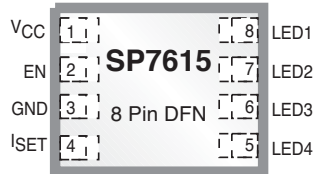# SP7615

Four Channel Constant Current LED Driver

FEATURES

- Cost Effective LED driver
- Constant current output ideal for Driving LED strings
- Four Channel LED Driver provides matched LED current
- Current adjusted via an external resistor
- PWM dimming possible
- Small 2mm x 3mm DFN package
- Outputs can be connected in parallel to increase drive
- Constant current for wide cathode voltage range (1.0V to 16V)
- Highly integrated design, minimal components
- Thermal shutdown protects the driver

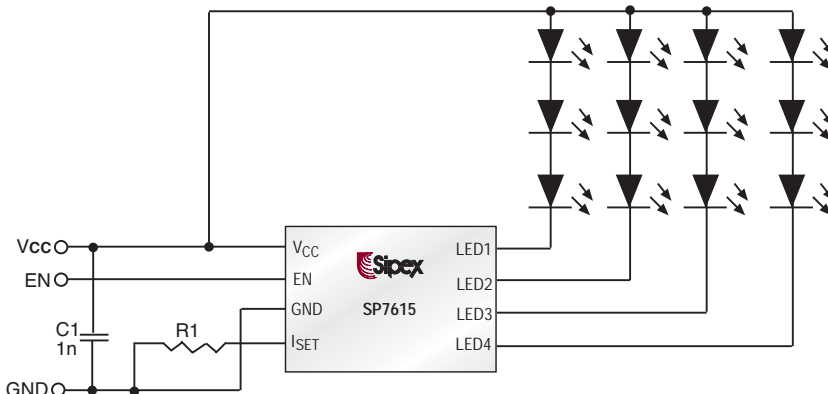|		
V_{CC} [1]		[8] LED1
EN [2]	SP7615	[7] LED2
GND [3]	8 Pin DFN	[6] LED3
I_{SET} [4]		[5] LED4

Now Available in Lead Free Packaging

APPLICATIONS

- Next Generation Mobile Phones
- PDA, DSC, MP3 Players
- Handheld Computers
- LCD Display Modules
- Keyboard Backlight
- LED Displays

DESCRIPTION

The SP7615 is a linear constant current driver designed to drive multiple LEDs in series from a high input voltage rail. The driver acts as a high current matched, four-channel current source ensuring constant LED current for a range of input voltages. The SP7615 allows implementing the lowest cost LED driver for a variety of applications. Internal circuitry maintains the pre-set constant current output for a wide voltage range at the LED outputs (LED1,2,3,4). LED current can be adjusted up to 125mA per string with an external resistor. The dimming can be achieved by controlling the I_{SET} input or by feeding a PWM signal to the EN pin. Fast EN turn-on and turn-off time allows for very fast PWM dimming frequencies, completely eliminating flicker. The built-in thermal protection automatically adjusts LED current to prevent overheating.

TYPICAL APPLICATION SCHEMATIC

VCC, VLED1, VLED2, VLED3,
VLED4, Voltage to GND ....0.3V to 16V
EN Voltage to GND.................................... 0 to (Vcc + 0.3V)
ISET Voltage to GND..................................0 to (Vcc + 0.3V)
                                      or 6V, whichever is lower
Output Current per LED (IOUT) 150mA
Power Dissipation per Package
        8-pin DFN at TA = 85°C ....… 1.1W
Junction Temperature ....+150°C
Storage Temperature .... -55°C to +150°C

ESD Level. .... 2kV HBM
DFN Thermal Resistance.......................................59°C/W
These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

ELECTRICAL CHARACTERISTICS

$4.5V < V_{CC} <16V$, $V_{EN} = 5V$, $V_{LED1} =V_{LED2} =V_{LED3} =V_{LED4} =1.0V$, $R_{SET} =10k\Omega$ or $I_{SET}=126\mu A$, $-40 < T_A < 85°C$, Unless otherwise noted.   Typical numbers are for $T_A = 25°C$.

