Three Channel LED Driver Demoboard

General Description

The HV9985DB1 is a three channel boost LED driver demoboard using Supertex's HV9985 LED Driver IC.

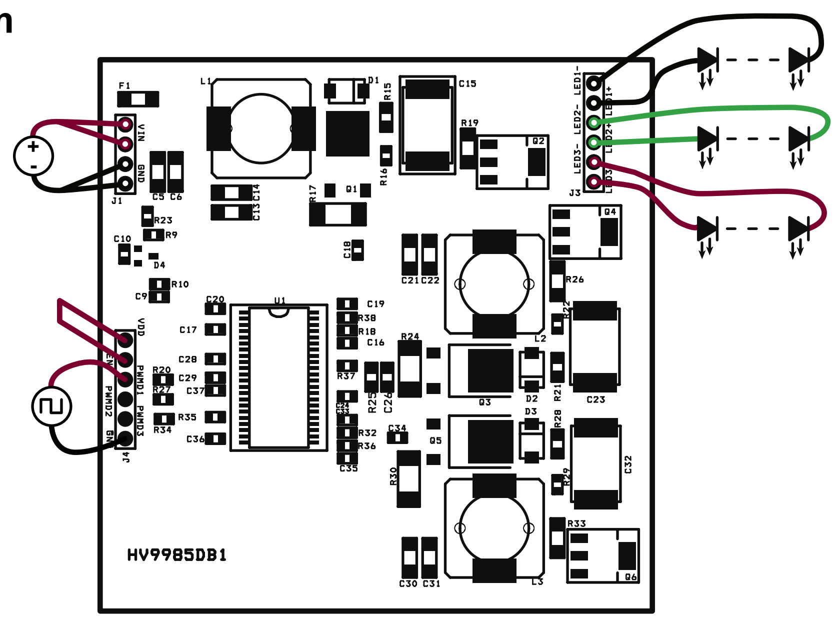
The LED driver can be used to drive RGB or multi-channel white LEDs from a 24V input at 300mA LED current. The demoboard has good current matching between strings and a good PWM dimming response making it ideal for LED backlight applications. The typical full load efficiency of the LED driver is 94%.

The HV9985DB1 includes hiccup mode protection for both short circuit and open circuit conditions to ensure that it recovers from a momentary fault condition. It also enables the board to survive prolonged fault conditions without any damage to both the driver as well as the LEDs.

Specifications

Parameter	Value
Input voltage	22 - 26V
LED string voltage (all channels)	50 – 80V
LED current (all channels)	300mA
LED Current Ripple	≤ ±5%
Switching frequency of the converters	250kHz
Current matching between channels	≤ ±3%
Typical full load efficiency	94%
PWM dimming rise and fall times	≤1.0μs
Shutdown mode current	≤ 500μA
Open LED drotection	Included; hiccup-mode
Output short circuit protection	Included; hiccup-mode
Hiccup time	1ms (typ)
PWM Dimming Ratio @ 120Hz PWMD frequency	400:1
Dimensions	71mm X 71mm

