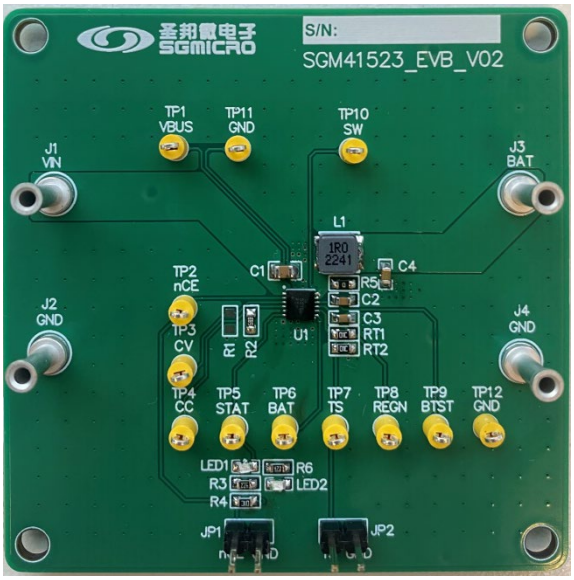
SGM41523 Demo Board Test Report



Demo Top picture

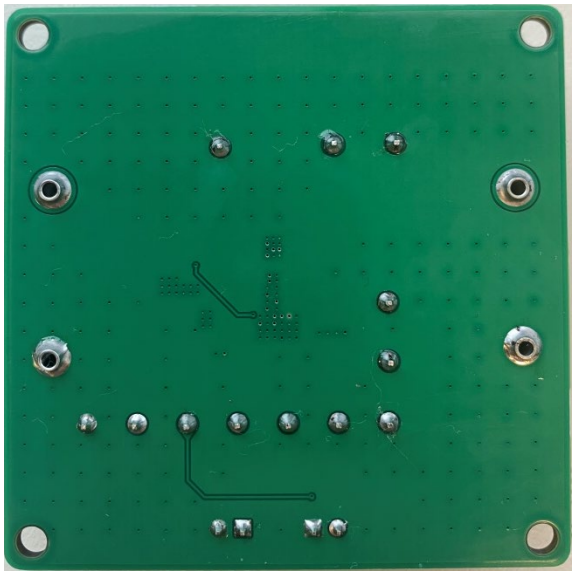
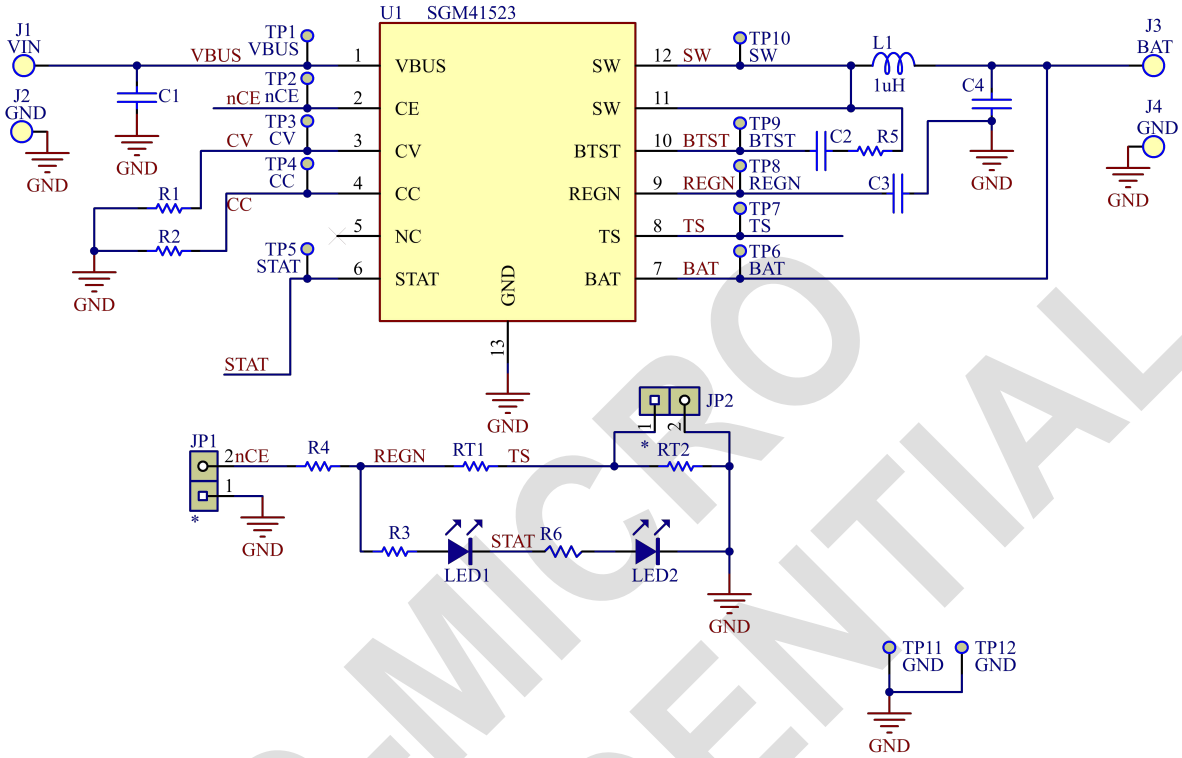

Demo Bottom picture

Table of Contents

1. Schematic and BOM List



Item	Reference	Description	QTY	Manuf.
1	C1	Ceramic capacitor, 10uF/25V, X5R, 0805	1	
2	C2	Ceramic capacitor,10nF/25V,X5R,0603	1	
3	C3	Ceramic capacitor,1uF/10V,X5R,0603	1	
4	C4	Ceramic capacitor,22uF/10V,X5R,0603	1	
5	L1	Inductor, 1uH, I_R=6.2A, I_S=12.5A, DCR=22mΩ, 74437324010	1	Wurth
6	LED1,LED2	LED, 0603, Green	2	
7	R1	NP	0	
8	R2	Chip Resistor, 4.99KΩ, 1/10W, 1%, 0603	1	
9	R3,R6	Chip Resistor, 4.7KΩ, 1/10W, 5%, 0603	2	
10	RT1,RT2,R4	Chip Resistor, 10KΩ, 1/10W, 1%, 0603	3	
11	R5	Chip Resistor, 0Ω, 1/10W, 1%, 0603	1	
12	U1	Charger IC, TDFN-3×3-12L, SGM41523	1	SG-Micro
Conclusion: Total 15 components				

2. Test Items

2.1 Charging Efficiency

Test condition: V_{BUS}=5V/9V/12V, CV: 4.45V, Fast charging current: 0.2A~2.5A set by ISET resistor, Inductor (Wurth 74438367010) parameters: 1uH, DCR=11.5mΩ, measure the charge efficiency at 3.8V/4.2V battery voltage.