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Supply Voltage	4.5	5	16	V	
Quiescent Supply Current		20	39	mA	$I_{LED1} = I_{LED2} = I_{LED3} = I_{LED4} =126mA$
Output/I_{SET} Current Multiplication Ratio	900	1000	1200		
LED Current (per diode)		126		mA	
LED to LED Current Matching	-2		+2	%	
LED Current Line Voltage Regulation		0.15	0.6	%/V	I_{OUT} change per volt V_{CC} change
LED Current Load Voltage Regulation		2	4	%/V	$0.4V < V_{LED} < 5V$, $I_{LED} = 25mA$
		9		%/V	$1.0V < V_{LED} < 5V$, $I_{LED} = 126mA$
LED Current Thermal Regulation		0.1		%/°C	$I_{LED} = 126mA$
I_{SET} Pin Voltage	1.20	1.26	1.32	V	$I_{SET} = 1\mu A$
Thermal Shutdown Threshold		150		°C	
Thermal Shutdown Hysteresis		20		°C	
Current in OFF Mode			1	μA	$V_{EN} = 0.0V$
Min. ENABLE "ON Voltage" (Note1)			1.6	V	
Max. ENABLE "OFF Voltage" (Note 2)	0.4			V	

Note 1. ENABLE "ON" is V_{EN} for which $I_{LED} > 80mA$
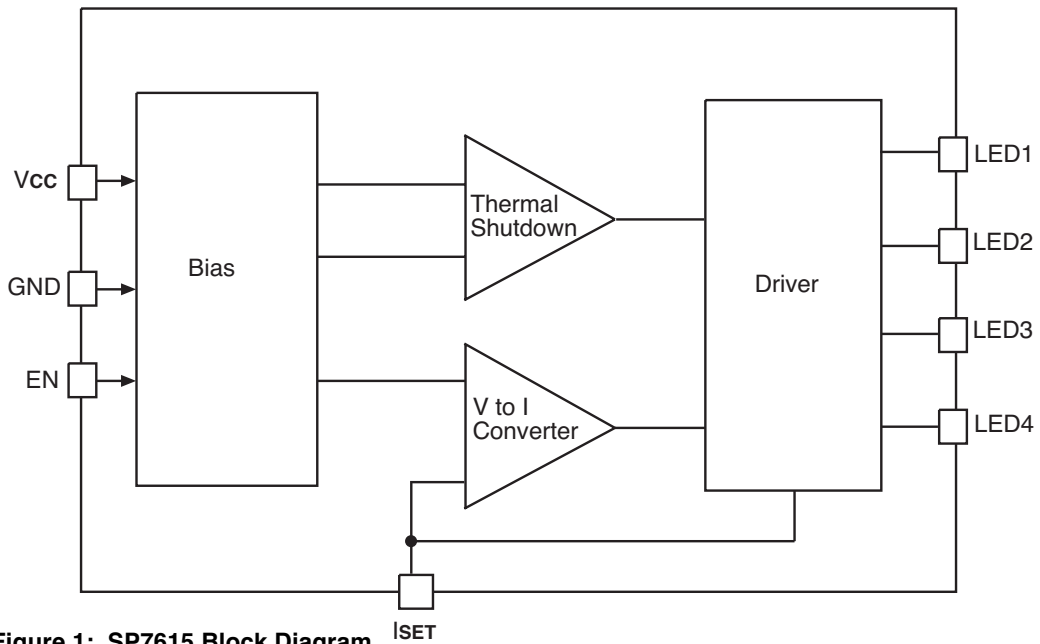Note 2. ENABLE "OFF" is V_{EN} for which $I_{LED} < 1uA @ V_{LED1} > 1.0V$

**Figure 1: SP7615 Block Diagram**

Introduction

The SP7615 is a four channel constant current source LED driver with programmable output current level. The design consists of a regulator bandgap, voltage-to-current converter, and output mirror drivers. The bandgap ensures good performance over voltage and temperature. The four outputs are tightly coupled allowing for excellent channel matching.

Thermal Shutdown

The SP7615 uses a thermal comparator to monitor the system temperature shutting the device down if the internal temperature reaches 150ºC. The device will remain off until the internal temperature drops below 130ºC.