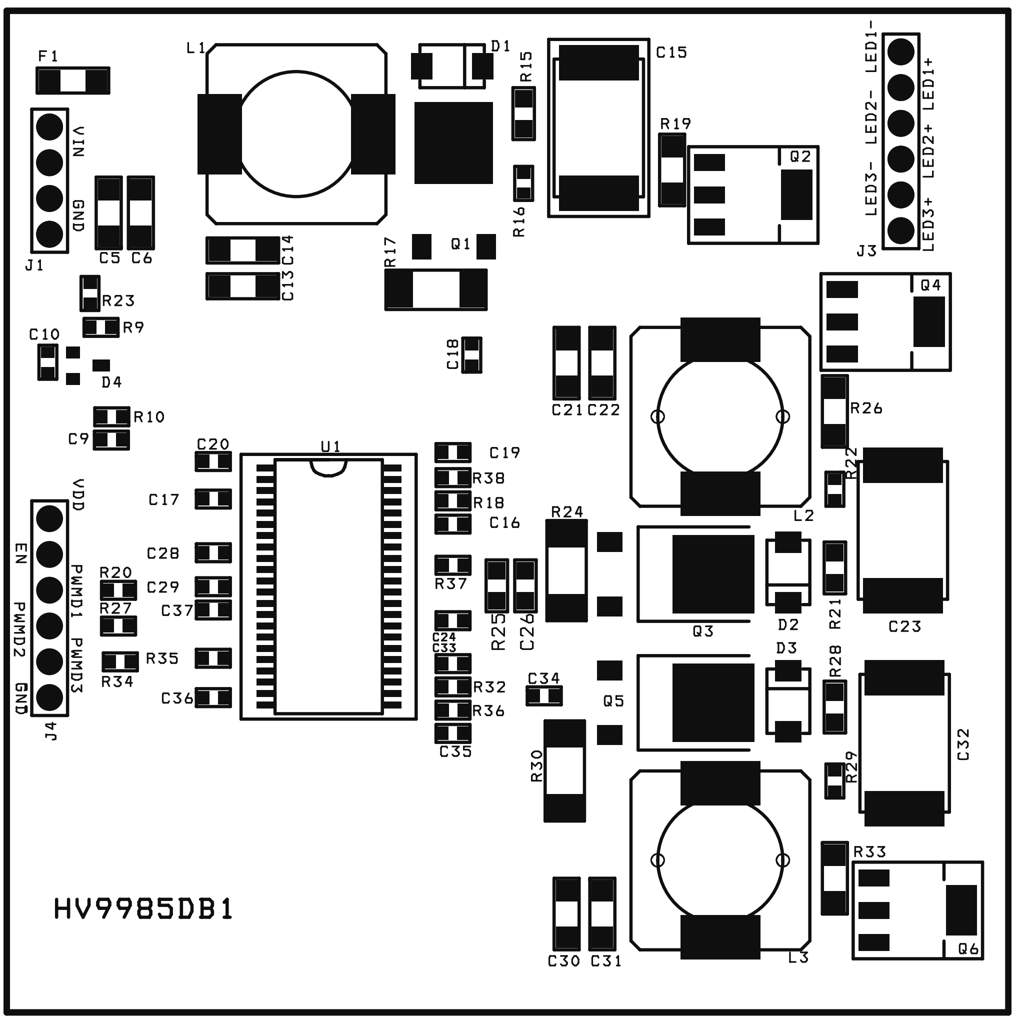
Connection Diagram



Connections

Pin	Connection
VIN	This terminal is the positive input of the 24V supply for the boost converters. It is also the input for the internal regulator of the IC.
GND	These terminals are the return paths for all the input voltages and signals for the demoboard. The input voltage, EN voltage and PWM dimming signals should be referenced to GND.
VDD	This terminal is connected to the VDD pin(s) of the HV9985 and provides a 5V signal. It can be used to connect to the EN and PWMD inputs.
EN	This terminal can be used to shut down the IC. Connecting this terminal to GND will cause the IC to go into a standby mode and the demoboard will draw less than 500µA.
PWMD1-3	These terminals are the PWM dimming inputs. A TTL compatible square wave can be connected to these terminals to PWM dim the respective channels.
LED+ 1-3	The anodes of the LED strings should be connected to these terminals as shown in the connection diagram.
LED- 1-3	The cathodes of the LED strings should be connected to these terminals as shown in the connection diagram.

Silk Screen



Testing the Demoboard

Normal Operation – Connect the board as shown in the connection diagram and turn on the 24V supply. Connect any of the PWMD pins to VDD. The LEDs of the corresponding channel will light up.

Current matching – Enable each channel individually by connecting the PWMD input of that channel to VDD and measure the current (or, if possible, enable all channels and measure the three output currents simultaneously). The deviation will be ≤ ±3%.

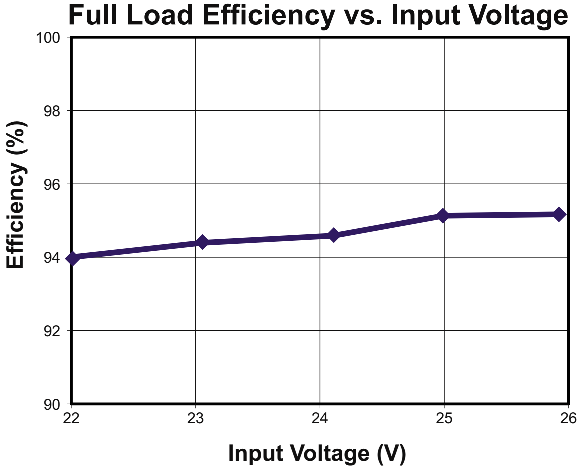
PWM Dimming – Apply a TTL compatible square wave signal (≤ 1kHz recommended). The LED current will dim based on the duty cycle of the PWM input.

Open LED protection – Connect a voltage probe between the LED+ terminal of any channel and GND and disconnect the LED string. The output voltage will rise up to 92V and trip the over voltage protection. At this point, all three channels will shut down and the output voltage of the channel with the open LED condition will be maintained hysteretically between 92 and 82V until the output voltage of the faulty channel falls below 82V or till the LED string is reconnected. Once the LED string is reconnected, all three channels will turn back on.

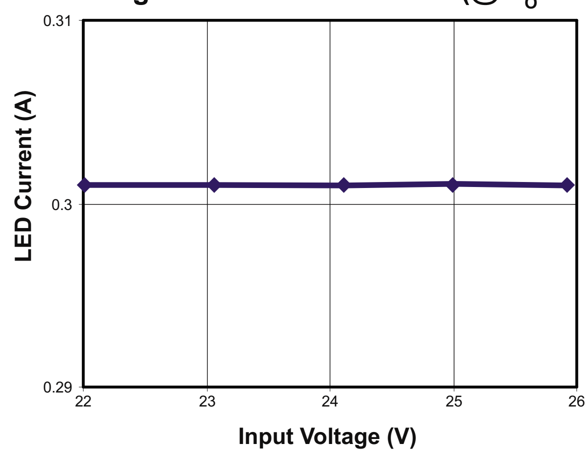
Short Circuit Protection – Short the output terminals of any one channel using a jumper. All three channels shut down and the IC tries restarting every 1.0ms. Once the short circuit is removed, all three channels come back into regulation.

Typical Results

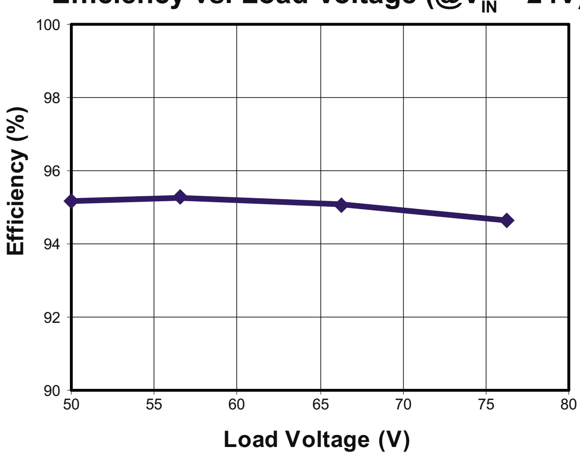
Full Load Efficiency vs. Input Voltage



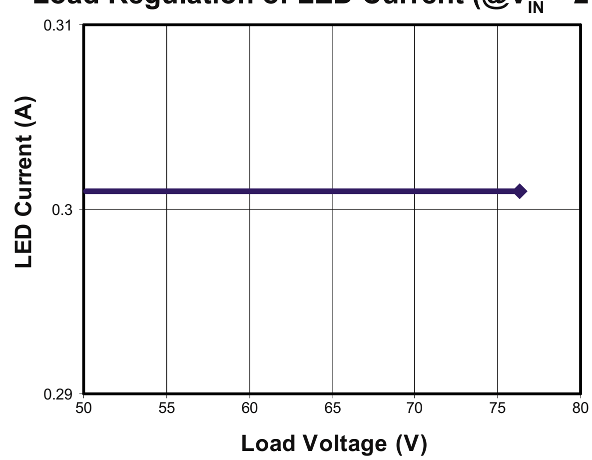
Line Regulation of LED Current (@ V_O = 80V)



