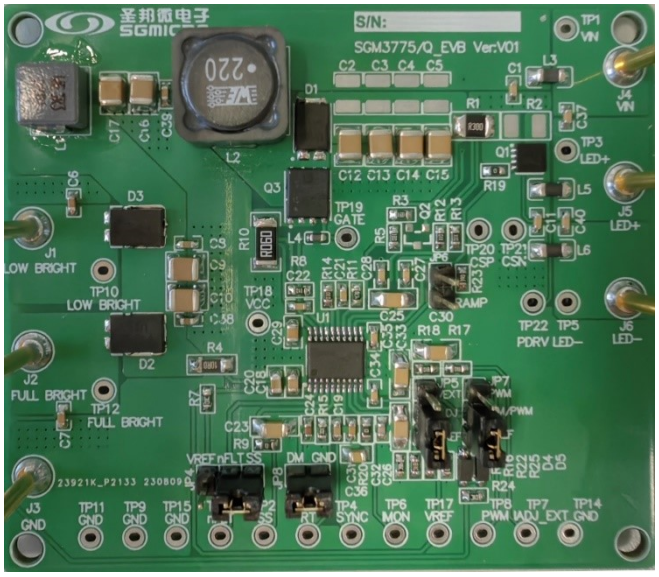
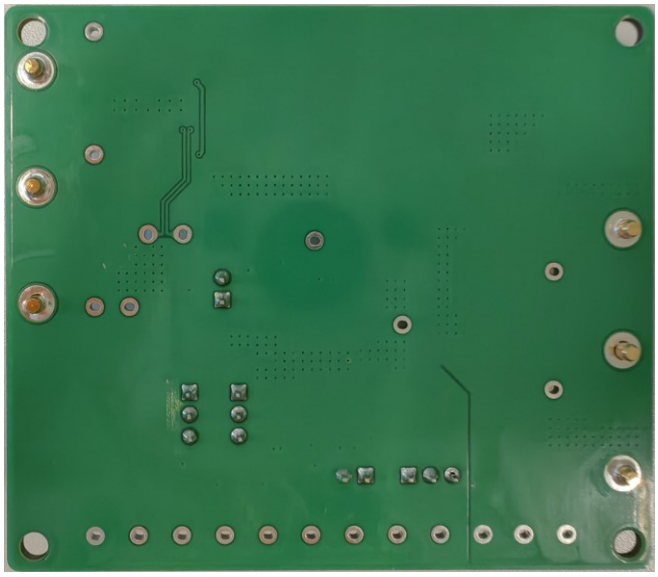
SGM3775Q Demo Board Test Report

Boost Application: 7V to 18V Input, 21V to 60V Output

Demo Board Picture:



Top Layer



Bottom Layer

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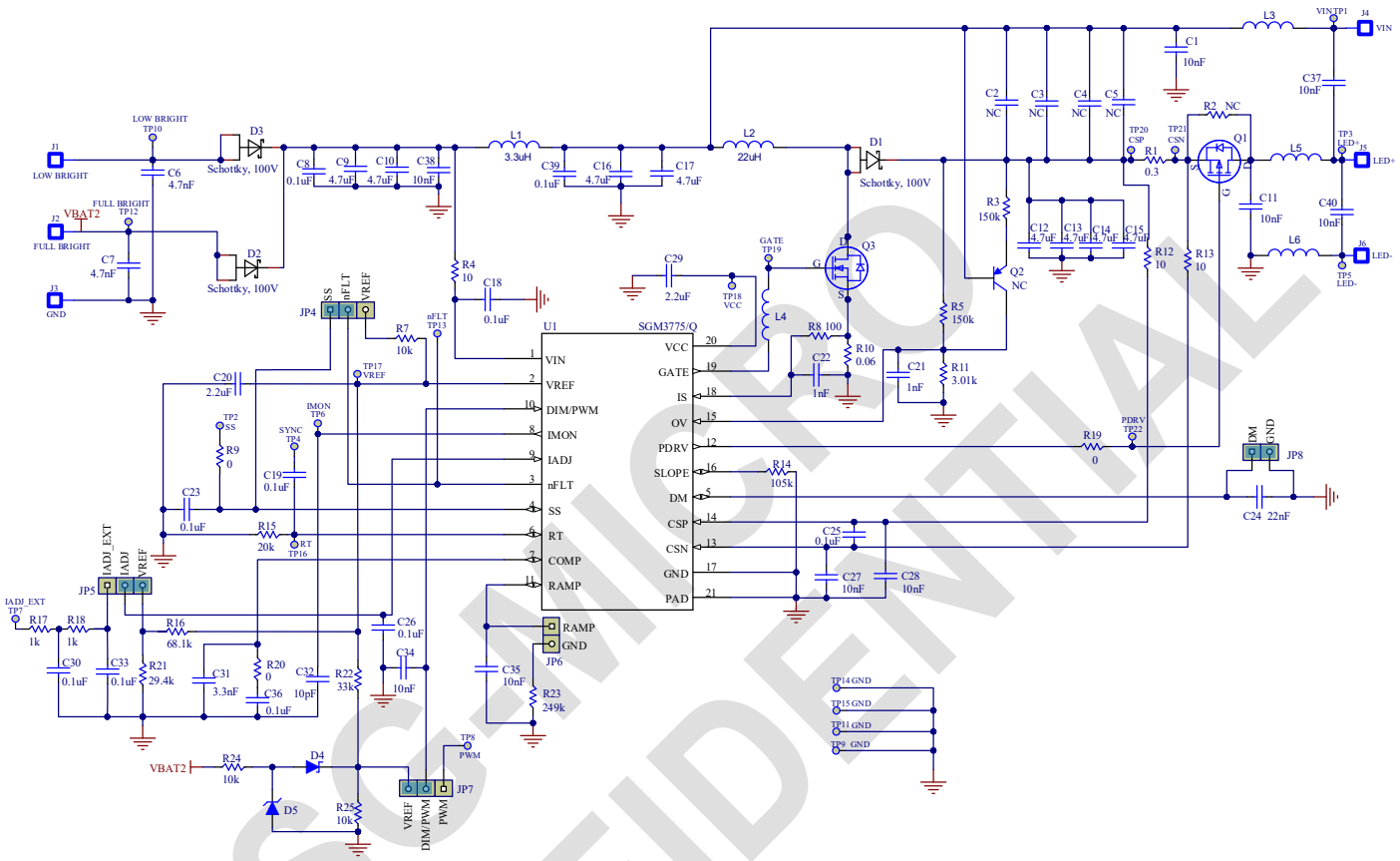
1. Schematic, BOM List and PCB Layout