Enable

The device has an enable function that is designed for TTL level inputs. This input will also track the V_{cc} pin so levels up to V_{cc} are acceptable. The enable pin can also be used to control the LED brightness with a pulse width modulated control signal. Duty Cycle or PWM control of the LED current maintains constant LED color while brightness is changing. The SP7615 responds in less than 10μs to PWM signals applied to this pin. The EN pin is internally pulled down with an approximately 80kOhm resistor. The SP7615 will remain in shutdown mode if this pin is left open.
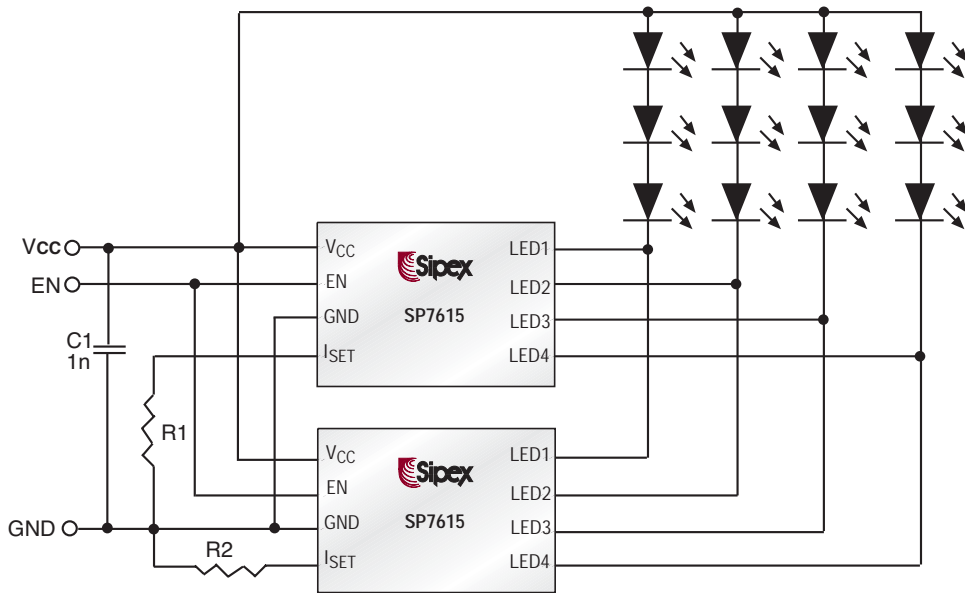
Current sharing capabilities allow two SP7615s to run in parallel for twice as much current through the LEDs.

CATHODE VOLTAGE, SUPPLY VOLTAGE AND POWER DISSIPATION

The voltage applied to the cathode of each LED determines the overall efficiency of the SP7615 circuit. The SP7615 is designed to be able to sink 125mA at each of its four outputs; LED1 - 4. The SP7615 is also designed to be able to handle up to 16V on these pins. This voltage handling capability assumes the total power can be dissipated by the SP7615. The power dissipation inside the SP7615 will de directly related to the voltage and current applied to these pins. For example, the typical operating cathode voltage is 500mV. At maximum current the power dissipated by one LED driver output is 125mA * 500mV = 62.5mW. The charts in the following pages show the power dissipation of the SP7615 under various conditions. The power dissipation should be kept below 1.3W for safe operation and long term reliability at room temperature and derated to 530mW at 85ºC. While the above operating conditions are recommended, the part cannot be damaged due to internal temperature control as described above in the thermal shutdown section.
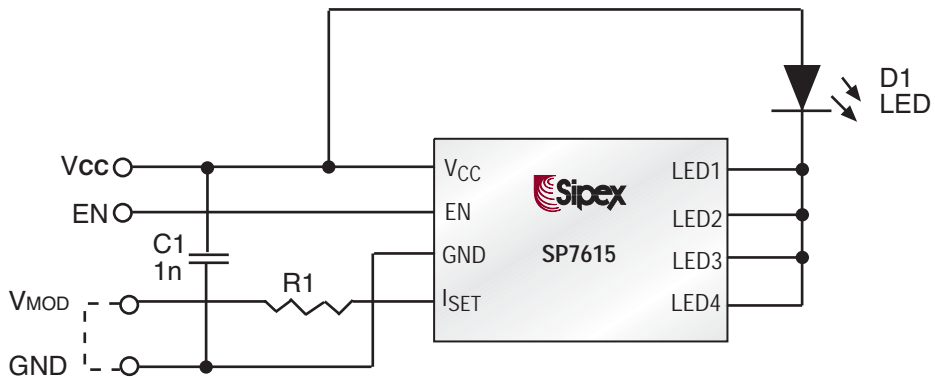
I_{SET} **Pin**

The I_{SET} pin is the servo point of an amplifier configured as a voltage-to-current converter. The voltage at this pin servos to the internal bandgap potential. A set resistor can be connected from the Iset pin to the ground to generate a reference current for the following current gain stages. A current could alternately be applied to this pin in the form of a current source or current output DAC.