Efficiency vs. Load Voltage (@V_{IN} = 24V)



Load Regulation of LED Current (@V_{IN} = 24V)



Typical Waveforms

Fig. 1. Normal Operation – Gate Voltages and LED Current

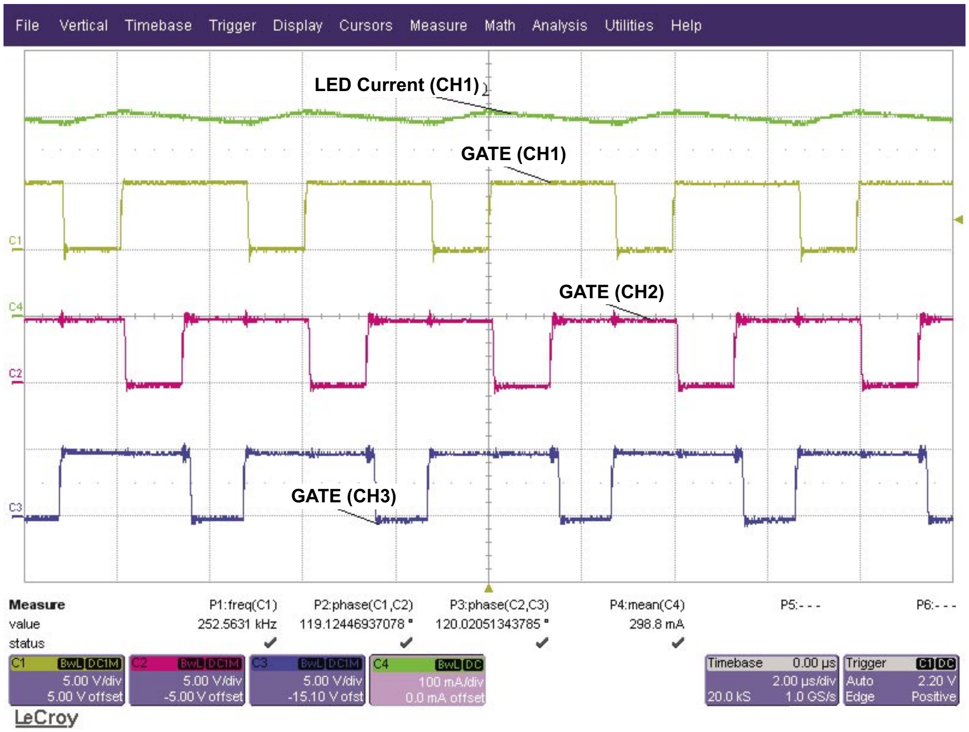