1.1 Schematic

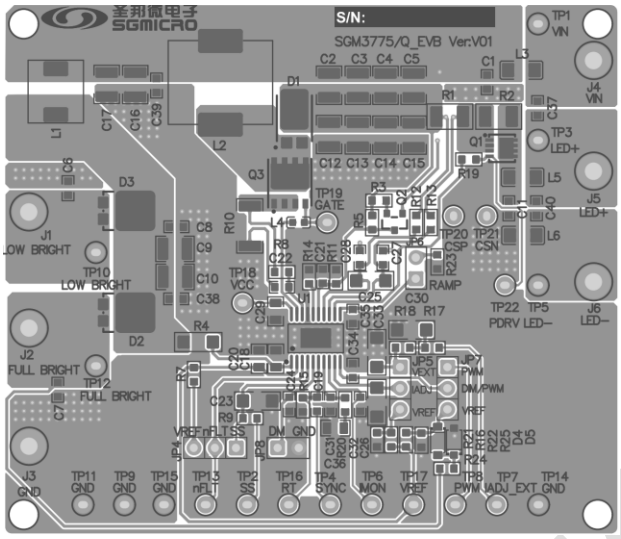


1.2 BOM List

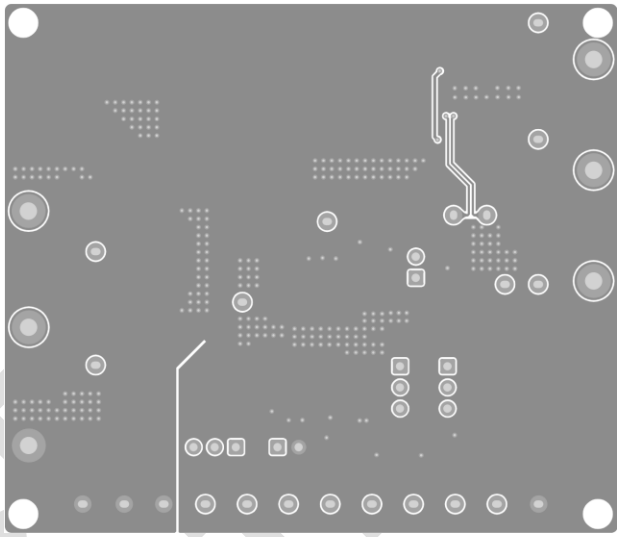
Item	Quantity	Designator	Description	Manufactory
1	9	C1, C11, C27, C28, C34, C35, C37, C38, C40	Ceramic Capacitor, 10nF, 100V, ±10%, X7R, 0603	
2	0	C2, C3, C4, C5	NC	
3	2	C6, C7	Ceramic Capacitor, 4.7nF, 100V, ±10%, X7R, 0603	
4	2	C8, C39	Ceramic Capacitor, 0.1μF, 100V, ±10%, X7R, 0603	
5	8	C9, C10, C12, C13, C14, C15, C16, C17	Ceramic Capacitor, 4.7μF, 100V, ±10%, X7S, 1210	
6	1	C18	Ceramic Capacitor, 0.1μF, 100V, ±10%, X7R, 0805	
7	1	C19	Ceramic Capacitor, 0.1μF, 50V, ±5%, C0G, 0603	
8	2	C20, C29	Ceramic Capacitor, 2.2μF, 50V, ±10%, X7R, 0805	
9	2	C21, C22	Ceramic Capacitor, 1nF, 100V, ±10%, X7R, 0603	
10	5	C23, C25, C26, C30, C33	Ceramic Capacitor, 0.1μF, 100V, ±10%, X7R, 1206	

Item	Quantity	Designator	Description	Manufactory
11	1	C24	Ceramic Capacitor, 22nF, 100V, ±10%, X7R, 0603	
12	1	C31	Ceramic Capacitor, 3.3nF, 50V, ±10%, X7R, 0603	
13	1	C32	Ceramic Capacitor, 10pF, 50V, ±5%, C0G, 0603	
14	1	C36	Ceramic Capacitor, 0.1μF, 50V, ±10%, X7R, 0805	
15	1	D1	Diode, Schottky, 100V, 3A, PowerDI5	
16	2	D2, D3	Diode, Schottky, 100V, 12A, TO-227A	
17	1	D4	Diode, Schottky, 30V, 0.2A, SOD-123	
18	1	D5	TVS, 10V, 500mW, SOD-123	
19	1	L1	Inductor, 3.3μH, I_S=12A, I_R=6A, DCR=20.9mΩ, 7050	Wurth: 74437349033
20	1	L2	Inductor, 22μH, I_S=5A, I_R=4.1A, DCR=43mΩ, 1280	Wurth: 744770122
21	3	L3, L5, L6	Ferrite Bead, 600Ω@100MHz, 1.5A, 1206	
22	1	L4	Ferrite Bead, 600Ω@100MHz, 1.3A, 0603	
23	1	Q1	MOSFET, P-CH, -60V, -6.8A, PowerPAK1212	
24	0	Q2	NC	
25	1	Q3	MOSFET, N-CH, 100V, 30A, PowerFLAT5×6	
26	1	R1	Film Resistor, 0.3Ω, 1%, 0.5W, 1210	
27	0	R2	NC	
28	2	R3, R5	Film Resistor, 150kΩ, 1%, 0.1W, 0603	
29	1	R4	Film Resistor, 10Ω, 1%, 0.25W, 1206	
30	3	R7, R24, R25	Film Resistor, 10kΩ, 1%, 0.1W, 0603	
31	1	R8	Film Resistor, 100Ω, 1%, 0.1W, 0603	
32	3	R9, R19, R20	Film Resistor, 0Ω, 5%, 0.1W, 0603	
33	1	R10	Film Resistor, 0.06Ω, 1%, 1W, 2010	
34	1	R11	Film Resistor, 3.01kΩ, 1%, 0.1W, 0603	
35	2	R12, R13	Film Resistor, 10Ω, 1%, 0.1W, 0603	
36	1	R14	Film Resistor, 105kΩ, 1%, 0.1W, 0603	
37	1	R15	Film Resistor, 20kΩ, 1%, 0.1W, 0603	
38	1	R16	Film Resistor, 68.1kΩ, 1%, 0.1W, 0603	
39	2	R17, R18	Film Resistor, 1kΩ, 1%, 0.1W, 0603	
40	1	R21	Film Resistor, 29.4kΩ, 1%, 0.1W, 0603	
41	1	R22	Film Resistor, 33kΩ, 1%, 0.1W, 0603	
42	1	R23	Film Resistor, 249kΩ, 1%, 0.1W, 0603	
43	1	U1	IC, High Accuracy LED Controller, TSSOP-20A	SGMICRO: SGM3775Q
Conclusion: Total 73 Components				

1.3 PCB Layout



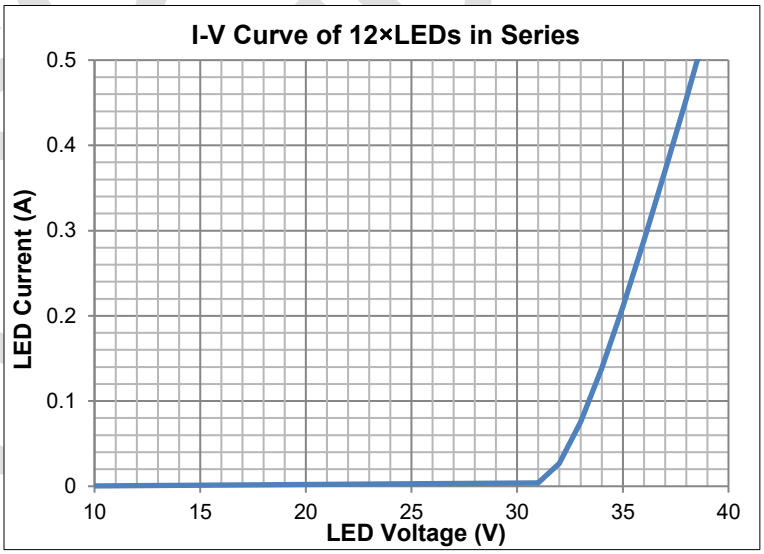
Top Layer



Bottom Layer

1.4 LED I-V Curve

The I-V curve for the LED string (12×LEDs in series) used in this test report (unless otherwise noted) is shown below:

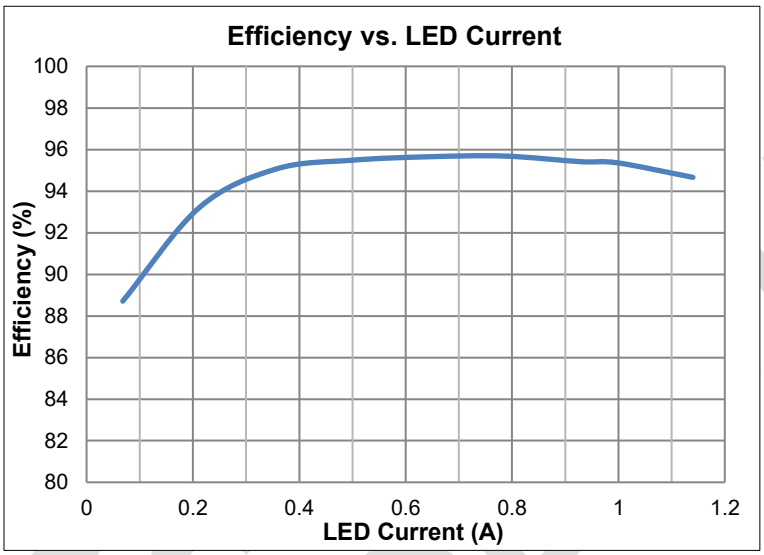


2. Test Item

Note for test conditions: L3, L4, L5, L6 are all shorted in the following waveforms test, unless otherwise noted.

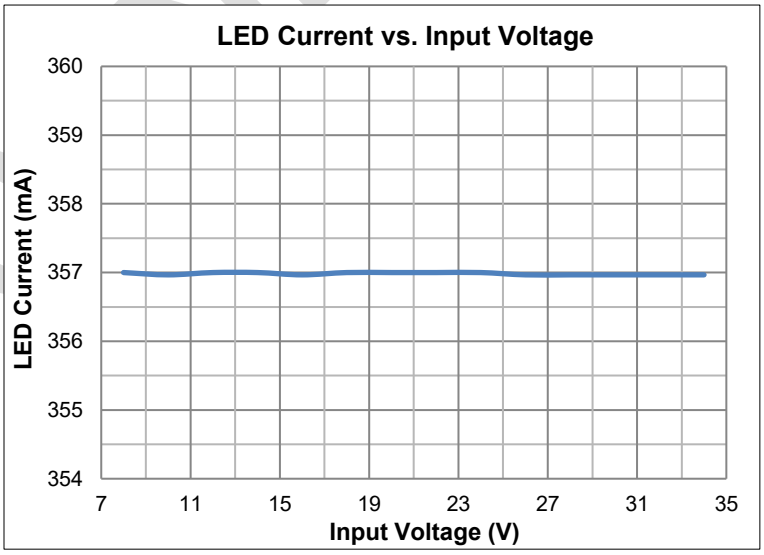
2.1 Efficiency

Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), R_{CS}=0.1Ω, $V_{DIM/PWM}$=3.2V, change the V_{IADJ} to adjust LED current and measure the efficiency.



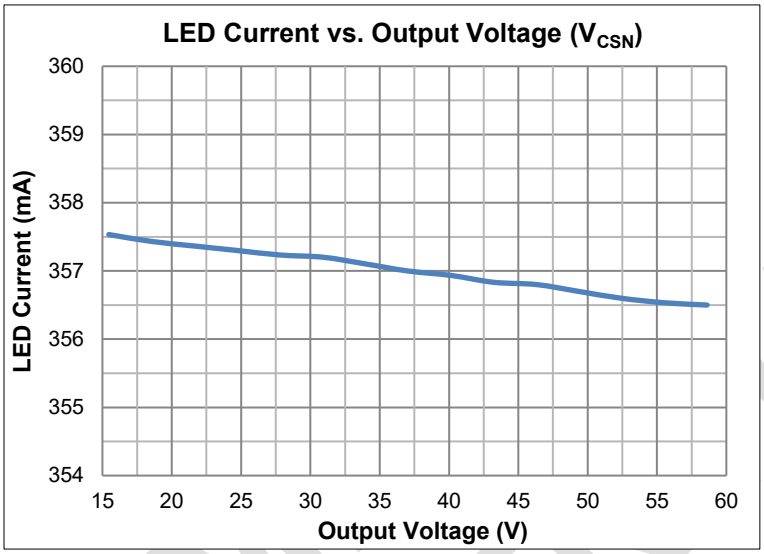
2.2 Line Regulation

Test conditions: f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V, change the input voltage and measure the LED current regulation.



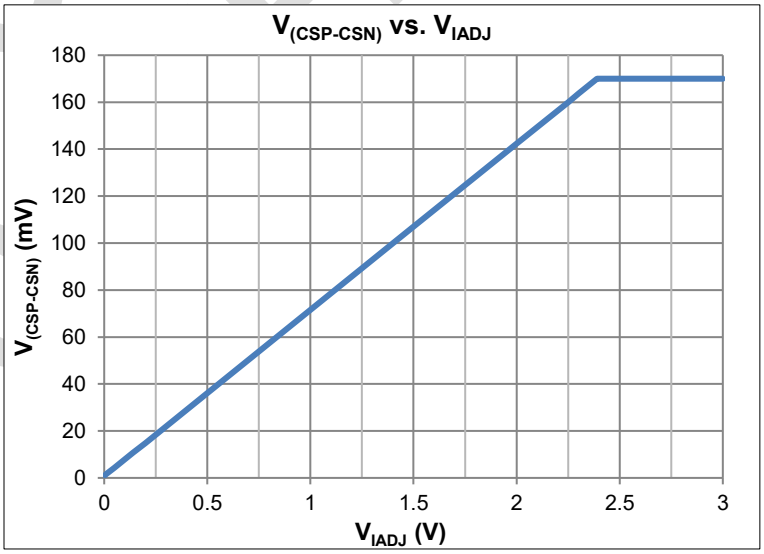
2.3 Load Regulation

Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V, change LED string pieces in series from 5 pieces to 19 pieces, and measure the LED current regulation.



