3-Channel LED Array Driver IC

General Description

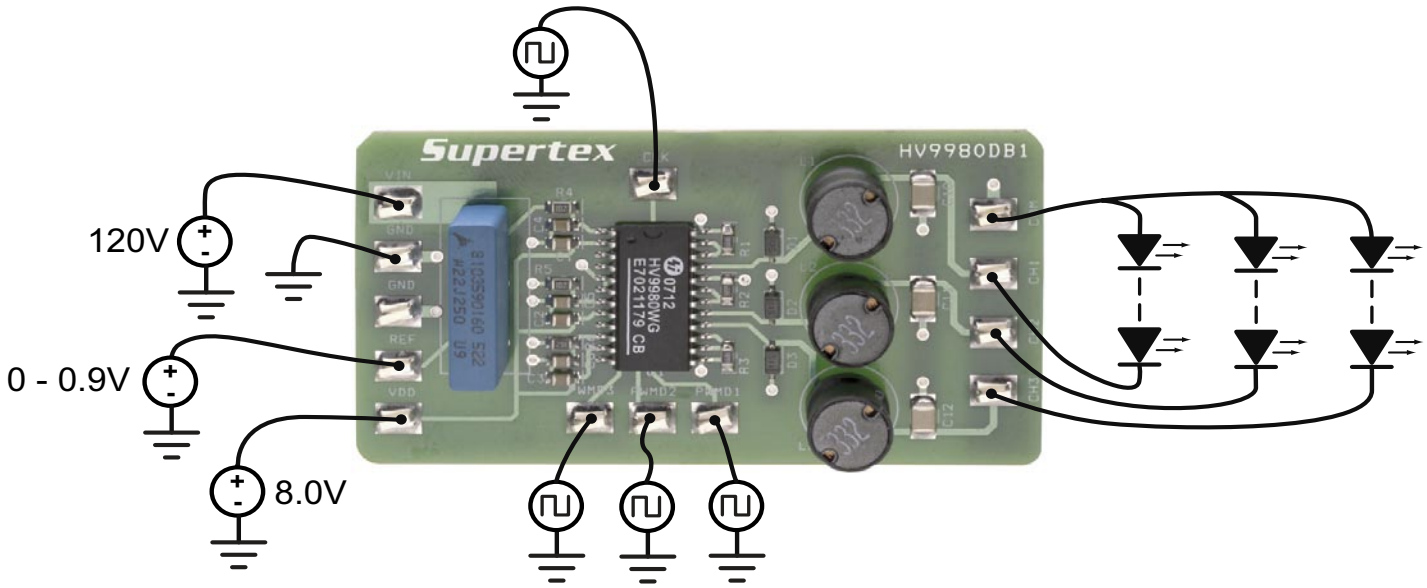
The HV9980B1 demoboard is an RGB or multi-channel white LED backlight driver designed to drive LEDs for a large-screen TV. The HV9980DB1 can drive three common-anode LED strings from a 100 - 140V input at currents up to 70mA in steady state. It can also drive the LEDs at currents as large as 160mA for short durations to facilitate backlight scanning mode.

Each of the three channels can be individually controlled by PWM dimming. The demoboard is also protected from short circuit conditions across any string and recovers automatically once the condition disappears.

Specifications

Parameter	Value
Input voltage (V_{IN})	100 - 140V
IC supply voltage (V_{DD})	6.0 - 10V
Output voltage	20V (min) < ½ of input voltage (max)
Output current (steady state)	70mA (max)
Output current (short durations)	160mA (max)
Switching frequency (requires an external 1.8MHz clock signal)	300kHz
REF input	0 - 1.0V
Output current ripple (typ)	<5% peak - peak
Efficiency (@ 120V input and 40V, 50mA output)	~90%
Open LED protection	YES
Output short circuit protection	YES