Fig. 2. PWM Dimming Waveform

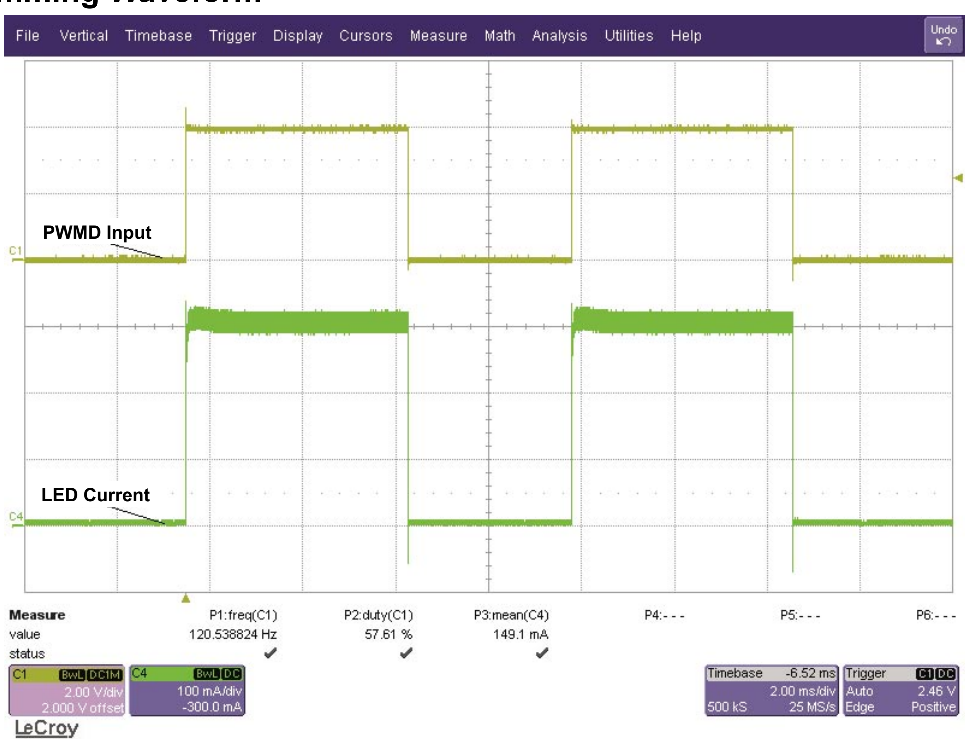


Fig. 3. PWM Dimming – Rising Edge Waveform

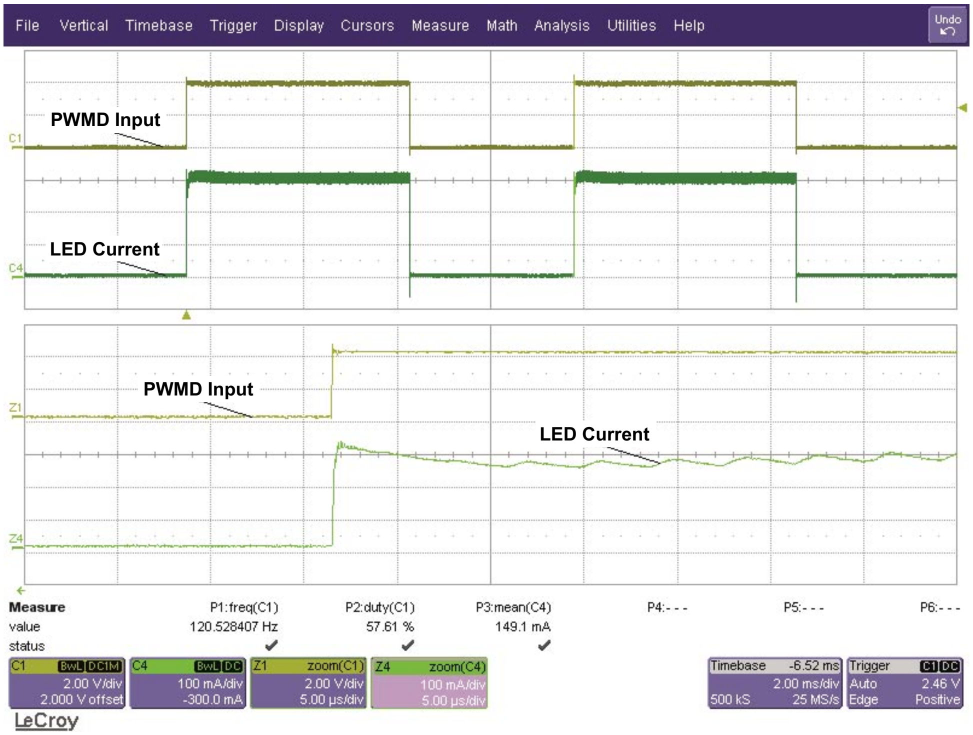


Fig. 4. PWM Dimming – Falling Edge Waveform