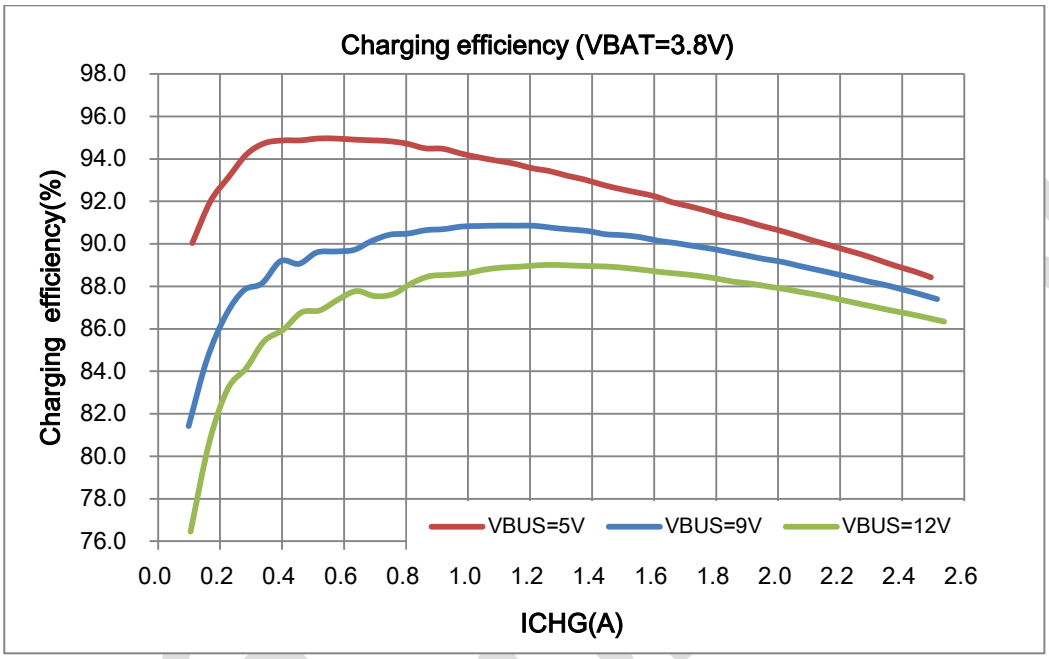


Chart 1 Charging Efficiency at VBAT=3.8V

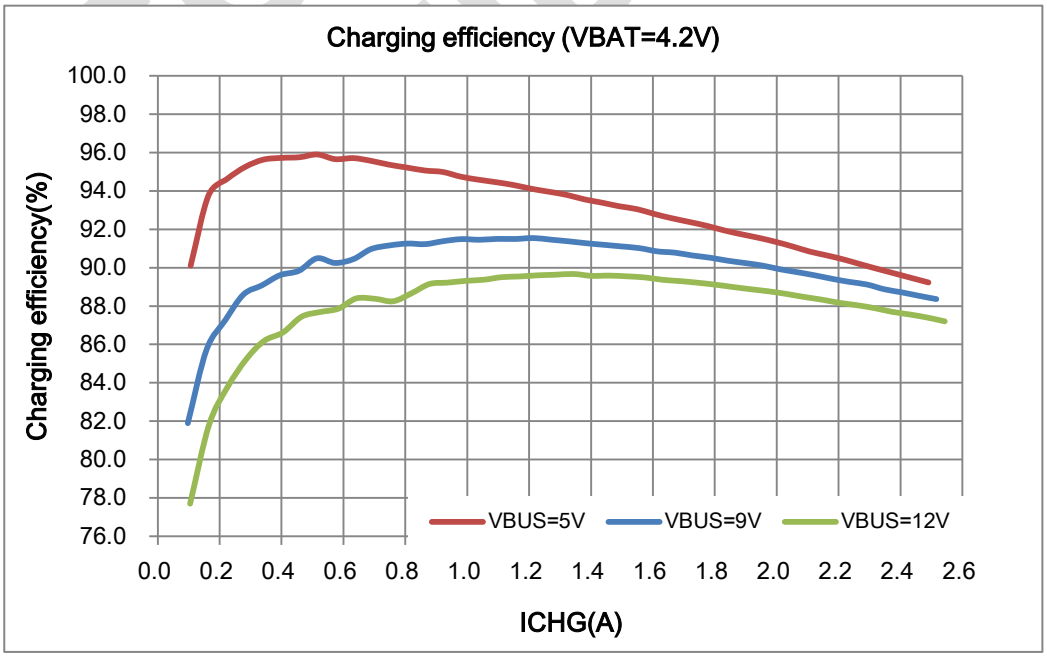


Chart 2 Charging Efficiency at VBAT=4.2V

2.2 Trickle Charging Current, Pre-charging Current and Fast Charging Current

Test condition: V_{BUS}=5V/9V/12V or other INPUT, V_{BAT}: 0V~4.2V, CV: 4.2V, fast charging current: 0.5A or 2A set by ISET resistor, measure the charging current with different VBUS and ISET setting.

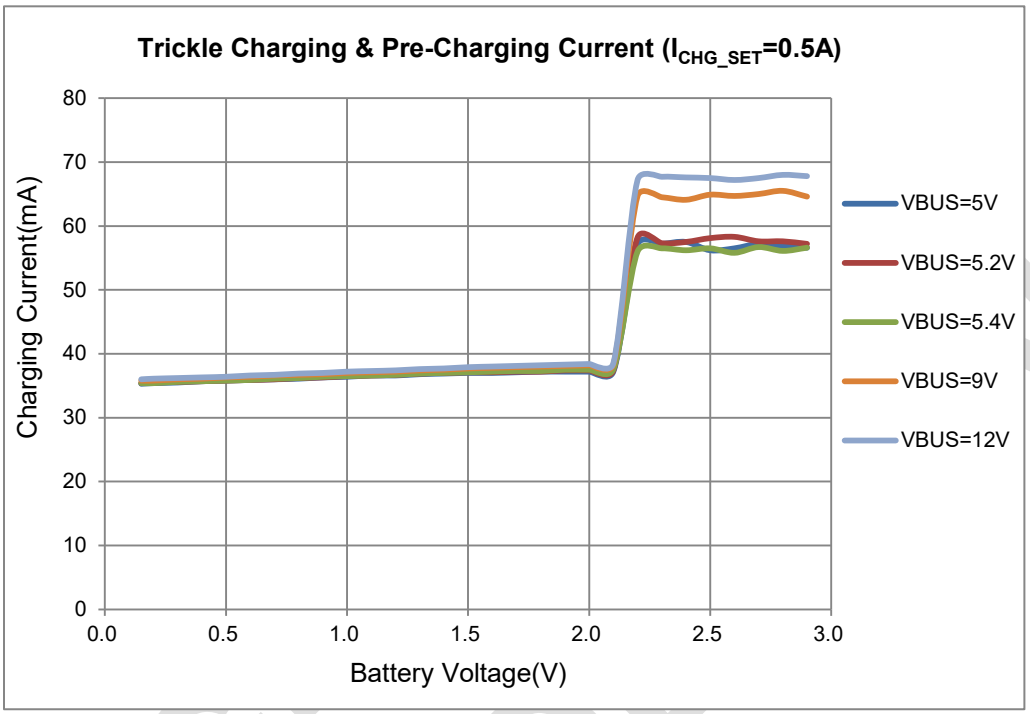


Chart 3 Trickle charging & Pre-charging Current at (I_{CHG_SET}=0.5A)

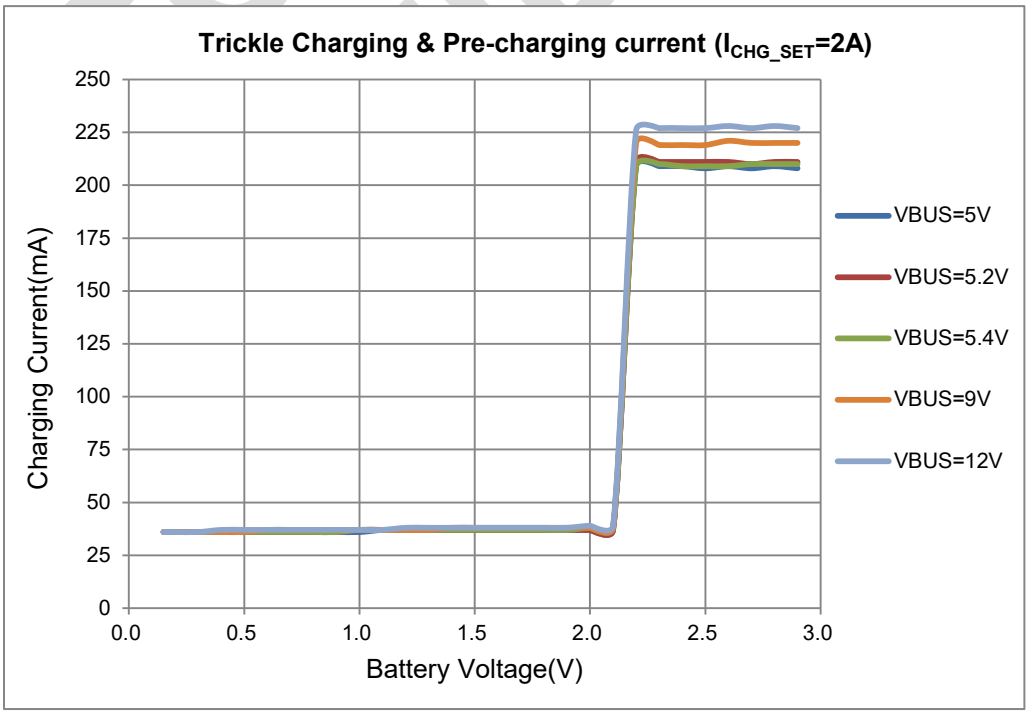


Chart 4 Trickle charging & Pre-charging Current at (I_{CHG_SET}=2A)

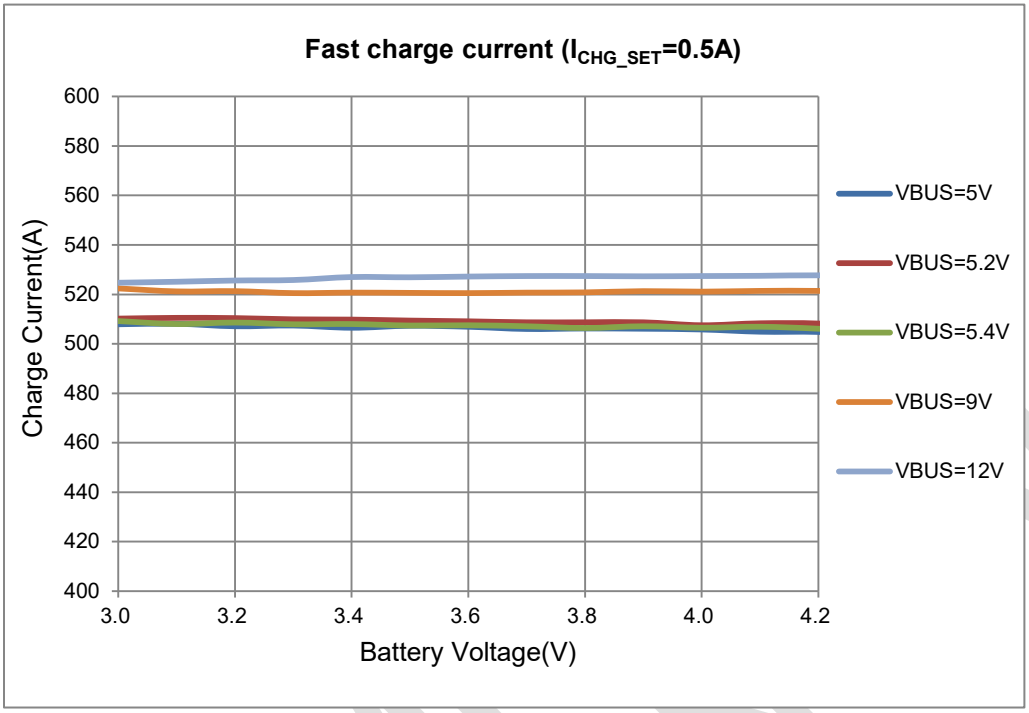


Chart 5 Fast Charging Current at (I_{CHG_SET}=0.5A)