Connection Diagram



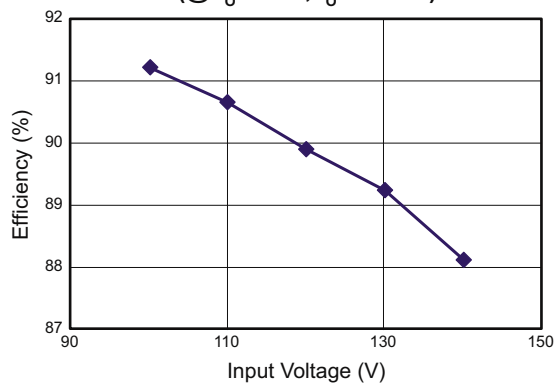
Actual Board Size: 68.8mm x 36.1mm

Connections

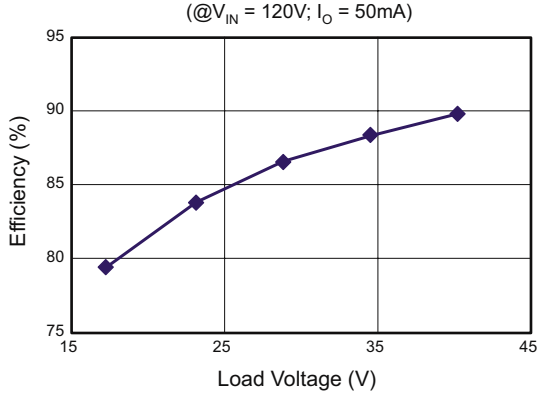
Pin	Connection
VIN	Powers the three LED strings, providing the LED string voltage is less than ½ of the input voltage. Connect a high voltage 100 - 140V source at this terminal.
VDD	Powers the HV9980 control circuit. Connect a 6.0 - 10V source at this terminal.
REF	Voltage at the REF terminal controls the output current level. The peak inductor current is approximately 1/5th of the REF voltage.
CLK	Provides a clock input to the HV9980. The switching frequency is 1/6th of the CLK frequency. Connect a 1.8MHz TTL compatible signal at this terminal.
PWMD1-3	These inputs can be used to PWM dim the three channels. Connect these pins to VDD to enable all three channels permanently. A TTL compatible, low frequency (<1kHz) square wave can be used to PWM dim each channel individually.
GND(s)	The two GND terminals are wired together on the board. They form the return path for all the input signals.
COM	This is the common anode connection for all three LED strings.
Ch1-3	These terminals are the cathode connections for the three LED strings.

Typical Results

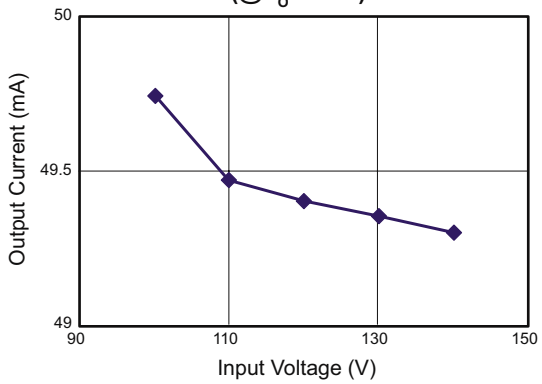
Efficiency vs. Input Voltage
(@V_O = 40V; I_O = 50mA)



Efficiency vs. Load Voltage
(@V_{IN} = 120V; I_O = 50mA)



Line Regulation of Output Current
(@V_O = 40V)



Load Regulation of Output Current
(@V_{IN} = 120V)

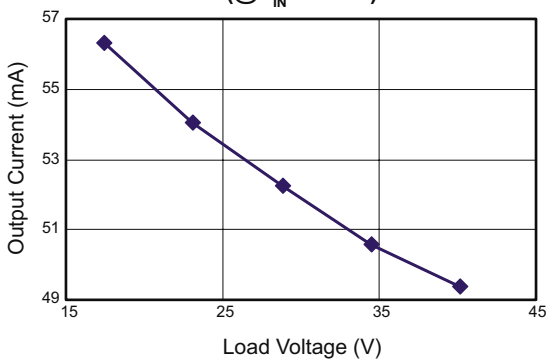


Fig.1 shows the drain voltage and LED current waveforms during normal operation. The three channels are phase shifted by 120° with respect to each other. The switching frequency for each channel is 300kHz (1/6th of the CLK frequency).