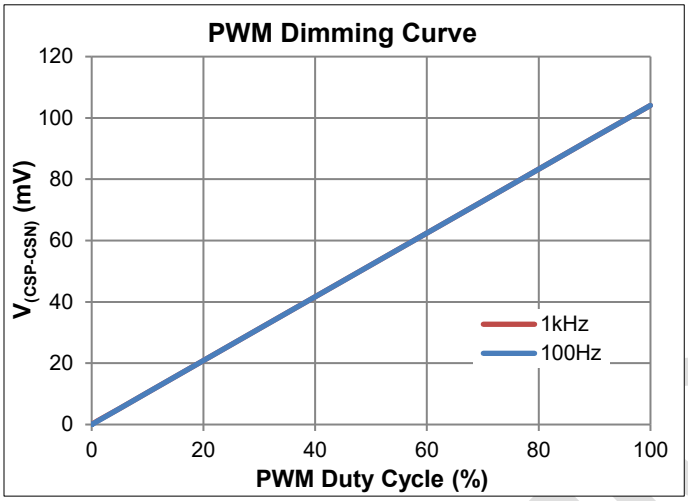
2.4 $V_{(CSP-CSN)}$ Threshold vs. V_{IADJ}

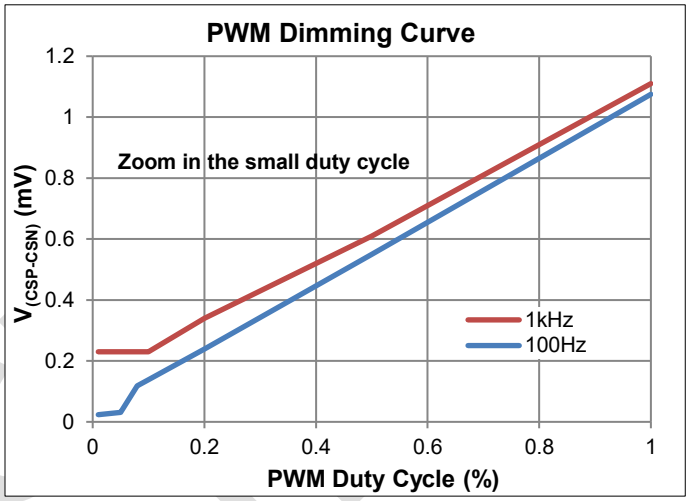
Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V, change IADJ pin voltage and measure the voltage between CSP and CSN (which divided by R_{CS} to set the LED current).



2.5 $V_{(CSP-CSN)}$ Threshold vs. PWM Duty Cycle

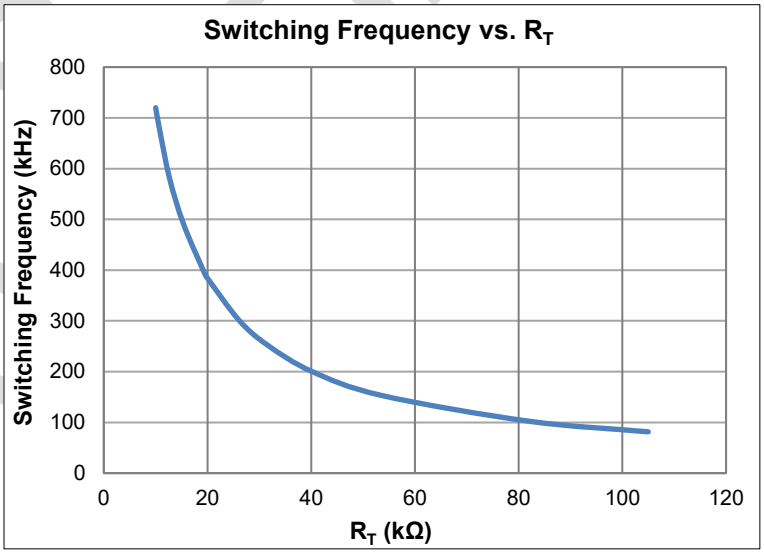
Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, set the external DIM/PWM signal frequency to 100Hz/1kHz, change the DIM/PWM duty cycle and measure the voltage between CSP and CSN.





2.6 Switching Frequency Curve

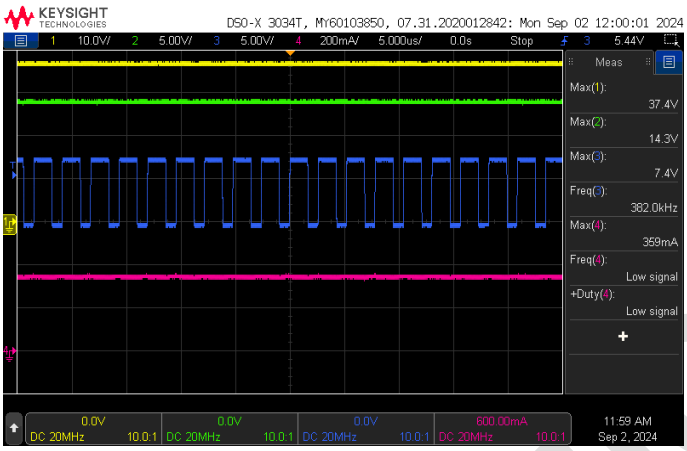
Test conditions: V_{IN}=14V, V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V, set different resistor between RT pin and GND to measure switching frequency curve.



2.7 Steady State Operation

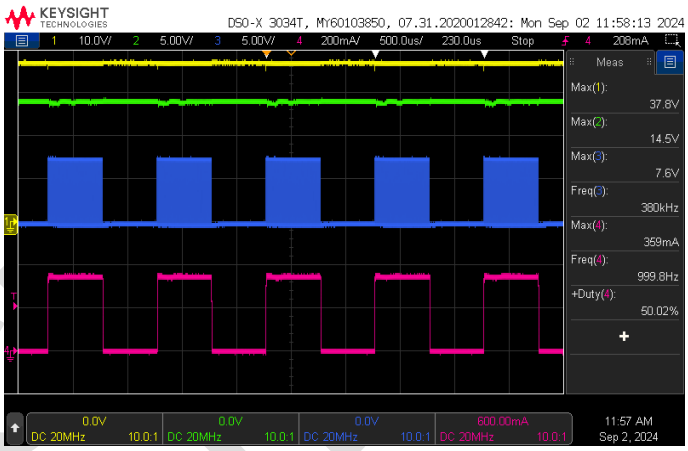
Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, apply external PWM signal on the DIM/PWM pin and set the PWM frequency to 1kHz, and change different PWM duty cycle.