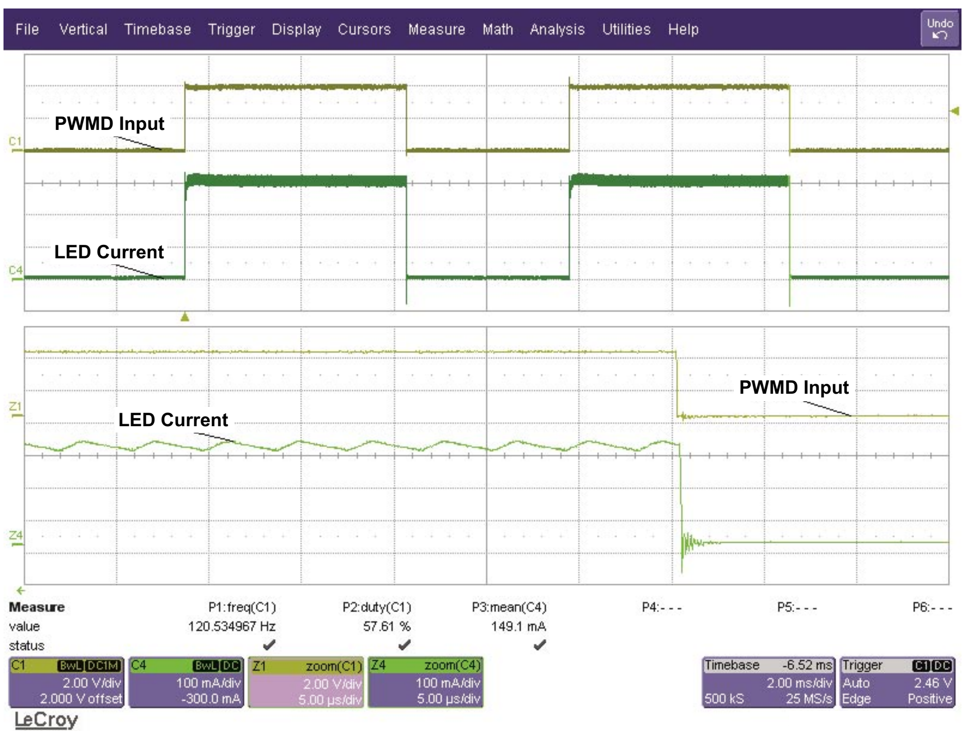


Fig. 5. PWM Dimming – Minimum Pulse Width

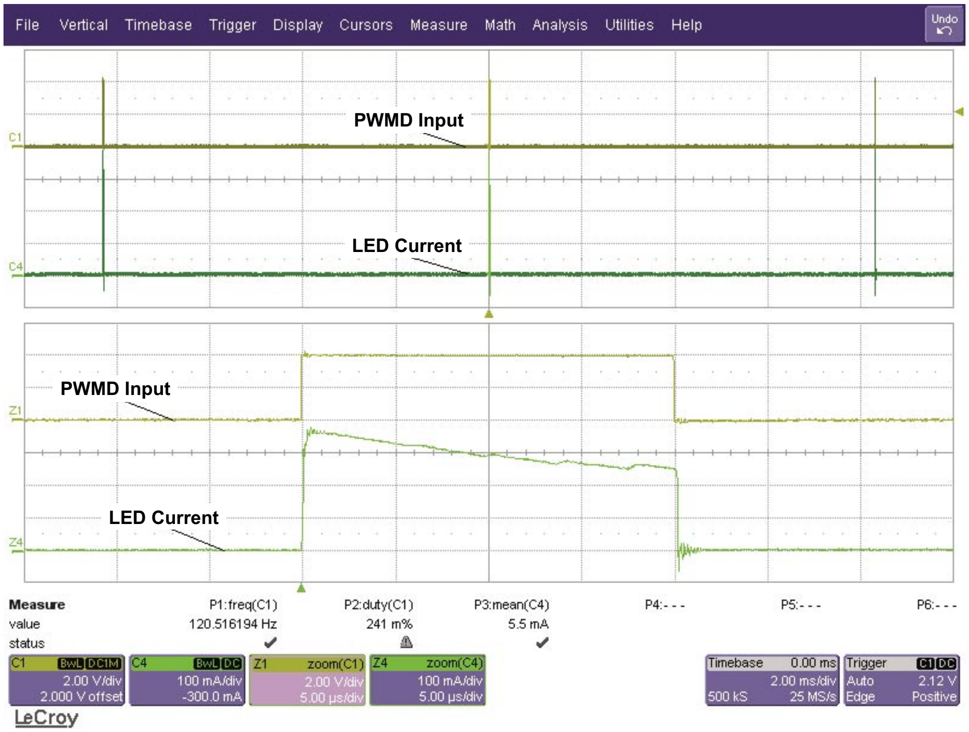


Fig. 6. Open Circuit Occurrence and Recovery