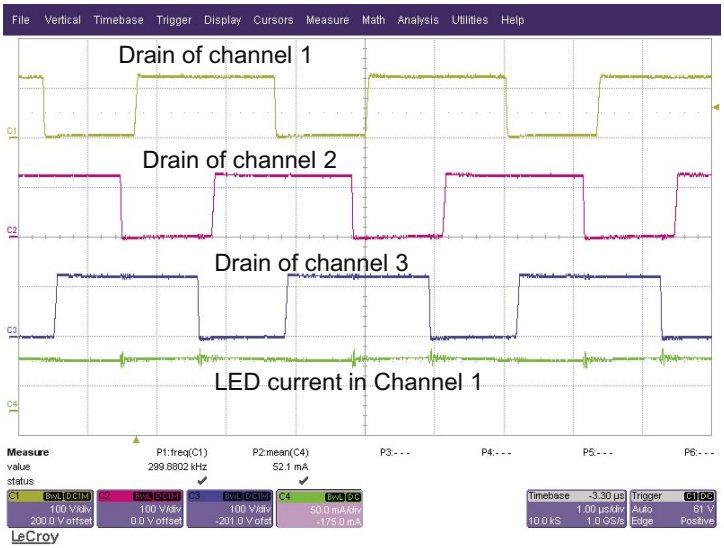


Fig. 1: Steady State Operation
(Time scale: 1.0µs/div)

Fig. 2 shows the hiccup mode short circuit protection of the HV9980. The output of channel is shorted by connecting COM to CH1. Channel 1 tries to restart every 200µs. The other two channels work normally and are not affected by the short circuit on one channel. The short circuit timing is started when the voltage at RS reaches 1.15V (about 230mA).

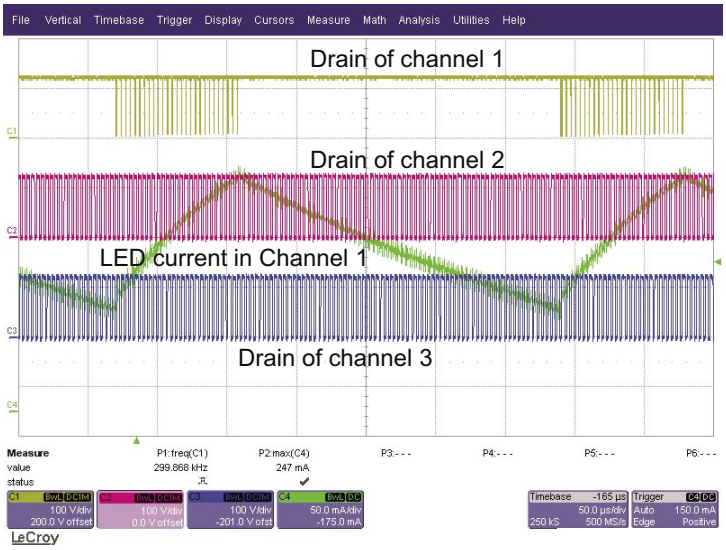


Fig. 2: Operation during Output Short Circuit
(Time scale: 50µs/div)

Fig. 3 shows the recovery of Channel 1 from short circuit condition to normal operation. The circuit transitions from a fault condition to normal operation does not cause any overshoots in the LED current.