PWM duty cycle=100%



Ch1-V_{CSN}, Ch2-V_{IN}, Ch3-V_{GATE}, Ch4-I_{LED}

PWM duty cycle=50%

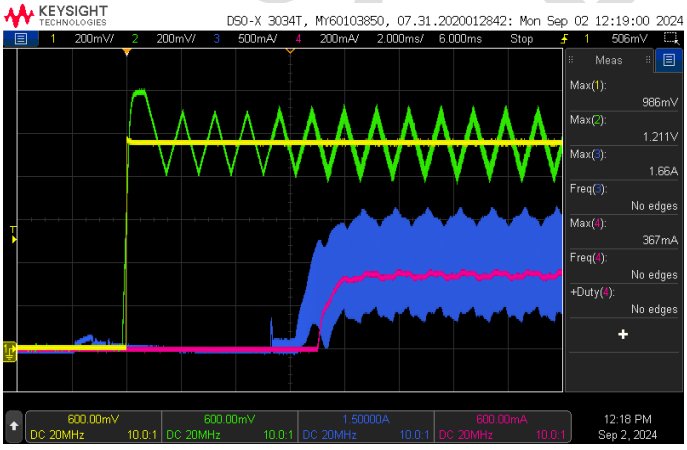


Ch1-V_{CSN}, Ch2-V_{IN}, Ch3-V_{GATE}, Ch4-I_{LED}

2.8 Spread Spectrum Frequency Modulation

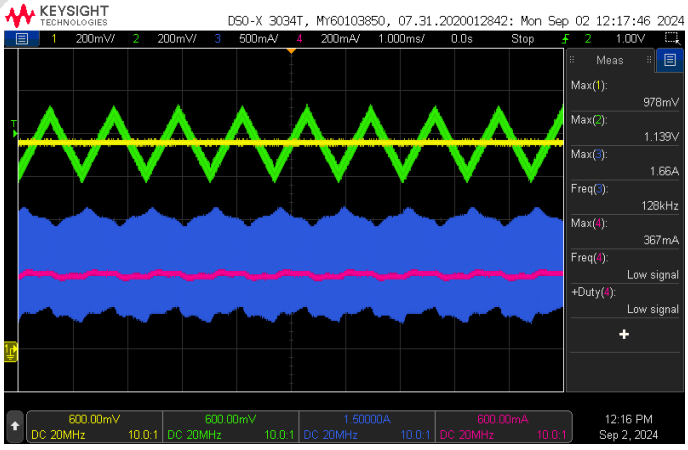
Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V (100% duty), C_{DM}=22nF.

V_{IN}=14V power on



Ch1-V_{RT}, Ch2-V_{DM}, Ch3-I_L, Ch4-I_{LED}

Zoom in steady state

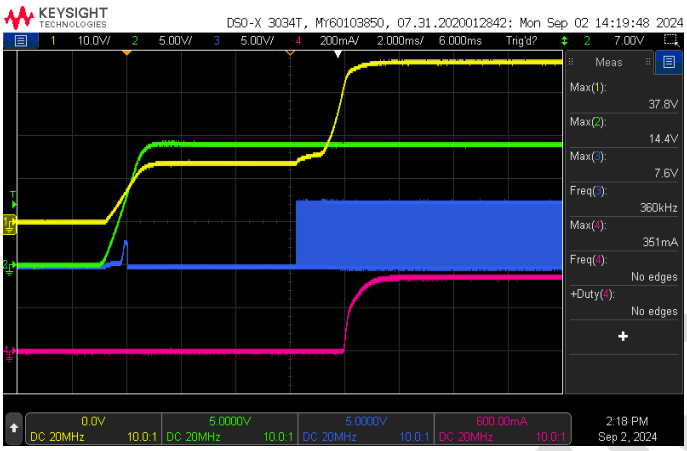


Ch1-V_{RT}, Ch2-V_{DM}, Ch3-I_L, Ch4-I_{LED}

2.9 VIN Power On/Off

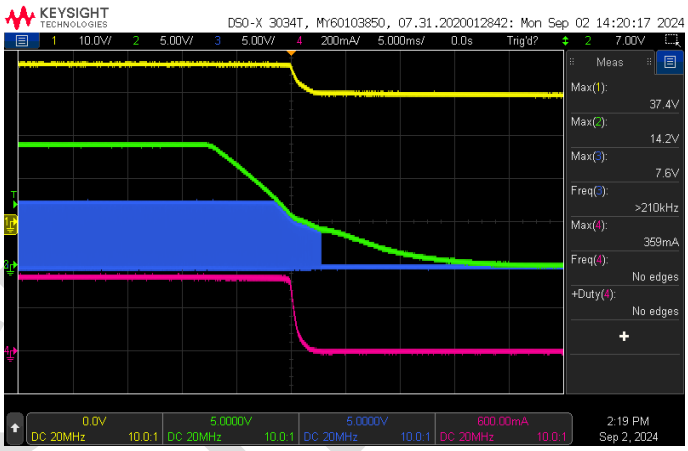
Test conditions: V_{IN}=14V power on/off, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V/2V, short DM to GND.

$V_{DIM/PWM}$=3.2V (100% duty), V_{IN}=14V power on



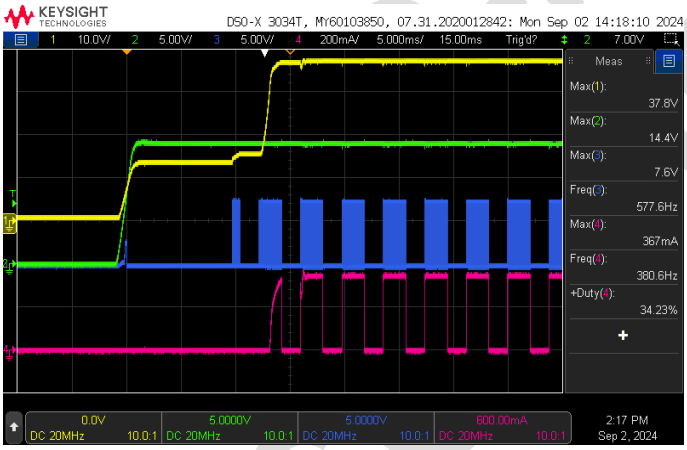
Ch1-V_{CSN}, Ch2-V_{IN}, Ch3-V_{GATE}, Ch4-I_{LED}

$V_{DIM/PWM}$=3.2V (100% duty), V_{IN}=14V power off



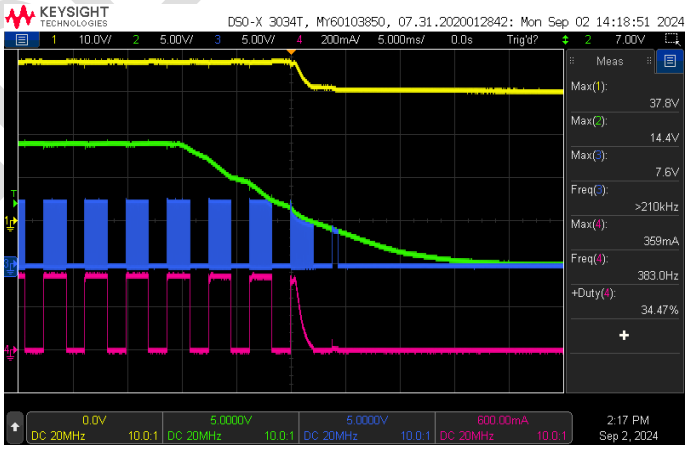
Ch1-V_{CSN}, Ch2-V_{IN}, Ch3-V_{GATE}, Ch4-I_{LED}

$V_{DIM/PWM}$=2V (50% duty), V_{IN}=14V power on



Ch1-V_{CSN}, Ch2-V_{IN}, Ch3-V_{GATE}, Ch4-I_{LED}

$V_{DIM/PWM}$=2V (50% duty), V_{IN}=14V power off



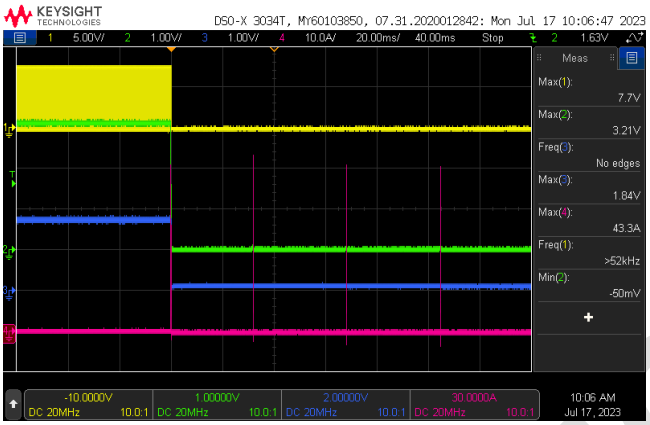
Ch1-V_{CSN}, Ch2-V_{IN}, Ch3-V_{GATE}, Ch4-I_{LED}