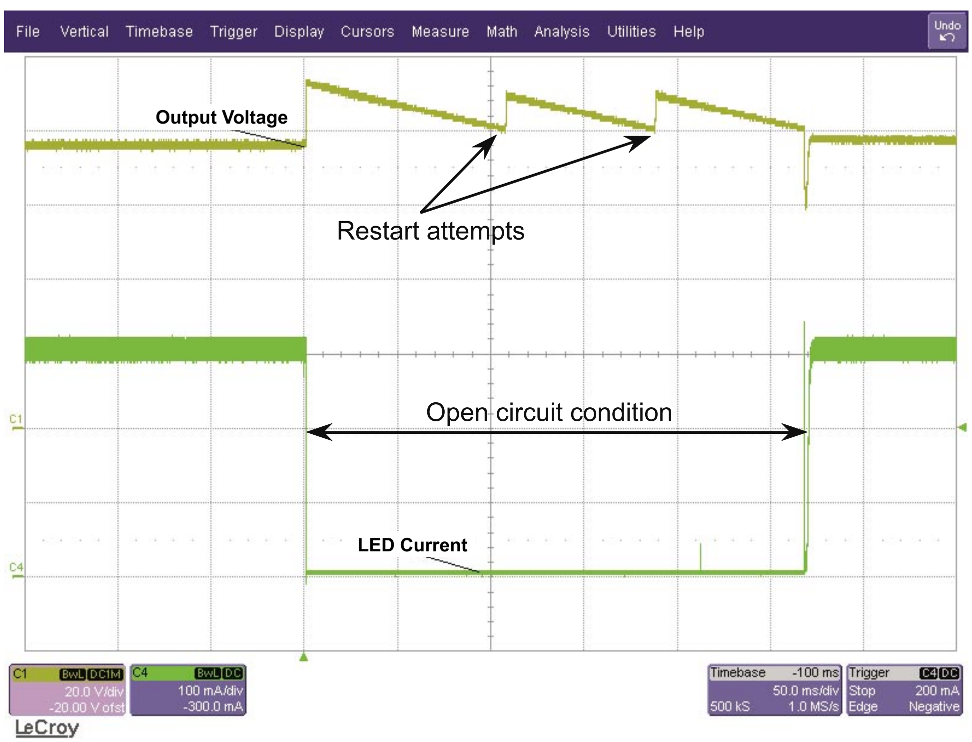


Fig. 7. Short Circuit Occurrence and Recovery

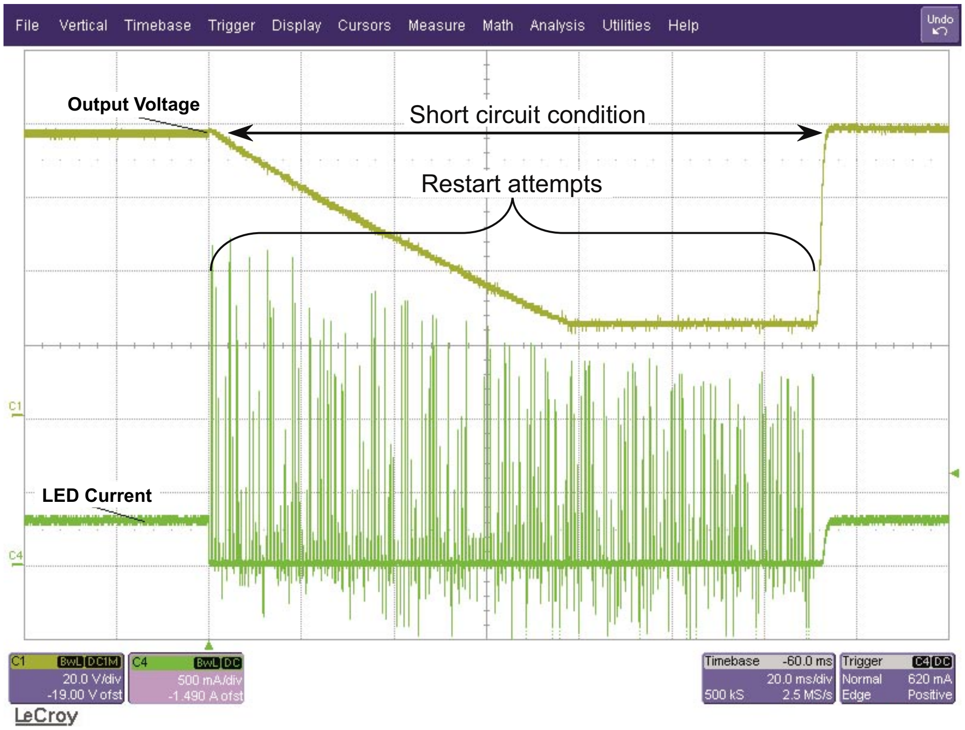
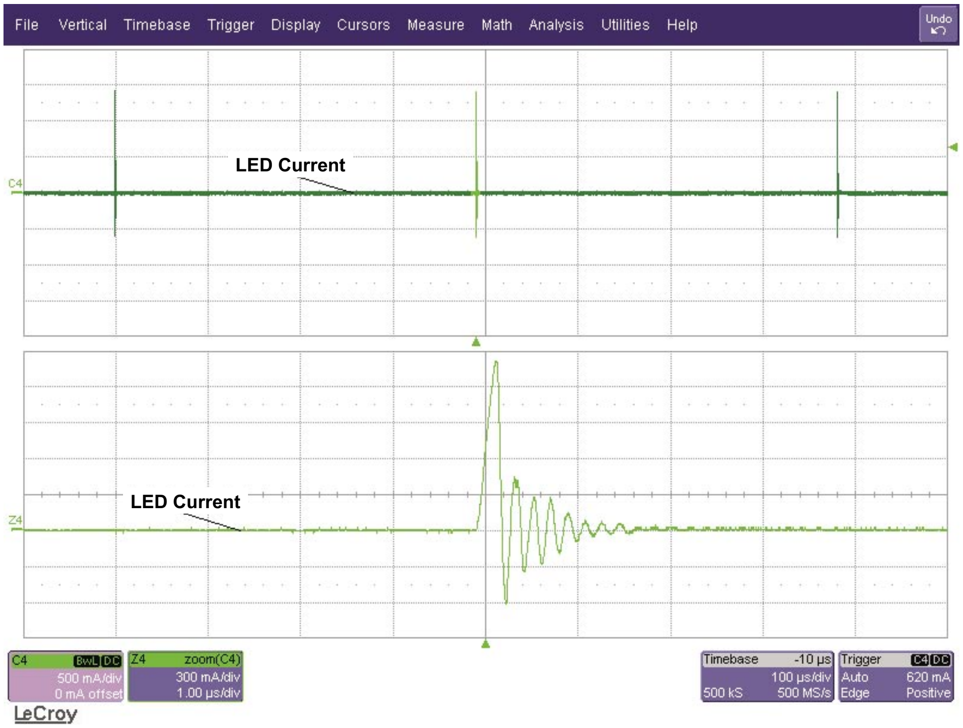
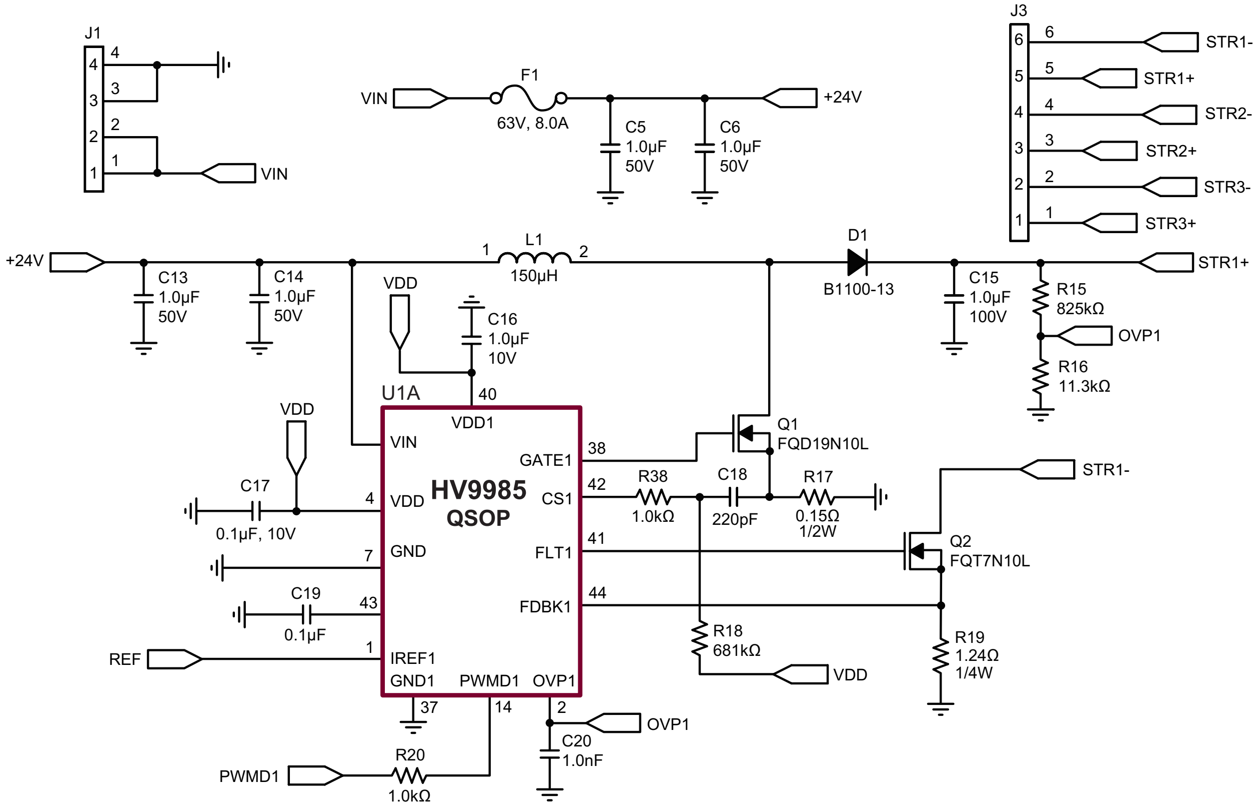