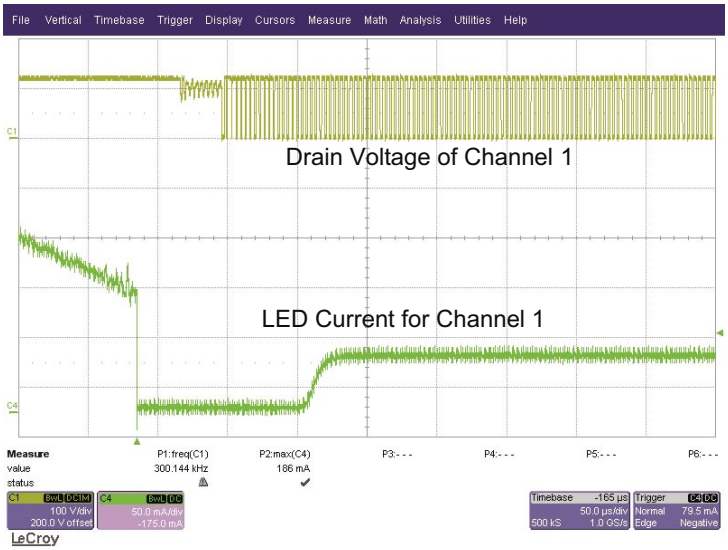
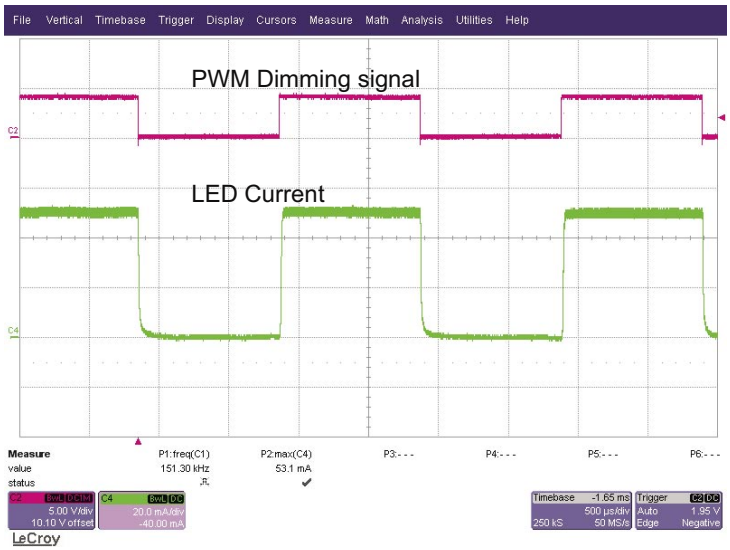
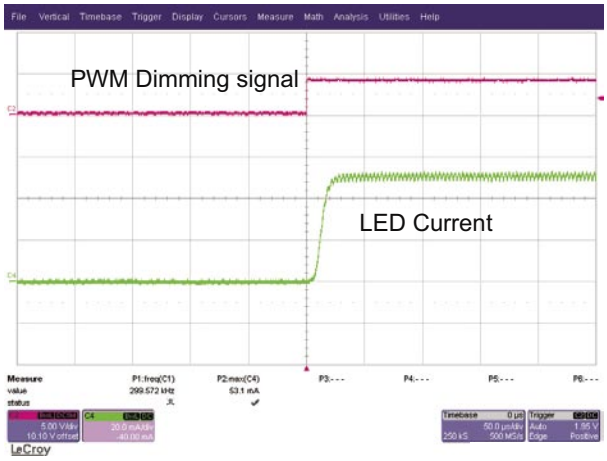


Fig. 3: Recovery from a short circuit condition
(Time scale: 50µs/div)

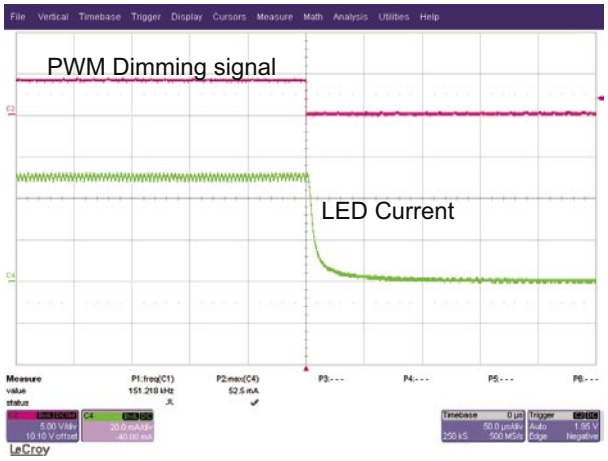
Fig. 4 shows the PWM dimming performance of the HV9980DB1 for one of the channels. The driver has a 25µs rise time and 50µs fall time.



(a): PWM Dimming Operation
(Time scale: 500µs/div)



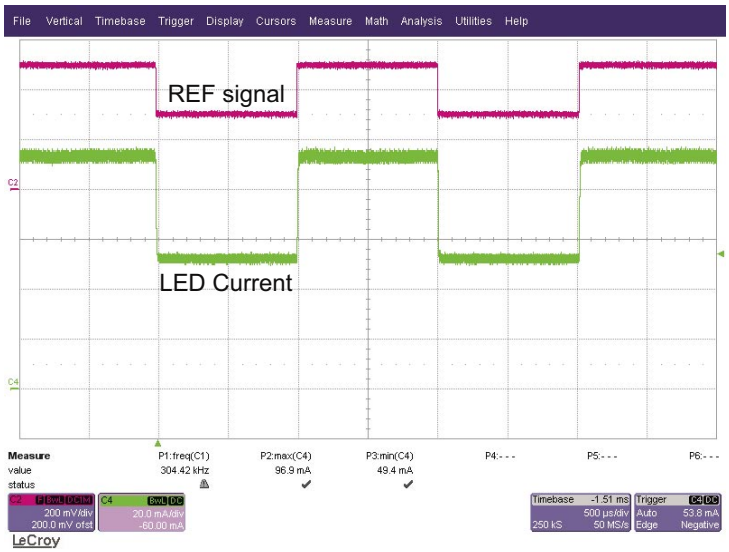
(b): PWM Dimming Rise
(Time scale: 50µs/div)



