V_{bat} CH4: IL
 $V_{out}=5V$, 设定负载 0A, 空载启动波形

Figure 44: Boost mode, $V_{BAT}=4.2V$, normal at no-load


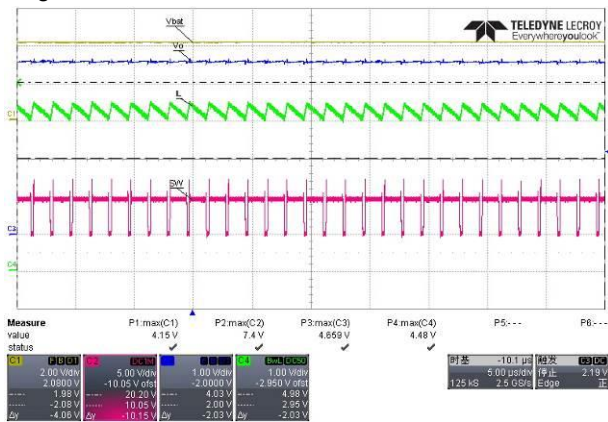
CH1: V_o CH2: sw CH3: V_{bat} CH4: IL
 $V_{out}=5V$, 设定负载 0A, 空载正常工作波形

Figure 45: Boost mode, $V_{BAT}=4.2V$, start at full load


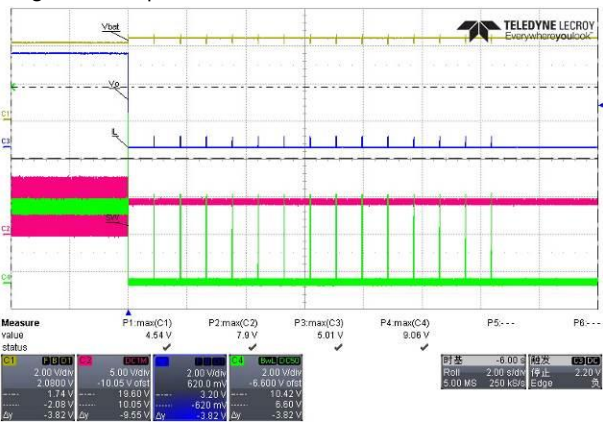
CH1: V_o CH2: sw CH3: V_{bat} CH4: IL
 $V_{out}=5V$, 设定负载 3.1A, 满载启动波形