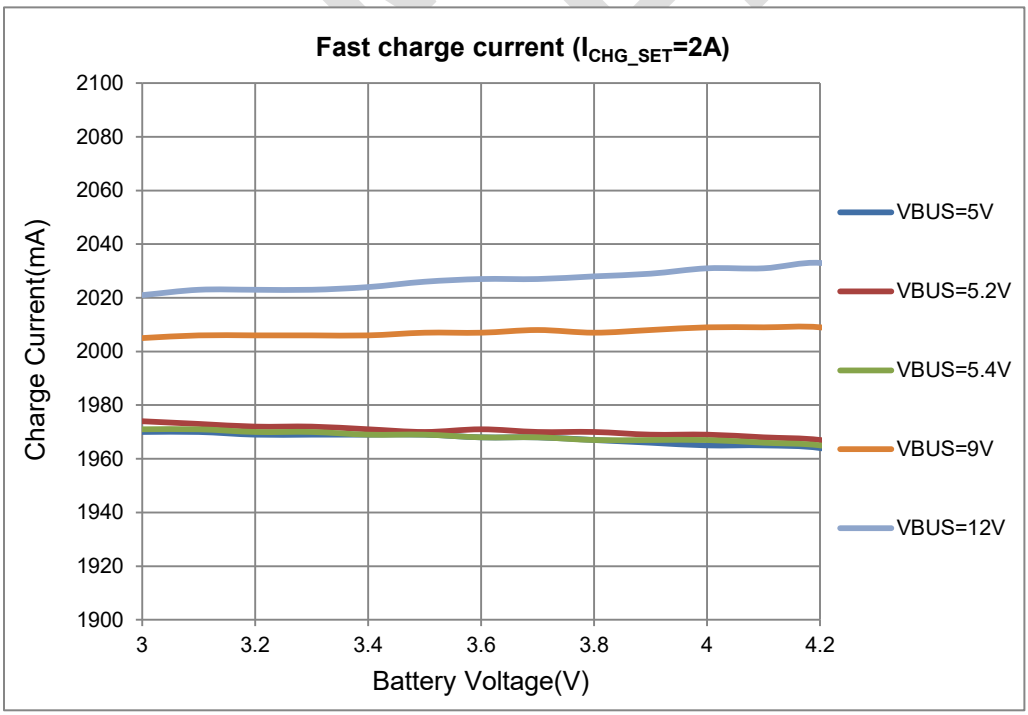


Chart 6 Fast Charging Current at (I_{CHG_SET}=2A)

2.3 Constant Charging Voltage Accuracy

Test condition: V_{BUS}=5V/12V, fast charging current: 2A, CV: 4.1V/4.2V/4.3V/4.35V/4.4V/4.45V, increase the battery voltage until charging current decrease obviously in CV mode, and record the VBAT.

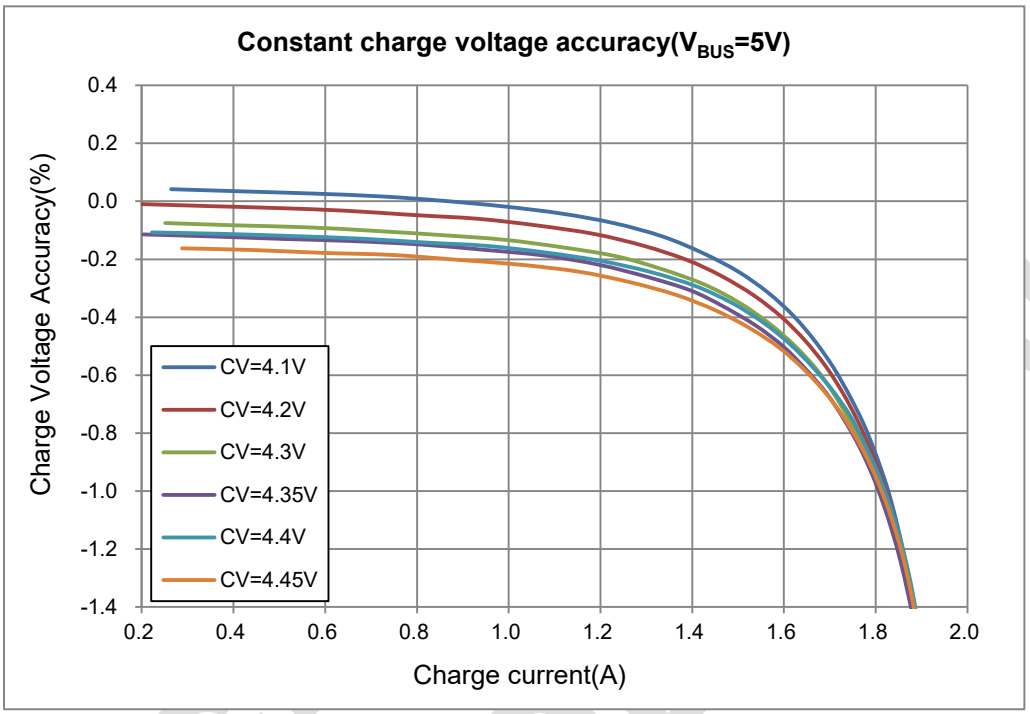


Chart 7 Constant Charging Voltage Accuracy (V_{BUS}=5V)

(Note: there is an overlapping range for CV and CC loop, which cause the charging current decrease when battery voltage is close to the set value.)

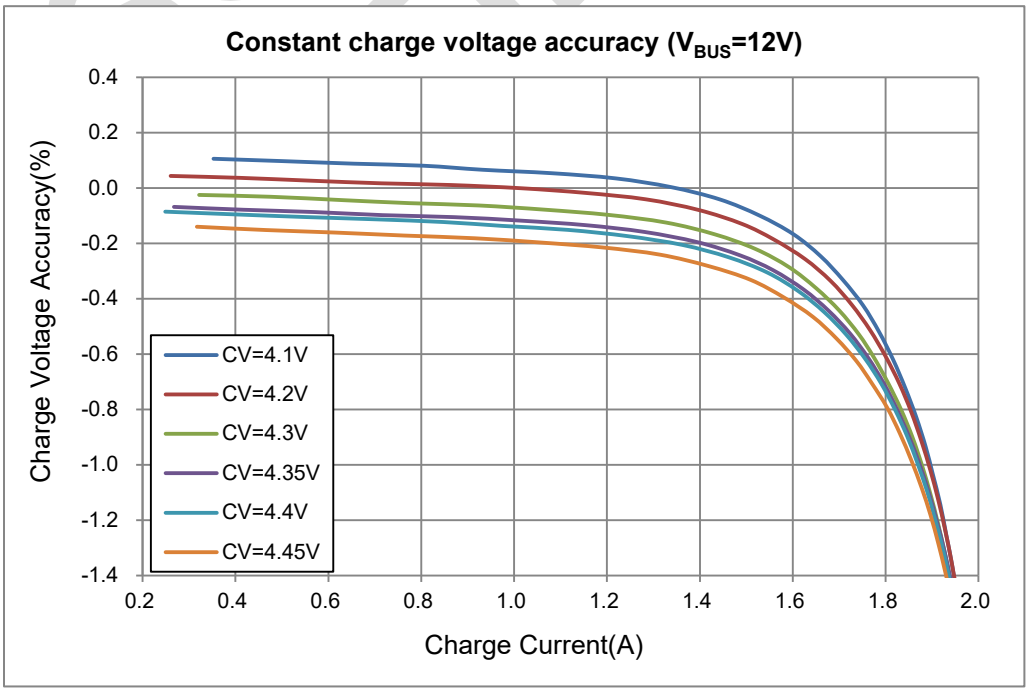


Chart 8 Constant Charging Voltage Accuracy (V_{BUS}=12V)

2.4 Real battery charging profile

Test condition: V_{BUS}=5V/12V, CV: 4.2V, CC: 2A, record the real battery charging profile.

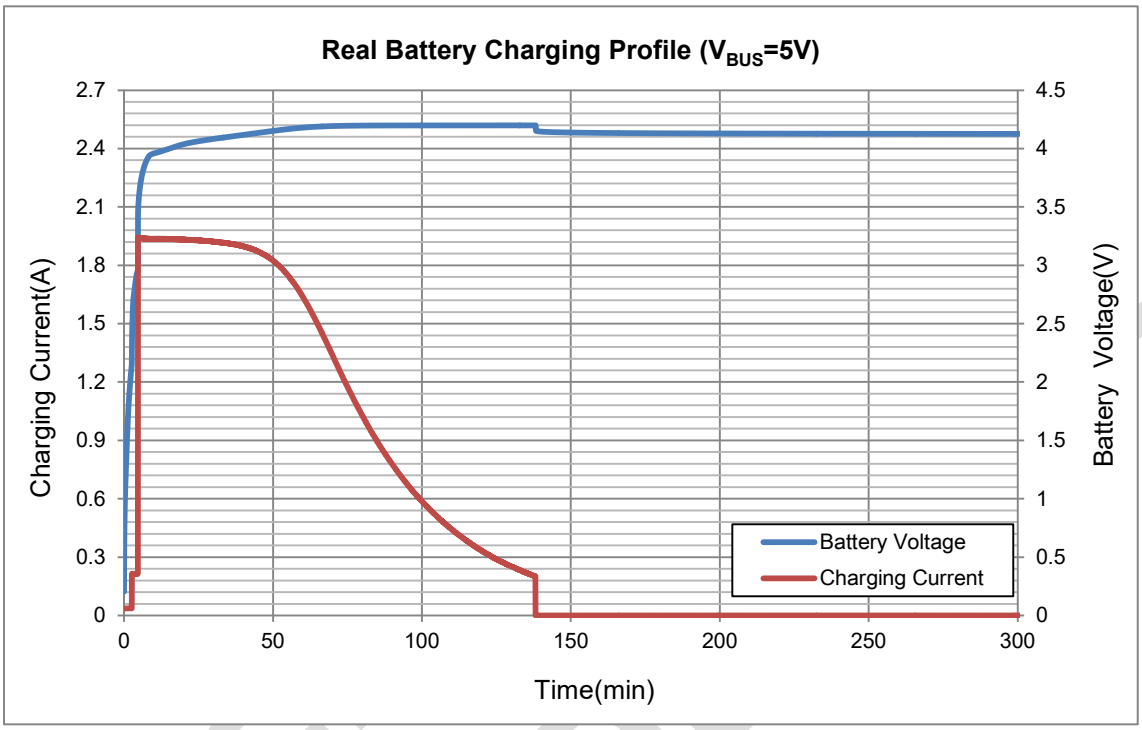


Chart 9 Charging profile (V_{BUS}=5V)