2.10 LED Short Protection

2.10.1 nFLT Short to SS

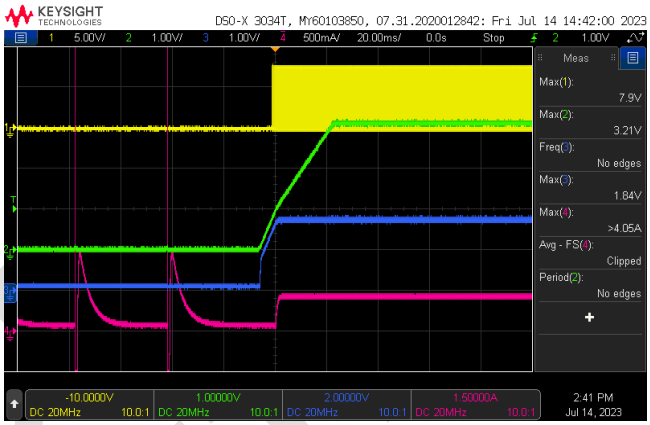
Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V (100% duty), short nFLT to SS.

Short LED+ to LED-

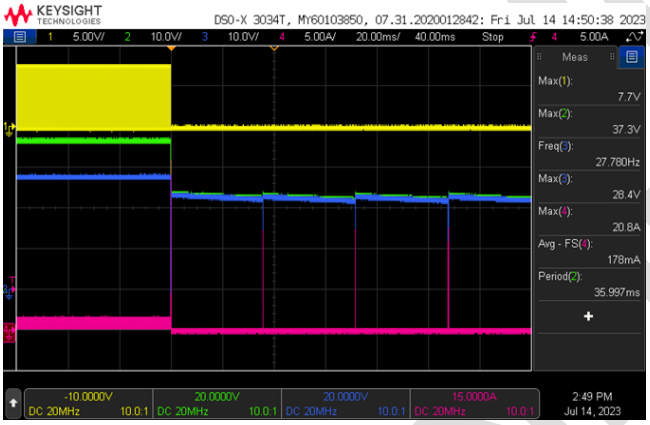


Ch1-V_{GATE}, Ch2-V_{SS}, Ch3-V_{COMP}, Ch4-I_{OUT}

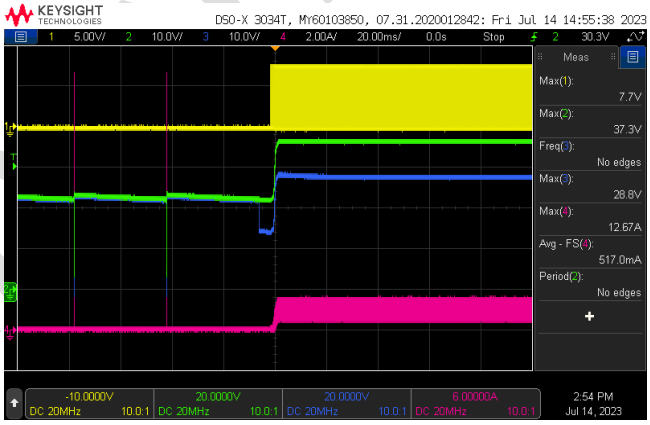
Release LED short



Ch1-V_{GATE}, Ch2-V_{SS}, Ch3-V_{COMP}, Ch4-I_{OUT}

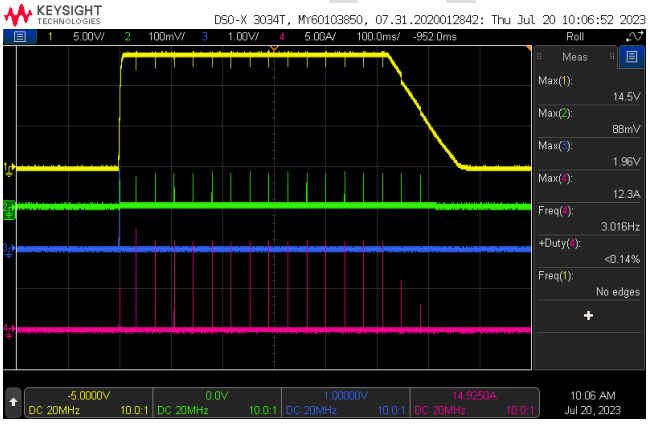


Ch1-V_{GATE}, Ch2-V_{CSP}, Ch3-V_{PDRV}, Ch4-I_L



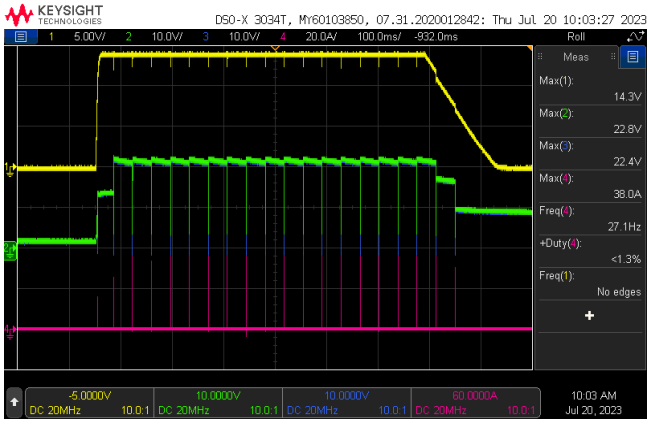
Ch1-V_{GATE}, Ch2-V_{CSP}, Ch3-V_{PDRV}, Ch4-I_L