This pin can be used also for LED current adjustment with external voltage from ambient light, optical feedback sensors or other voltage source. This voltage should not exceed 1.25V.

The R_{SET} value may be determined as

$$R_{SET} = (1.26 - V_{MOD}) * 1000/I_{OUT} \text{ k}\Omega,$$

where 1.26 is a typical I_{SET} pin voltage,
V_{MOD} is an adjustment voltage (V),
1000 is a typical current multiplication ratio,
I_{OUT} is a required LED current in mA/channel.

If adjustment voltage V_{MOD} isn't used, R_{SET} resistor should be connected to the ground.
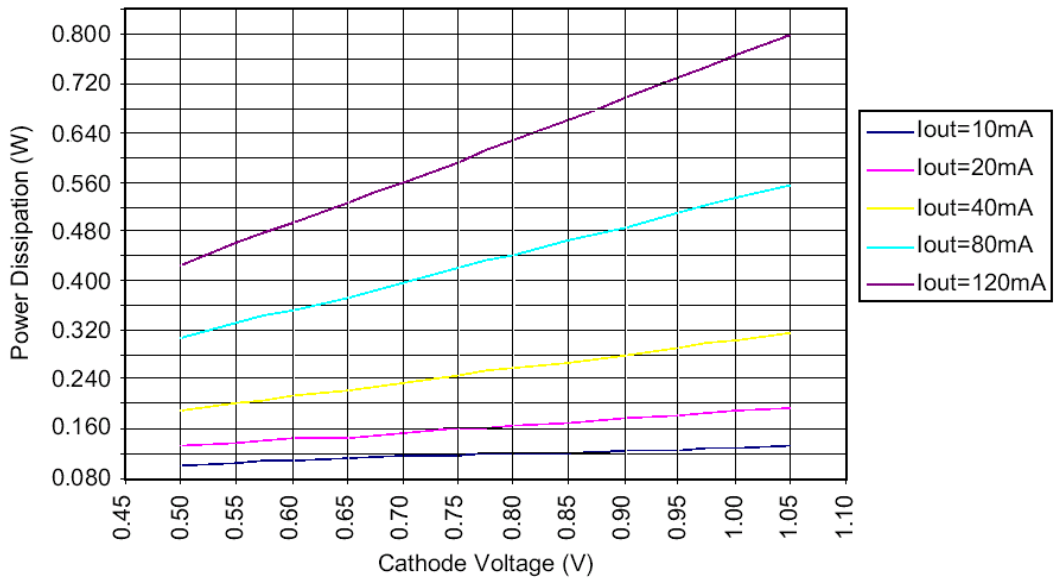
Figure 2 – Four Channel Total Power Dissipation versus Cathode Voltage at Vcc = 5V
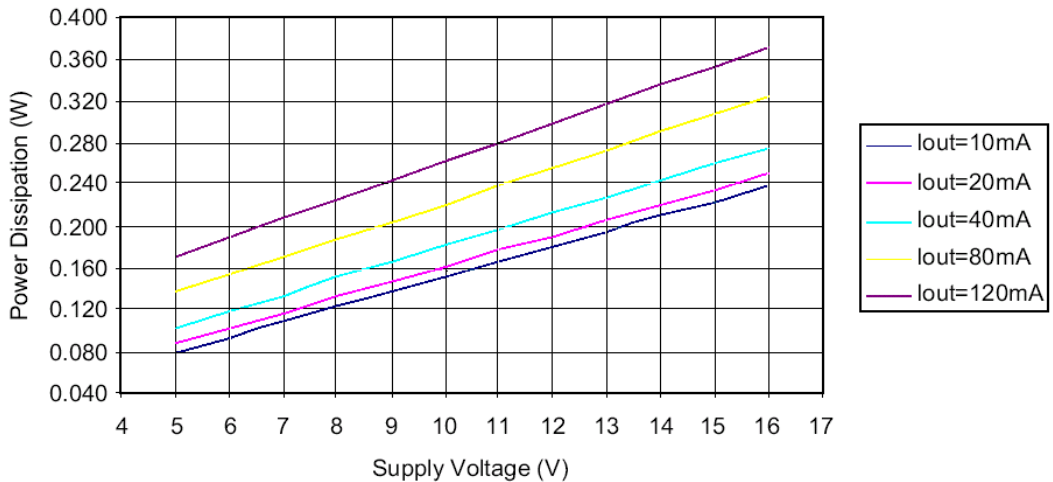
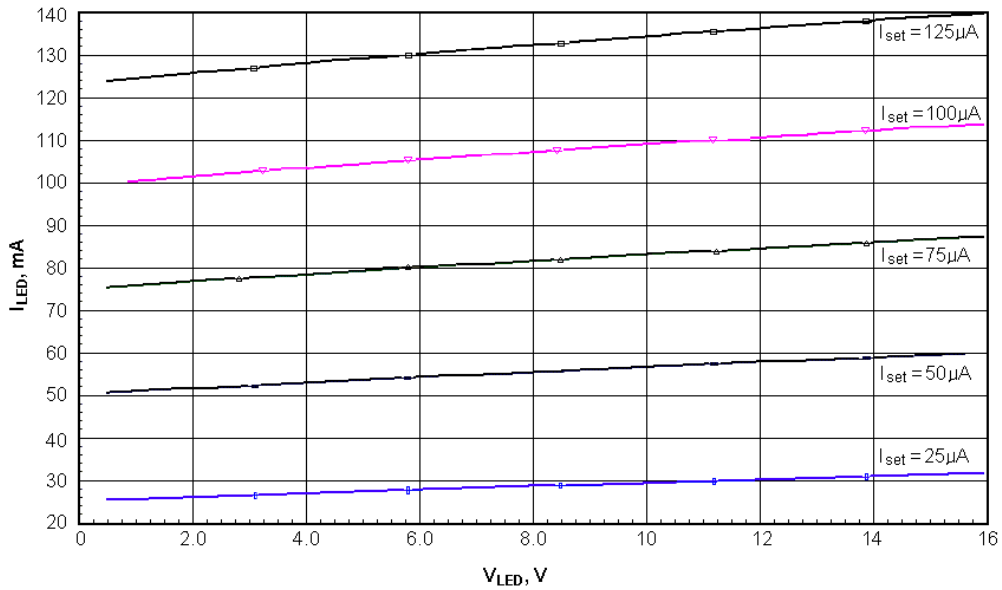**Figure 3 – Four Channel Total Power Dissipation versus Supply Voltage at Vcathode = 500mV**