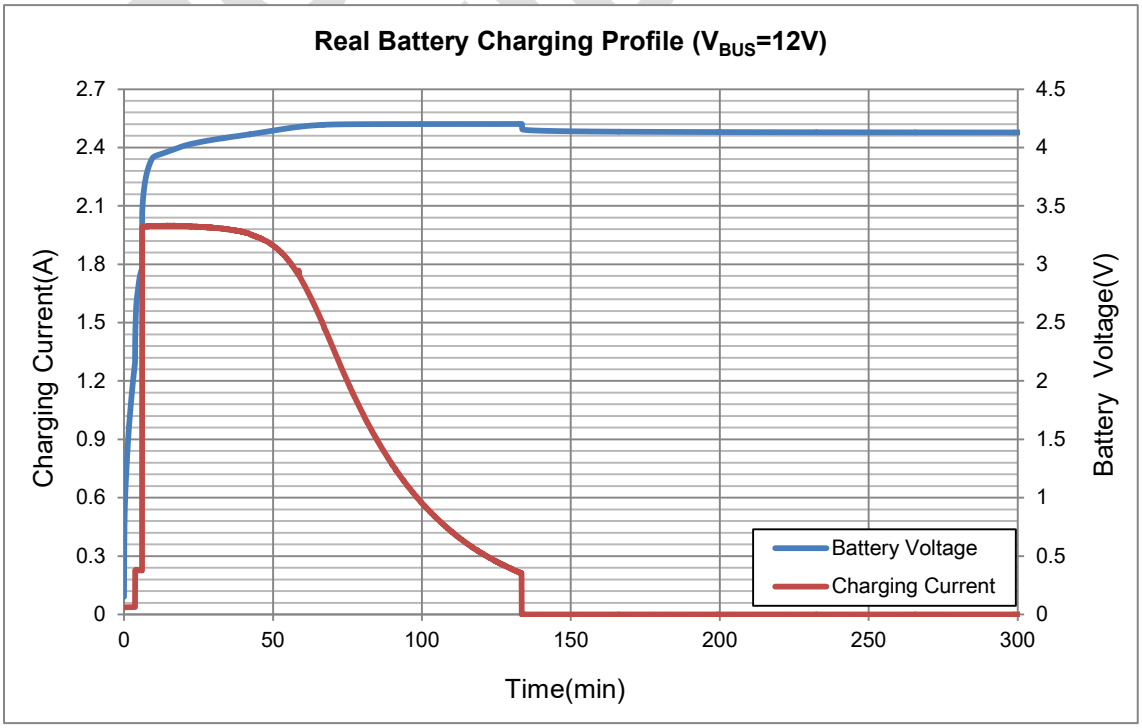


Chart 10 Charging profile (V_{BUS}=12V)

2.5 Electrical Performance Test

2.5.1 Adaptor Plug in/out without Battery

Test condition: V_{BUS}=5V/12V, no battery, CV: 4.2V, charge enabled, plug in/out adaptor by air switch.

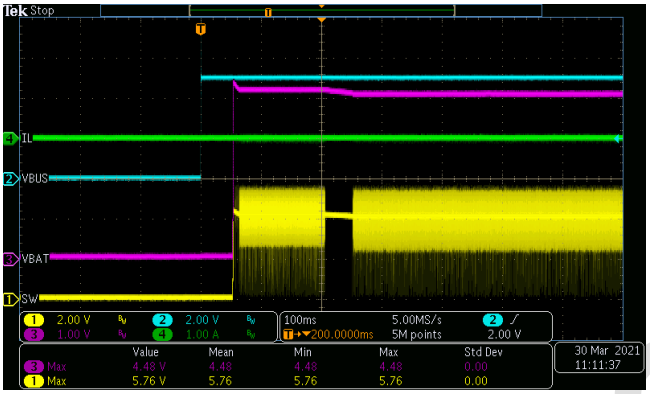


Figure 1. Plug in 5V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

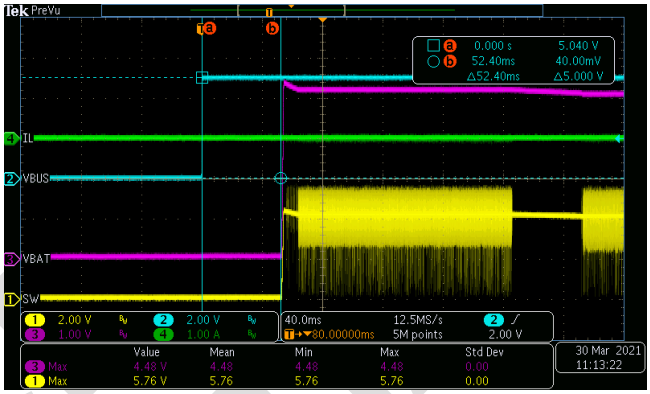


Figure 2. Zoom in
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

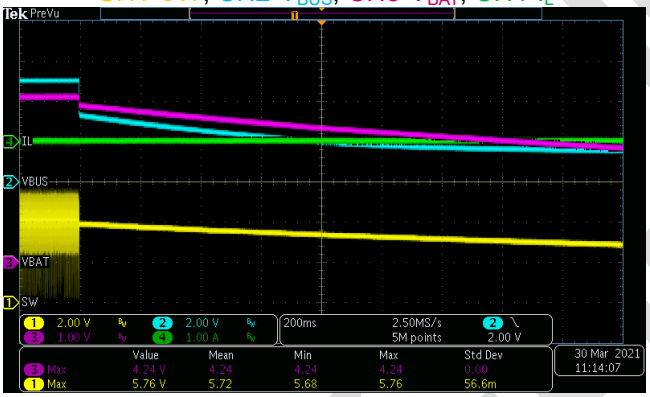


Figure 3. Plug out 5V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

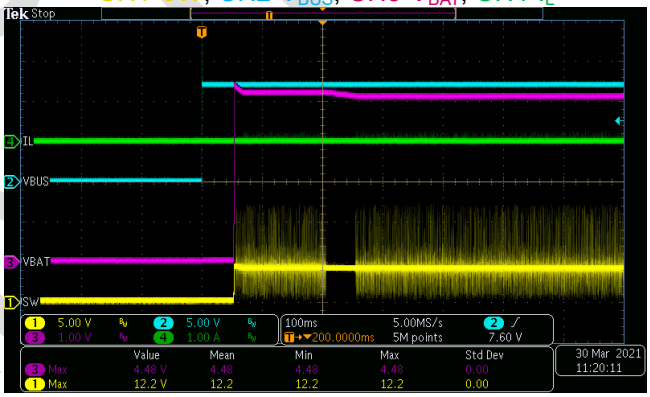


Figure 4. Plug in 12V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

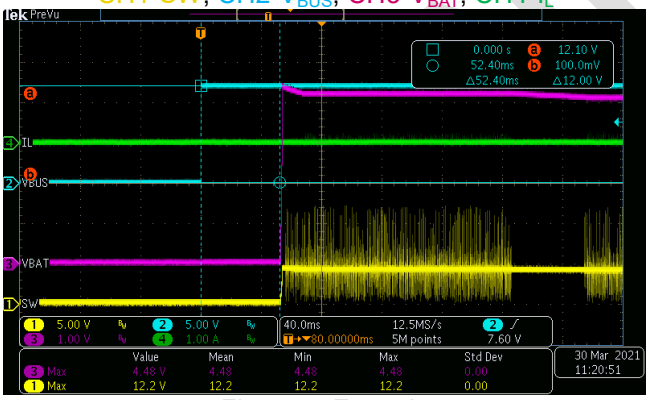


Figure 5. Zoom in
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

Figure 6. Plug out 12V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

2.5.2 Adaptor Plug in/out with Battery

Test condition: V_{BUS}=5V/12V, V_{BAT}=2.5V/3.8V/4.3V, CV: 4.2V, charge enabled, plug in/out adaptor by air switch.