V_{IN} power on/off during LED short



Ch1-V_{IN}, Ch2-V_{SS}, Ch3-V_{GATE}, Ch4-I_L

V_{IN} power on/off during LED short

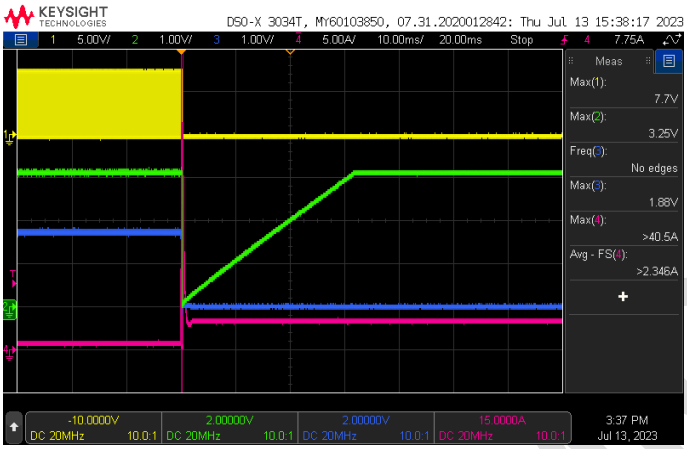


Ch1-V_{IN}, Ch2-V_{CSP}, Ch3-V_{PDRV}, Ch4-I_{OUT}

2.10.2 nFLT Pullup to VREF

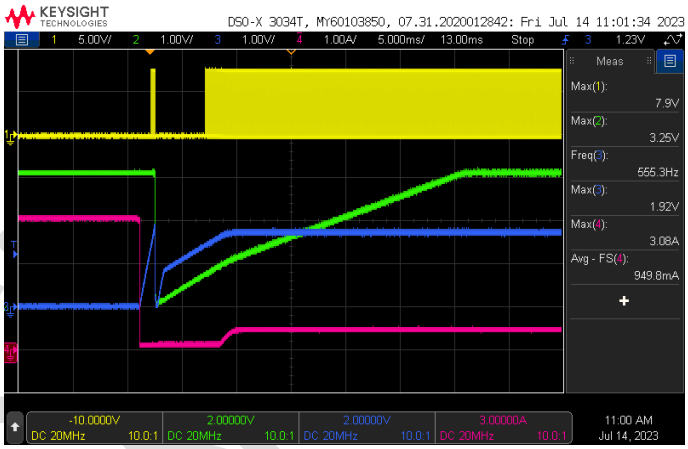
Test conditions: V_{IN}=14V/3A, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V (100% duty), pull nFLT pin up to VREF through 10kΩ resistor. (Note: In this case, it is recommended that the input source current limit be set small enough to avoid R1 or Q1 damage due to excessive current)

Short LED+ to LED-



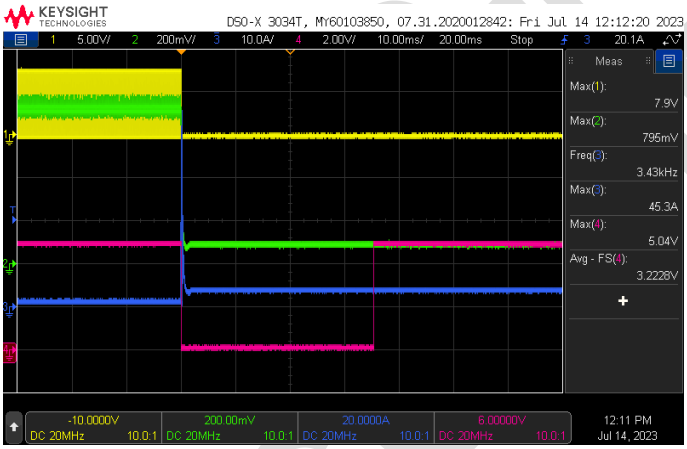
Ch1-V_{GATE}, Ch2-V_{SS}, Ch3-V_{COMP}, Ch4-I_{OUT}

Release LED short



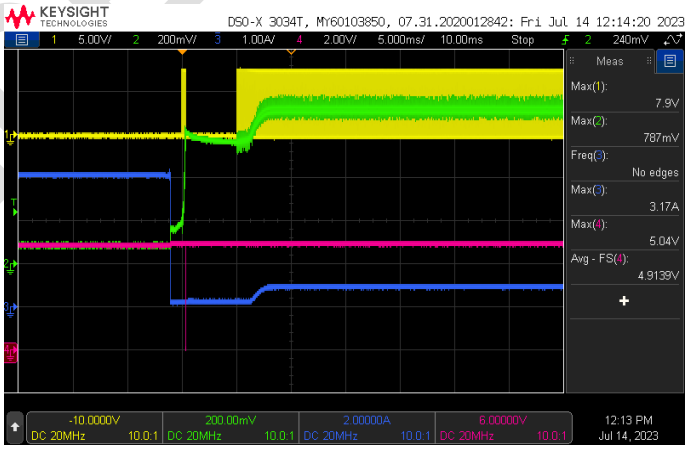
Ch1-V_{GATE}, Ch2-V_{SS}, Ch3-V_{COMP}, Ch4-I_{OUT}

Short LED+ to LED-



Ch1-V_{GATE}, Ch2-V_{OV}, Ch3-I_{OUT}, Ch4-V_{nFLT}

Release LED short

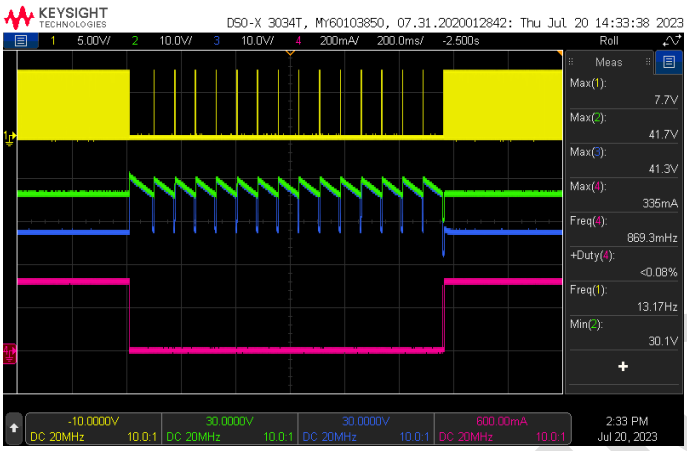


Ch1-V_{GATE}, Ch2-V_{OV}, Ch3-I_{OUT}, Ch4-V_{nFLT}

2.11 LED Open Protection

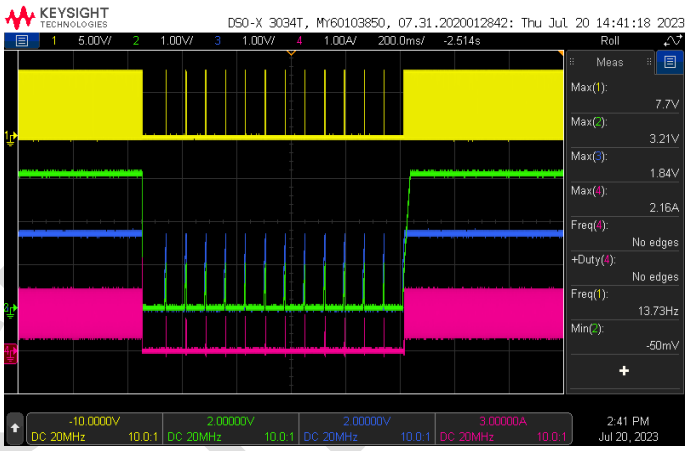
Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V (100% duty), set V_{OV_RISE}=40.5V (R_5=150kΩ, R_{11}=4.7kΩ).