Figure 4 – LED Current versus I_{SET} Current and Cathode Voltage, Vcc=5V, T= 27°C
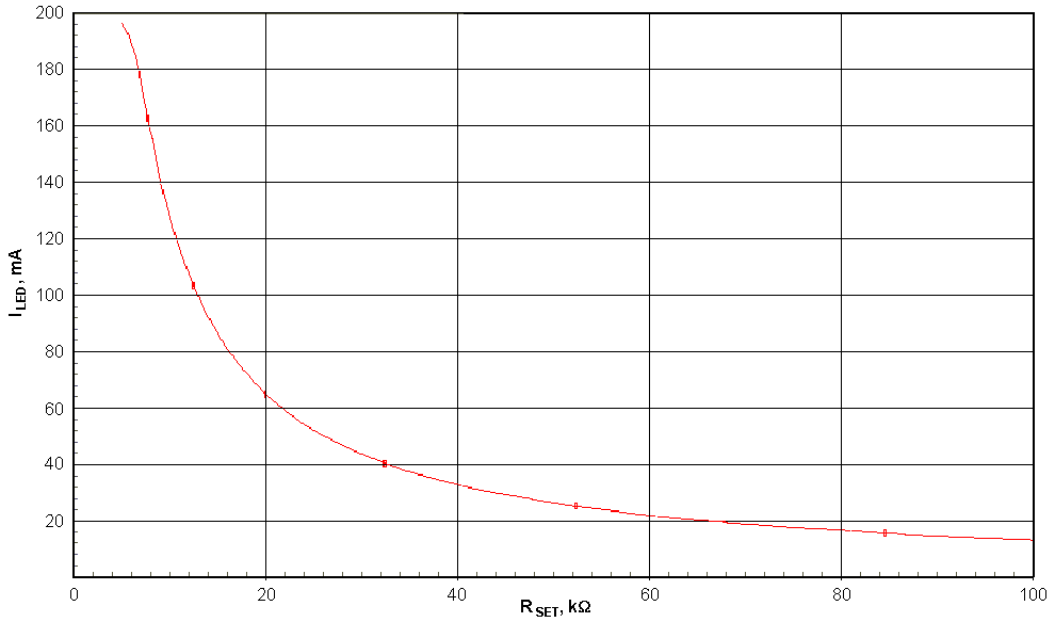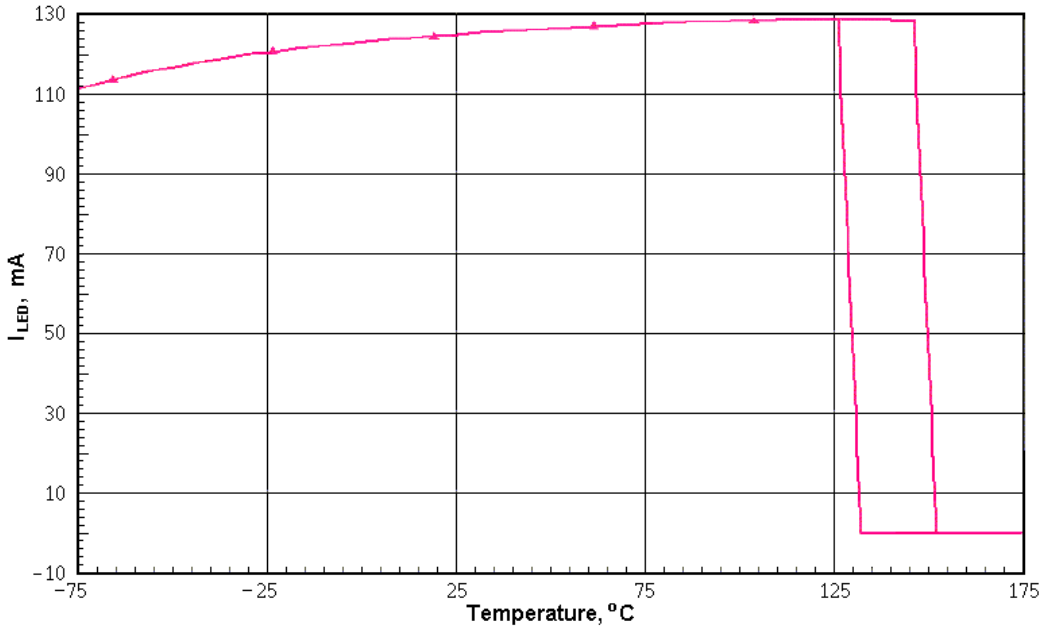