Figure 7. V_{BAT}=2.5V, plug in 5V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

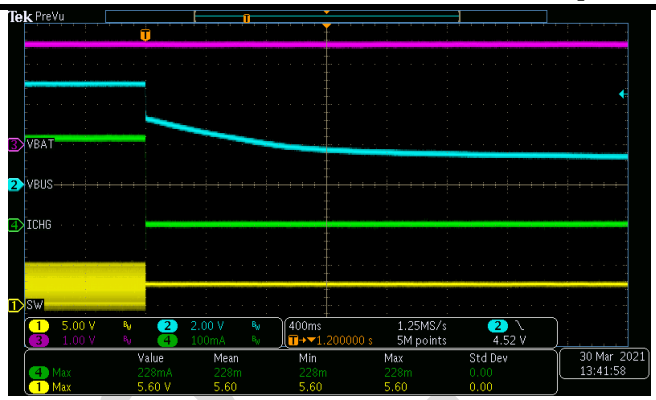


Figure 8. V_{BAT}=2.5V, plug out 5V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

Figure 9. V_{BAT}=3.8V, plug in 5V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

Figure 10. V_{BAT}=3.8V, plug out 5V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

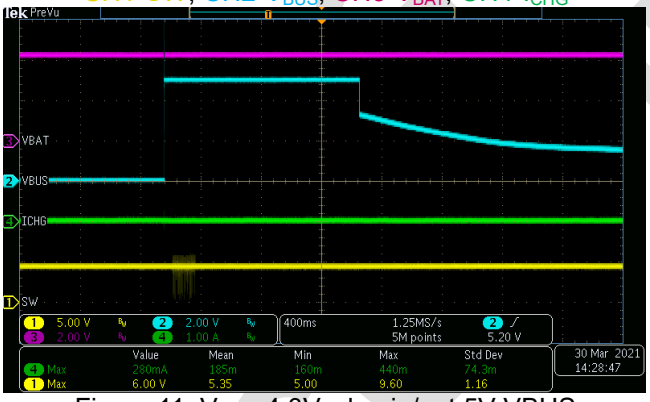


Figure 11. V_{BAT}=4.3V, plug in/out 5V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

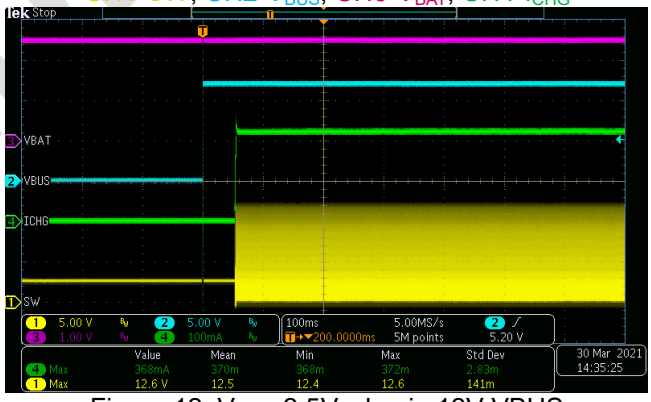


Figure 12. V_{BAT}=2.5V, plug in 12V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

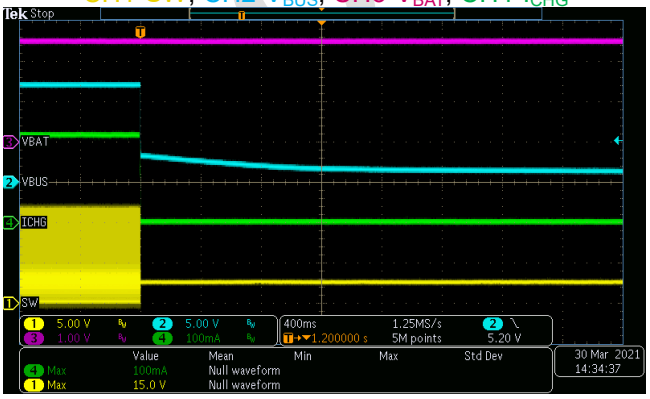


Figure 13. V_{BAT}=2.5V, plug out 12V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

Figure 14. V_{BAT}=3.8V, plug in 12V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

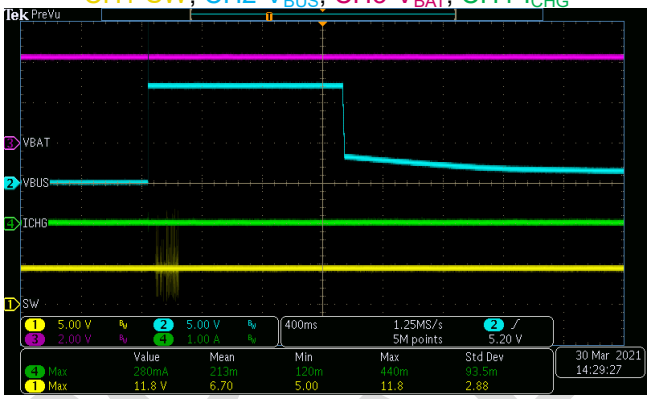


Figure 15. V_{BAT}=3.8V, plug out 12V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

Figure 16. V_{BAT}=4.3V, plug in/out 12V VBUS
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

2.5.3 Battery Plug in/out with Adaptor

Test condition: V_{BUS}=5V, V_{BAT}=1V/2.5V/3.8V/4.3V, CV: 4.2V, fast charging current: 2A, charge enabled, and plug in/out emulated battery by air switch.

Figure 17. V_{BUS}=5V, plug in/out 1V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

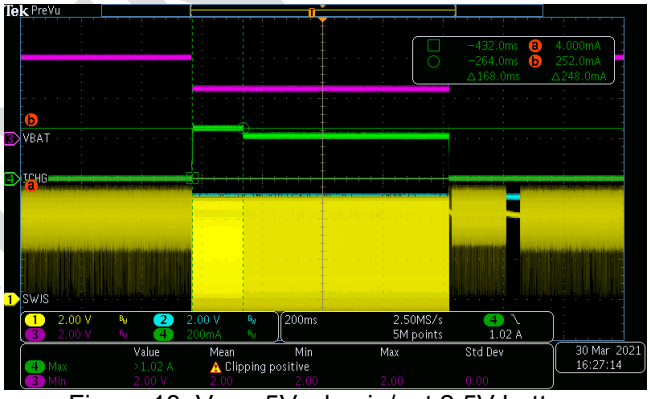


Figure 18. V_{BUS}=5V, plug in/out 2.5V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

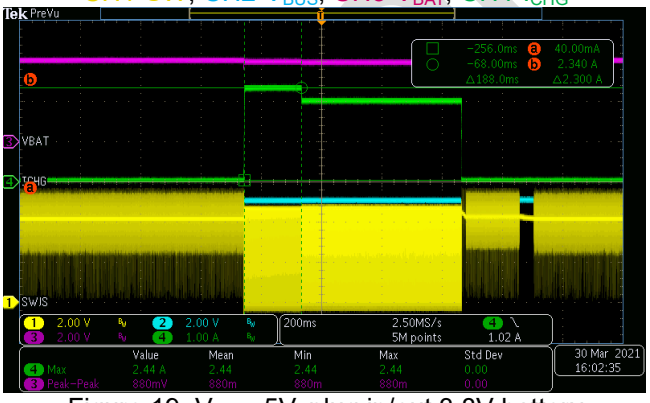


Figure 19. V_{BUS}=5V, plug in/out 3.8V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

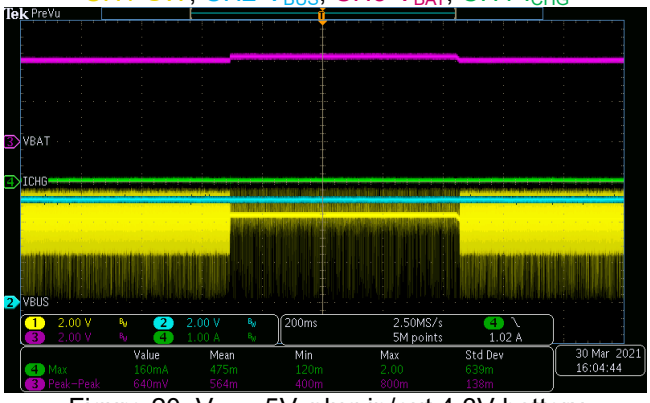


Figure 20. V_{BUS}=5V, plug in/out 4.3V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

2.5.4 Battery Plug in/out without Adaptor

Test condition: no VBUS, V_{BAT}=1V/3.8V, plug in/out emulated battery by air switch.

Figure 21. No VBUS, plug in 1V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

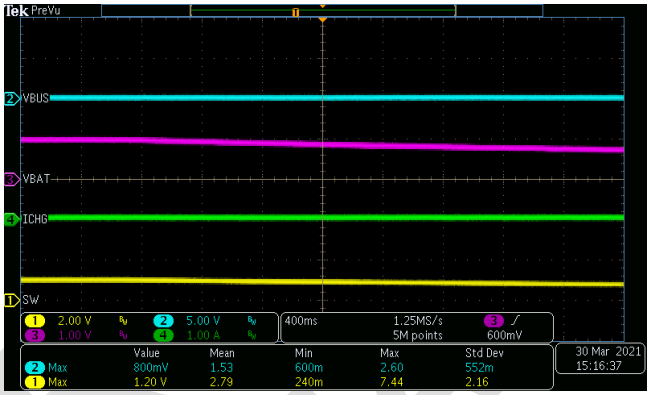


Figure 22. No VBUS, plug out 1V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

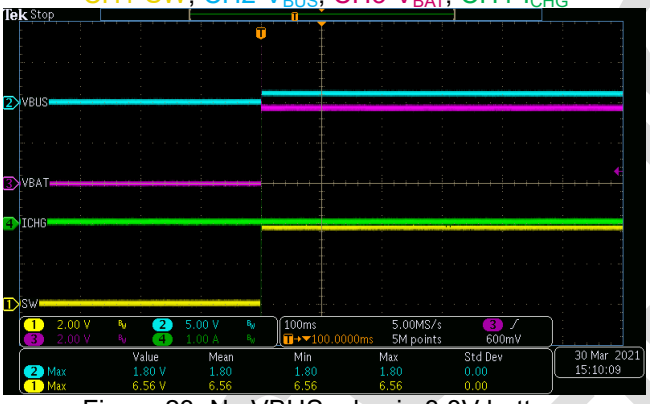


Figure 23. No VBUS, plug in 3.8V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

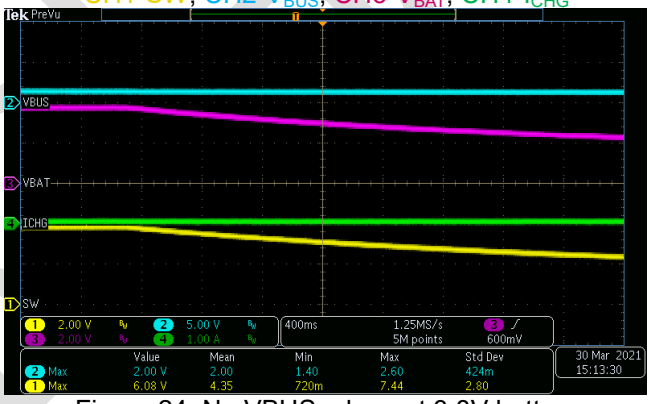


Figure 24. No VBUS, plug out 3.8V battery
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{CHG}

2.5.5 Enable/Disable the charging

Test condition: V_{BUS}=5V, V_{BAT}=3.8V, CV: 4.2V, fast charging current: 2A, set CE pin voltage to: 0V-1V-0V.