Open LED and recovery



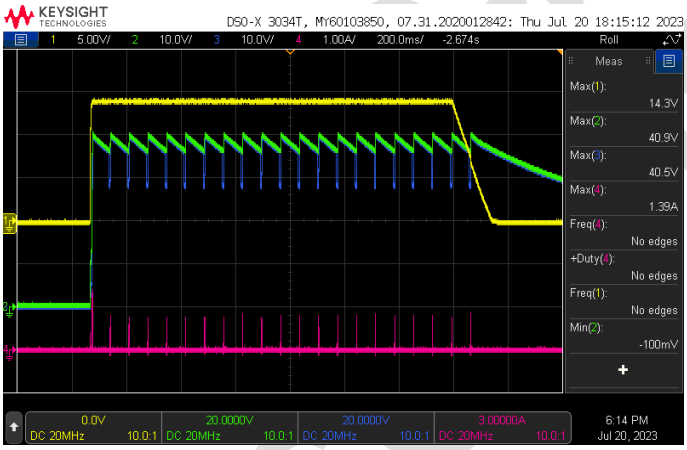
Ch1-V_{GATE}, Ch2-V_{CSP}, Ch3-V_{PDRV}, Ch4-I_{LED}

Open LED and recovery



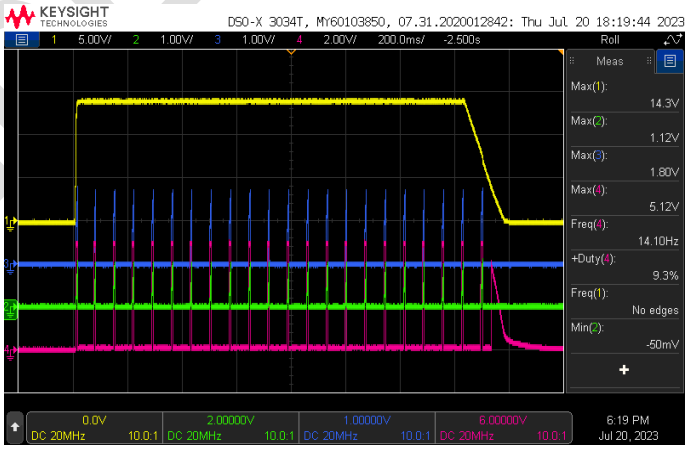
Ch1-V_{GATE}, Ch2-V_{SS}, Ch3-V_{COMP}, Ch4-I_L

V_{IN} power on/off during LED open



Ch1-V_{IN}, Ch2-V_{CSP}, Ch3-V_{PDRV}, Ch4-I_L

V_{IN} power on/off during LED open

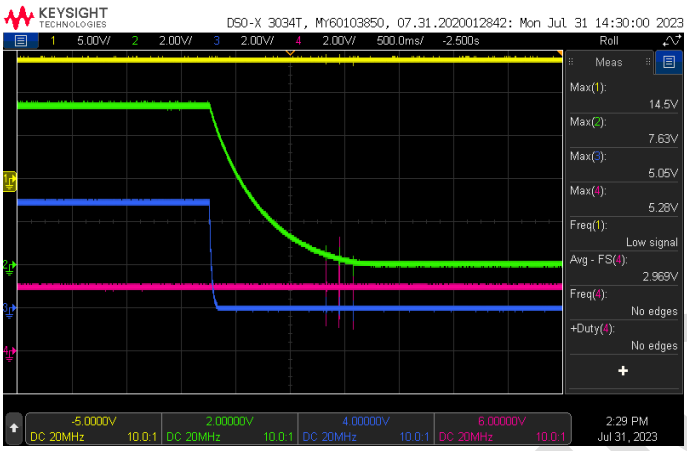


Ch1-V_{IN}, Ch2-V_{SS}, Ch3-V_{COMP}, Ch4-V_{nFLT}

2.12 Thermal Shutdown

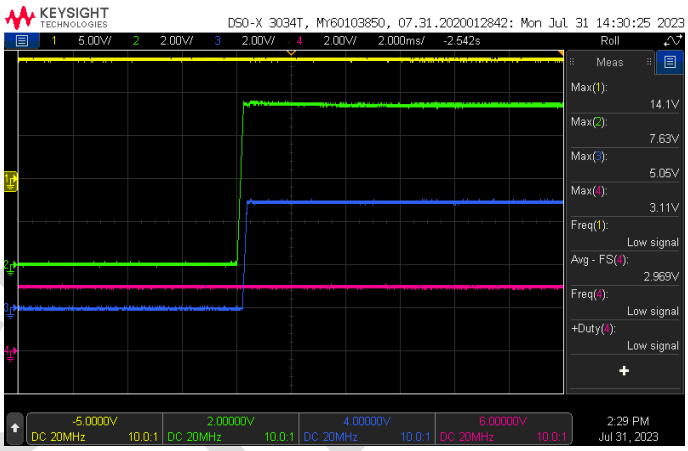
Test conditions: V_{IN}=14V, f_{SW}=390kHz (R_T=20kΩ), V_{IADJ}=1.51V, R_{CS}=0.3Ω, $V_{DIM/PWM}$=3.2V (100% duty), pull nFLT up to external 3V. Heat IC with the hot gun to trigger thermal shutdown.

Thermal shutdown



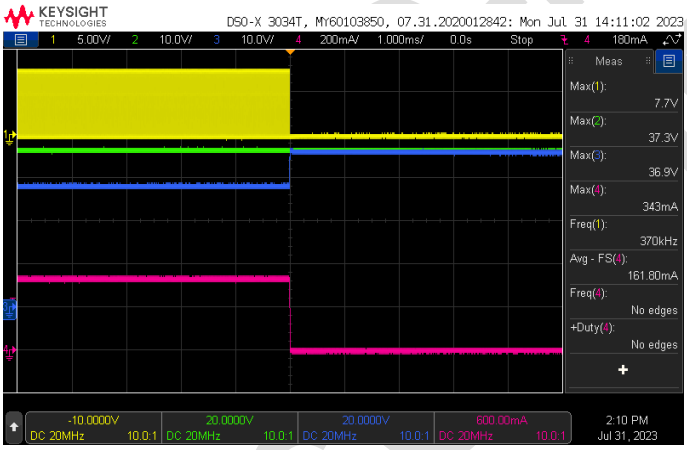
Ch1-V_{IN}, Ch2-V_{CC}, Ch3-V_{REF}, Ch4-V_{nFLT}

Thermal shutdown recovery



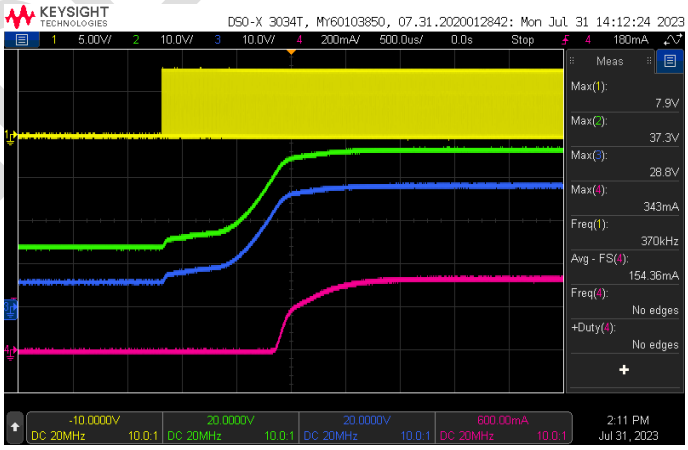
Ch1-V_{IN}, Ch2-V_{CC}, Ch3-V_{REF}, Ch4-V_{nFLT}

Thermal shutdown



Ch1-V_{GATE}, Ch2-V_{CSP}, Ch3-V_{PDRV}, Ch4-I_{LED}

Thermal shutdown recovery



Ch1-V_{GATE}, Ch2-V_{CSP}, Ch3-V_{PDRV}, Ch4-I_{LED}