Figure 5 – LED Current versus R_{SET} Value

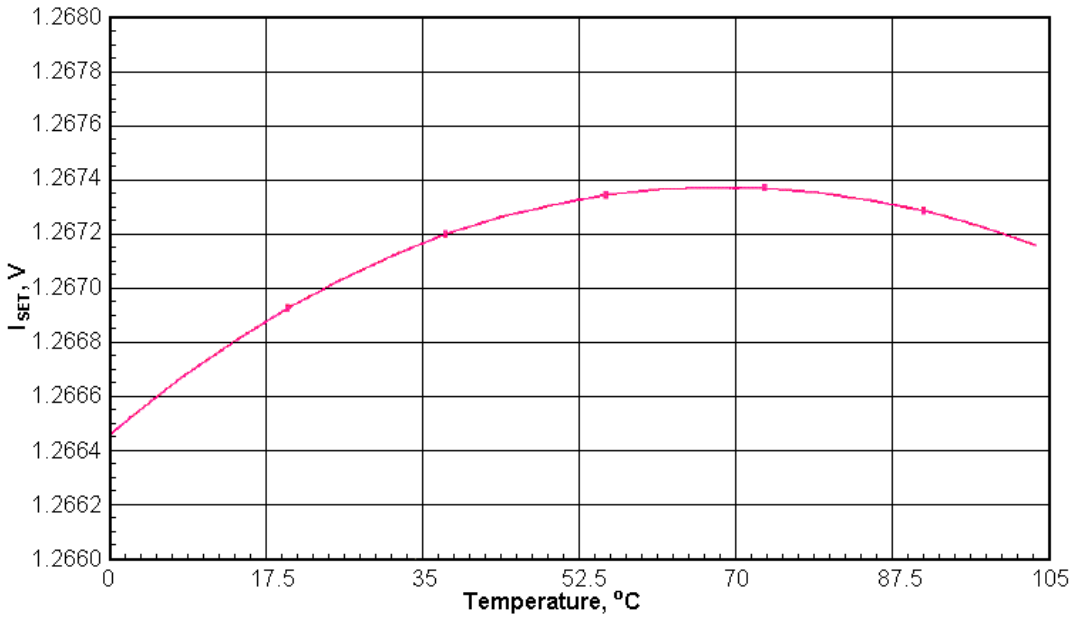**Figure 6 – LED Current versus Temperature with Thermal Shutdown**
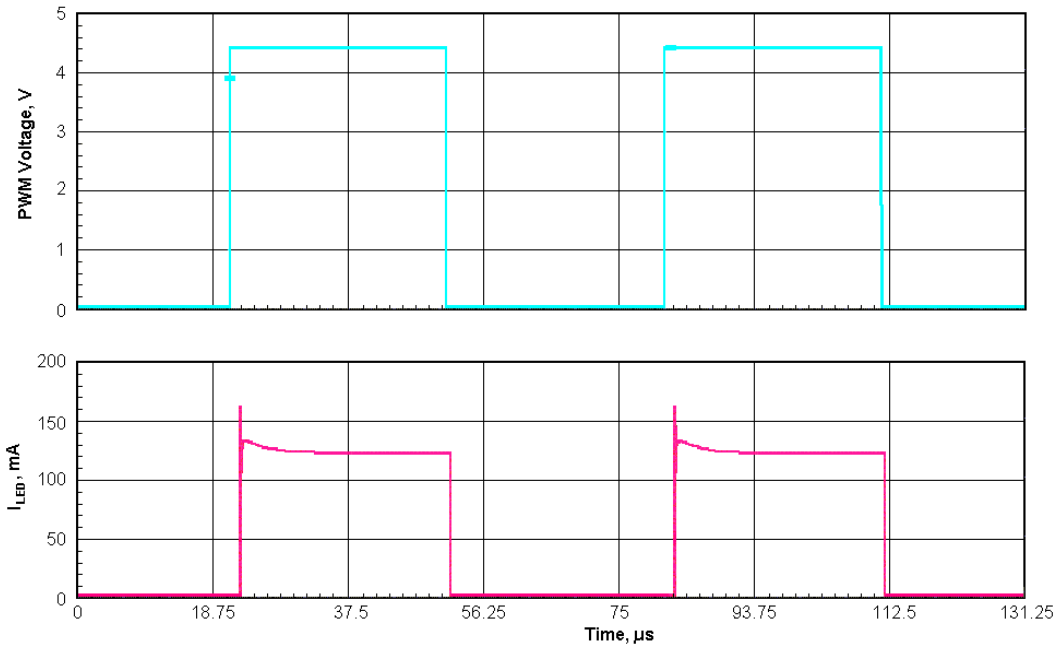