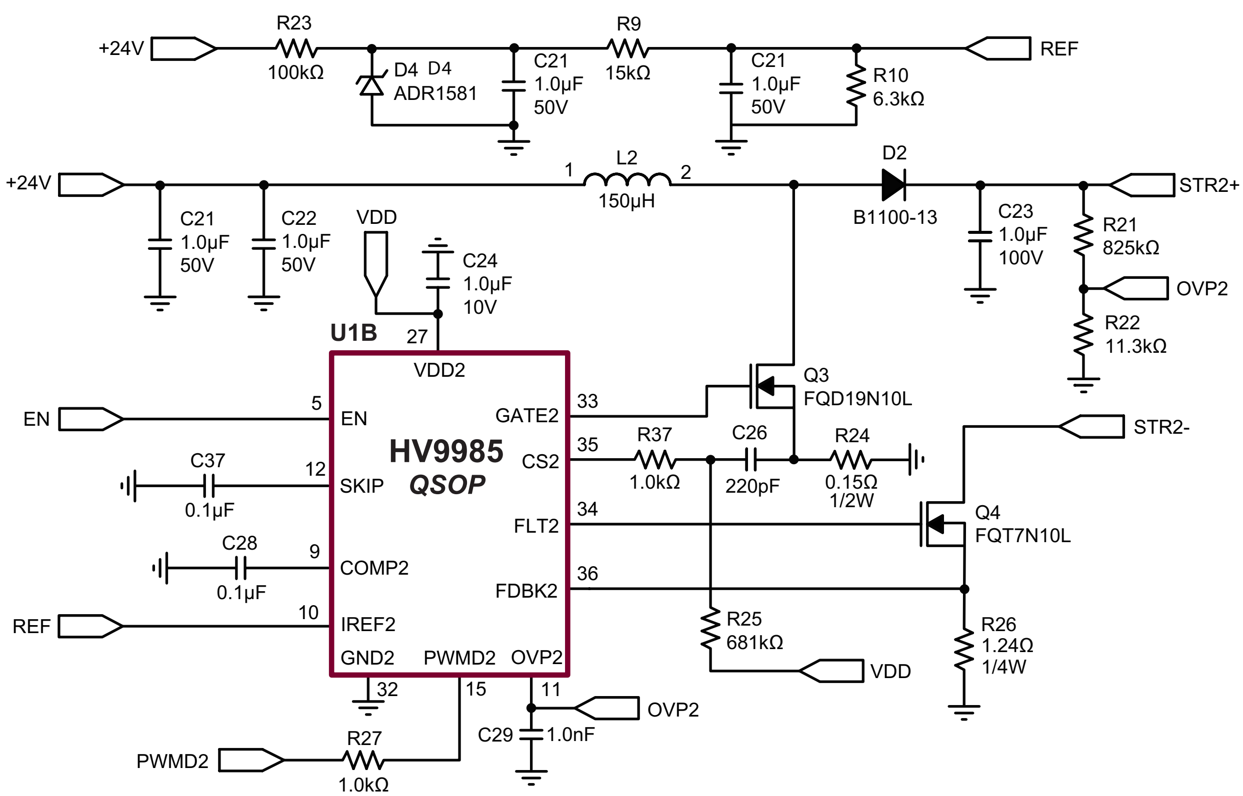
Fig. 8. Short Circuit Restart Attempts



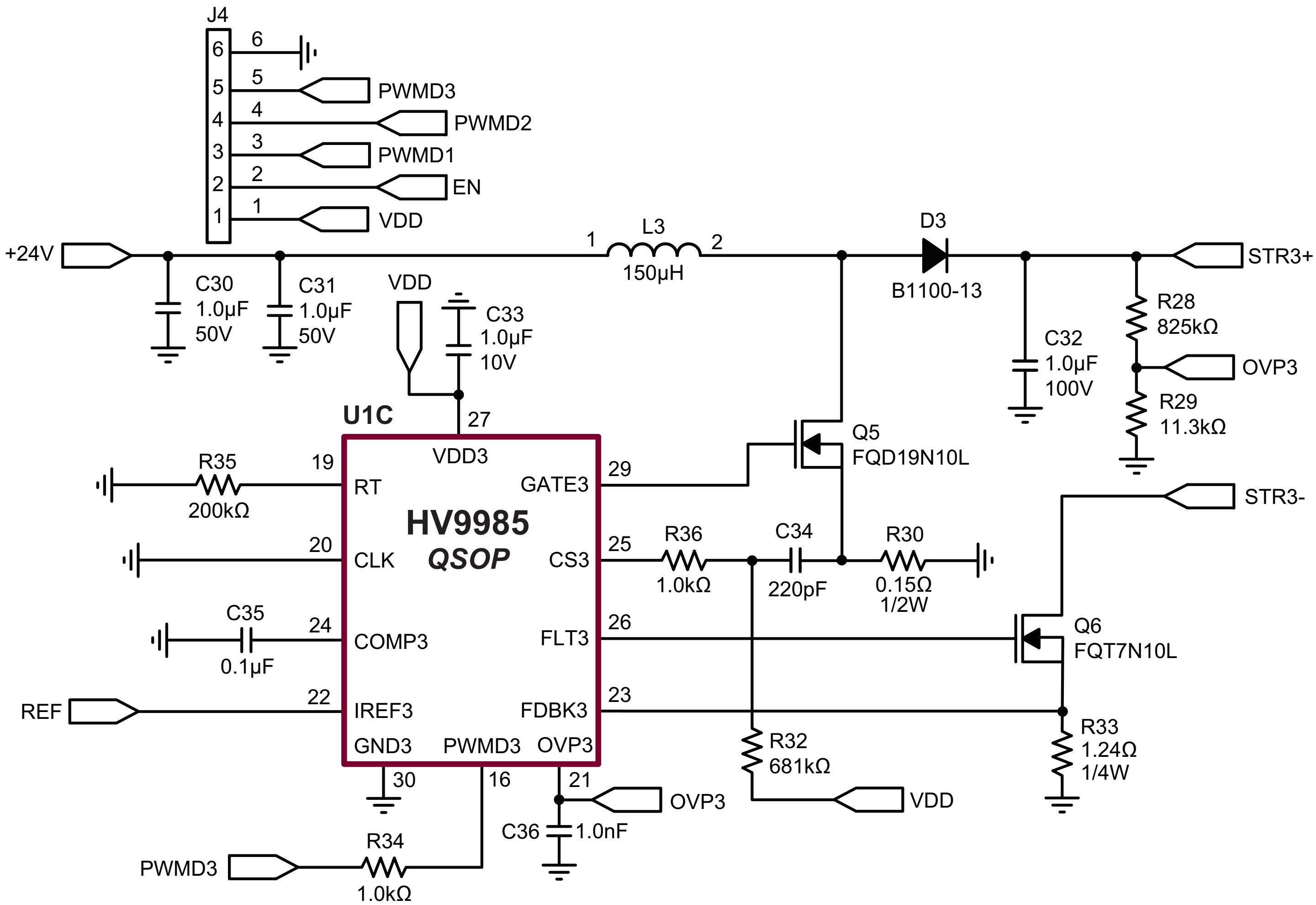
Circuit Schematic 1



Circuit Schematic 2



Circuit Schematic 3



Bill of Materials

Item #	Quan.	RefDes	Description	Package	Manufac-turer	Manufacturer's Part #
1	8	C5, C6, C13, C14, C21, C22, C30, C31	1μF, 50V, X7R ceramic chip capacitor	SMD1206	Murata	GCM31MR71H105KA55L
2	5	C9, C10, C19, C28, C35	0.1μF, 16V, X7R ceramic chip capacitor	SMD0603	Yageo	CC0603KRX7R7BB104
3	3	C15, C23, C32	1μF, 100V PEN Film capacitor	SMT	Panasonic	ECW-U1105KCV
4	4	C16, C17, C24, C33	1μF, 16V, X7R ceramic chip capacitor	SMD0603	Murata	GRM188R71C105KA12D
5	3	C18, C26, C34	220pF, 50V, NP0 ceramic chip capacitor	SMD0603	Kemet	C0603C221J5GACTU
6	4	C20, C29, C36, C37	1.0nF, 50V, X7R ceramic chip capacitor	SMD0603	Kemet	C0603C102K5RACTU
7	3	D1, D2, D3	100V, 1.0A schottky diode	SMA	Diodes Inc	B1100-13
8	1	D4	1.25V, 0.12% precision reference shunt	SOT-23	Analog Devices	ADR1581ARTZ
9	1	F1	63V, 8.0A fast acting fuse	SMD1206	Littelfuse	0458008.DR
10	1	J1	4 pin 0.1" header	Thru-Hole	Molex	22-03-2041
11	2	J3, J4	6 pin 0.1" header	Thru-Hole	Molex	22-03-2061