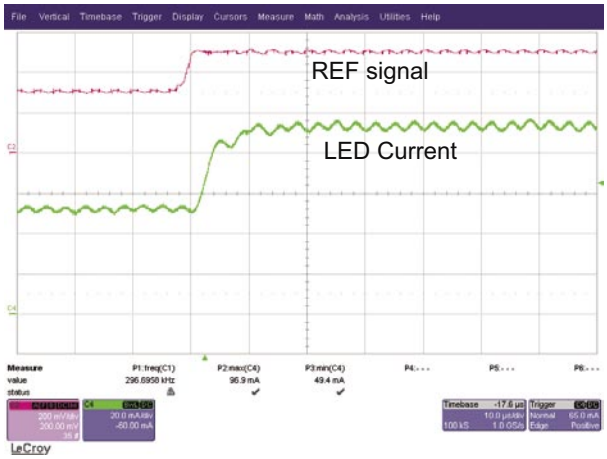
(c): PWM Dimming Fall
(Time scale: 50µs/div)

Fig. 4: PWM Dimming performance

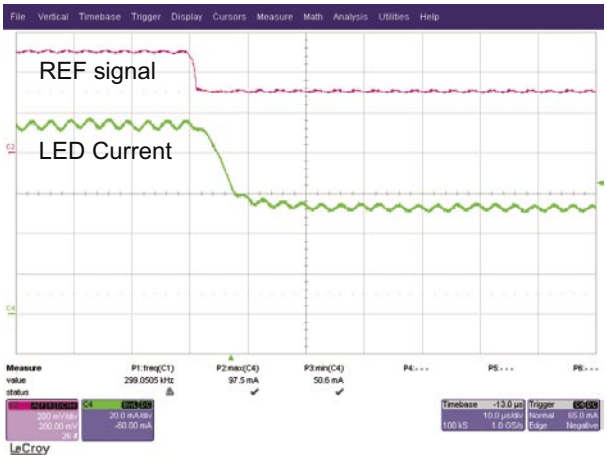
Fig. 5 shows the response of the HV9980DB1 to a quickly varying reference voltage, similar to variation found in the back-light-scanning mode. The reference voltage is varied from 250mV to 500mV using a square wave signal (corresponding to an LED current variation from 50mA to 100mA). The LED current transitions quickly between the two levels within 10µs.



(a): Operation with a REF change
(Time scale: 500µs/div)