Figure 7 – I$_{SET}$ Voltage versus Temperature

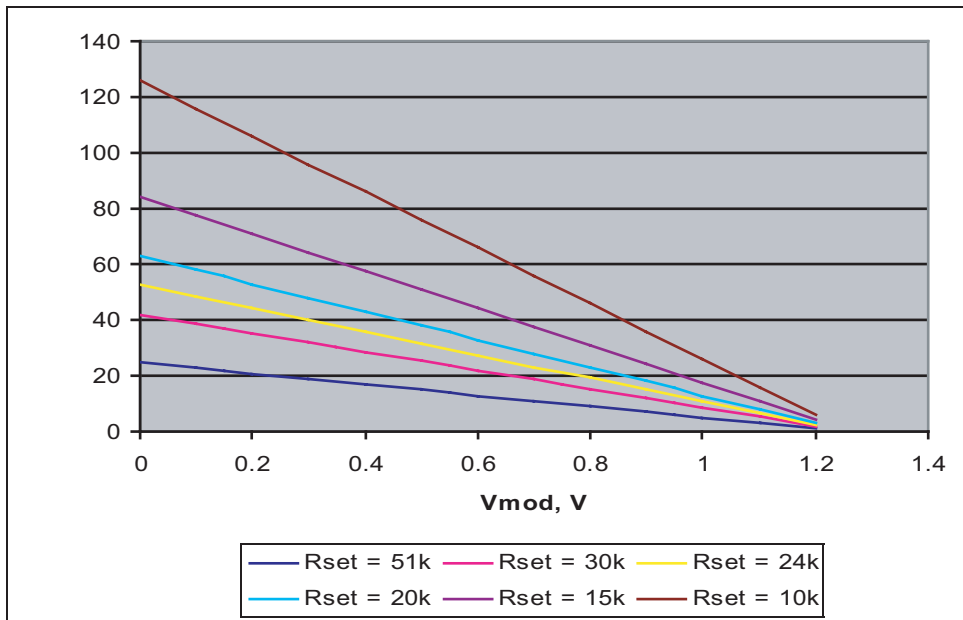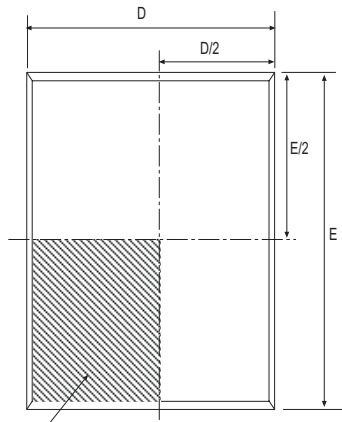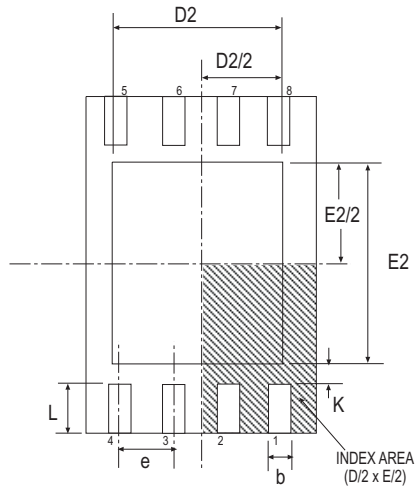**Figure 8 –PWM Signal Applied To The Enable Pin, Amplitude=5V, Duty Cycle=50%**

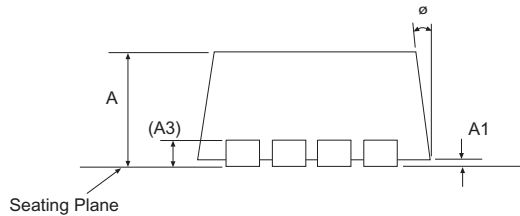**Figure 9 -- Iout current (mA per channel) vs. V$_{MOD}$ voltage**

TOP VIEW

Pin1 Designator
to be within this
INDEX AREA
(D/2 x E/2)

BOTTOM VIEW

INDEX AREA
(D/2 x E/2)

SIDE VIEW

Seating Plane

2x3 8 Pin DFN	JEDEC MO-229		VARIATION VCED-2		
SYMBOL	Dimensions in Millimeters: Controlling Dimension			Dimensions in Inches Conversion Factor: 1 Inch = 25.40 mm	
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.90	1.00	0.032	0.036	0.039
A1	0.00	0.02	0.05	0.000	0.001	0.002
A3	0.20 REF			0.008 REF		
K	0.20	-	-	0.008	-	-
ø	0º	-	14º	0º	-	14º
b	0.18	0.25	0.30	0.008	0.010	0.012
D	2.00 BSC			0.079 BSC		
D2	1.50	-	1.75	0.059	-	0.069
E	3.00 BSC			0.118 BSC		
E2	1.60	-	1.90	0.063	-	0.075
e	0.50 BSC			0.020 BSC		
L	0.30	0.40	0.50	0.012	0.016	0.020
SIPEX Pkg Signoff Date/Rev:			JL Aug18-05 / RevA		

SP7615 Four Channel Constant Current LED Driver

Part Number	Operating Temperature Range	Package Type
SP7615ER	-40°C to +85°C	8 Pin DFN (2 x 3mm)
SP7615ER/TR	-40°C to +85°C	8 Pin DFN (2 x 3mm)

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SP7615ER/TR = standard; SP7615ER-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 3000 for DFN.

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