Figure 46: Boost mode, $V_{BAT}=4.2V$, normal at full load


CH1: V_o CH2: sw CH3: V_{bat} CH4: IL
 $V_{out}=5V$, 设定负载 3.1A, 满载正常工作波形

3.7.6 Boost CC mode & SCP
Figure 47: Boost CC mode, $V_{BAT}=4.2V$


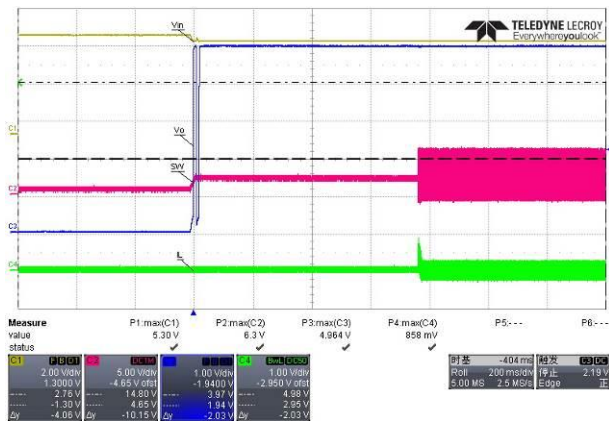
CH1: V_o CH2: sw CH3: V_{bat} CH4: IL

Figure 48: Output short, $V_{BAT}=4.2V$, full load


CH1: V_o CH2: sw CH3: V_{bat} CH4: IL

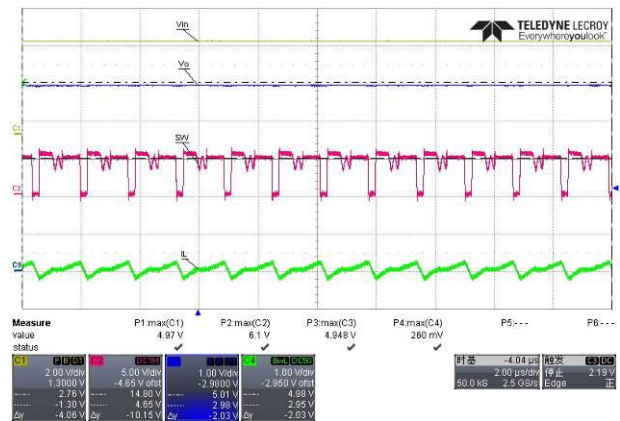
3.7.7 Path BUCK

Figure 49: PATH BUCK mode, $V_{in}=5V$, start at full load



CH1: V_0 CH2: sw CH3: Vbat CH4: IL
 设定 $V_{inT}=5.0V$, $I_o=3.1A$ 启动波形

Figure 50: PATH BUCK mode, $V_{in}=5V$, normal at full load



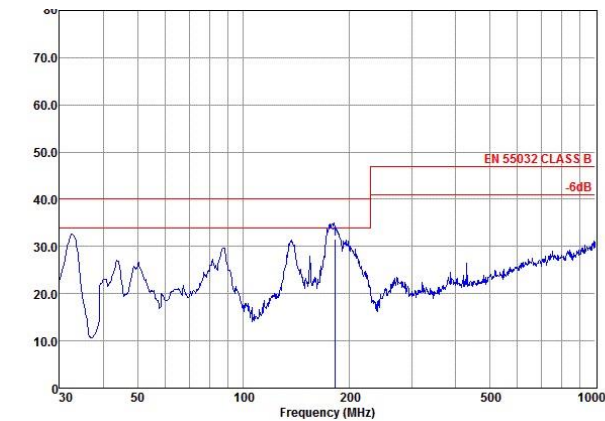
CH1: V_0 CH2: sw CH3: Vbat CH4: IL
 设定 $V_{BAT}=4.2V$, $3.1A$ 满载正常工作波形

4 Radiation EMI Test

EN55032 CLASS B @ full load report

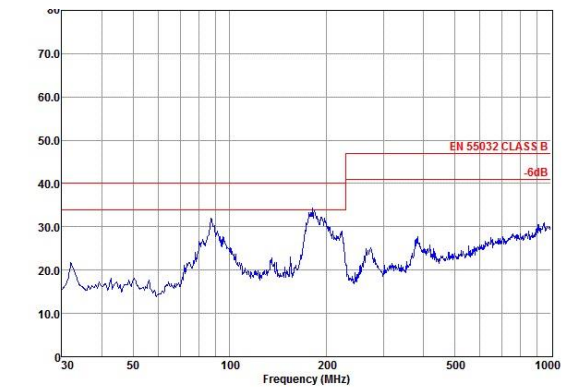
4.1 Charging TEST

Micro vin(5V2.5A)



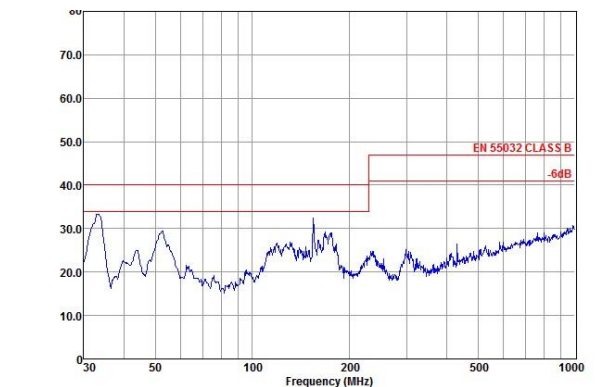
Site : Audix(Shanghai) Chamber3
 Condition : EN 55032 CLASS B VERTICAL
 Project No. :
 Applicant :
 EUT : OB2113
 M/N :
 S/N :
 Power Supply : DC4V
 Ambient : 22°C 60%RH
 Test Mode : 5V 2.5A
 Test Engineer: Avalon
 Memo : MICRO charging

	Read	Cable	Antenna	Preamp	Limit	Over	
Freq	Level	Loss	Factor	Factor	Line	Level	Limit Remark
MHz	dBuV	dB	dB/m	dB	dBuV/m	dBuV/m	dB
1	181.89	39.00	1.49	18.17	27.08	40.00	31.58 -8.42 QP