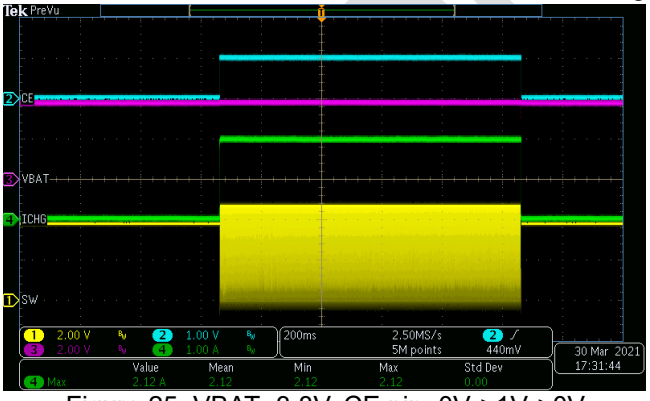


Figure 25. VBAT=3.8V, CE pin: 0V->1V->0V
CH1-SW, CH2-CE, CH3-V_{BAT}, CH4-I_{CHG}

2.5.6 OCP and ZCD for FET

Test condition:

1) V_{BUS}=5V/9V/12V, V_{BAT}=3.1V, CV: 4.2V, CC: 2A, charge enable, short BAT to GND.
2) V_{BUS}=5V/9V/12V, CV: 4.2V, CC: 0.2A, increase V_{BAT} to enter CV charge mode, reduce I_{CHG} to ~120mA.

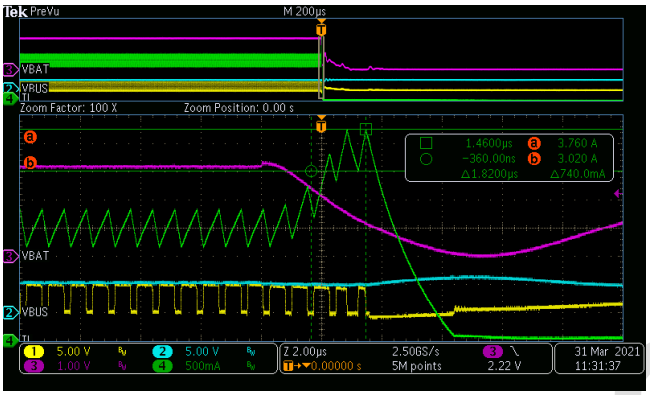


Figure 26. V_{BUS}=5V, OCP: 3.76A
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

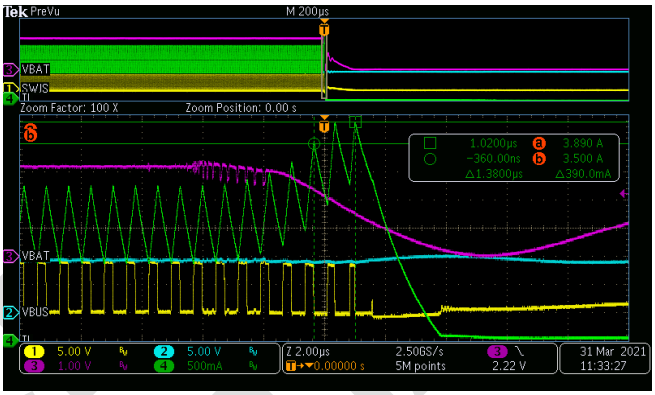


Figure 27. V_{BUS}=9V, OCP: 3.89A
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

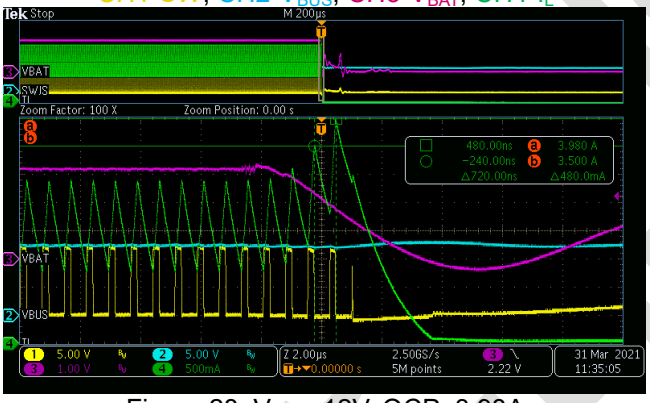


Figure 28. V_{BUS}=12V, OCP: 3.98A
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

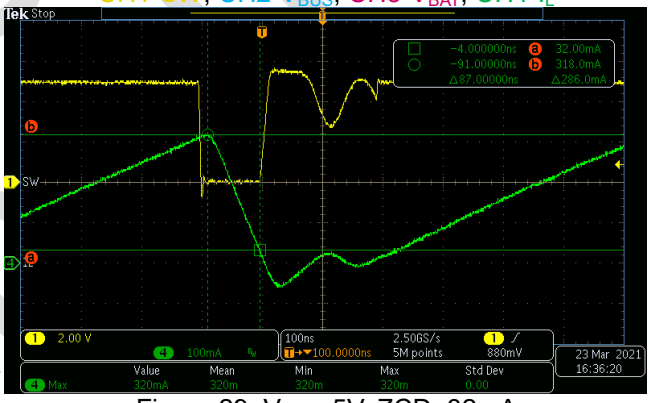


Figure 29. V_{BUS}=5V, ZCD: 32mA
CH1-SW, CH4-I_L

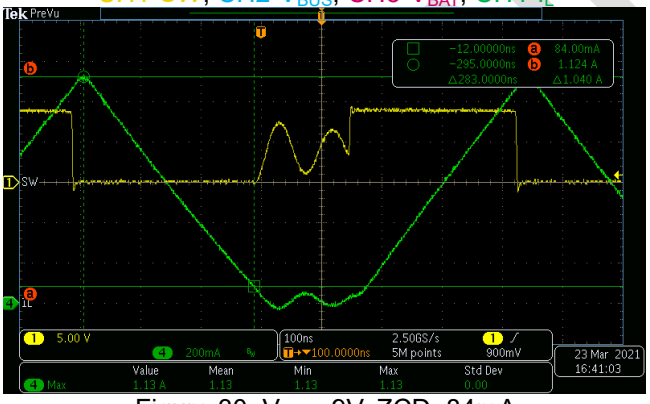


Figure 30. V_{BUS}=9V, ZCD: 84mA
CH1-SW, CH4-I_L

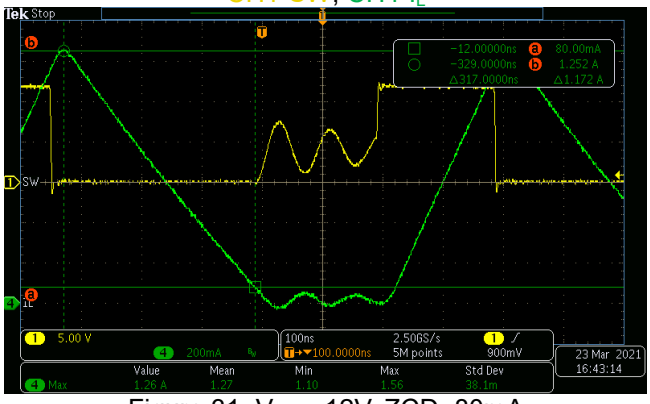


Figure 31. V_{BUS}=12V, ZCD: 80mA
CH1-SW, CH4-I_L

2.6 Reliability Test

2.6.1 Thermal images

Test condition: V_{BUS}=5V/9V/12V, V_{BAT}=4.2V, fast charging current: 2A, Inductor (Wurth 74438367010) parameters: 1uH, DCR=11.5mohm, record the thermal images of demo board.