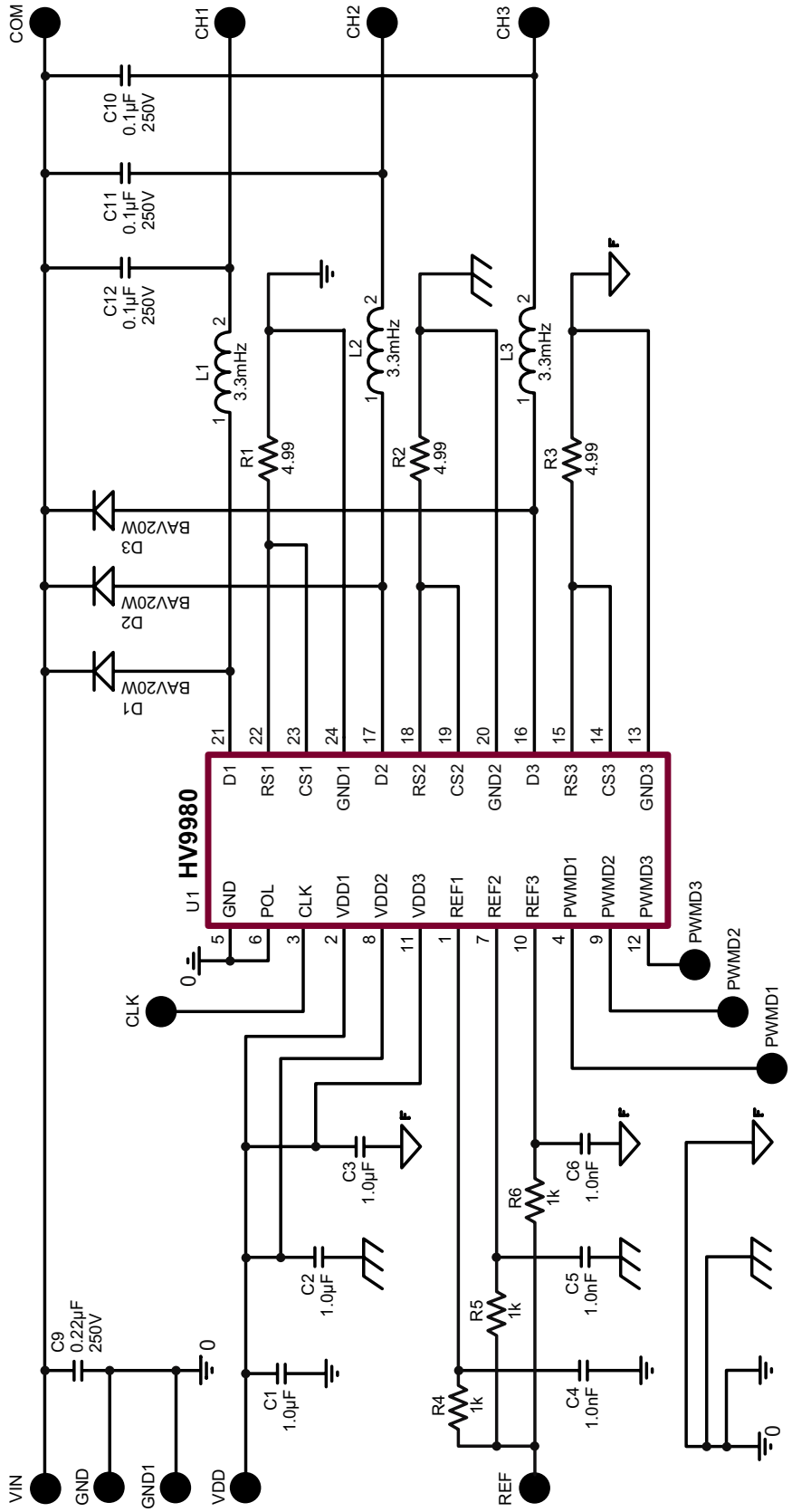
(b) : Rise Time of LED Current
(Time scale: 10µs/div)



(c) : Fall Time of LED Current
(Time scale: 10µs/div)

Fig. 5: REF change response

Circuit Schematic



Bill of Materials

Item #	Qty	RefDes	Description	Package	Mfg	Mfg Part Number
1	13	PWMD1-3, Ch1-3, REF, VDD, VIN, COM, GND, GND1, CLK	Compact surface mount test points	SMT	Keystone Electronics	5016
2	3	C1, C2, C3	1.0uF, 16V X7R ceramic chip capacitor	SMD0805	TDK Corp	C2012X7R1C105K
3	3	C4, C5, C6	1.0nF, 50V X7R ceramic chip capacitor	SMD0805	Kemet	C0805C102K5RACTU
4	1	C9	0.22µF, 250V metal film capacitor	Radial	Epcos Inc.	B32521C3224J
5	3	C10, C11, C12	0.1µF, 200V, X7R ceramic chip capacitor	SMD1210	AVX Corp	12102C104KAT2A
6	3	D1, D2, D3	200V, 200mA switching diode	SOD-123	Diodes Inc	BAV20W
7	3	L1, L2, L3	3.3mH, 225mA sat, 150mA rms inductor	Radial	Coilcraft	RFB0810-332
-	-	---	Cross Reference (for L1, L2, and L3)	Radial	Renco USA	RL-5480-3-3300
8	3	R1, R2, R3	4.99Ω, 1/8W, 1% chip resistor	SMD0805	---	---
9	3	R4, R5, R6	1.0kΩ, 1/8W, 5% chip resistor	SMD0805	---	---
10	1	U1	Three Channel LED Driver	SOIC-24	Supertex	HV9980WG-G

Supertex inc.
1235 Bordeaux Drive, Sunnyvale, CA 94089
Tel: 408-222-8888
www.supertex.com