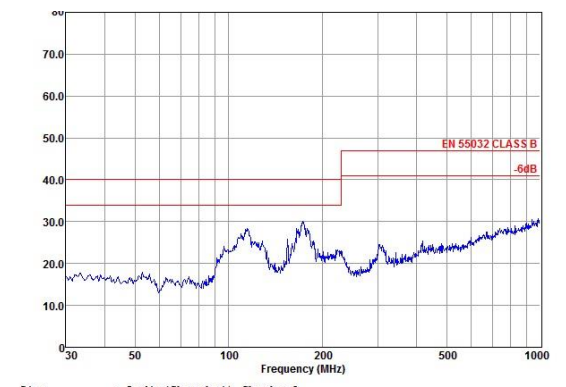


Site : Audix(Shanghai) Chamber3
 Condition : EN 55032 CLASS B HORIZONTAL
 Project No. :
 Applicant :
 EUT : OB2113
 M/N :
 S/N :
 Power Supply : DC4V
 Ambient : 22°C 60%RH
 Test Mode : 5V 2.5A
 Test Engineer: Avalon
 Memo : MICRO charging

Type-c vin(5V3.1A)



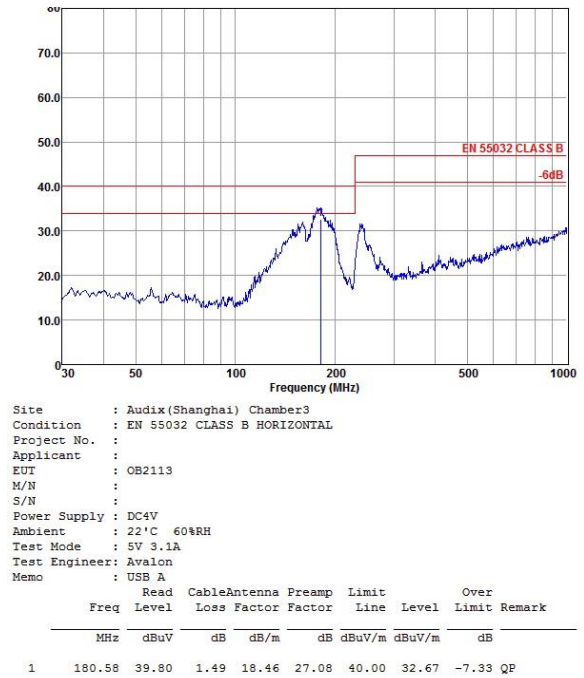
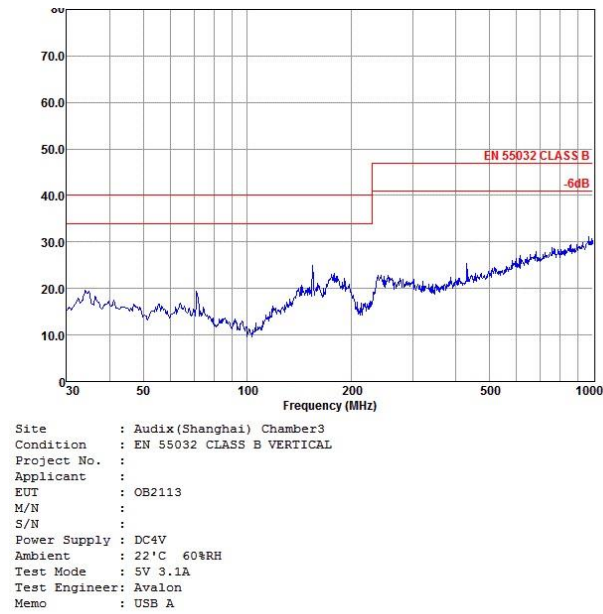
Site : Audix(Shanghai) Chamber3
 Condition : EN 55032 CLASS B VERTICAL
 Project No. :
 Applicant :
 EUT : OB2113
 M/N :
 S/N :
 Power Supply : DC4V
 Ambient : 22°C 60%RH
 Test Mode : 5V 3.1A
 Test Engineer: Avalon
 Memo : TYPE C charging