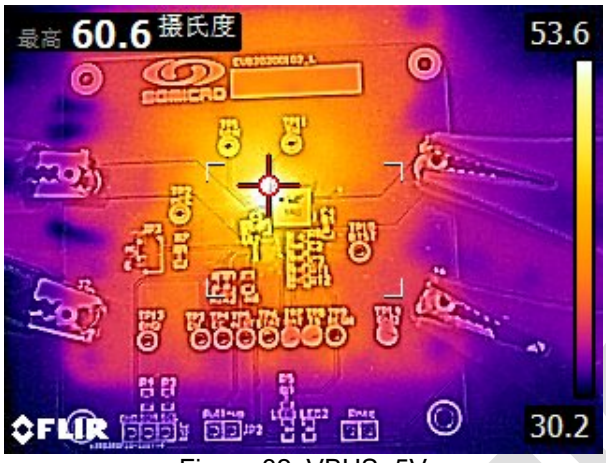


Figure 32. VBUS=5V

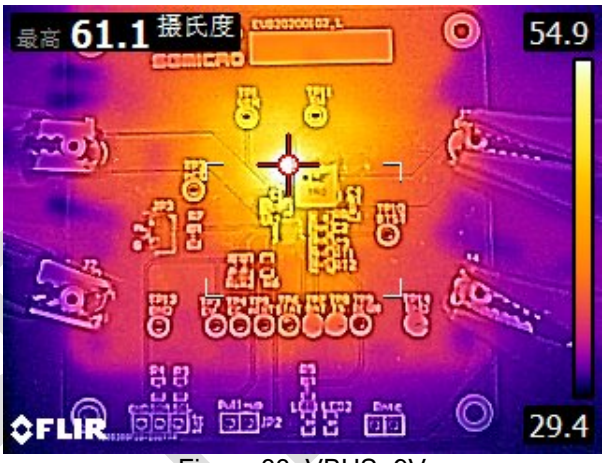


Figure 33. VBUS=9V

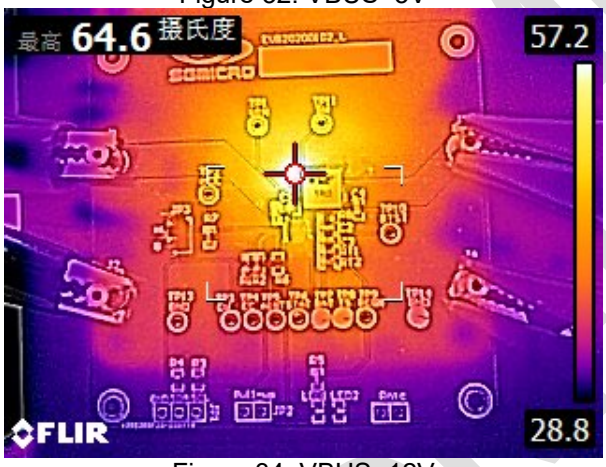


Figure 34. VBUS=12V

Note: the chip temperature rising in the thermal image is decided by the ambient, inductor DCR and PCB layout, which is only used for reference.

2.6.2 Short test (VBAT, SW)

Test condition: V_{BUS}=5V/12V, V_{BAT}=3.5V or no battery, CV: 4.2V, CC: 2A, charge enable, short VBAT/SW to GND respectively.

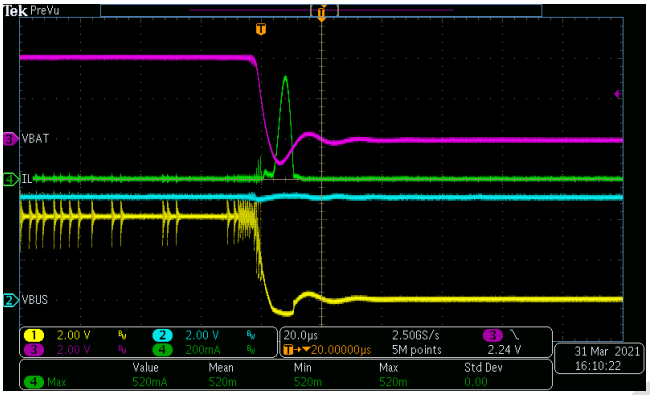


Figure 35. VBUS=5V, No battery, short the VBAT
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

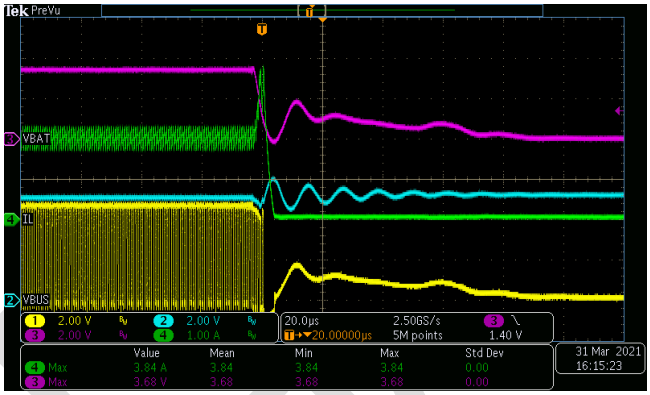


Figure 36. VBUS=5V, VBAT=3.5V, short the VBAT
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

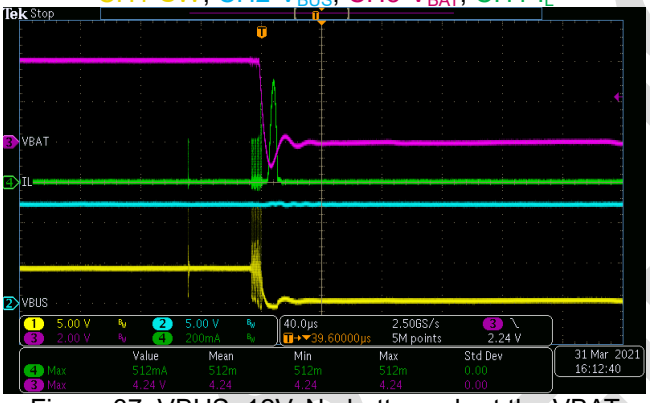


Figure 37. VBUS=12V, No battery, short the VBAT
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

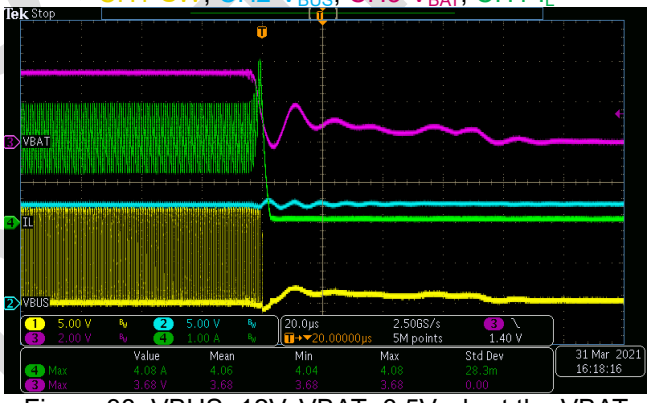


Figure 38. VBUS=12V, VBAT=3.5V, short the VBAT
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

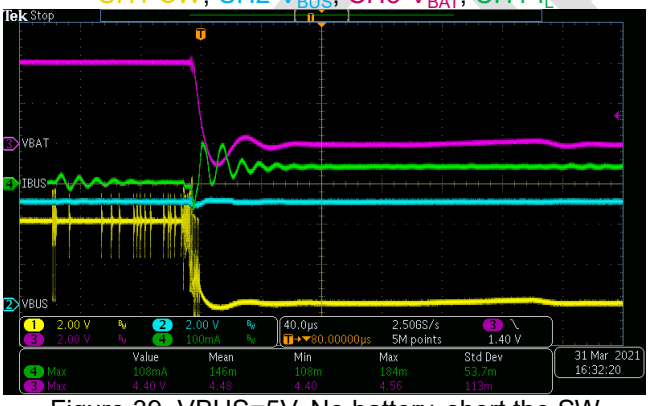


Figure 39. VBUS=5V, No battery, short the SW
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{BUS}

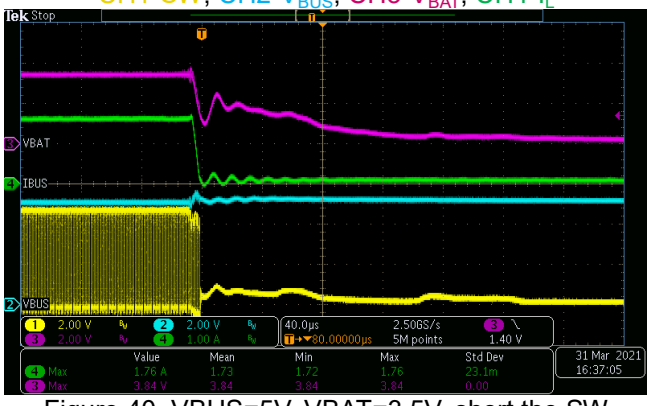


Figure 40. VBUS=5V, VBAT=3.5V, short the SW
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_{BUS}

Figure 41. VBUS=12V, No battery, short the SW
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

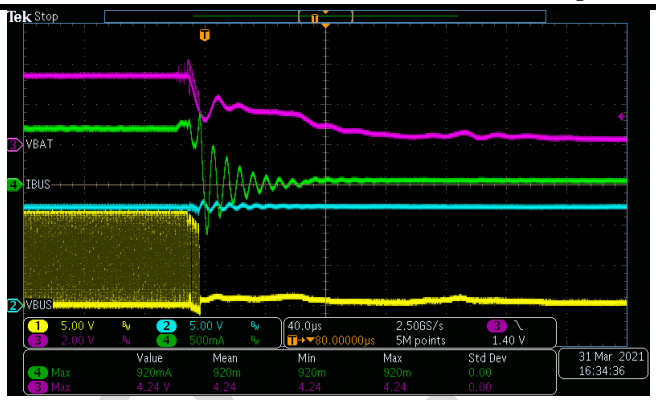


Figure 42. VBUS=12V, VBAT=3.5V, short the SW
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

2.6.3 VBUS OVP

Test condition: V_{BUS}=5V, V_{BAT}=3.8V, CV: 4.2V, fast charging current: 2A, charge enable, ramp up V_{BUS} to 14V, then decrease to 5V.