12	3	L1, L2, L3	150μH, 1.5A rms, 2.26A sat inductor	SMT	Coiltronics	DRA127-151-R
13	3	Q1, Q3, Q5	100V, 0.11Ω, 18nC, logic level FET	DPAK	Fairchild Semi	FQD19N10L
14	3	Q2, Q4, Q6	100V, 0.38Ω, 6.0nC, logic level FET	SOT-223	Fairchild Semi	FQT7N10L
15	1	R9	15.0kΩ, 1/10W, 1% chip resistor	SMD0603	Yageo	RC0603FR-0715KL
16	1	R10	6.34kΩ, 1/10W, 1% chip resistor	SMD0603	Yageo	RC0603FR-076K34L
17	3	R15,R21,R28	825kΩ, 1/8W, 1% chip resistor	SMD0805	Yageo	RC0805FR-07825KL
18	3	R16,R22,R29	11.3kΩ, 1/10W, 1% chip resistor	SMD0603	Yageo	RC0603FR-0711K3L
19	3	R17,R24,R30	0.15Ω, 1/2W, 1% chip resistor	SMD2010	Rohm	MCR50JZHFLR150
20	3	R18,R25,R32	681kΩ, 1/10W, 1% chip resistor	SMD0603	Yageo	RC0603FR-07681KL
21	3	R19,R26,R33	1.24Ω, 1/4W, 1% chip resistor	SMD1206	Yageo	RC1206FR-071R24L
22	6	R20,R27,R34, R36, R37,R38	1.00kΩ, 1/10W, 1% chip resistor	SMD0603	Yageo	RC0603FR-071KL
23	1	R23	100kΩ, 1/10W, 1% chip resistor	SMD0603	Yageo	RC0603FR-07100KL
24	1	R35	200kΩ, 1/10W, 1% chip resistor	SMD0603	Yageo	RC0603FR-07200KL
25	1	U1	Three channel closed loop LED driver	QSOP-44	Supertex	HV9985QP-G

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