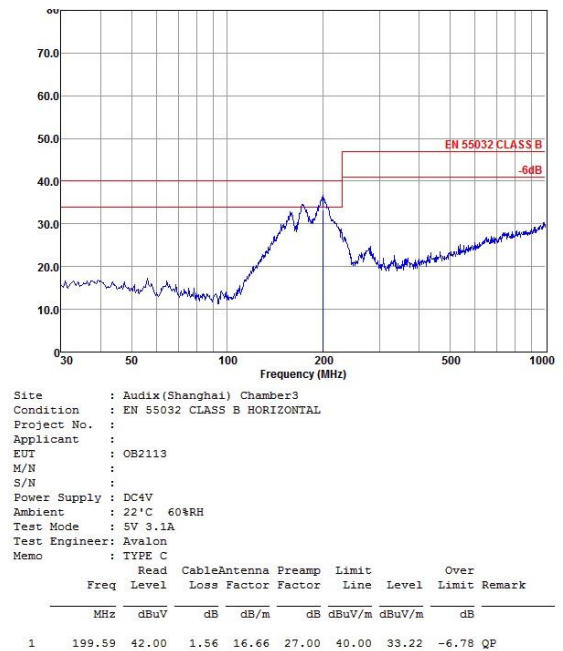
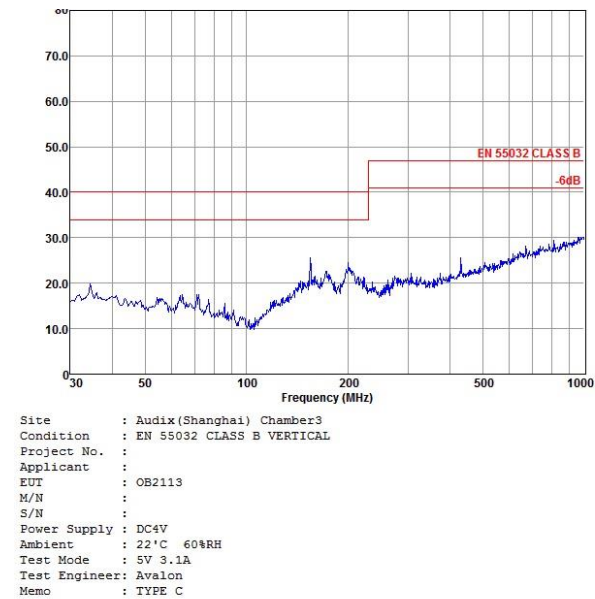
Site : Audix(Shanghai) Chamber3
 Condition : EN 55032 CLASS B HORIZONTAL
 Project No. :
 Applicant :
 EUT : OB2113
 M/N :
 S/N :
 Power Supply : DC4V
 Ambient : 22°C 60%RH
 Test Mode : 5V 3.1A
 Test Engineer: Avalon
 Memo : TYPE C charging

4.2 Discharging TEST

USB-A Vo(5V3.1A)



Type-c Vo(5V3.1A)



5 Thermal Test

Test method: Ambient temperature 40°C .In the box of 11.4cm*8.5cm*4.3cm.

IC Temperature rise as follows:

Buck CC	IC Temperature rise $\Delta T (^{\circ}C)$ @ Vbat=2.8V,Type_C Iin=3.02A
Max Load	70.2
Boost CC	IC Temperature rise $\Delta T (^{\circ}C)$ @ Vbat=3V,Io=3.1A
Max Load	83.2

6 NTC 保护阈值

表 1 BUCK 部分 RT 电压阈值

IC	Cold SPEC/V	Cold	Cold Recover	Hot SPEC/V	Hot	Hot Recover	Warm Spec	Warm (CV=4.1V)	Warm Recover
#1	1.32	1.29	1.24	0.49	0.48	0.54	0.56	0.56	0.61
#2		1.30	1.26		0.49	0.53		0.57	0.62
#3		1.30	1.26		0.50	0.55		0.57	0.63

表 2 BOOST 部分 RT 电压阈值

IC	Cold SPEC/V	Cold	Cold Recover	Hot SPEC/V	Hot	Hot Recover
#1	1.44	1.39	1.36	0.42	0.42	0.49
#2		1.41	1.38		0.43	0.48
#3		1.41	1.38		0.44	0.50

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