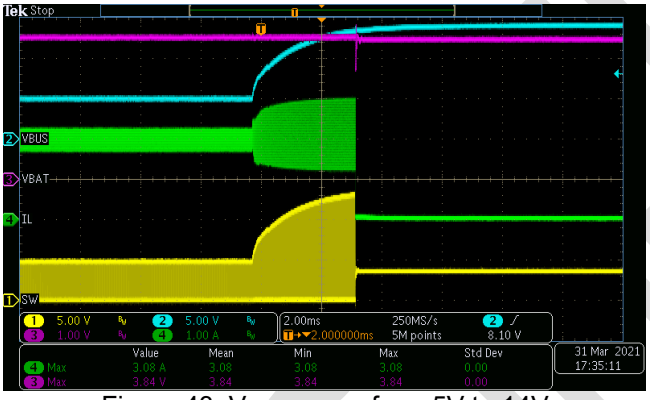


Figure 43. V_{BUS} ramps from 5V to 14V
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

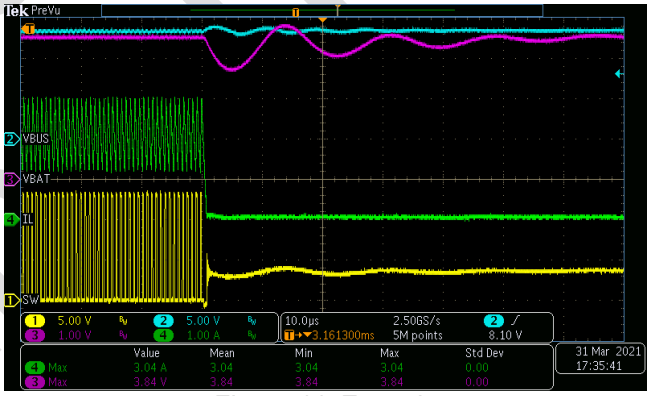


Figure 44. Zoom in
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

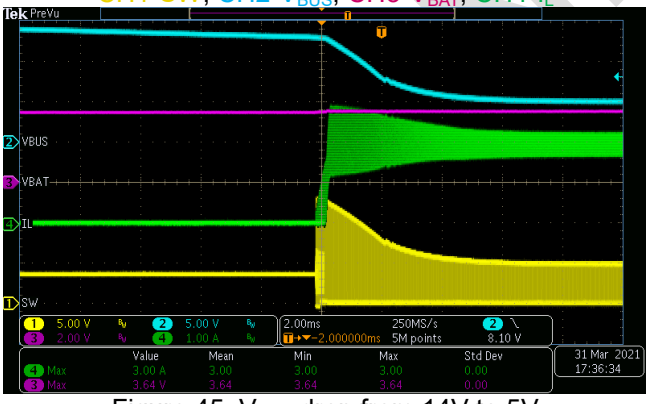


Figure 45. V_{BUS} drop from 14V to 5V
CH1-SW, CH2-V_{BUS}, CH3-V_{BAT}, CH4-I_L

2.6.4 Thermal shutdown

Test condition: V_{BUS}=5V/9V/12V, V_{BAT}=3.8V, CV: 4.2V, fast charging current: 2A, charge enable, heat the part by hot air gun.

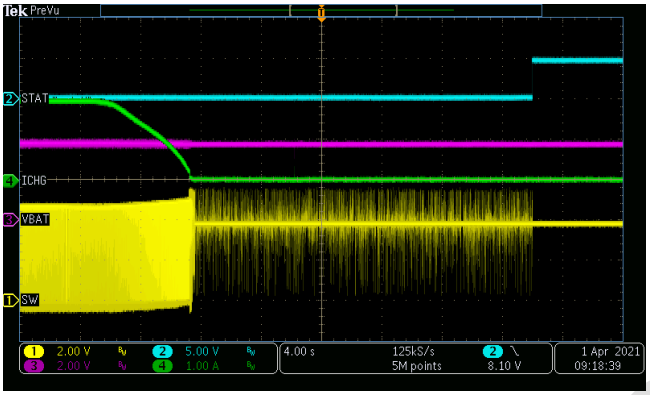


Figure 46. V_{BUS}=5V, Thermal shutdown
CH1-SW, CH2-STAT, CH3-V_{BAT}, CH4-I_{CHG}

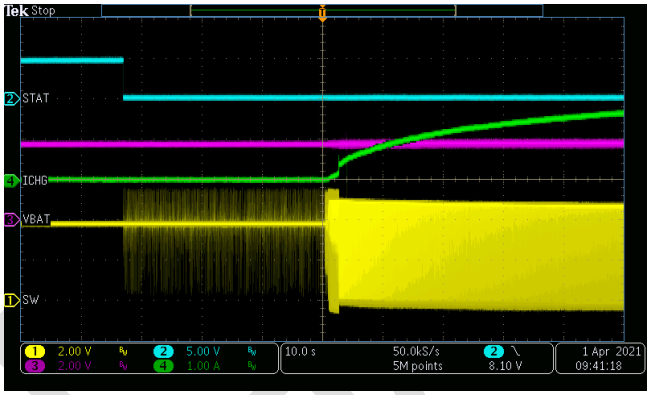


Figure 47. V_{BUS}=5V, Recovery from thermal shutdown
CH1-SW, CH2-STAT, CH3-V_{BAT}, CH4-I_{CHG}

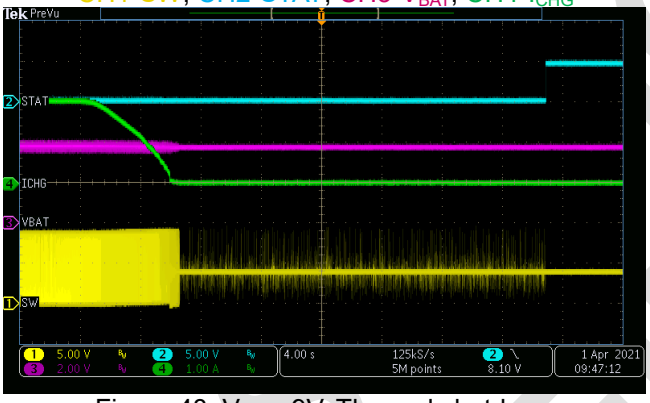


Figure 48. V_{BUS}=9V, Thermal shutdown
CH1-SW, CH2-STAT, CH3-V_{BAT}, CH4-I_{CHG}

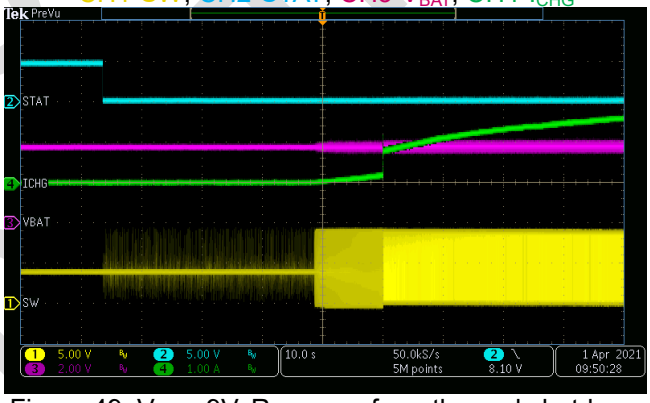


Figure 49. V_{BUS}=9V, Recovery from thermal shutdown
CH1-SW, CH2-STAT, CH3-V_{BAT}, CH4-I_{CHG}

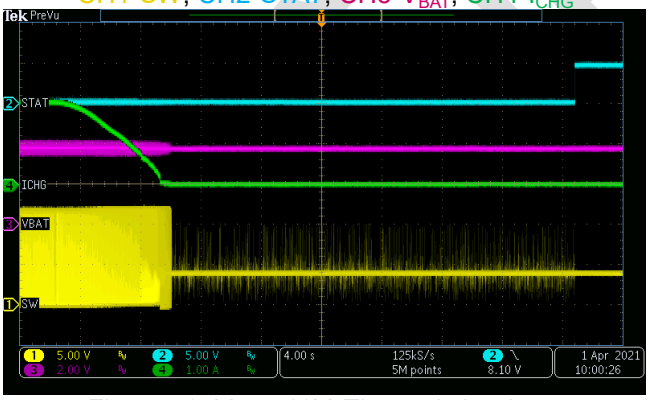


Figure 50. V_{BUS}=12V, Thermal shutdown
CH1-SW, CH2-STAT, CH3-V_{BAT}, CH4-I_{CHG}

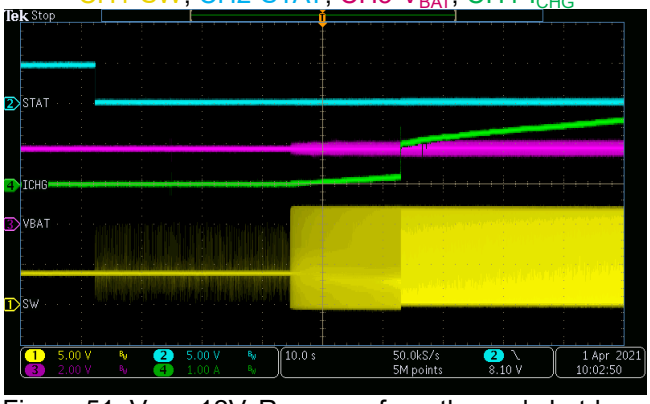


Figure 51. V_{BUS}=12V, Recovery from thermal shutdown
CH1-SW, CH2-STAT, CH3-V_{BAT}, CH4-I_{CHG}